SEOUL

ASPA 2023

19th ASPA conference & 31st KSPA annual meeting

Equity and Quality in Pediatric Anesthesia

16 (Fri) – 18 (Sun) June, 2023
SC Convention Center, Seoul, Korea

ASA

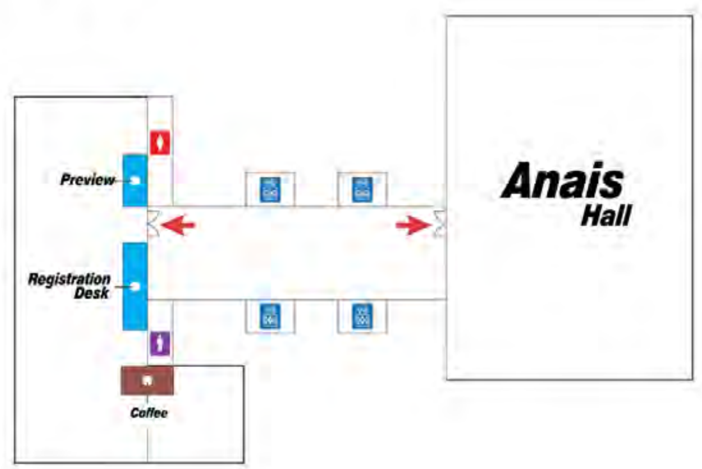
The Korean Society Pediatric Anesthesia
대한소아마취학회

INFORMATION

WIFI ID: KOFST-2
PW: 12345678

Floor Plan

12 F



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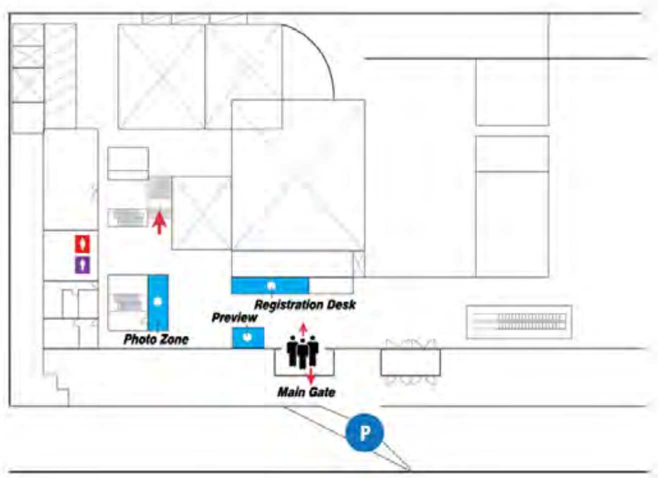

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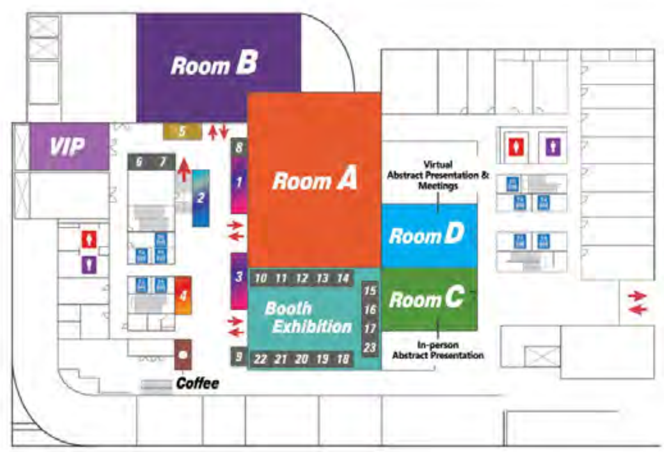

WELCOME MESSAGE

The Korean Society of Pediatric Anesthesiologists (KSPA)

Dear Colleagues and Friends,

On behalf of the Organizing Committee, I am honored to host the 19th conference of the Asian Society of Paediatric Anaesthesiologists (ASPA 2023) in conjunction with the 31st Korean Society of Pediatric Anesthesiologists annual meeting in Seoul, South Korea on June 16-18, 2023.

Children are our future. Taking care of children's health is keeping "the value of the future." Pediatric anesthesiologists have a mission to ensure the safety and health of pediatric patients during the perioperative period. ASPA 2023 and its scientific program have been prepared with this in mind.

We have an exciting program at ASPA 2023 that will allow all of you to reflect upon and celebrate our past accomplishments, renew friendships and extend our networks, and jointly explore current and future research directions. We hope you will have a productive and fun?filled time at this special conference. The backdrop of the beautiful and historic city of Seoul will add to the pleasure of the meeting and provide lasting memories beyond medicine. You can expect a fascinating, fruitful, and enjoyable time in Seoul.

Looking forward to welcoming you to Seoul, South Korea for ASPA 2023!

President of Korean Society of Pediatric Anesthesiologists

Jin-Tae Kim

Jintae Kim

WELCOME MESSAGE

The Asian Society of Paediatric Anaesthesiologists (ASPA)

Dear friends and colleagues

We have now entered a new year, a fresh beginning. With the pandemic mostly under control, I am thankful that we can meet face to face, in Seoul for the 19th ASPA meeting.

People say that "Children's health is our nation's wealth" and health in the early years is important to allow children to thrive and grow into healthy adults.

ASPA is dedicated to fostering safe and high standards of Paediatric Anaesthesia for children in Asia. We hope to achieve this through sharing and supporting each other through research, with development of newer drugs and improved technology enhancing our knowledge of how to monitor our patients in greater detail and depth.

The theme of ASPA 2023 is "Equity and Quality in Paediatric Anaesthesia". We recognize that children are not small adults and Paediatric Anaesthesiologists need to be sharper and have heightened senses when caring for a young child.

I trust that we will be learning plenty from the wonderful programme drawn up by Professor Jin Tae Kim and his team in the organizing committee for ASPA 2023.

I would like to thank everyone for their contributions in making ASPA 2023 a success.

President of Asian Society of Paediatric Anaesthesiologists

Josephine Tan

COMMITTEES

Committee of KSPA 2023

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Director of Planning	Byung Gun Lim	Korea University
Director of Academic Affairs	Jeong-Rim Lee	Yonsei University
Director of Publications	Hee Young Kim	Pusan National University
Director of Training	Eugene Kim	Hanyang University
Director of Education	Hyo-Jin Byon	Yonsei University
Director of Medical Insurance	Yong-Hee Park	Chung-ang University
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	Helen Ki Shinn	Inha University
	Sang Hun Kim	Chosun University
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	Hee-Soo Kim	Seoul National University
	Tae-Hun Ahn	Chosun University
	Sungsik Park	Kyungpook National University
	Ah Young Oh	Seoul National University

Committee of ASPA 2023

President	Josephine Tan	Singapore
President-Elect	Serpil Ustalar Ozgen	Türkiye
Honorary Secretary	Teddy Fabila	Philippines
Honorary Treasurer	Tracy Tan	Singapore
Committee Member	Vibhavari Naik	India
	Soichiro Obara	Japan
	Fauzia Khan	Pakistan
	Yunita Widyastuti	Indonesia
	Usha Nair	Malaysia
	Lydia Quitoriano	Philippines
	Hee-Soo Kim	Republic of Korea
	Duenpen Horatanaruang	Thailand
	Sokha Tep	Cambodia
Internal Auditor	Elsa Verghese	India
	Niki Suneerat	Thailand

DAY 1 16 June 2023 (Fri)

SC Convention Anais Hall (12F)

12:00-12:50	Registration	
12:50-13:00	Opening Remarks	
13:00-14:40	**Session 1. Safe Anesthesia for Children with Co-Morbidity**	Josephine Tan (Singapore) Jin-Tae Kim (Korea)
13:00-13:20	URI and Anesthesia: Toward Zero Complication	Byung Gun Lim (Korea)
13:20-13:40	Anaesthesia for Patient with Mucopolysaccharidosis	Vivian Yuen (Hong Kong)
13:40-14:00	Airway and Ventilation Management in Neurosurgical Cases (Virtual)	Rudin Domi (Albania)
14:00-14:20	Risk Assessment of Morbidity and Mortality in Children with CHD Undergoing Noncardiac Surgery	Viviane Nasr (USA)
14:20-14:40	Q&A	
14:40-15:20	Coffee Break	
15:20-16:40	**Session 2. Choices Are Yours: Debating and Challenging Issues in Airway Management**	Evangeline Lim (Singapore) Hyo-Seok Na (Korea)
15:20-15:40	Supraglottic Airway Devices in a Variety of Situations: Not-Supine Position, Tonsillectomy, Laparoscopic Surgery	Abhyuday Kumar (India)
15:40-16:00	LMA Removal and Endotracheal Tube Extubation: Deep or Awake?	Ayuko Igarashi (Japan)
16:00-16:20	Beyond the Mainstem: Lung Isolation Technique in Small Children	Rebecca Margolis (USA)
16:20-16:40	Q&A	

DAY 1 16 June 2023 (Fri)

SC Convention Anais Hall (12F)

16:40-18:00	**Session 3. Beyond Drugs and Blocks: Latest Knowledge of Pediatric Pain Management**	Sang Hun Kim (Korea) Seokyoung Song (Korea)
16:40-17:00	Psychosocial and Behavioral Factors in the Transition from Acute to Chronic Postsurgical Pain (Virtual)	Jennifer Rabbitts (USA)
17:00-17:20	A Non-Pharmacological Approach to Postoperative Pain Management in Children with Multiple Traumatic Injuries: A Presentation by KKH CHAMPs (Child Life, Art, and Music Therapy Programs)	Tanuja Nair (Singapore)
17:20-17:40	Role of Analgesic Adjuvants in Severe Burn Injury in Children: Timing and Precision	Teddy Fabila (Philippines)
17:40-18:00	Q&A	
18:00	Closing Remarks	Jin-Tae Kim, President of KSPA
18:30	**Welcome Faculty Dinner**	

DAY 2 17 June 2023 (Sat)

SC Convention International Conference Hall (B1F)

Room A

08:30-09:00	Registration	
09:00-09:20	Welcome and Introduction	
	Opening Remarks	Jin-Tae Kim, President of KSPA
	Congratulatory Message	Jun Heum Yon, President of KSA
		Josephine Tan, President of ASPA

09:20-10:40	**Session 1. Society for Pediatric Anesthesia in the World: Past, Present, and Future**	Agnes Ng (Singapore) Jin-Tae Kim (Korea)
09:20-09:35	Why Pediatric Anesthesia Society is Special and Needed	Jim Fehr (USA)
09:35-09:50	The Future of Pediatric Anesthesiology around the World; We are Stronger Together	Randall Flick (USA)
09:50-10:05	ASPA: Past, Present, and Future	Josephine Tan (Singapore)
10:05-10:20	ESPA: How to Collaborate Internationally and Intercontinentally	Jurgen de Graaff (Netherlands)
10:20-10:40	Q&A	

10:40-11:00	Coffee Break	

11:00-12:30	**Session 2. WFSA Panel Discussion: Universal Coverage of Safe Pediatric Anesthesia All Over Asia**	Erlinda Oracion (Philippines) Il-Ok Lee (Korea)
11:00-11:15	Current Status of Pediatric Anesthesia in Cambodia, their Challenges and Opportunities for Improvement	Sokha Tep (Cambodia)
11:15-11:30	Current Status of Pediatric Anesthesia in Bangladesh, their Challenges and Opportunities for Improvement	Debabrata Banik (Bangladesh)
11:30-11:45	Activities of the WFSA Pediatric Anesthesia Committee	Norifumi Kuratani (Japan)
11:45-12:00	Activities and Accomplishments of the WFSA-BARTC Pediatric Fellowship Program	Patcharee Sriswasdi (Thailand)
12:00-12:15	Activities to Improve Patient Safety in WFSA	Erlinda Oracion (Philippines)
12:15-12:30	Q&A	

DAY 2 17 June 2023 (Sat)

SC Convention International Conference Hall (B1F)

12:30-14:00	**Luncheon Symposium**	Dong Woo Han (Korea)
	EEG Guided Anesthesia in Young Children (Virtual)	Ian Yuan (USA)
14:00-15:40	**Session 3. Preparing for the Future**	Choon Looi Bong (Singapore) Jun Heum Yon (Korea) Seong-Hyop Kim (Korea)
14:00-14:20	Thoughts on Professional Development and Career Success	Randall Flick (USA)
14:20-14:40	How to Prepare for the Next Pandemic?	Nicola Disma (Italy)
14:40-15:00	Time to Obtain Epidemiologic Data on Pediatric Anesthesia in Asia Itself: Introduction of PEACH Study	Soichiro Obara (Japan)
15:00-15:20	Future of Anesthesia-Related Neurotoxicity Issue: Update of TREX Study	Dean B Andropoulos (USA)
15:20-15:40	Q&A	
15:40-16:00	Coffee Break	
16:00-17:20	**Session 4. Issues We Are Facing & Need to Overcome**	Vibhavari Naik (India) Hee-Soo Kim (Korea)
16:00-16:20	Environmental Impact of Anesthesia (Virtual)	Diane Gordon (USA)
16:20-16:40	Healing the Culture of Medicine	Rebecca Margolis (USA)
16:40-17:00	Challenges Faced in Providing Safe Anaesthesia to Children in Low and Middle-Income Countries	Rebecca Jacob (India)
17:00-17:20	Q&A	
17:20	Closing Remarks	
18:30	**Gala Dinner**	

DAY 2 17 June 2023 (Sat)

SC Convention International Conference Hall (B1F)

Room B		
09:00-09:20	Welcome and Introduction (Room A)	
09:20-10:40	**Session 1. Optimization of Intraoperative Ventilation in Children**	Ekta Rai (India) Chul-Ho Chang (Korea)
09:20-09:35	Optimal Target of O_2 and CO_2	Sung-Ae Cho (Korea)
09:35-09:50	PEEP and Recruitment, Mode of Ventilation	Pichaya Waitayawinyu (Thailand)
09:50-10:05	Smart Choice of Ventilation-Related Equipment	Joy Luat-Inciong (Philippines)
10:05-10:20	How to Optimize Our Children's Intraoperative Ventilation Care with POCUS	Ayse Çiğdem Tutuncu (Türkiye)
10:20-10:40	Q&A	
10:40-11:00	Coffee Break	
11:00-12:30	**Session 2. Experts' Advice of Monitoring for Better Anesthesia Care**	Joy Luat-Inciong (Philippines) Hyo-Jin Byon (Korea)
11:00-11:20	Blood Pressure Considerations in Pediatric Anesthesia	Stephen Gleich (USA)
11:20-11:40	The Use of Neuromonitoring in Neonatal Pain Assessment (Virtual)	Ian Yuan (USA)
11:40-12:00	Accurate and Reliable Neuromuscular Monitoring in Children	Serpil Ozgen (Türkiye)
12:00-12:20	How to Assess Fluid Responsiveness in Children	Eun-Hee Kim (Korea)
12:20-12:30	Q&A	
12:30-14:00	**Luncheon Symposium (Room A)**	Dong Woo Han (Korea)
	EEG Guided Anesthesia in Young Children (Virtual)	Ian Yuan (USA)

DAY 2 17 June 2023 (Sat)

SC Convention International Conference Hall (B1F)

14:00-15:40	**Session 3. Sharing the Knowledge of NORA**	Vivian Yuen (Hong Kong) Yong-Hee Park (Korea)
14:00-14:15	Remimazolam and Dexmedetomidine: Clinical Applications and Limitations	Keira Mason (USA)
14:15-14:30	Needle-Free Sedation	Jurgen de Graaff (Netherlands)
14:30-14:45	How to Deal with Challenging Sedation Cases	Eun-Young Joo (Korea)
14:45-15:00	NORA for Children with Special Needs	Ina Ismiarti Binti Shariffuddin (Malaysia)
15:00-15:15	Neonatal Sedation for MRI	Yu Cui (China)
15:15-15:40	Q&A	
15:40-16:00	Coffee Break	
16:00-17:20	**Session 4. Perioperative Concerns in Pediatric Anesthesia**	Tae-Hun Ahn (Korea) Woo Suk Chung (Korea)
16:00-16:20	Perioperative Hypothermia in Children: Risk Factor and Preventive Stretagy	Djayanti Sari (Indonesia)
16:20-16:40	Emergence Agitation and Long Term Behavioral Consequences	Agnes Ng (Singapore)
16:40-17:00	Anesthesia-Induced Neurotoxicity: Recent Updates and Preclinical Research Trends	Woo Suk Chung (Korea)
17:00-17:20	Q&A	
17:20	Closing Remarks (Room A)	

DAY 2 17 June 2023 (Sat)

SC Convention International Conference Hall (B1F)

Room C

09:00-09:20	Welcome and Introduction (Room A)	
09:20-10:50	**Abstract Presentation 1 (In-person)**	Seokyoung Song (Korea) In-Kyung Song (Korea)
AP1-1	Nasotracheal vs Orotracheal Intubation and Post-Extubation Airway Complications Among Children Undergoing Congenital Heart Surgery	Deniz Sivrioglu (Türkiye)
AP1-2	Anesthesia Management of Cleft Lip Repair, Complicated with Gordon Syndrome and its Challenges	Rina Cordeiro (India)
~~AP1-3~~	~~Pediatric Airway Management in Undiagnosed Congenital Subglottic Stenosis Undergoing Congenital Cardiac Surgery~~	Virtual
AP1-4	Risk Factors for Delayed Extubation After Pediatric Perineal Anoplasty: A Retrospective Study	Qianqian Zhang (China)
AP1-5	Anaesthetic Management of a Case of Fraser Syndrome with Group III Cleft Lip-Palate with Laryngomalacia and Subglottic Stenosis	Sumit Kumar Singh (India)
AP1-6	Developing Interdicipline Communication to Enhabced Patient Safety in Pediatric Difficult Airway Management	Raihanita Zahra (Indonesia)
AP1-7	Guidewire Use for Nasopharyngeal Passage in Pediatric Nasotracheal Intubation: A Randomized Prospective Study	Asim Esen (Türkiye)
AP1-8	Case Reports: Newborns with Tracheal Agenesis	Hye Su Kim (Korea)
10:50-11:00	Coffee Break	
11:00-12:30	**Abstract Presentation 2 (In-person)**	Won-Jung Shin (Korea) Young Eun Jang (Korea)
~~AP2-1~~	~~Comparison of Morphine and Fentanyl Induced Cardioprotection Against Ischemia-Reperfusion Injury In Acyanotic Children Undergoing Open Heart Surgery: A Preliminary Report~~	Withdrawn
AP2-2	Report of the First Successful Senning Procedure from Nepal	Santosh S Parajuli (Nepal)
AP2-3	Evaluation of an Enhanced Recovery Protocol in Pediatric Cardiac Surgical Patients in a Single Tertiary Care Unit	Esha Nilekani (India)

DAY 2 17 June 2023 (Sat)

SC Convention International Conference Hall (B1F)

AP2-4	Multisystem Inflammatory Syndrome in Children. An Emerging Clinical Challenge for Pediatric Cardiac Surgery in the COVID 19 Era: Case Series	Withdrawn
AP2-5	Anesthetic Management of Patent Ductus Arteriosus Ligation by Video-Assisted Thoracoscopy in Premature Babies Low-Birth Weight<2kg: A Retrospective Observational Study	Qinghua Huang (China)
AP2-6	Anesthetic Experience of Repair of Esophageal Atresia in a Child with BPFM, Esophageal Atresia, and Full-length Tracheal Stenosis	Takashi Fujiwara (Japan)
AP2-7	Anesthetic Management in a Child with Single Ventricle Heart Undergoing Drainage of Brain Abscesses	Pryl Kim Ngoslab (Philippines)
AP2-8	Anesthetic Management in a Child with Late Onset Congenital Diaphragmatic Hernia Undergoing Repair	Anna Loraine Ostrea (Philippines)

12:30-14:00	**Luncheon Symposium (Room A)**	Dong Woo Han (Korea)
	EEG Guided Anesthesia in Young Children (Virtual)	Ian Yuan (USA)

14:00-15:30	**Abstract Presentation 3 (In-person)**	Eugene Kim (Korea) Young Sung Kim (Korea)
AP3-1	Perioperative Hypothermia in Pediatric Population in University Malaysia Medical Centre	Noor Iftitah/AR (Malaysia)
AP3-2	Atelectasis and Re-expansion Pulmonary Edema in Patient Undergoing Atrial Septal Defect (ASD) Closure with Minimally Invasive Cardiac Surgery	Stephanus AP/Kaligis (Indonesia)
AP3-3	Activation of Rapid Response Team in Pediatric Ward: A Cross Sectional Study in Indonesia's Top Referral Hospital	Hilferia Simbolon (Indonesia)
AP3-4	Towards a Zero Postoperative Vomiting (POV) in Children after Tonsillectomy	Joseph Tobias (Australia)
AP3-5	Anesthetic Management in a Patient with Nonketotic Hyperglycinemia	Withdrawn
AP3-6	Distraction Techniques for Post-operative Paediatric Patients in Post Anaesthesia Care Unit (PACU) a Randomized Control Trial	Virtual
AP3-7	Perioperative Respiratory Adverse Events Following General Anesthesia Among Pediatric Patients after COVID-19	Jung-Bin Park (Korea)

SC Convention International Conference Hall (B1F)

AP3-8	Platelet-lymphocyte Ratio and Neutrophil-lymphocyte Ratio for Predicting Respiratory Complications after Congenital Heart Surgery	Ji-Woong Yang (Korea)
15:30-15:50	Coffee Break	
15:50-17:20	**Abstract Presentation 4 (In-person)**	Sang Hun Kim (Korea) Hyun Kang (Korea)
AP4-1	Transversus Abdominis Plane Block after Sub Arachnoid Block Reduces Postoperative Pain Intensity and Analgesic Consumption in Elective Lower Abdominal Surgeries in Pediatric Patients-Case Series	Gunjan Singh (India)
~~AP4-2~~	~~Postoperative Sedation and Analgesia in Pediatric Cardiac Surgery~~	Virtual
AP4-3	Erector Spinae Plane Block with Ropivacaine 0.2% in Children-A Case Series, Single Center Experience in Tertiary Pediatric Center in Malaysia	Noor Hasimah (Malaysia)
AP4-4	ESP Block for Anesthesia in a Pediatric Patient Who Underwent Diagnostic Laparoscopy after Foreign Body Injury	Kubra Ozturk (Türkiye)
~~AP4-5~~	~~Epidural Analgesia in Major Paediatric Oncosurgeries: A Review of Safety Profile and Practices~~	Withdrawn
AP4-6	Analgesic Efficacy and Safety of Ultrasound-guided Erector Spinae Plane Block in Pediatric Patients Undergoing Surgery: A Systematic Review and Meta-Analysis of Randomized Controlled Trials	Seokwoo Jeong (Korea)
AP4-7	Prediction of Effect and Complications of PCA in Children Undergoing Urologic Surgery	Ho-Jae Nam (Korea)
17:20	Closing Remarks (Room A)	

SC Convention International Conference Hall (B1F)

Room D

09:00-09:20	Welcome and Introduction (Room A)	
09:20-10:50	**Abstract Presentation 1 (Virtual)**	Sooyoung Cho (Korea) Hee Young Kim (Korea)
V1-1	"Know It to Deal with It"- Neonatal Airway Management with a Large Sincipital Encephalocele	Pranita Mandal (India)
~~V1-2~~	~~Nasotracheal Intubation Guided by the Esophageal Temperature Probe in Children~~	Withdrawn
V1-3	Risk Factors for Failed First Attempt of Intubation in Pediatric Patients: Preliminary Results of a Prospective Observational Study	Faiza Grati (Tunisia)
V1-4	Management of a Rapidly Growing Sublingual Congenital Ranula: A Case Report	Anouar Jarraya (Tunisia)
V1-5	An Innovative Technique to Deflate and Reinflate the Tracheostomy Tube to Facilitate Ventilation During Tracheal Resection and Reconstruction Surgeries	Nesara N (India)
V1-6	Airway Management of a Congenital Teratoma with a Cleft Palate: An Original Case Report	Kammoun Manel (Tunisia)
V1-7	Airway Management of Congenital Pulmonary Airway Malformation Resection in an Infant in Resource limited Setting: A Case Report	Shephali (India)
V1-8	Pediatric Airway Management in Undiagnosed Congenital Subglottic Stenosis Undergoing Congenital Cardiac Surgery	Demet Altun Bingöl (Türkiye)
10:50-11:00	Coffee Break	
11:00-12:30	**Abstract Presentation 2 (Virtual)**	Ji-Hyun Lee (Korea) Ye Yun Phang (Malaysia)
V2-1	Anesthesia Management of Left Pulmonary Artery Sling: LPA Reimplantation Without Cardiopulmonary Bypass	Anshoril Arifin (Indonesia)
V2-2	Fast Track Extubation in Severe Scoliosis with Cor Pulmonale: The Role of Non Invasive Ventilation	Lakshmipraba M (India)
V2-3	A Single Institute Retrospective Audit of the Anaesthesia Management in Children Undergoing Epilepsy Surgery	Vedhika Shanker (India)

SC Convention International Conference Hall (B1F)

V2-4	Anaesthesia Management in a Rare Skeletal Dysplasia-Desbuquois Syndrome: A Case Report	Vedhika Shanker (India)
V2-5	Perioperative Management of a Preterm Infant for Subgaleo-ventricular Shunt	Archana Raichurkar (India)
V2-6	Ultrasound Assessment of Cricothyroid Membrane (CTM) in Children with Respect to Front of Neck Access – An Observational Study	Sandeep Viyyuri (India)
V2-7	Anaesthetic Implications and Considerations in Children with Permanent Pacemaker for Non-Cardiac Surgery: A Report of 2 Cases	Ismail@Mamat NN (Malaysia)
V2-8	Spinal Anaesthesia: The choice in Preterm Neonates with Chronic Lung Disease	Pavitra G C S (India)

12:30-14:00 ASPA 16th Annual General Meeting (Hybrid)

DAY 3 18 June 2023 (Sun)

SC Convention International Conference Hall (B1F)

Room A		
08:30-10:05	**Session 1. Innovation / Renovation**	Ina Ismiarti Binti Shariffuddin (Malaysia) Jeong-Rim Lee (Korea)
08:30-08:50	Medical Simulation, including Augmented Reality & Virtual Reality	Jim Fehr (USA)
08:50-09:10	Big Data Analysis in Pediatric Anesthesia	Jurgen de Graaff (Netherlands)
09:10-09:30	Reducing Our Carbon Footprint: Easy Changes to Our Practice that Reduce Cost and Carbon Emissions (Virtual)	Diane Gordon (USA)
09:30-09:50	Consideration of Pharmacokinetic Models for Pediatric Patients	Young Sung Kim (Korea)
09:50-10:05	Q&A	
10:05-10:20	Coffee Break	
10:20-12:20	**Session 2. Quality Improvement**	Erlinda Oracion (Philippines) Sungsik Park (Korea)
10:20-10:40	Emergency Checklists During a Crisis in Pediatric Anesthesia	Stephen Gleich (USA)
10:40-11:00	Unplanned ICU Administration: Characteristics and Outcome	Kaoru Tsuboi (Japan)
11:00-11:20	Improving Pediatric Anesthesia Safety in Low-Resource Setting	Fauzia Anis Khan (Parkistan)
11:20-11:40	Quality Improvement of Pediatric Anesthesia in India	Elsa Varghese (India)
11:40-12:00	New Considerations for Optimizing Ambulatory Pediatric Anesthesia	Keira Mason (USA)
12:00-12:20	Q&A	
12:20-13:30	**Luncheon Symposium**	Ah Young Oh (Korea)
	Sugammadex: Game Changer of NM Reversal	Nicola Disma (Italy)

DAY 3 18 June 2023 (Sun)

SC Convention International Conference Hall (B1F)

13:30-15:10	**Session 3. From Design to Publication: Special Tips for Young and New Asian Researchers**	Soichiro Obara (Japan) Hyun Kang (Korea)
13:30-13:50	Where and How I Get the Research Idea?	Fauzia Anis Khan (Parkistan)
13:50-14:10	How to Build Primary EndPoint: Statistical and Clinical Solution	Dong Kyu Lee (Korea)
14:10-14:30	How to Improve Weak Points: From Editor's Perspectives	Norifumi Kuratani (Japan)
14:30-14:50	How to Collaborate with Other (international) Researchers?	Choon Looi Bong (Singapore)
14:50-15:10	Q&A	
15:10-15:30	Coffee Break	
15:30-17:00	**Session 4. Best Abstracts Presentation and Awards**	Rufinah Teo (Malaysia) Byung Gun Lim (Korea)
BAP-1	A Randomised Controlled Trial to Compare the Blockbuster™ and Air-Q® Supraglottic Airway Devices as a Conduit to Blind Endotracheal Intubation in Pediatric Patients (Virtual)	Arunima Pattanayak (India)
BAP-2	Changes in Diaphragmatic Ultrasonography Findings and Their Association with Postoperative Complications in Children Undergoing Pulmonary Resection: A Single-Center Prospective Observational Study	Pyoyoon Kang (Korea)
BAP-3	Damage-Associated Molecular Patterns (DAMPs) as a Mechanism of Sevoflurane-Induced Neuroinflammation in Neonatal Rodents	Yongmin Lee (Korea)
BAP-4	Effect of Oxygen Reserve Index Monitoring for Preventing Hypoxemia in Pediatric Airway Surgery: A Randomized Controlled Trial	Honghyeon Kim (Korea)
BAP-5	Sevoflurane-Induced Burst Suppression is Associated with Long-Term Behavioral Changes in Late Postnatal Mice Undergoing Laparotomy	Tao Zhang (China, Korea)
BAP-6	Comparison of Lateral and Supine Positions for Tracheal Extubation in Infants: Preliminary Results of a Randomized Clinical Trial (Virtual)	Kammoun Manel (Tunisia)
BAP-7	The Utility of Difficult IntraVenous Access (DIVA) Score ≥ 4 in Predicting Failure of the First Attempt of Intravenous Access in Children Aged 0 to 12 years at a Tertiary Care, Teaching Hospital (Virtual)	Aparna Williams (India)
17:00	ASPA 2024 Promotion Closing and Farewell	

DAY 3 18 June 2023 (Sun)

SC Convention International Conference Hall (B1F)

Room B		
08:30-10:05	**Session 1. All Things Considered for Best Postoperative Analgesia**	Teddy Fabila (Philippines) Won Uk Koh (Korea)
08:30-08:50	Oldies Revisited: Caudal Block and Pudendal Nerve Block	Jae Hoon Lee (Korea)
08:50-09:10	Impact of Sleep on Pain and Recovery after Surgery (Virtual)	Jennifer Rabbitts (USA)
09:10-09:30	ESP or Those Trunk Blocks for Children	Pinar Kendigelen (Türkiye)
09:30-09:50	Expert's Tip of Regional Block in Neonate and Infants	Vrushali Ponde (India)
09:50-10:05	Q&A	
10:05-10:20	Coffee Break	
10:20-12:20	**Session 2. Cardiac Anesthesia**	Jong Wha Lee (Korea) Won-Jung Shin (Korea)
10:20-10:40	ECMO: What Should We Anesthesiologists Know? (Virtual)	Viviane Nasr (USA)
10:40-11:00	Anesthesia for Patients with Transposition of Great Arteries	Dean B Andropoulos (USA)
11:00-11:20	Anesthesia for Children Who Go Through Journeys to Fontan	Tracy Tan (Singapore)
11:20-11:40	How to Mend a Broken Heart: An Approach to the Failing RV in CHD Patients	In-Kyung Song (Korea)
11:40-12:00	To Extubate or Not to Extubate after Simple Cardiac Surgery	Evangeline Lim (Singapore)
12:00-12:20	Q&A	
12:20-13:30	**Luncheon Symposium (Room A)**	Ah Young Oh (Korea)
	Sugammadex: Game Changer of NM Reversal	Nicola Disma (Italy)

DAY 3 18 June 2023 (Sun)

SC Convention International Conference Hall (B1F)

13:30-15:10	**Session 3. Neonates and Infants Need Special Anesthetic Care**	Serpil Ozgen (Türkiye) Ji-Hyun Lee (Korea)
13:30-13:50	Key Anesthesia Concepts for Each Neonatal Emergency	Yunxia Zuo (China)
13:50-14:10	Postop Apnea in Preterm Infants: Updated	Duenpen Horatanaruang (Thailand)
14:10-14:30	How to Improve the Success Rate of Small Vessel Cannulation	Young Eun Jang (Korea)
14:30-14:50	Anesthetic Management of Neonates Undergoing Diagnostic and Therapeutic Cardiac Catheterization	Duygu Kara (Türkiye)
14:50-15:10	Q&A	
15:10-15:30	Coffee Break	
15:30-17:00	**Session 4. Fluid and Transfusion**	Yoshie Taniguchi (Japan) Sun Young Park (Korea)
15:30-15:50	Glucose Management: Would You Like Some Sugar?	Mineto Kamata (Japan)
15:50-16:10	No More Hypotonic Fluid! (Virtual)	Hyungmook Lee (Korea)
16:10-16:30	Transfusion Triggers: RBC, Plasma, and Platelet	Vibhavari Naik (India)
16:30-16:50	Tranexamic Acid: Antifibrinolysis and Beyond	Angelina Gapay (Philippines)
16:50-17:00	Q&A	
17:00	ASPA 2024 Promotion Closing and Farewell (Room A)	

SC Convention International Conference Hall (B1F)

Room C		
08:30-10:00	Abstract Presentation 5 (In-person)	Hyo-Jin Byon (Korea) Hye Mi Lee (Korea)
~~AP5-1~~	~~Predictors of Sedation Failure with Initial dose of Intranasal Dexmedetomidine and Oral Midazolam for Pediatric Procedural Sedation~~	Withdrawn
AP5-2	Retrospective Study on an Inhalational Sevoflurane Technique for Ex-preterm Infants Undergoing Elective Inguinal Hernia Surgery	Esha Nilekani (India)
AP5-3	The Use of Dexmedetomidine for Pediatric Patients with Conjoined Twins Undergoing Computed Tomography Thoracoabdominal	Priscilla Tulong (Indonesia)
AP5-4	Stirp Sugar Midazolam! New Formulation of Midazolam (Midazolam Loaded Oral Film Via Electrospinning)(Preluminary Study)	Şükran Geze Saatçi (Türkiye)
AP5-5	Sedation in a Child with Difficult Airway for Magnetic Resonance Imaging (MRI)	Nirawanti (Malaysia)
~~AP5-6~~	~~A Balancing Act of Survival: A Case Report on the Anesthetic Management of an Ex Utero Intrapartum Procedure~~	Virtual
AP5-7	Effect of High-flow Nasal and Buccal Oxygenation on Safe Apnea Time in Children with Open Mouth	Chan-Ho Hong (Korea)
AP5-8	Near-infrared Spectroscopy Monitoring Failure in a Patient with Chronic Hypoxemia Undergoing Total Correction of Tetralogy of Fallot	Hwa-Young Jang (Korea)
10:00-10:50	Coffee Break	
10:50-12:20	Abstract Presentation 6 (In-person)	Eun-Hee Kim (Korea) Yong-Hee Park (Korea)
~~AP6-1~~	~~Implementation of "Goal Directed Bleeding Management" at Shahid Gangalal National Heart Center~~	Virtual
AP6-2	The Outcomes of PICC Insertion in Pediatric Patient at Siriraj Hospital	Niracha (Thailand)
AP6-3	Routine to Risk-based: A Pediatric Hemophilia B Case Report and the Adoption of Targeted Preoperative Blood Testing Practices with Questionnaires	Aya Sueda (Japan)

SC Convention International Conference Hall (B1F)

AP6-4	Use of Continuous Positive Airway Pressure During Sevoflurane Inhalational Induction does not Result in Faster Induction but Increases Sevoflurane Consumption	Akhil Kant Singh (India)
AP6-5	Effect of Single-dose Intravenous Lignocaine versus Fentanyl on Neuromuscular Recovery Time after General Anesthesia in Elective Pediatric Surgery: A Randomized Controlled Pilot Study	Mridul Dhar (India)
AP6-6	The Perioperative Coagulation Profile in Pediatric Patients Undergoing Liver Transplant Surgery	Komang Ayu Ferdiana (Indonesia)
AP6-7	Experiences of Our Pediatric Anesthesia After Devastating Earthquakes in Turkey	Melike Demir (Türkiye)

12:20-13:30	Luncheon Symposium (Room A)	Ah Young Oh (Korea)
	Sugammadex: Game Changer of NM Reversal	Nicola Disma (Italy)
15:10-15:30	Coffee Break	
17:00	ASPA 2024 Promotion Closing and Farewell (Room A)	

DAY 3 18 June 2023 (Sun)

SC Convention International Conference Hall (B1F)

Room D		
08:30-10:00	**Abstract Presentation 3 (Virtual)**	Jin Hee Ahn (Korea) Sung-Ae Cho (Korea)
V3-1	Bispectral Index Relation with Delirium in Post Cardiac Surgery Patients	Abdul Fatah Abro (Lithuania)
V3-2	The Impact of Oral Fluid Intake 1 Hour Prior to Surgery on Anxiety Levels and Gastric Volume in Pediatric Patients	Zehra Hatipoglu (Türkiye)
V3-3	Improvement of Broviac Catheter-related Outcomes after the Implementation of a Quality Management System: A Before-and-After Prospective Observational Study	Faiza Grati (Tunisia)
V3-4	Predictors of Perioperative Respiratory Adverse Events Among Children with a Cold Undergoing Pediatric Ambulatory Ilio-inguinal Surgery: Prospective Observational Research	Kammoun Manel (Tunisia)
V3-5	Intra Operative Fat Embolism in A Child with Osteogenesis Imperfecta-Double Whammy!	Snehal Tare (India)
V3-6	Risk Factors for Hickman-broviac Catheter Complications: The Experience of a Tunisian Hospital	Kammoun Manel (Tunisia)
V3-7	Complications and Risk Factors of Percutaneous Subclavian Vein Catheters in Pediatric Patients: Enhancing the Outcomes of a University Hospital in a Developing Country	Jarraya Anouar (Tunisia)
V3-8	Implementation of "Goal Directed Bleeding Management" at Shahid Gangalal National Heart Center	Ashish G. Amatya (Nepal)
10:00-10:50	Coffee Break	
10:50-12:20	**Abstract Presentation 4 (Virtual)**	Eun-Young Joo (Korea) Woo Suk Chung (Korea)
V4-1	The Utility of Enhanced Recovery After Surgery (ERAS) Protocols in Adolescent Scoliosis Surgery: A Systematic Review and Meta Analysis	Bharat Yalla (India)
V4-2	Comparison of Ultrasound Guided Thoracic Paravertebral Block Versus Serratus Anterior Plane Block in Children Undergoing Thoracic Surgery: A Prospective Observational Study	Emre Sertaç Bingül (Türkiye)

SC Convention International Conference Hall (B1F)

V4-3	Procedural Sedation and Anaesthetic Technique in Paediatric Patients with Anterior Mediastinal Mass in a Quaternary Centre-Our 3 Years of Experience	Rowena Lee (Hong Kong)
V4-4	Distraction Techniques for Post-operative Paediatric Patients in Post Anaesthesia Care Unit (PACU) a Randomized Control Trial	Shemila Abbasi (Pakistan)
V4-5	Perioperative Anaesthetic Management of Button Battery Ingestion: A Case Report	Won Jee Lee (Malaysia)
V4-6	Computed Tomographic(CT) Scan Measurements of Anatomical Landmark for Suprazygomatic Maxillary Nerve Block in Children	Sushma Konduri (India)
V4-7	A Balancing Act of Survival: A Case Report on the Anesthetic Management of an Ex Utero Intrapartum Procedure	Alexandra Lao (Philippines)
V4-8	Postoperative Sedation and Analgesia in Pediatric Cardiac Surgery	Elmira Satvaldieva (Uzbekistan)

12:20-13:30	Luncheon Symposium (Room A)	Ah Young Oh (Korea)
	Sugammadex: Game Changer of NM Reversal	Nicola Disma (Italy)

15:10-15:30	Coffee Break

17:00	ASPA 2024 Promotion Closing and Farewell (Room A)

Day 1

16 June 2023

Session 1.

Safe Anesthesia for Children with Co-Morbidity

Chair(s): Josephine Tan (Singapore)
Jin-Tae Kim (Korea)

URI and Anesthesia: Toward Zero Complication

Byung Gun Lim

Korea University Guro Hospital, Korea

Learning Objectives

1. Review preoperative considerations for the decision to proceed with anesthesia and surgery for pediatric patients with upper respiratory tract infection (URI)
2. Review independent risk factors for perioperative respiratory adverse events in pediatric patients with URI
3. Review the current evidence for perioperative management including preoperative optimization and anesthetic management of pediatric patients with URI and share your own practical experience for better outcomes
4. Discuss additional concerns and overall considerations for pediatric patients with URI during epidemics such as the COVID-19 pandemic

Introduction

The available evidence suggests that although children experience less severe symptoms of Coronavirus Disease 2019 (COVID-19) than adults and some children are asymptomatic, the most common clinical features of COVID-19 in children are fever and upper respiratory tract symptoms such as cough, sore throat, and rhinorrhea [1]. These coronaviruses as well as other viruses that invade respiratory tracts develop various symptoms depending on the anatomical location of the infected mucosa. In general, viral infection of the mucus membranes causes airway inflammation, resulting in increased secretions, airway susceptibility, and bronchial hyperreactivity. The airway inflammation is the main pathophysiology of increased risk of perioperative respiratory adverse events (PRAEs) including predominantly laryngospasm and bronchospasm [2]. Therefore, a pediatric patient with a current or recent upper respiratory tract infection (URI) has an irritable airway and can be at increased risk for PRAEs including bronchospasm, laryngospasm, postintubation croup, breath holding (apnea), desaturation (hypoxemia), atelectasis, and pneumonia.

1. Preoperative considerations for the decision whether to proceed with surgery and anesthesia in pediatric patients with URI

The question of whether to cancel a surgery in children with URI and, if so for how long, is difficult to answer and is influenced by many factors including patient, surgical, and anesthetic factors [3]. There is now an increasing expert consensus that it is not necessary to postpone a surgery for 6 weeks after any URI in children—although bronchial hyperreactivity may last for up to 6 weeks after URI in pediatric patients—, and thus recent recommendations emphasize an about 2-week-long time lag between the resolutions of URI symptoms and anesthesia [3]. It means that URI is commonly associated with an increased risk for PRAEs mostly when symptoms are present or have occurred within 2 weeks before surgery [4,5]. Especially, if the child is febrile or has rhonchi, productive cough and mucopurulent airway secretions, an elective surgery should be canceled. In other words, for children with severe URI symptoms (fever, green runny nose, moist cough, wheezing, or lethargy), it is recommended to postpone the surgery for at least 2 weeks if possible [3]. Therefore, a thorough history taking (symptoms and past/familial medical history) and physical examination, and preoperative risk assessment using a proper tool (e.g., a 'COLDS' score [2,6]) are needed and thereafter a proper perioperative management should be provided to reduce a risk for PRAEs in the patients when the surgery proceeds.

2. Independent risk factors for PRAEs in pediatric patients with URI

Independent risk factors for PRAEs in pediatric patients with URI include use of endotracheal tube (vs. use of laryngeal mask airway [LMA] or face mask), history of parental/passive smoking [4,5,7-10], history of prematurity or reactive airway disease, airway surgery, presence of copious secretions, and nasal congestion [4,5,7].

Risk factors for PRAEs in pediatric patients with URI can be divided into patient, surgical, and anesthetic factors as follows [2,3,11]: (1) Patient factors: presence of copious secretions, sputum, and nasal congestion; parental/passive smoking; history of reactive airway disease (pulmonary comorbidity); younger age (less than 1 year); prematurity (less than 37 weeks of gestation); parental belief, 'the child has a cold'. (2) Surgical factors: major surgery or surgery requiring tracheal intubation including surgery involving the airway, ear-nose-throat surgery, eye surgery, upper abdominal and thoracic surgery, and cardiac surgery. (3) Anesthetic factors: invasive airway insertion (endotracheal intubation), anesthetic agents (desflurane), inexperience of the anesthesiologist in performing pediatric anesthesia.

These risk factors should be investigated during the preoperative assessment in all pediatric patients with URI to establish an optimized anesthetic management. The decision to proceed or cancel the surgery in pediatric patients with URI depends on the risk factors including the severity of URI symptoms, the presence of other coexisting illnesses, and the type and urgency of the surgery, and a final decision should be made by an individual risk-benefit ratio.

3. The current evidence for perioperative management of pediatric patients with URI

Current evidence for anesthetic management to decrease the incidence of PRAE in pediatric patients with URI can be summarized as follows [3]: Premedication with an aerosol of salbutamol has been shown to be effective in both the prevention and treatment of perioperative bronchospasm. Current evidence does not support the preventive effect of intravenous lidocaine bolus (1 mg/kg) on the incidence of PRAE. Anesthesia induction through intravenous propofol has been suggested to result in a lower incidence of PRAE in children with URI when compared to inhalational induction. Endotracheal intubation has been shown to be associated with a higher incidence of PRAE when compared with ventilation via a LMA or face mask. Use of desflurane should be avoided. The experience of the anesthesiologist is crucial to prevent and treat perioperative complications. As for a treatment tool at the occurrence of PRAEs, oxygen is used to treat hypoxemia, inhaled salbutamol or albuterol and inhaled anesthetics can treat bronchospasm, and neuromuscular blocking agents are available to treat laryngospasm.

In summary, anesthetic management to reduce the incidence of PRAE in pediatric patients with URI include preoperative inhalational therapy with salbutamol, avoidance of endotracheal intubation whenever possible, use of a LMA or face mask, intravenous induction with propofol, and avoidance of desflurane, and prevention, early recognition and immediate treatment of complications by an experienced anesthesiologist.

4. Additional concerns and overall considerations for pediatric patients with URI during epidemics such as the COVID-19 pandemic

Pediatric patients with URI require special considerations during epidemics like the COVID-19 pandemic. Here are some additional concerns and overall considerations for managing pediatric URI during such situations:

(1) Increased susceptibility: Children, especially infants and young children, may have a higher susceptibility to respiratory infections, including URI. This vulnerability is important to consider during epidemics, as they may be more prone to contracting viral illnesses.

(2) COVID-19 transmission: The COVID-19 pandemic has highlighted the importance of understanding the transmission dynamics of respiratory viruses. Pediatric patients with URI should be evaluated for COVID-19 symptoms and tested when necessary. Considering that they can contribute to the transmission of COVID-19, adherence to preventive measures like wearing masks, practicing hand hygiene, and maintaining physical distancing is crucial.

(3) Differential diagnosis: During epidemics, it becomes even more important to differentiate between various respiratory pathogens causing URI. While COVID-19 is a significant concern, other common viruses like influenza, respiratory syncytial virus (RSV), adenovirus, and rhinovirus can also cause similar symptoms in children. Proper testing and diagnosis are essential to guide appropriate management and infection control measures.

(4) Severity and complications: Pediatric URI can vary in severity, ranging from mild symptoms to more severe presentations. While the majority of children with URI recover without complications, certain populations, such as infants, those with underlying medical conditions, or immunocompromised individuals, may be at

higher risk for severe illness and complications. These high-risk groups should receive special attention and appropriate medical care.

(5) Impact on healthcare resources: Epidemics can place a strain on healthcare resources, including hospital beds, intensive care units, and healthcare personnel. Pediatric patients with URI, particularly those requiring hospitalization or intensive care, may need to be carefully managed to optimize resource utilization and ensure adequate care for all patients.

(6) Psychological impact: Epidemics can cause anxiety and fear among children and their caregivers. The fear of contracting COVID-19 or other respiratory illnesses can lead to stress and emotional distress. Healthcare providers should address these concerns and provide support to children and families, including clear communication, education, and mental health resources when needed.

(7) Vaccination: During epidemics, vaccination plays a crucial role in preventing and reducing the severity of respiratory infections. Ensuring that pediatric patients receive recommended vaccinations, including the influenza vaccine, when available, can help protect them from additional respiratory illnesses and reduce the burden on healthcare systems.

In summary, managing pediatric patients with URI during epidemics like the COVID-19 pandemic requires considering their increased susceptibility, the need for accurate differential diagnosis, adherence to infection prevention measures, special attention to high-risk populations, optimization of healthcare resources, addressing psychological impact, and promoting vaccination when available.

5. Long-term impact of the COVID-19 pandemic on PRAEs in pediatric patients with URI.

During the COVID-19 pandemic, anesthesiologists have been recommended to change their routine practices according to pragmatic decisions rather than based on solid scientific evidence. Organizational adaptations regarding personal protective equipment (PPE), patient admission, flow of patients, preoperative examination, intraoperative management, and postoperative discharge are few areas to mention [12]. We are obliged to assess the true value of the strategies, approaches, and treatment modalities during this pandemic in a solid scientific manner, and we should not compromise our standards and scientific rigor. Definitely, COVID-19 pandemic has impacted the testing, safety, clinical management, and economics of pediatric anesthesia practice, but the long-term consequences are difficult to predict [12].

Likewise, the long-term impact of the COVID-19 pandemic on PRAEs in pediatric patients with URI is a topic that requires further research and investigation. Although the available information is limited, some general considerations can be made:

(1) Delayed surgeries and changes in healthcare utilization patterns: The COVID-19 pandemic has led to the postponement or cancellation of many elective surgeries, including those in pediatric patients. This could potentially affect the incidence and management of pediatric patients with URI requiring surgery and their

subsequent respiratory outcomes. Delaying surgeries in children with URI during the pandemic may have reduced the occurrence of PRAEs as these patients were likely screened and rescheduled [13]. The impact of public health measures such as universal mask use in many countries, physical distancing, school and nursery care closures, and travel bans had an unprecedented impact on transmission of infectious diseases such as RSV and influenza and subsequent decreased pediatric patients with URIs in operating rooms [12,14]. It left much wondering if the sanitary measures were the solution for elimination of such diseases [12,15]. This may have been influenced by the cancellation of elective surgery for various reasons and the reluctance of parents to take their child to the hospital. Conversely, it can be inferred from the fact that when hospitals reopened for elective surgery, there was a lower incidence of surgery cancellations due to URIs either because of prehospital screening or increased knowledge about the implications of the COVID-19 pandemic and infections such as URIs [12]. As a result, children with recent acute respiratory symptoms were not admitted to the hospital for elective procedures, and the subsequent withdrawal rate was low. Ideally, the lessons learned here would result in lower cancellations and rescheduling of procedures [12]. However, precaution must be taken not to delay appropriate surgery unnecessarily, and the specific impact on long-term outcomes related to respiratory events requires further study.

(2) Impact of COVID-19 on respiratory health: While COVID-19 primarily affects the respiratory system, the long-term impact of the disease on pediatric patients with URI in the perioperative setting is not yet fully understood. It is important to consider the potential respiratory sequelae of COVID-19, such as lung damage or persistent respiratory symptoms, which could affect the occurrence of PRAEs in the future.

(3) Changes in perioperative protocols: The COVID-19 pandemic has prompted changes in perioperative protocols and infection control measures to reduce the risk of viral transmission. These measures, such as preoperative screening, PPE use, and enhanced cleaning and disinfection, may have had an impact on mitigating PRAEs in pediatric patients with URI. However, the extent of this impact and its long-term consequences require further investigation.

(4) Increased vigilance: The COVID-19 pandemic has heightened awareness of respiratory infections, including the need for screening and testing prior to medical procedures. Healthcare providers may be more vigilant in identifying pediatric patients with URI and taking appropriate precautions to minimize the risk of PRAEs.

Conclusions

<Strategies for achieving “Toward Zero Complications” in the perioperative management of pediatric patients with URI>

(1) Preoperative assessment: Thoroughly evaluate the child's medical history, including any previous complications with URI, asthma, or other respiratory conditions. Assess the severity and duration of the URI symptoms, including the presence of fever, cough, or congestion.

(2) Multidisciplinary collaboration: Foster communication and coordination between the surgical team, anesthesiologists, and pediatricians to develop a comprehensive perioperative plan. Ensure everyone is aware

of the child's respiratory status and the potential risks associated with the URI.

(3) Optimization of respiratory status: Implement measures to improve the child's respiratory function before surgery. This may include bronchodilator therapy, or other appropriate interventions to reduce airway inflammation and improve breathing.

(4) Timing of surgery: Whenever possible, consider postponing elective procedures in pediatric patients with active URI. Delaying surgery allows time for the child's immune system to recover, reducing the risk of complications. Emergency or urgent procedures should be assessed on a case-by-case basis.

(5) Anesthesia considerations: Choose anesthetic techniques that minimize the impact on respiratory function. Regional anesthesia or monitored anesthesia care may be suitable alternatives to general anesthesia in certain cases. Use appropriate airway management techniques to maintain optimal oxygenation and ventilation during the procedure.

(6) Infection control measures: Strictly adhere to infection prevention protocols, including hand hygiene, appropriate use of PPE, and environmental cleaning. Minimize the risk of transmission by isolating patients with contagious URI and encouraging respiratory etiquette.

(7) Postoperative care: Monitor the pediatric patients closely after surgery, paying attention to respiratory function and signs of complications. Provide adequate pain management and promote early mobilization to prevent respiratory complications. Ensure proper discharge planning, including instructions for follow-up care and monitoring.

(8) Patient and family education: Educate the patient and their caregivers about the importance of identifying and reporting URI symptoms before surgery. Emphasize the need for timely communication with healthcare providers to assess the appropriateness of proceeding with the procedure.

(9) Shared decision-making: Engage in shared decision-making with the child's family, weighing the risks and benefits of proceeding with surgery during a URI. Consider their input and concerns, ensuring they have a clear understanding of the potential complications associated with URI.

(10) Continuous quality improvement: Regularly review and analyze outcomes and complications related to pediatric patients undergoing surgery with URI. Identify areas for improvement, develop protocols, and implement evidence-based strategies to enhance perioperative care and patient safety.

It's important to note that these strategies are general guidelines, and the specific management of each pediatric patient with a URI should be tailored to their individual needs. Consulting with anesthesiologists experienced in pediatric perioperative care is crucial for optimal decision-making.

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Anaesthesia for Patient with Mucopolysaccharidosis

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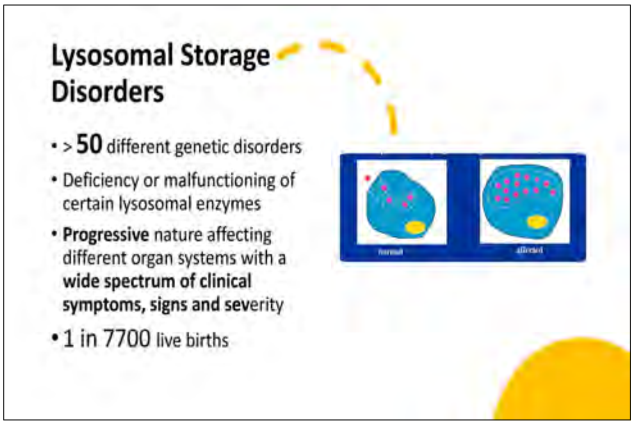
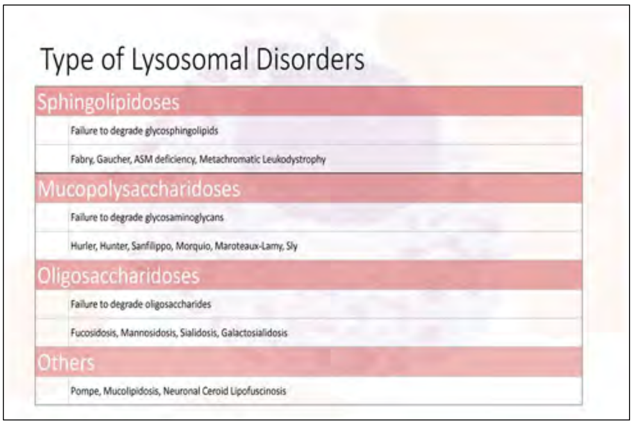
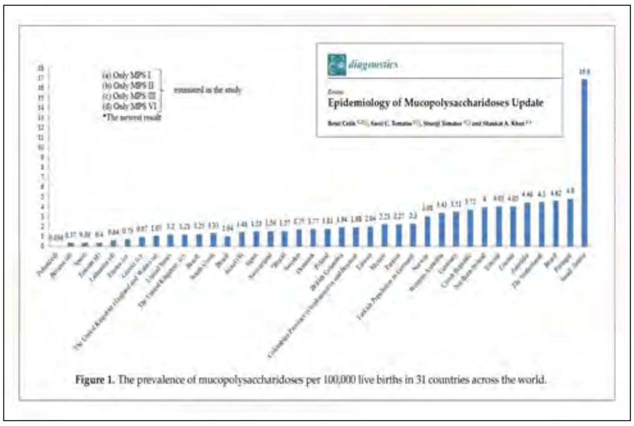
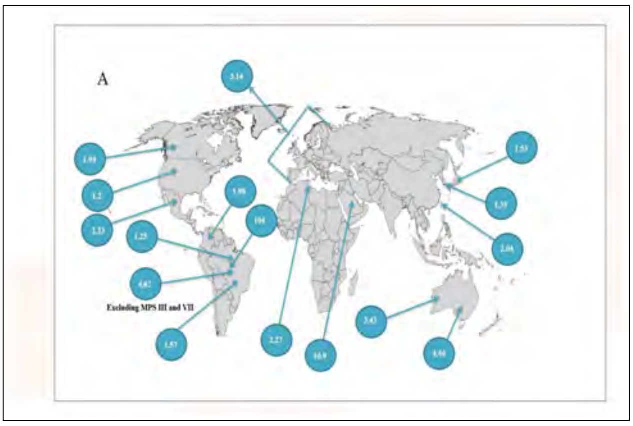
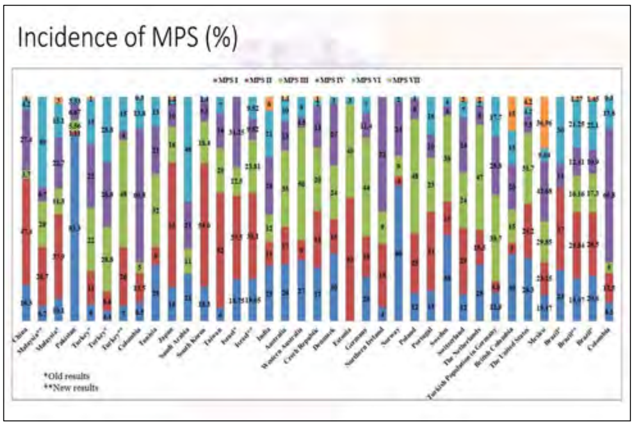








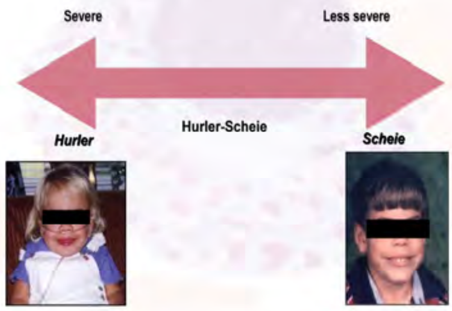


Types of MPS

Disorder	Deficient Enzyme	GAG Accumulation	Inheritance	Severity	Treatment Options
MPS I H (Hurler)	α-L-Iduronidase	HS, DS	AR	Severe	ERT, HSCT
MPS I H/S (Hurler-Scheie)				Intermediate	
MPS I S (Scheie)				Mild	
MPS II (Hunter)	Iduronate-2-sulfatase	HS, DS	XR	Variable	ERT, HSCT
MPS III (Sanfilippo A)	Heparan-N-sulfatase	HS	AR	Variable	Supportive
MPS III (Sanfilippo B)	α-N-Acetylglucosaminidase				
MPS III (Sanfilippo C)	α-Glucosaminidase acetyltransferase				
MPS III (Sanfilippo D)	N-Acetylglucosamine 6-sulfatase				
MPS IVA (Morquio A)	N-Acetylgalactosamine-6-sulfate sulfatase	KS, C6S	AR	Variable	ERT, HSCT
MPS IVB (Morquio B)	b-Galactosidase	KS	AR	Mild	ERT, HSCT
MPS VI (Maroteaux-Lamy)	N-Acetylgalactosamine-4-sulfatase	DS, C4S	AR	Variable	ERT, HSCT
MPS VII (Sly)	b-D-Glucuronidase	HS, DS, C4S, C6S	AR	Variable	ERT, HSCT
MPS IX	Hyaluronidase	Hyaluronan	AR	Mild	Supportive

HS- Heparan sulfate, DS – Dermatan sulfate, KS – Keratan sulfate, C6S – Chondroitin-6-sulfate, C4S – Chondroitin 4,6-sulfate

MPS I Spectrum of Disease Severity



MPS II – Hunter Syndrome

- X-linked recessive disorder
- Occurs predominantly in males.
- Children with the more severe form of MPS II share many of the neurological and physical features associated with severe MPS I but with milder symptoms.
- Onset of the disease is usually between ages 2 and 4.
- Developmental decline is usually noticed between the ages of 18 and 36 months, followed by progressive loss of skills.

MPS III - Sanfilippo syndrome

- Normal up to 6 year of age, Neurodegenerative disease with predominate CNS symptoms
- Relative lack of somatic features with no skeletal abnormalities
- Usually present at young childhood with behavioral problems or change of behaviour and cognitive regression.
- Other symptoms include seizures, regression in language skills, deafness, blindness, enlarged tonsils, adenoids, and respiratory infections.
- Universally lethal by end of teens – early 20s

MPS IV - Morquio syndrome

- 2 subtypes that result from the missing or deficient enzymes N-acetylgalactosamine 6-sulfatase (Type A) or beta-galactosidase (Type B)
- Short stature, atlantoaxial instability, odontoid hypoplasia, pectus carinatum, spine and skeletal deformities secondary to **laxity of joints** (as oppose to other types of MPS with stiff joints & contractures), corneal clouding, dental anomalies, hepatomegaly, and restrictive lung disease.
- **Normal intelligience**

MPS VI - Maroteaux-Lamy syndrome

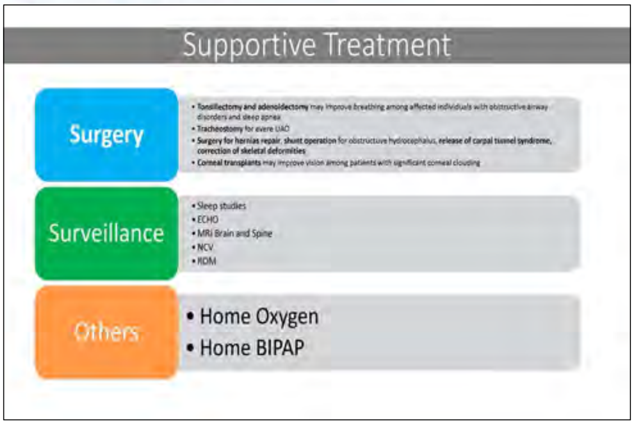
MPS VI - Maroteaux-Lamy syndrome

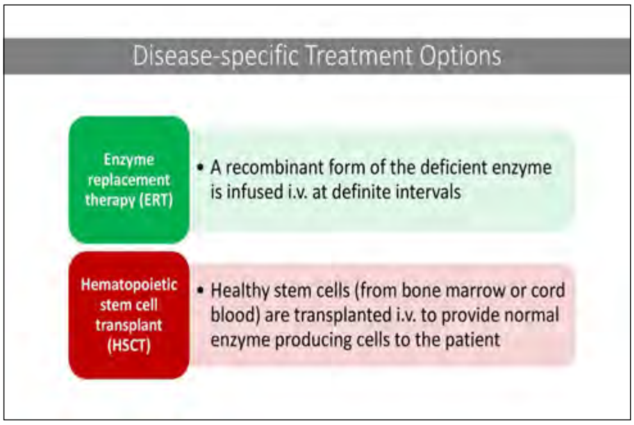
Short trunk, crouched stance, restricted movement with stiff joints and valvular heart disease, corneal clouding, deafness

Normal intelligence

MPS VII - Sly Syndrome

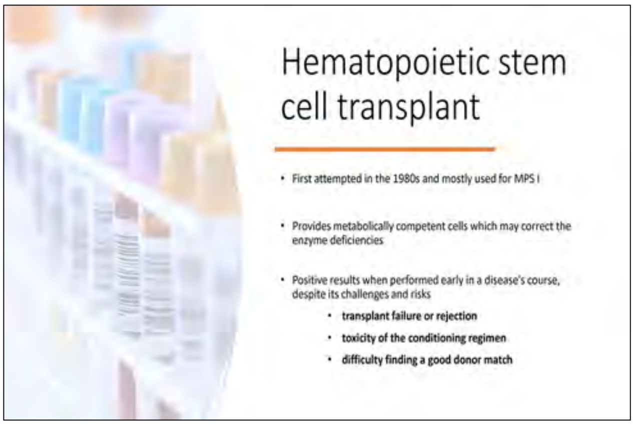
- Least common form
- Skeletal dysplasia, short stature, nerve entrapment
- Developmental delay
- Hepatomegaly

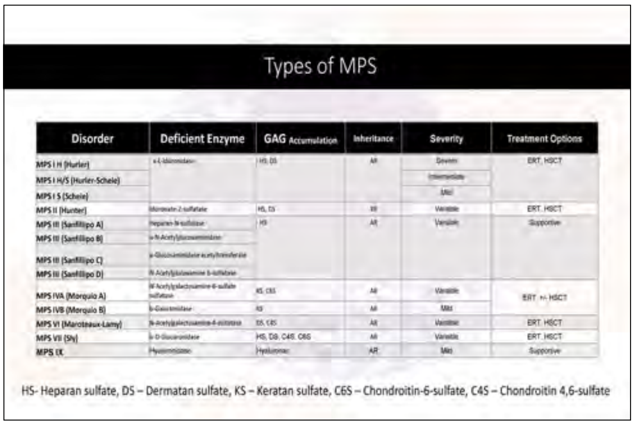

Supportive Treatment
Surgery
• Tonsillectomy and adenoidectomy may improve breathing among affected individuals with obstructive airway disorders and sleep apnea
• Tracheostomy for severe UAO
• Surgery for hernias repair, shunt operation for obstructive hydrocephalus, release of carpal tunnel syndrome, correction of skeletal deformities
• Corneal transplants may improve vision among patients with significant corneal clouding
Surveillance
• Sleep studies
• ECHO
• MRI Brain and Spine
• NCV
• ROM
Others
• Home Oxygen
• Home BIPAP


Disease-specific Treatment Options
Enzyme replacement therapy (ERT)
• A recombinant form of the deficient enzyme is infused i.v. at definite intervals
Hematopoietic stem cell transplant (HSCT)
• Healthy stem cells (from bone marrow or cord blood) are transplanted i.v. to provide normal enzyme producing cells to the patient

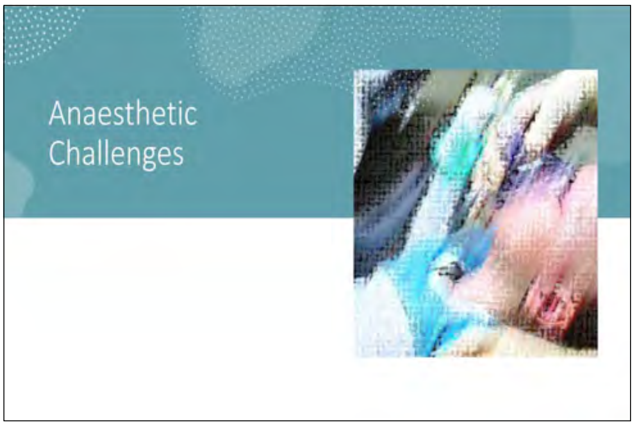

ENZYME REPLACEMENT THERAPY (ERT)
• Medical treatment by giving the patient an intravenous (IV) infusion at regular intervals that contains the deficient or absent enzyme
• R&D began in the mid-1960s
• Clinical trials by the 1980s
• Advances in recombinant DNA manufacturing in the early 1990s enabled enzyme production in quantities large enough for commercial development
• The first ERT went on the market in 1991 for Gaucher type I
• Currently available for: Gaucher disease, Gabry disease, MPS I< MPS II, MPS IV, MPS VI, Glycogen storage disease type II


Issues of concern with ERT
• ERT does not "treat" the underlying disease, only the symptoms
• Long term data on survival benefit & drug safety
• Data on drug efficacy continued to be accumulated from ongoing studies & patients registry
• Extremely Costly


Hematopoietic stem cell transplant
• First attempted in the 1980s and mostly used for MPS I
• Provides metabolically competent cells which may correct the enzyme deficiencies
• Positive results when performed early in a disease's course, despite its challenges and risks
• transplant failure or rejection
• toxicity of the conditioning regimen
• difficulty finding a good donor match


Types of MPS
Disorder
Deficient Enzyme
GAG Accumulation
Inheritance
Severity
Treatment Options
MPS I H (Hurler)
MPS I H/S (Hurler-Scheie)
MPS I S (Scheie)
MPS II (Hunter)
MPS III (Sanfilippo A)
MPS III (Sanfilippo B)
MPS III (Sanfilippo C)
MPS III (Sanfilippo D)
MPS IVA (Morquio A)
MPS IVB (Morquio B)
MPS VI (Maroteaux-Lamy)
MPS VII (Sly)
MPS IX
HS, DS
HS, DS
HS
KS, C6S
KS
DS, C4S
HS, DS, C4S, C6S
AR
AR
AR
AR
AR
AR
Variable
Variable
Variable
Mild
Variable
Variable
Mild
ERT, HSCT
ERT, HSCT
Supportive
ERT +/- HSCT
ERT, HSCT
ERT, HSCT
Supportive
HS- Heparan sulfate, DS – Dermatan sulfate, KS – Keratan sulfate, C6S – Chondroitin-6-sulfate, C4S – Chondroitin 4,6-sulfate


PROGNOSIS
• Early diagnosis is essential for early initiation of various treatment options → Newborn Screening
• Early intervention is mandatory for the most serious and debilitating symptoms, particularly involving the neurological and skeletal systems


Anaesthetic Challenges

Studies on Airway Management in MPS

Study	year of publication	No of patients/No of Anaesthetics	No of procedure per patient	Difficult mask		Difficult intubation		Failed intubation		Remark
Frawley et al.	2012	17/141	8.3	20/141	14%	40/141	28.4%	2		Mixed
Moores et al.	1996	28/99	3.5	11/44	25%	23/52	44.2%	2		Mixed
Walker et al.	2013	34/89	2.6	-	-	20/60	33.0%	5		Mixed
Megens et al.	2014	19/136	7.2	9./130	7%	24/67	35.8%	7		Mixed
Clark et al.	2017	18/49	2.7	4/6	66.7%	3/36	8.3%	3		Mixed
Cingi et al.	2013	25/73	2.9	0		0		0		MPS III
Osthaus et al.	2012	10/41	4.1	5/41	12.2%	11/29	37.9%	3/29		MPS I
Cohen and Stuart	2017	34/86	2.5	0	0	2/63	3.2%	1/63		MPS III
Kamata et al.	2017	25/43	1.7	0	0	-		-		MPS III
Lao et al.	2022	51/151	3.0	1/80	1.20%	10/80	12.50%			Mixed

Clark *et al. Bosn J Basic Med Sci.* 2018;18(1):1-7.
Lao et al. J. Pers. Med. 2022, 12, 1343.

Studies on Airway Management in MPS

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The Anesthetic Strategy for Patients with Mucopolysaccharidoses: A Retrospective Cohort Study

Summary of anaesthesia methods		
General Anesthesia (N=136)		
Bag-mask	15	11.0%
Supraglottic Device	15	11.7%
Endotracheal intubation	80	58.8%
Pre-existing airway	26	19.1%
Neuroaxial anesthesia (N=15)		

- Thorough preoperative evaluation for the airway is essential to ensure a safer general anesthesia.
- For each of the MPS patient in our institute, a preprocedural consultation with the experienced otolaryngological doctor is not only routine but a strict rule.
- Adequate preoxygenation, **sufficient spontaneous breathing, and maintenance of protective laryngeal reflexes prior to securing the airway would lower the risk of hypoxia**.
- Standby ENT team is available for most of the anesthetic inductions.
- Multidisciplinary experienced team would contribute to the vast quality assurance for safe perioperative airway management.

45.6% available Cormack–Lehane classifications were Grade III or IV, mostly from MPS I

Treatment and Airway

ERT
- AHI and OSAs seem to be reduced by ERT, but it is clear that macroglossia and adeno-tonsils hypertrophy are not modified during long-term treatment
- No direct evidence revealing the effect of ERT and airway

HSCT
- Theoretically slow down progression
- Awaiting evidence and experience

Case 1 – MPS I

- M/10 32kg 135cm
- s/p HSCT at 3 year of age
- GDD, Mild Snoring, Echo revealed thickened MV and AV
- MRI – odontoid hypoplasia with upper dens soft tissue deposition, spinal canal stenosis C2 – C5, no C1/2 subluxation
- Previous GA revealed grade IIb larynx at 3 year of age

Multi-team Examination Under Anaesthesia

Order	Team	Procedures
1	ENT	ENT exam, hearing test +/- grommet insertion
2	Eye	Eye exam
3	Dental	Dental exam +/- tooth extraction/filling
4	Cardiology	Cardiac exam, ECG, Echo
5	Physiotherapy	PT / OT (passive ROM)

Case 1 – MPS I

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- MRI – odontoid hypoplasia with upper dens soft tissue deposition, spinal canal stenosis C2 – C5, no C1/2 subluxation
- Previous GA revealed grade IIb larynx at 3 year of age

Anticipated problems:
- **Anxiety and behavioural problem at induction**
- **Difficult airway**
- **Unstable Cervical spine**
- **Prolong Procedure**

Case 1 – MPS I

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- Previous GA revealed grade IIb larynx at 3 year of age

Anaesthetic techniques:
A. IV Sedation with spontaneous ventilation
B. GA with suprglottic airway device (SAD) and spontaneous ventilation
C. GA with SAD and IPPV
D. GA with ETT and IPPV

Case 1 – MPS I

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- MRI – odontoid hypoplasia with upper dens soft tissue deposition, spinal canal stenosis C2 – C5, no C1/2 subluxation
- Previous GA revealed grade IIb larynx at 3 year of age

- IV Sedation with TCI propofol, bolus Ketamine and fentanyl after premed with IN dexm
- ENT procedure was performed with MIS, DL with Videoscope revealed grade III larynx
- HFNC used after ENT completed EUA
- Procedure time: 150 mins

Case 2 – MPS II

- M/5, Developmental delay
- Macroglossia large tonsils s/p T&A
  - Grade IIa Larynx previous GA x T&A
- Suspected C1/2 instability on XR
  - MRI 2 years ago revealed dysplastic odontoid process with associated soft tissue mass, no evidence cervical canal stenosis or anterior displacement of C1 – not for intervention
- For repeat MRI brain and whole spine

Case 2 – MPS II

- M/5, diagnosed at 2 year of age, Developmental delay
- Not suitable for ERT, Not keen for BMT
- Macroglossia large tonsils s/p tonsillectomy
- Suspected C1/2 instability on XR, MRI 2 years ago revealed dysplastic odontoid process with associated soft tissue mass, no evidence cervical canal stenosis or anterior displacement of C1 – not for intervention
- For repeat MRI brain and whole spine

What would be your anaesthetic Plan?

A. No Anaesthesia
B. Oral Sedation
C. IV sedation
D. General Anaesthesia with SAD
E. General Anaesthesia with ETT

Case 2 – MPS II

- M/5, Developmental delay
- Macroglossia large tonsils s/p tonsillectomy
- Suspected C1/2 instability on XR, MRI 2 years ago revealed dysplastic odontoid process with associated soft tissue mass, no evidence cervical canal stenosis or anterior displacement of C1 – not for intervention
- For repeat MRI brain and whole spine

Anaesthetic Concerns:

- Potential difficult airway
- Unstable c-spine
- Uncooperative child for prolong MRI
- Would this MRI help the patient in anyway?

Case 2 – MPS II

- M/5, Developmental delay
- Macroglossia large tonsils s/p tonsillectomy
- Suspected C1/2 instability on XR, MRI 2 years ago revealed dysplastic odontoid process with associated soft tissue mass, no evidence cervical canal stenosis or anterior displacement of C1 – not for intervention
- For repeat MRI brain and whole spine

Discussion with referring team, the team feels this MRI is important as if it reveal unstable c-spine, counselling and surgical intervention maybe offered.

Balancing the risk and benefits, consensus achieved – iv sedation with an aim to maintain spontaneous respiration with minimal disturbance to c-spine and airway, may need to abort or perform limited sequence

Case 2 – MPS II

- M/5, Developmental delay
- Macroglossia large tonsils s/p tonsillectomy
- Suspected C1/2 instability on XR, MRI 2 years ago revealed dysplastic odontoid process with associated soft tissue mass, no evidence cervical canal stenosis or anterior displacement of C1 – not for intervention
- For repeat MRI brain and whole spine

Sedation

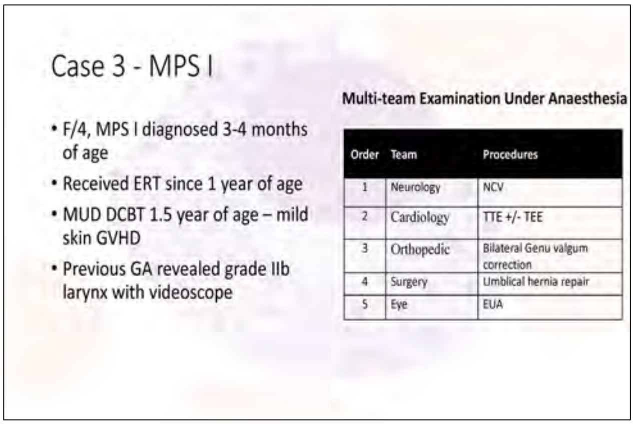
- Premed with IN dexmedetomidine and Ketamine
- Follow by IV dexmedetomidine infusion at 1.5ug/kg/hr
- Needed 2 boluses of propofol (15mg + 15mg) for position

Spinal pathology

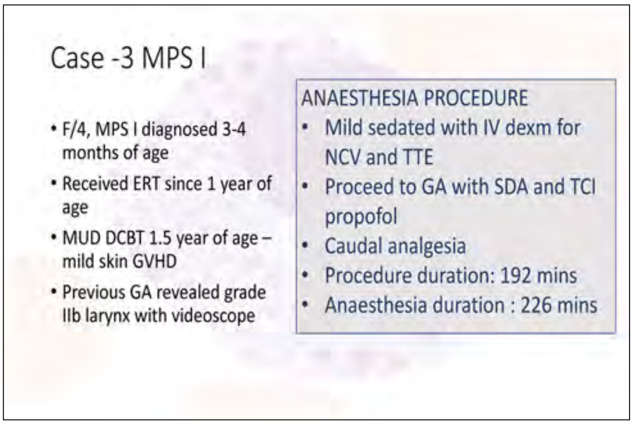
- Spinal stenosis is a frequent pathology in MPS. Cervical spine instability poses extra challenge in anaesthesia.
- Patients with MPS I, II and VI may present with pathology related to GAG accumulation leading to spinal stenosis and spinal cord compression.
- Patients with MPS IV may have atlantoaxial (C1-C2) subluxation arising from dens hypoplasia and ligamentous laxity.
- Spinal pathologies together with kyphoscoliosis may lead to spinal cord compression which may either present as
  - a chronic progressive myelopathic condition
  - a sudden catastrophic cord compression resulting in major neurological sequelae with quadriplegia or even sudden death

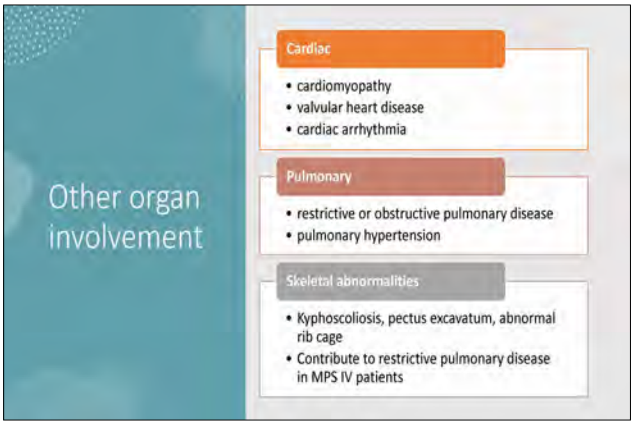
Case of MPS IV patient with normal intelligence and unstable c-spine for MRI with flexion and extension

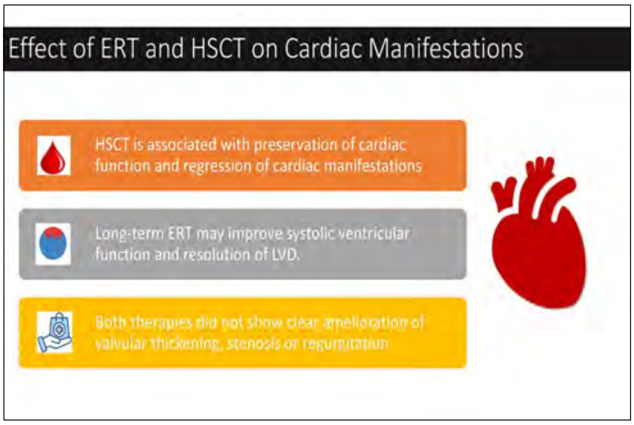
MDT approach with play therapy, mock scan training, physiotherapist and MRI sequence adjustment

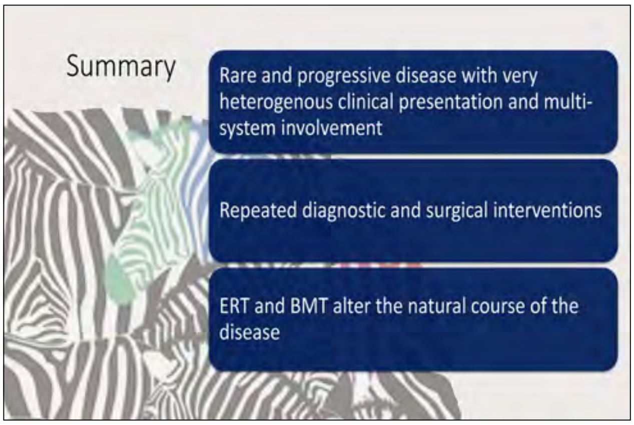


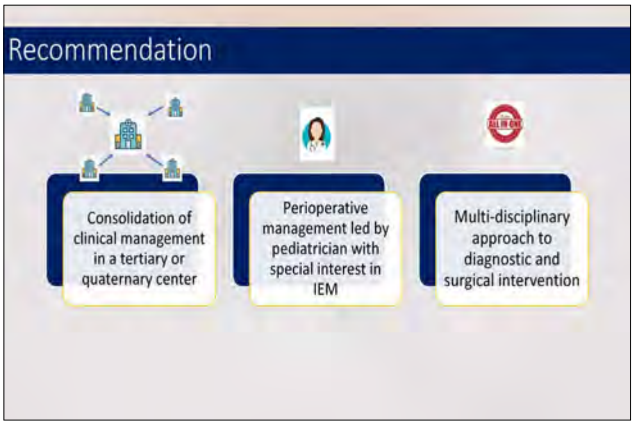
Order	Team	Procedures
1	Neurology	NCV
2	Cardiology	TTE +/- TEE
3	Orthopedic	Bilateral Genu valgum correction
4	Surgery	Umblical hernia repair
5	Eye	EUA







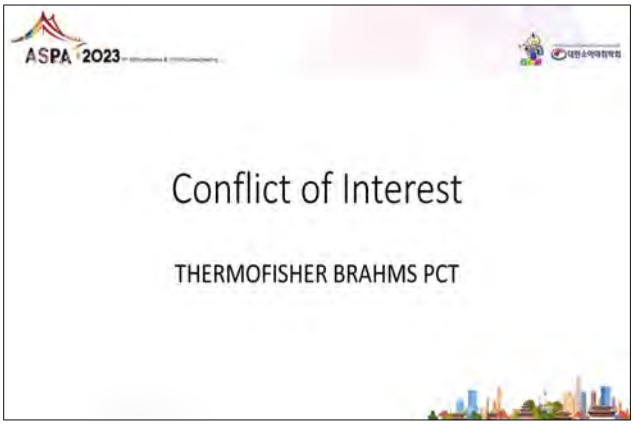


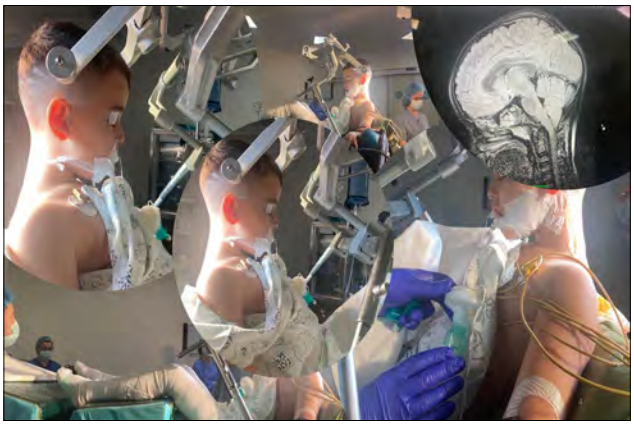


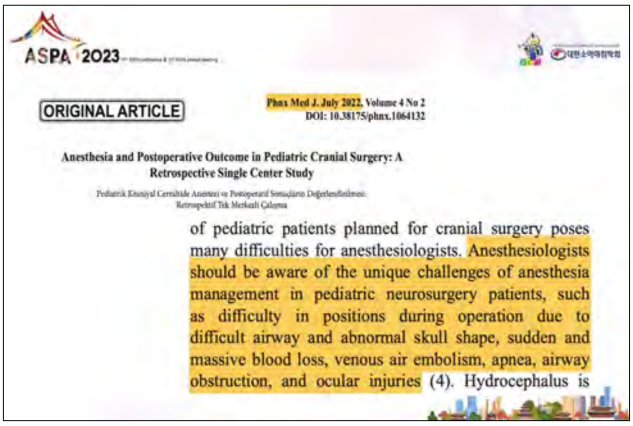
Airway and Ventilation Management in Pediatric Neurosurgical Cases

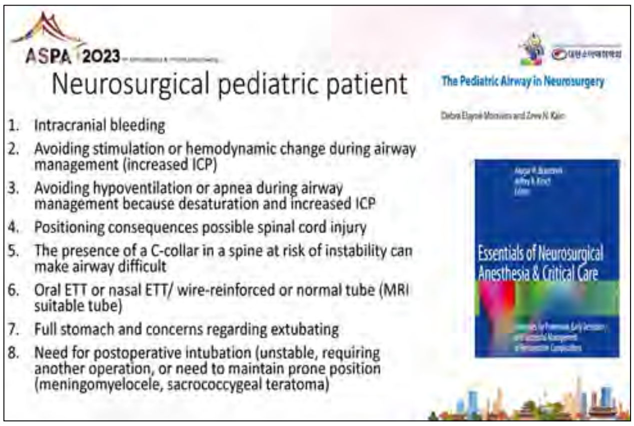
Rudin Domi

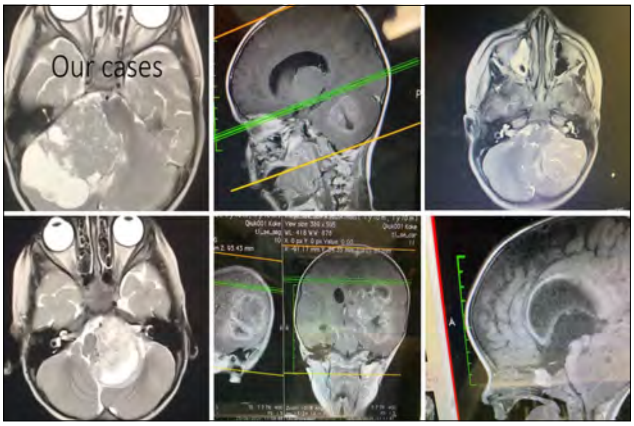
Faculty of Medicine, University of Medicine, Albania

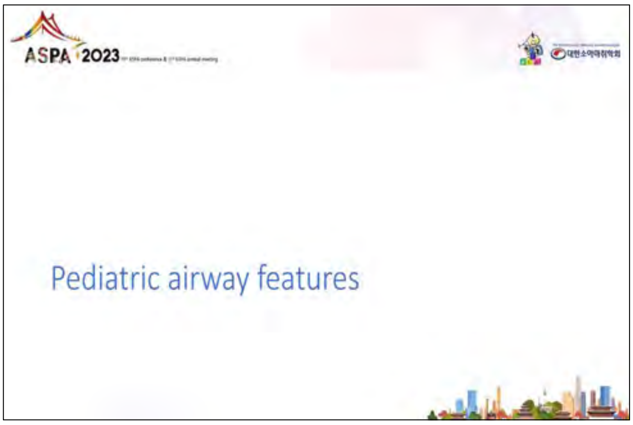


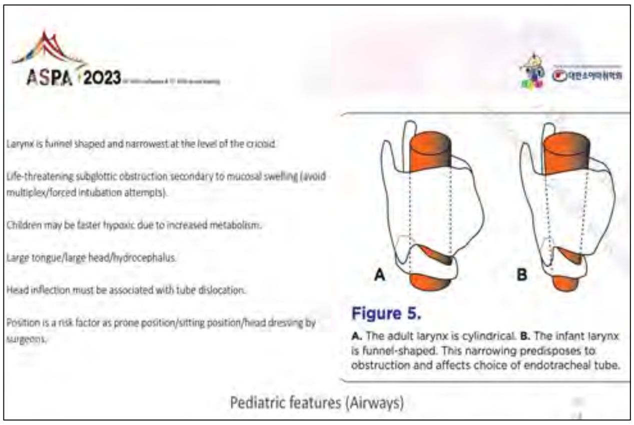


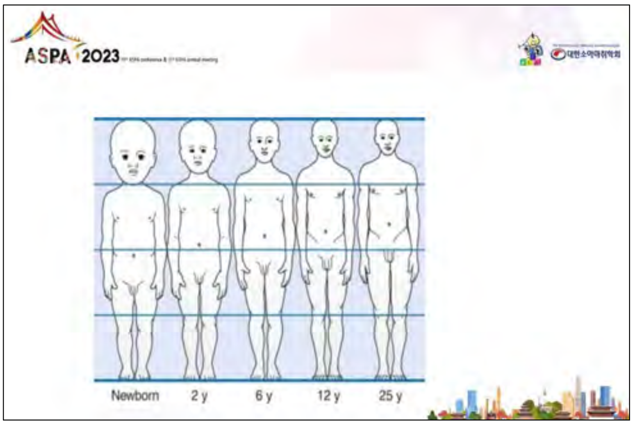


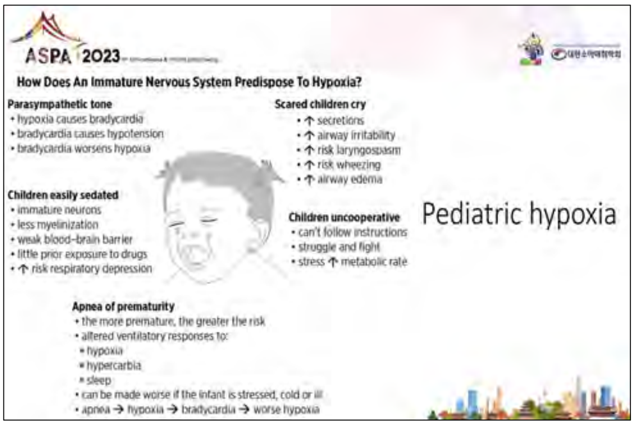


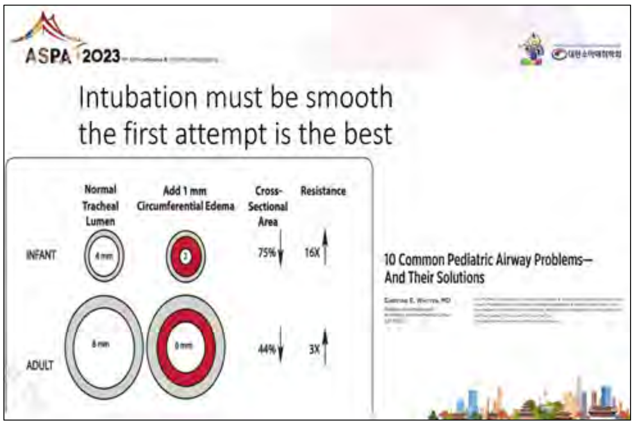

Our cases


ASPA 2023
Pediatric airway features

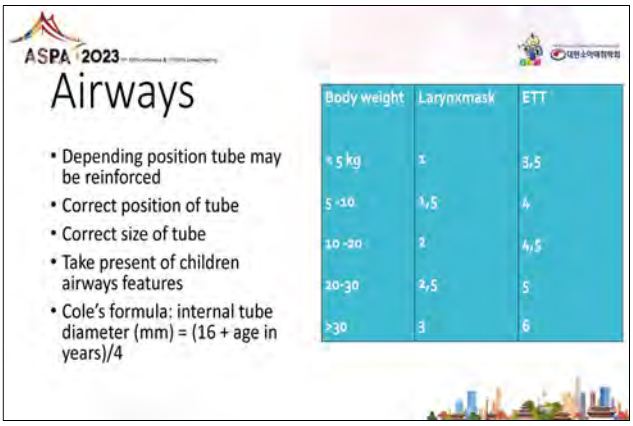

ASPA 2023
Larynx is funnel shaped and narrowest at the level of the cricoid.
Life-threatening subglottic obstruction secondary to mucosal swelling (avoid multiplex/forced intubation attempts).
Children may be faster hypoxic due to increased metabolism.
Large tongue/large head/hydrocephalus.
Head inflection must be associated with tube dislocation.
Position is a risk factor as prone position/sitting position/head dressing by surgeons.
A
B
Figure 5.
A. The adult larynx is cylindrical. B. The infant larynx is funnel-shaped. This narrowing predisposes to obstruction and affects choice of endotracheal tube.
Pediatric features (Airways)


ASPA 2023
Newborn
2 y
6 y
12 y
25 y

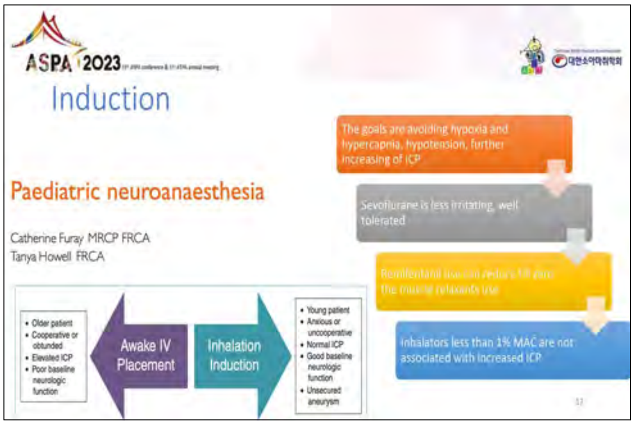

ASPA 2023
How Does An Immature Nervous System Predispose To Hypoxia?
Parasympathetic tone
• hypoxia causes bradycardia
• bradycardia causes hypotension
• bradycardia worsens hypoxia
Scared children cry
• ↑ secretions
• ↑ airway irritability
• ↑ risk laryngospasm
• ↑ risk wheezing
• ↑ airway edema
Children easily sedated
• immature neurons
• less myelinization
• weak blood–brain barrier
• little prior exposure to drugs
• ↑ risk respiratory depression
Children uncooperative
• can't follow instructions
• struggle and fight
• stress ↑ metabolic rate
Pediatric hypoxia
Apnea of prematurity
• the more premature, the greater the risk
• altered ventilatory responses to:
▪ hypoxia
▪ hypercarbia
▪ sleep
• can be made worse if the infant is stressed, cold or ill
• apnea → hypoxia → bradycardia → worse hypoxia

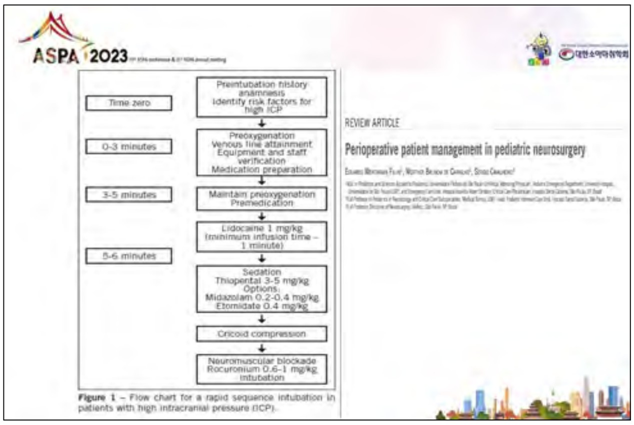

ASPA 2023
Intubation must be smooth
the first attempt is the best
Normal Tracheal Lumen
Add 1 mm Circumferential Edema
Cross-Sectional Area
Resistance
INFANT
4 mm
2
75%↓
16X↑
ADULT
8 mm
6 mm
44%↓
3X↑
10 Common Pediatric Airway Problems—And Their Solutions

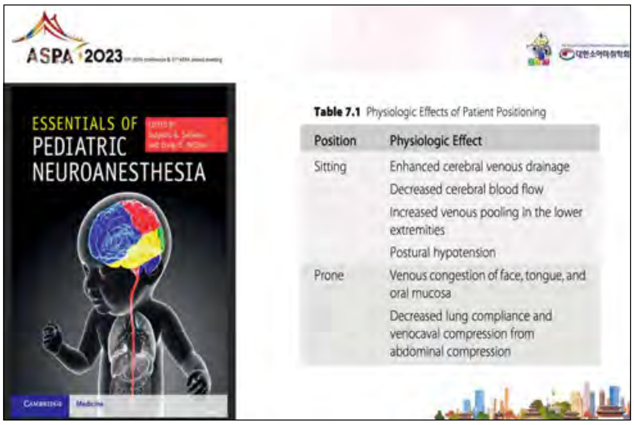

ASPA 2023
Preoperative evaluation
Anesthesia for intracranial surgery in infants and children
Curr Opin Anesthesiol 2014, 27:465–469
DOI:10.1097/ACO.0000000000000112
Table 1. Coexisting conditions that impact anesthetic management
Condition | Anesthetic implications
Congenital heart disease | Hypoxia; Arrhythmias; Cardiovascular instability; Paradoxical air emboli
Prematurity | Postoperative apnea
Gastrointestinal reflux | Aspiration pneumonia
Upper respiratory tract infection | Laryngospasm, bronchospasm, hypoxia, pneumonia
Craniofacial abnormality | Difficult tracheal intubation
Denervation injuries | Hyperkalemia after succinylcholine; Resistance to nondepolarizing muscle relaxants; Abnormal response to nerve stimulation
Epilepsy | Hepatic and hematological abnormalities; Increased metabolism of anesthetic agents; Ketogenic diet
Arteriovenous malformation | Congestive heart failure
Neuromuscular disease | Malignant hyperthermia; Respiratory failure; Sudden cardiac death
Chiari malformation | Apnea; Aspiration pneumonia

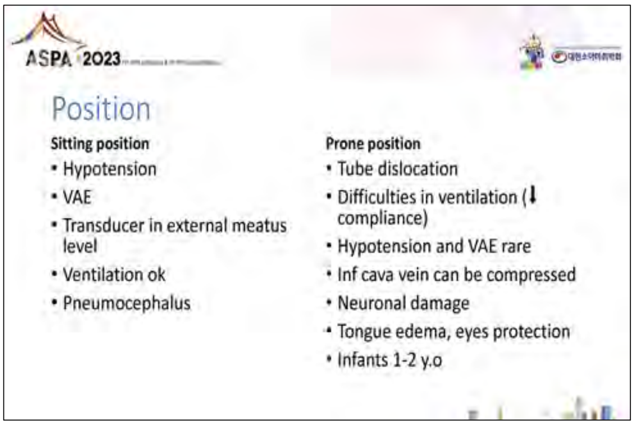

ASPA 2023
Airways
• Depending position tube may be reinforced
• Correct position of tube
• Correct size of tube
• Take present of children airways features
• Cole's formula: internal tube diameter (mm) = (16 + age in years)/4
Body weight | Larynxmask | ETT
< 5 kg | 1 | 3,5
5 -10 | 1,5 | 4
10 -20 | 2 | 4,5
20-30 | 2,5 | 5
>30 | 3 | 6

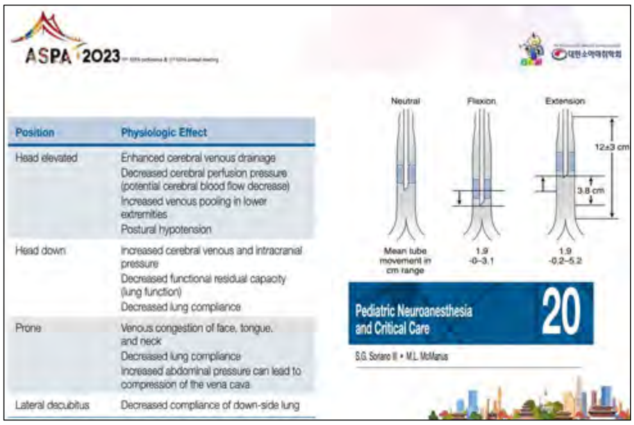

ASPA 2023
Induction
• Mentally stable: sevoflurane + iv cannula/ if iv stabilized so iv induction
• Mentally compromised than rapid induction/Sellick is preferred to minimize aspiration
• Standard iv induction based on child hemodynamic (if on anticonvulsants then larger dose of muscle-relaxants due to increased metabolism)
• Central vein cannula if no peripheral possible, not suitable for air aspiration if VAE
• Femoral route for central line may be suitable and must be removed asap to minimize thrombosis
Anaesthesia for neurosurgical procedures in paediatric patients

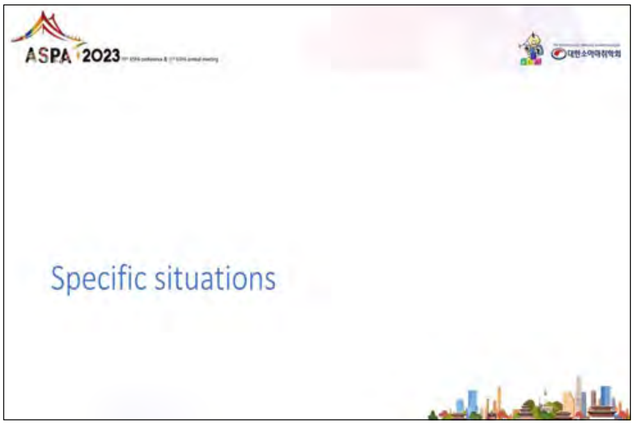

ASPA 2023
Induction
Paediatric neuroanaesthesia
Catherine Furay MRCP FRCA
Tanya Howell FRCA
The goals are avoiding hypoxia and hypercapnia, hypotension, further increasing of ICP
Sevoflurane is less irritating, well tolerated
Inhalators less than 1% MAC are not associated with increased ICP
Awake IV Placement
Inhalation Induction
• Older patient
• Cooperative or obtunded
• Elevated ICP
• Poor baseline neurologic function
• Young patient
• Anxious or uncooperative
• Normal ICP
• Good baseline neurologic function
• Unsecured aneurysm

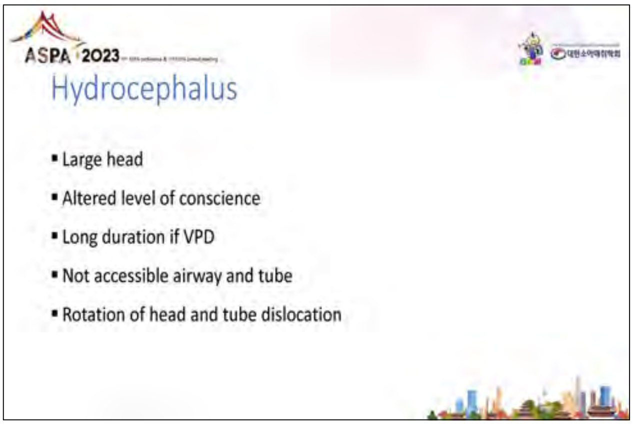

ASPA 2023
Time zero
0-3 minutes
3-5 minutes
5-6 minutes
Preintubation history anamnesis
Identify risk factors for high ICP
Preoxygenation
Venous line attainment
Equipment and staff verification
Medication preparation
Maintain preoxygenation
Premedication
Lidocaine 1 mg/kg (minimum infusion time – 1 minute)
Sedation
Thiopental 3-5 mg/kg
Options:
Midazolam 0.2-0.4 mg/kg
Etomidate 0.4 mg/kg
Cricoid compression
Neuromuscular blockade
Rocuronium 0.6-1 mg/kg
Intubation
Figure 1 – Flow chart for a rapid sequence intubation in patients with high intracranial pressure (ICP).
REVIEW ARTICLE
Perioperative patient management in pediatric neurosurgery

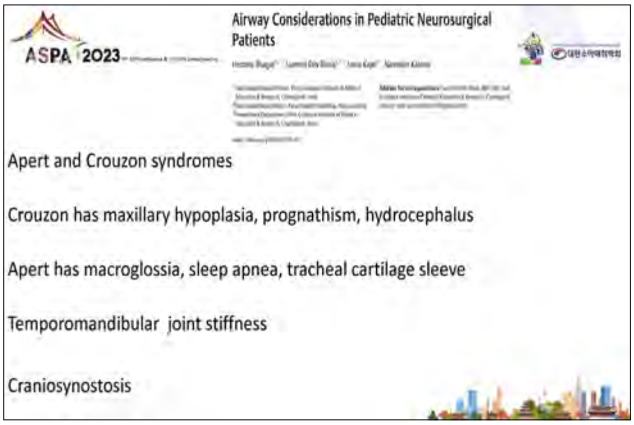

ASPA 2023
ESSENTIALS OF
PEDIATRIC
NEUROANESTHESIA
Table 7.1 Physiologic Effects of Patient Positioning
Position
Physiologic Effect
Sitting
Enhanced cerebral venous drainage
Decreased cerebral blood flow
Increased venous pooling in the lower extremities
Postural hypotension
Prone
Venous congestion of face, tongue, and oral mucosa
Decreased lung compliance and venocaval compression from abdominal compression

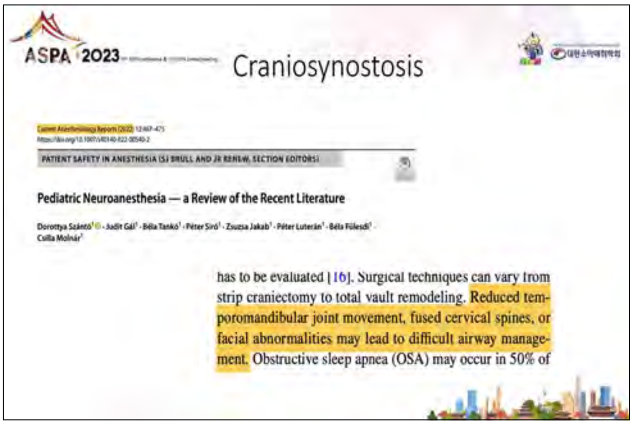

ASPA 2023
Position
Sitting position
• Hypotension
• VAE
• Transducer in external meatus level
• Ventilation ok
• Pneumocephalus
Prone position
• Tube dislocation
• Difficulties in ventilation (↓ compliance)
• Hypotension and VAE rare
• Inf cava vein can be compressed
• Neuronal damage
• Tongue edema, eyes protection
• Infants 1-2 y.o

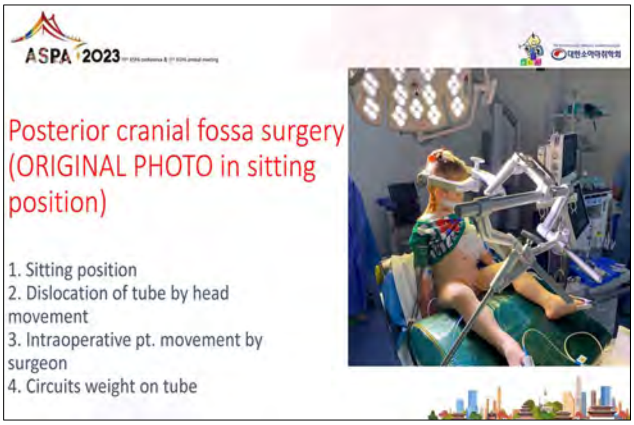

ASPA 2023
Position
Physiologic Effect
Head elevated
Enhanced cerebral venous drainage
Decreased cerebral perfusion pressure (potential cerebral blood flow decrease)
Increased venous pooling in lower extremities
Postural hypotension
Head down
Increased cerebral venous and intracranial pressure
Decreased functional residual capacity (lung function)
Decreased lung compliance
Prone
Venous congestion of face, tongue, and neck
Decreased lung compliance
Increased abdominal pressure can lead to compression of the vena cava
Lateral decubitus
Decreased compliance of down-side lung
Neutral
Flexion
Extension
12±3 cm
3.8 cm
Mean tube movement in cm range
1.9
-0-3.1
1.9
-0.2-5.2
Pediatric Neuroanesthesia and Critical Care
20

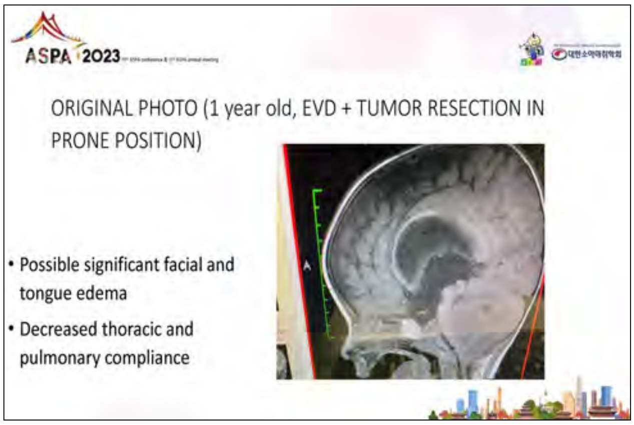

ASPA 2023
Specific situations

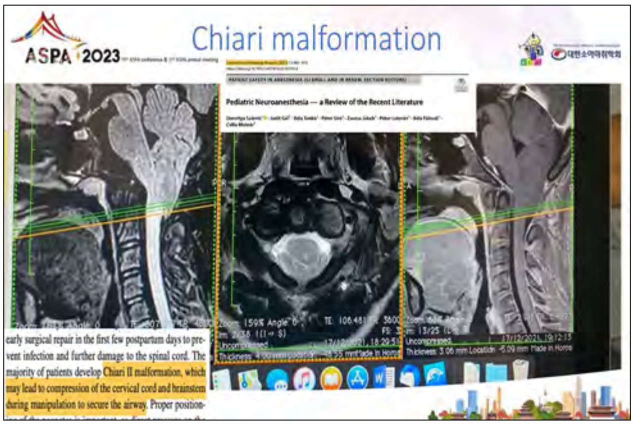

ASPA 2023
Hydrocephalus
▪ Large head
▪ Altered level of conscience
▪ Long duration if VPD
▪ Not accessible airway and tube
▪ Rotation of head and tube dislocation

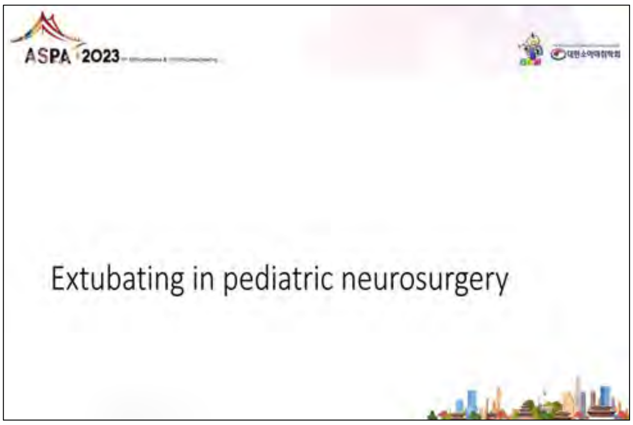

ASPA 2023
Airway Considerations in Pediatric Neurosurgical Patients
Apert and Crouzon syndromes
Crouzon has maxillary hypoplasia, prognathism, hydrocephalus
Apert has macroglossia, sleep apnea, tracheal cartilage sleeve
Temporomandibular joint stiffness
Craniosynostosis

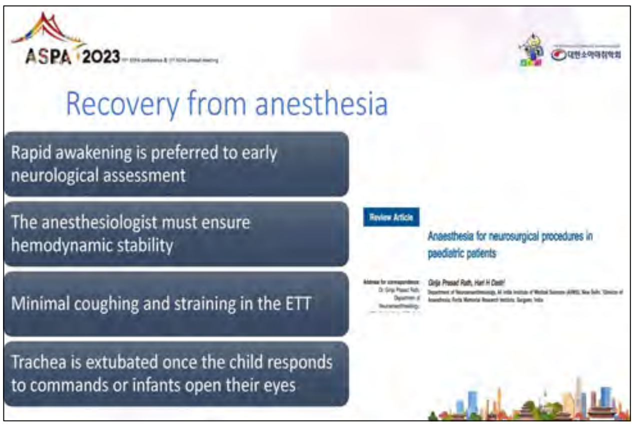

ASPA 2023
Craniosynostosis
PATIENT SAFETY IN ANESTHESIA (SJ BRULL AND JR RENEW, SECTION EDITORS)
Pediatric Neuroanesthesia — a Review of the Recent Literature
has to be evaluated [16]. Surgical techniques can vary from strip craniectomy to total vault remodeling. Reduced temporomandibular joint movement, fused cervical spines, or facial abnormalities may lead to difficult airway management. Obstructive sleep apnea (OSA) may occur in 50% of

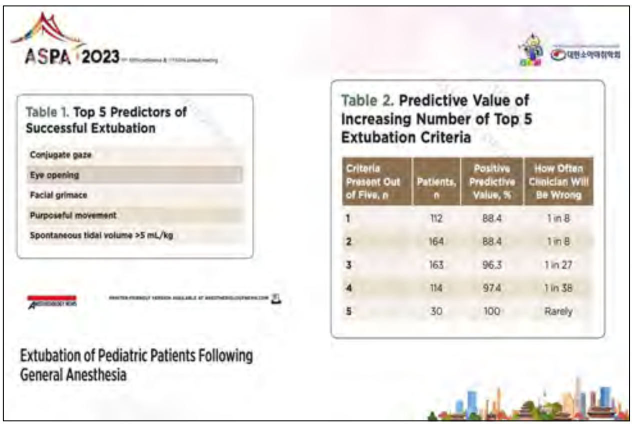

ASPA 2023
Posterior cranial fossa surgery (ORIGINAL PHOTO in sitting position)
1. Sitting position
2. Dislocation of tube by head movement
3. Intraoperative pt. movement by surgeon
4. Circuits weight on tube

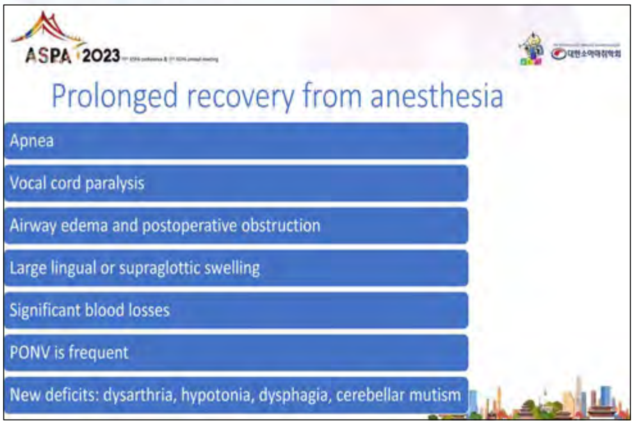

ASPA 2023
ORIGINAL PHOTO (1 year old, EVD + TUMOR RESECTION IN PRONE POSITION)
• Possible significant facial and tongue edema
• Decreased thoracic and pulmonary compliance

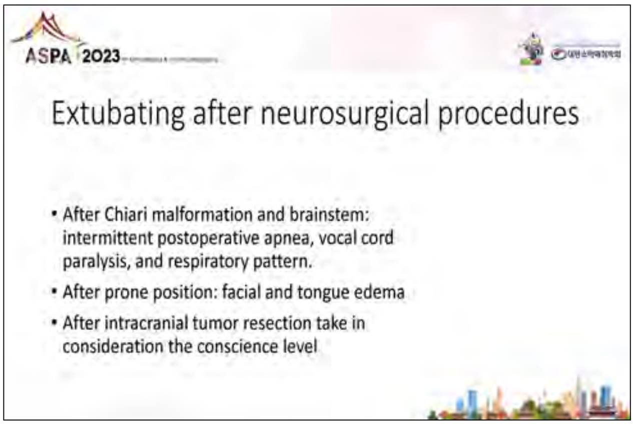

ASPA 2023
Chiari malformation
Pediatric Neuroanesthesia — a Review of the Recent Literature
early surgical repair in the first few postpartum days to prevent infection and further damage to the spinal cord. The majority of patients develop Chiari II malformation, which may lead to compression of the cervical cord and brainstem during manipulation to secure the airway. Proper position-


ASPA 2023
Extubating in pediatric neurosurgery


ASPA 2023
Recovery from anesthesia
Rapid awakening is preferred to early neurological assessment
The anesthesiologist must ensure hemodynamic stability
Minimal coughing and straining in the ETT
Trachea is extubated once the child responds to commands or infants open their eyes
Review Article
Anaesthesia for neurosurgical procedures in paediatric patients


ASPA 2023
Table 1. Top 5 Predictors of Successful Extubation
Conjugate gaze
Eye opening
Facial grimace
Purposeful movement
Spontaneous tidal volume >5 mL/kg
Extubation of Pediatric Patients Following General Anesthesia
Table 2. Predictive Value of Increasing Number of Top 5 Extubation Criteria
Criteria Present Out of Five, n | Patients, n | Positive Predictive Value, % | How Often Clinician Will Be Wrong
1 | 112 | 88.4 | 1 in 8
2 | 164 | 88.4 | 1 in 8
3 | 163 | 96.3 | 1 in 27
4 | 114 | 97.4 | 1 in 38
5 | 30 | 100 | Rarely





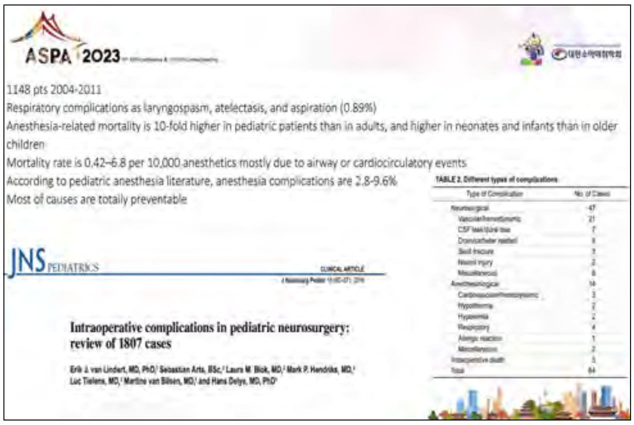
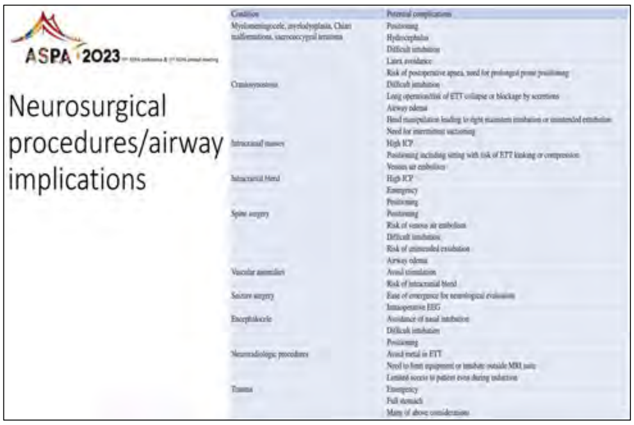
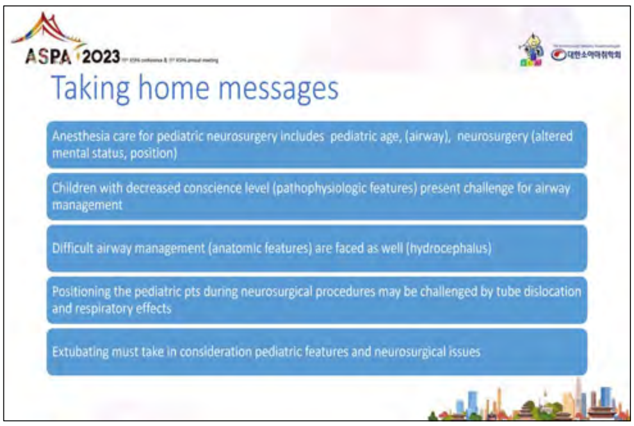


TABLE 2. Different types of complications

Type of Complication	No. of Cases
Neurosurgical	47
Vascular/hemodynamic	21
CSF leak/wound ...	7
Drain/catheter related	6
Skull fracture	3
Neural injury	2
Miscellaneous	8
Anesthesiological	14
Cardiovascular/hemodynamic	3
Hypothermia	2
Hypoxemia	2
Respiratory	4
Allergic reaction	1
Miscellaneous	2
Intraoperative death	3
Total	64



Condition	Potential complications
Myelomeningocele, myelodysplasia, Chiari malformations, sacrococcygeal teratoma	Positioning
	Hydrocephalus
	Difficult intubation
	Latex avoidance
	Risk of postoperative apnea, need for prolonged prone positioning
Craniosynostosis	Difficult intubation
	Long operation/risk of ETT collapse or blockage by secretions
	Airway edema
	Head manipulation leading to right mainstem intubation or unintended extubation
	Need for intermittent suctioning
Intracranial masses	High ICP
	Positioning including sitting with risk of ETT kinking or compression
	Venous air embolism
Intracranial bleed	High ICP
	Emergency
	Positioning
Spine surgery	Positioning
	Risk of venous air embolism
	Difficult intubation
	Risk of unintended extubation
	Airway edema
Vascular anomalies	Avoid stimulation
	Risk of intracranial bleed
Seizure surgery	Ease of emergence for neurological evaluation
	Intraoperative EEG
Encephalocele	Avoidance of nasal intubation
	Difficult intubation
	Positioning
Neuroradiologic procedures	Avoid metal in ETT
	Need to limit equipment or intubate outside MRI suite
	Limited access to patient even during induction
Trauma	Emergency
	Full stomach
	Many of above considerations




ASPA 2023
Time for holidays (Welcome to Albania)

Risk Stratification of Patients with Congenital Heart Disease

Viviane G. Nasr

Boston Children's Hospital, Harvard Medical School, USA

No Disclosures

Boston Children's Hospital

Objectives

- Describe patients with Congenital Heart Disease as a high risk population.
- Review recent publications on patients with CHD undergoing noncardiac procedures
- Understand risk stratification when presenting for noncardiac procedure

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WHAT IS RISK?

- Measure of probability (statistical chance) of an occurrence (usually undesirable)
- Everyday
- Risk vs benefit
- Different perspective: Patients, Health care providers, Hospital management, Insurance companies

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HIGH RISK POPULATION

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Pediatrics. 2000 Feb;105(2):332-5.

Influence of congenital heart disease on mortality after noncardiac surgery in hospitalized children.

Baum VC[1], Barton DM, Gutgesell HP.

Presence of CHD:
=> 2 fold increase in mortality for neonates and infants

Anesthesiology. 2007 Feb;106(2):226-37; quiz 413-4.

Perioperative cardiac arrests in children between 1988 and 2005 at a tertiary referral center: a study of 92,881 patients.

Flick RP[1], Sprung J, Harrison TE, Gleich SJ, Schroeder DR, Hanson AC, Buenvenida SL, Warner DO.

88% of patients who experienced cardiac arrest had CHD

Anesth Analg. 2011 Jun;112(6):1440-7. doi: 10.1213/ANE.0b013e318213be52. Epub 2011 May 5.

Postoperative mortality in children after 101,885 anesthetics at a tertiary pediatric hospital.

van der Griend BF[1], Lister NA, McKenzie IM, Martin N, Ragg PG, Sheppard SJ, Davidson AJ.

50% of cases with mortality involved patients with pulmonary HTN

Anesth Analg. 2007 Aug;105(2):344-50.

Anesthesia-related cardiac arrest in children: update from the Pediatric Perioperative Cardiac Arrest Registry.

Bhananker SM[1], Ramamoorthy C, Geiduschek JM, Posner KL, Domino KB, Haberkern CM, Campos JS, Morray JP.

Single ventricle, unrepaired; <6months

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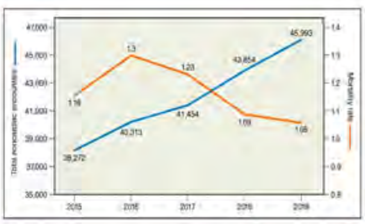
Sci Rep. 2021 Jan 15;11(1):1543. doi: 10.1038/s41598-021-81161-3.

Trends in mortality rate in patients with congenital heart disease undergoing noncardiac surgical procedures at children's hospitals

Viviane G Nasr[1], Steven J Staffa[2], David Faraoni[1], James A DiNardo[2]

CHILDREN'S HOSPITAL ASSOCIATION

The mortality rate in patients with CHD in 2019 in this cohort was 1.06% compared to non-CHD patients of 0.12%



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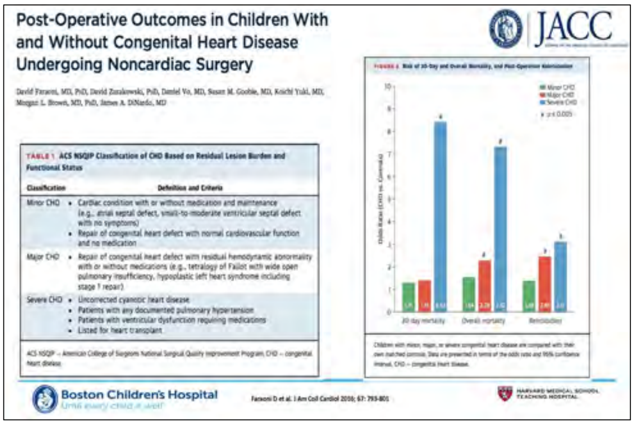
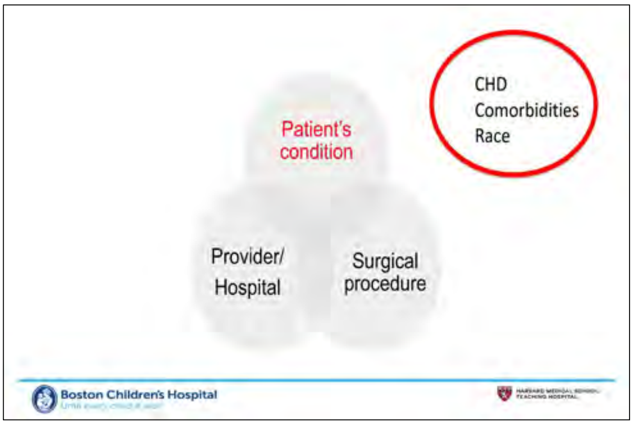
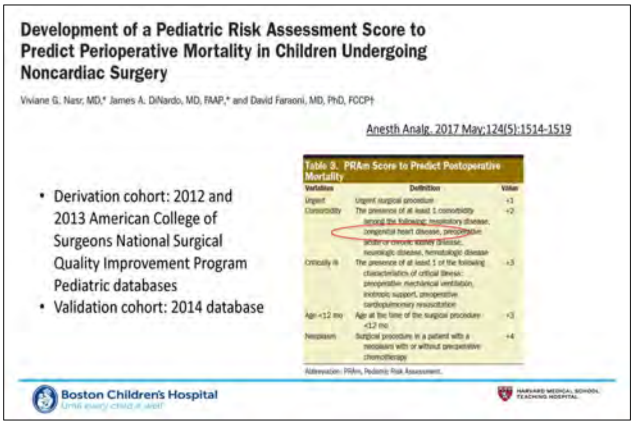
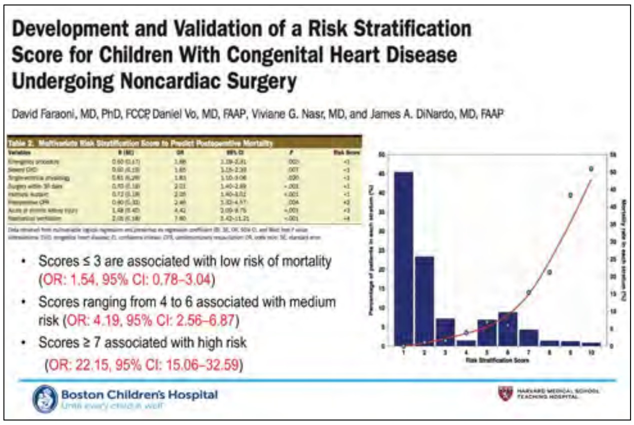








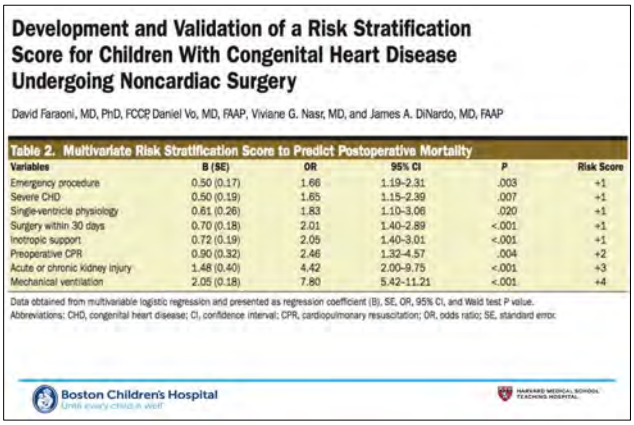
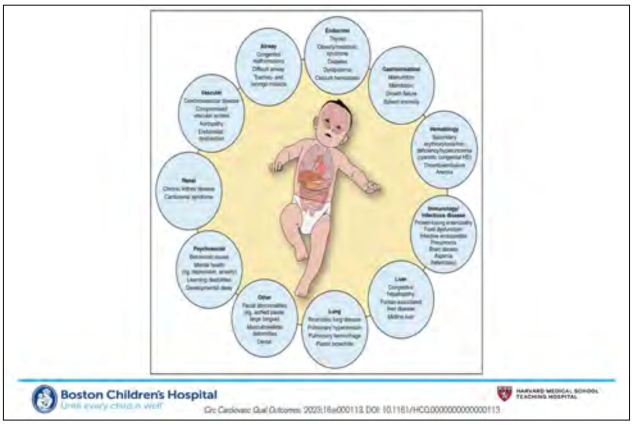
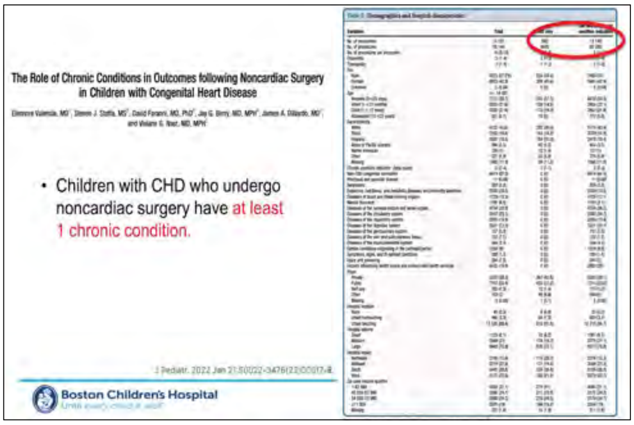


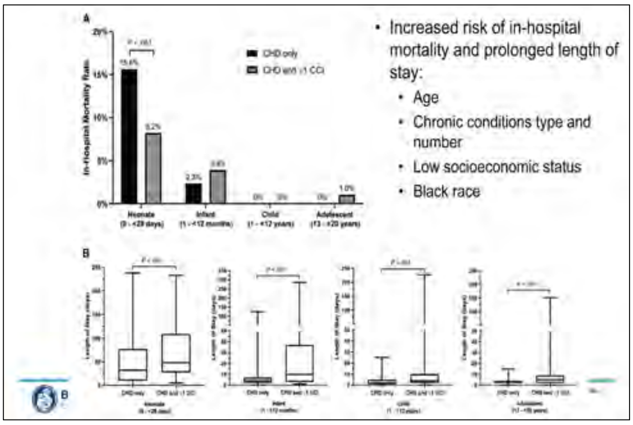
Table 2. Multivariate Risk Stratification Score to Predict Postoperative Mortality

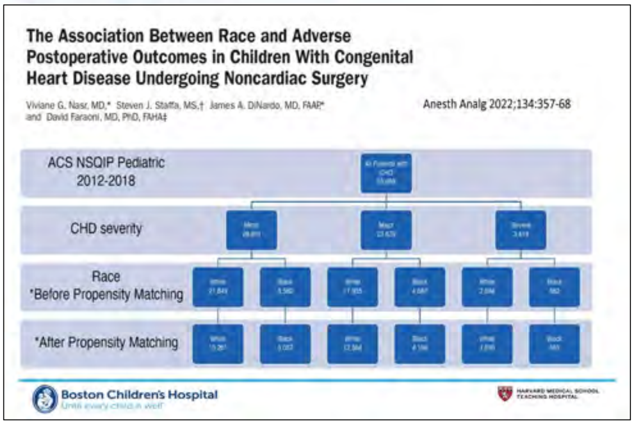
Variables	B (SE)	OR	95% CI	P	Risk Score
Emergency procedure	0.50 (0.17)	1.66	1.19–2.31	.003	+1
Severe CHD	0.50 (0.19)	1.65	1.15–2.39	.007	+1
Single-ventricle physiology	0.61 (0.26)	1.83	1.10–3.06	.020	+1
Surgery within 30 days	0.70 (0.18)	2.01	1.40–2.89	<.001	+1
Inotropic support	0.72 (0.19)	2.05	1.40–3.01	<.001	+1
Preoperative CPR	0.90 (0.32)	2.46	1.32–4.57	.004	+2
Acute or chronic kidney injury	1.48 (0.40)	4.42	2.00–9.75	<.001	+3
Mechanical ventilation	2.05 (0.18)	7.80	5.42–11.21	<.001	+4

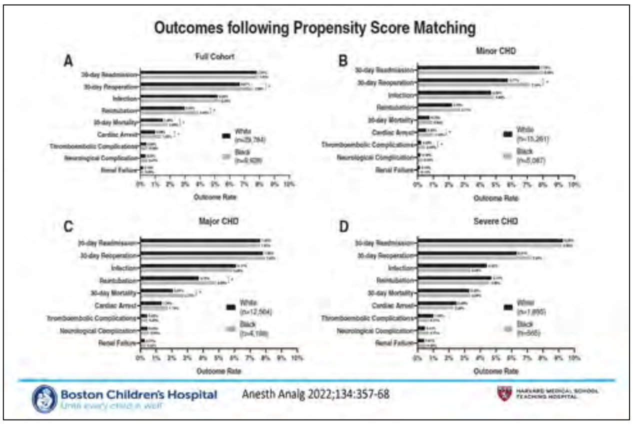
Data obtained from multivariable logistic regression and presented as regression coefficient (B), SE, OR, 95% CI, and Wald test P value.
Abbreviations: CHD, congenital heart disease; CI, confidence interval; CPR, cardiopulmonary resuscitation; OR, odds ratio; SE, standard error.

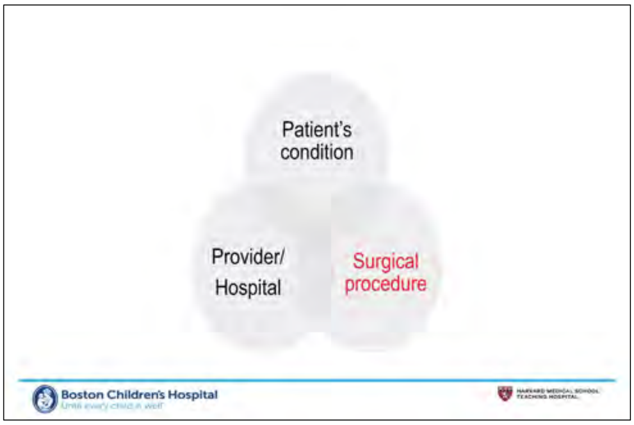


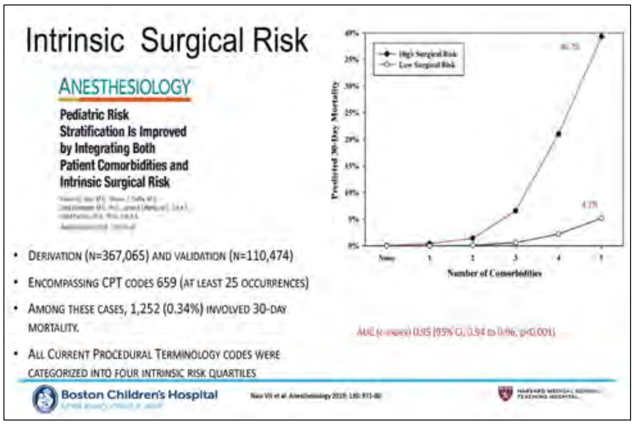


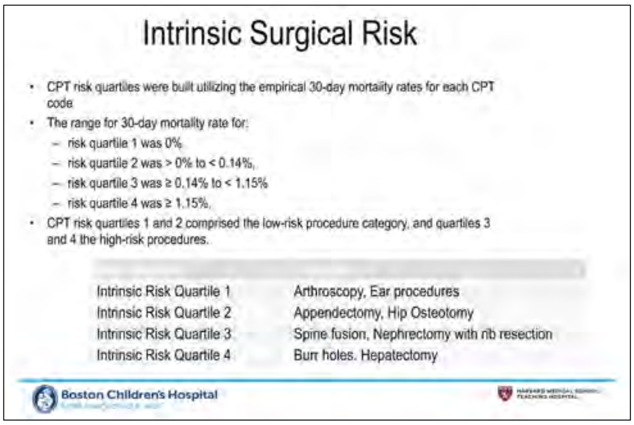



The Association Between Race and Adverse Postoperative Outcomes in Children With Congenital Heart Disease Undergoing Noncardiac Surgery
Viviane G. Nasr, MD,* Steven J. Staffa, MS,† James A. DiNardo, MD, FAAP* and David Faraoni, MD, PhD, FAHA‡
Anesth Analg 2022;134:357-68
ACS NSQIP Pediatric 2012-2018
CHD severity
Race
*Before Propensity Matching
*After Propensity Matching
Boston Children's Hospital

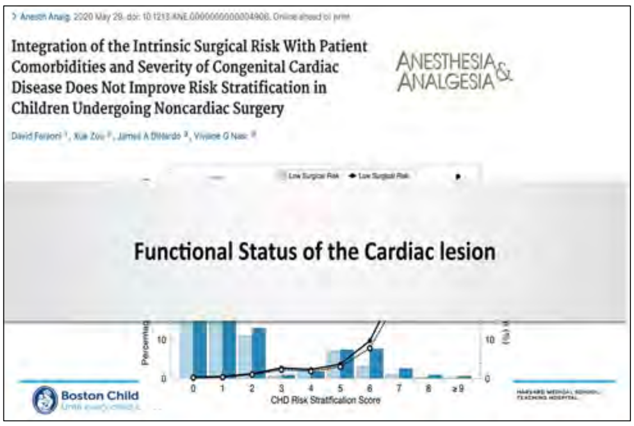

Outcomes following Propensity Score Matching
A
Full Cohort
B
Minor CHD
C
Major CHD
D
Severe CHD
Outcome Rate
Boston Children's Hospital
Anesth Analg 2022;134:357-68

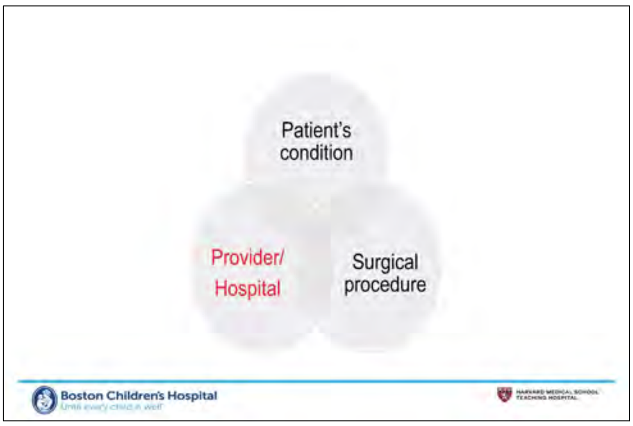

Patient's condition
Provider/ Hospital
Surgical procedure
Boston Children's Hospital

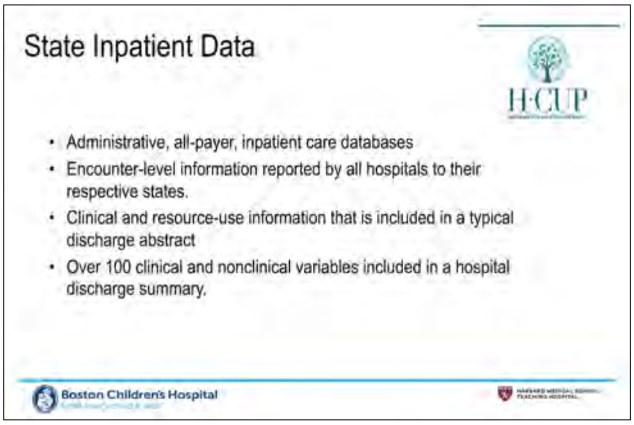

Intrinsic Surgical Risk
ANESTHESIOLOGY
Pediatric Risk Stratification Is Improved by Integrating Both Patient Comorbidities and Intrinsic Surgical Risk
Derivation (N=367,065) and validation (N=110,474)
Encompassing CPT codes 659 (at least 25 occurrences)
Among these cases, 1,252 (0.34%) involved 30-day mortality.
All Current Procedural Terminology codes were categorized into four intrinsic risk quartiles
Predicted 30-Day Mortality
Number of Comorbidities
Boston Children's Hospital

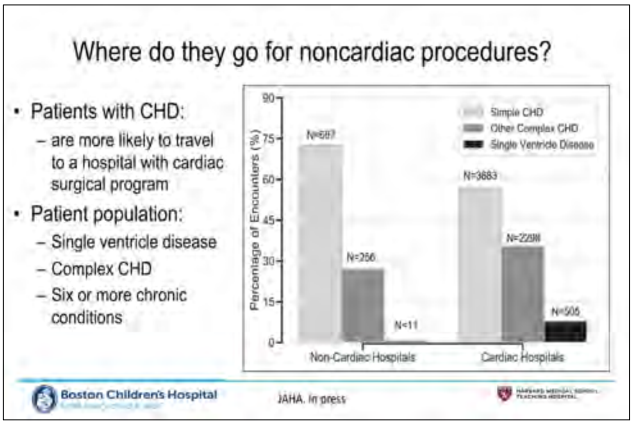

Intrinsic Surgical Risk
CPT risk quartiles were built utilizing the empirical 30-day mortality rates for each CPT code
The range for 30-day mortality rate for:
risk quartile 1 was 0%
risk quartile 2 was > 0% to < 0.14%,
risk quartile 3 was ≥ 0.14% to < 1.15%
risk quartile 4 was ≥ 1.15%.
CPT risk quartiles 1 and 2 comprised the low-risk procedure category, and quartiles 3 and 4 the high-risk procedures.
Intrinsic Risk Quartile 1 Arthroscopy, Ear procedures
Intrinsic Risk Quartile 2 Appendectomy, Hip Osteotomy
Intrinsic Risk Quartile 3 Spine fusion, Nephrectomy with rib resection
Intrinsic Risk Quartile 4 Burr holes. Hepatectomy
Boston Children's Hospital

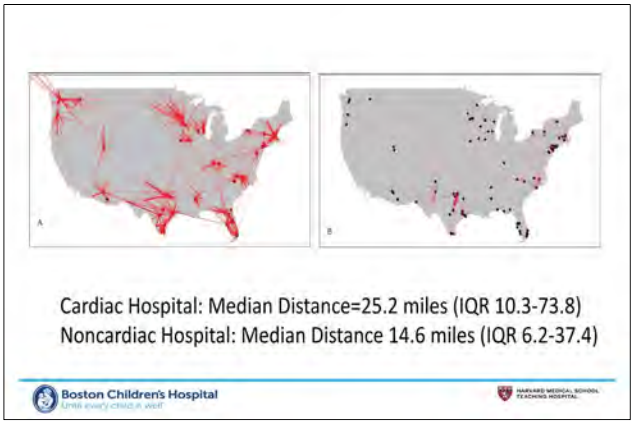

Integration of the Intrinsic Surgical Risk With Patient Comorbidities and Severity of Congenital Cardiac Disease Does Not Improve Risk Stratification in Children Undergoing Noncardiac Surgery
ANESTHESIA & ANALGESIA
37,658 children with CHD undergoing non-cardiac surgery
Incidence of overall 30-day mortality of 1.7% in the derivation cohort
1.5% in the validation cohort
Boston Children's Hospital

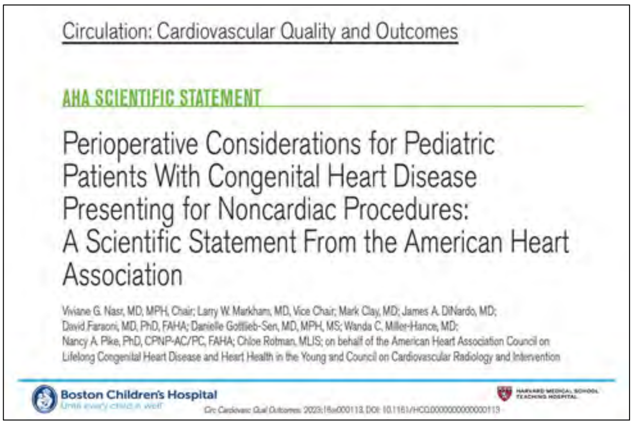

Integration of the Intrinsic Surgical Risk With Patient Comorbidities and Severity of Congenital Cardiac Disease Does Not Improve Risk Stratification in Children Undergoing Noncardiac Surgery
ANESTHESIA & ANALGESIA
Functional Status of the Cardiac lesion
CHD Risk Stratification Score
Boston Child

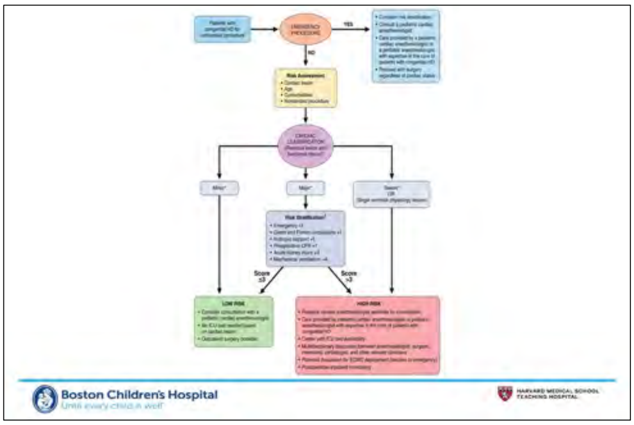

Patient's condition
Provider/ Hospital
Surgical procedure
Boston Children's Hospital

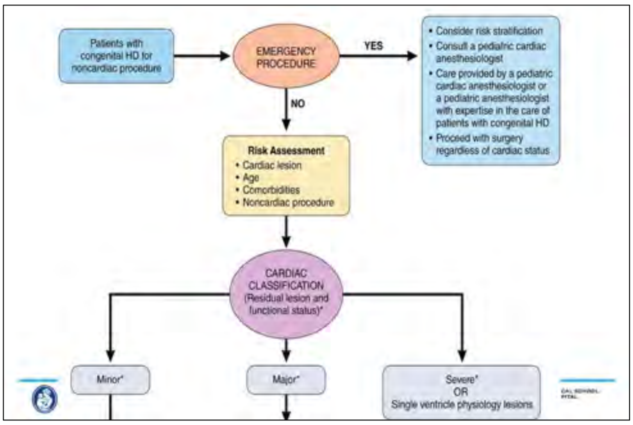

State Inpatient Data
H·CUP
Administrative, all-payer, inpatient care databases
Encounter-level information reported by all hospitals to their respective states.
Clinical and resource-use information that is included in a typical discharge abstract
Over 100 clinical and nonclinical variables included in a hospital discharge summary.
Boston Children's Hospital

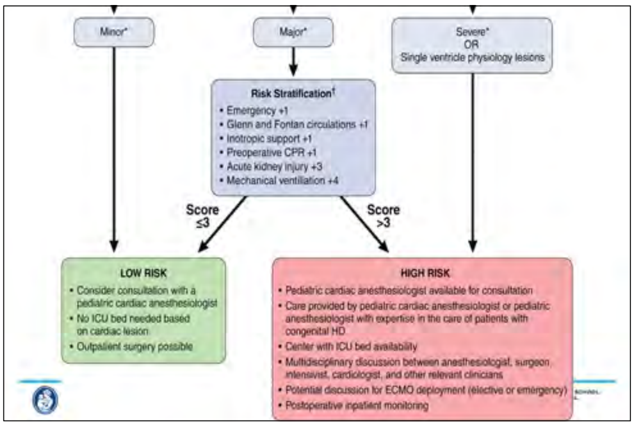

Where do they go for noncardiac procedures?
Patients with CHD:
– are more likely to travel to a hospital with cardiac surgical program
Patient population:
– Single ventricle disease
– Complex CHD
– Six or more chronic conditions
Percentage of Encounters (%)
Simple CHD
Other Complex CHD
Single Ventricle Disease
N=687
N=256
N=11
N=3683
N=2298
N=505
Non-Cardiac Hospitals
Cardiac Hospitals
JAHA. In press
Boston Children's Hospital

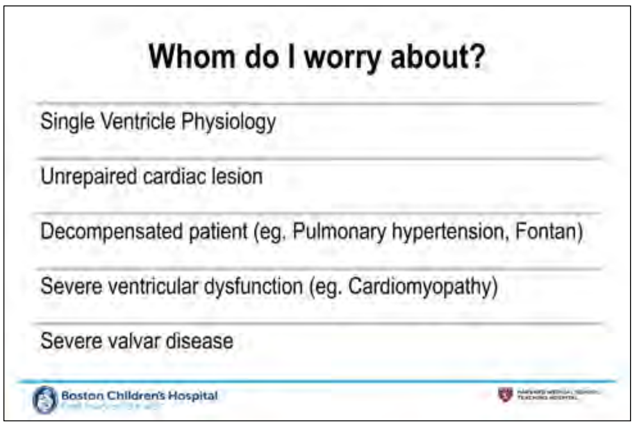

Cardiac Hospital: Median Distance=25.2 miles (IQR 10.3-73.8)
Noncardiac Hospital: Median Distance 14.6 miles (IQR 6.2-37.4)
Boston Children's Hospital

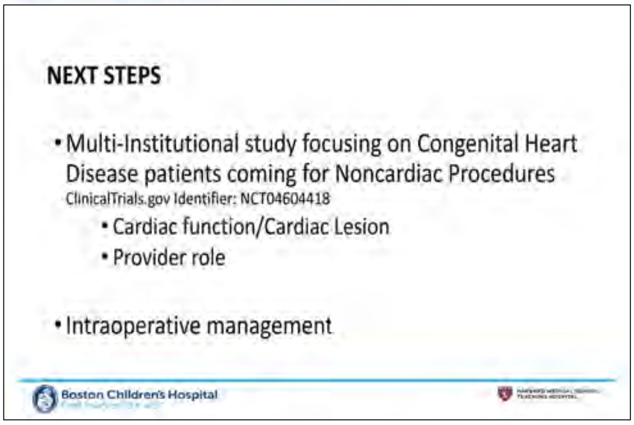

Circulation: Cardiovascular Quality and Outcomes
AHA SCIENTIFIC STATEMENT
Perioperative Considerations for Pediatric Patients With Congenital Heart Disease Presenting for Noncardiac Procedures: A Scientific Statement From the American Heart Association
Viviane G. Nasr, MD, MPH, Chair; Larry W. Markham, MD, Vice Chair; Mark Clay, MD; James A. DiNardo, MD; David Faraoni, MD, PhD, FAHA; Danielle Gottlieb-Sen, MD, MPH, MS; Wanda C. Miller-Hance, MD; Nancy A. Pike, PhD, CPNP-AC/PC, FAHA; Chloe Rotman, MLIS; on behalf of the American Heart Association Council on Lifelong Congenital Heart Disease and Heart Health in the Young and Council on Cardiovascular Radiology and Intervention
Boston Children's Hospital


Boston Children's Hospital


Patients with congenital HD for noncardiac procedure
EMERGENCY PROCEDURE
YES
NO
Consider risk stratification
Consult a pediatric cardiac anesthesiologist
Care provided by a pediatric cardiac anesthesiologist or a pediatric anesthesiologist with expertise in the care of patients with congenital HD
Proceed with surgery regardless of cardiac status
Risk Assessment
Cardiac lesion
Age
Comorbidities
Noncardiac procedure
CARDIAC CLASSIFICATION (Residual lesion and functional status)*
Minor*
Major*
Severe* OR Single ventricle physiology lesions


Minor*
Major*
Severe* OR Single ventricle physiology lesions
Risk Stratification†
Emergency +1
Glenn and Fontan circulations +1
Inotropic support +1
Preoperative CPR +1
Acute kidney injury +3
Mechanical ventilation +4
Score ≤3
Score >3
LOW RISK
Consider consultation with a pediatric cardiac anesthesiologist
No ICU bed needed based on cardiac lesion
Outpatient surgery possible
HIGH RISK
Pediatric cardiac anesthesiologist available for consultation
Care provided by pediatric cardiac anesthesiologist or pediatric anesthesiologist with expertise in the care of patients with congenital HD
Center with ICU bed availability
Multidisciplinary discussion between anesthesiologist, surgeon, intensivist, cardiologist, and other relevant clinicians
Potential discussion for ECMO deployment (elective or emergency)
Postoperative inpatient monitoring


Whom do I worry about?
Single Ventricle Physiology
Unrepaired cardiac lesion
Decompensated patient (eg. Pulmonary hypertension, Fontan)
Severe ventricular dysfunction (eg. Cardiomyopathy)
Severe valvar disease
Boston Children's Hospital


NEXT STEPS
• Multi-Institutional study focusing on Congenital Heart Disease patients coming for Noncardiac Procedures
ClinicalTrials.gov Identifier: NCT04604418
• Cardiac function/Cardiac Lesion
• Provider role
• Intraoperative management
Boston Children's Hospital

ASPA 2023

Session 2.

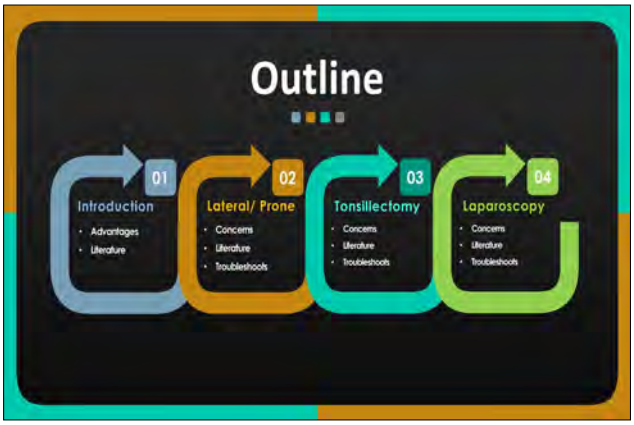
Choices Are Yours: Debating and Challenging Issues in Airway Management

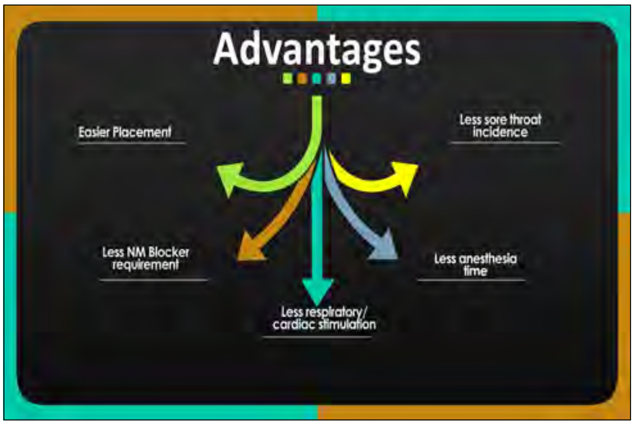
Chair(s): Evangeline Lim (Singapore)
Hyo-Seok Na (Korea)

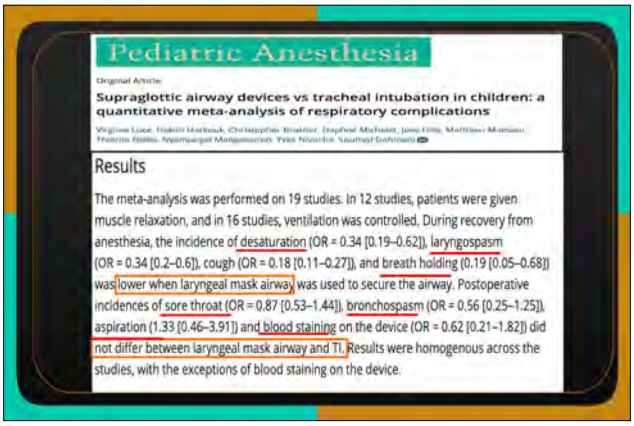
Supraglottic devices in variety of situations: Non supine position, Tonsillectomy, Laparoscopy

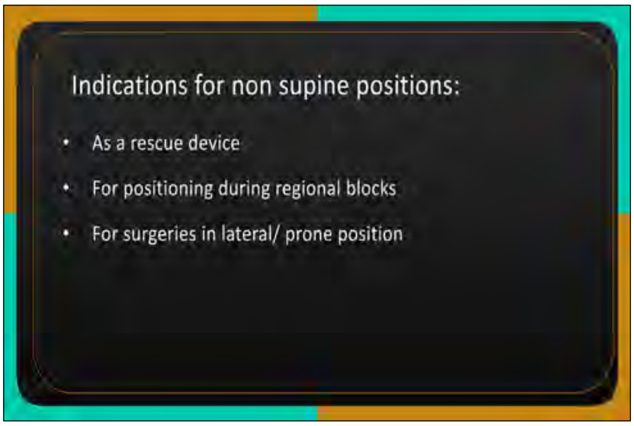
Abhyuday Kumar

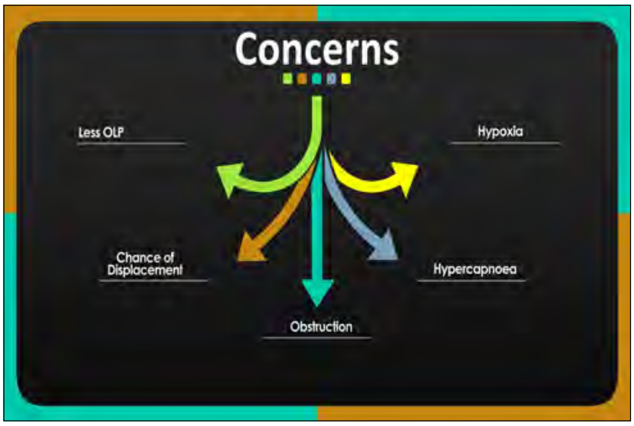
All India Institute of Medical Sciences Patna, India

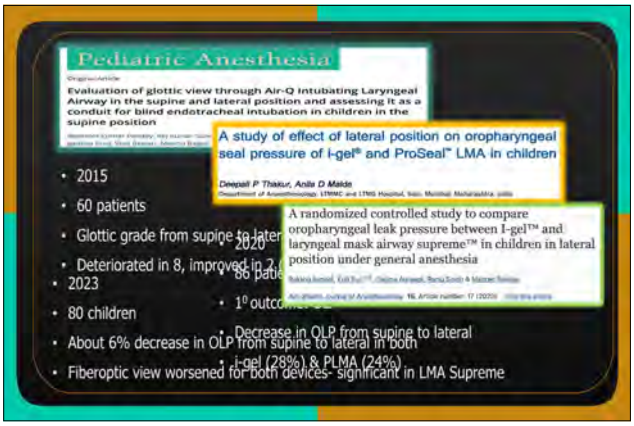




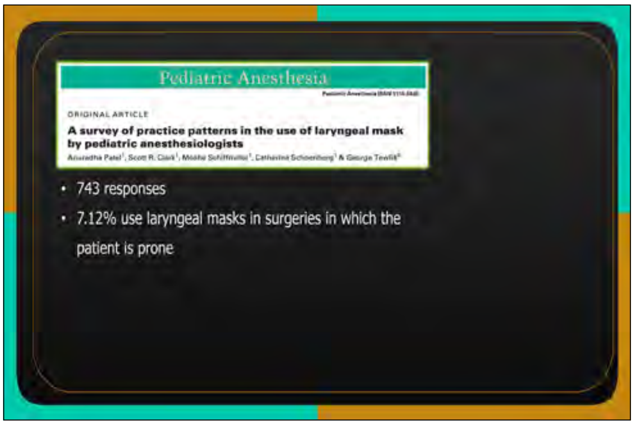


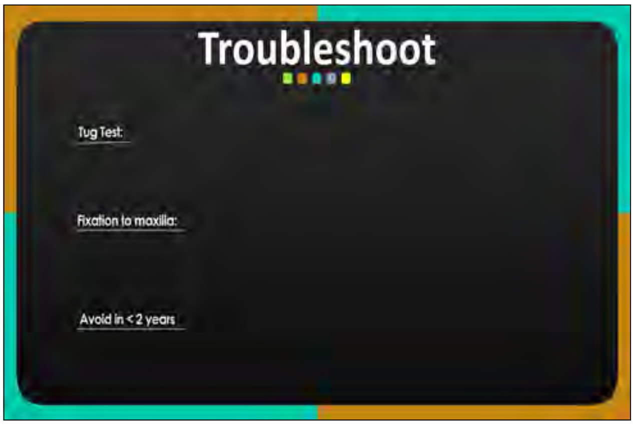


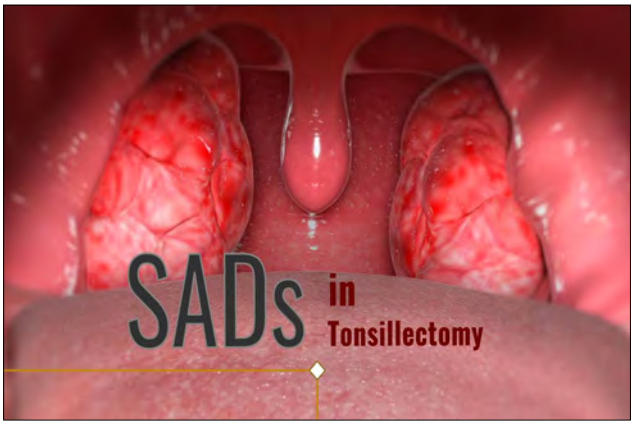


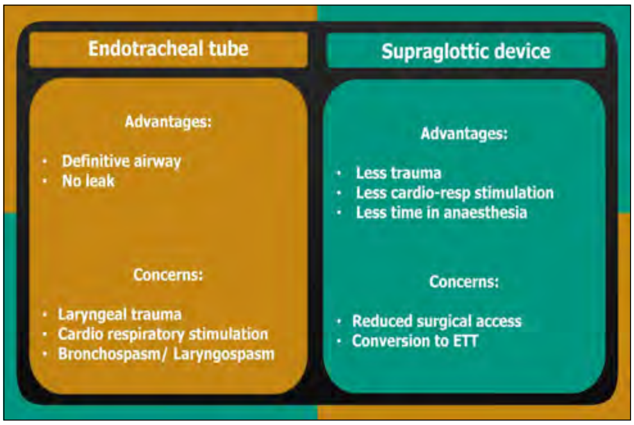

Pediatric Anesthesia
Evaluation of glottic view through Air-Q intubating Laryngeal Airway in the supine and lateral position and assessing it as a conduit for blind endotracheal intubation in children in the supine position
A study of effect of lateral position on oropharyngeal seal pressure of i-gel® and ProSeal™ LMA in children
Deepali P Thakur, Anila D Malde
A randomized controlled study to compare oropharyngeal leak pressure between I-gel™ and laryngeal mask airway supreme™ in children in lateral position under general anesthesia
2015
60 patients
Glottic grade from supine to lateral
Deteriorated in 8, improved in 2
2020
86 patients
1° outcome- OLP
Decrease in OLP from supine to lateral in both i-gel (28%) & PLMA (24%)
2023
80 children
About 6% decrease in OLP from supine to lateral in both
Fiberoptic view worsened for both devices- significant in LMA Supreme

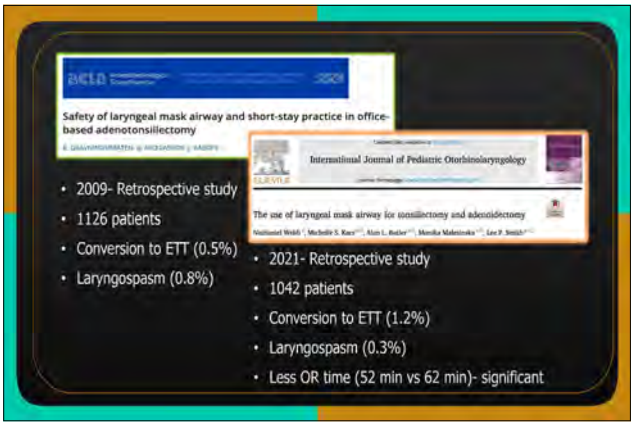

Prone positions:
Less manpower requirement
SAD unlike ETT can be inserted in prone position
Saves OR time

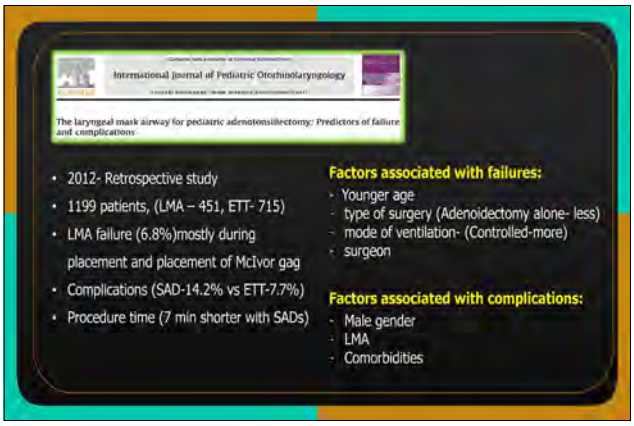

Pediatric Anesthesia
ORIGINAL ARTICLE
A survey of practice patterns in the use of laryngeal mask by pediatric anesthesiologists
743 responses
7.12% use laryngeal masks in surgeries in which the patient is prone


Troubleshoot
Tug Test
Fixation to maxilla
Avoid in < 2 years


SADs in Tonsillectomy


Endotracheal tube
Advantages:
Definitive airway
No leak
Concerns:
Laryngeal trauma
Cardio respiratory stimulation
Bronchospasm/ Laryngospasm
Supraglottic device
Advantages:
Less trauma
Less cardio-resp stimulation
Less time in anaesthesia
Concerns:
Reduced surgical access
Conversion to ETT


Safety of laryngeal mask airway and short-stay practice in office-based adenotonsillectomy
International Journal of Pediatric Otorhinolaryngology
The use of laryngeal mask airway for tonsillectomy and adenoidectomy
2009- Retrospective study
1126 patients
Conversion to ETT (0.5%)
Laryngospasm (0.8%)
2021- Retrospective study
1042 patients
Conversion to ETT (1.2%)
Laryngospasm (0.3%)
Less OR time (52 min vs 62 min)- significant


International Journal of Pediatric Otorhinolaryngology
The laryngeal mask airway for pediatric adenotonsillectomy: Predictors of failure and complications
2012- Retrospective study
1199 patients, (LMA – 451, ETT- 715)
LMA failure (6.8%)mostly during placement and placement of McIvor gag
Complications (SAD-14.2% vs ETT-7.7%)
Procedure time (7 min shorter with SADs)
Factors associated with failures:
Younger age
type of surgery (Adenoidectomy alone- less)
mode of ventilation- (Controlled-more)
surgeon
Factors associated with complications:
Male gender
LMA
Comorbidities

RCTs

	Cand J Anaesth 1993	Laryngoscope 2012	Rev Bras Anestesiol 2012
Sample Size	109	117	204
Type of SAD	Flexible	Flexible	Disposable (unique)
Displacement		None	7.7%
Conversion to ETT	9%	None	1.5%
Difficult Sx Access	None		
Time difference		4.2 minutes less (SAD)	
Laryngospasm	6%(SAD) vs 11%(ETT)	2%(SAD) vs None(ETT)	6%(SAD) vs 12%(ETT)
Coughing		20%(SAD) vs 40%(ETT)	

Troubleshoot

- Maintain depth of anesthesia during gag placement
- Caution during positioning
- Surgeons experience matters
- Avoid in young children

Concerns

Minerva Anestesiologica 2010 August;76(8):592-9

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Language: English

Comparison of the effect of LMA and ETT on ventilation and intragastric pressure in pediatric laparoscopic procedures

Ozdamar D., Güvenç B. H., Toker K., Solak M., Ekingen G.

- 2010- RCT
- 40 patients (Classic LMA vs ETT)
- 1⁰ outcome: Intragastric pressure (IGP)
- No significant change in IGP and ventilatory parameters
- No significant difference in complication rates

Pediatric Anesthesia

ProSeal™ as an alternative to endotracheal intubation in pediatric laparoscopy

- 2007- RCT
- 60 patients (Proseal LMA vs ETT)
- 1⁰ outcome: Peak inspiratory pressures (PIP)
- Significant increase in PIP before and carboperitoneum in both groups
- No significant difference in PIP between two groups
- Cough and laryngospasm: significantly less with PLMA
- PLMA provided similar ventilation and oxygenation without producing clinically significant gastric distension

Journal of Pediatric Surgery

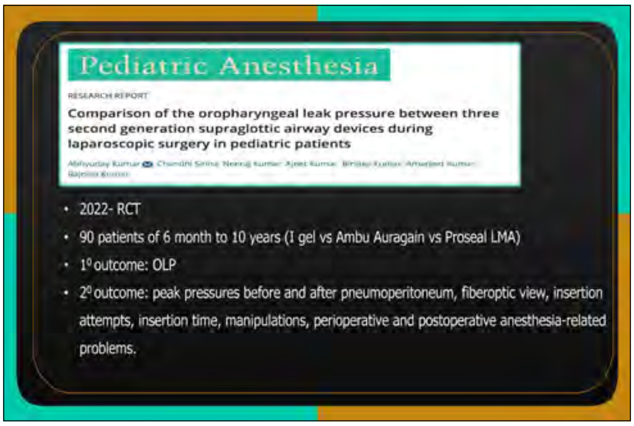
Short-lasting pediatric laparoscopic surgery: Are muscle relaxants necessary? Endotracheal intubation vs. laryngeal mask airway

- 2017- RCT
- 80 patients (ETT with & without MR vs LMA with & without MR)
- Anaesthesia time shortest in LMA without MR (significant)
- Recovery time was statistically significantly longer in ETT with MR
- no difference between basal intragastric pressure, average intragastric pressure during insufflation, peak airway pressure, and average peak airway pressure during insufflation of groups.

Comparative evaluation of I-gel vs. endotracheal intubation for adequacy of ventilation in pediatric patients undergoing laparoscopic surgeries

Megha Kohli, Sonia Wadhawan, Poonam Bhadoria, Simmi K. Ratan

- 2019- RCT
- 80 patients of 2-8 years (I gel vs ETT)
- 1⁰ outcome: adequacy of ventilation
- Increase in Peak Pressure after carboperitoneum was more with ETT
- no significant difference between ETCO2, Spo2 and complications
- Significant increase in OLP after carboperitoneum (20.7 vs 24.6 cm of H2O)



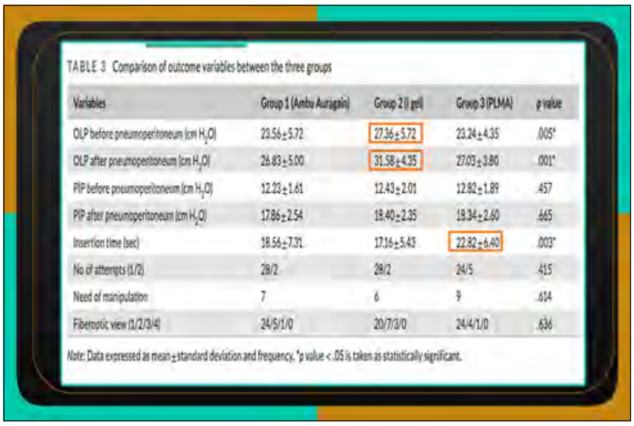
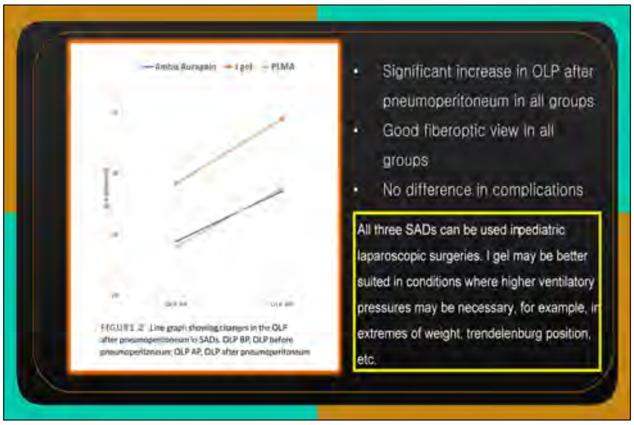
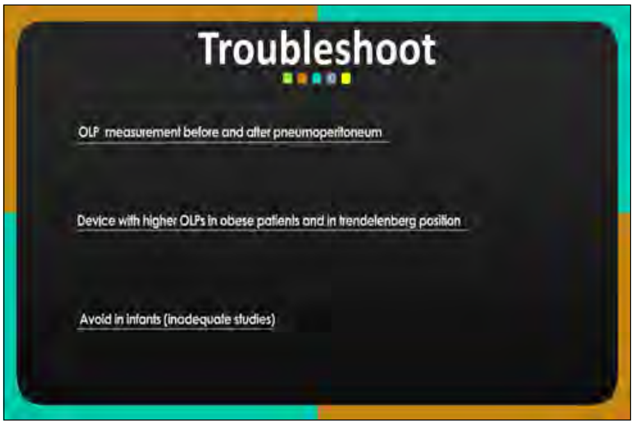


TABLE 3 Comparison of outcome variables between the three groups

Variables	Group 1 (Ambu Auragain)	Group 2 (I gel)	Group 3 (PLMA)	p value
OLP before pneumoperitoneum (cm H_2O)	23.56±5.72	27.36±5.72	23.24±4.35	.005*
OLP after pneumoperitoneum (cm H_2O)	26.83±5.00	31.58±4.35	27.03±3.80	.001*
PIP before pneumoperitoneum (cm H_2O)	12.23±1.61	12.43±2.01	12.82±1.89	.457
PIP after pneumoperitoneum (cm H_2O)	17.86±2.54	18.40±2.35	18.34±2.60	.665
Insertion time (sec)	18.56±7.31	17.16±5.43	22.82±6.40	.003*
No of attempts (1/2)	28/2	28/2	24/5	.415
Need of manipulation	7	6	9	.614
Fiberoptic view (1/2/3/4)	24/5/1/0	20/7/3/0	24/4/1/0	.636

Note: Data expressed as mean±standard deviation and frequency. *p value < .05 is taken as statistically significant.

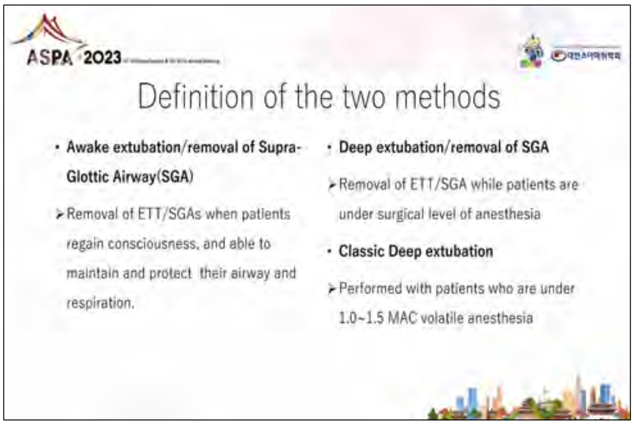


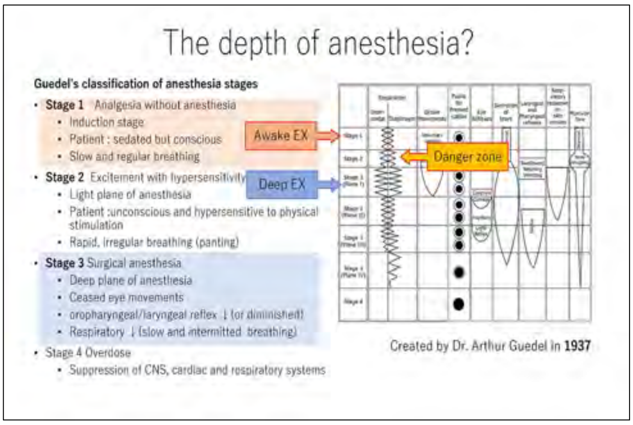


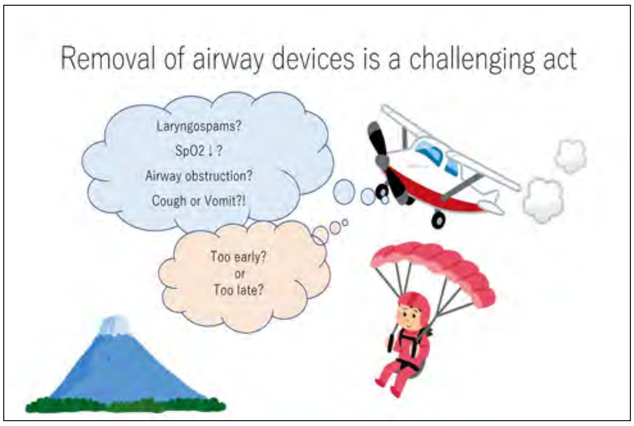
LMA removal and Endotracheal extubation: Deep or Awake?

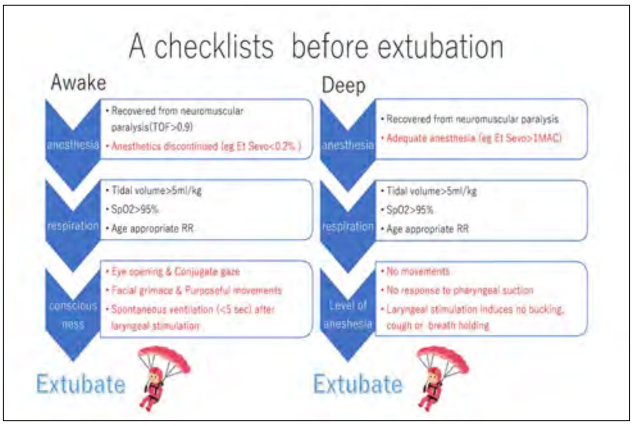
Ayuko Igarashi

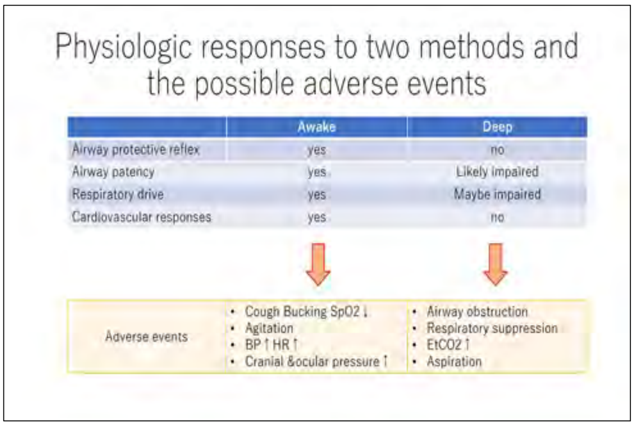
Department of Anesthesia, Miyagi Children's Hospital, Japan

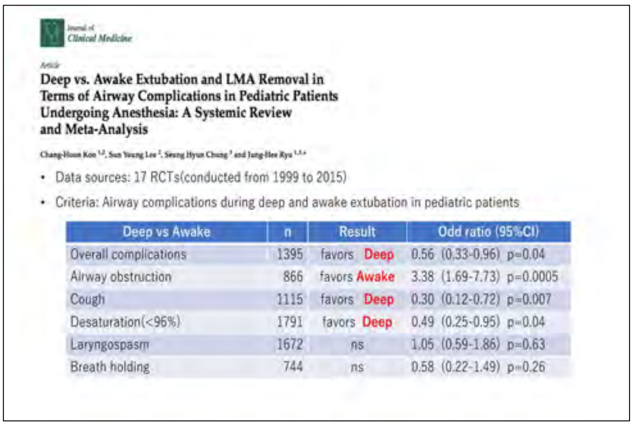


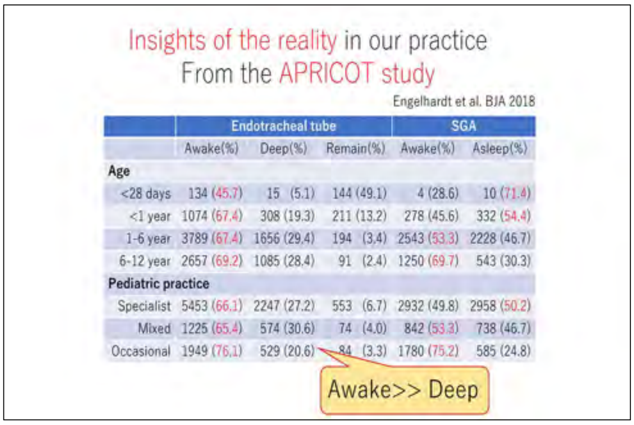


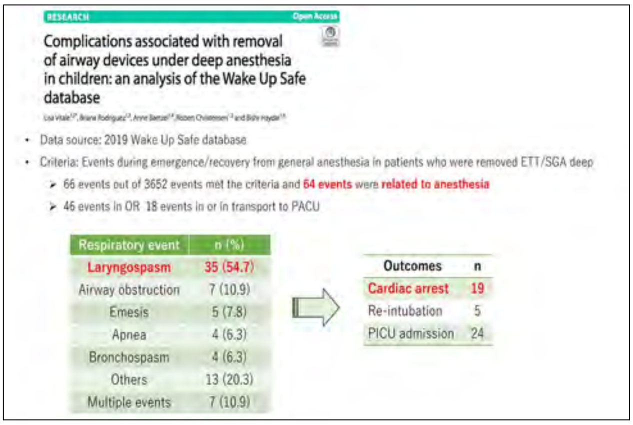


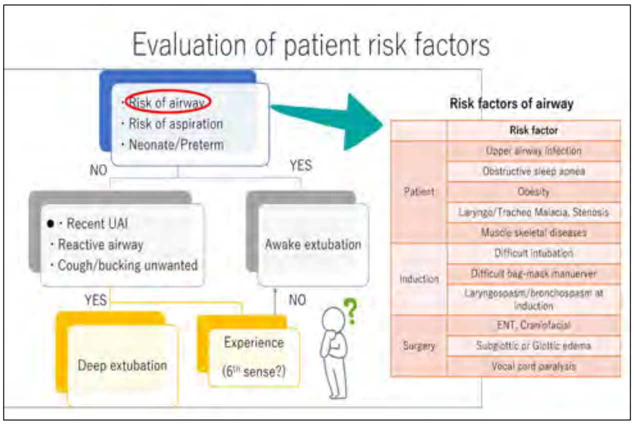


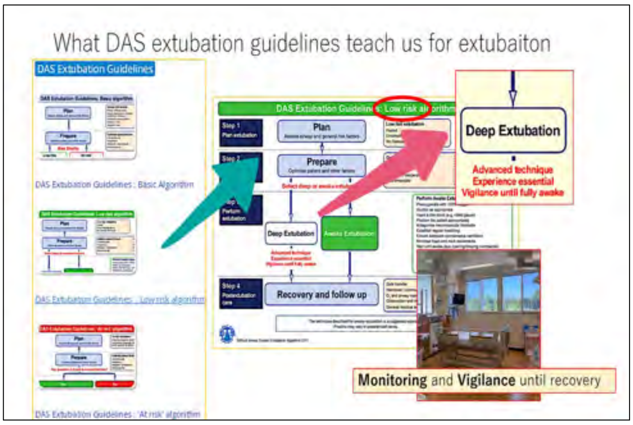


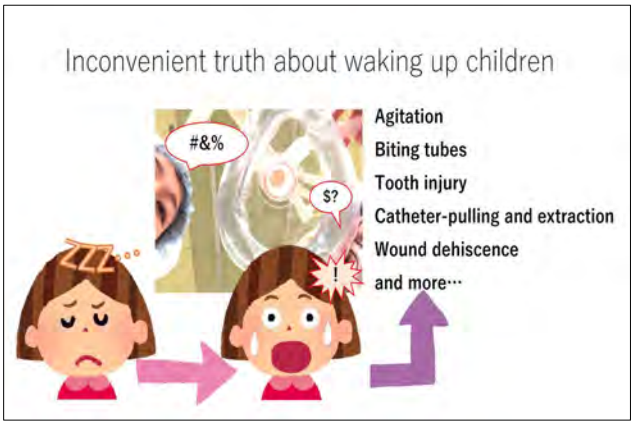


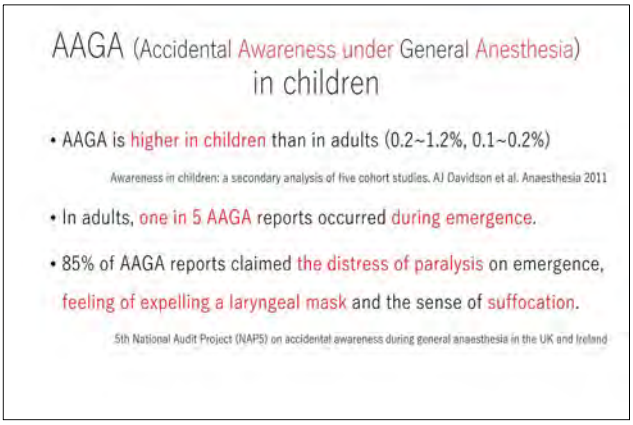

Insights of the reality in our practice
From the APRICOT study
Engelhardt et al. BJA 2018
Endotracheal tube | SGA
Awake(%) Deep(%) Remain(%) Awake(%) Asleep(%)
Age
<28 days 134 (45.7) 15 (5.1) 144 (49.1) 4 (28.6) 10 (71.4)
<1 year 1074 (67.4) 308 (19.3) 211 (13.2) 278 (45.6) 332 (54.4)
1-6 year 3789 (67.4) 1656 (29.4) 194 (3.4) 2543 (53.3) 2228 (46.7)
6-12 year 2657 (69.2) 1085 (28.4) 91 (2.4) 1250 (69.7) 543 (30.3)
Pediatric practice
Specialist 5453 (66.1) 2247 (27.2) 553 (6.7) 2932 (49.8) 2958 (50.2)
Mixed 1225 (65.4) 574 (30.6) 74 (4.0) 842 (53.3) 738 (46.7)
Occasional 1949 (76.1) 529 (20.6) 84 (3.3) 1780 (75.2) 585 (24.8)
Awake>> Deep

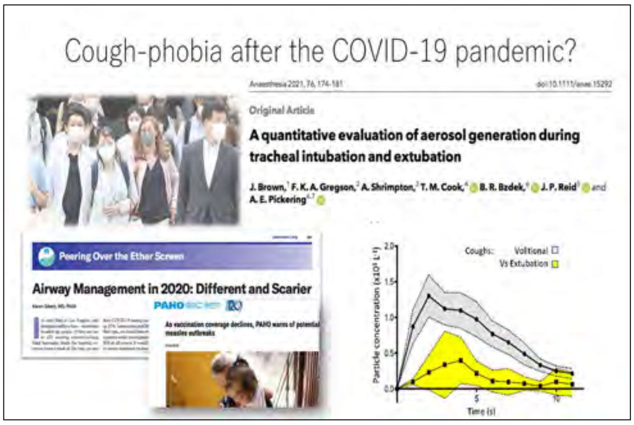

RESEARCH
Open Access
Complications associated with removal of airway devices under deep anesthesia in children: an analysis of the Wake Up Safe database
Data source: 2019 Wake Up Safe database
Criteria: Events during emergence/recovery from general anesthesia in patients who were removed ETT/SGA deep
66 events out of 3652 events met the criteria and 64 events were related to anesthesia
46 events in OR 18 events in or in transport to PACU
Respiratory event n (%)
Laryngospasm 35 (54.7)
Airway obstruction 7 (10.9)
Emesis 5 (7.8)
Apnea 4 (6.3)
Bronchospasm 4 (6.3)
Others 13 (20.3)
Multiple events 7 (10.9)
Outcomes n
Cardiac arrest 19
Re-intubation 5
PICU admission 24


Evaluation of patient risk factors
Risk of airway
Risk of aspiration
Neonate/Preterm
NO
YES
Recent UAI
Reactive airway
Cough/bucking unwanted
Awake extubation
YES
NO
Deep extubation
Experience
(6th sense?)
Risk factors of airway
Risk factor
Patient
Upper airway infection
Obstructive sleep apnea
Obesity
Laryngo/Tracheo Malacia, Stenosis
Muscle skeletal diseases
Induction
Difficult intubation
Difficult bag-mask maneuver
Laryngospasm/bronchospasm at induction
Surgery
ENT, Craniofacial
Subglottic or Glottic edema
Vocal cord paralysis


What DAS extubation guidelines teach us for extubaiton
DAS Extubation Guidelines
DAS Extubation Guidelines : Basic Algorithm
DAS Extubation Guidelines : Low risk algorithm
DAS Extubation Guidelines : 'At risk' algorithm
Plan
Prepare
Deep Extubation
Awake Extubation
Recovery and follow up
Deep Extubation
Advanced technique
Experience essential
Vigilance until fully awake
Monitoring and Vigilance until recovery


Inconvenient truth about waking up children
#&%
$?
Agitation
Biting tubes
Tooth injury
Catheter-pulling and extraction
Wound dehiscence
and more…


AAGA (Accidental Awareness under General Anesthesia) in children
AAGA is higher in children than in adults (0.2~1.2%, 0.1~0.2%)
Awareness in children: a secondary analysis of five cohort studies. AJ Davidson et al. Anaesthesia 2011
In adults, one in 5 AAGA reports occurred during emergence.
85% of AAGA reports claimed the distress of paralysis on emergence, feeling of expelling a laryngeal mask and the sense of suffocation.
5th National Audit Project (NAP5) on accidental awareness during general anaesthesia in the UK and Ireland


Cough-phobia after the COVID-19 pandemic?
Original Article
A quantitative evaluation of aerosol generation during tracheal intubation and extubation
Peering Over the Ether Screen
Airway Management in 2020: Different and Scarier
Coughs: Voluntal
Vs Extubation
Particle concentration
Time (s)


New School, New Anesthetics
1937
2023

Adjuvant agents helping smooth extubation

Agent	dose			
Propofol	223, 134 ug/kg/min	• •		
Remifentanil	0.036ug/kg/min	• Cough ↓ • Fast discharge from PACU	Sevo 1MAC	Xia S et al.2012
Dexmedetomidine	0.7ug/kg	• Cough reflex ↓ (adults)	Sevo 1MAC	Fan Q et al. 2015
	1,2 ug/kg	• Upper airway obstruction ↓	Sevo1,1.5,0.8MA	Di M et al. 2017
Lidocaine	2mg/kg	•		Erb TO et al. 2017
Remimazolam	0.5-2mg/kg/min			Future authors

Respiratory Reflex Responses of the Larynx Differ between Sevoflurane and Propofol in Pediatric Patients

The safety and efficacy of remimazolam tosylate for induction and maintenance of general anesthesia in pediatric patients undergoing elective surgery: Study protocol for a multicenter, randomized, single-blind, positive-controlled clinical trial

Positioning matters for extubation

Best position and depth of anaesthesia for laryngeal mask airway removal in children

A randomised controlled trial

European Journal of Anaesthesiology

- 212 pediatric patients were assigned to 4 position group for removal of LMA

	Lateral deep	Lateral awake	Supine deep	Supine awake
Complication ratio (%)	15.4	27.8	50.0	40.4
Complication occurence	Airway obstruction 8 Retching 1	Secretions 11 Biting 8	Airway obstruction 26 Retching 2 SpO2<90% 1	Airway obstruction 3 Secretions 13 Biting 8 SpO2<90% 1

High Flow Nasal Cannula (HFNC) for post-extubation

Comparison of High-Flow Nasal Cannula Versus Conventional Oxygen Therapy After Extubation in Children Undergoing Cardiac Surgery: A Meta-analysis Karedath J et al. Cureus 2023 DOI: 10.7759/cureus.36922

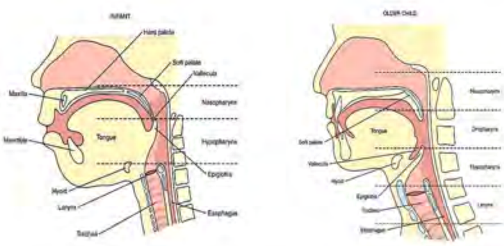
- 2RCTs, 1 Cohort study 227patients (HFNC 113 Conventional O2 therapy 114)
- HFNC did not decrease the ratio of reintubation, but increase PaO2 and decrease PaCO2.

Mechanisms of HFNC action	
PEEP	↑
Mechanical splinting of nasopharynx	↑
CO2 washout	↑
Nasopharyngeal dead space	↓
Work of breathing	↓
Consistent O2 supply	↑

Summary

- Removing airway devices is the crucial step in emergence from anesthesia. It could be associated with adverse events and various complications.
- Careful evaluation of patient airway risks and planning optimal methods to remove airway devices are the keys for safe airway management in pediatric patients.

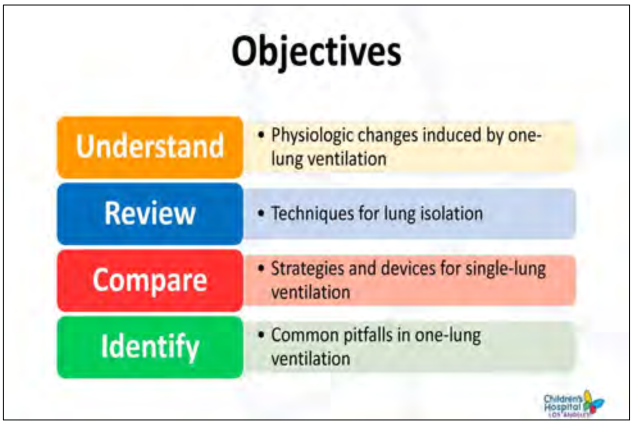
Children's airway is narrow and collapsible

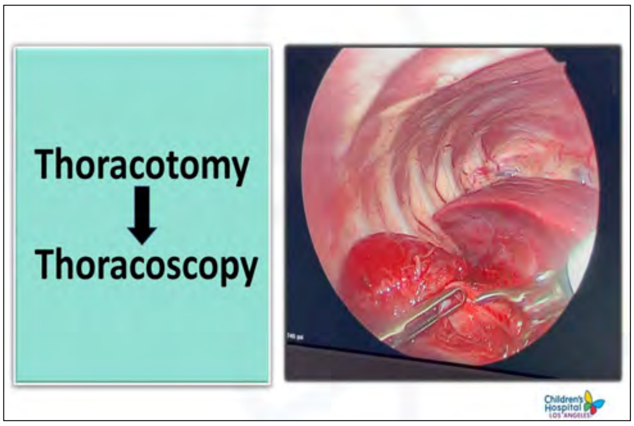


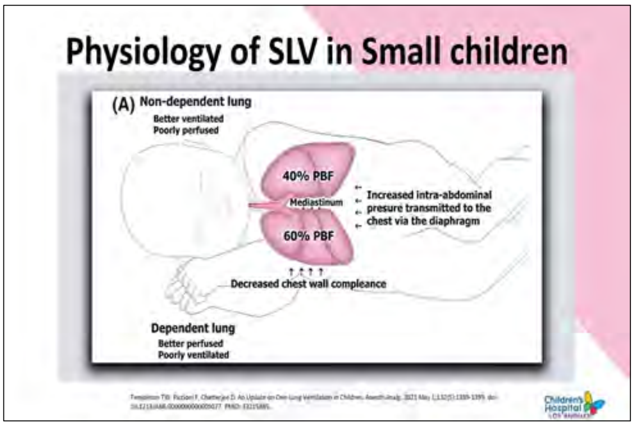
Beyond the Mainstem: Lung Isolation Techniques in Small Children

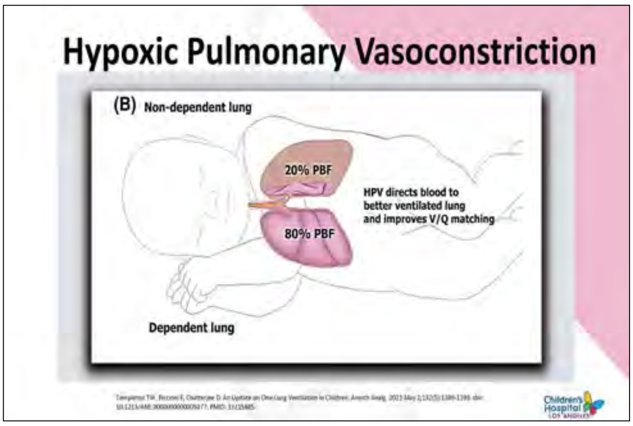
Rebecca Donovan Margolis

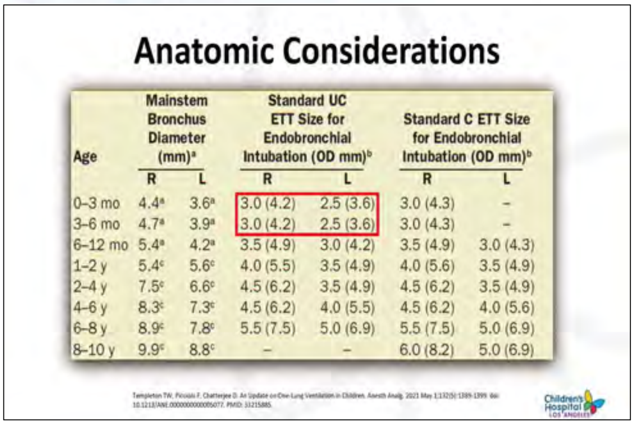
Department of Anesthesiology and Critical Care Medicine, Children's Hospital Los Angeles,
University of Southern California Keck School of Medicine, USA



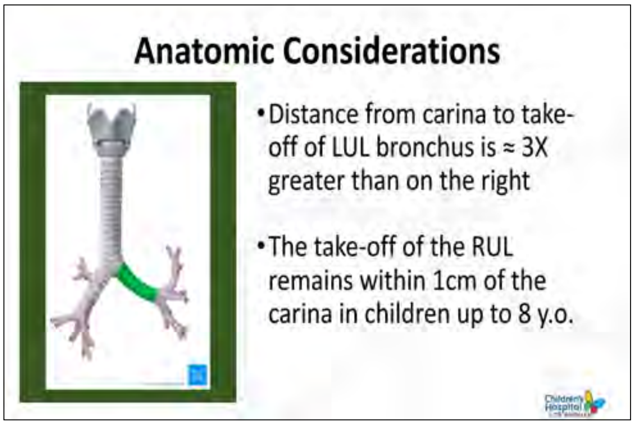


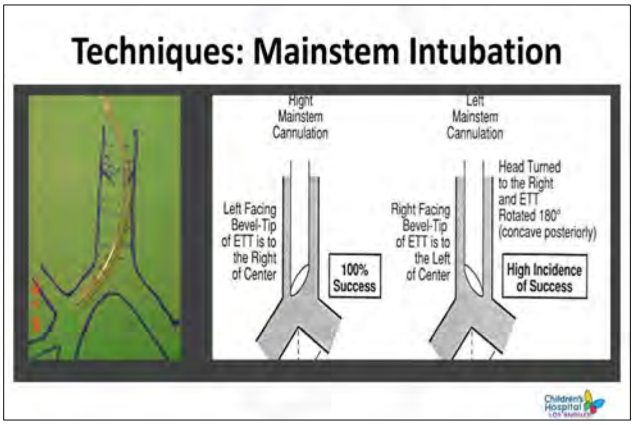


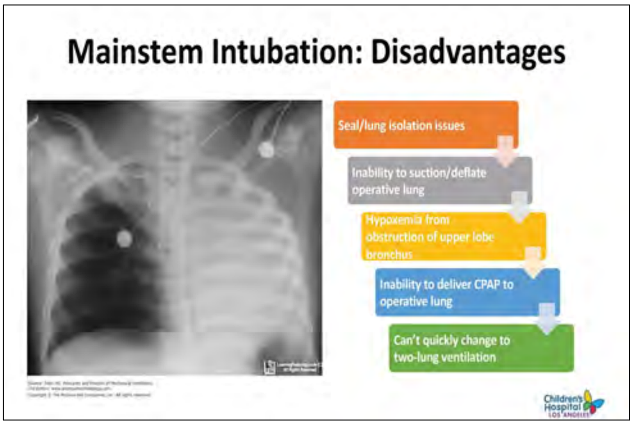


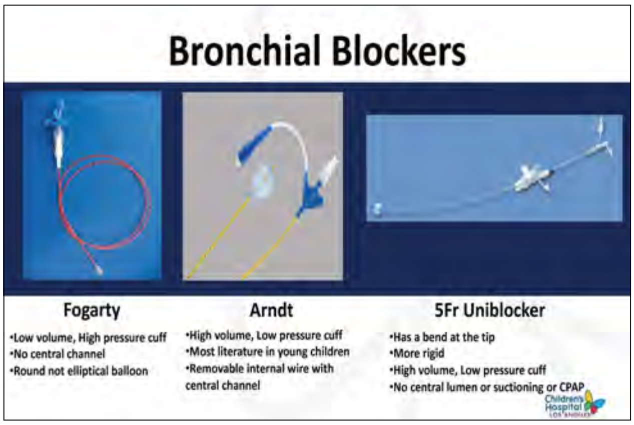


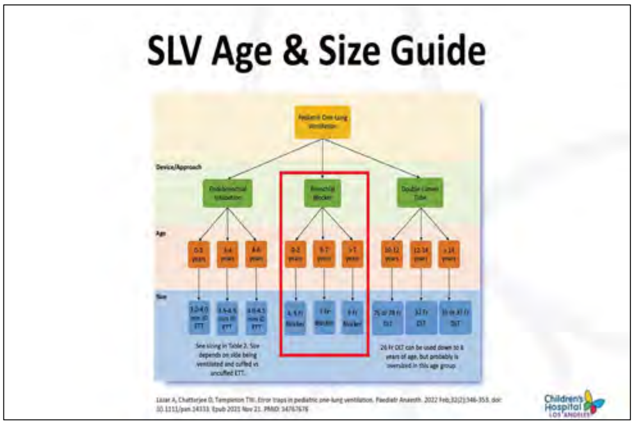
Age	Mainstem Bronchus Diameter (mm)[a] R	Mainstem Bronchus Diameter (mm)[a] L	Standard UC ETT Size for Endobronchial Intubation (OD mm)[b] R	Standard UC ETT Size for Endobronchial Intubation (OD mm)[b] L	Standard C ETT Size for Endobronchial Intubation (OD mm)[b] R	Standard C ETT Size for Endobronchial Intubation (OD mm)[b] L
0–3 mo	4.4[a]	3.6[a]	3.0 (4.2)	2.5 (3.6)	3.0 (4.3)	–
3–6 mo	4.7[a]	3.9[a]	3.0 (4.2)	2.5 (3.6)	3.0 (4.3)	–
6–12 mo	5.4[a]	4.2[a]	3.5 (4.9)	3.0 (4.2)	3.5 (4.9)	3.0 (4.3)
1–2 y	5.4[c]	5.6[c]	4.0 (5.5)	3.5 (4.9)	4.0 (5.6)	3.5 (4.9)
2–4 y	7.5[c]	6.6[c]	4.5 (6.2)	3.5 (4.9)	4.5 (6.2)	3.5 (4.9)
4–6 y	8.3[c]	7.3[c]	4.5 (6.2)	4.0 (5.5)	4.5 (6.2)	4.0 (5.6)
6–8 y	8.9[c]	7.8[c]	5.5 (7.5)	5.0 (6.9)	5.5 (7.5)	5.0 (6.9)
8–10 y	9.9[c]	8.8[c]	–	–	6.0 (8.2)	5.0 (6.9)

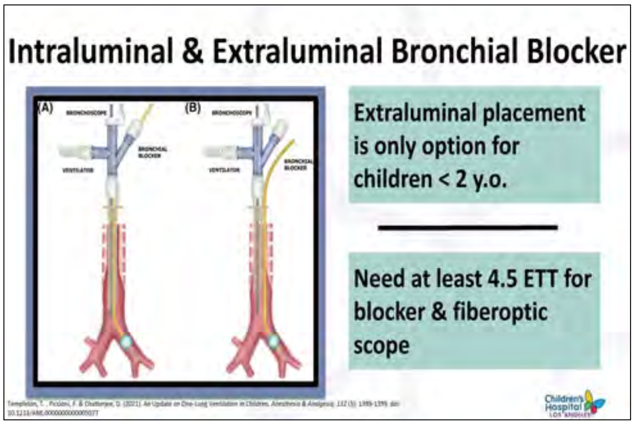


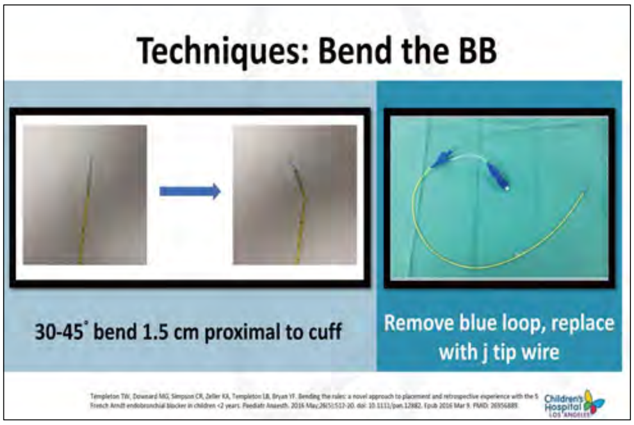


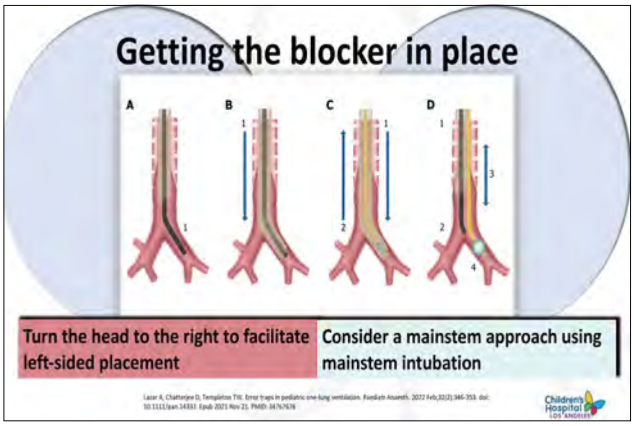


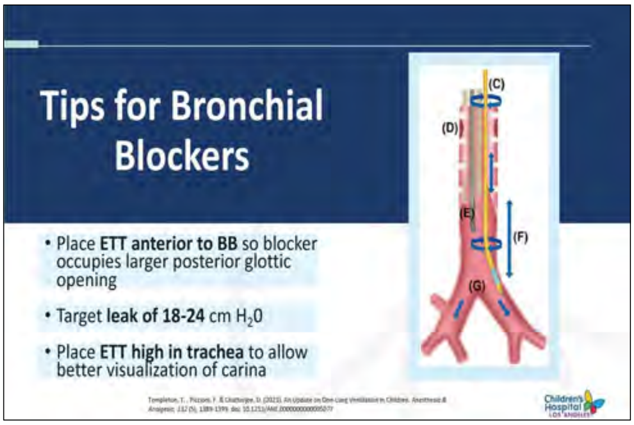


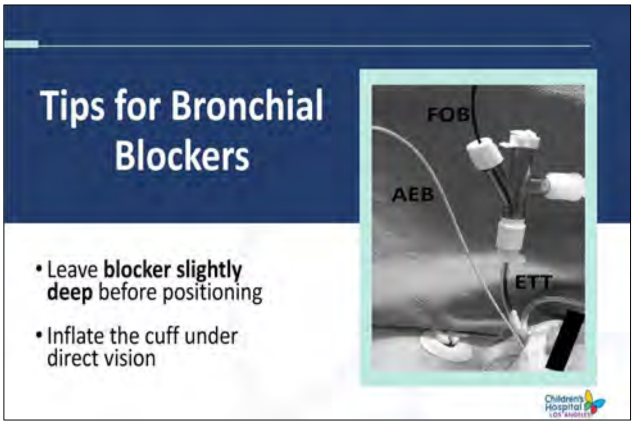


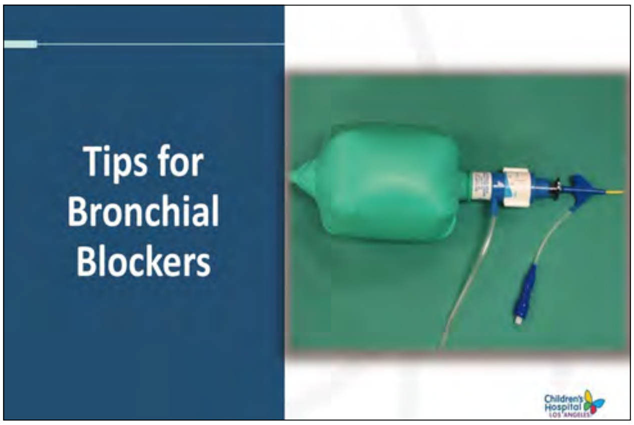


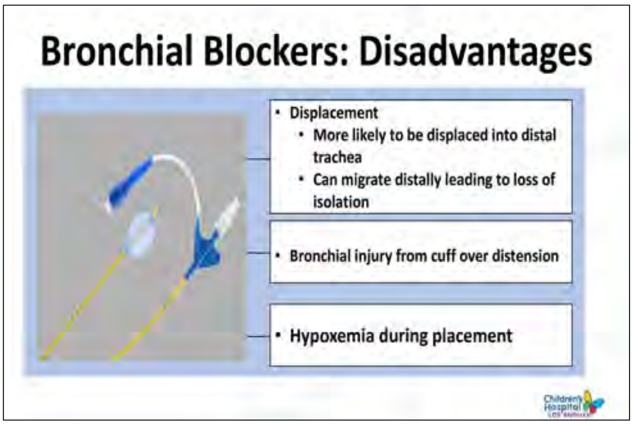

Techniques: Bend the BB
30-45° bend 1.5 cm proximal to cuff
Remove blue loop, replace with j tip wire

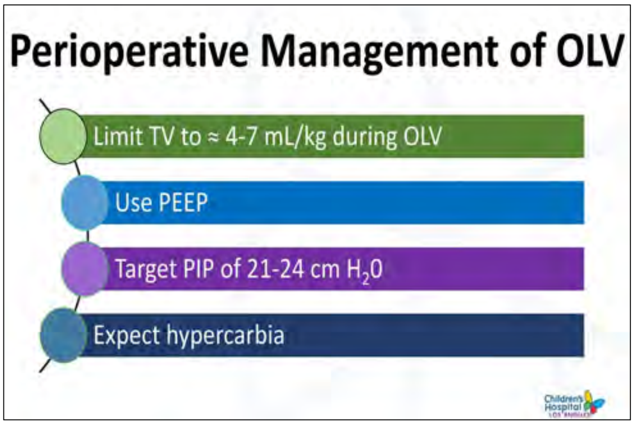

Getting the blocker in place
A
B
C
D
Turn the head to the right to facilitate left-sided placement
Consider a mainstem approach using mainstem intubation

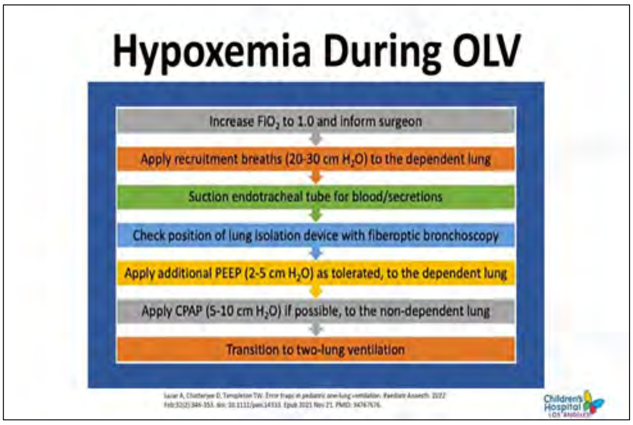

Tips for Bronchial Blockers
• Place ETT anterior to BB so blocker occupies larger posterior glottic opening
• Target leak of 18-24 cm H$_2$0
• Place ETT high in trachea to allow better visualization of carina
(C)
(D)
(E)
(F)
(G)

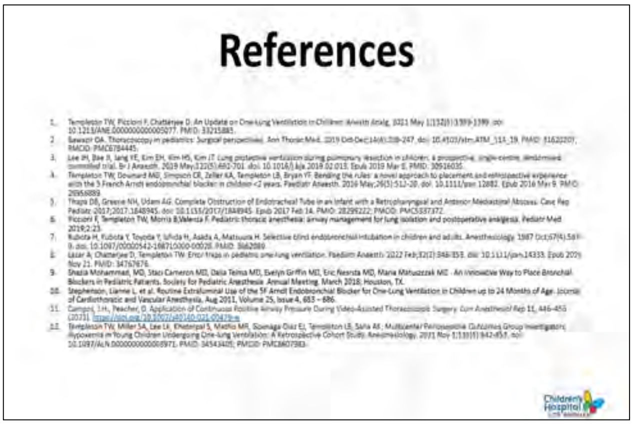

Tips for Bronchial Blockers
• Leave blocker slightly deep before positioning
• Inflate the cuff under direct vision
FOB
AEB
ETT


Tips for Bronchial Blockers


Bronchial Blockers: Disadvantages
• Displacement
• More likely to be displaced into distal trachea
• Can migrate distally leading to loss of isolation
• Bronchial injury from cuff over distension
• Hypoxemia during placement


Perioperative Management of OLV
Limit TV to ≈ 4-7 mL/kg during OLV
Use PEEP
Target PIP of 21-24 cm H$_2$0
Expect hypercarbia


Hypoxemia During OLV
Increase FiO$_2$ to 1.0 and inform surgeon
Apply recruitment breaths (20-30 cm H$_2$O) to the dependent lung
Suction endotracheal tube for blood/secretions
Check position of lung isolation device with fiberoptic bronchoscopy
Apply additional PEEP (2-5 cm H$_2$O) as tolerated, to the dependent lung
Apply CPAP (5-10 cm H$_2$O) if possible, to the non-dependent lung
Transition to two-lung ventilation



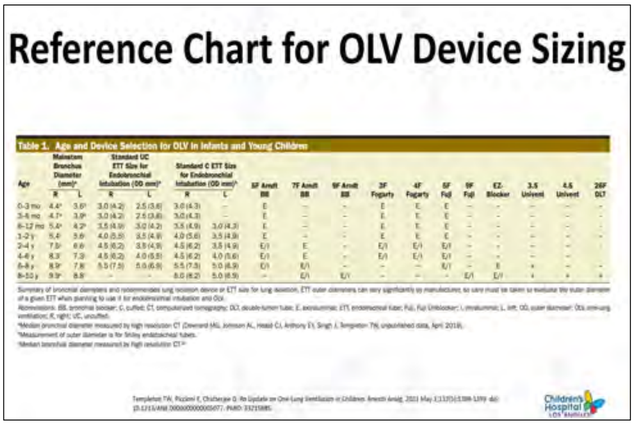


Table 1. Age and Device Selection for OLV in Infants and Young Children

Age	Mainstem Bronchus Diameter (mm) R	Mainstem Bronchus Diameter (mm) L	Standard UC ETT Size for Endobronchial Intubation (OD mm) R	Standard UC ETT Size for Endobronchial Intubation (OD mm) L	Standard C ETT Size for Endobronchial Intubation (OD mm) R	Standard C ETT Size for Endobronchial Intubation (OD mm) L	5F Arndt BB	7F Arndt BB	9F Arndt BB	3F Fogarty	4F Fogarty	5F Fuji	9F Fuji	EZ-Blocker	3.5 Univent	4.5 Univent	26F DLT
0-3 mo	4.4	3.6	3.0 (4.2)	2.5 (3.6)	3.0 (4.3)	–	E	–	–	E	E	E	–	–	–	–	–
3-6 mo	4.7	3.9	3.0 (4.2)	2.5 (3.6)	3.0 (4.3)	–	E	–	–	E	E	E	–	–	–	–	–
6-12 mo	5.4	4.2	3.5 (4.9)	3.0 (4.2)	3.5 (4.9)	3.0 (4.3)	E	–	–	E	E	E	–	–	–	–	–
1-2 y	5.4	5.6	4.0 (5.5)	3.5 (4.9)	4.0 (5.6)	3.5 (4.9)	E	–	–	E	E	E	–	–	–	–	–
2-4 y	7.0	6.6	4.5 (6.2)	3.5 (4.9)	4.5 (6.2)	3.5 (4.9)	E/I	E	–	E/I	E/I	E/I	–	–	–	–	–
4-6 y	8.3	7.3	4.5 (6.2)	4.0 (5.5)	4.5 (6.2)	4.0 (5.6)	E/I	E	–	E/I	E/I	E/I	–	–	–	–	–
6-8 y	8.9	7.8	5.5 (7.5)	5.0 (6.9)	5.5 (7.5)	5.0 (6.9)	E/I	E/I	–	–	–	E/I	–	E	+	–	–
8-10 y	9.9	8.8	–	–	6.0 (8.2)	5.0 (6.9)	–	E/I	E/I	–	–	–	E/I	E/I	+	+	+

Templeton TW, Piccioni F, Chatterjee D. An Update on One-Lung Ventilation in Children. Anesth Analg. 2021 May 1;132(5):1389-1399. doi: 10.1213/ANE.0000000000005077. PMID: 33215885.

Session 3.

Beyond Drugs and Blocks: Latest Knowledge of Pediatric Pain Management

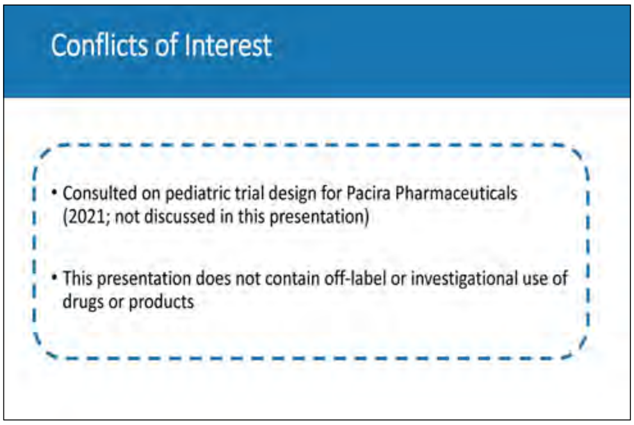
Chair(s): Sang Hun Kim (Korea)

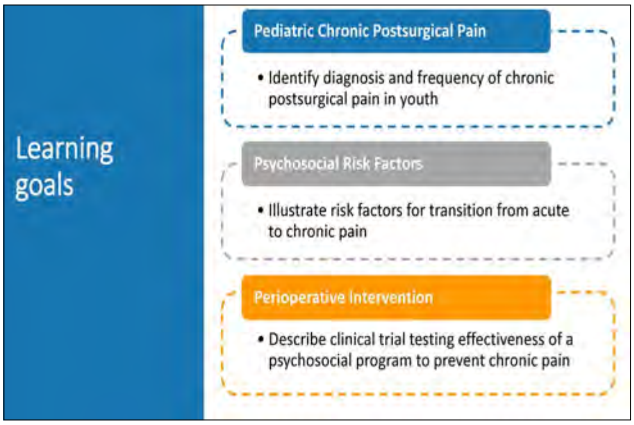
Seokyoung Song (Korea)

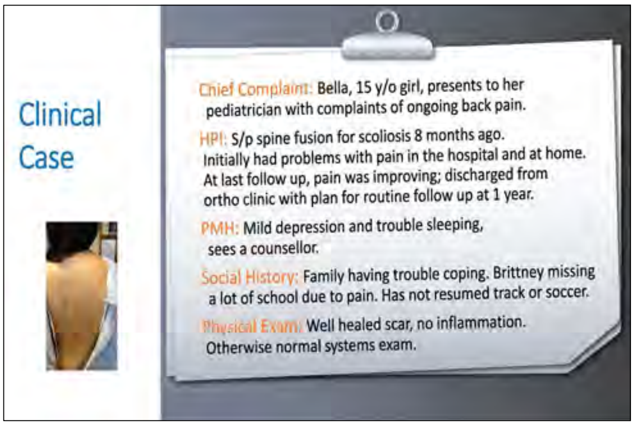
Acute to Chronic Postsurgical Pain: Influence of Psychosocial Factors

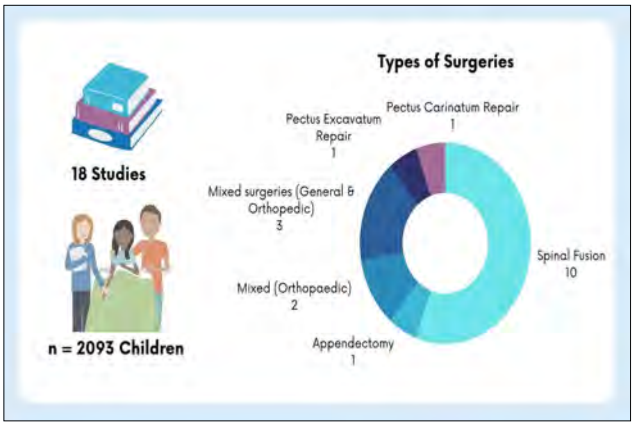
Jennifer A. Rabbitts

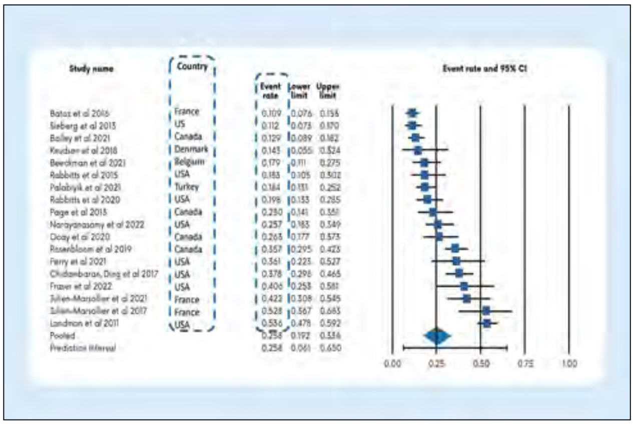
Department of Anesthesiology & Pain Medicine, University of Washington, Seattle Children's Hospital, USA

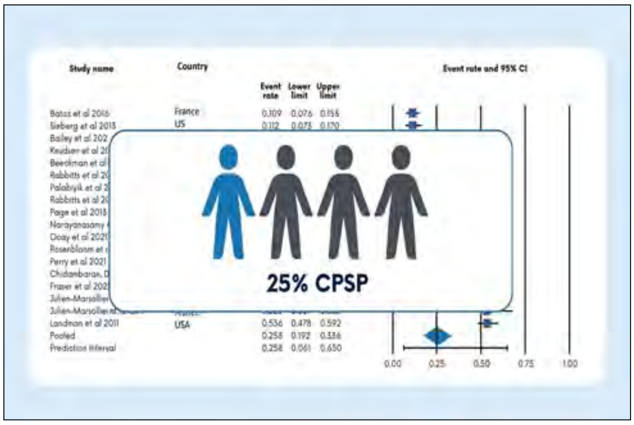


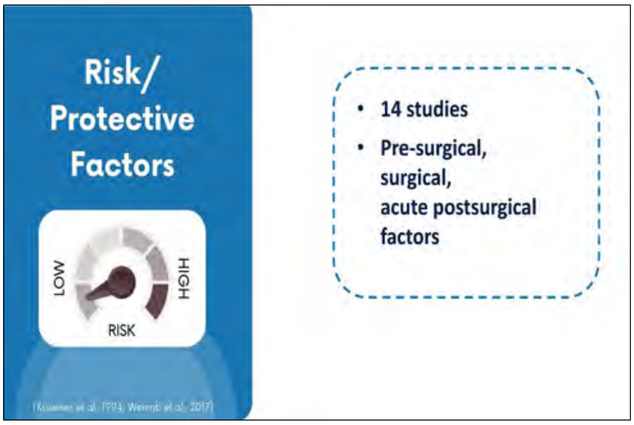


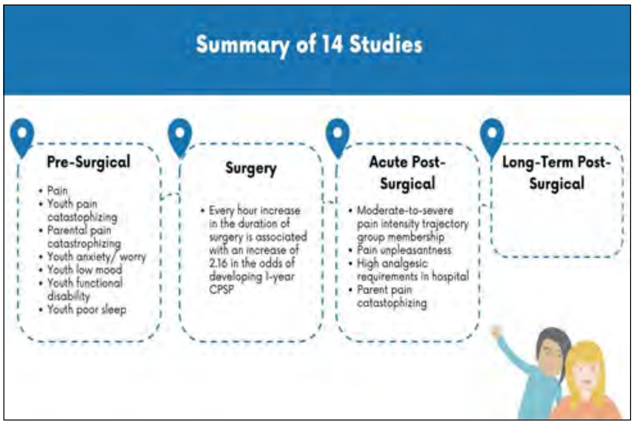


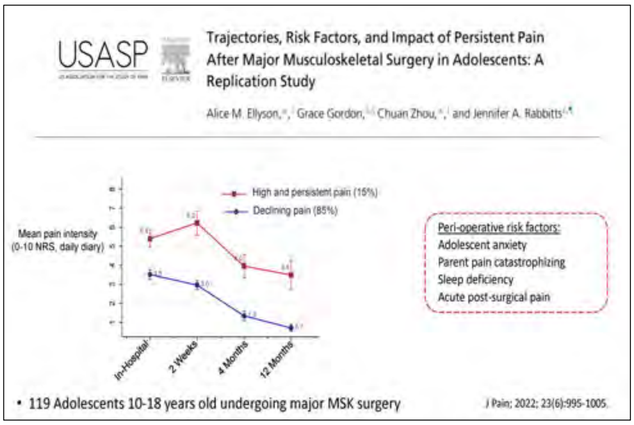



Study name
Country
Event rate
Lower limit
Upper limit
Event rate and 95% CI
Batoz et al 2016 France 0.109 0.076 0.155
Sieberg et al 2013 US 0.112 0.073 0.170
Bailey et al 2021 Canada 0.129 0.089 0.182
Knudsen et al 2018 Denmark 0.143 0.055 0.324
Beeckman et al 2021 Belgium 0.179 0.111 0.275
Rabbitts et al 2015 USA 0.183 0.105 0.302
Palabıyık et al 2021 Turkey 0.184 0.131 0.252
Rabbitts et al 2020 USA 0.198 0.133 0.285
Page et al 2013 Canada 0.230 0.141 0.351
Narayanasamy et al 2022 USA 0.257 0.183 0.349
Ocay et al 2020 Canada 0.263 0.177 0.373
Rosenbloom et al 2019 Canada 0.357 0.295 0.423
Perry et al 2021 USA 0.361 0.223 0.527
Chidambaran, Ding et al 2017 USA 0.378 0.298 0.465
Frazer et al 2022 USA 0.406 0.253 0.581
Julien-Marsollier et al 2021 France 0.422 0.308 0.545
Julien-Marsollier et al 2017 France 0.528 0.367 0.683
Landman et al 2011 USA 0.536 0.478 0.592
Pooled 0.258 0.192 0.336
Prediction Interval 0.258 0.061 0.650
0.00 0.25 0.50 0.75 1.00

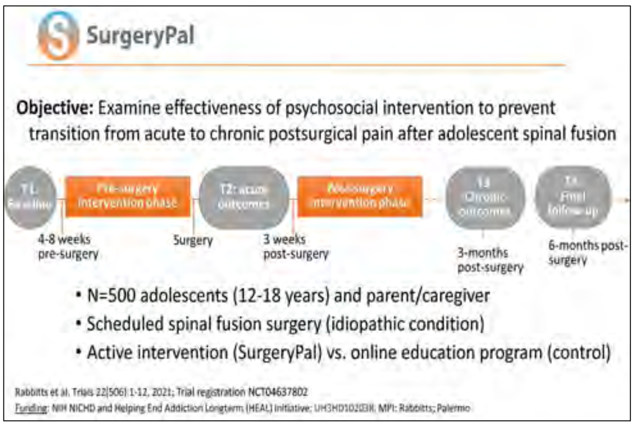

Study name
Country
Event rate and 95% CI
25% CPSP
0.00 0.25 0.50 0.75 1.00

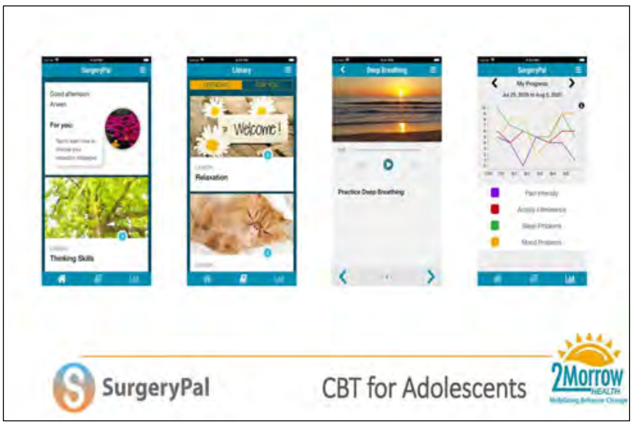

Risk/
Protective
Factors
LOW
HIGH
RISK
(Kraemer et al. 1994; Weinrib et al. 2017)
• 14 studies
• Pre-surgical, surgical, acute postsurgical factors

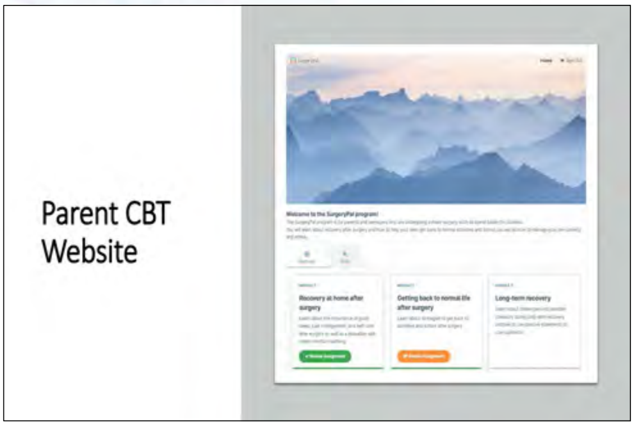

Summary of 14 Studies
Pre-Surgical
• Pain
• Youth pain catastrophizing
• Parental pain catastrophizing
• Youth anxiety/ worry
• Youth low mood
• Youth functional disability
• Youth poor sleep
Surgery
• Every hour increase in the duration of surgery is associated with an increase of 2.16 in the odds of developing 1-year CPSP
Acute Post-Surgical
• Moderate-to-severe pain intensity trajectory group membership
• Pain unpleasantness
• High analgesic requirements in hospital
• Parent pain catastrophizing
Long-Term Post-Surgical


USASP
Trajectories, Risk Factors, and Impact of Persistent Pain After Major Musculoskeletal Surgery in Adolescents: A Replication Study
Alice M. Ellyson, Grace Gordon, Chuan Zhou, and Jennifer A. Rabbitts
Mean pain intensity (0-10 NRS, daily diary)
High and persistent pain (15%)
Declining pain (85%)
In-Hospital
2 Weeks
4 Months
12 Months
Peri-operative risk factors:
Adolescent anxiety
Parent pain catastrophizing
Sleep deficiency
Acute post-surgical pain
• 119 Adolescents 10-18 years old undergoing major MSK surgery
J Pain; 2022; 23(6):995-1005.


PAIN
Psychological interventions in managing postoperative pain in children: a systematic review
• Meta-analysis demonstrated efficacy in reducing acute postoperative pain
• 14 studies, moderate effect size, including adolescent spine surgery
• Longer term postsurgical pain outcomes not examined
• Parent interventions not included
• Barriers to implementation of psychological interventions into perioperative care
• Lack of access to psychosocial resources

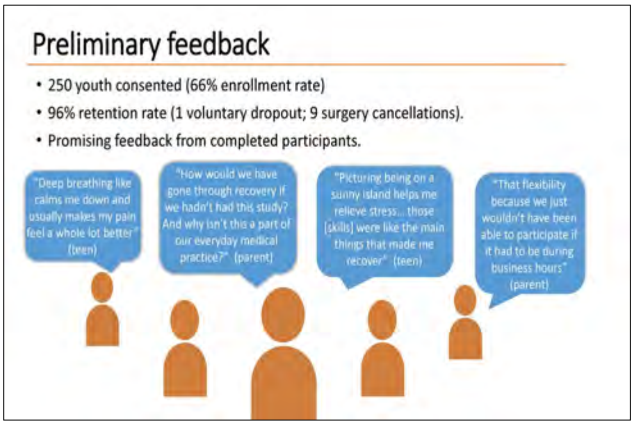

SurgeryPal
Objective: Examine effectiveness of psychosocial intervention to prevent transition from acute to chronic postsurgical pain after adolescent spinal fusion
T1: Baseline
Pre-surgery intervention phase
T2: acute outcomes
Post-surgery intervention phase
T3 Chronic outcomes
T4 Final follow-up
4-8 weeks pre-surgery
Surgery
3 weeks post-surgery
3-months post-surgery
6-months post-surgery
• N=500 adolescents (12-18 years) and parent/caregiver
• Scheduled spinal fusion surgery (idiopathic condition)
• Active intervention (SurgeryPal) vs. online education program (control)
Rabbitts et al. Trials 22(506):1-12, 2021; Trial registration NCT04637802
Funding: NIH NICHD and Helping End Addiction Longterm (HEAL) initiative; UH3HD102038; MPI: Rabbitts; Palermo


SurgeryPal
Welcome!
Relaxation
Thinking Skills
Deep Breathing
My Progress
SurgeryPal
CBT for Adolescents
2Morrow HEALTH

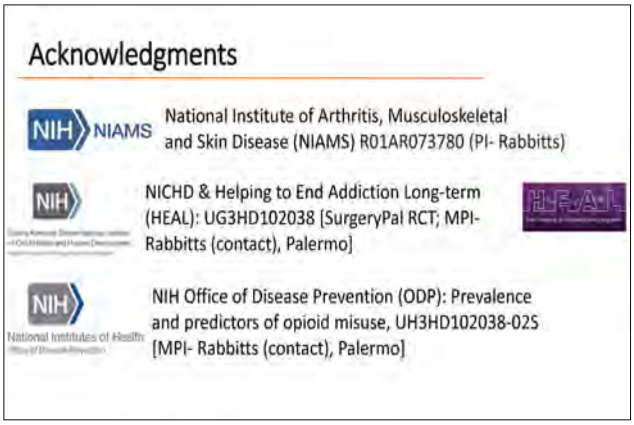


Module	CBT Skills	Additional Parent Skills
1	**Preparing for surgery** -Deep breathing. -Strategies to improve sleep habits.	-Gathering information from the medical team.
2	**Coping with worry** -Thought replacement and mindfulness.	-Parent-teen communication.
3	**Getting ready for the hospital and recovery** -Imagery and distraction for managing anxiety or pain.	-Social connections and support.

Module	CBT Skills	Additional Parent Skills
1	**Coping at home after surgery** -Strategies to improve sleep habits. -Music distraction and mindful breathing.	-Principles of self-care.
2	**Getting back to activities** -Behavioral activation, and activity pacing.	-Handling daily stress.
3	**Long-term recovery** -Progressive muscle relaxation.	-Positive self-statements to reduce distress.




Pediatric Pain and Sleep Innovations Lab
Seattle Children's

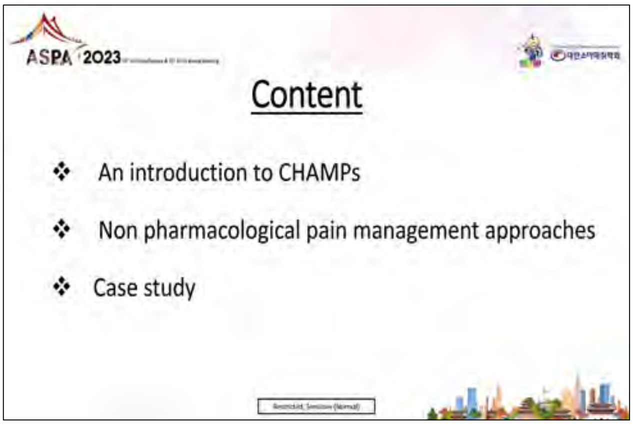

Acknowledgments
NIH NIAMS
National Institute of Arthritis, Musculoskeletal and Skin Disease (NIAMS) R01AR073780 (PI- Rabbitts)
NIH
NICHD & Helping to End Addiction Long-term (HEAL): UG3HD102038 [SurgeryPal RCT; MPI- Rabbitts (contact), Palermo]
HEAL
NIH
National Institutes of Health
NIH Office of Disease Prevention (ODP): Prevalence and predictors of opioid misuse, UH3HD102038-02S [MPI- Rabbitts (contact), Palermo]

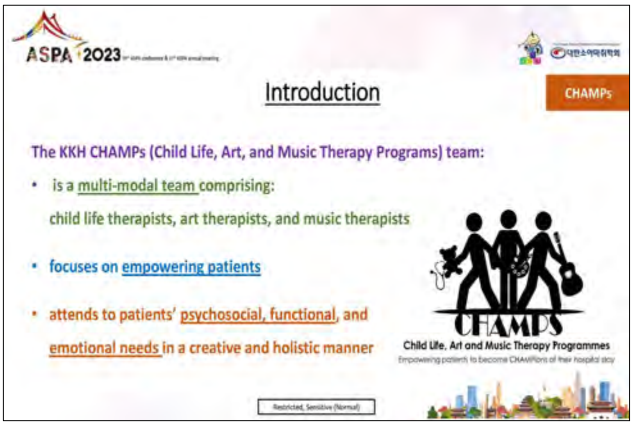

Special Interest Group on
Pain in Childhood
INTERNATIONAL ASSOCIATION FOR THE STUDY OF PAIN
ISPP 2023 will be held in Halifax, Nova Scotia, Canada from 1st to 4th October 2023.
ISPP

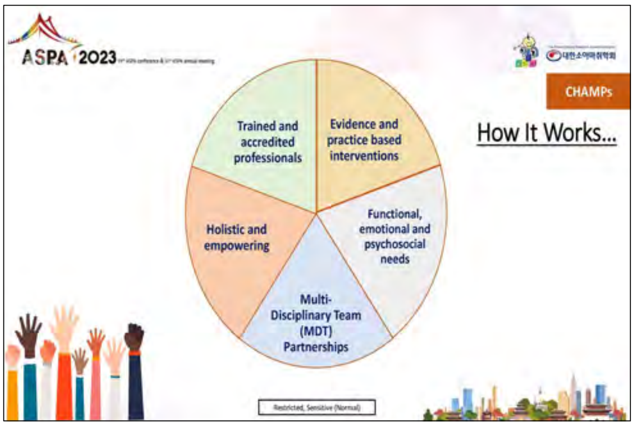
A Non-Pharmacological Approach to Post-Operative Pain Management in Children with Multiple Traumatic Injuries -A Presentation for ASPA 2023 by KKH CHAMPs

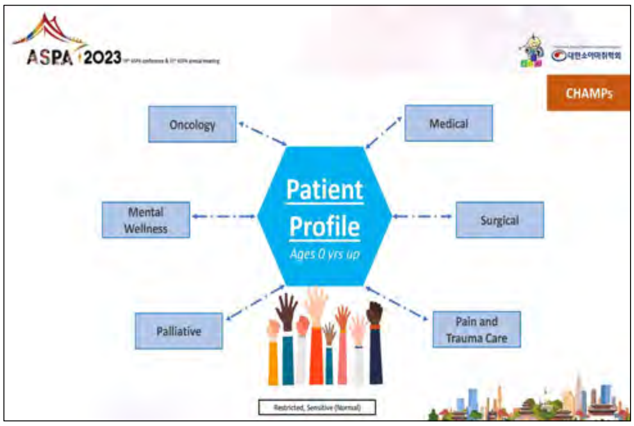
Tanuja Nair

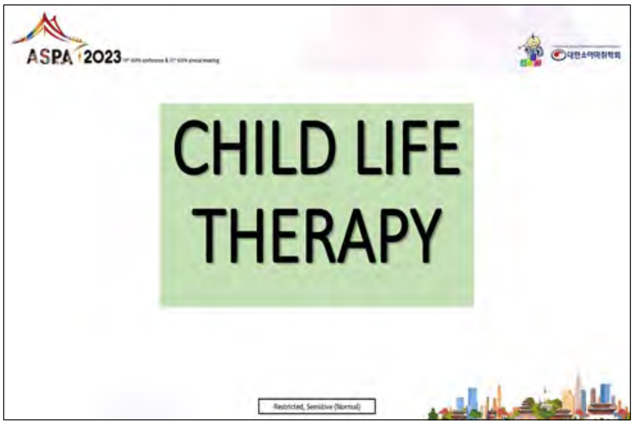
KK Women's and Children's Hospital (KKH), Singapore

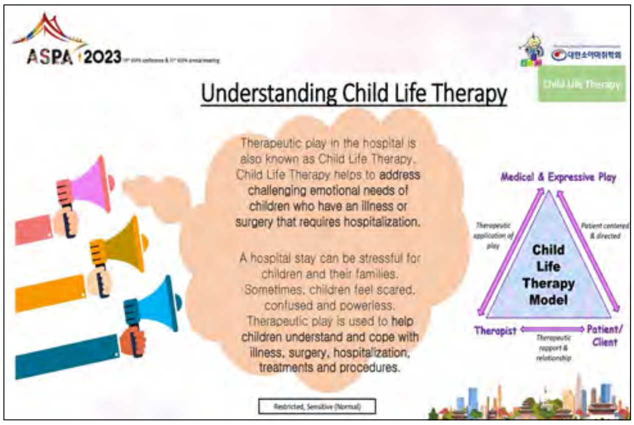


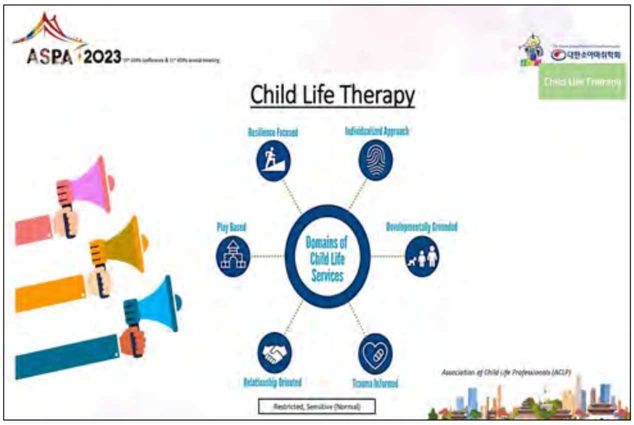


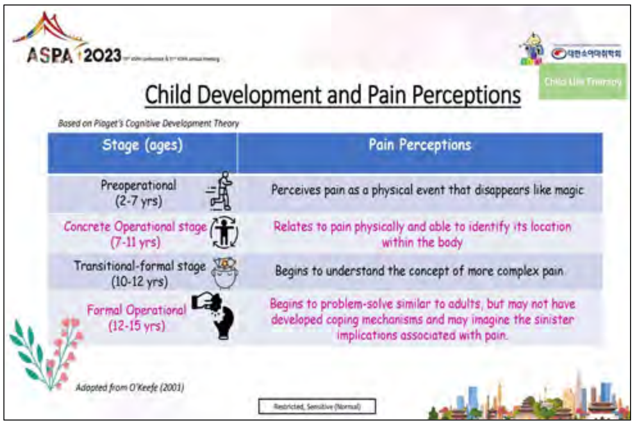


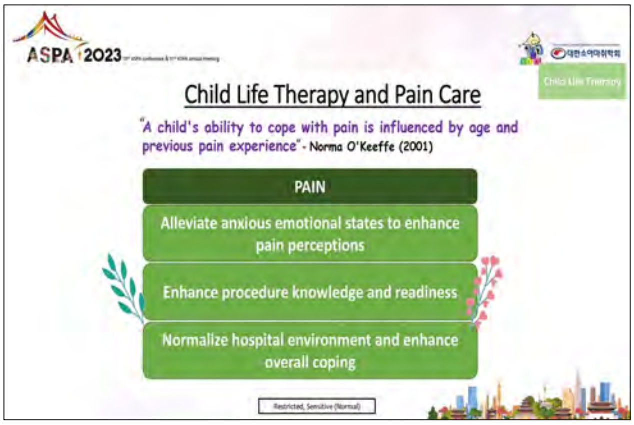



ASPA 2023
CHILD LIFE THERAPY
Restricted, Sensitive (Normal)

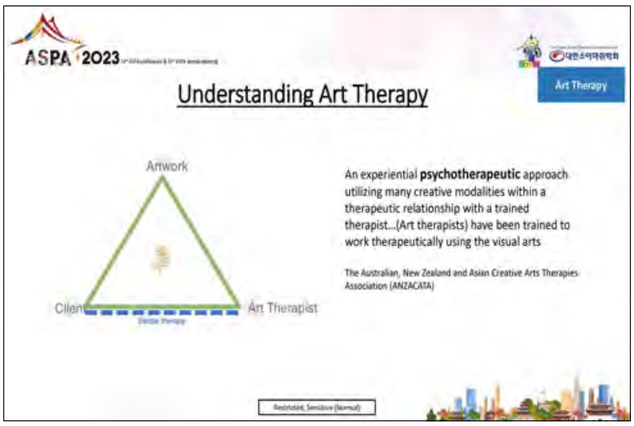

ASPA 2023
Child Life Therapy
Understanding Child Life Therapy
Therapeutic play in the hospital is also known as Child Life Therapy. Child Life Therapy helps to address challenging emotional needs of children who have an illness or surgery that requires hospitalization.
A hospital stay can be stressful for children and their families. Sometimes, children feel scared, confused and powerless. Therapeutic play is used to help children understand and cope with illness, surgery, hospitalization, treatments and procedures.
Medical & Expressive Play
Therapeutic application of play
Patient centered & directed
Child Life Therapy Model
Therapist
Patient/ Client
Therapeutic rapport & relationship
Restricted, Sensitive (Normal)


ASPA 2023
Child Life Therapy
Child Life Therapy
Resilience Focused
Individualized Approach
Play Based
Domains of Child Life Services
Developmentally Grounded
Relationship Oriented
Trauma Informed
Association of Child Life Professionals (ACLP)
Restricted, Sensitive (Normal)


ASPA 2023
Child Life Therapy
Child Development and Pain Perceptions
Based on Piaget's Cognitive Development Theory
Stage (ages)
Pain Perceptions
Preoperational (2-7 yrs)
Perceives pain as a physical event that disappears like magic
Concrete Operational stage (7-11 yrs)
Relates to pain physically and able to identify its location within the body
Transitional-formal stage (10-12 yrs)
Begins to understand the concept of more complex pain
Formal Operational (12-15 yrs)
Begins to problem-solve similar to adults, but may not have developed coping mechanisms and may imagine the sinister implications associated with pain.
Adapted from O'Keefe (2001)
Restricted, Sensitive (Normal)

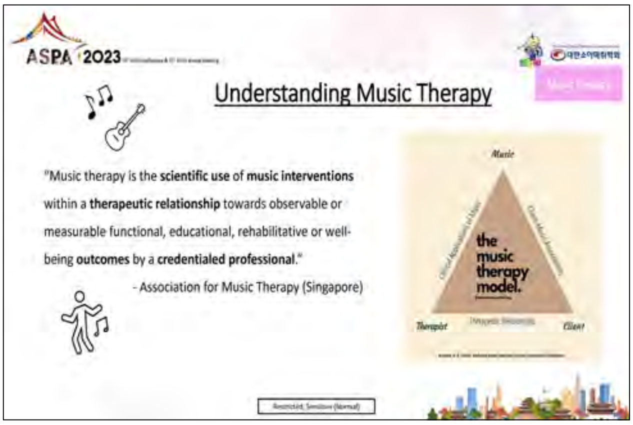

ASPA 2023
Child Life Therapy
Child Life Therapy and Pain Care
"A child's ability to cope with pain is influenced by age and previous pain experience"- Norma O'Keeffe (2001)
PAIN
Alleviate anxious emotional states to enhance pain perceptions
Enhance procedure knowledge and readiness
Normalize hospital environment and enhance overall coping
Restricted, Sensitive (Normal)

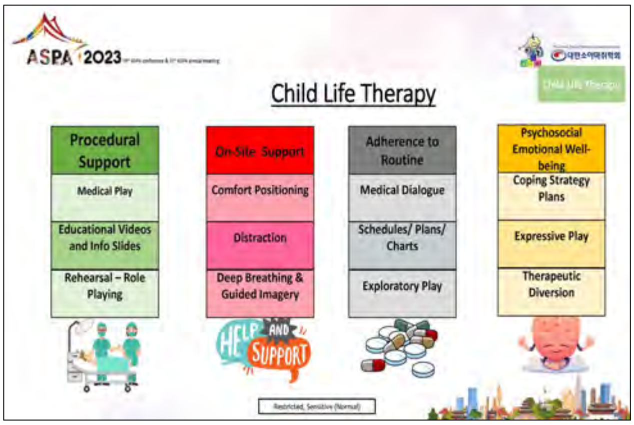

ASPA 2023
ART THERAPY
Restricted, Sensitive (Normal)

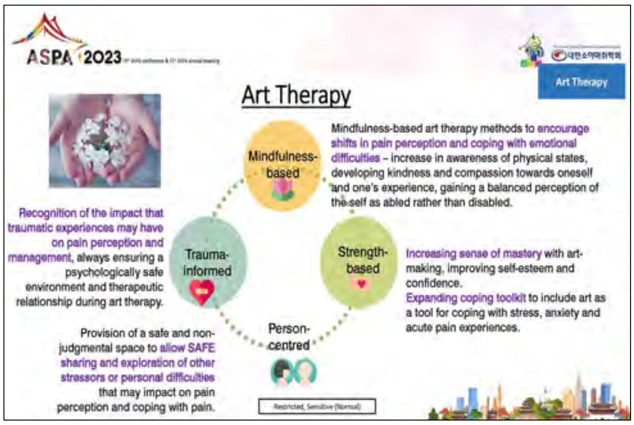

ASPA 2023
Art Therapy
Understanding Art Therapy
Artwork
Client
Art Therapist
An experiential psychotherapeutic approach utilizing many creative modalities within a therapeutic relationship with a trained therapist...(Art therapists) have been trained to work therapeutically using the visual arts
The Australian, New Zealand and Asian Creative Arts Therapies Association (ANZACATA)
Restricted, Sensitive (Normal)

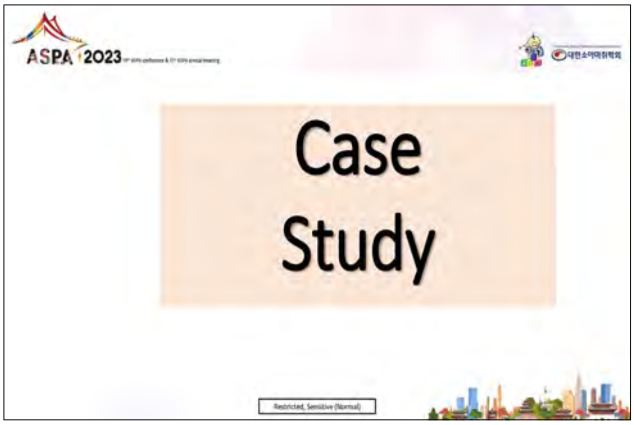

ASPA 2023
Art Therapy
Art Therapy in Pain & Trauma Care
Through art making...
PAIN
Modify response to emotional and physical problems
Manage symptoms of stress and anxiety
Reduces pain perception by moving the mental focus and improve mood (Shella, 2018)
Restricted, Sensitive (Normal)

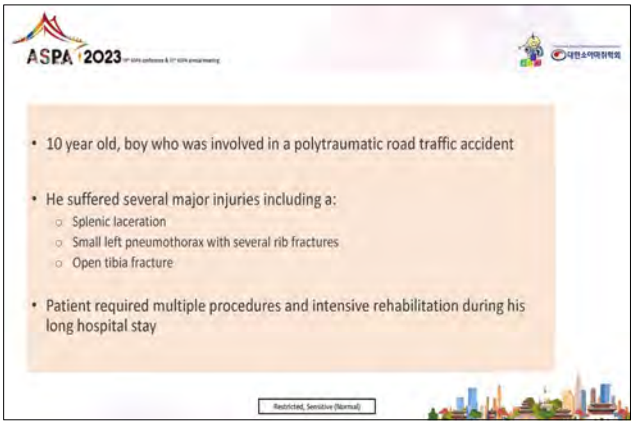
Tanuja Nair: A Non-Pharmacological Approach to Post-Operative Pain Management in Children with Multiple Traumatic Injuries

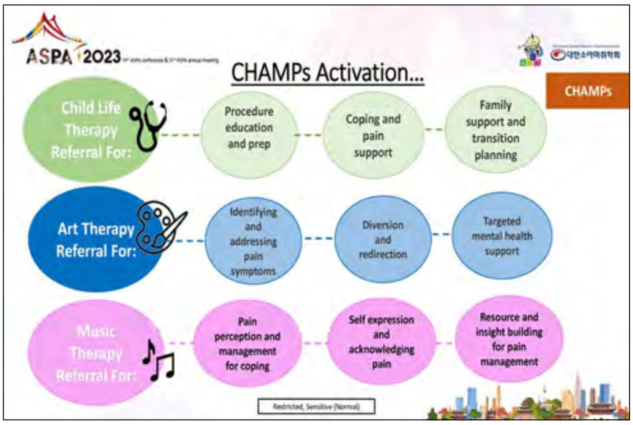


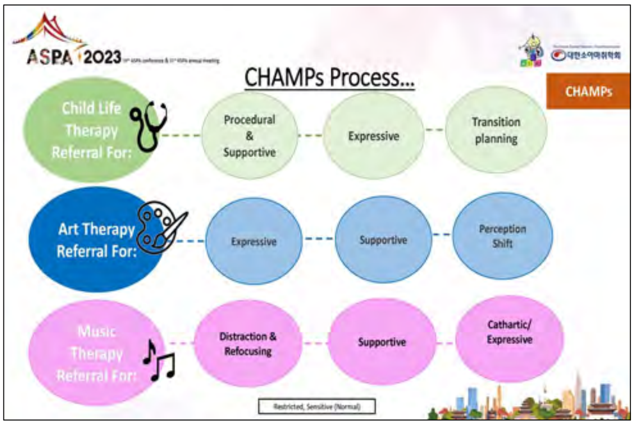


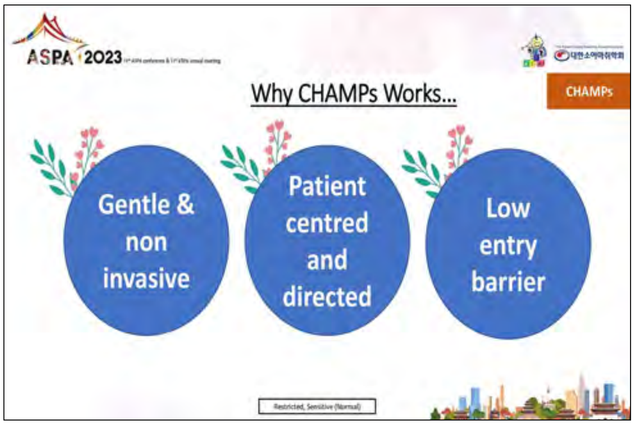


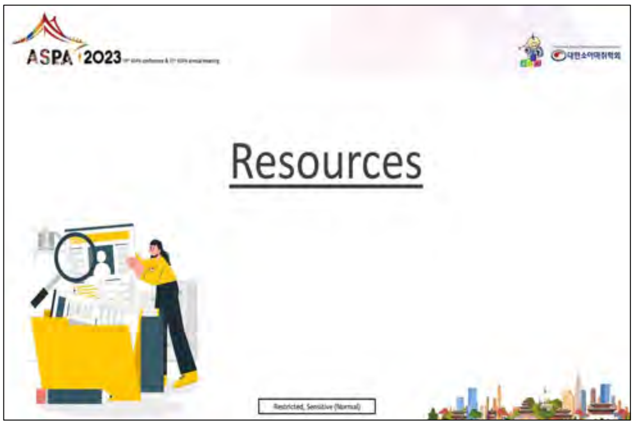


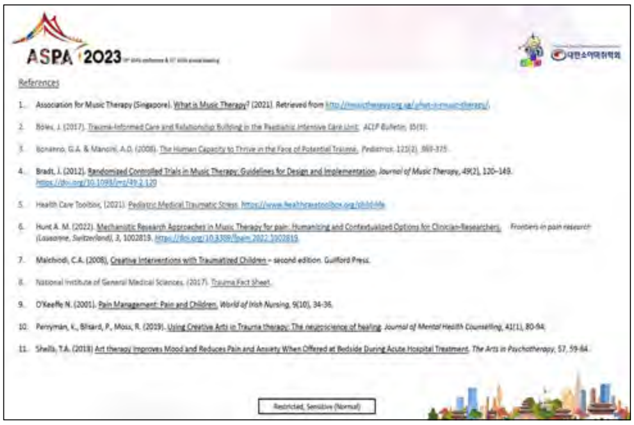








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6. Hunt A. M. (2022). Mechanistic Research Approaches in Music Therapy for pain: Humanizing and Contextualized Options for Clinician-Researchers. Frontiers in pain research (Lausanne, Switzerland), 3, 1002819. https://doi.org/10.3389/fpain.2022.1002819
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8. National Institute of General Medical Sciences. (2017). Trauma Fact Sheet.
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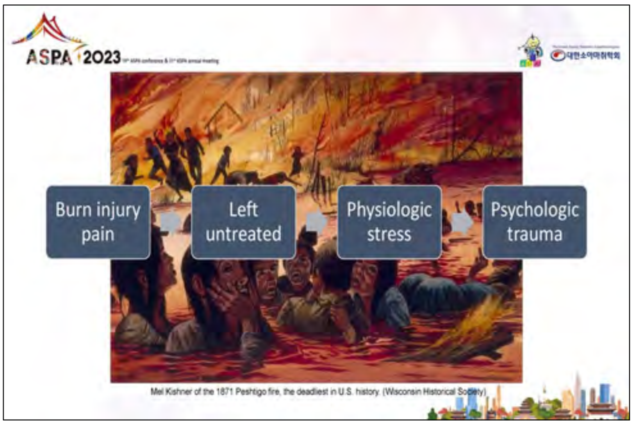
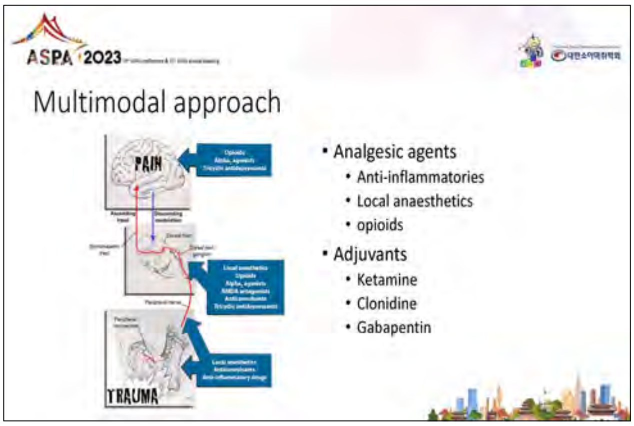
10. Perryman, K., Blisard, P., Moss, R. (2019). Using Creative Arts in Trauma therapy: The neuroscience of healing. Journal of Mental Health Counselling, 41(1), 80-94.
11. Shella, T.A. (2018) Art therapy Improves Mood and Reduces Pain and Anxiety When Offered at Bedside During Acute Hospital Treatment. The Arts in Psychotherapy, 57, 59-64.

Role of Analgesic Adjuvants in Severe Burn Injury in Children: Timing and Precision

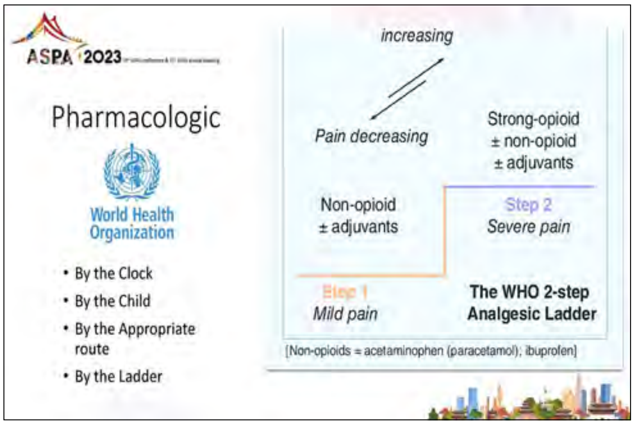
Teddy Fabila

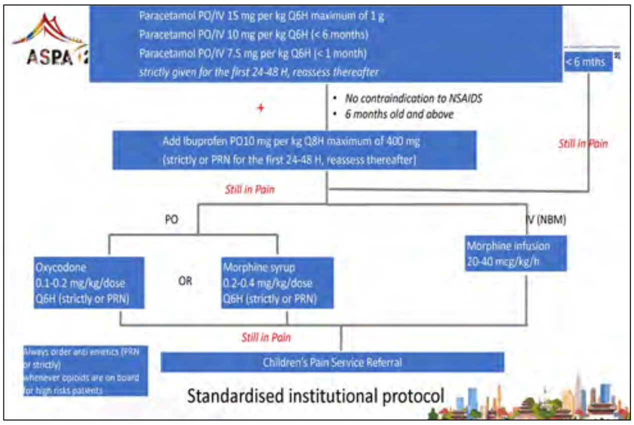
KK Women's and Children's Hospital, Singapore/Philippine

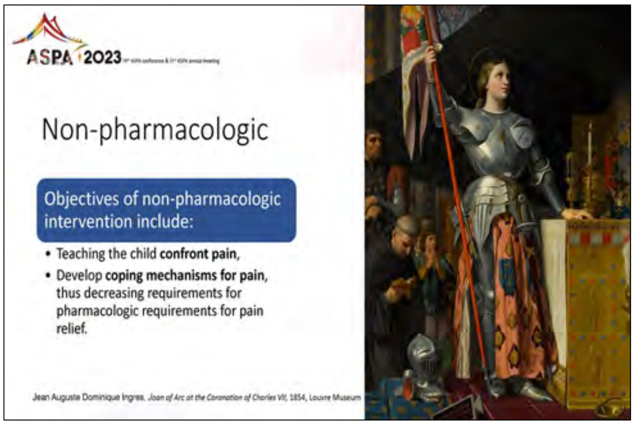


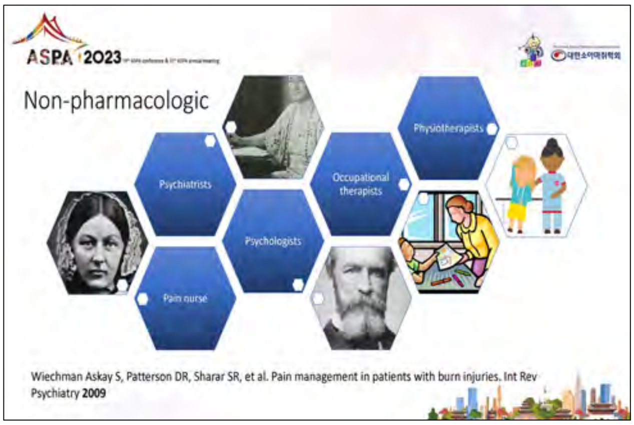


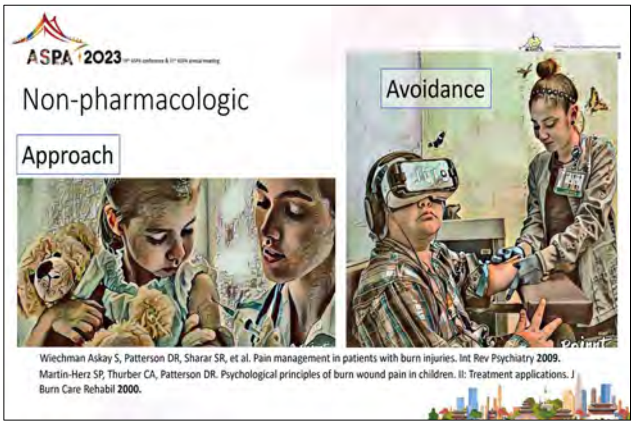

ASPA 2023
Multimodal
Multispecialty
Opioid sparing technique
Pharmacologic
Non-Pharmacologic
Carlos "Botong" Francisco, Bayanihan, 1962
UNILAB's administration building in Manila


ASPA 2023
Pharmacologic
World Health Organization
By the Clock
By the Child
By the Appropriate route
By the Ladder
increasing
Pain decreasing
Strong-opioid
± non-opioid
± adjuvants
Non-opioid
± adjuvants
Step 2
Severe pain
Step 1
Mild pain
The WHO 2-step Analgesic Ladder
[Non-opioids = acetaminophen (paracetamol); ibuprofen]

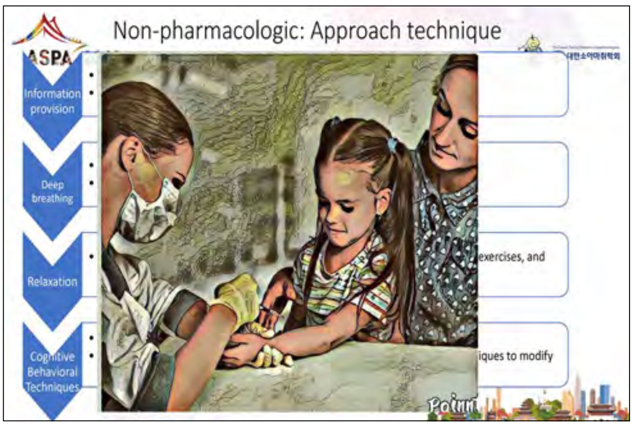

Paracetamol PO/IV 15 mg per kg Q6H maximum of 1 g
Paracetamol PO/IV 10 mg per kg Q6H (< 6 months)
Paracetamol PO/IV 7.5 mg per kg Q6H (< 1 month)
strictly given for the first 24-48 H, reassess thereafter
< 6 mths
+
No contraindication to NSAIDS
6 months old and above
Add Ibuprofen PO10 mg per kg Q8H maximum of 400 mg
(strictly or PRN for the first 24-48 H, reassess thereafter)
Still in Pain
Still in Pain
PO
IV (NBM)
Oxycodone
0.1-0.2 mg/kg/dose
Q6H (strictly or PRN)
OR
Morphine syrup
0.2-0.4 mg/kg/dose
Q6H (strictly or PRN)
Morphine infusion
20-40 mcg/kg/h
Still in Pain
Always order anti emetics (PRN or strictly)
whenever opioids are on board
for high risks patients
Children's Pain Service Referral
Standardised institutional protocol

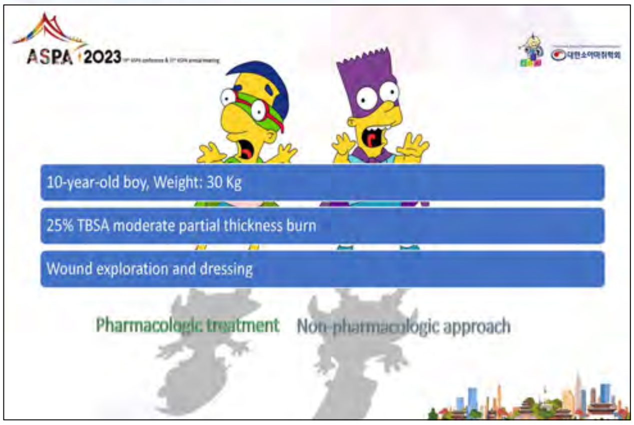

ASPA 2023
Non-pharmacologic
Objectives of non-pharmacologic intervention include:
Teaching the child confront pain,
Develop coping mechanisms for pain, thus decreasing requirements for pharmacologic requirements for pain relief.
Jean Auguste Dominique Ingres, Joan of Arc at the Coronation of Charles VII, 1854, Louvre Museum

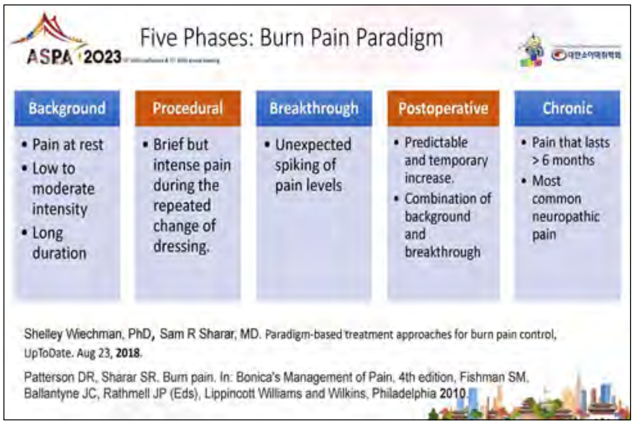

ASPA 2023
Non-pharmacologic
Physiotherapists
Psychiatrists
Occupational therapists
Psychologists
Pain nurse
Wiechman Askay S, Patterson DR, Sharar SR, et al. Pain management in patients with burn injuries. Int Rev Psychiatry 2009

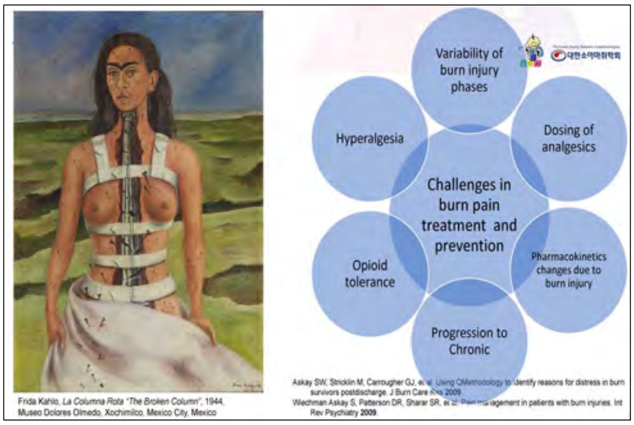

ASPA 2023
Non-pharmacologic
Approach
Avoidance
Wiechman Askay S, Patterson DR, Sharar SR, et al. Pain management in patients with burn injuries. Int Rev Psychiatry 2009.
Martin-Herz SP, Thurber CA, Patterson DR. Psychological principles of burn wound pain in children. II: Treatment applications. J Burn Care Rehabil 2000.

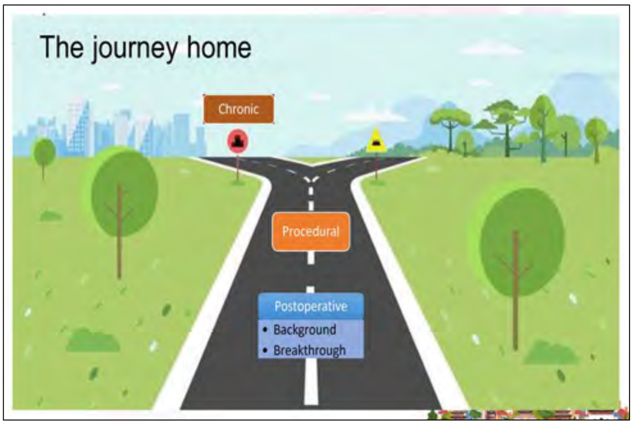

Non-pharmacologic: Avoidance technique
Distraction
Guided imagery
Hypnotic analgesia
Virtual reality
to alter
rated

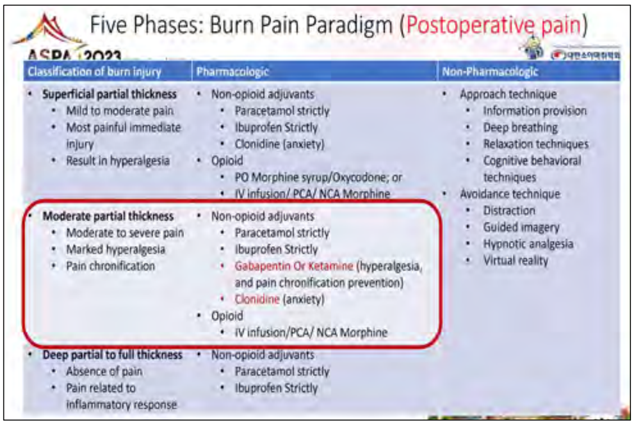

Non-pharmacologic: Approach technique
Information provision
Deep breathing
Relaxation
Cognitive Behavioral Techniques
exercises, and
iques to modify

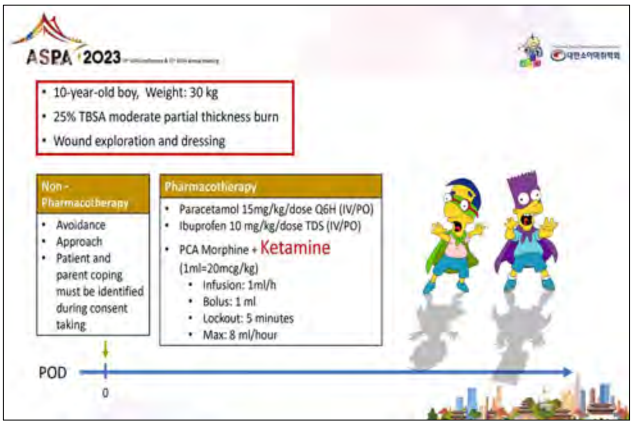

ASPA 2023
10-year-old boy, Weight: 30 Kg
25% TBSA moderate partial thickness burn
Wound exploration and dressing
Pharmacologic treatment
Non-pharmacologic approach

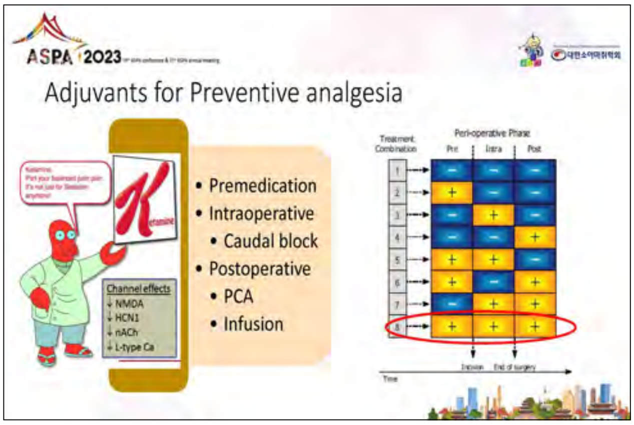

ASPA 2023
Five Phases: Burn Pain Paradigm
Background
• Pain at rest
• Low to moderate intensity
• Long duration
Procedural
• Brief but intense pain during the repeated change of dressing.
Breakthrough
• Unexpected spiking of pain levels
Postoperative
• Predictable and temporary increase.
• Combination of background and breakthrough
Chronic
• Pain that lasts > 6 months
• Most common neuropathic pain
Shelley Wiechman, PhD, Sam R Sharar, MD. Paradigm-based treatment approaches for burn pain control, UpToDate. Aug 23, 2018.
Patterson DR, Sharar SR. Burn pain. In: Bonica's Management of Pain, 4th edition, Fishman SM, Ballantyne JC, Rathmell JP (Eds), Lippincott Williams and Wilkins, Philadelphia 2010.

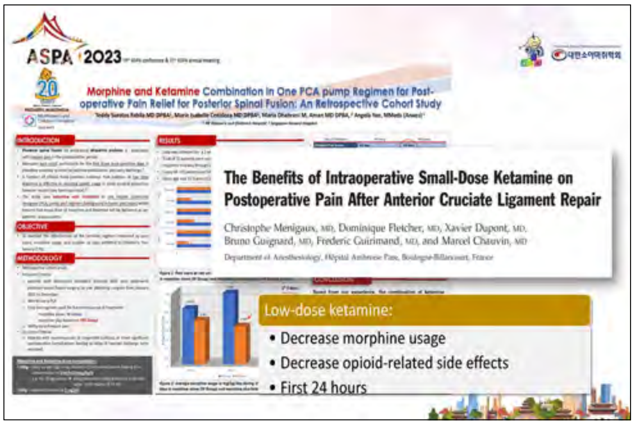

Variability of burn injury phases
Hyperalgesia
Dosing of analgesics
Challenges in burn pain treatment and prevention
Opioid tolerance
Pharmacokinetics changes due to burn injury
Progression to Chronic
Frida Kahlo, La Columna Rota "The Broken Column", 1944, Museo Dolores Olmedo, Xochimilco, Mexico City, Mexico
Askay SW, Stricklin M, Carrougher GJ, et al. Using QMethodology to identify reasons for distress in burn survivors postdischarge. J Burn Care Res 2009
Wiechman Askay S, Patterson DR, Sharar SR, et al. Pain management in patients with burn injuries. Int Rev Psychiatry 2009

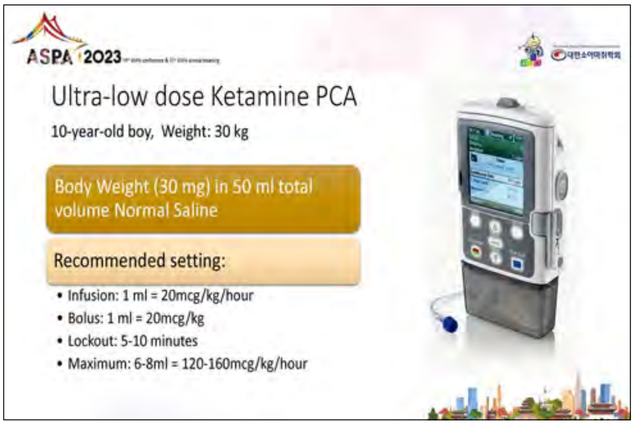

The journey home
Chronic
Procedural
Postoperative
• Background
• Breakthrough

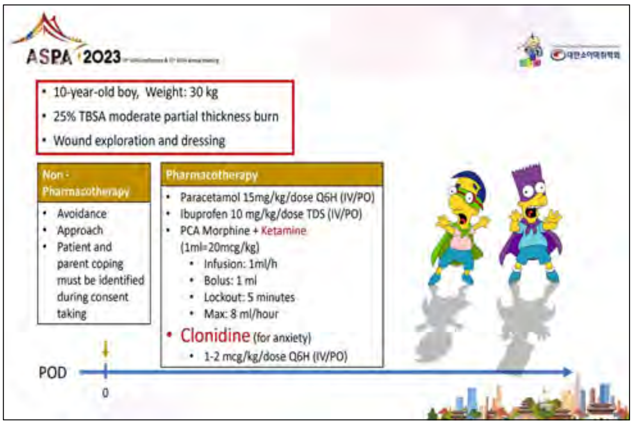

Five Phases: Burn Pain Paradigm (Postoperative pain)
ASPA 2023
Classification of burn injury
Pharmacologic
Non-Pharmacologic
• Superficial partial thickness
• Mild to moderate pain
• Most painful immediate injury
• Result in hyperalgesia
• Non-opioid adjuvants
• Paracetamol strictly
• Ibuprofen Strictly
• Clonidine (anxiety)
• Opioid
• PO Morphine syrup/Oxycodone; or
• IV infusion/ PCA/ NCA Morphine
• Approach technique
• Information provision
• Deep breathing
• Relaxation techniques
• Cognitive behavioral techniques
• Avoidance technique
• Distraction
• Guided imagery
• Hypnotic analgesia
• Virtual reality
• Moderate partial thickness
• Moderate to severe pain
• Marked hyperalgesia
• Pain chronification
• Non-opioid adjuvants
• Paracetamol strictly
• Ibuprofen Strictly
• Gabapentin Or Ketamine (hyperalgesia, and pain chronification prevention)
• Clonidine (anxiety)
• Opioid
• IV infusion/PCA/ NCA Morphine
• Deep partial to full thickness
• Absence of pain
• Pain related to inflammatory response
• Non-opioid adjuvants
• Paracetamol strictly
• Ibuprofen Strictly

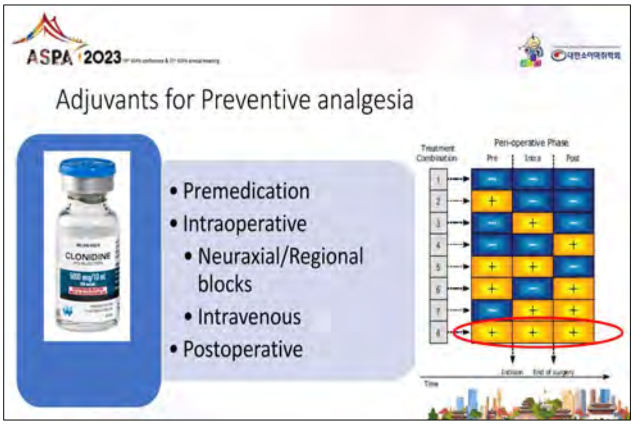

ASPA 2023
• 10-year-old boy, Weight: 30 kg
• 25% TBSA moderate partial thickness burn
• Wound exploration and dressing
Non - Pharmacotherapy
• Avoidance
• Approach
• Patient and parent coping must be identified during consent taking
Pharmacotherapy
• Paracetamol 15mg/kg/dose Q6H (IV/PO)
• Ibuprofen 10 mg/kg/dose TDS (IV/PO)
• PCA Morphine + Ketamine (1ml=20mcg/kg)
• Infusion: 1ml/h
• Bolus: 1 ml
• Lockout: 5 minutes
• Max: 8 ml/hour
POD
0


ASPA 2023
Adjuvants for Preventive analgesia
Ketamine
Channel effects
• NMDA
• HCN1
• nACh
• L-type Ca
• Premedication
• Intraoperative
• Caudal block
• Postoperative
• PCA
• Infusion
Treatment Combination
Peri-operative Phase
Pre
Intra
Post
Incision
End of surgery
Time


ASPA 2023
Morphine and Ketamine Combination in One PCA pump Regimen for Post-operative Pain Relief for Posterior Spinal Fusion: An Retrospective Cohort Study
INTRODUCTION
RESULTS
OBJECTIVE
METHODOLOGY
The Benefits of Intraoperative Small-Dose Ketamine on Postoperative Pain After Anterior Cruciate Ligament Repair
Christophe Menigaux, MD, Dominique Fletcher, MD, Xavier Dupont, MD, Bruno Guignard, MD, Frederic Guirimand, MD, and Marcel Chauvin, MD
Department of Anesthesiology, Hôpital Ambroise Paré, Boulogne-Billancourt, France
Low-dose ketamine:
• Decrease morphine usage
• Decrease opioid-related side effects
• First 24 hours

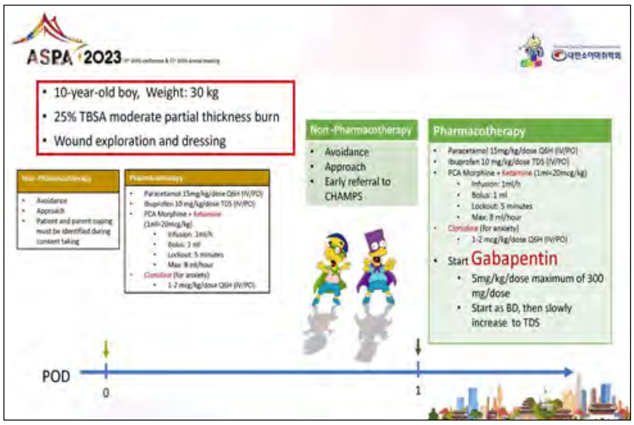

Ultra-low dose Ketamine PCA
10-year-old boy, Weight: 30 kg
Body Weight (30 mg) in 50 ml total volume Normal Saline
Recommended setting:
• Infusion: 1 ml = 20mcg/kg/hour
• Bolus: 1 ml = 20mcg/kg
• Lockout: 5-10 minutes
• Maximum: 6-8ml = 120-160mcg/kg/hour

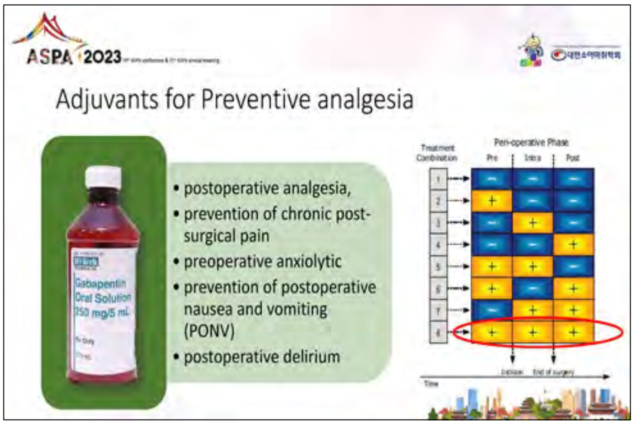

• 10-year-old boy, Weight: 30 kg
• 25% TBSA moderate partial thickness burn
• Wound exploration and dressing
Non - Pharmacotherapy
• Avoidance
• Approach
• Patient and parent coping must be identified during consent taking
Pharmacotherapy
• Paracetamol 15mg/kg/dose Q6H (IV/PO)
• Ibuprofen 10 mg/kg/dose TDS (IV/PO)
• PCA Morphine + Ketamine (1ml=20mcg/kg)
• Infusion: 1ml/h
• Bolus: 1 ml
• Lockout: 5 minutes
• Max: 8 ml/hour
• Clonidine (for anxiety)
• 1-2 mcg/kg/dose Q6H (IV/PO)
POD
0

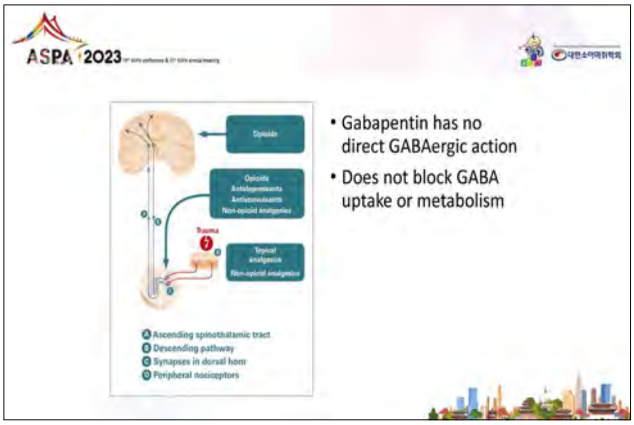

Adjuvants for Preventive analgesia
CLONIDINE
• Premedication
• Intraoperative
• Neuraxial/Regional blocks
• Intravenous
• Postoperative
Treatment Combination
Peri-operative Phase
Pre
Intra
Post
Time
Incision
End of surgery

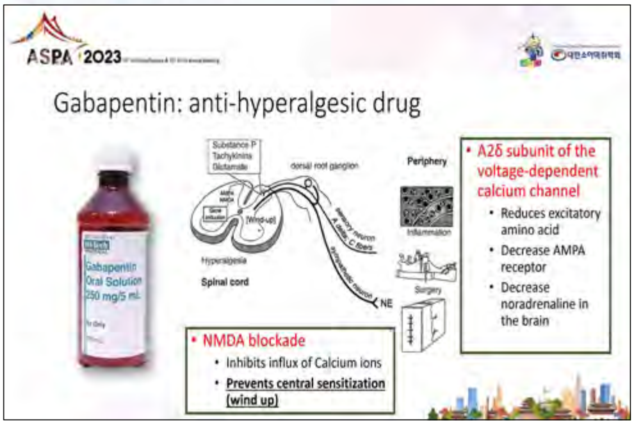

CLONIDINE
Clonidine is an alpha2-agonist
It inhibits the secretion of the neurotransmitter noradrenaline.
Lowered blood pressure and ultimately led to feelings of calm and relaxation.
In turn, symptoms of anxiety, and sleep difficulties, are improved.

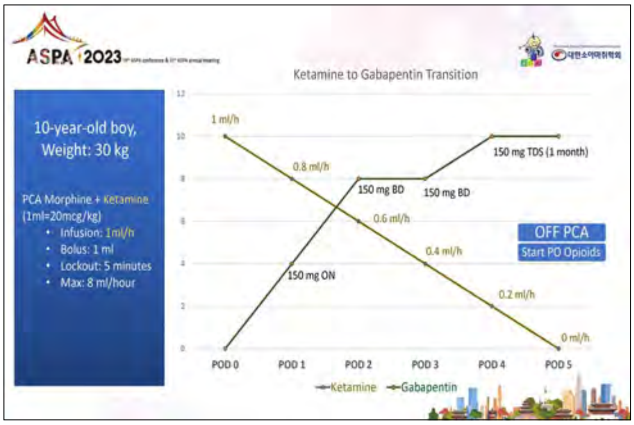

CLONIDINE
10-year-old boy, Weight: 30 kg
Clonidine PO 30 mcg (1 mcg/kg) Q6H strictly for 5 days
Maximum dose: PO 60 mcg Q6H (2mcg/kg)
Safety measures:
• Titrate 20% (increase/decrease) daily
• Titrate according to patients' behavioural changes and hemodynamic status

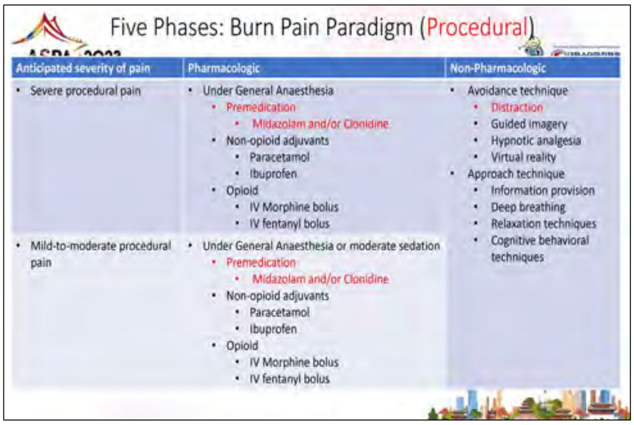

• 10-year-old boy, Weight: 30 kg
• 25% TBSA moderate partial thickness burn
• Wound exploration and dressing
Non -Pharmacotherapy
• Avoidance
• Approach
• Early referral to CHAMPS
Pharmacotherapy
• Paracetamol 15mg/kg/dose Q6H (IV/PO)
• Ibuprofen 10 mg/kg/dose TDS (IV/PO)
• PCA Morphine + Ketamine (1ml=20mcg/kg)
• Infusion: 1ml/h
• Bolus: 1 ml
• Lockout: 5 minutes
• Max: 8 ml/hour
• Clonidine (for anxiety)
• 1-2 mcg/kg/dose Q6H (IV/PO)
• Start Gabapentin
• 5mg/kg/dose maximum of 300 mg/dose
• Start as BD, then slowly increase to TDS
POD
0
1

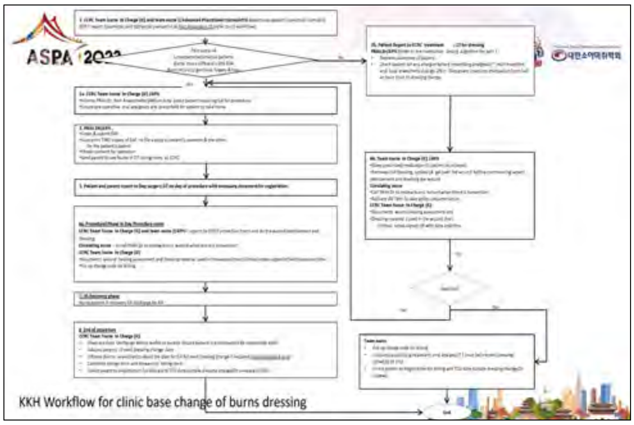

Adjuvants for Preventive analgesia
Gabapentin Oral Solution 250 mg/5 mL
• postoperative analgesia,
• prevention of chronic post-surgical pain
• preoperative anxiolytic
• prevention of postoperative nausea and vomiting (PONV)
• postoperative delirium
Treatment Combination
Peri-operative Phase
Pre
Intra
Post
Time
Incision
End of surgery

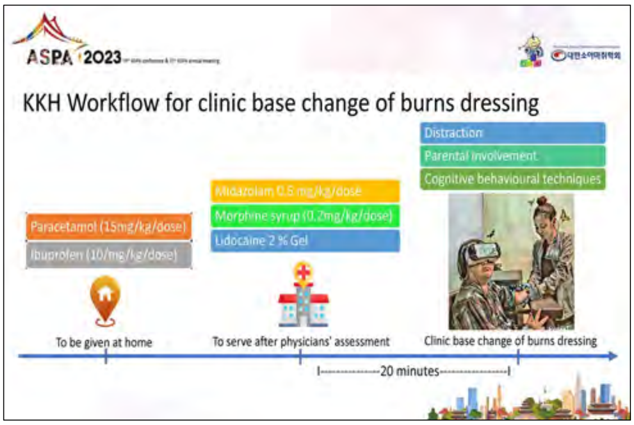

Opioids
Opioids
Antidepressants
Anticonvulsants
Non-opioid analgesics
Trauma
Topical analgesics
Non-opioid analgesics
A Ascending spinothalamic tract
B Descending pathway
C Synapses in dorsal horn
D Peripheral nociceptors
• Gabapentin has no direct GABAergic action
• Does not block GABA uptake or metabolism

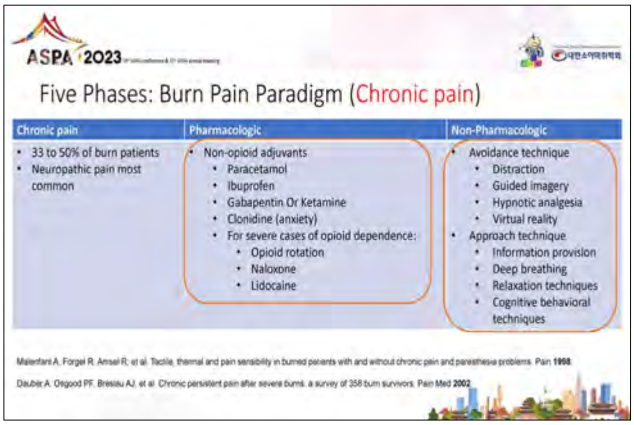

ASPA 2023
Gabapentin: anti-hyperalgesic drug
Gabapentin Oral Solution 250 mg/5 mL
Substance P
Tachykinins
Glutamate
dorsal root ganglion
Periphery
Inflammation
Surgery
Hyperalgesia
Spinal cord
NE
A2δ subunit of the voltage-dependent calcium channel
Reduces excitatory amino acid
Decrease AMPA receptor
Decrease noradrenaline in the brain
NMDA blockade
Inhibits influx of Calcium ions
Prevents central sensitization (wind up)

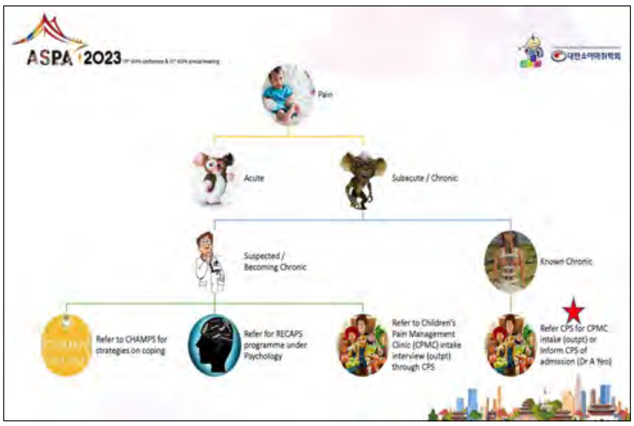

ASPA 2023
Ketamine to Gabapentin Transition
10-year-old boy, Weight: 30 kg
PCA Morphine + Ketamine (1ml=20mcg/kg)
Infusion: 1ml/h
Bolus: 1 ml
Lockout: 5 minutes
Max: 8 ml/hour
1 ml/h
0.8 ml/h
0.6 ml/h
0.4 ml/h
0.2 ml/h
0 ml/h
150 mg ON
150 mg BD
150 mg BD
150 mg TDS (1 month)
OFF PCA
Start PO Opioids
POD 0
POD 1
POD 2
POD 3
POD 4
POD 5
Ketamine
Gabapentin

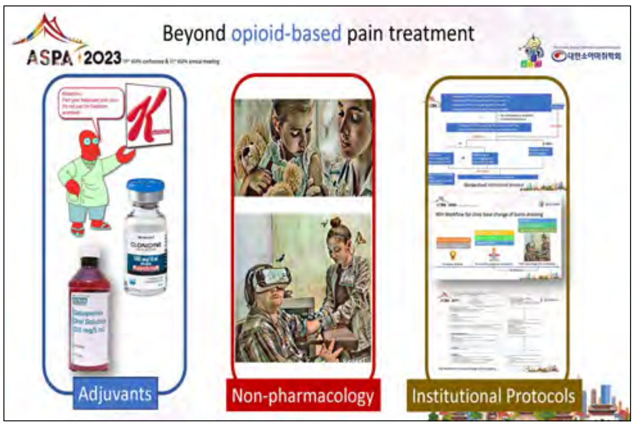

Five Phases: Burn Pain Paradigm (Procedural)
Anticipated severity of pain
Pharmacologic
Non-Pharmacologic
Severe procedural pain
Under General Anaesthesia
Premedication
Midazolam and/or Clonidine
Non-opioid adjuvants
Paracetamol
Ibuprofen
Opioid
IV Morphine bolus
IV fentanyl bolus
Mild-to-moderate procedural pain
Under General Anaesthesia or moderate sedation
Premedication
Midazolam and/or Clonidine
Non-opioid adjuvants
Paracetamol
Ibuprofen
Opioid
IV Morphine bolus
IV fentanyl bolus
Avoidance technique
Distraction
Guided imagery
Hypnotic analgesia
Virtual reality
Approach technique
Information provision
Deep breathing
Relaxation techniques
Cognitive behavioral techniques

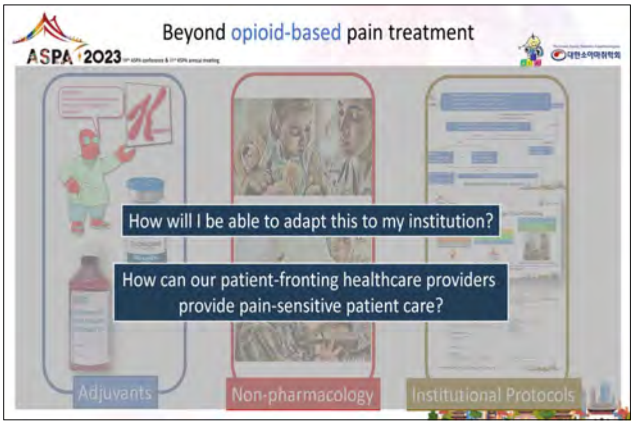

ASPA
KKH Workflow for clinic base change of burns dressing

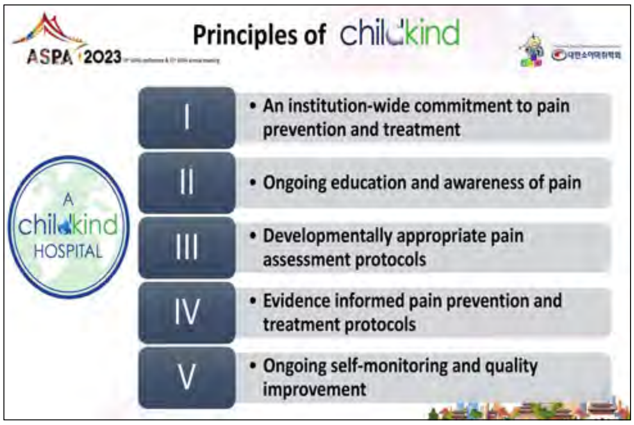

ASPA 2023
KKH Workflow for clinic base change of burns dressing
Distraction
Parental involvement
Cognitive behavioural techniques
Midazolam 0.5 mg/kg/dose
Morphine syrup (0.2mg/kg/dose)
Lidocaine 2 % Gel
Paracetamol (15mg/kg/dose)
Ibuprofen (10/mg/kg/dose)
To be given at home
To serve after physicians' assessment
Clinic base change of burns dressing
20 minutes


ASPA 2023
Five Phases: Burn Pain Paradigm (Chronic pain)
Chronic pain
Pharmacologic
Non-Pharmacologic
33 to 50% of burn patients
Neuropathic pain most common
Non-opioid adjuvants
Paracetamol
Ibuprofen
Gabapentin Or Ketamine
Clonidine (anxiety)
For severe cases of opioid dependence:
Opioid rotation
Naloxone
Lidocaine
Avoidance technique
Distraction
Guided imagery
Hypnotic analgesia
Virtual reality
Approach technique
Information provision
Deep breathing
Relaxation techniques
Cognitive behavioral techniques
Malenfant A, Forget R, Amsel R, et al. Tactile, thermal and pain sensibility in burned patients with and without chronic pain and paresthesia problems. Pain 1998
Dauber A, Osgood PF, Breslau AJ, et al. Chronic persistent pain after severe burns: a survey of 358 burn survivors. Pain Med 2002


ASPA 2023
Pain
Acute
Subacute / Chronic
Suspected / Becoming Chronic
Known Chronic
Refer to CHAMPS for strategies on coping
Refer for RECAPS programme under Psychology
Refer to Children's Pain Management Clinic (CPMC) intake interview (outpt) through CPS
Refer CPS for CPMC intake (outpt) or inform CPS of admission (Dr A Yeo)

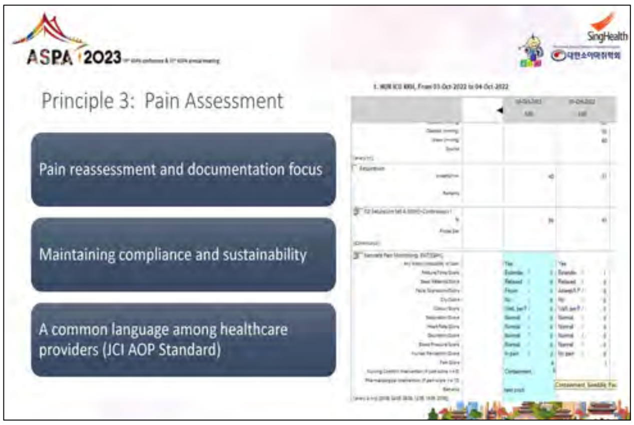

ASPA 2023
Beyond opioid-based pain treatment
Adjuvants
Non-pharmacology
Institutional Protocols

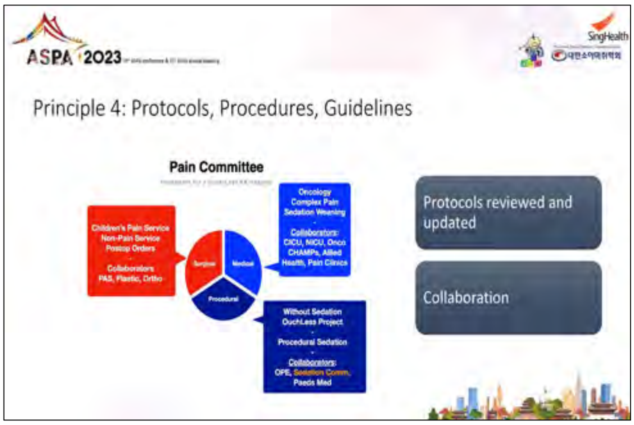

ASPA 2023
Beyond opioid-based pain treatment
How will I be able to adapt this to my institution?
How can our patient-fronting healthcare providers provide pain-sensitive patient care?
Adjuvants
Non-pharmacology
Institutional Protocols

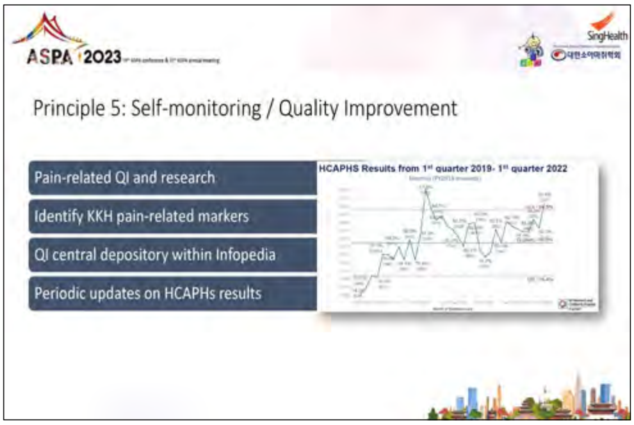

ASPA 2023
Principles of ChildKind
A childkind HOSPITAL
I
• An institution-wide commitment to pain prevention and treatment
II
• Ongoing education and awareness of pain
III
• Developmentally appropriate pain assessment protocols
IV
• Evidence informed pain prevention and treatment protocols
V
• Ongoing self-monitoring and quality improvement


ASPA 2023
SingHealth
Principle 1: Institutional Commitment to Pain Prevention, Assessment and Management
Awareness and acknowledgement
• Handwritten appreciation postcard
• ChildKind Champion Award 23
Leadership support
Pain Awareness Week
Leadership
Managers
Staff


ASPA 2023
SingHealth
Principle 2: Ongoing Education and Awareness of Pain
KKH pain handbook
Annual multidisciplinary Pain conference
Online education for new staff (pain culture awareness)

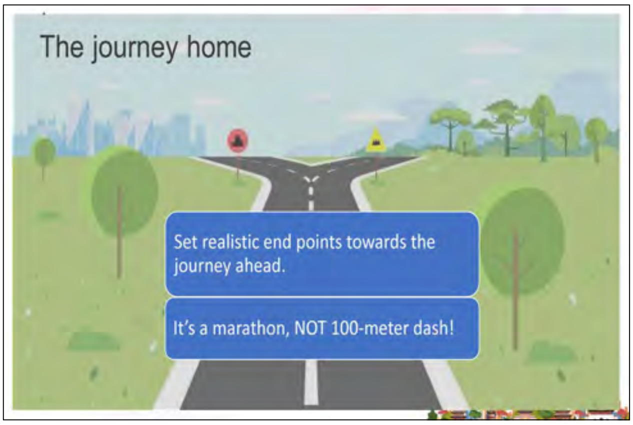

ASPA 2023
SingHealth
Principle 3: Pain Assessment
Pain reassessment and documentation focus
Maintaining compliance and sustainability
A common language among healthcare providers (JCI AOP Standard)

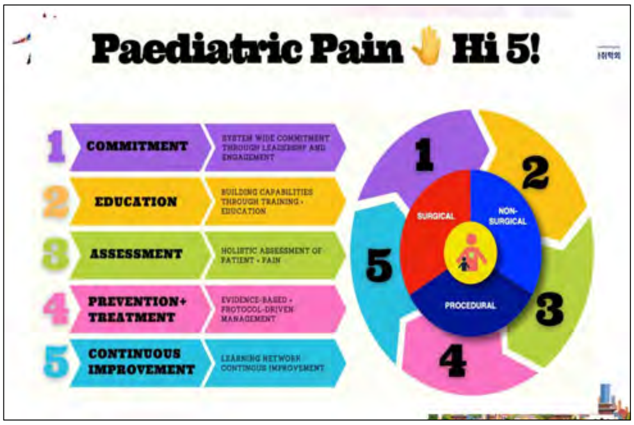

ASPA 2023
SingHealth
Principle 4: Protocols, Procedures, Guidelines
Pain Committee
Children's Pain Service
Non-Pain Service
Postop Orders
Collaborators:
PAS, Plastic, Ortho
Oncology
Complex Pain
Sedation Weaning
Collaborators:
CICU, NICU, Onco
CHAMPs, Allied
Health, Pain Clinics
Surgical
Medical
Procedural
Without Sedation
OuchLess Project
Procedural Sedation
Collaborators:
OPE, Sedation Comm,
Paeds Med
Protocols reviewed and updated
Collaboration


ASPA 2023
SingHealth
Principle 5: Self-monitoring / Quality Improvement
Pain-related QI and research
Identify KKH pain-related markers
QI central depository within Infopedia
Periodic updates on HCAPHs results
HCAPHS Results from 1st quarter 2019- 1st quarter 2022


ASPA 2023
Summary
The multimodal, multispecialty, opioid-sparing technique: treatment and prevention of choice for children with severe burn pain.


ASPA 2023
Summary
Pharmacologic and
non-pharmacologic approaches:
• Tailored according to the patient's requirements during the five phases of the burn pain paradigm
• Timely given and precisely administered
• Build rapport and trust from patients and care providers
• Involve parents, and give them roles


The journey home
Set realistic end points towards the journey ahead.
It's a marathon, NOT 100-meter dash!


Paediatric Pain Hi 5!
1 COMMITMENT
SYSTEM WIDE COMMITMENT THROUGH LEADERSHIP AND ENGAGEMENT
2 EDUCATION
BUILDING CAPABILITIES THROUGH TRAINING + EDUCATION
3 ASSESSMENT
HOLISTIC ASSESSMENT OF PATIENT + PAIN
4 PREVENTION+ TREATMENT
EVIDENCE-BASED + PROTOCOL-DRIVEN MANAGEMENT
5 CONTINUOUS IMPROVEMENT
LEARNING NETWORK CONTINOUS IMPROVEMENT
SURGICAL
NON-SURGICAL
PROCEDURAL

Day 2

17 June 2023

Room A

Session 1.

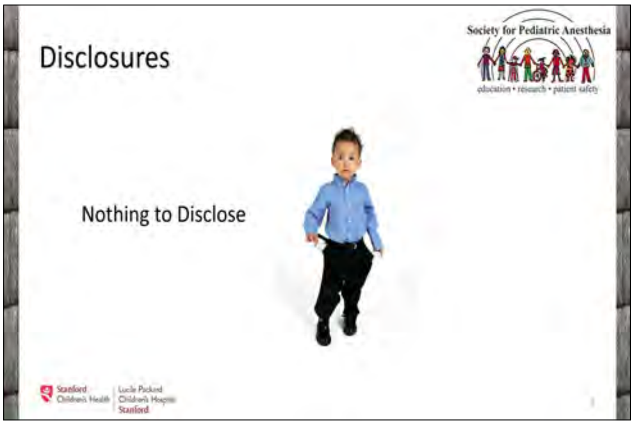
Society for Pediatric Anesthesia in the World: Past, Present, and Future

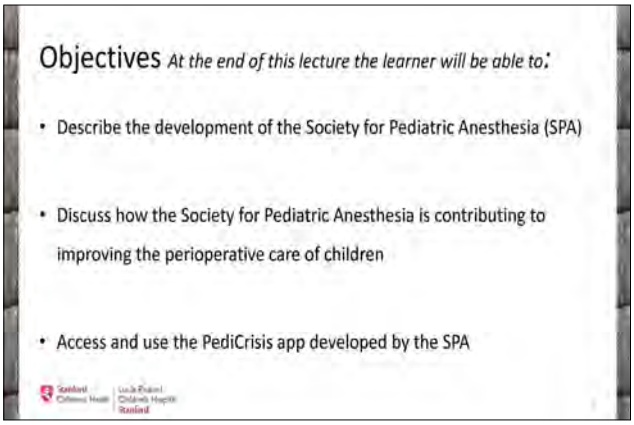
Chair(s): Agnes Ng (Singapore)
Jin-Tae Kim (Korea)

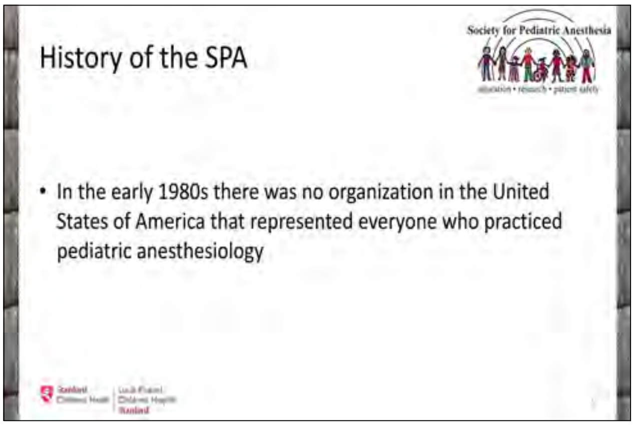
Why the Society for Pediatric Anesthesia is Special and Needed

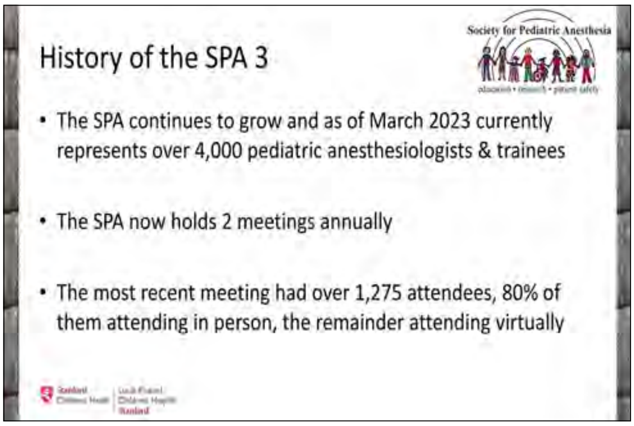
Jim Fehr

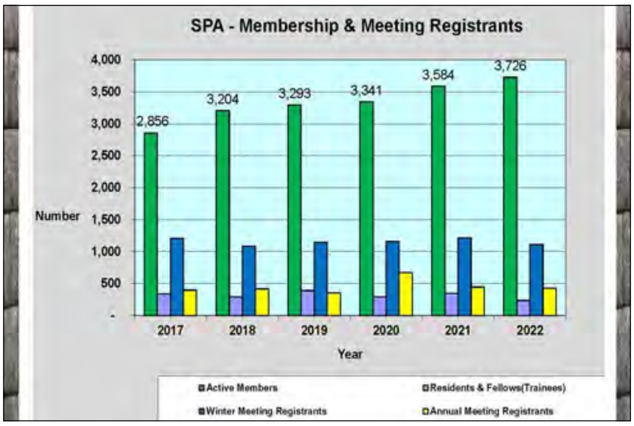
Stanford's Lucile Packard Children's Hospital, USA





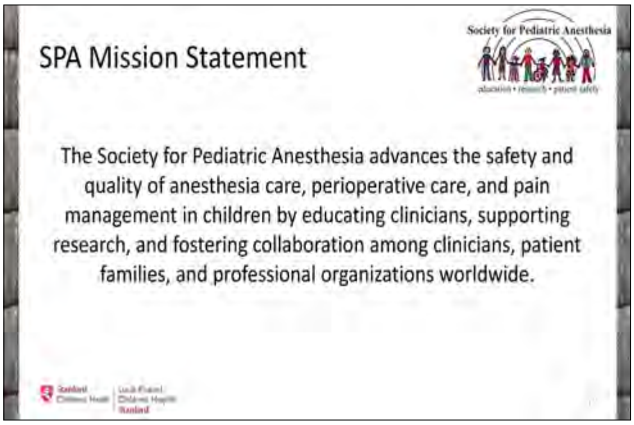





SPA - Membership & Meeting Registrants
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
-
Number
2,856
3,204
3,293
3,341
3,584
3,726
2017
2018
2019
2020
2021
2022
Year
Active Members
Residents & Fellows(Trainees)
Winter Meeting Registrants
Annual Meeting Registrants


Society for Pediatric Anesthesia
2023 ANNUAL MEETING
October 13, 2023 | San Francisco, CA
pedsanesthesia.org


American Academy of Pediatrics
SPA-AAP PEDIATRIC ANESTHESIOLOGY 2024
A meeting co-sponsored by the Society for Pediatric Anesthesia and the American Academy of Pediatrics Section on Anesthesiology and Pain Medicine
April 12-14, 2024 | Anaheim Marriott | Anaheim, CA


SPA Mission Statement
Society for Pediatric Anesthesia
The Society for Pediatric Anesthesia advances the safety and quality of anesthesia care, perioperative care, and pain management in children by educating clinicians, supporting research, and fostering collaboration among clinicians, patient families, and professional organizations worldwide.


SPA Organizational Structure
Society for Pediatric Anesthesia
• Executive Committee
– President, Vice-President, Secretary-Treasurer, Past President
– Each serves two year terms
– This provides for an 8-year path of leadership continuity
– Executive Committee members are elected by the SPA membership
• Board of Directors
– Eight Directors elected by the SPA membership for 2-year terms


SPA Component Societies
Society for Pediatric Anesthesia
CONGENITAL CARDIAC ANESTHESIA SOCIETY
CCAS
PEDIATRIC ANESTHESIA LEADERSHIP COUNCIL
PAPDA
SOCIETY FOR PEDIATRIC PAIN MEDICINE
SPPM


SPA Committees
Society for Pediatric Anesthesia
• Education Committee
• Quality & Safety Committee
• Research Committee
• SPA Global
• SPA Committee on Diversity, Equity and Inclusion (DEI)
• Well Being Committee


SPA Special Interest Groups
Society for Pediatric Anesthesia
• Disaster Preparedness
• Mitochondrial Diseases
• Simulation
• Integrative Medicine
• PeDiR-Airway
• Pediatric Neuroanesthesia
• Trainee SIG
• Children with Special Needs SIG
• Liver & Intestinal Transplanation
• Biomedical Informatics
• Blood Management
• Fetal Anesthesia
• Pediatric Ambulatory Anesthesia
• Pediatric Craniofacial
• Pediatric Critical Care
• Sustainability
• Pediatric ERAS
• Ultrasound for Regional & POCUS

Dr. Myron Yaster, SPA Founder

- Trained at CHOP under Dr. Jack Downes
- Came to Hopkins under Dr. Mark Rogers
- 1987 Created the Society for Pediatric Anesthesia
- 2014 Received the SPA's Lifetime Achievement Award, subsequently known as the Yaster Award

"Myron Yaster" Lifetime Achievement Award

- 2015: Bill Greeley, MD, MBA, CHOP
- 2016: Anne Lynn, MD, U Washington
- 2017: Aubrey Maze MD, Valley Anesthesia, Phoenix
- 2018: Chuck Berde, MD, PhD, Children's Boston
- 2019: George Gregory, MD, UCSF
- 2021: Eugenie S. Heitmiller, MD, FAAP, Hopkins/DC Children's
- 2022: Adrian T. Bosenberg, MB, ChB, FFA, U Washington

Objectives

- Describe the development of the Society for Pediatric Anesthesia (SPA)
- Discuss how the Society for Pediatric Anesthesia is contributing to improving the perioperative care of children
- Access and use the PediCrisis app developed by the SPA

SPA Component Societies

SPA Component Societies

- CCAS: Congenital Cardiac Anesthesia Society
- SPPM: Society for Pediatric Pain Medicine
- PALC: Pediatric Anesthesia Leadership Council
- PAPDA: Pediatric Anesthesiology Program Directors' Association

SPA WELI

- Founded by Dr. Jennifer Lee in June 2018, Women's Empowerment Leadership Initiative (WEI) supports the development of female leaders in pediatric anesthesiology
- The mission of WELI is to empower highly productive women pediatric anesthesiologists to achieve equity, promotion, and leadership.
- Mentor-mentee pairings, workshops, and coaching sessions are provided throughout the year

SPA DEI Committee

- The SPA Committee on Diversity, Equity and Inclusion (DEI) was founded in Spring 2018 and advocates for members of the SPA who have traditionally been underrepresented
- The SPA DEI Committee also speaks for marginalized patients and families whose care may be below standard and seeks to assure that all patients get the best of care regardless of their background

SPA Investment in Research

- SPA Research, Education & Safety Fund (RE&SF) was established in 2014
- The SPA RE&SF provides $100,000 annually for research grants to one or two young investigators
- The SPA RE&SF also supports SPA's global outreach

SPA Global

- Created to focus efforts to enhance pediatric perioperative care world wide
- SPA Global has supported a fellow in Kenya for the last 10 years
- SPA Global has added support for a pediatric anesthesiology fellow in Thailand

SPA Global Outreach

Supports international scholars attendance at the SPA meeting

- 2018 – **Walid Habre MD, PhD**; Geneva, Switzerland
- 2019 – **Britta Von Ungern-Sternberg, MD MB BCh PhD**; Perth, Australia
- 2020 – **Clover-Ann Lee, MD**; Johannesburg, South Africa
- 2021 – **Jeong-Rim Lee, MD, PhD**; Seoul, South Korea
- 2022 – **Rodrigo Lopez Barreda MD**; Santiago, Chile
- 2023 – **Zipporah Gathuya, MBCHB, MMED** Nairobi, Kenya

Objectives

- Describe the development of the Society for Pediatric Anesthesia (SPA)
- Discuss how the Society for Pediatric Anesthesia is contributing to improving the perioperative care of children
- Access and use the PediCrisis app developed by the SPA

SPA Critical Events Checklists

- In 2007 the SPA Quality & Safety Committee created the Critical Event Checklists which are evidence-based and supported by expert consensus
- Current languages: Spanish, Chinese, French, Portuguese, Tagalog, Turkish, Ukrainian, Hebrew

https://pedsanesthesia.org/critical-events-checklists/

SPA Critical Events Checklists

- The 26 checklists are continually updated based on the most recently available evidence/guidelines
- Focused on what a pediatric anesthesiologist needs to know to manage an emergency in the perioperative period

SPA Critical Events Checklists

Cardiac Arrest

Pulseless cardiac arrest — 6

- Notify team, call for help and code cart/defibrillator
- Increase oxygen to 100%. Turn off anesthetics
- If ETT, 100-120 chest compressions/min + 10 breaths/min. Avoid hyperventilation.
- If no ETT, 15:2 compression:ventilation ratio (100-120 chest compressions/min + 8 breaths/min)
- For chest compressions, maximize $EtCO_2$ > 10 mmHg (see next card for more details):
  - Switch compressor every 2 min
  - Use sudden increase in $EtCO_2$ for ROSC, Do NOT stop compressions for pulse check
- Obtain defibrillator. **Attach pads**. If VF/VT, shock 2 joules/kg. Continue chest compressions x 2 minutes.
- Start timer. Designate team leader. Assign roles. Designate a scribe/recorder. Notify family. Continue with next items in yellow box

Repeat sequence below until return of spontaneous circulation:

- If still in VF/VT, shock 4 joules/kg q2 min (up to 10 joules/kg on subsequent shocks)
- Resume chest compressions immediately regardless of rhythm
- EPINEPHrine 10 MICROgrams/kg IV q 3-5 min while in arrest (MAX 1 mg)
  - If still no ROSC after second dose of EPINEPHrine, **activate ECMO** (if available)
- Check pulse & rhythm q 2 min during compressor change
- Check for reversible causes (Hs and Ts) early and often (see table below)
- Lidocaine 1 mg/kg bolus (MAX 100 mg); may repeat (total: 2 doses) **OR** amiodarone 5 mg/kg bolus; may repeat (total: 3 doses)
- Repeat sequence in this box until return of spontaneous circulation

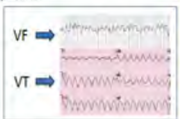
Hs and Ts: Reversible Causes	
• Hypovolemia • Hypoxemia • Hydrogen ion (acidosis) • Hyperkalemia/Hypoglycemia • Hypothermia	• Tension Pneumothorax • Tamponade (Cardiac) • Thrombosis • Toxin (anesthetic, β-blocker) • Trauma (surgical or nonsurgical bleeding)

Cardiac Arrest

Cardiac Arrest: VF/VT

Shockable, pulseless cardiac arrest — 7

- Start chest compressions (100 chest compressions/min + 8 breaths/min)
  - Place pt on backboard, maintain good hand position; if prone, see 'Prone CPR' card
  - Maximize $EtCO_2$ > 10 mmHg with force/depth of compressions
  - Allow full recoil between compressions
  - Switch compressor every 2 min
  - Use sudden increase in $EtCO_2$ for ROSC
  - Do NOT stop compressions for pulse check
- Give 100% oxygen. Turn off anesthetics
- Start timer. Designate team leader. Assign roles
- Obtain defibrillator. Attach pads. Shock 2-4 joules/kg
- Resume chest compressions immediately
- Epinephrine 10 MICROgrams/kg IV q 3-5 min while in arrest
- Check pulse & rhythm q 2 min during compressor change
- Check for reversible causes (Hs and Ts) early and often (see previous 'Cardiac Arrest' card)
- If VF/VT continue:
  - Shock 4 joules/kg
  - Resume chest compressions for 2 min regardless of rhythm
  - Check pulse & rhythm q 2 min during compressor switch
  - Repeat epinephrine 10 MICROgrams/kg IV q 3-5 min if VF/VT continue
  - If VF/VT continue 2 min after previous defib attempt, shock 4-10 joules/kg and resume chest compressions for 2 min; check pulse with compressor change; repeat sequence until ROSC
- Lidocaine 1 mg/kg bolus OR amiodarone 5 mg/kg bolus; may repeat (total of 2 doses)
- If cardiac arrest > 6 min, activate ECMO (if available)



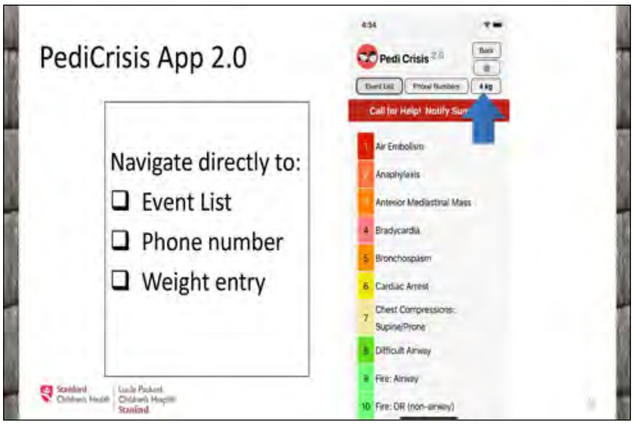
Cardiac Arrest: VF/VT

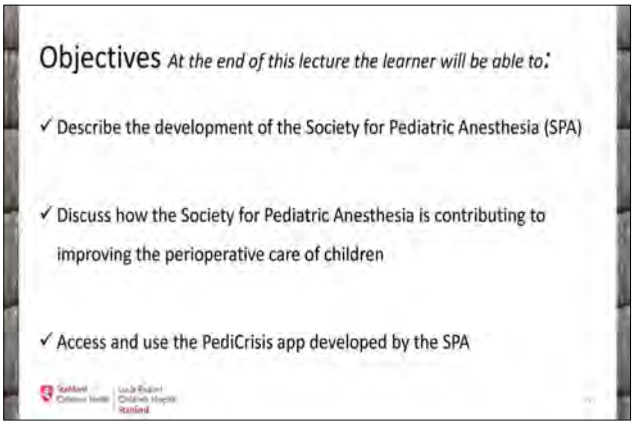

PediCrisis App 2.0
• The SPA Critical Events checklists were adapted as a free smartphone app in 2013
• PediCrisis 1.0 featured 18 scenarios
• PediCrisis 2.0, the most recent version, features all 26 scenarios


PediCrisis App 2.0
• Smartphone versions are available in English & Spanish
• PediCrisis has been downloaded over 25,000 times from 132 countries


PediCrisis App 2.0
• Download for free from Apple iOS and Android Store
• No internet connection needed after initial download
Pedi Crisis
Call for Help! Notify Surgeon!
Air Embolism
Anaphylaxis
Anterior Mediastinal Mass
Bradycardia
Bronchospasm
Cardiac Arrest
Chest Compressions: Supine/Prone
Difficult Airway
Fire: Airway
Fire: OR (non-airway)


PediCrisis App 2.0

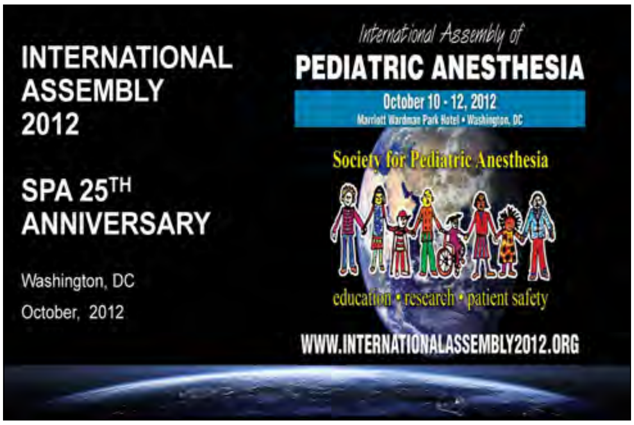

PediCrisis App 2.0
Navigate directly to:
❑ Event List
❑ Phone number
❑ Weight entry
Pedi Crisis
Air Embolism
Anaphylaxis
Anterior Mediastinal Mass
Bradycardia
Bronchospasm
Cardiac Arrest
Chest Compressions: Supine/Prone
Difficult Airway
Fire: Airway
Fire: OR (non-airway)

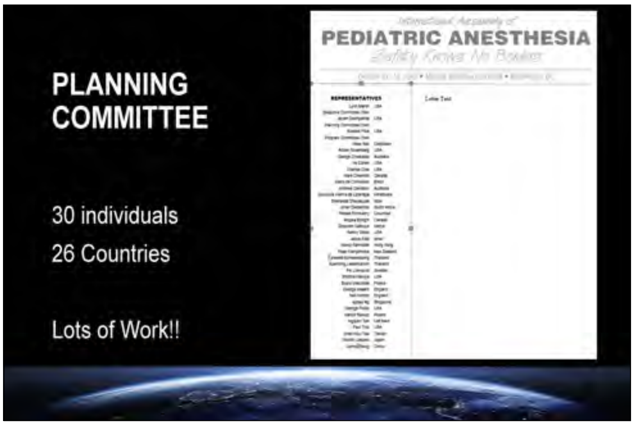

Objectives At the end of this lecture the learner will be able to:
✓ Describe the development of the Society for Pediatric Anesthesia (SPA)
✓ Discuss how the Society for Pediatric Anesthesia is contributing to improving the perioperative care of children
✓ Access and use the PediCrisis app developed by the SPA

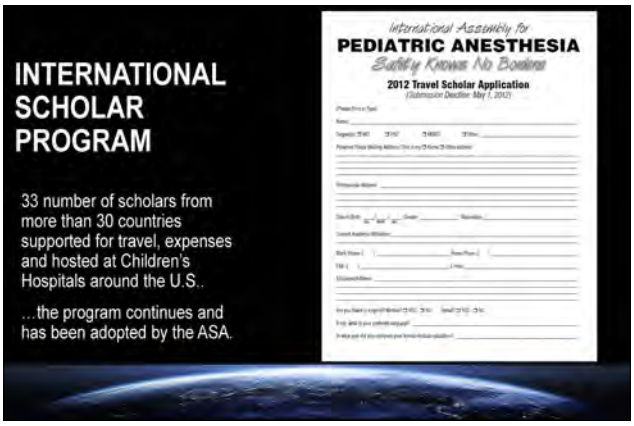
The Future of Pediatric Anesthesiology around the World; We are Better Together

Randall Flick

Mayo Clinic Children's Center, USA








PAIF
PEDIATRIC ANESTHESIA INTERNATIONAL FORUM
Paediatric Anaesthesia Internationa
Nigel Turner, Andrew Davidson and I
October 18, 2013
Situation
The specialty of paediatric anaesthes
new societies and increasing membe
industrialized and the developing wo
formed in Africa, Southeast Asia, Chi
cooperation between the world's soc
Recommendations


PAIF
FIRST STEP TOWARD AN INTERNATIONAL SOCIETY
Forum of leaders from societies around the world.
One leader from each society participates.
If no organized society – an individual from that country can be appointed by PAIF.
PAIF membership will select leaders.
Meeting will occur once per year in conjunction with a member society.
Dues are paid by the member's society.


World Federation of Societies for Pediatric Anesthesia


INTERNATIONAL ASSEMBLY FOR PEDIATRIC ANESTHESIA
Spring 2027 ?????

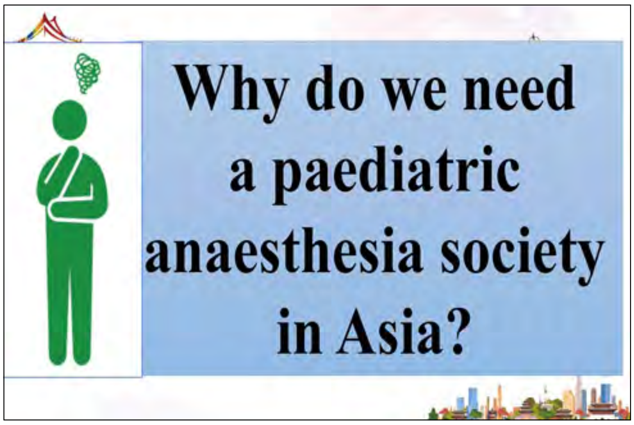

American Academy of Pediatrics
SPA-AAP PEDIATRIC ANESTHESIOLOGY 2024
April 12-14, 2024 | Anaheim Marriott | Anaheim, CA

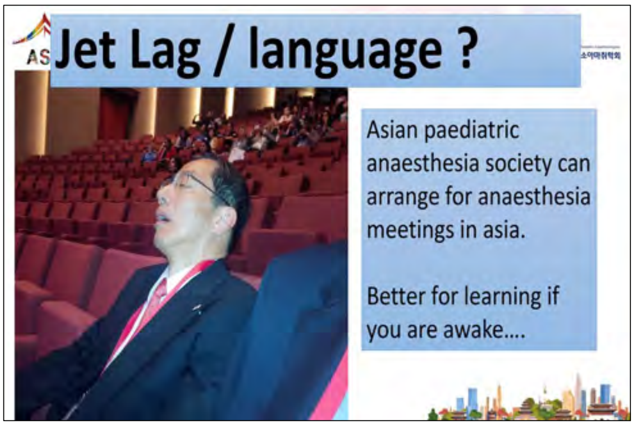

Society for Pediatric Anesthesia
2023 ANNUAL MEETING
October 13, 2023 | San Francisco, CA
pedsanesthesia.org

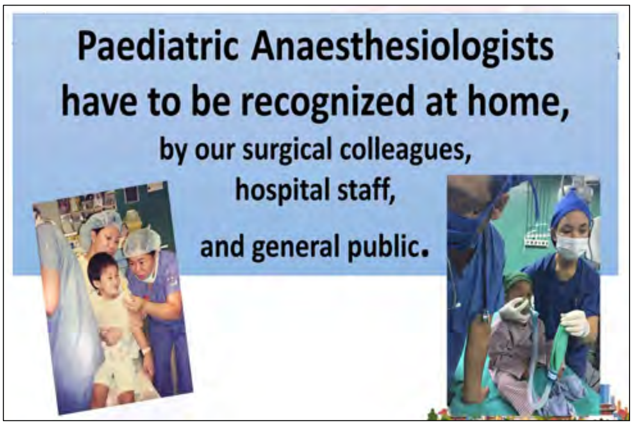
Asian Society of Paediatric Anaesthesiologists: Past, Present, and Future

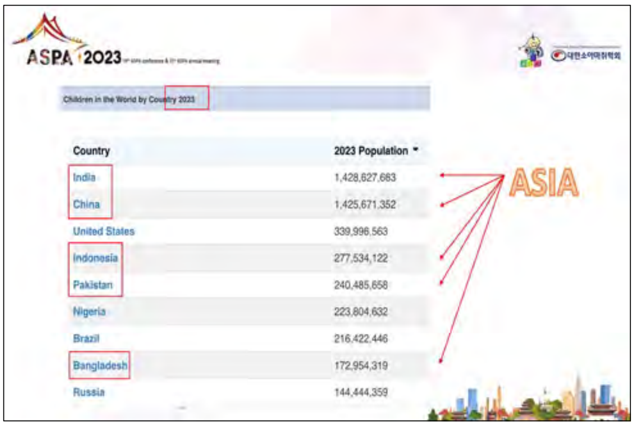
Josephine Tan

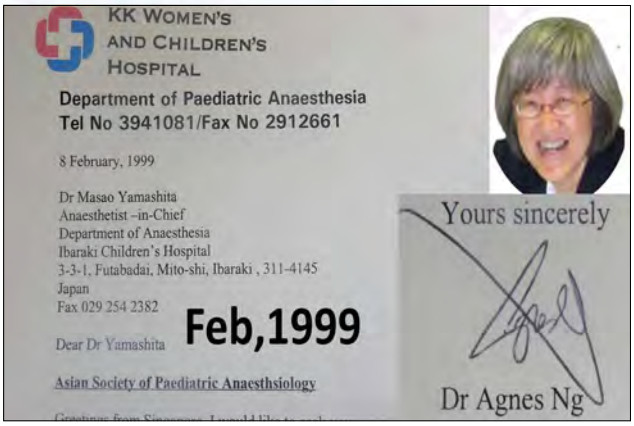
KK Women's and Children's Hospital, Singapore

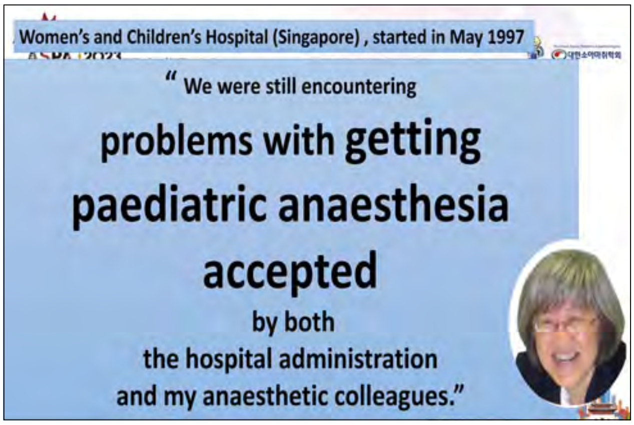


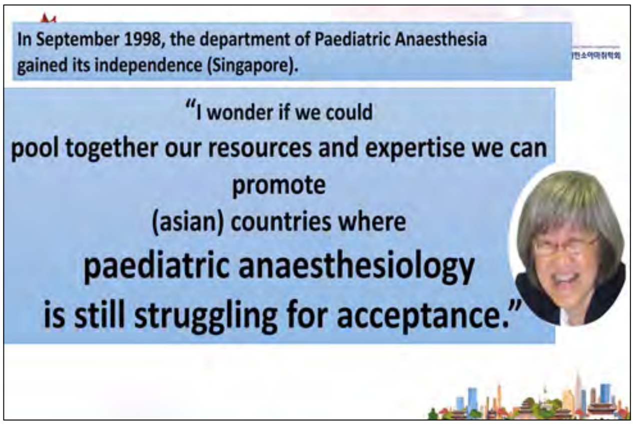




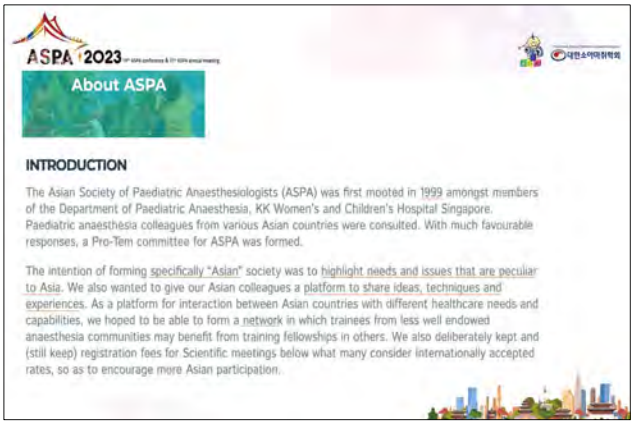


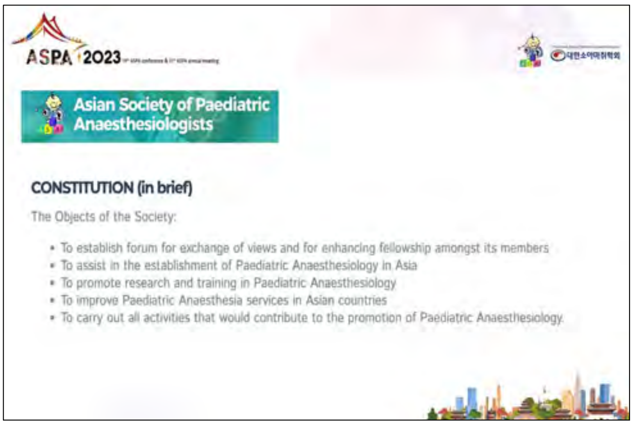

KK Women's and Children's Hospital
Department of Paediatric Anaesthesia
Tel No 3941081/Fax No 2912661
8 February, 1999
Dr Masao Yamashita
Anaesthetist –in-Chief
Department of Anaesthesia
Ibaraki Children's Hospital
3-3-1, Futabadai, Mito-shi, Ibaraki , 311-4145
Japan
Fax 029 254 2382
Dear Dr Yamashita
Feb,1999
Asian Society of Paediatric Anaesthsiology
Yours sincerely
Dr Agnes Ng

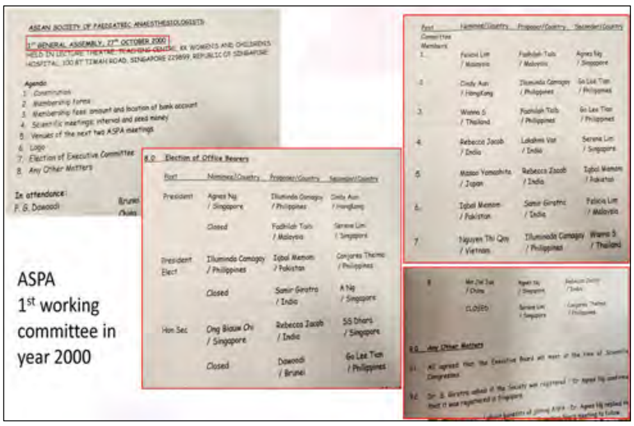

Women's and Children's Hospital (Singapore) , started in May 1997
" We were still encountering
problems with getting
paediatric anaesthesia
accepted
by both
the hospital administration
and my anaesthetic colleagues."


In September 1998, the department of Paediatric Anaesthesia gained its independence (Singapore).
"I wonder if we could
pool together our resources and expertise we can
promote
(asian) countries where
paediatric anaesthesiology
is still struggling for acceptance."

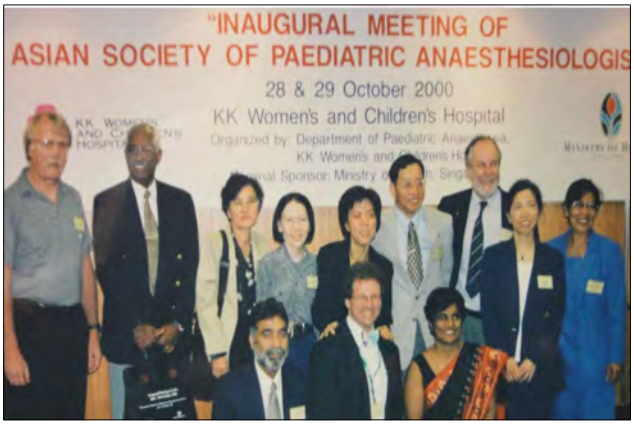

ASPA 2023
ASPA Vision Statement
Asian Society of Paediatric Anaesthesiologists
About
Contact
Membership
Past Meetings
ASPA e-Education (ASPA FLEX)
ASPA PPSIG
PPLS Manual
ASPA
Dedicated to fostering the highest standard of Paediatric Anaesthesia care in Asia.


ASPA 2023
About ASPA
INTRODUCTION
The Asian Society of Paediatric Anaesthesiologists (ASPA) was first mooted in 1999 amongst members of the Department of Paediatric Anaesthesia, KK Women's and Children's Hospital Singapore. Paediatric anaesthesia colleagues from various Asian countries were consulted. With much favourable responses, a Pro-Tem committee for ASPA was formed.
The intention of forming specifically "Asian" society was to highlight needs and issues that are peculiar to Asia. We also wanted to give our Asian colleagues a platform to share ideas, techniques and experiences. As a platform for interaction between Asian countries with different healthcare needs and capabilities, we hoped to be able to form a network in which trainees from less well endowed anaesthesia communities may benefit from training fellowships in others. We also deliberately kept and (still keep) registration fees for Scientific meetings below what many consider internationally accepted rates, so as to encourage more Asian participation.


ASPA 2023
Asian Society of Paediatric Anaesthesiologists
CONSTITUTION (in brief)
The Objects of the Society:
• To establish forum for exchange of views and for enhancing fellowship amongst its members
• To assist in the establishment of Paediatric Anaesthesiology in Asia
• To promote research and training in Paediatric Anaesthesiology
• To improve Paediatric Anaesthesia services in Asian countries
• To carry out all activities that would contribute to the promotion of Paediatric Anaesthesiology.

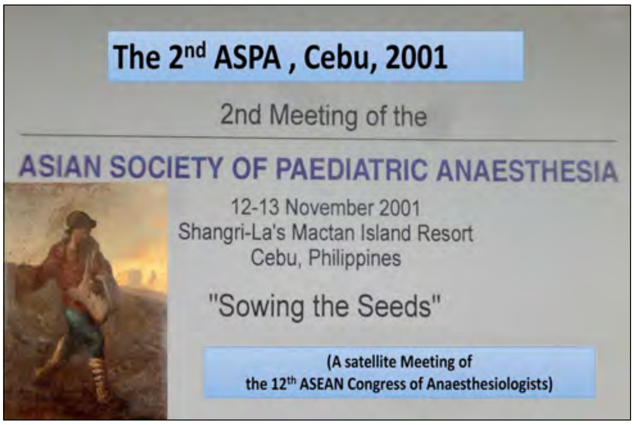

ASPA
1st working
committee in
year 2000


The 1st ASPA,
Singapore,2000


"INAUGURAL MEETING OF
ASIAN SOCIETY OF PAEDIATRIC ANAESTHESIOLOGIS
28 & 29 October 2000
KK Women's and Children's Hospital


Bubbles to distract young surgery patients
October 27, 2000
Singapore
The Straits Times
MEETING:
The first
TO DEVELOP this specialised field further, the Asian Society of Paediatric Anaesthesiologists was set up here in August last year.
The society will hold its first meeting this weekend, bringing together speakers from across Asia as well as from Britain, Canada and South Africa.


The 2nd ASPA
Cebu, 2001
The 1st ASPA,
Singapore,2000
Thailand
Vietnam
Cambodia
Philippines
Malaysia
Singapore
Indonesia


The 2nd ASPA , Cebu, 2001
2nd Meeting of the
ASIAN SOCIETY OF PAEDIATRIC ANAESTHESIA
12-13 November 2001
Shangri-La's Mactan Island Resort
Cebu, Philippines
"Sowing the Seeds"
(A satellite Meeting of
the 12th ASEAN Congress of Anaesthesiologists)


Greetings to colleagues and friends who come to "sow the seeds" of the youngest association of anaesthesiologists. It is appropriate that we, who care for the youngest member of the human population, gather to share, communicate, cultivate and expand our frontiers. We are in a unique position. Asia's young population is large and growing rapidly. We also lie at the crossroads of dizzying change born of technology. The ASPA in the Philippines Committee has prepared a program that aspires to bring out the best in the discipline.
Come to experience and participate at the 2nd meeting of the Asian Society of Paediatric Anaesthesia.
Dr. Iluminada T. Camagay
President
ASPA in the Philippines

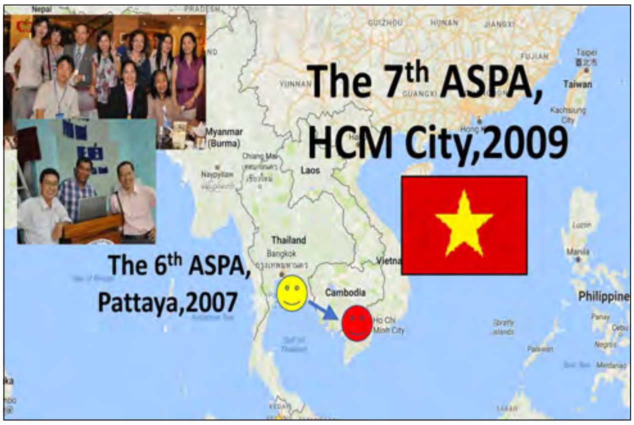

The 3rd ASPA,
New Delhi,2003
The 2nd ASPA
Cebu, 2001
China
India
Nepal
Bangladesh
Myanmar (Burma)
Thailand
Vietnam
Cambodia
Philippines
Sri Lanka
Taiwan
Malaysia


T.C.K. Brown
International Conference on
Paediatric Anaes
ASPA 2003 , New Delhi , India
Sharing culture and friendship after lectures


The 3rd ASPA,
New Delhi,2003
The 4th ASPA,
Singapore,2005
Afghanistan
Pakistan
Nepal
Bangladesh
Myanmar (Burma)
Thailand
Vietnam
Cambodia
Philippines
Sri Lanka
Taiwan
Singapore

Only specialists can administer anaesthesia to children: experts

"Severe shortage of paediatric anaesthesiologists world over"



Hospitals cut infant death rates

HCM CITY — More than 200 leading health experts in Asia are attending a two-day seminar at the seventh Asian Society of Paediatric Anaesthesiologists (APSA) meeting, started yesterday at HCM City Children's Hospital 1.

Dr Tăng Chí Thượng, director of the hospital, said specialty hospitals in Việt Nam, including his hospital, had been successful in reducing ... during anaesthesiology.

The use of anaesthesia in children's surgery and in surgeries related to congenital heart disease was the main topic of discussion.

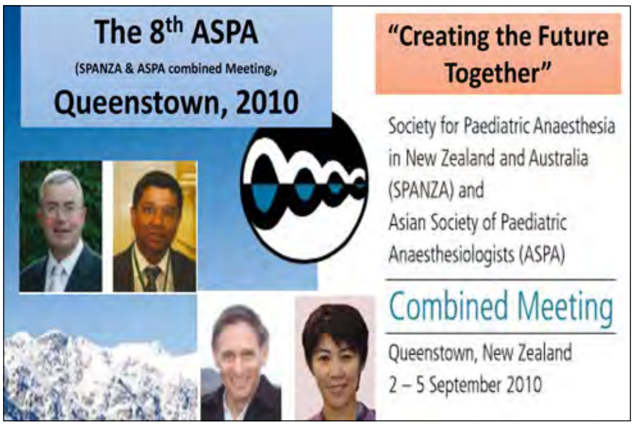
Doctors also discussed anaesthesia methods for fetal, neonatal, lung and craniofacial surgeries, among others.

Professor George Gregory from San Francisco University in the US shared his ... field in the medical sector.

He said that survival of newborns with a diaphragmatic hernia was poor, despite the care given by advanced neonatal intensive care units.

Such surgeries require a team of physicians and nurses who understand embryology and fetal issues.

APSA was founded in 2000. The conference previously was held on six occa-




The 9th ASPA,
Manila, 2011
Manila
13 h 55 min
The 8th ASPA,
Queenstown, 2010
Queenstown


The 10th ASPA, Chengdu,
2012,成都
Chengdu
The 9th ASPA, Manila,2011
Manila

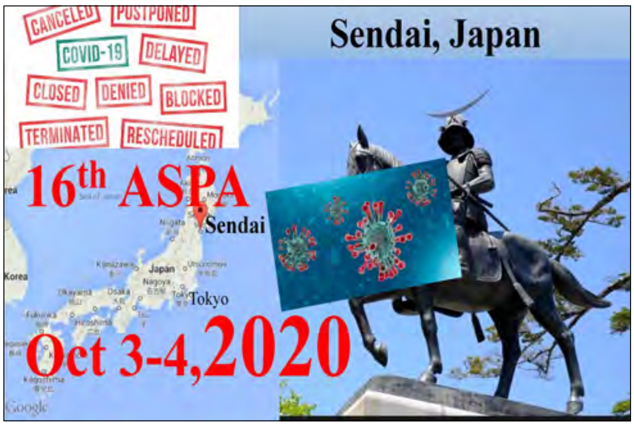

The 10th ASPA , Chengdu, 2012
成都
7 h 55 min
The 11th ASPA,
Jakarta, 2013
indoanesthesia 2013


The 12th ASPA,
Istanbul, 2014
12 h 10 min
The 11th ASPA, Jakarta,2013
ISTANBUL
ASPA2014

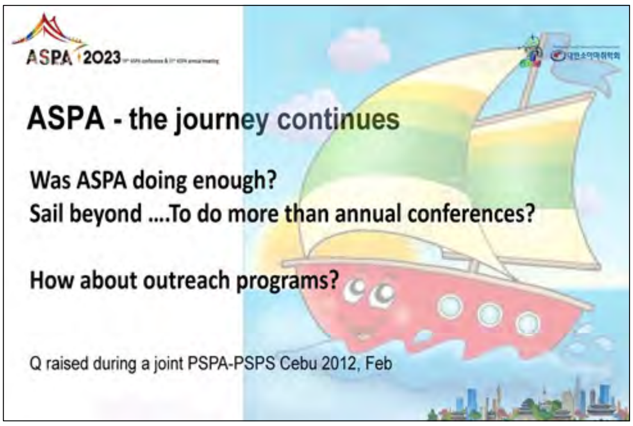

The 12th ASPA, Istanbul, 2014
13 h 15
The 13th ASPA,
Penang, 2015
George Town


The 14th ASPA,
Mumbai, 2017
7 h 35 min
The 13th ASPA, Penang, 2015


The 14th ASPA, Mumbai, 2017
4 h 15 min
The 15th ASPA,
Bangkok,2018


CANCELED
POSTPONED
COVID-19
DELAYED
CLOSED
DENIED
BLOCKED
TERMINATED
RESCHEDULED
Sendai, Japan
16th ASPA
Sendai
Tokyo
Oct 3-4,2020

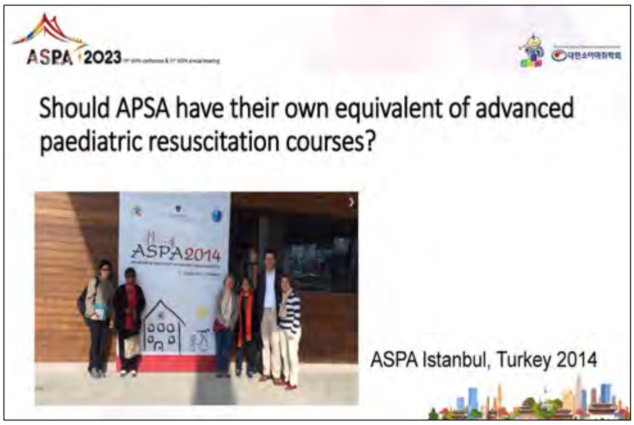

COVID LOCKDOWN but learning must continue..
ASPA 2021
A VIRTUAL EXPERIENCE
SINGAPORE • 13-14 NOVEMBER 2021


ASPA 2023
ASPA - the journey continues
Was ASPA doing enough?
Sail beyond ....To do more than annual conferences?
How about outreach programs?
Q raised during a joint PSPA-PSPS Cebu 2012, Feb

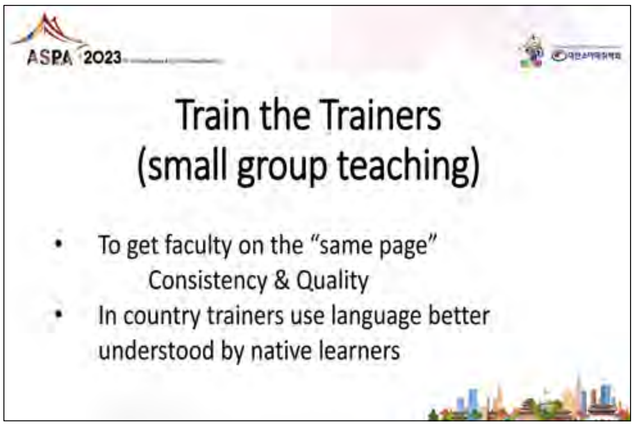

ASPA 2023
ASPA – Brainstorming in Singapore Aug, 2012
ASPA is small in size...
But BIG in commitment


ASPA 2023
"Safe PAN workshop"
FOCUS on Basic & Safe Paediatric Anaesthesia Practice
Maldives 2014
Mauritius 2015


ASPA 2023
"Safe PAN workshops"
Siem Reap, Cambodia 2015
Luang Prabang, Laos 2016


ASPA 2023
Should APSA have their own equivalent of advanced paediatric resuscitation courses?
ASPA 2014
ASPA Istanbul, Turkey 2014


ASPA 2023
NEW ASPA workshop...
"Paediatric Perioperative Life Support" (PPLS)
2014 Singapore
2015 Penang, Malaysia (fine-tune)


ASPA 2023
Train the Trainers
(small group teaching)
• To get faculty on the "same page"
Consistency & Quality
• In country trainers use language better understood by native learners


ASPA 2023
"Train the Trainers/TTT sessions"


ASPA 2023
Malaysian Society of Paediatric Anaesthesiologist PPLS – TTT course Jan 2018


ASPA 2023
Philippine Society of Pediatric Anesthesia
PPLS and TTT, Feb 2018


ASPA 2023
ASPA Collaborations
International, National and Local societies & Healthcare organisations
IAPA
SmileTrain
WFSA


ASPA 2023
ASPA NOW….
TODAY in 2023


© WorldAtlas.com
Pyongyang
North Korea
Seoul
South Korea
Busan
Japan
SOUTH KOREA
ASPA 2023
Equity and Quality in Paediatric Anaesthesia
19th Conference of the Asian Society of Paediatric Anaesthesiologists
31st Annual Meeting of the Korean Society of Paediatric Anaesthesiologists
16 (Fri) - 18 (Sun) June, 2023
SC Convention Center, Seoul, Korea

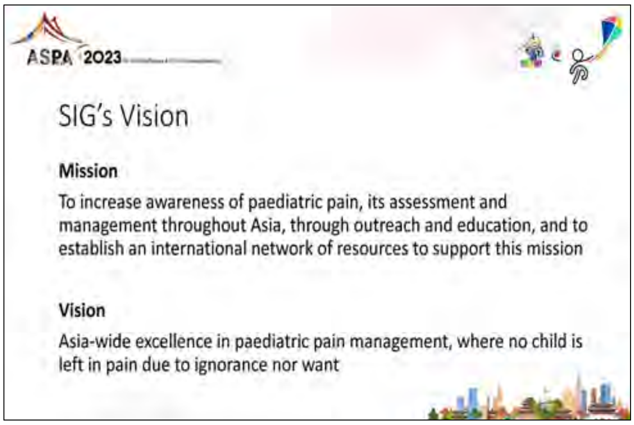

ASPA 2023
MEMBERSHIP
• 596
Singapore
Philippines
China
Parkistan
Thailand
cambodia
India
Hong Kong
Indonesia
Malaysia
Korea
Vietnam
Canada
Bhutan
Japan
Turkey
Maldives
Kenya
Bangladesh
USA
Uzbeckistan
Myanmar
Sri Lanka
Mongolia
Kosovo
Nepal
UAE
Mauritius


ASPA 2023
ASPA e-Education
Our Pursuit: To disseminate education for a holistic paediatric anaesthesia care.
ASPA Education Committee
Now into 3rd season of webinars......all available at ASPA website aspa-2000.com
Second ASPA-FLEX Webinar
First ASPA FLEX Webinar session capture
ASPA-FLEX Webinar Series Launch


ASPA 2023
Despite Covid restrictions... Still continuing with existing programmes --> PPLS
e-PPLS Philippines


ASPA 2023
ASPA TODAY ......
Started 4 (+ 1) Special Interest Groups since 2021 (young but productive..)
Pain
Research
Cardiac
Patient Safety
(Regional Anaesthesia- almost there...)

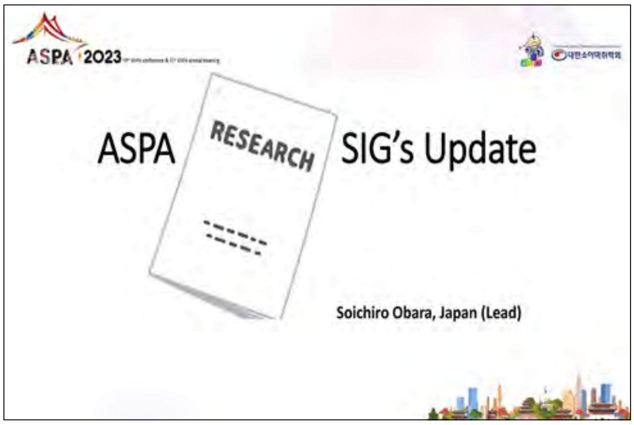

ASPA 2023
ASPA
Paediatric Pain
Honorary Advisor : Prof Allen Finley
President : Angela Yeo
President-Elect : Kathrina Epino
Secretary : Teddy Fabila
Treasurer : Jang Young-Eun
Education : Andi Ade Ramlan
Research : Ritu Pradhan
Membership : Janice Ng
Special Projects : Elvan Ocmen


ASPA 2023
SIG's Vision
Mission
To increase awareness of paediatric pain, its assessment and management throughout Asia, through outreach and education, and to establish an international network of resources to support this mission
Vision
Asia-wide excellence in paediatric pain management, where no child is left in pain due to ignorance nor want


ASPA 2023
ASPA
Paediatric Pain
2022-23 SIG activities and outcomes
1. Set up our website
2. Created a PPSIG logo
3. Conducted a Childkind in Asia webinar talk during ASPA 2022
4. Created a pain assessment resource for members to share during Pain Awareness Month
5. Started a quarterly webinar series (see next slide)
Bringing childkind to Asia
September is Pain Awareness Month!
PAIN ASSESSMENT TOOL


ASPA 2023
ASPA
Paediatric Pain
2022-23 SIG activities and outcomes
Neurobiology of Pain
PEDIATRIC PERIOPERATIVE PAIN MANAGEMENT
Save the date!
8th July 2023 5pm SGT
Detecting neuropathic pain in children
Managing neuropathic pain in children
14 Oct 2023 5pm SGT
Oncological pain
Palliative pain
Interventional Procedures in Chronic Cancer Pain


ASPA 2023
ASPA
Paediatric Pain
Plans moving forward
Education
Continued Quarterly webinars
Essential Pain Management - Paeds Train the Trainer sessions (in conjunction with Pain in Childhood SIG of IASP)
Paediatric Pain Masterclass
Research & Networking
Survey on paediatric pain education / resource needs
Membership & Welfare
Facebook page for education & training & networking events


ASPA 2023
ASPA
RESEARCH
SIG's Update
Soichiro Obara, Japan (Lead)


Asian PEdiatric Anesthesia Research (A-PEAR) team
(contributing to our research project)
Shemila Abbasi (Pakistan)
Josephine Tan (Singapore)
Choon Looi Bong (Singapore)
Soichiro Obara (Lead) (Japan)
Norifumi Kuratani (Japan)
Pheakdey Nhoung (Cambodia)
Evangeline Villa (Philippines)
Elsa Varghese (India)
Ekta Rai (India)
Z Serpil Ustalar Ozgen (Turkey)
Andi Ade W Ramlan (Indonesia)
Hyo-Jin Byon (South Korea)
Mahin Seyedhejazi (Iran)
Ina Ismiarti Shariffuddin (Malaysia)
Teresita A Batanes (Philippines)


ASPA 2023
Research SIG's Vision
• To work on determination of the important research questions in our field of pediatric anesthesia, to hopefully trigger research endeavors in this area
• To foster the generation and propagation of research ideas in pediatric anesthesia beyond borders throughout Asia


ASPA 2023
PEACH in Asia study project
2022-23 research SIG activities and outcomes
• Current focus -> launch ASPA's inaugural ASIAN collaborative research project prospective cohort research on peri-anesthetic morbidity in children in Asia, "Peach in Asia study project"


ASPA 2023
GO
Moving forward plans
• Future Collaborations with research committees of other anesthesia societies
– To participate in the CRICKET (CRItiCal events in anaesthetised Kids undergoing Elective or emergency Tracheal intubation) project
• Launching novel research projects beyond borders (e.g. web-based surveys...)
• Holding a webinar regarding basics of research methods and biostatistics


Asian Society of Paediatric Anaesthesiologist
Cardiac
Special Interest Group
Cardiac SIG Sign Up
Paediatric cardiac anaesthesiologists are a small group.
Collective knowledge and group wisdom is the way forward
The Vision:
A platform to share insights and expertise with the vision of improving standards of paediatric cardiac care in the region.

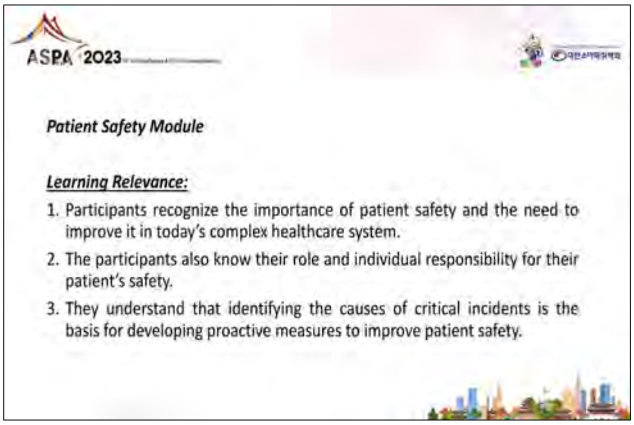

ASPA 2023
Cardiac SIG members
Cindy Boom
Yunita Widya
Evangeline Villa
Gina Gumintad
Dilek Altun
Kamlesh Tailor
Raj Sahajanandan
Shreedhar S Joshi
Unnikrishnan KP
Varsha A V
Angela Tan
Josephine Tan
Satish Reddy
Swapna Thampi
Tracy Tan
Hang Nguyen
Thao Giang
Nghi Huynh Bao Phan
Kelvin Ng
Maliwan Oofuvong
Suneerat Kongsayreepong
Wanutchaporn Sujarittham
Kevin Umani


Asian Society of Paediatric Anaesthesiologists
ASPA Cardiac SIG Forum
11th March 2023 (Saturday)
Children with Congenital Heart Disease for Non- Cardiac Surgery
Speakers
Moderators
Inaugural Cardiac SIG webinar – led by team from Thailand


ASPA 2023
SIG activities
ASPA Cardiac SIG Forum
Children with Congenital Heart Disease for Non- Cardiac Surgery
Children with Congenital Heart Disease for Non-Cardiac Surgery (Part 2)
Speakers
Upcoming Talks
2-part talk on Issues in ICU after Cardiac Surgery
12th August 2023
9th September 2023

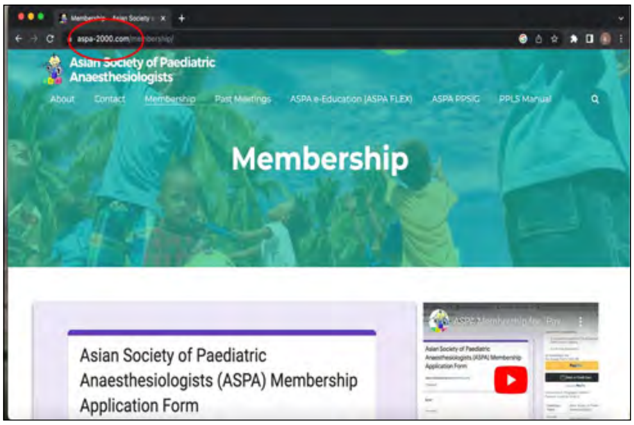

ASPA 2023
Patient Safety
Special Interest Group

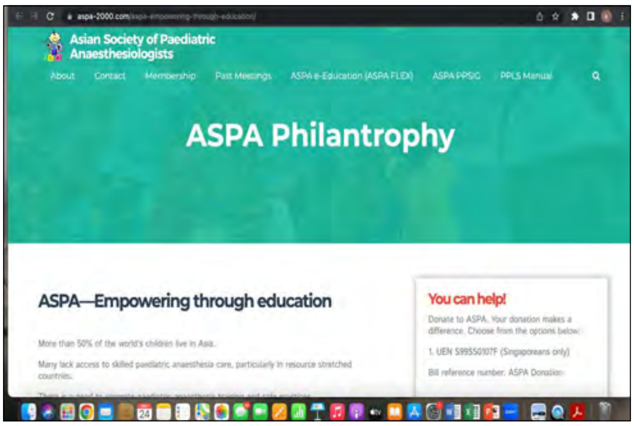

ASPA 2023
Members
• Canan Bor (Turkey)
• Angelina Gapay (Philippines)
• Rebecca Jacob (India)
• Arif HM Marsaban (Indonesia)
• Siow Yew Nam (Singapore)
• Erlinda Oracion (Philippines) - Lead
• Sana Urooj Shaheer (Pakistan)
• Shu Ching Teo (Malaysia)
• Josephine Tan (Singapore)

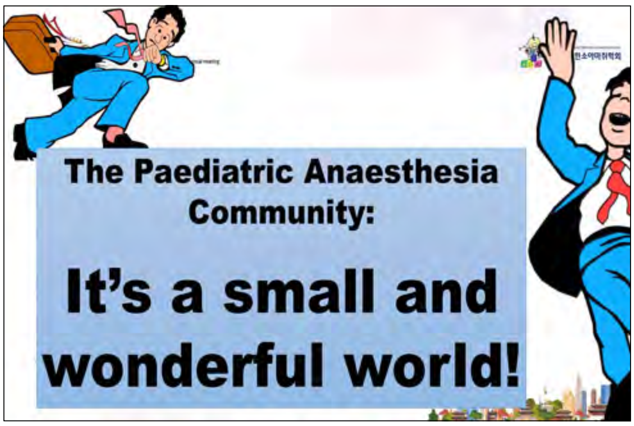

ASPA 2023
Patient Safety Module
Learning Relevance:
1. Participants recognize the importance of patient safety and the need to improve it in today's complex healthcare system.
2. The participants also know their role and individual responsibility for their patient's safety.
3. They understand that identifying the causes of critical incidents is the basis for developing proactive measures to improve patient safety.


ASPA 2023
ASPA FUTURE
? Clinical Fellowship
? Mentorship programme
Collaborations & Partnerships


ASPA 2023
To continue ASPA journey -
Younger members to step forward!
ASIAN SOCIETY OF PAEDIATRIC ANAESTHESIOLOGISTS


Asian Society of Paediatric Anaesthesiologists
Membership
Asian Society of Paediatric Anaesthesiologists (ASPA) Membership Application Form


Asian Society of Paediatric Anaesthesiologists
ASPA Philantrophy
ASPA—Empowering through education
You can help!


The Paediatric Anaesthesia Community:
It's a small and wonderful world!


ASPA 2023
Children in Asia receive
safe anaesthesia care at
any time, any place ...

ESPA: How to Collaborate Internationally and Intercontinentally

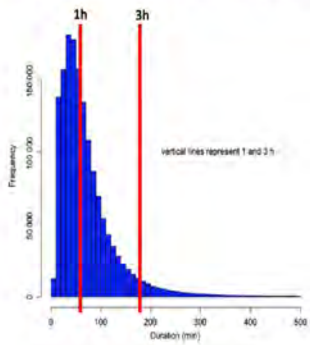
Jurgen C. de Graaff

Erasmus Medical Center, Netherlands

Anesthesia in children is common!

- One in 7 children were exposed to general anesthesia before age 3 yrs.
  = 4 children per class/24 children

Most anesthetics in children are short



Bartels Ped Anesth 2018

What do we measure
Neonates ≠ Infants ≠ Children ≠ Adolescents

- Mortality
- Morbidity
  - less clearly defined compared to mortality

Overall perioperative Morbidity:

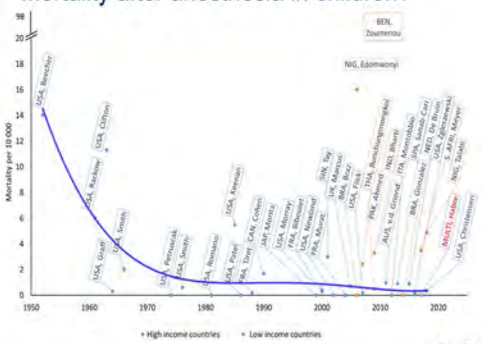
	Adults	Pediatrics
Mortality	1-4%	?
Myocardial infarction	1-3%	?
Stroke	0.1-0.7%	?
ARDS	0.2%	?
Acute kidney injury	1%	?

EuSOS-cohort, Pearse Lancet. 2012 Sep 22; 380(9847): 1059–1065.

Pediatric perioperative outcomes are different...
Neonates ≠ Infants ≠ Children ≠ Adolescents

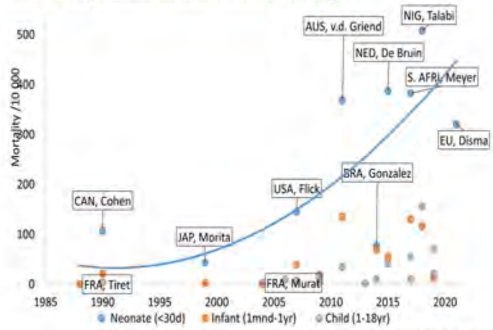
Adults	Children
Mortality	Rare
Myocardial infarction	Rare
Kidney failure	Rare
Perioperative stroke	Rare
Thromboembolism	Rare
Postoperative cognitive decline	Postoperative behavior change
Return to work	Emergence delirium
	Parent proxy outcome measures
	Developmental/age-specific measures

Mortality after anesthesia in children?



de Graaff Best Pract Res Clin Anesth 2021

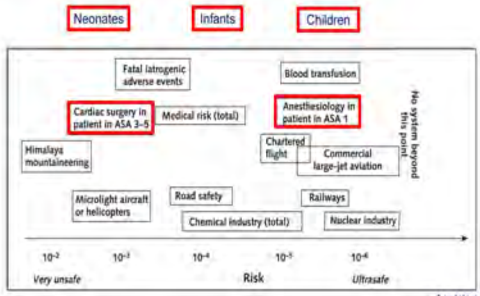
Mortality after anesthesia by age



de Graaff Best Pract Res Clin Anesth 2021

Five System Barriers to Achieving Ultrasafe Health Care

René Amalberti, MD, PhD; Yves Auroy, MD; Don Berwick, MD, MPP; and Paul Barach, MD, MPH



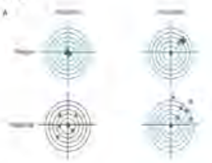
Ann Intern Med. 2005;142:756-764

Study design

- Define aim study!
- Define primary outcome!
- Frequency outcome?
- Sample
  - Age
  - Location
- Sample size
- Tool outcome maesure

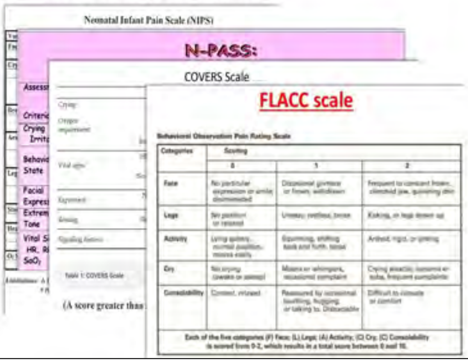
How do we measure outcome?

- Definition of outcome?
- Clinical relevance
- Defined minimal clinically important difference
- Metric properties
  - Validity
  - Reliability
  - Utility
  - Responsiveness



Number of pain scales for neonates and infants

Neonatal pain scales



Selection of pain instruments for (premature) neonates

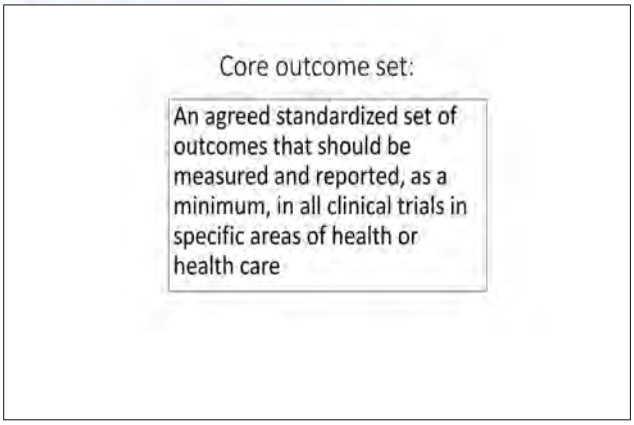
Pain assessment instruments neonates	First author, year of first publication	Type of pain I procedural II postoperative III prolonged	Facial Expression	Body movement	Posture/ tone	Cry/ vocal	Behavioural state sleep pattern	Physiology	Conso-lability
NIPS	Lawrence et al. 1993	I	√	√√		√	√	√	
BPS	Pokela et al 1995	I	√	√	√				√
CRIES	Krechel et al. 1995	II	√			√	√	√√	
PIPP	Stevens et al. 1996	I / II	√√√				√	√√	
DAN	Carbajal et al 1997	I	√	√		√			
COMFORT-B	Van Dijk et al. 2000	II, sedation	√	√	√	√	√		
CHIPPS	Büttner et al. 2000	II	√	√√	√	√			
EDIN	Debillon et al. 2001	III	√	√			√		√
BPNS	Cignacco et al 2004	I	√		√	√	√	√√	√
BIIP	Holsti et al. 2007	I	√√√√	√			√		
N-PASS	Hummel et al. 2008	II/III, sedation	√		√	√	√	√√√	
COMFORTneo	Van Dijk et al. 2009	II, III	√	√	√	√	√		
			100%	83%		67%	75%	42%	25%

Problems

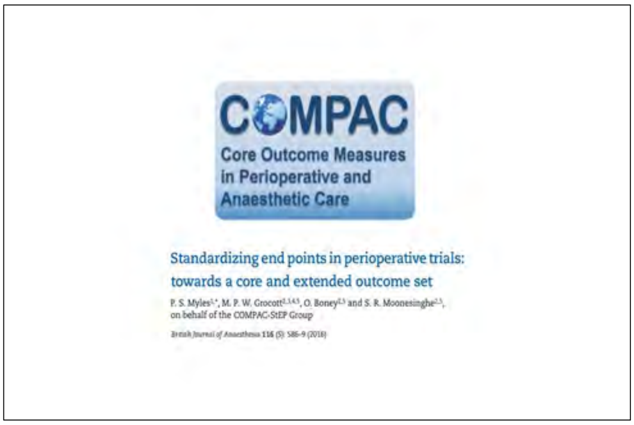
- Large variability
- Large variation
- Difficult Meta-analysis
  - Variability undermines systematic reviews & meta-analyses
- Difficult combined outcome measures
- Selective outcome reporting
  - Report only outcomes of statistical or 'clinical' significance.

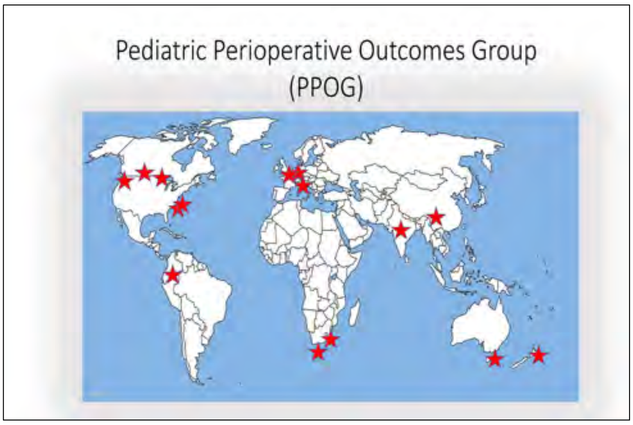
Advantages of core outcome sets

- Increases consistency across trials
- Maximise potential for trial to contribute to systematic reviews of these key outcomes
- Much more likely to measure appropriate outcomes
- Major reduction in selective reporting


Core outcome set:
An agreed standardized set of outcomes that should be measured and reported, as a minimum, in all clinical trials in specific areas of health or health care


COMET
INITIATIVE
Core Outcome Measures in Effectiveness Trials
www.comet-initiative.org
Twitter: @COMETinitiative

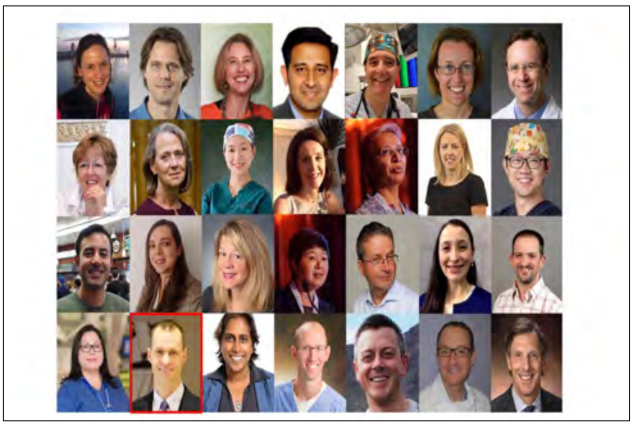

COMPAC
Core Outcome Measures in Perioperative and Anaesthetic Care
Standardizing end points in perioperative trials: towards a core and extended outcome set
P. S. Myles, M. P. W. Grocott, O. Boney and S. R. Moonesinghe, on behalf of the COMPAC-StEP Group
British Journal of Anaesthesia 116 (5): 586–9 (2016)


Pediatric Perioperative Outcomes Group (PPOG)


EDITORIAL
WILEY
Pediatric perioperative outcomes group: Defining core outcomes for pediatric anesthesia and perioperative medicine
Paul A. Stricker
Jurgen C. de Graaff
Laszlo Vutskits
Wallis T. Muhly
Ting Xu
Alexandra M. Torborg
Yifei Jiang
Suellen M. Walker
Goal Representation:
• Europe
• United Kingdom
• China
• South Africa
• Australia
• New Zealand
• United States
• India
• Colombia
• Canada


EDITORIAL
WILEY
Pediatric perioperative outcomes group: Defining core outcomes for pediatric anesthesia and perioperative medicine

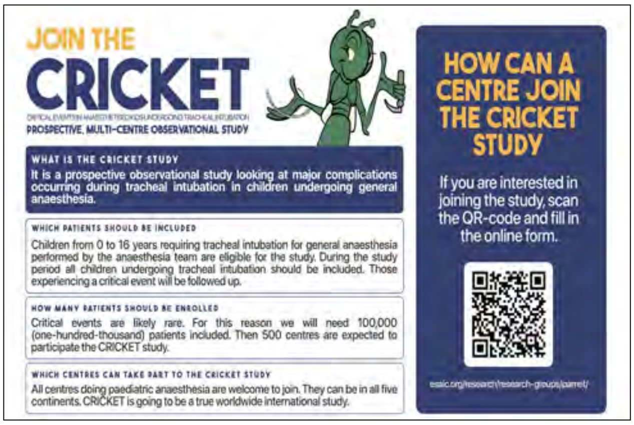

SPECIAL INTEREST ARTICLE
WILEY
Pediatric Anesthesia 2020;30:1166–1182.
A systematic review of outcomes reported in pediatric perioperative research: A report from the Pediatric Perioperative Outcomes Group
Wallis T. Muhly | Elsa Taylor | Cyrus Razavi | Suellen M. Walker | Lei Yang | Jurgen C. de Graaff | Laszlo Vutskits | Andrew Davidson | Yunxia Zuo | Carolina Pérez-Pradilla | Piedad Echeverry | Alexandra M. Torborg | Ting Xu | Ellen Rawlinson | Rajeev Subramanyam | Simon Whyte | Robert Seal | Heidi M. Meyer | Sandhya Yaddanapudi | Susan M. Goobie | Joseph P. Cravero | Aideen Keaney | M. Ruth Graham | Tania Ramos | Paul A. Stricker | on behalf of The Pediatric Perioperative Outcomes Group



How to collaborate?

- Clear Aim
- Accurate & precise international primary outcome
- Accurate sample size
- Define cohort
- Sample size
- Start simple, not too much!
- Work together and enjoy

- Have fun!



Session 2.

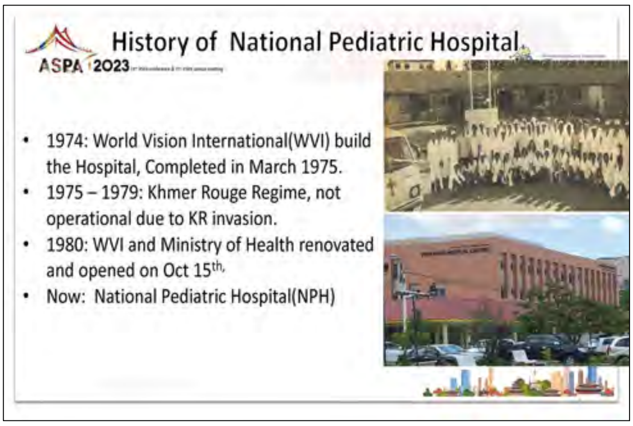
WFSA Panel Discussion: Universal Coverage of Safe Pediatric Anesthesia All Over Asia

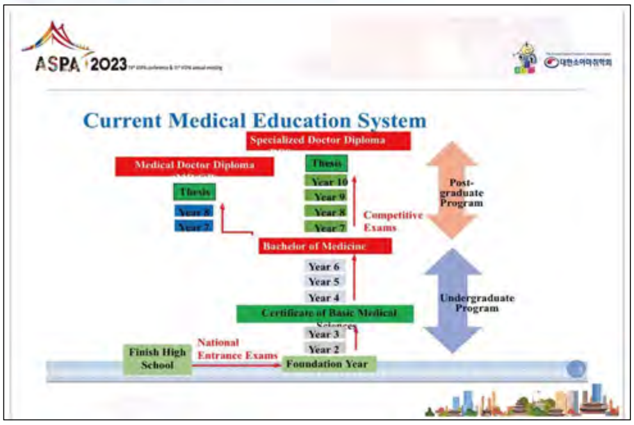
Chair(s): Erlinda Oracion (Philippines)
Il-Ok Lee (Korea)

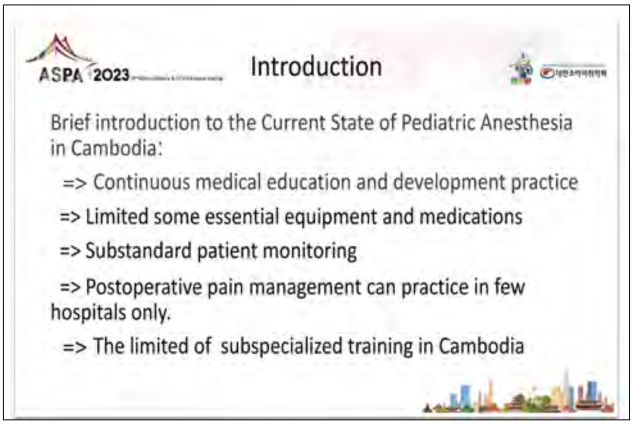
Universal Coverage of Safe Pediatric Anesthesia in Cambodia

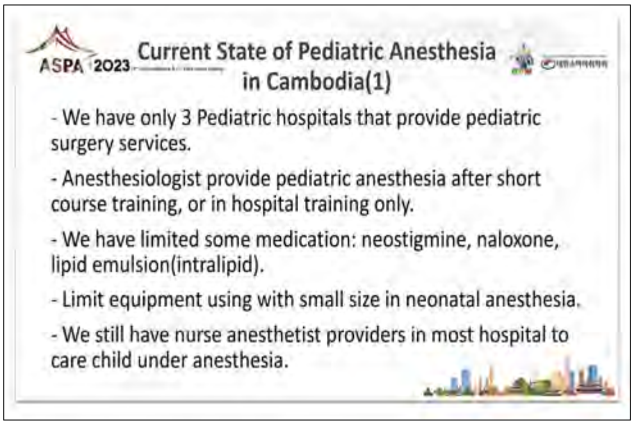
Sokha Tep

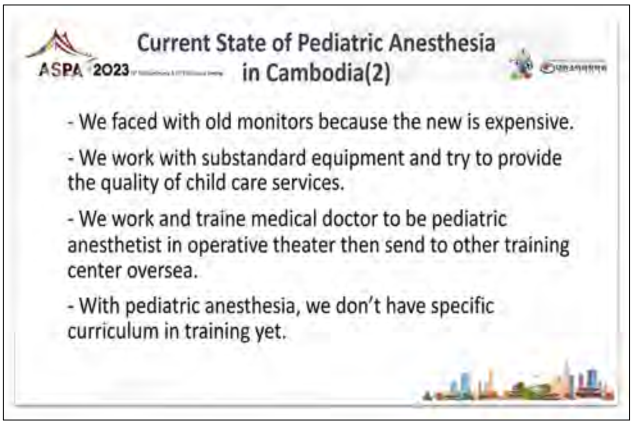
National Pediatric Hospital, University of Health Sciences, Cambodia

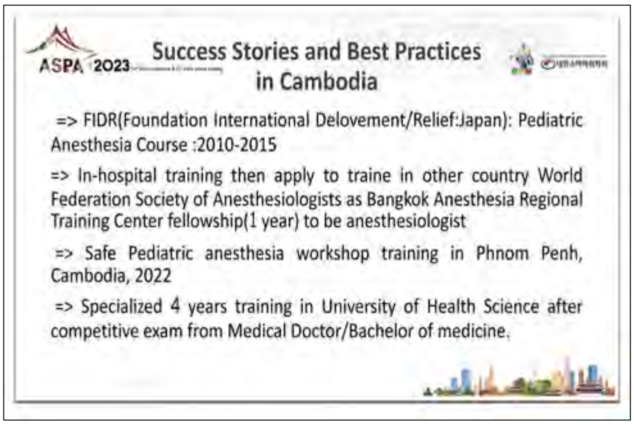


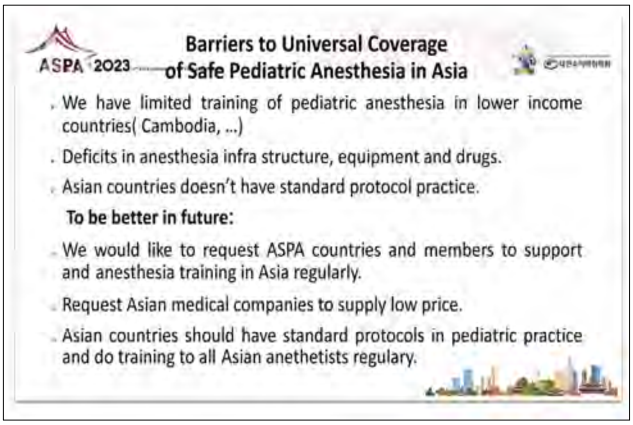

ASPA 2023
Current Medical Education System
Specialized Doctor Diploma
Medical Doctor Diploma
Thesis
Year 8
Year 7
Thesis
Year 10
Year 9
Year 8
Year 7
Competitive Exams
Post-graduate Program
Bachelor of Medicine
Year 6
Year 5
Year 4
Undergraduate Program
Certificate of Basic Medical
Year 3
Year 2
Foundation Year
Finish High School
National Entrance Exams

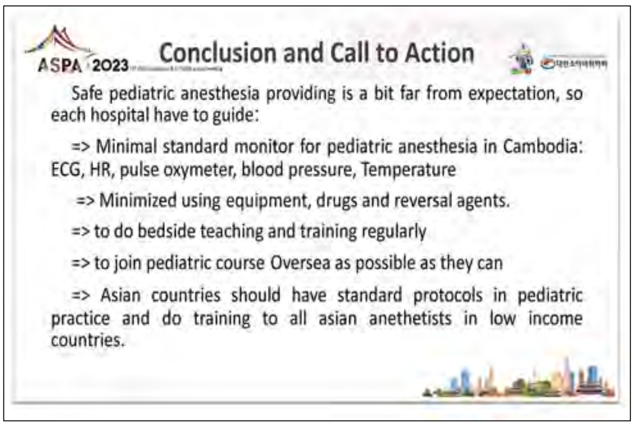

ASPA 2023
Introduction
Brief introduction to the Current State of Pediatric Anesthesia in Cambodia:
=> Continuous medical education and development practice
=> Limited some essential equipment and medications
=> Substandard patient monitoring
=> Postoperative pain management can practice in few hospitals only.
=> The limited of subspecialized training in Cambodia


ASPA 2023
Current State of Pediatric Anesthesia in Cambodia(1)
- We have only 3 Pediatric hospitals that provide pediatric surgery services.
- Anesthesiologist provide pediatric anesthesia after short course training, or in hospital training only.
- We have limited some medication: neostigmine, naloxone, lipid emulsion(intralipid).
- Limit equipment using with small size in neonatal anesthesia.
- We still have nurse anesthetist providers in most hospital to care child under anesthesia.


ASPA 2023
Current State of Pediatric Anesthesia in Cambodia(2)
- We faced with old monitors because the new is expensive.
- We work with substandard equipment and try to provide the quality of child care services.
- We work and traine medical doctor to be pediatric anesthetist in operative theater then send to other training center oversea.
- With pediatric anesthesia, we don't have specific curriculum in training yet.


ASPA 2023
Success Stories and Best Practices in Cambodia
=> FIDR(Foundation International Delovement/Relief:Japan): Pediatric Anesthesia Course :2010-2015
=> In-hospital training then apply to traine in other country World Federation Society of Anesthesiologists as Bangkok Anesthesia Regional Training Center fellowship(1 year) to be anesthesiologist
=> Safe Pediatric anesthesia workshop training in Phnom Penh, Cambodia, 2022
=> Specialized 4 years training in University of Health Science after competitive exam from Medical Doctor/Bachelor of medicine.


ASPA 2023
Barriers to Universal Coverage of Safe Pediatric Anesthesia in Asia
We have limited training of pediatric anesthesia in lower income countries(Cambodia, ...)
Deficits in anesthesia infra structure, equipment and drugs.
Asian countries doesn't have standard protocol practice.
To be better in future:
We would like to request ASPA countries and members to support and anesthesia training in Asia regularly.
Request Asian medical companies to supply low price.
Asian countries should have standard protocols in pediatric practice and do training to all Asian anethetists regulary.


ASPA 2023
Conclusion and Call to Action
Safe pediatric anesthesia providing is a bit far from expectation, so each hospital have to guide:
=> Minimal standard monitor for pediatric anesthesia in Cambodia: ECG, HR, pulse oxymeter, blood pressure, Temperature
=> Minimized using equipment, drugs and reversal agents.
=> to do bedside teaching and training regularly
=> to join pediatric course Oversea as possible as they can
=> Asian countries should have standard protocols in pediatric practice and do training to all asian anethetists in low income countries.

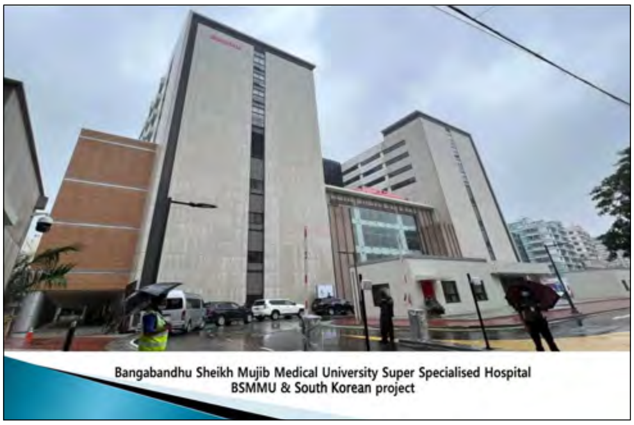

LOCAL PEDIATRIC ANESTHESIA TRAINING
ASPA 2023

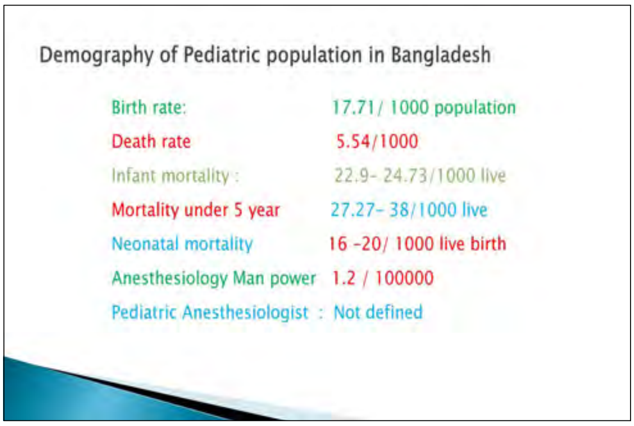

Safe Paediatric Aesthestesia Course
in Cambodia,18-20 Nov 2022
ASPA 2023

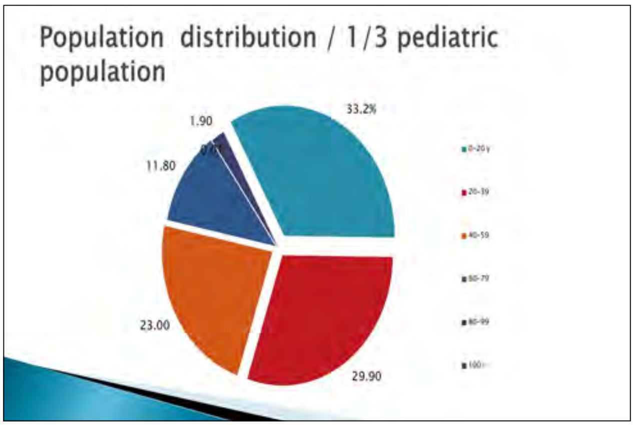
Current Status of Pediatric Anesthesia In Bangladesh Challenges and Opportunities for Improvement

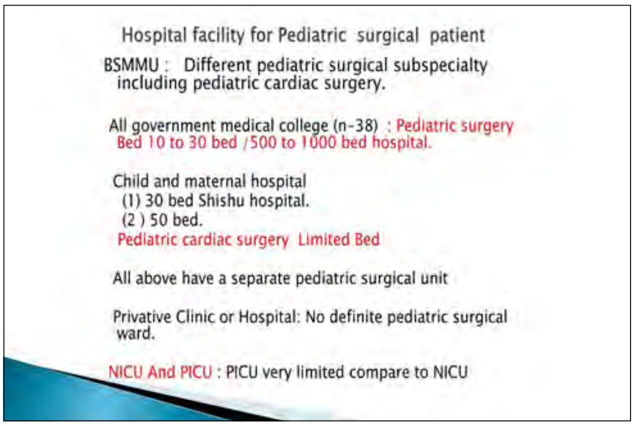
Debabrata Banik

Department of Anesthesia, Analgesia and Intensive Care Medicine,
Bangubandhu Shiekh Mujib Medical University, Bangladesh









Every Anesthesiologist All over the world

Anesthesia

- Anesthesiology is one of the most demanding and essential specialty of modern medical science not only to provide anesthesia for surgical operation but also involve in the management of different medical condition.
- Anesthesiology is the largest single hospital specialty.
- But is probably the least well understood in the developing counties like Bangladesh

Work load of Anesthesiologists in Bangladesh

Anesthesia

- Anesthesiologists treat patients of all ages with a variety of medical problems.
- Anesthesiologists provides anesthesia operate on wide range of cases, from heart and brain procedures to births and catastrophes.

Anesthesia

- In reality- Anesthesia is a rewarding and challenging specialty and acute in nature.
- It is truly one of the few specialties where decisions made in critical situations can mean the difference between "life and death."
- Among anesthesia specialty- pediatric anesthesia is more risky than other specialty

DS (Child) H J 2018; 34(1) : 3-4

LEADING ARTICLE

History of Pediatric Anesthesia in Bangladesh

Md. Shahidul Islam

Children are very special people who require special care in order to provide safe anesthesia. The history of pediatric anesthesia is the steps towards maintaining normal limits of neurologic, respiratory, cardiovascular and other body systems. The goal of the specialty of the pediatric anesthesiology is the reduction of perioperative morbidity and mortality and promotion of monitoring, resuscitation and supportive fields through teaching, research, organizational activity throughout the world.[1,2] Before discussing the history of pediatric anesthesia in Bangladesh I want to discuss what was the global condition. Before introduction of ether in 1846, circumcision, believed that the development of modern pediatric anesthesia started in 1930.[8] The rapid growth of pediatric anesthesia was divided into two chronological categories. First were 1930 to 1950 and the second 1950 to present. During the first period the anesthesia techniques and equipment were developed. In the second phase with further techniques, equipment, refinement, modern anesthetics and vital system monitoring were introduced into everyday practice.[9] Ether and chloroform could be given for orthopedic and limb surgery but problems were with cleft lip, palate, abdominal, ENT and chest surgery.[10] Digital tracheal intubation with a soft rubber catheter was

The history of pediatric anesthesia

- The history of pediatric anesthesia in Bangladesh was miserable.
- In early 1970 's the only agent was ether and chloroform to anesthetize the pediatric patient.
- Pediatric endotracheal tube, laryngoscope, pediatric circuit and IV cannula was available late 1980
- Pediatric surgeon and pediatric anesthetists were not available before 1980
- Mortality rate was very high due to aspiration and respiratory depression in 1970 1980
- The condition was horrible for the anesthetists and surgeon.

The history of pediatric anesthesia in Bangladesh

- Individual pediatric surgery started after 1980
- Before 1980 all pediatric surgery was done by general surgeon
- 1980 to 2000 pediatric anesthesia started to provided by qualified senior anesthesiologist

History of pediatric Anesthesia In Bangladesh

- But morbidity and mortality was high due to lack proper skill and institutional support.
- One study support only 13% qualified anesthesiologist provide safe pediatric anesthesia .
- Revolution for Specialty anesthesia started after 2000.
- When the patient safety is a pioneer and more medico legal issue came out — Improved Action plan start

Development of Specialty

- **Safety Issue:** Today high profile advances in surgical practice mostly depends on efficient and effective methods of anesthesia and intensive care medicine.
- More and more safety is a crucial point for surgical patient .
- So on this point surgical specialty divided into different surgical sub specialties and super specialties for more skill and successful outcome

Development of Specialty

- The American College of Surgeons recognizes **14** surgical specialties:
- and in Royal college of Surgeon UK recognized 10 surgical specialties,
- With this changes in developed country was initiate the development of anesthesia subspecialty.
- Among them Pediatric anesthesia is most important subspecialty and it is different in all respect

Development of Specialty

- In Bangladesh 17 surgical specialty with different division were created.
- Dental and medical faculty also divided into many subspecialy.
- However, in Bangladesh single Anesthesiologists have to performed wide range of clinical practice related to all surgical specialties for a long period
- So there is less scope to anesthesiologist to develop skill and Knowledge on a specific surgical specialty.

Development of Specialty

- There were confidential report in Bangladesh that if anesthesia provided by specific subject specialty outcome is better in respect of morbidity and mortality.
- Pediatric Anesthesiologists works in more urgent and risky conditions specially neonatal surgery
- . There is limited anesthetists are able to provide safe anesthesia for children.

Pediatr Clin North Am 1994; 41: 1-14

MedCrave — Journal of Anesthesia & Critical Care: Open Access

Review Article

Open Access — CrossMark

Issues and challenges of pediatric anesthesia in Bangladesh

Volume 10 Issue 6 - 2018

Abul Kalam Azad,[1] Mohammad Safi Ullah[2]

Received: August 03, 2018 | Published: November 13, 2018

Abstract

Geographically Bangladesh is located in an area where natural calamities like flood, cyclone, and drought are very common. The country is hugely populated (1252/Sq km) due to its livable plain terrain with a good reserve of natural resources but as usual, we have a developing health management system. So, as a non-earning member of family women and children is the most vulnerable group of society. Children constitute more than one third (51.3million) of total population on the other hand woman constitute almost half (49.40%) as well. Due to low Gross Domestic Product (GDP), allocation of budget in health (0.92% of GDP) specifically for addressing children and maternal health is not sufficient. Despite the diversity in their geographical, linguistic, and political structures, Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka face common health challenges. Moreover socioeconomic status of these countries differs very little, even though Bangladesh had achieved United Nations Award for successful reduction of infant (28.2/1000) and maternal mortality rate (170/1000) on Millennium Development Goals-4 during the 65th United Nations General Assembly.

Combined Military Hospital, Dhaka is a 1500 beds tertiary care teaching hospital which has 30 beds pediatric surgery ward, 130 beds pediatric medical ward, 10 beds neonatal ICU, 10 beds pediatric ICU and 58 beds adult ICU as well. On an average 100

- After 2000 1st Pediatric anesthesia workshop was arranged with the help of WFSA and faculty was Prof Dilip Power from India
- Includes Pediatric anesthesia in Every post gradute training and course like DA,MD and FCPS
-

Pediatric anesthesia and Surgery - Outcome

Statistics of neonatal surgery in 2016 at Dhaka Shishu (Children) Hospital

Name of month	Total op	Total death
January	78	12
February	64	9
	62	13
March	60	10
April	67	14
May	70	13
June	74	11
July	69	9
August	72	10
September	66	8
October	57	6
Novembe	63	15
December		
Total	802	130 (16.20%)

Statistics of neonatal surgery from 2012 to 2016 at CMH, Dhaka

Year	Total op	Total death
2012	28	3
2013	31	5
2014	35	8
2015	43	7
2016	37	6
Total	174	29 (16.66)

High mortality rate in pediatric surgical patient

Causes of death in Dhaka children hospital 2016

- Delayed reporting sick and delayed intervention
- Complex medical diseases & co-morbidity
- Ongoing sepsis & multi-resistant organisms
- Hospital set-up is not well equipped
- Peripheral hospitals are neither well prepared & equipped
- Lack of trained staffs
- Maternal causes: poor nutrition, preterm, multiple pregnancies

Less skilled manpower specially anethesiologist ?
Overload of work for anethesiologist

Causes of death in military hospitals 2012 to 2016

- Military hospitals having a very effective chain of evacuation system from field hospital to base hospital
- Good infrastructure with excellent instrumental support
- Trained manpower
- Qualify Anesthesiologist

But mortality is same compare to other hospital

So patient factor and management protocol is very important

Not all related to anesthesia

Pediatric AnesthesiOlogist is providing different surgery of following Diseases with different surgical specialty

- Pediatric surgery
- Hernia . Esophageal atresia with/without fistula / Intestinal atresia. Billiary atresia or deformaty
- A diaphragmatic hernia ,Eventration of diaphragm
- Mesenteric cyst , Myelomeningocele
- Gastroschisis, Omphalocele PUV UDT ARM
- Hirschsprung's disease, Intussusceptions, Rectal polyp
- IHPS. Hydrocephalus, Hypospadias, Tongue tie
- Appendicitis .Cholecystectomy . Child hood cancer etc.

CURRENT STATUS OF PEDIATRIC ANESTHESIA IN BANGLADESH

Rare cerebrovascular disease MOYAMOYA mandates anaesthesiologists to formulate an individualized anaesthetic plan for these patient

Common Surgical procedure in pediatric patient in Bangladesh

Pediatric Anesthesia is providing In the different surgery with following Diseases or specialty

- **ENT :-** Adeniodectitomy Tonsellectomy / Mostiodectomy
- **Orthropedric :-** Correction of structure abnormality, Trauma
- **Neurosurgery :-** Conginital Hydrocephalus ,Miningocel, Brain tumor
- **Endo Leparoscopic :-**Lap Chol,Appen, ERCP, Spleenectomy
- **Anesthesia outsite operation theater:-** CT scan MRI,Endoscope ,Bronchoscope
- **Plastric Surgery :-** Cleft lip ,plalete other stuctural abnormal or burn or burn contrcture
- **Pediatric kidney Transplant** :- Kidney transplant
- **Pediatric cardiac surgery** : Correction of congenital cardiac disease . Open heart surgery ,Non invasive procedure

Common anesthetic Technique in Pediatric surgery

Mostly Provide General anesthesia with or with out tracheal intubation.

Regional anesthesia combined General anesthesia or independent in specific and limited surgery .

Among them caudal , spinal is commonly practice

Monitoring anesthesia or proper way of sedation anesthesia of pediatric patient is less practice

Common anesthetic Technique in Pediatric surgery

Anesthestic Drugs

IV induction TPS, Propafol Ketamine
Inhalation :Halothan ,Isoflurene and Sevoflurane

Opiod : Pethedine and Fentanyl

Muscle ralaxant , Suxa, Rocurium.Vecurium Atracurium

Local Anesthetic : Lignocaine , Bupivacaine

Monitoring : Clinical.SPO2.BP ECG Limited ETCO2 Precordial Stethoscope

Per operative Fluid :open

Post operative Analgesic : Paracetamol, NSAID , Pethedine and caudal block

CURRENT STATUS OF PEDIATRIC ANESTHESIA IN BANGLADESH

- Pediatric patient is not a miniature of adult
- So it needs special knowledge and skill to provide safe pediatric anesthesia
- Pediatric anesthesia can be divided into three group Intrauterine life ,neonatal and infant to adolescent
- Considering this: BSA-CCPP and university take some initiative to improve by providing short term training and organised SAFE pediatric courses.
- One international workshop arranged - Faculty Prof Dilip Power in 2000 supported by WFSA.
- Arranged Three SAFE course: Faculty from UK, Australia and IRLAND supported by WSFA and AAIB -2012 to2020
- After this there may reduced mortality but not morbidity which reflect in recent studies

SAFE PEDIATRIC Course

EAS Journal of Anaesthesiology and Critical Care

Abbreviated Key Title: EAS J Anesthesiol Crit Care

ISSN: 2663-094X (Print) & ISSN: 2663-676X (Online)

Published By East African Scholars Publisher, Kenya

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OPEN ACCESS

Original Research Article

Complication of Anesthesia in Children: A Prospective Observational Study

Dr. Asma Afroz[1*], Dr. Rehan Uddin Khan[2], Dr. Chandra Shekhor Kormokar[3]

[1]Assistant Professor, Department of Anesthesia, ICU & Pain Medicine, Shaheed Suhrawardy Medical College and Hospital, Dhaka, Bangladesh

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[3]Assistant Professor, Department of Anesthesia, ICU & Pain Medicine, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh

Article History

Abstract: Background: Any anesthetic procedure, either regional or general, has some potential for complications. For this reason, careful preoperative assessment

Patient status according to ASA

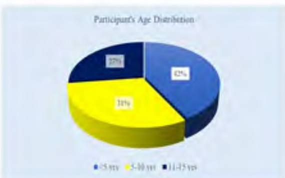
shaheed Suharawardy Medical College and Hospital, Dhaka, Bangladesh January 2018 to December 2018

ASA Score	n	%
ASA I	42	68%
ASA II	12	19%
ASA III	4	7%
ASA IV	2	3%
ASA V	2	3%
	62	100%

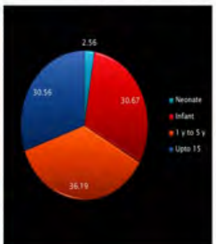
BSMMU Year report 2021to 2022

ASA Score		
ASA I	1062	59.23%
ASA II	605	33.74%
ASA III	78	4.35%
ASA IV	16	0.89%
ASA V	2	0.11%
Emergency	30	1.69%
	1793	100%

Pediatric anesthesia in different aged group



Age -Shaheed Suharawardy Medical College and Hospital, Dhaka, Bangladesh January 2018 to December 2018



BSMMU 2021 to 2022

Pediatric anesthesia for different surgical speciality

Pediatric surgery bed 10

Surgical Procedures	n	%
General surgery	30	48%
ENT	11	18%
Orthopedics	8	13%
Maxillofacial	6	10%
Ophthalmic	5	8%
Cardiothoracic	2	3%
Total	62	100%

Pediatric surgery bed 40

Surgical Procedures		
Pediatric surgery Dept	1305	72 .78%
ENT	115	6.41%
Orthopedics	31	1.72%
Maxillofacial	2	0.11%
Ophthalmic	68	3.79%
Cardiothoracic/	30	1.67%
Urology	20	1.11%
Plastic Surgery	32	1.78%
Outside OT/ Procedural	190	9.92%
	1793	100%

Anesthetic technique

Anesthetic technique Medical college hospital

Technique	n	%
General anesthesia	54	871 %
General anesthesia & local infiltration	3	5%
General anesthesia & caudal block	4	6%
Subarachnoid block	1	2%

Technique		
General anesthesia	837	46.68%
General anesthesia & local infiltration	205	11.43%
General anesthesia & caudal block	408	22.75%
Subarachnoid block/epidural	172	9.59%
Monitoring anesthesia	171	9.53%

Morbidity in Pediatric Anesthesia

Per-operative Complication Medical college hospital

Complications	n 62	%
Bronchospam	7	11%
Bradycardia	6	10%
Hypotension	5	8%
Hypoventilation	4	6%
Tachycardia	4	6%
Laryngeal spasm	4	6%
Hypertension	4	6%
Apnoea	4	6%
Dysrrhythmia	3	5%
Total Morbidity	41	64%
Cardiac arrest table	2	3%

Complications	N 1703	%
Bronchospasm	50	2.78%
Bradycardia	69	3,38%
Hypoxemia	67	3.73%
Hypoventilation/Inadequate ventilation	34	1.89%
Tachycardia	156	8.70%
Laryngeal spasm	57	3.17%
Hypertension	61	3.40%
Apnoea	5	0.27%
Dysrhythmia	103	5.74%
Hypothermia	67	3.73%
Total	669	37,31%
Cardiac arrest On table	6	0.32%

Morbidity in Pediatric Anesthesia

Post-operative Complication
Medical college hospital

Complications	n	%
Tachycardia	12	19%
Prolonged unconsciousness	6	10%
Hypoventilation	5	8%
Restlessness	3	5%
Respiratory arrest	3	5%
Pain	3	5%
Shivering	3	5%
Hypotension	2	3%
Hypertension	2	3%
Hemorrhage	2	3%
Laryngospasm	2	3%
Bronchospasm	2	3%

Post-operative Complication : BSMMU

Complications	n1793	%
Air way obstruction/hypoxemia	75	4.18
Tachycardia	185	10.31
Prolonged unconsciousness /delay recovery	45	2.50
Hypoventilation/hypoxemia	105	5.85
Restlessness	209	11.65
Respiratory arrest	21	1.17
Pain inadequate controle	107	5.96
Shivering	121	6.74
Hypotension	81	4.51
Hypertension	65	3.62
Hemorrhage	43	2.39
Laryngospasm	67	3.73
Bronchospasm	75	4.18
Total	1132	63.13

Mortality Pediatric surgery IN BSMMU 2022

Age and group	N Operation done	Mortality	%
Neonatal	130	16	12.3%
Infant	579	3	0.51%
Pre school	583	2	0.34%
Aldocent	501	1	0.19%
Pediatric cardiac surgery	85	15	17.64%
On table mortality		2	All other in post operative period

BJA

British Journal of Anaesthesia, 126 (6): 1157–1172 (2021)

PAEDIATRIC ANAESTHESIA

Morbidity and mortality after anaesthesia in early life: results of the European prospective multicentre observational study, neonate and children audit of anaesthesia practice in Europe (NECTARINE)

Nicola Disma[1,*], Francis Veyckemans[2], Katalin Virag[3], Tom G. Hansen[4,5], Karin Becke[6], Pierre Harlet[7], Laszlo Vutskits[8,9], Suellen M. Walker[10], Jurgen C. de Graaff[11], Marzena Zielinska[12], Dusica Simic[13], Thomas Engelhardt[14] and Walid Habre[8,9], for the NECTARINE Group of the European Society of Anaesthesiology Clinical Trial Network

[1]Department of Anaesthesia, Unit for Research & Innovation, Istituto Giannina Gaslini, Genova, Italy, [2]Departement d'Anaesthésie-Réanimation pédiatrique, Hôpital Jeanne de Flandre, CHRU de Lille, Lille, France, [3]Department of Medical Physics and Informatics, University of Szeged, Szeged, Hungary, [4]Department of Anaesthesia and Intensive Care -Paediatrics, Odense University Hospital, Odense, Denmark, [5]Department of Clinical Research - Anaesthesiology, University of Southern Denmark, Odense, Denmark, [6]Department of Anaesthesia and Intensive Care, Cnopf Children's Hospital/Hospital Hallerwiese, Nürnberg, Germany, [7]Research Department, European Society of Anaesthesiology,

Audit report on pediatric anesthesia

Critical events requiring intervention occurred in 35.2% of cases--

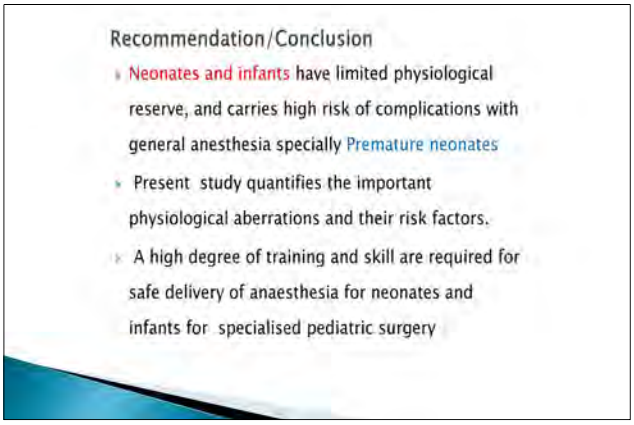
- Mainly hypotension (>30% decrease in blood pressure) or reduced oxygenation (SpO2 <85%).
- Postmenstrual age influenced the incidence and thresholds for intervention.
- Risk of critical events was increased by prior neonatal medical conditions, congenital anomalies, or both.

Audit report on pediatric anesthesia

- The incidence of peri-operative complications and mortality is higher in neonate and infant than in older children,
- Specific impact of anaesthesia technique and management has not been fully characterized.
- Alterations in perioperative physiological parameters have a significant factors affecting early and late neuro-developmental and health outcomes.


Challenges
Administrative and Financial
a. Capacity building and organized health management system is still going on
b. Socioeconomic status of Bangladesh is devoloping
2. Infrastructure : a. Many of our Hospital are inadequate for specialized facilities,
b. Universal precaution and awareness for infection control is insufficient in theater & PICU, NICU
3. Shortage of Skill manpower , anesthesiologist and supporting staff.
4. Need Motivation and remunerations ,reorganization
5. Lack of Social awareness with various superstitions
6. Government planning

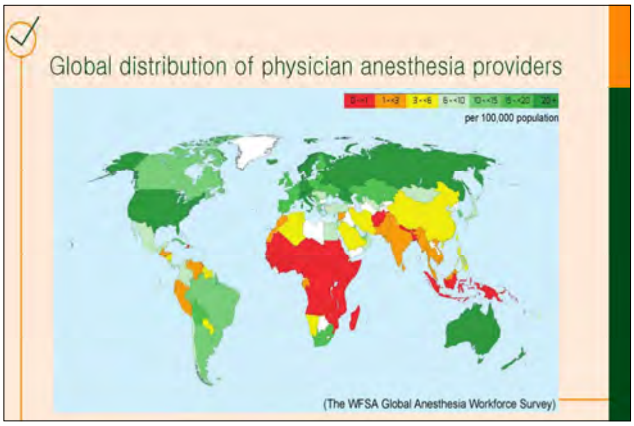

Opportunities For Improvement
Regional and international co-operation is essential leaded by AAPA And WFSA
Arrange Short term training program for qualifying anesthesiologist and OT and post operative nurses Like SAFE pediatric Courses
Special training schedule in all post graduate program at least 3moonth to one year.
Training exchange program within developed and developing Country
One year fellowship program organized by BSMMU and scholarship from WFSA

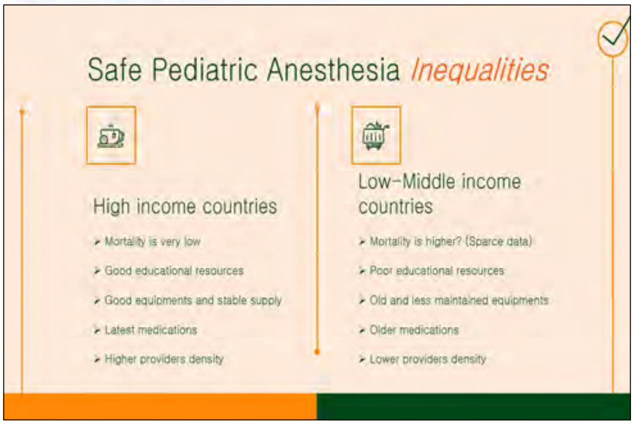

Recommendation/Conclusion
Neonates and infants have limited physiological reserve, and carries high risk of complications with general anesthesia specially Premature neonates
Present study quantifies the important physiological aberrations and their risk factors.
A high degree of training and skill are required for safe delivery of anaesthesia for neonates and infants for specialised pediatric surgery

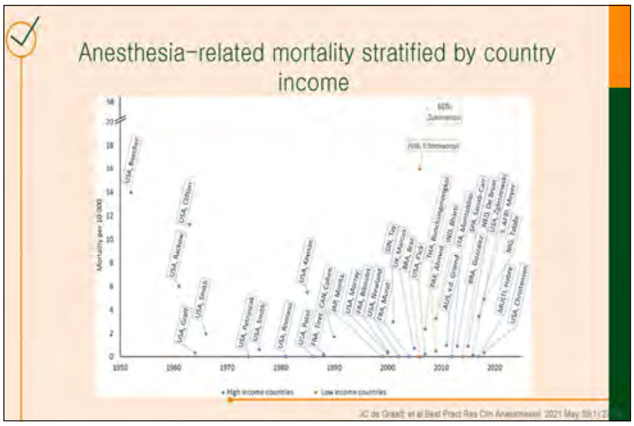
Universal Coverage of Safe Pediatric Anesthesia all over the World: WFSA pediatric Anesthesia Committee

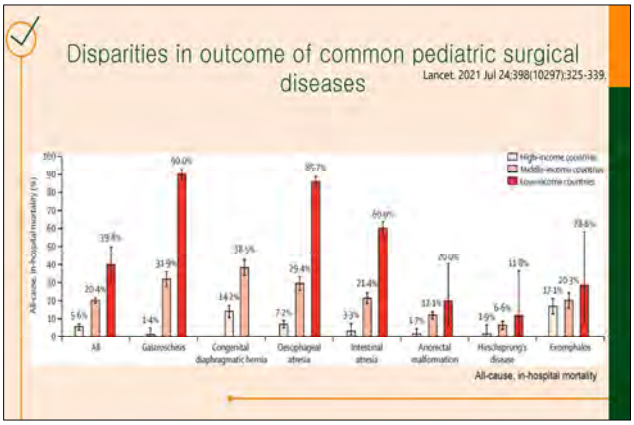
Norifumi Kuratani

Saitama Children's Medical Center, Japan



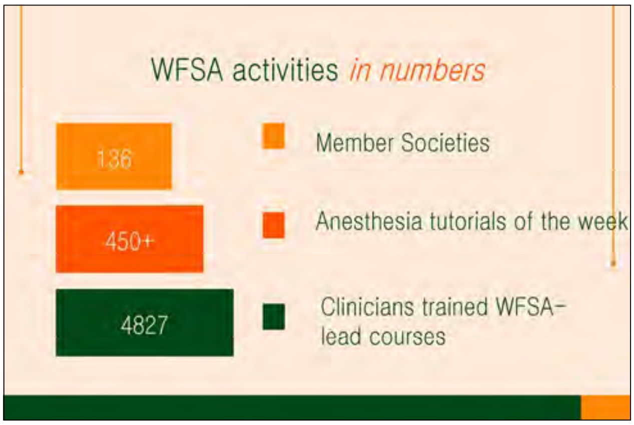

Safe Pediatric Anesthesia Inequalities
High income countries
Mortality is very low
Good educational resources
Good equipments and stable supply
Latest medications
Higher providers density
Low-Middle income countries
Mortality is higher? (Sparce data)
Poor educational resources
Old and less maintained equipments
Older medications
Lower providers density


Anesthesia-related mortality stratified by country income


Disparities in outcome of common pediatric surgical diseases
Lancet. 2021 Jul 24;398(10297):325-339.
All-cause, in-hospital mortality


02
WFSA
WFSA
WORLD FEDERATION OF SOCIETIES OF ANAESTHESIOLOGISTS

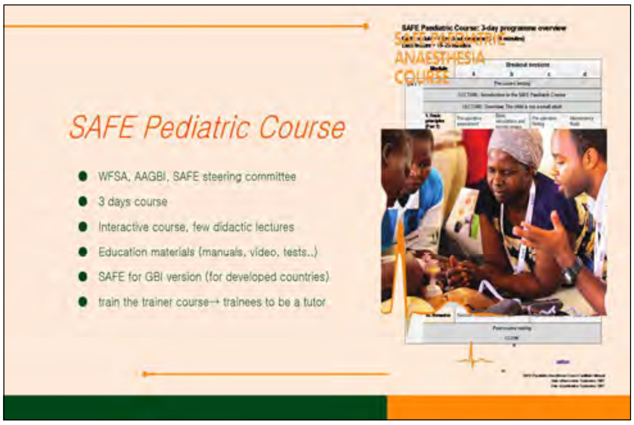

Our Vision
Universal access to safe anaesthesia.
Our Mission
To unite and empower anaesthesiologists around the world to improve patient care.


WFSA activities in numbers
136
Member Societies
450+
Anesthesia tutorials of the week
4827
Clinicians trained WFSA-lead courses

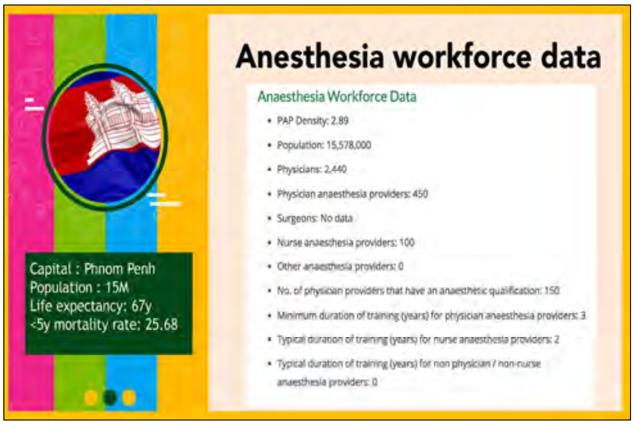

03
pediatric anesthesia committee
WFSA


1. WFSA pediatric anesthesia committee member


Ongoing Committee Projects
SAFE Course
Implementing SAFE pediatric anesthesia course all over the world
Textbook
Case-based pediatric anesthesia textbook authored by committee members
Webinars
Working together with ASPA providing educational resorces
Fellowship
Development of new pediatric anesthesia fellowship program in Bosnia and Herzegovina
PEACH
Epidemiologic study to learn the incidence of critical adverse events in pediatric anesthesia
Cancer Care
Anesthesia is important in pediatric oncology care


SAFE Pediatric Course
WFSA, AAGBI, SAFE steering committee
3 days course
Interactive course, few didactic lectures
Education materials (manuals, video, tests..)
SAFE for GBI version (for developed countries)
train the trainer course→ trainees to be a tutor
SAFE PAEDIATRIC ANAESTHESIA COURSE


SAFE pediatric anesthesia & ToT course in Cambodia
Nov. 18-20, 2022
Paediatric Anaesthetic and Train the Trainers Course
SAFE


Anesthesia workforce data
Capital : Phnom Penh
Population : 15M
Life expectancy: 67y
<5y mortality rate: 25.68
Anaesthesia Workforce Data
PAP Density: 2.89
Population: 15,578,000
Physicians: 2,440
Physician anaesthesia providers: 450
Surgeons: No data
Nurse anaesthesia providers: 100
Other anaesthesia providers: 0
No. of physician providers that have an anaesthetic qualification: 150
Minimum duration of training (years) for physician anaesthesia providers: 3
Typical duration of training (years) for nurse anaesthesia providers: 2
Typical duration of training (years) for non physician / non-nurse anaesthesia providers: 0


Faculties
Faculty leaders
Lowri Bowen (UK, SAFE steering committee)
Nori Kuratani (Japan, WFSA pediatric chair)
Tep Sokha (Cambodia, SCARMU)
UK:4, Japan:4, Cambodia:5
SAFE pediatric course
2 days course
5 lectures, 19 modules
26 local providers trained
Train the Trainer
1 day course
10 new trainers
WFSA
SAFE PAEDIATRICS
Association of Anaesthetists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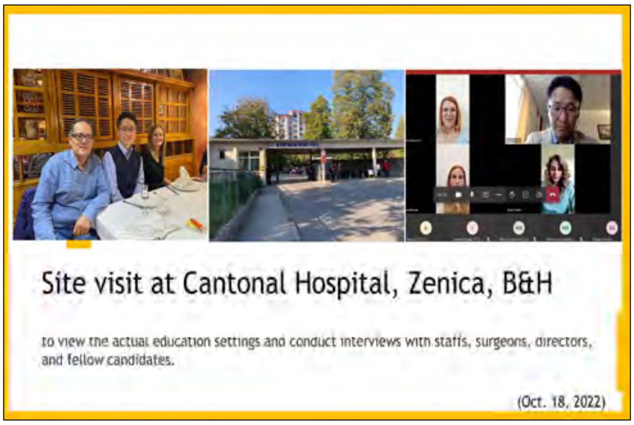
Pediatric Anesthesia fellowship program at Bosnia and Herzegovina
GERMANY
CZECH REPUBLIC
SLOVAKIA
SWITZERLAND
AUSTRIA
HUNGARY
SLOVENIA
ROMANIA
CROATIA
BOSNIA AND HERZEGOVINA
SERBIA
ITALY
KOSOVO
MONTENEGRO
BULGARIA
MACEDONIA
ALBANIA


Anesthesia workforce data
Capital : Saraevo
Population : 3.8M
Life expectancy: 77y
<5y mortality rate: 5.86
PAP Density: 6.04
Population: 3,810,000
Physicians: 6,224
Physician anaesthesia providers: 230
Surgeons: 275
Nurse anaesthesia providers: 0
Other anaesthesia providers: 0
No. of physician providers that have an anaesthetic qualification: 195
Minimum duration of training (years) for physician anaesthesia providers: 5
Typical duration of training (years) for nurse anaesthesia providers: 0
Typical duration of training (years) for non physician / non-nurse anaesthesia providers: 0


Progress
Requested by Dr. Adisa Šabanović Adilović, BiH society
Draft program developed and discussed in pediatric committee
Approved and endorsed by
Medical chamber Zenica-Doboj Canton
Cantonal Hospital Zenica
Association of anesthesiologists of the Federation of BIH
Faculty of Medicine Zenica
Ministry of Health Zenica-Doboj Canton
Waiting for WFSA approval


Program overview
Practice
3 month
Zenica hospital
Dr. Adisa Šabanović Adilović
To accuire competency
Lectures
Didatic lectures
Case-conference
Online by committee members
To learn theoretical background
Evaluation
Formative and summative evaluation


Site visit at Cantonal Hospital, Zenica, B&H
to view the actual education settings and conduct interviews with staffs, surgeons, directors, and fellow candidates.
(Oct. 18, 2022)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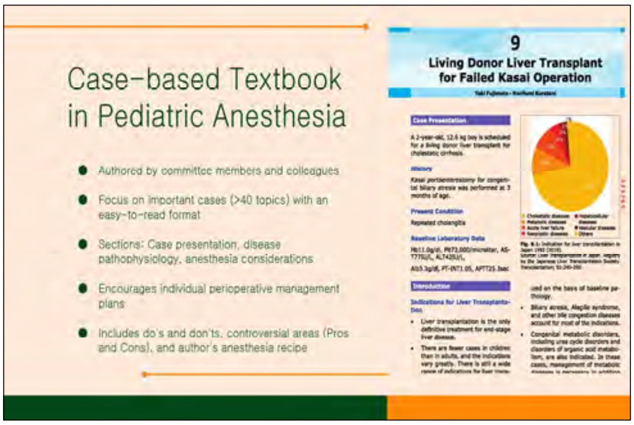
Case-based Textbook in Pediatric Anesthesia
Authored by committee members and colleagues
Focus on important cases (>40 topics) with an easy-to-read format
Sections: Case presentation, disease pathophysiology, anesthesia considerations
Encourages individual perioperative management plans
Includes do's and don'ts, controversial areas (Pros and Cons), and author's anesthesia recipe
9
Living Donor Liver Transplant for Failed Kasai Operation


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PEACH in Asia study
16
Design
multinational, multicenter, prospective, observational study
Outcome measures
Primary: Incidence of severe critical events
① laryngospasm, ② bronchospasm, ③ pulmonary aspiration, ④ drug error,
⑤ anaphylaxis, ⑥ cardiovascular instability, ⑦ neurological damage,
⑧ peri-anesthetic cardiac arrest, ⑨ post-anesthetic stridor
[Time Frame: Children will be followed for the duration of their anesthesia procedure and up to 60 minutes afterwards]
Secondary:
1. Risk factors for the occurrence of severe critical events
2. Consequences of the critical events: irreversible damage, in-hospital mortality
[Time Frame: in-hospital and up to 30 days]


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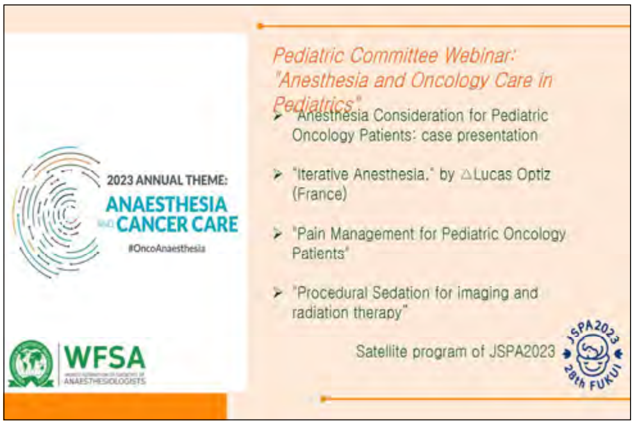
monthly ASPA FLEX webinar series, supported by WFSA committee project funding
PAEDIATRIC SEDATION
8th ASPA FLEX
Paediatric Perioperative Fluid Therapy

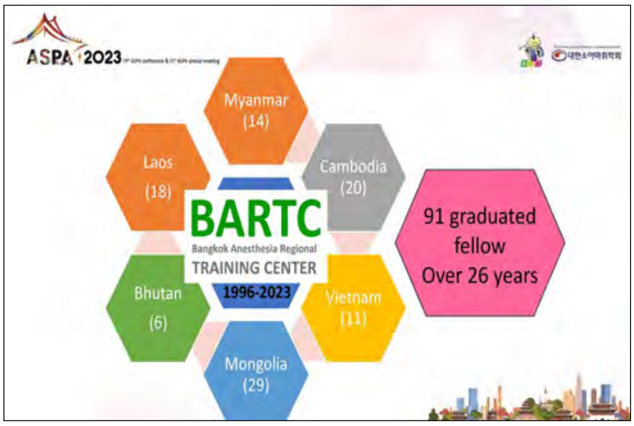

2023 ANNUAL THEME:
ANAESTHESIA CANCER CARE
#OncoAnaesthesia
WFSA
Pediatric Committee Webinar: "Anesthesia and Oncology Care in Pediatrics"
"Anesthesia Consideration for Pediatric Oncology Patients: case presentation
"Iterative Anesthesia," by △Lucas Optiz (France)
"Pain Management for Pediatric Oncology Patients"
"Procedural Sedation for imaging and radiation therapy"
Satellite program of JSPA2023
JSPA2023
28th FUKUI

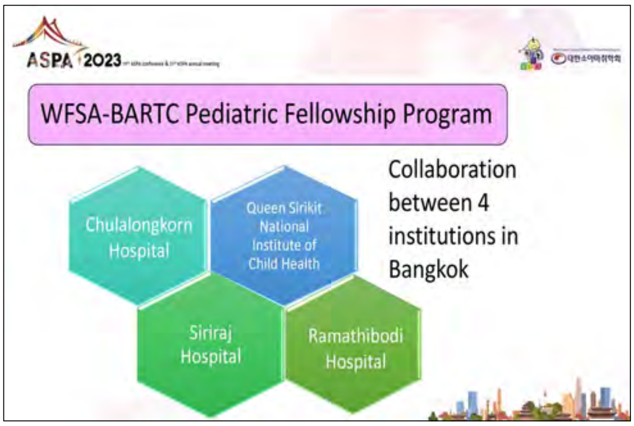

Conclusions
Unmet need
is common for safe pediatric anesthesia
Education
is key to change
Work together
to implement safe pediatric anesthesia all over the world
SAFE
WFSA

Activities and Accomplishments of the WFSA BARTC Pediatric Fellowship Program

Patcharee Sriswasdi

Department of Anesthesiology, Critical Care and Pain Medicine, Boston Children's Hospital, USA





WFSA-BARTC Pediatric Fellowship Program

Applicant requirement

- He/she works in a Government hospital and will return to this institution work after the training. (with letter recommendation from the Head of Department where he/she works)
- Recommendation from the Society of Anesthesia in his/her country.
- Work as an anesthesiologist for at least 3 years

WFSA-BARTC Pediatric Fellowship Program

Applicant requirement

- The number of pediatric cases in the institute that he/she works per year
- List of the surgical services for pediatric patients in your institution.
- The total number of pediatric cases that he/she has anesthetized per year in the past.

12 months Rotation

Institute	Month	Rotation	Topic discussion
Siriraj	15-31 January 2021	General surgery	Premature babies, neonates and infants: basic science, physiology, pharmacology, monitoring, psychology
Siriraj	1-14 February 2021	Urology	URI, emergence delirium, airway obstruction, laryngospasm, laryngeal edema
Siriraj	15 February - 15 March 2021	Neuro-ENT	Anesthesia for neuro-surgery: craniotomy, myelomeningocele, spine surgery
Chula	16 March - 15 April 2021	Gen-Uro-Thoracic	Upper and lower abdominal, groin, perineal and anorectal surgery, endoscopic surgery, thoracotomy
Chula	16 April 2021	Outside OR	Anesthesia for eye surgery: retinopathy of prematurity, strabismus & muscle correction
Chula	1-31 May 2021	Plastic/EENT	Anesthesia for maxillofacial surgery: craniofacial reconstruction, cleft lip/palate surgery
Rama	1-30 June 2021	Gen-Uro	Common congenital anomalies: Down syndrome
Rama	1-15 July 2021	Outside OR	Anesthesia for outside OR procedure: CT, MRI, bone scan, cath lab, endoscopy
Rama	16 July -15 August 2021	Plastic/EENT/Uro	Anesthesia for ENT: bronchoscopy, airway surgery, adenotonsillectomy, tympanoplasty, morbid obesity
Queen Sirikit	16 August -15 September 2021	Ortho/EENT	Anesthesia for orthopedics: scoliosis, limb deformity correction
Queen Sirikit	16 September-15 October 2021	Gen-Uro	Hypothermia, malignant hyperthermia, muscular dystrophy, Postoperative pain management (multimodal analgesia)
Queen Sirikit	16-31 October 2021	Neuro/Outside OR	Massive bleeding, glucose, fluid, electrolyte management
Siriraj	1-15 November 2021	GEN	Examination
	16 November 2021 - 10 January 2022		**Elective in 4 institutes**
	11-14 January 2022		**Final Presentation on Graduation Day**

Minimal case requirement 100 cases

Age group	Cases	ETT	SI	CU	RA	QS
NEONATE	10	15	5	5	5	5
INFANT	40					
Age >1- 5 year	50	10	3	3	3	3
Age > 5 year	20					
Type of patients						
In-patient	70					
Ambulatory patient	15					
Anesthesia for outside OR	15					
Type of surgery						
Anesthesia for Gen-Uro surgery	30	All				
Anesthesia for Neuro	5	Si				
Anesthesia for EYE-ENT	15	All				
Anesth. for Plastic & maxillofacial	10	Cu Ra				
Anesthesia for orthopedics	5	Qs				
Anesthesia for outside OR	15	Cu Ra				

Procedures	Cases	SI	CU	RA	QS
Peripheral IV access	10	3	3	3	3
Supraglottic airway device	10	3	3	2	3
Undermask (General anesthesia)	10	3	3	3	3
Setting mechanical ventilator	5	2	2	2	2
Arterial line insertion	4	1	1	1	1
Central line insertion	4	1	1	1	1
Caudal block/ Epidural block/ Neuraxial block	5	2	1	1	2
Peripheral nerve blockade/Femoral/ Ilioinguinal/iliohypogastric block	5	1	2	2	1
Acute pain	10	3	3	3	3
Management of difficult airway	Work shop				
PALS					
Postoperative care in ICU	8	2	2	2	2

WFSA-BARTC Pediatric Fellowship Program

- Started in January 2021: 1 Fellow from Nepal
- Stopped in January 2022 due to COVID
- July 2022- June 2023: 1 Fellow from Bhutan (Funding from Bhutan government)
- Restart in January 2023: 1 Fellow from Mongolia

Our current fellow

- Our goal is to promote safe anesthesia for patients in developing countries in Asia.

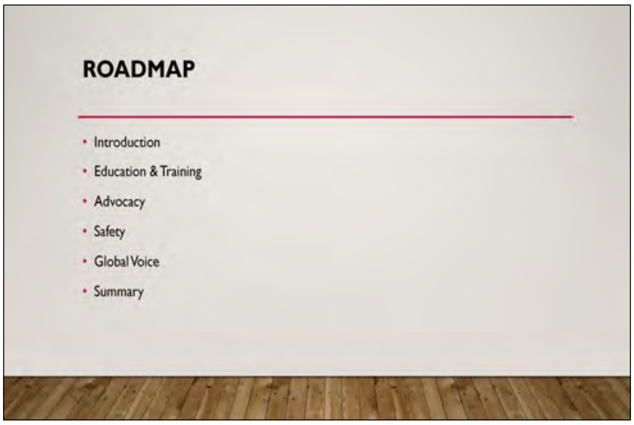
Our first graduated fellow

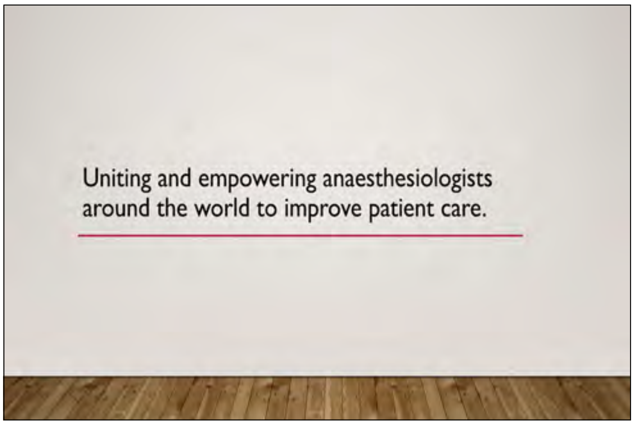
First trained pediatric anesthesiologist in Nepal

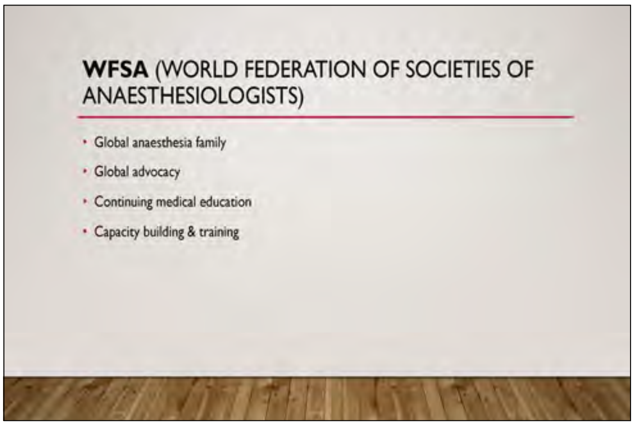
Improving Patient Safety Through the WFSA

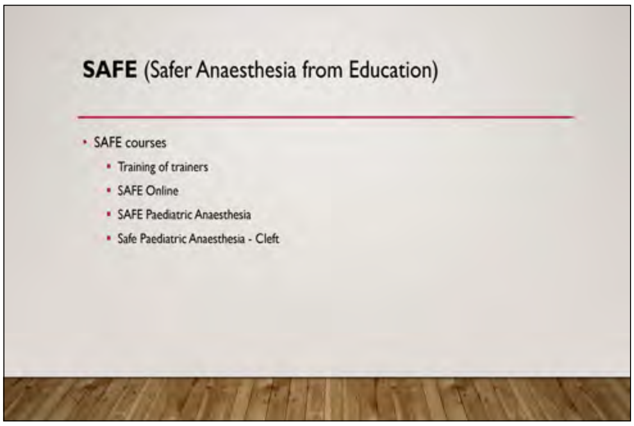
Erlinda C. Oracion

WFSA Safety & Quality Of Practice Committee, Philippines









SAFE (Safer Anaesthesia from Education)

- VAST (Vital Anaesthesia Simulation Training)
  - Essential practices to perioperative teams
  - On-line learning + hands-on simulations
  - Resuscitation for OB, Pedia, Trauma
  - Pre- and post-operative care

"The WFSA is unique in terms of its positioning, global membership and reach. There are no other organizations in the perioperative space quite like it, and our role…. on the international stage is a powerful one."

Kristine Stave, Chief Executive Officer

ADVOCACY

- Engagement with decision makers
- Advance availability, safety, and quality of anaesthesia and perioperative services worldwide
- Amplify the voices of anaesthesiologists at the local, regional, and international levels
- Relationships
  - WHO (World Health Organization)
  - UN ECOSOC (United Nations Economic and Social Council)

"A concern of the WFSA in the early 1960's was anaesthesia workforce capacity building at the international level, in line with its objective of 'providing better anaesthesia for all the peoples of the world.'
In retrospect, it was the beginning of global anaesthesia, meaning that before globalization became a thing, there was a WFSA worldwide concept of anaesthesia."

Dr. Bisola Onajin-Obembe, President of G4 Alliance's Permanent Council
2022 WFSA Board Member

GUIDING PILLARS

1. UNITY
2. ACCESS
3. SAFETY

SAFETY

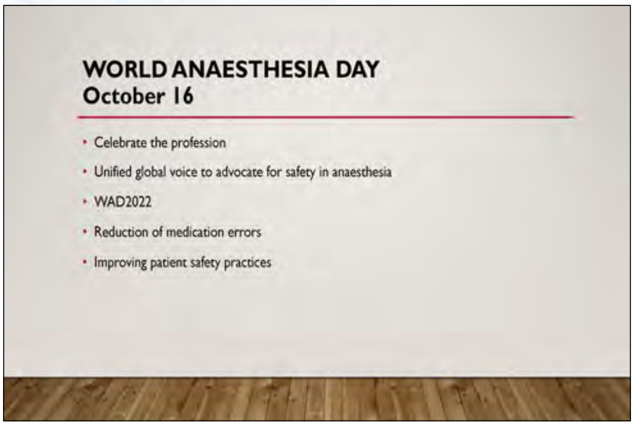
- WHO-WFSA International Standards for a Safe Practice of Anesthesia
- Minimum Capnometer Specifications 2021
- Consensus Statement on Environmentally– Sustainable Anaesthesia

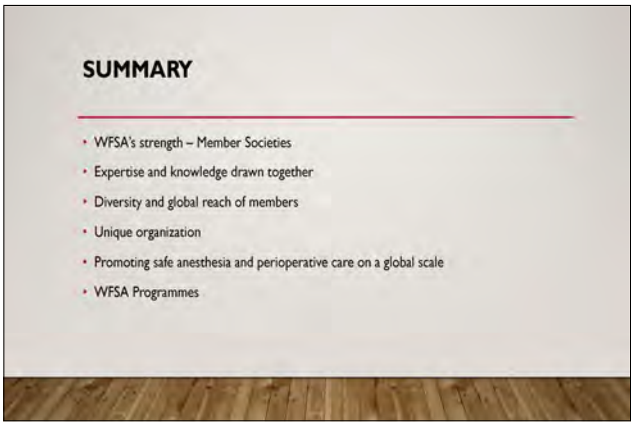
SAFETY & QUALITY OF PRACTICE COMMITTEE

- To promote the highest standards of safety and quality in anaesthesiology internationally
- Seek new methods to implement safe practices throughout the world
- Provide the necessary educational and human resources needed in the provision of access to safe anesthesia for essential surgery
- Deliver safe anesthesia care as a basic human right
- Collaborate with other WFSA committees incorporating patient safety and quality improvement in their plans and activities

WORLD PATIENT SAFETY DAY September 17

- Advocate for improved global patient safety standards and practices
- 2022 – Medication Without Harm


WORLD ANAESTHESIA DAY
October 16
Celebrate the profession
Unified global voice to advocate for safety in anaesthesia
WAD2022
Reduction of medication errors
Improving patient safety practices


SUMMARY
WFSA's strength – Member Societies
Expertise and knowledge drawn together
Diversity and global reach of members
Unique organization
Promoting safe anesthesia and perioperative care on a global scale
WFSA Programmes

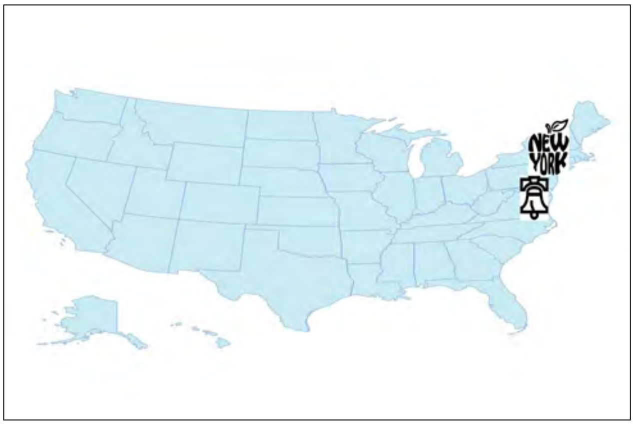
Luncheon Symposium

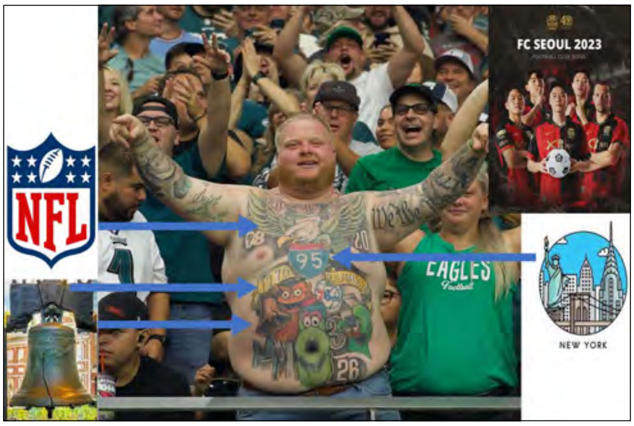
Chair(s): Dong Woo Han (Korea)

EEG Guided Anesthesia in Young Children (Virtual)

Ian Yuan

Anesthesiology and Critical Care Medicine, Children's Hospital of Philadelphia, University of Pennsylvania, USA





CHOP Childrens Hospital of PHiladelphia

33k cases / year

75 Pediatric Anesthesiologist (9 Cardiac)

30 Nurse Anesthetists

11 Fellows

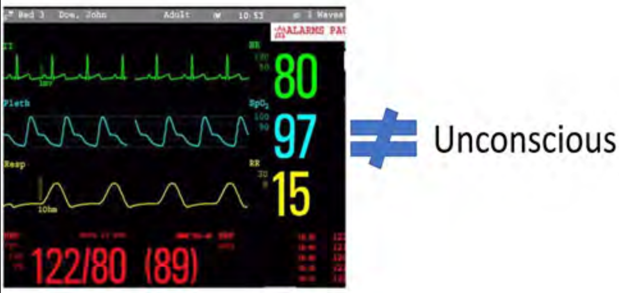
10 Residents

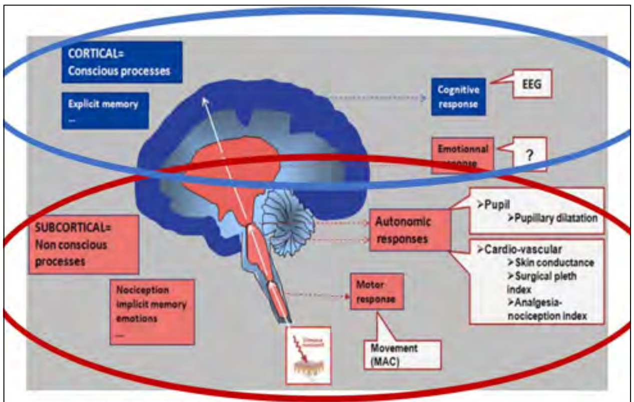
A. Increase the Sevoflurane

B. Bolus Propofol

C. Muscle relaxant

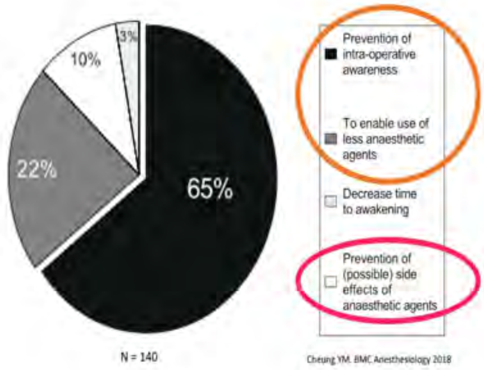
D. EEG





Constant I, Sabourdin N. Pediatric anesthesia. 2015

Chan MT, A&A 2020



Cheung YM. BMC Anesthesiology 2018

Young children sensitive to effects of excess anesthesia (hypotension)

Proprietary EEG indices (eg. BIS, PSI) not reliable

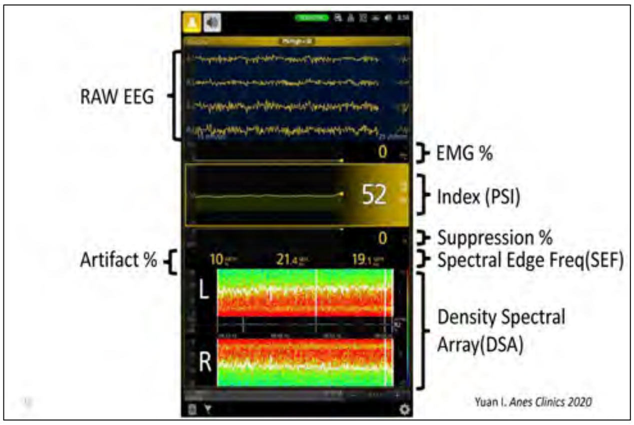
How to use EEG to guide anesthesia in young children

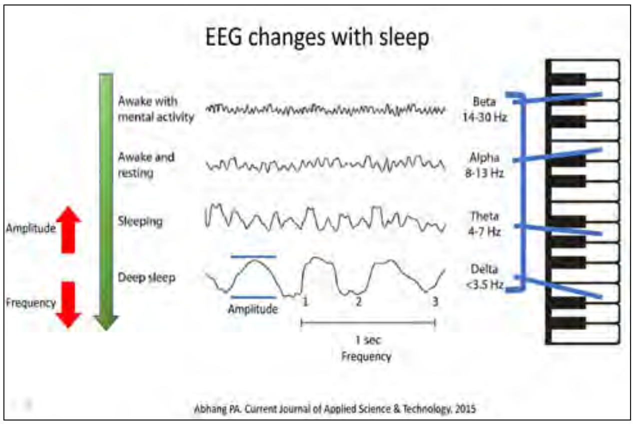
EEG guided anesthetic in young children

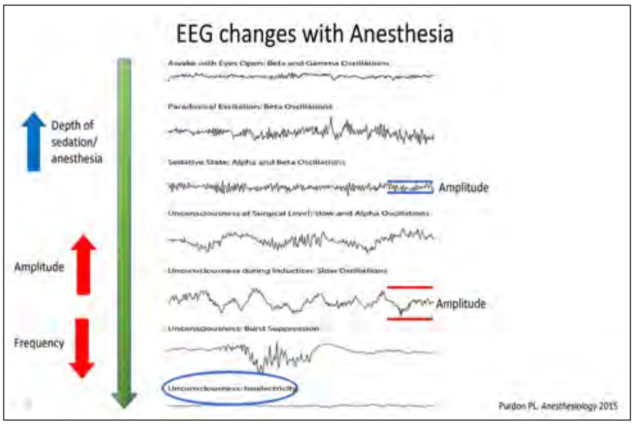
EEG waveforms and processed EEG parameters

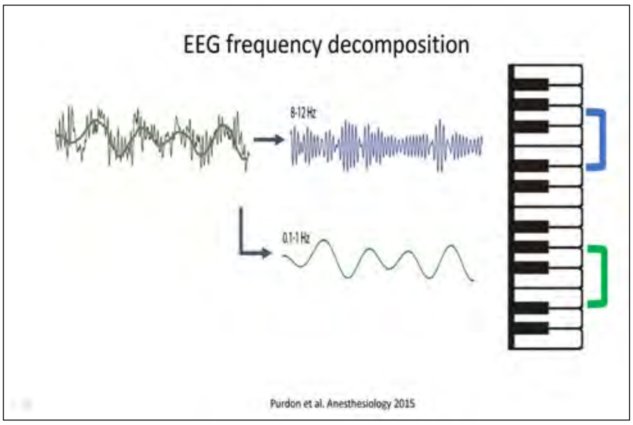
EEG changes with anesthetic and age

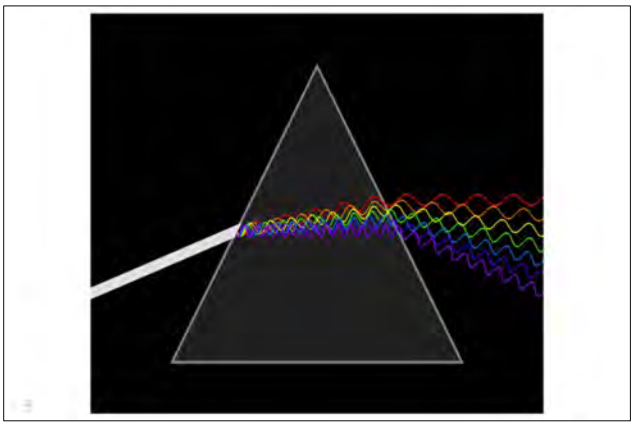
2 cases studies

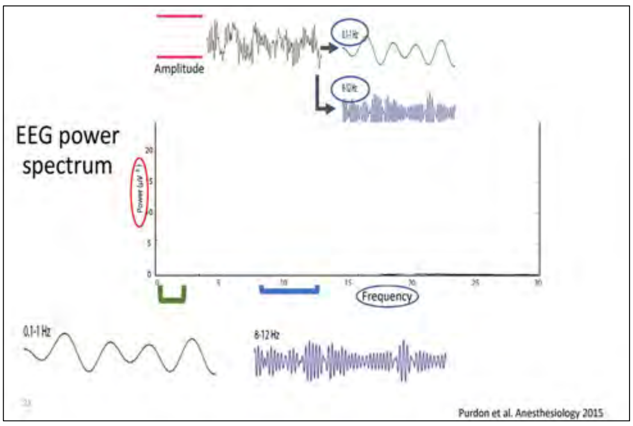






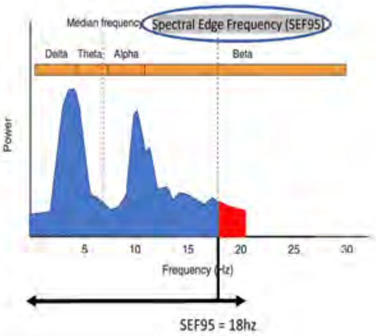






Spectral Edge Frequency (SEF)

Frequency where majority (95%) of power lies below it.

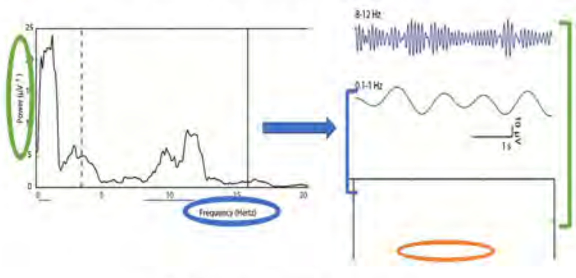


SEF targets (> 3-6mo)

Anesthetic state	*Clinical endpoint*	*SEF targets (hz)*
Conscious	Emergence	> 20
Light anesthesia	Sedation	15-20
Surgical anesthesia	Surgical maintenance	10-15
Deep anesthesia	Incision/Laryngoscopy	6-9
Burst suppression		< 5

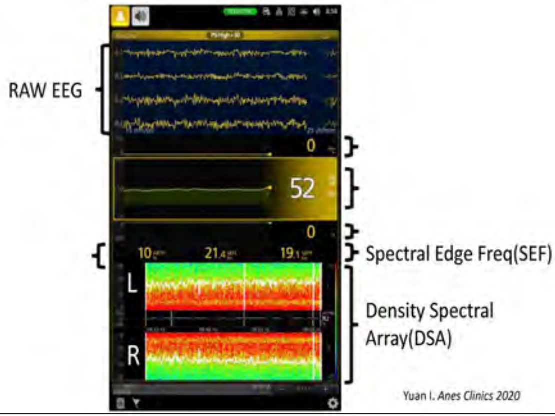
Yuan I. Anes Clinics 2020

DSA (Density Spectral Array)



EEG changes over time.

Purdon et al. Anesthesiology 2015



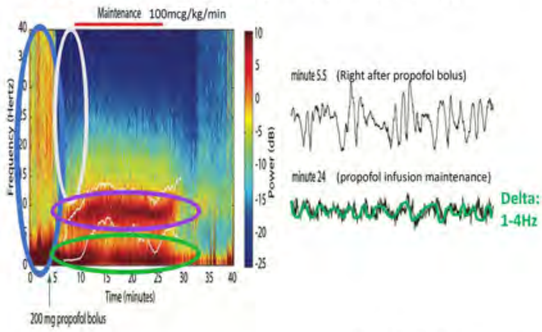
Yuan I. *Anes Clinics 2020*

EEG guided anesthetic in young children

EEG waveforms and processed EEG parameters

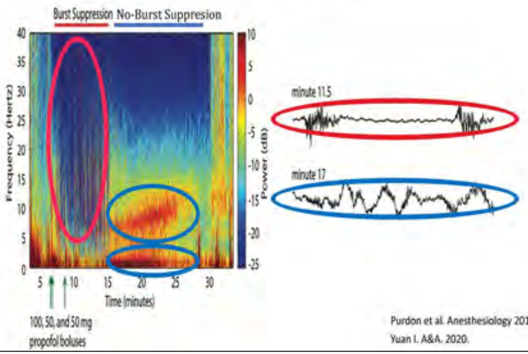
EEG changes with anesthetic and age

Propofol: Delta (1-4hz) & Alpha (8-13hz)



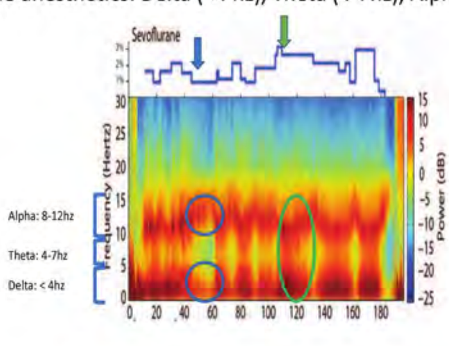
Purdon et al. Anesthesiology 2015

Too much propofol…

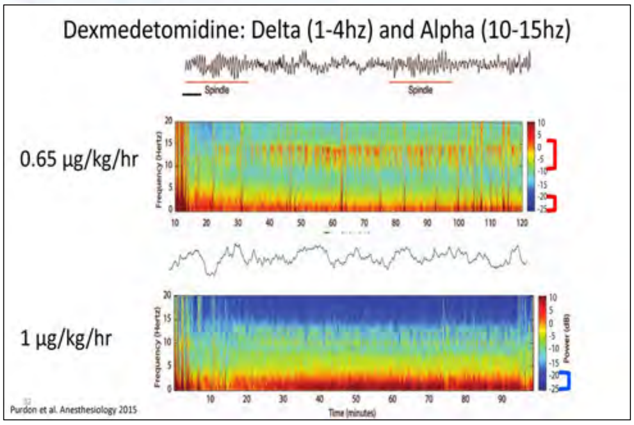


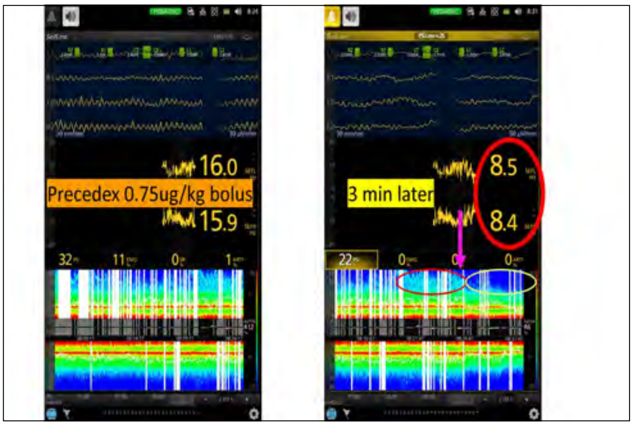
Purdon et al. Anesthesiology 2015
Yuan I. A&A. 2020.

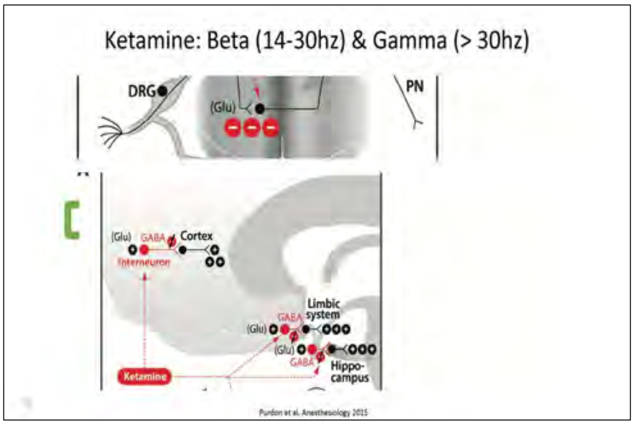
Volatile anesthetics: Delta (<4 hz), Theta (4-7hz), Alpha (8-13hz)

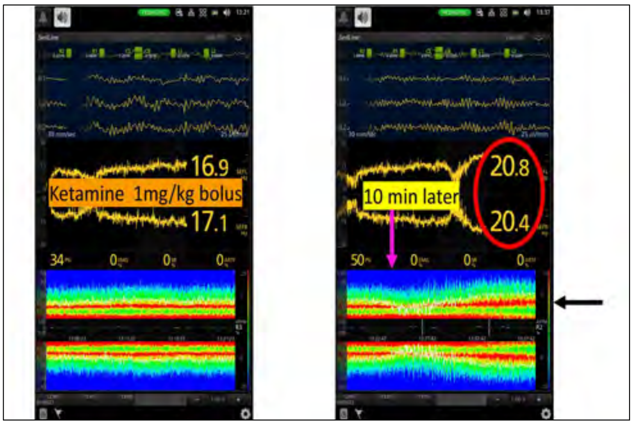


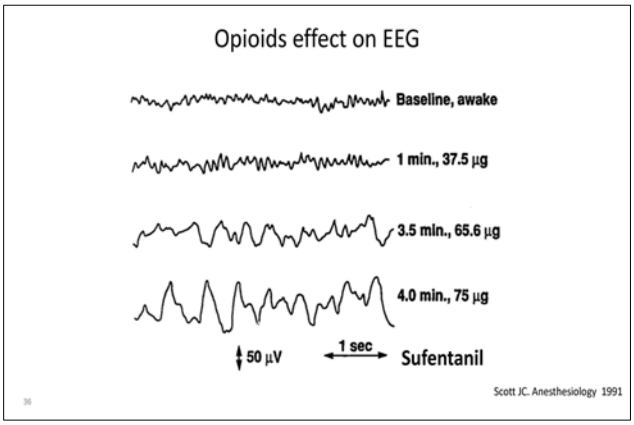
Purdon et al. Anesthesiology 2015

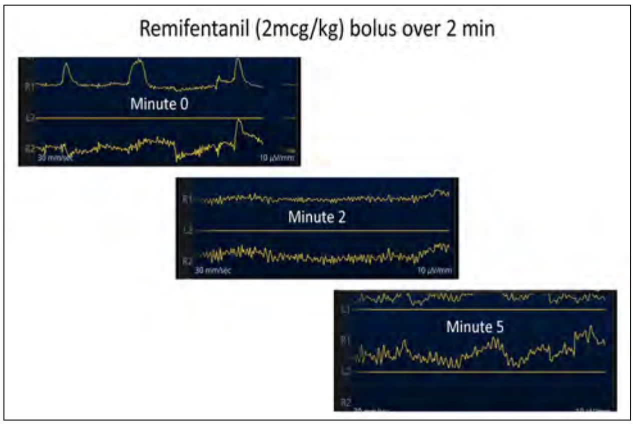

Dexmedetomidine: Delta (1-4hz) and Alpha (10-15hz)
Spindle
Spindle
0.65 µg/kg/hr
1 µg/kg/hr
Frequency (Hertz)
Power (dB)
Time (minutes)
Purdon et al. Anesthesiology 2015

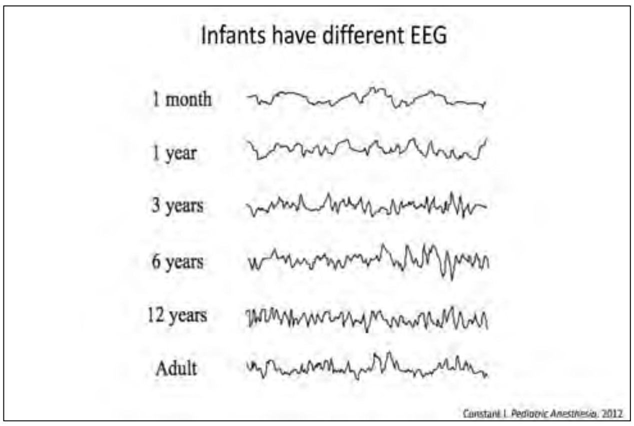

16.0
Precedex 0.75ug/kg bolus
15.9
3 min later
8.5
8.4

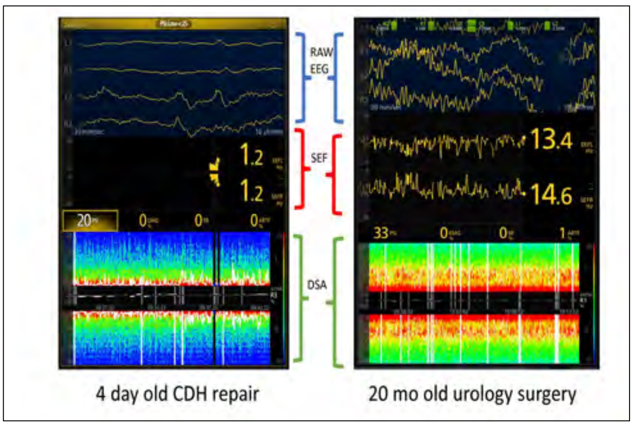

Ketamine: Beta (14-30hz) & Gamma (> 30hz)
DRG
PN
(Glu)
GABA
Cortex
Interneuron
Limbic system
Hippo-campus
Ketamine
Purdon et al. Anesthesiology 2015

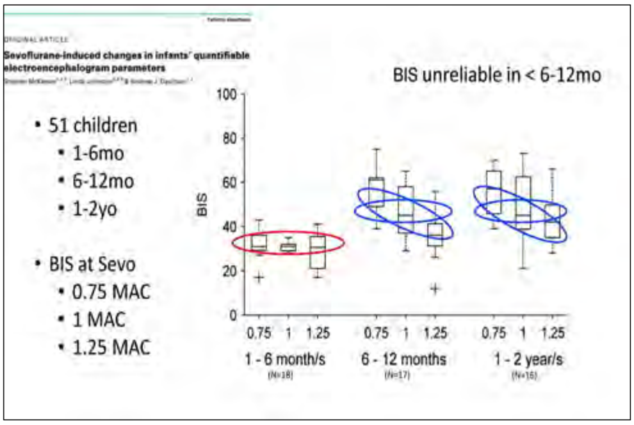

16.9
Ketamine 1mg/kg bolus
17.1
10 min later
20.8
20.4

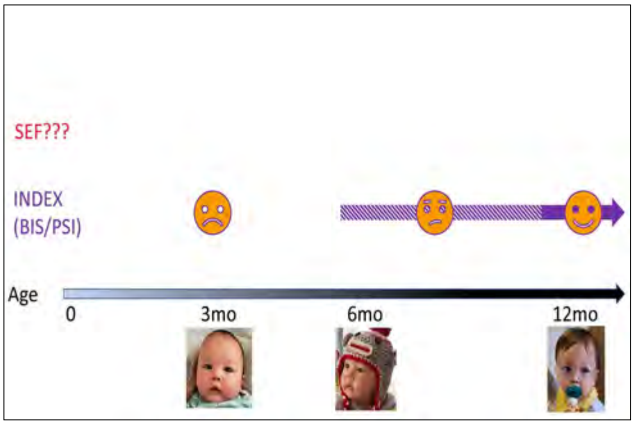

Opioids effect on EEG
Baseline, awake
1 min., 37.5 µg
3.5 min., 65.6 µg
4.0 min., 75 µg
50 µV
1 sec
Sufentanil
Scott JC. Anesthesiology 1991

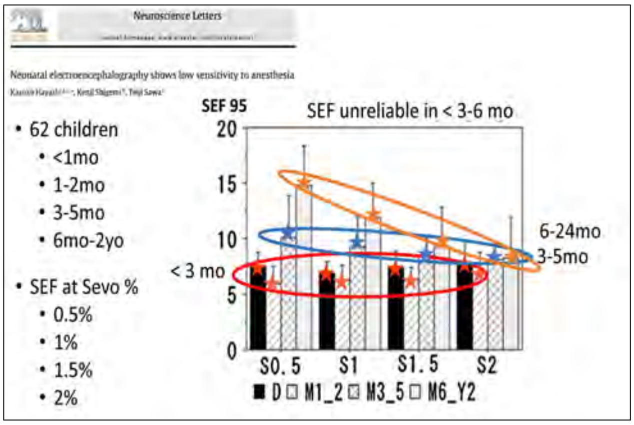

Remifentanil (2mcg/kg) bolus over 2 min
Minute 0
Minute 2
Minute 5

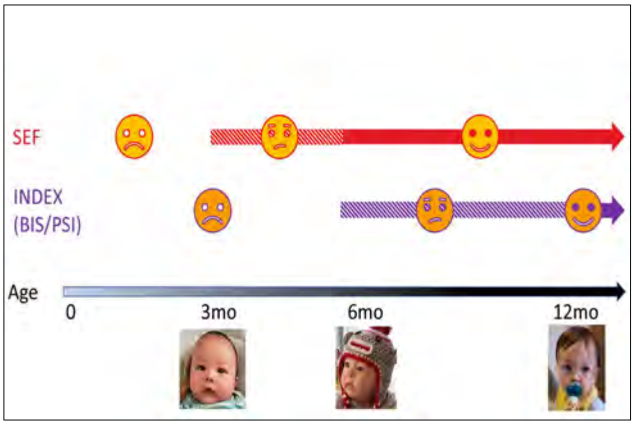

Infants have different EEG
1 month
1 year
3 years
6 years
12 years
Adult
Constant I. Pediatric Anesthesia. 2012

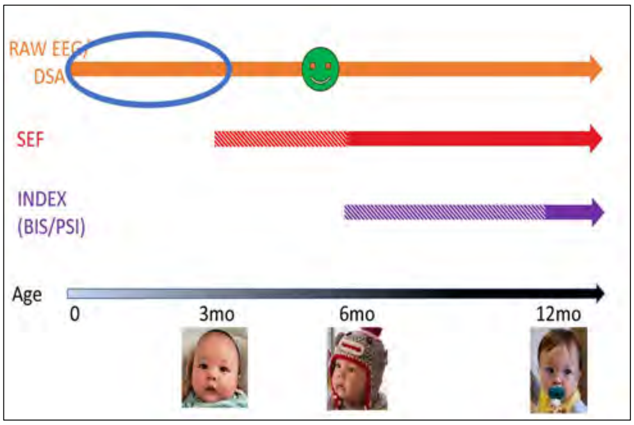

RAW EEG
SEF
DSA
1.2
1.2
13.4
14.6
4 day old CDH repair
20 mo old urology surgery

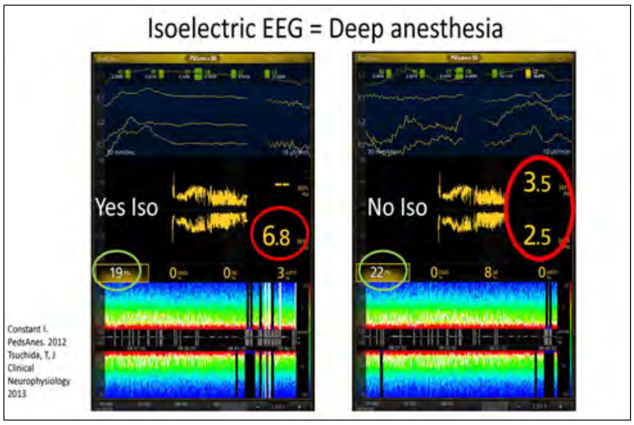












Isoelectric EEG bad?

Adults	Postop delirium, cognitive decline, and increased morbidity.
Children	32% children < 3y; 60% of infants < 3mo. Higher eSevo, propofol bolus, hypotension, and lower PedsQL.

Unnecessary in most situations.

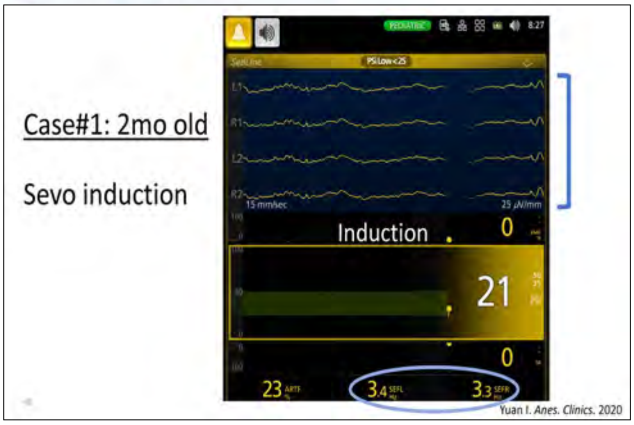
Fritz, A&A 2016; Saczynski, NEJM 2012; Marcantonio, NEJM 2017
Seltzer, JTCVS 2016; Yuan, A&A 2020; Yuan, Anesthesiology 2022

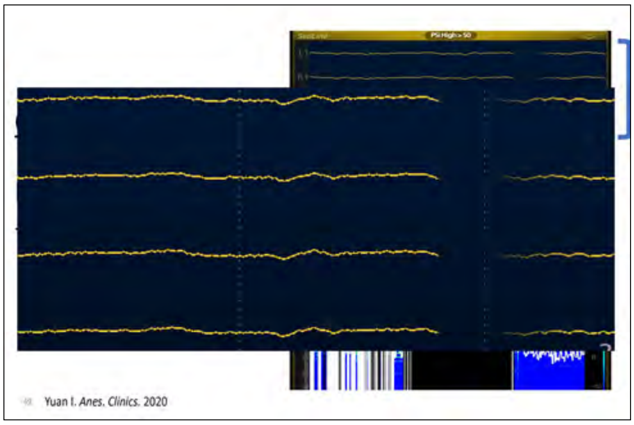
EEG monitoring in children

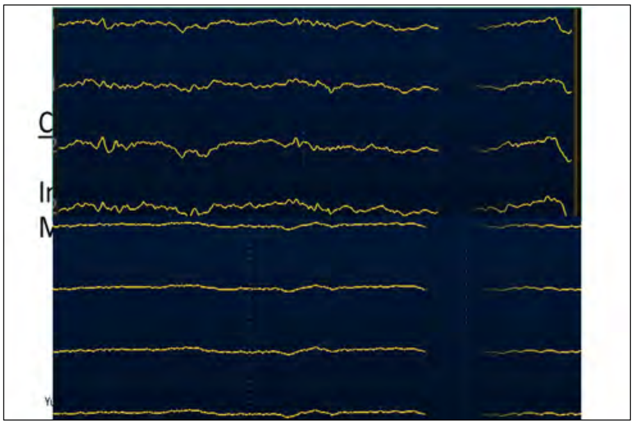
EEG waveforms and processed EEG parameters

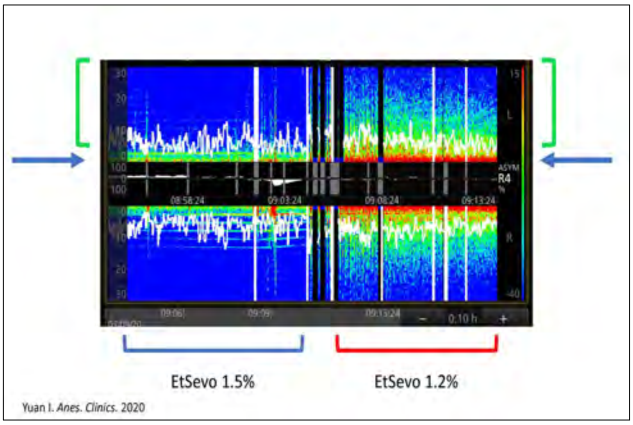
EEG changes with anesthetic and age

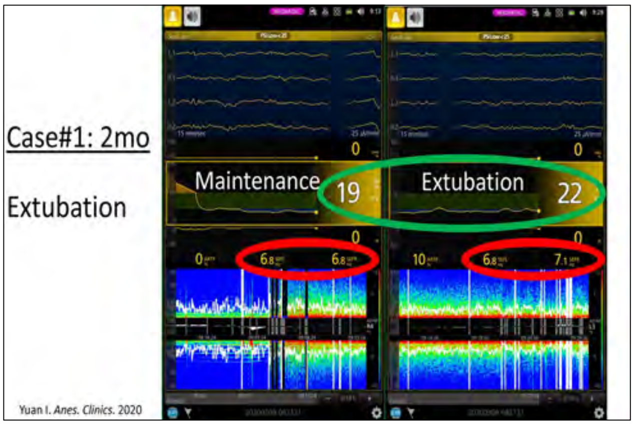
Cases studies

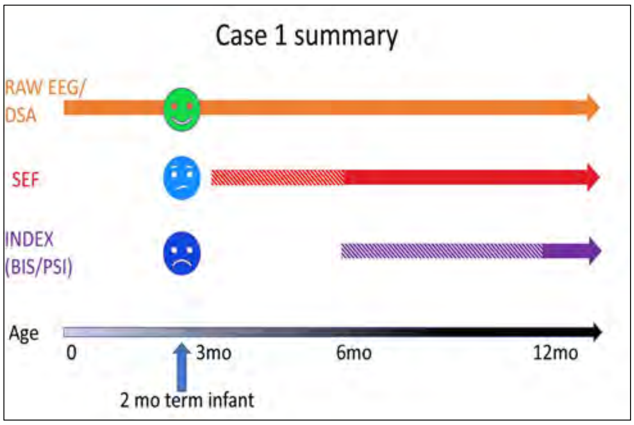


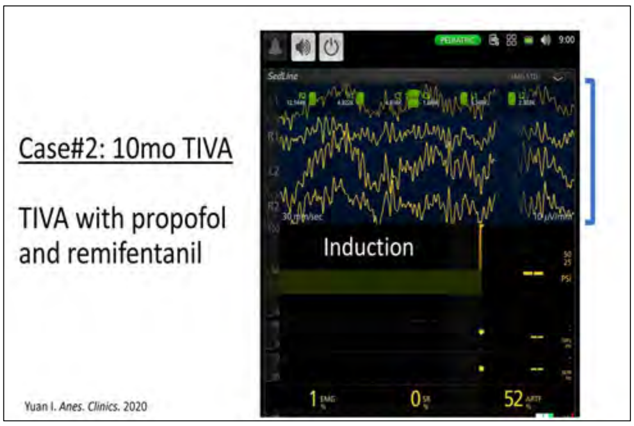












Propofol dosing table

Age group	*0-1 mo*	*1-3 mo*	*3-6 mo*	*6-12 mo*	*1-3 yrs*	*3-12 yrs*
Propofol bolus (mg/kg)	3.5	3	3	3	3	2.5
Propofol 0-15 min (μg/kg/min)	183	200	200	208	217	250
Propofol 16-30 min	167	183	192	200	200	217
Propofol 30-60 min	150	167	175	183	192	183
Propofol 60-120 min	133	158	167	175	183	167
Propofol 120-180 min	117	150	158	167	175	150
Propofol 180-300 min	100	133	150	158	167	142

Yuan I. Anes. Clinics. 2020
Steur RJ. Ped Anes 2004
Morse J. Ped Anes 2019
Eleveld DJ. Br J Anaes 2018

Propofol Ce 3 μg/ml

Recommended SEF ranges (> 3-6mo)

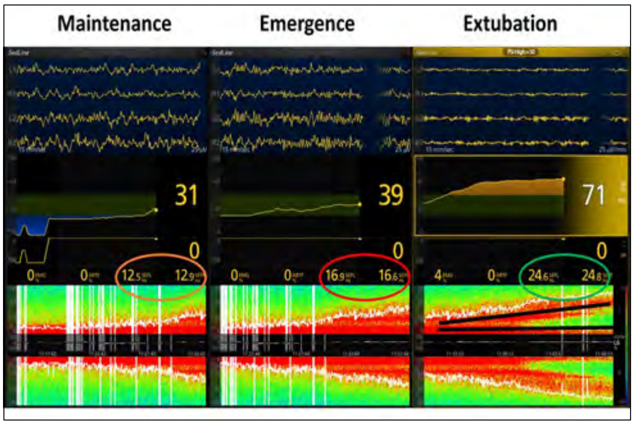
Clinical endpoint	*SEF range (hz)*
Emergence	> 20
Sedation	15-20
Surgical maintenance	10-15
Incision/Laryngoscopy	6-9
Burst Suppression	< 5

Case#2: 10mo TIVA

Intubation

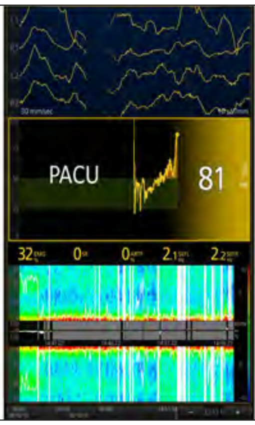
Case#2: 10mo TIVA

Incision -> Maintenance

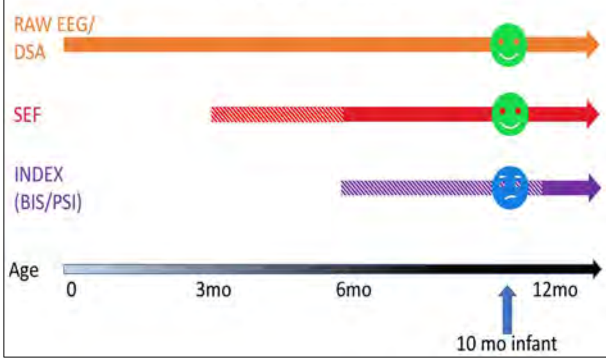


Case#2: 10mo TIVA

PACU



Case 2 summary



Session 3.

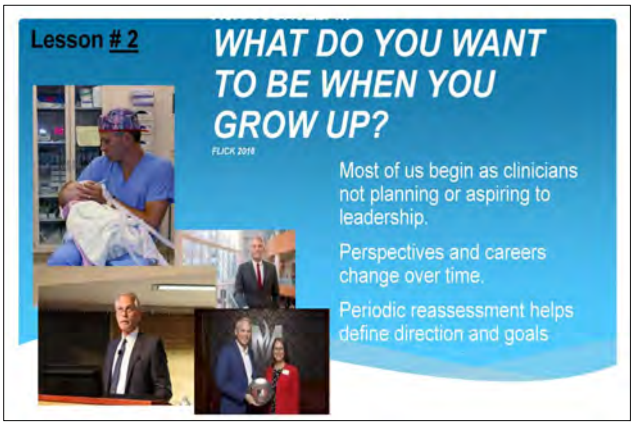
Preparing for the Future

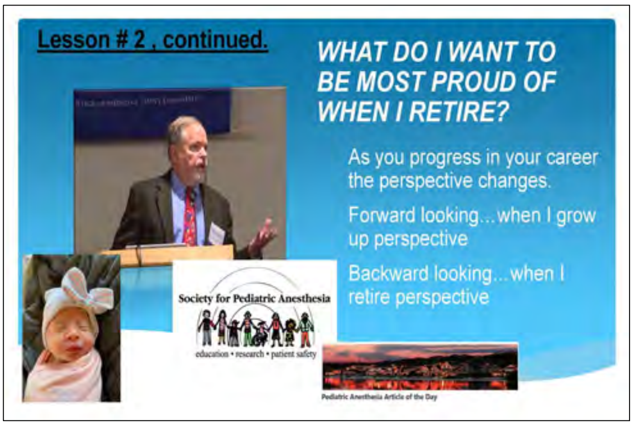
Chair(s): Choon Looi Bong (Singapore)
Jun Heum Yon (Korea)
Seong-Hyop Kim (Korea)

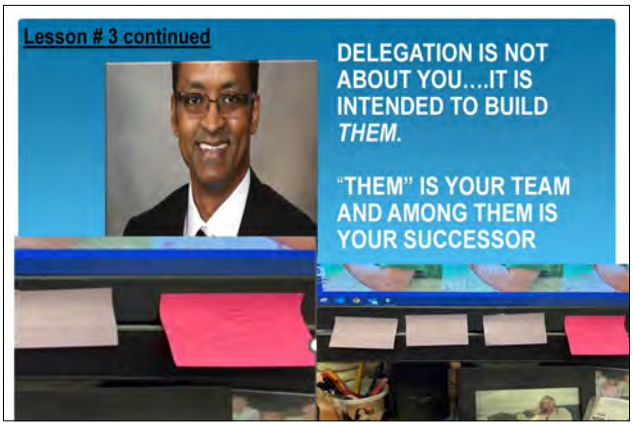
Thoughts on Leadership Professional Development and Career Success: Building the Future of Pediatric Anesthesiology Thoughts on Leadership

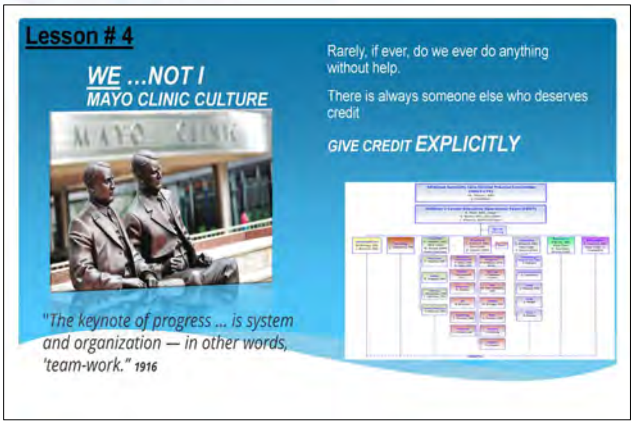
Randall Flick

Mayo Clinic Children's Center, USA

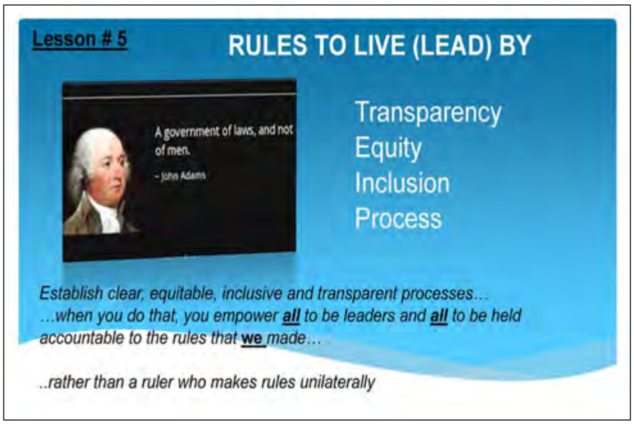




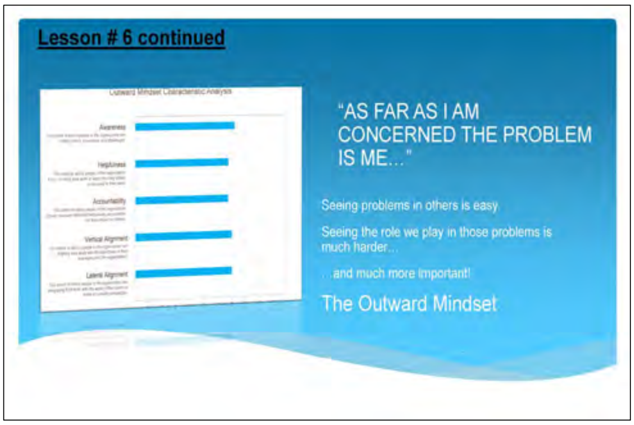



Lesson # 4
WE ...NOT I
MAYO CLINIC CULTURE
MAYO CLINIC
"The keynote of progress ... is system and organization — in other words, 'team-work." 1916
Rarely, if ever, do we ever do anything without help.
There is always someone else who deserves credit
GIVE CREDIT EXPLICITLY


Lesson # 4
A culture of "We"
"If the only tool you have is a hammer, it is tempting to treat everything as if it were a nail." Abraham Maslow 1966
TEAMS AND PROCESSES
DON'T JUST BE PROBLEM SOLVER (MANAGER)...
...BE A PROCESS BUILDER
Success of an organization is dependent on processes not on individual people...
... but on people (leaders) who build processes using teams of people
Managers fix problems...often with a hammer
Leaders address challenges not with a hammer... but with a team


Lesson # 5
RULES TO LIVE (LEAD) BY
A government of laws, and not of men.
- John Adams
Transparency
Equity
Inclusion
Process
Establish clear, equitable, inclusive and transparent processes...
...when you do that, you empower all to be leaders and all to be held accountable to the rules that we made...
..rather than a ruler who makes rules unilaterally


Lesson # 6
LEADERSHIP
AND SELF-DECEPTION
THE PEOPLE ON YOUR TEAM ARE....PEOPLE.
PEOPLE WHO HAVE HOPES DREAMS FEELINGS STRENGTHS WEAKNESSES...
JUST LIKE YOU AND I
The Concept of Self- Betrayal and Self-Deception

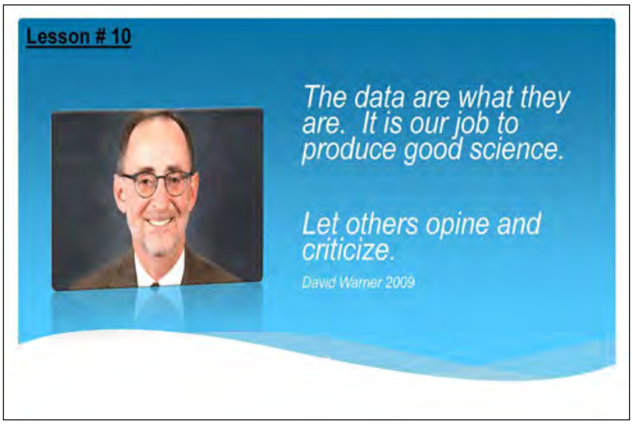

Lesson # 6 continued
"AS FAR AS I AM CONCERNED THE PROBLEM IS ME..."
Seeing problems in others is easy
Seeing the role we play in those problems is much harder...
and much more important!
The Outward Mindset

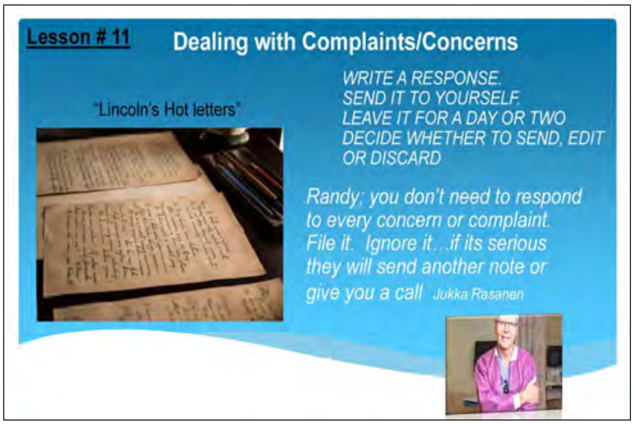

Lesson # 7
THE ANSWER IS ALWAYS.....YES!
This is advice that was given to me early in my career, I gave to my division members and have carried forward in my career.
My successor has made this a centerpiece of his leadership

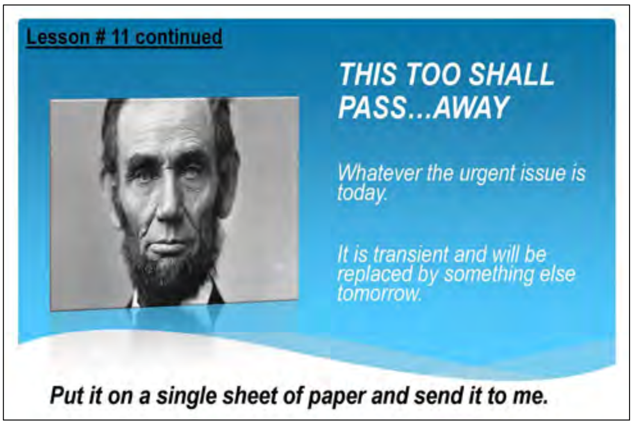

Lesson # 8
LEADERSHIP IS NOT ABOUT BEING RIGHT OR KNOWING MORE...
...The need add value
Resist the need to add value to every conversation
Adding value is another way of showing how much you know.
Good leaders are not necessarily the smartest people in the room.
More valuable is the ability to identify talent and use it effectively
John, I am thinking of getting an MBA...
John Noseworthy 2014

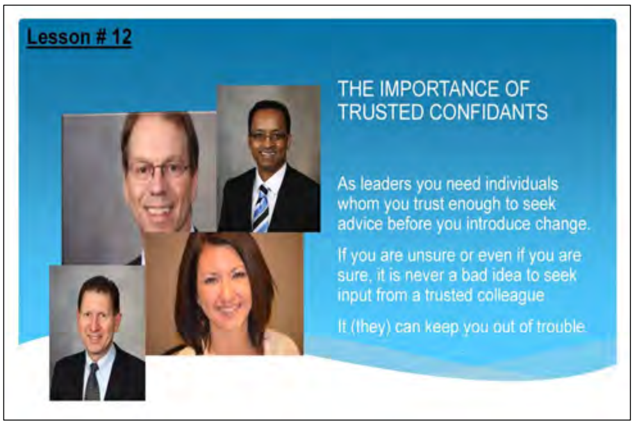

Lesson # 9
If you listen,...
...your team will teach you what you need to know and often what you don't know you need to know
BEING RIGHT DOES MATTER
KNOWING THINGS ALSO MATTERS
BUT...YOU CANNOT KNOW MORE THAN ALL THE PEOPLE WHO YOU CHOSE TO HAVE ON THE TEAM.
REMEMBER THEY ARE JUST LIKE YOU. THEY WANT TO HAVE A CHANCE TO LET YOU AND THE TEAM KNOW HOW MUCH THEY CAN CONTRIBUTE.


Lesson # 9
LISTEN!
MIKE HARPER 2015
Listening tells those engaged that you want to hear from them and their input is important.
Take notes!
Taking notes sends a message that what is being said is important enough to write down.
Taking notes also forces you to listen


Lesson # 10
The data are what they are. It is our job to produce good science.
Let others opine and criticize.
David Warner 2009


Lesson # 11
Dealing with Complaints/Concerns
"Lincoln's Hot letters"
WRITE A RESPONSE.
SEND IT TO YOURSELF.
LEAVE IT FOR A DAY OR TWO
DECIDE WHETHER TO SEND, EDIT OR DISCARD
Randy; you don't need to respond to every concern or complaint. File it. Ignore it…if its serious they will send another note or give you a call
Jukka Rasanen


Lesson # 11 continued
THIS TOO SHALL PASS…AWAY
Whatever the urgent issue is today.
It is transient and will be replaced by something else tomorrow.
Put it on a single sheet of paper and send it to me.


Lesson # 12
THE IMPORTANCE OF TRUSTED CONFIDANTS
As leaders you need individuals whom you trust enough to seek advice before you introduce change.
If you are unsure or even if you are sure, it is never a bad idea to seek input from a trusted colleague
It (they) can keep you out of trouble

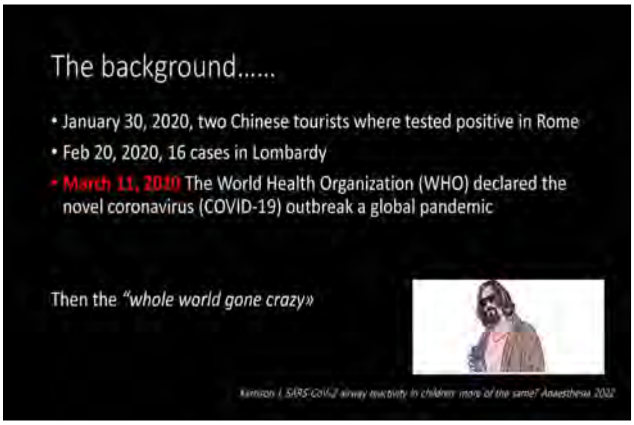

Lesson # 13
ASSUME BENIGN INTENT
Often we assume that the behavior of others is directed toward us especially when it seems negative

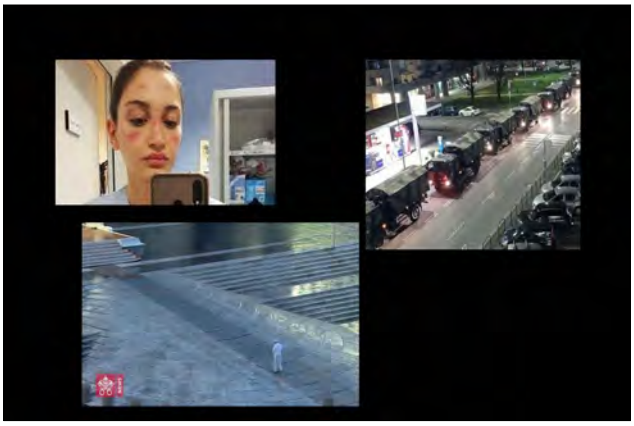

QUESTIONS
& ANSWERS

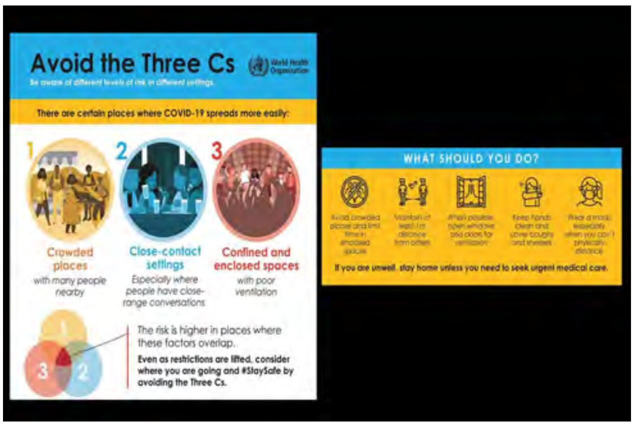
How to Prepare for the Next Pandemic?

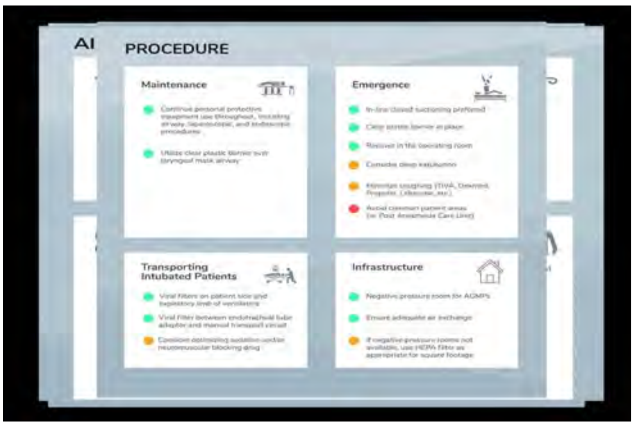
Nicola Disma

Research & Innovation Unit at Istituto Giannina Gaslini, Italy

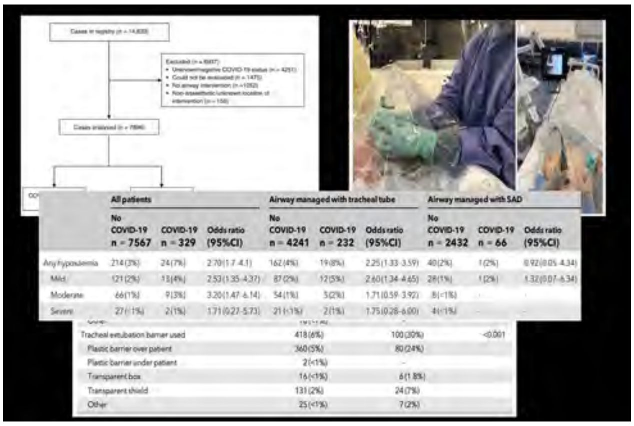


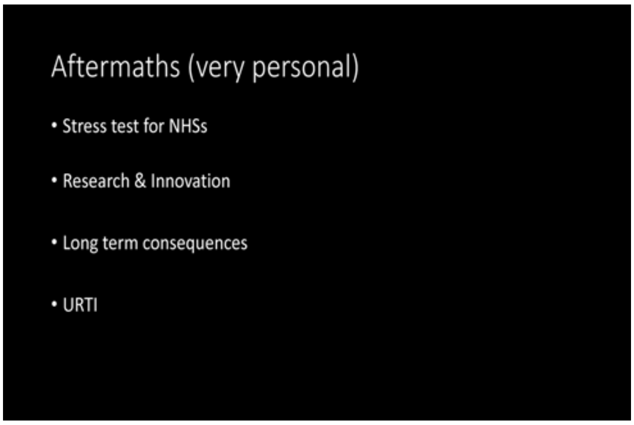


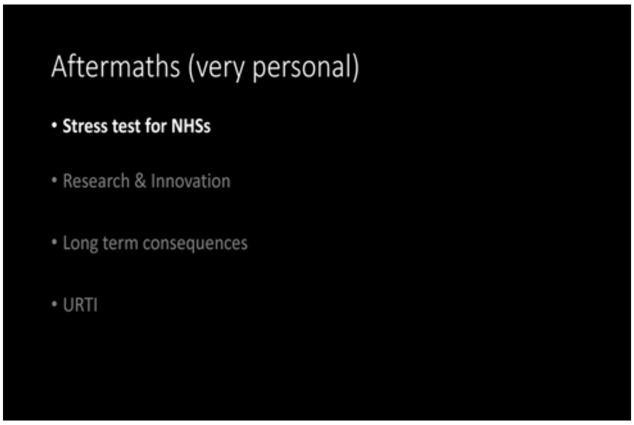





PEDIATRIC AIRWAY MANAGEMENT COMPLICATIONS DURING THE COVID-19 PANDEMIC.
An International, Multicenter, Observational Registry: The PAWS-COVID-19 (Pediatric AirWay complicationS COVID-19) Registry


All patients
Airway managed with tracheal tube
Airway managed with SAD
No COVID-19 n = 7567
COVID-19 n = 329
Odds ratio (95%CI)
No COVID-19 n = 4241
COVID-19 n = 232
Odds ratio (95%CI)
No COVID-19 n = 2432
COVID-19 n = 66
Odds ratio (95%CI)
Tracheal extubation barrier used
Plastic barrier over patient
Plastic barrier under patient
Transparent box
Transparent shield
Other


Aftermaths (very personal)
• Stress test for NHSs
• Research & Innovation
• Long term consequences
• URTI


Aftermaths (very personal)
• Stress test for NHSs
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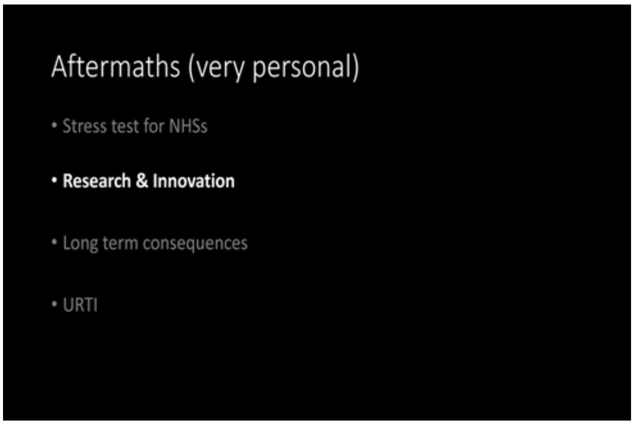
• Long term consequences
• URTI


Pandemics
• HIV/AIDS (2005-2012)
• Death Toll: 36 million
• FLU PANDEMIC (1968)
• Death Toll: 1 million
• ASIAN FLU (1956-1958)
• Death Toll: 2 million
• Polio (1950s)
• Death Toll: >100k
• SPANISH FLU (1918-1920)
• Death Toll: 100 millions


Aftermaths (very personal)
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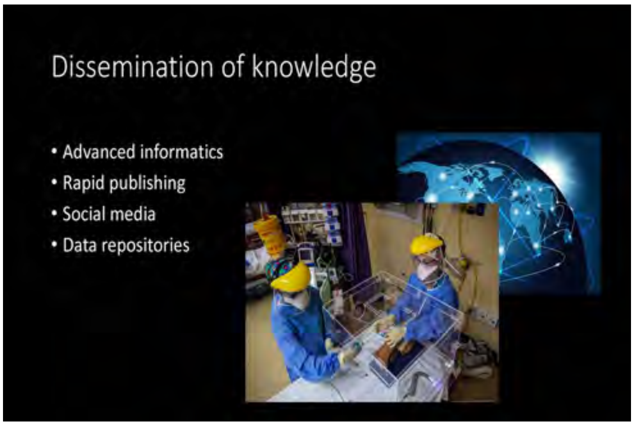
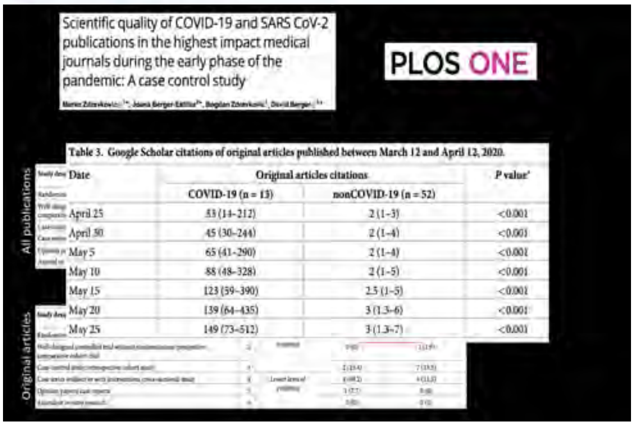
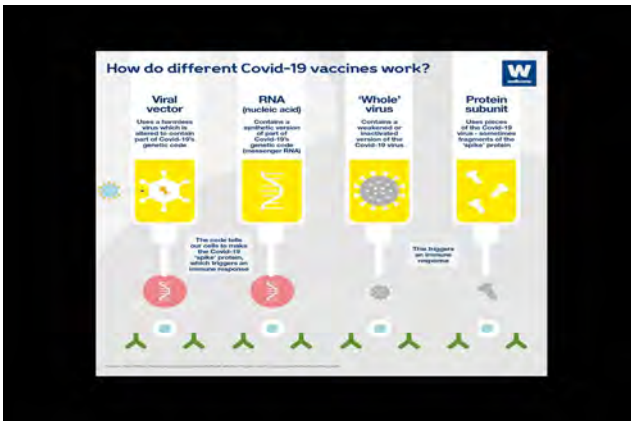
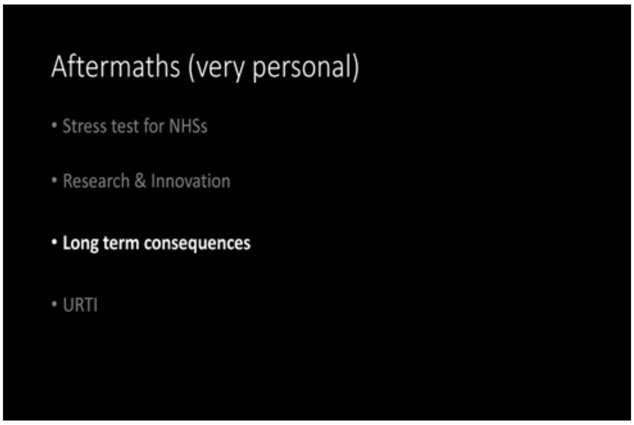

Dissemination of knowledge
• Advanced informatics
• Rapid publishing
• Social media
• Data repositories


Pubmed search 20 Sept 2022
• 296 187 published papers in 2020
• ((wuhan[All Fields] AND ("coronavirus"[MeSH Terms] OR "coronavirus"[All Fields])) AND 2019/12[PDAT] : 2030[PDAT]) OR 2019-nCoV[All Fields] OR 2019nCoV[All Fields] OR COVID-19[All Fields] OR SARS-CoV-2[All Fields]
• 30,801 articles for children
• ((wuhan[All Fields] AND ("coronavirus"[MeSH Terms] AND "coronavirus"[All Fields])) AND 2019/12[PDAT] : 2030[PDAT]) OR 2019-nCoV[All Fields] OR 2019nCoV[All Fields] OR COVID-19[All Fields] OR SARS-CoV-2[All Fields] AND children

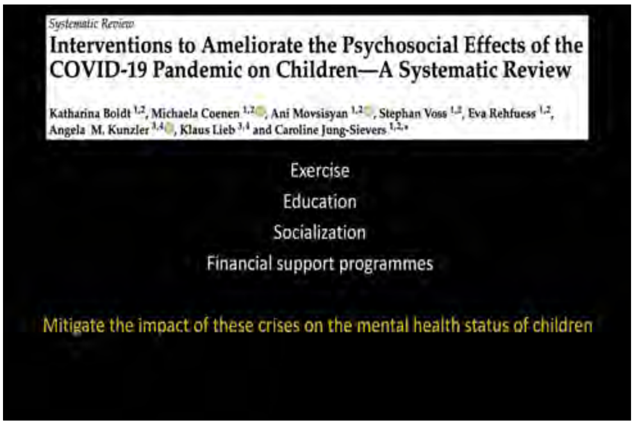

Scientific quality of COVID-19 and SARS CoV-2 publications in the highest impact medical journals during the early phase of the pandemic: A case control study
PLOS ONE
Table 3. Google Scholar citations of original articles published between March 12 and April 12, 2020.
Date | Original articles citations | P value
COVID-19 (n = 13) | nonCOVID-19 (n = 52)
April 25 | 53 (14–212) | 2 (1–3) | <0.001
April 30 | 45 (30–244) | 2 (1–4) | <0.001
May 5 | 65 (41–290) | 2 (1–4) | <0.001
May 10 | 88 (48–328) | 2 (1–5) | <0.001
May 15 | 123 (59–390) | 2.5 (1–5) | <0.001
May 20 | 139 (64–435) | 3 (1.5–6) | <0.001
May 25 | 149 (73–512) | 3 (1.3–7) | <0.001
All publications
Original articles

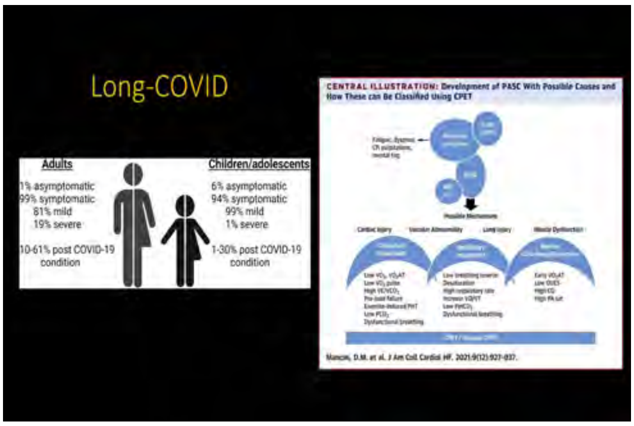

How do different Covid-19 vaccines work?
Viral vector
RNA (nucleic acid)
'Whole' virus
Protein subunit

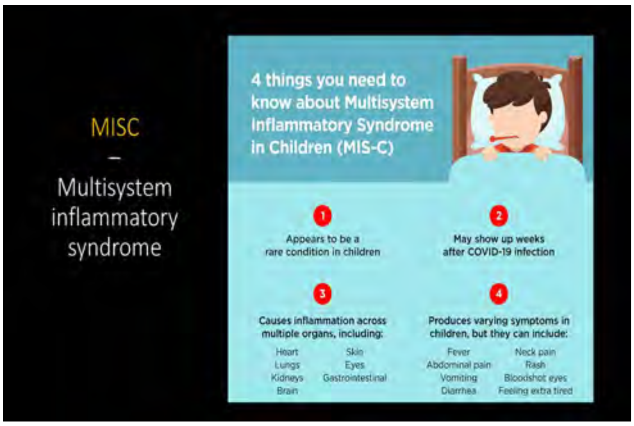

Innovation
Pre-anaesthesia evaluation
Telemedicine
Apps
Videoconferences
Faster discharge
Treatment at home

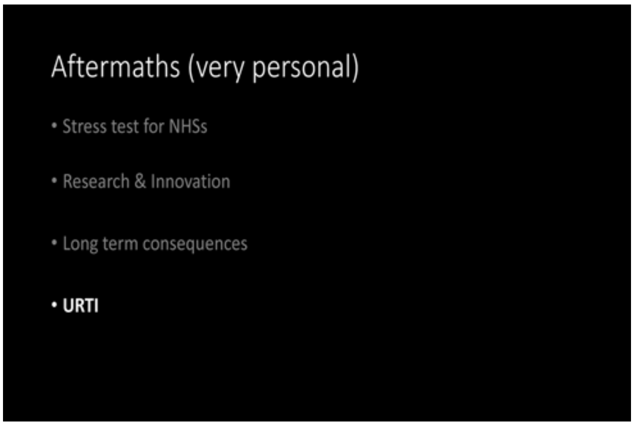

Aftermaths (very personal)
Stress test for NHSs
Research & Innovation
Long term consequences
URTI


CHILDREN AND YOUTH MENTAL HEALTH UNDER COVID-19
unicef
suicide
death
depression
despair
hopeless
hopelessness
pain

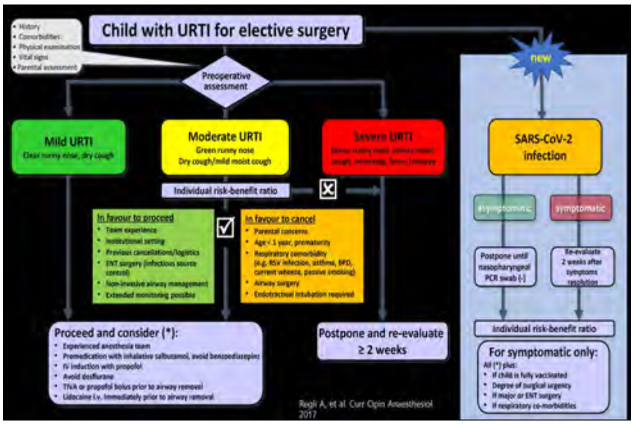

Systematic Review
Interventions to Ameliorate the Psychosocial Effects of the COVID-19 Pandemic on Children—A Systematic Review
Katharina Boldt, Michaela Coenen, Ani Movsisyan, Stephan Voss, Eva Rehfuess, Angela M. Kunzler, Klaus Lieb and Caroline Jung-Sievers
Exercise
Education
Socialization
Financial support programmes
Mitigate the impact of these crises on the mental health status of children

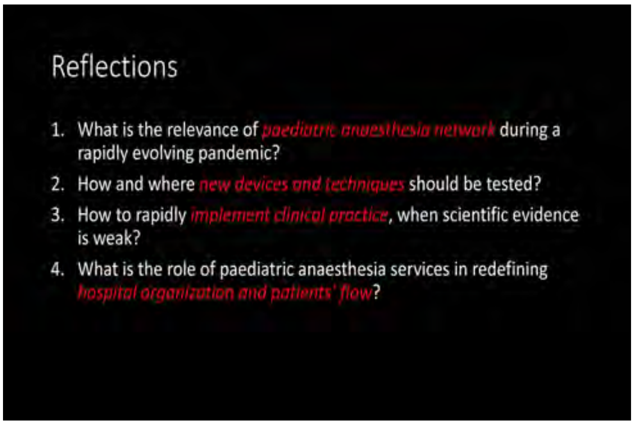

Long-COVID
Adults
1% asymptomatic
99% symptomatic
81% mild
19% severe
10-61% post COVID-19 condition
Children/adolescents
6% asymptomatic
94% symptomatic
99% mild
1% severe
1-30% post COVID-19 condition
CENTRAL ILLUSTRATION: Development of PASC With Possible Causes and How These can Be Classified Using CPET


MISC
–
Multisystem inflammatory syndrome
4 things you need to know about Multisystem Inflammatory Syndrome in Children (MIS-C)
Appears to be a rare condition in children
May show up weeks after COVID-19 infection
Causes inflammation across multiple organs, including:
Heart
Lungs
Kidneys
Brain
Skin
Eyes
Gastrointestinal
Produces varying symptoms in children, but they can include:
Fever
Abdominal pain
Vomiting
Diarrhea
Neck pain
Rash
Bloodshot eyes
Feeling extra tired


Aftermaths (very personal)
• Stress test for NHSs
• Research & Innovation
• Long term consequences
• URTI


Paediatric infectious disease – "The perfect storm"
• COVID-19 variants, RSV, influenza A and B, haemophilus influenzae, rhinovirus, and pneumococcal variants, etc....
• Precautionary measures like
• rapid point of care testing
• appropriate methods for securing the airways
• techniques designed to limit the spread of disease


Child with URTI for elective surgery
• History
• Comorbidities
• Physical examination
• Vital signs
• Parental assessment
Preoperative assessment
Mild URTI
Clear runny nose, dry cough
Moderate URTI
Green runny nose
Dry cough/mild moist cough
Severe URTI
Individual risk-benefit ratio
In favour to proceed
• Team experience
• Institutional setting
• Previous cancellations/logistics
• ENT surgery (infectious source control)
• Non-invasive airway management
• Extended monitoring possible
In favour to cancel
• Parental concerns
• Age < 1 year, prematurity
• Respiratory comorbidity (e.g. RSV infection, asthma, BPD, current wheeze, passive smoking)
• Airway surgery
• Endotracheal intubation required
Proceed and consider (*):
• Experienced anesthesia team
• Premedication with inhalative salbutamol, avoid benzodiazepines
• IV induction with propofol
• Avoid desflurane
• TIVA or propofol bolus prior to airway removal
• Lidocaine i.v. immediately prior to airway removal
Postpone and re-evaluate ≥ 2 weeks
new
SARS-CoV-2 infection
asymptomatic
symptomatic
Postpone until nasopharyngeal PCR swab (-)
Re-evaluate 2 weeks after symptoms resolution
Individual risk-benefit ratio
For symptomatic only:
All (*) plus:
• If child is fully vaccinated
• Degree of surgical urgency
• If major or ENT surgery
• If respiratory co-morbidities
Regli A, et al. Curr Opin Anaesthesiol 2017


Reflections
1. What is the relevance of paediatric anaesthesia network during a rapidly evolving pandemic?
2. How and where new devices and techniques should be tested?
3. How to rapidly implement clinical practice, when scientific evidence is weak?
4. What is the role of paediatric anaesthesia services in redefining hospital organization and patients' flow?


``Has the whole world gone crazy?´´
``I can't be worried about that.... anymore. Life goes on, man!´´
Karlsson J. SARS-CoV-2 airway reactivity in children: more of the same? Anaesthesia 2022

Time to Obtain Epidemiologic Data on Pediatric Anesthesia in Asia Itself: Introduction of PEACH in Asia Study

Soichiro Obara

Tokyo Metropolitan Otsuka Hospital, Japan

Learning Objectives

1. Describe the rates of pediatric anesthesia related mortality and morbidity (serious adverse events) in developing and developed countries, although those definitions varies among studies
2. Review a number of large national or international epidemiological studies regarding the morbidity in children undergoing anesthesia and sedation which have been conducted or trialed in Europe, North America, Latin America, and Africa in recent years
3. Discuss the need for data describing the morbidity and mortality throughout Asia and the ongoing ASPA epidemiological research project, PEri Anesthetic morbidity in CHildren in Asia (PEACH in Asia) study

1. Epidemiology of peri-anesthetic complications in pediatric anesthesia

Incidence of morbidity and mortality in pediatric anesthesia

- Pediatric anesthesia-related mortality
  - ↓ 0.01-0.05% in high-income countries
  - × 2-3 in developing countries
- Pediatric anesthesia-related severe adverse events
  - 2-8 % in developed countries

    the definitions of "severe adverse events" varies among studies

1. Epidemiology of peri-anesthetic complications in pediatric anesthesia

Previous studies related to severe critical events in pediatric anesthesia in developed countries outside Asia

	Philadelphia, USA	Cincinnati, USA	Perth, Australia	Utrecht, Netherlands	Paris, France
Study design	Retrospective, case-control, Single center	Prospective, single center	Prospective, single center	Retrospective, single center	Prospective, single center
Study period	30 months (2010-2012)	6 years (2007-2012)	1 year (2007-2008)	6 years (2007-2013)	30 months (2000-2002)
Number of registered cases	55,070	19,059	9,297	35,190	24,165
Severe critical events [%]	0.4			3.4	7.9
Respiratory critical events [%]	0.26	2.8	15.0	1.6	4.1
Cardiac arrest [%]					0.033

1. Epidemiology of peri-anesthetic complications in pediatric anesthesia

Previous studies related to severe critical events in pediatric anesthesia in Asia

	Pakistan	Singapore	Thailand	South Korea	Japan
Study design	Retrospective, single center	Retrospective, single center	Prospective, 20 centers	Retrospective, single center	Clinical audit, 739 centers
Study period	25 years (1992-2016)	11 years (2000-2010)	1 year (2003-2004)	6 years (2014-2019)	5 years (1999-2003)
Number of registered cases	48,828	75,331	25,098	53,541	342,840
Severe critical events [%]	0.08	3.34	1.88	0.55	
Respiratory critical events [%]	0.027	2.33		0.32	
Cardiac arrest [%]	0.026	0.015 (near cardiac arrest)	0.051	0.047	0.0511 – 0.103, depending on institution type

1. Epidemiology of peri-anesthetic complications in pediatric anesthesia

Incidence of severe critical events in paediatric anaesthesia (APRICOT): a prospective multicentre observational study in 261 hospitals in Europe

Lancet Respir Med 2017 Published Online March 28, 2017 http://dx.doi.org/10.1016/S2213-2600(17)30116-9

- Design: **a prospective, international, multicenter, observational study**
- Aims:
  1. To establish the incidence of severe critical events in children undergoing anesthesia
  2. To describe the differences in pediatric anesthesia practice
  3. To study the potential impact of this variability on the occurrence of severe critical events

     ① laryngospasm, ② bronchospasm, ③ pulmonary aspiration, ④ drug error, ⑤ anaphylaxis, ⑥ cardiovascular instability, ⑦ neurological damage, ⑧ peri-anesthetic cardiac arrest, ⑨ post-anesthetic stridor

1. Epidemiology of peri-anesthetic complications in pediatric anesthesia

Incidence of severe critical events in paediatric anaesthesia (APRICOT): a prospective multicentre observational study in 261 hospitals in Europe

Results:

- Recruitment period: 10 months (Apr 2014 – Jan 2015)
- No. of participating institutions: 261, across 33 European countries
- No. of anesthetics included: 31,127
- Incidence of severe critical events: **5.2%** (95%CI 5.0–5.5)
- Incidence of respiratory critical events: **3.1%** (95%CI 2.9–3.3)
- The experience of the anesthesiologist in charge reduced respiratory and cardiovascular severe critical events

1. Epidemiology of peri-anesthetic complications in pediatric anesthesia

Morbidity and mortality after anaesthesia in early life: results of the European prospective multicentre observational study, neonate and children audit of anaesthesia practice in Europe (NECTARINE)

Nicola Disma[1,*], Francis Veyckemans[2], Katalin Virag[3], Tom G. Hansen[4,5], Karin Becke[6], Pierre Harlet[7], Laszlo Vutskits[8,9], Suellen M. Walker[10], Jurgen C. de Graaff[11], Marzena Zielinska[12], Dusica Simic[13], Thomas Engelhardt[14] and Walid Habre[8,9], for the NECTARINE Group of the European Society of Anaesthesiology Clinical Trial Network[1]

- Design: **a prospective, international, multicenter, observational study**
- Patients: Up to 60 weeks' postmenstrual age undergoing anesthesia for surgical or diagnostic procedures
- Aims:
  1. To to identify thresholds of pre-determined physiological variables that triggered a medical intervention
  2. To evaluate morbidities, mortality at 30 and 90 days, or both, and associations with critical events

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1. Epidemiology of peri-anesthetic complications in pediatric anesthesia

Morbidity and mortality after anaesthesia in early life: results of the European prospective multicentre observational study, neonate and children audit of anaesthesia practice in Europe (NECTARINE)

Results:

- Recruitment period: 11 months (Mar 2016 – Jan 2017)
- No. of participating institutions: 165, across 31 European countries
- No. of recruited neonates included: 5,609
- Incidence of critical events: **35.2% of cases**
  - mainly hypotension (>30% decrease in BP) or reduced oxygenation (SpO_2 <85%)

---

1. Epidemiology of peri-anesthetic complications in pediatric anesthesia

Systematic Review / Meta-analysis

Global mortality of children after perioperative cardiac arrest: A systematic review, meta-analysis, and meta-regression

Semagn Mekonnen Abate[a,*], Solomon Nega[b], Bivash Basu[a], Kidanemariam Tamrat[c]

[a] Department of Anesthesiology, College of Health Sciences and Medicine, Dilla University, Ethiopia
[b] Department of Internal Medicine, College of Health Sciences and Medicine, Dilla University, Ethiopia
[c] Department of Anesthesiology, College of Health Sciences and Medicine, Hawassa University, Ethiopia

Annals of Medicine and Surgery 74 (2022) 103285

- **38 studies with 3.35 million participants were included**
- The global incidence of **perioperative cardiac arrest: 0.254%** (95% CI: 0.223-0.284)
- The global incidence of **perioperative mortality: 4.118%** (95% CI: 3.568-4.668)
- **Significant difference in anesthesia-related mortality** between low middle income countries and high income countries

---

1. Epidemiology of peri-anesthetic complications in pediatric anesthesia

You can't manage what you don't measure

- Peter F. Drucker

---

1. Epidemiology of peri-anesthetic complications in pediatric anesthesia

Large multicenter collaborative projects regarding pediatric peri-anesthetic adverse events

---

2. PEACH in Asia study

What is "PEACH in Asia study"?

Peri-Anesthetic morbidity in Children in Asia (PEACH in Asia) study:
a prospective international multicenter observational study on epidemiology of severe critical events in pediatric anesthesia in Asia

PEACH in Asia study project

---

2. PEACH in Asia study

Design: **multinational, multicenter, prospective, observational study**

Outcome measures:

- **Primary: Incidence of severe critical events**
  - **① laryngospasm, ② bronchospasm, ③ pulmonary aspiration, ④ drug error, ⑤ anaphylaxis, ⑥ cardiovascular instability, ⑦ neurological damage, ⑧ peri-anesthetic cardiac arrest, ⑨ post-anesthetic stridor**
  - Time Frame: Children will be followed for the duration of their anesthesia procedure and up to 60 minutes afterwards
- Secondary:
  1. **Risk factors for the occurrence of severe critical events**
  2. **Consequences of the critical events: irreversible damage, in-hospital mortality**
  - Time Frame: in-hospital and up to 30 days

---

2. PEACH in Asia study

Data acquisition

- Each participating institutions collect data over a period of **two week including weekends and after-hours**
- **The 2-week recruitment period will be chosen by each institution**
- Participating institutions will be provided with data collection sheets
- The data will be filled in the electronic case report form (e-CRF)
- e-CRF has already been created on the internationally affiliated and safe cloud system, UMIN-INDICE

Data collection flow chart

2. PEACH in Asia study

Study population

Children from birth to 15 years

✓ admitted for an inpatient or outpatient procedure under general anesthesia with or without regional analgesia

✓ admitted for a diagnostic procedure under general anesthesia (such as endoscopy, radiology, bone marrow puncture, etc.)

✓ admitted out-of-hours for emergency procedures

Exclusion criteria:

➢ Children admitted directly from the ICUs to the ORs

➢ Anesthesia procedures in the NICU or the PICU

2. PEACH in Asia study

Sample size estimation

the European APRICOT

- mean 5.2% [95% confidence interval(CI) 5.0-5.5]

In several Asian countries

- 3.3% in Singapore, 8.9% in India, and so on

↓

A minimum of **7,600** patients → a 95% CI of 1.0%

(assuming that the incidence of severe critical events is 5.2%, (ie, 95% exact CI is 4.7-5.7%),

or

A minimum of **30,000** patients → a 95% CI of 0.5%

2. PEACH in Asia study

Publication policy

- After submitting grant proposal, recruitment of patients, data acquisition, cleaning and analysis of the data obtained, **authorship will be distributed according to differences in investment.**
- Each participating center including at least 5 patients can designate one collaborator that will be mentioned in the publication. Furthermore, for each additional 50 patients included, one more collaborator can be designated.
- **These collaborators will be mentioned in the manuscript and will be traceable via Pubmed.**
- Also, on request, centers will be allowed to use their data. Proposals for secondary analyses can be submitted to the Steering Committee that will need to approve those analyses and that will revise all papers originating from final analysis prior to submission.

2. PEACH in Asia study

Current protocol issued on medRxiv

medRxiv THE PREPRINT SERVER FOR HEALTH SCIENCES — CSH — BMJ — Yale

https://www.medrxiv.org/content/10.1101/2022.11.13.22282262v3

PEACH in Asia: PEri-Anesthetic morbidity in CHildren in Asia: A prospective multinational multicenter observational study to investigate epidemiology of severe critical events in pediatric anesthesia in Asia

Soichiro Obara, Choon Looi Bong, Norifumi Kuratani, Zehra Serpil Ustalar Ozgen, Mahin Seyedhejazi, Shemila Abbasi, Ekta Rai, Elsa Varghese, Evangeline K Villa, Andi Ade W Ramlan, Ina Ismiarti Shariffuddin, Patcharee Sriswasdi, Pheakdey Nhoung, Vivian Yuen, Hyo-Jin Byon, Josephine S K Tan

doi: https://doi.org/10.1101/2022.11.13.22282262

2. PEACH in Asia study

The dedicated website will be updated soon

2. PEACH in Asia study

Updated information available on newsletters

As of May 12th, 2023

PEACH in Asia study project

Questions and Answers

for the PEACH in Asia study

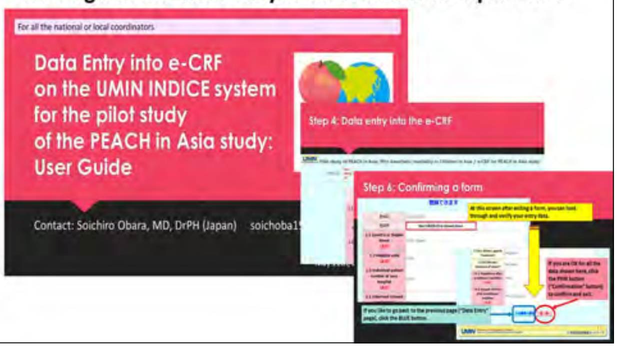
Soichiro Obara, the principal investigator of the PEACH in Asia study

Thank you all the national coordinators for contributing to the progress of our study project!

Our PEACH in Asia study is now recruiting the patients for the pilot study.

2. PEACH in Asia study

"User's guide for data entry in electronic case report form"



2. PEACH in Asia study

A pilot study on-going in May to June 2023

(facilities scheduled to participate as of mid-May)

Country/ Region Name	Country/ Region Code	Hospital Name	Hospital Code	Coordinator Name
Singapore	029	KK Womens' and Children's Hp	001	Choon Looi Bong, Siti Nuru Diyanah
Turkey	034	University of Acibadem	001	Z Serpil Ustalar Ozgen
Indonesia	010	Dr. Cipto Mangunkusumo Hp	001	Andi Ade W Ramlan
Malaysia	018	University of Malaya	001	Ina Ismiarti Shariffuddin
India	009	Christian Medical College	001	Ekta Rai
Pakistan	024	Aga Khan University Hp	001	Shemila Abbasi
Hong Kong	038	Hong Kong Children's Hp		Vivian Yuen, Jasmin Tong
Japan	013	Tokyo Metropolitan Otsuka Hp	001	Soichiro Obara
Japan	013	Saitama Children's Medical Center	002	Norifumi Kuratani

2. PEACH in Asia study

Research SIG's Vision

- To work on determination of the important research questions in our field of pediatric anesthesia, to hopefully trigger research endeavors in this area
- To foster the generation and propagation of research ideas in pediatric anesthesia beyond borders throughout Asia
- To collaborate with research committees of other anesthesia societies

2. PEACH in Asia study

2022-23 research SIG activities and outcomes

- Our main project: launching the internationally collaborative research project regarding prospective cohort research regarding peri-anesthetic morbidity in children in Asia, **PEACH in Asia study** project
- The Protocol was published on a pre-print server (MedRxiv)
- IRB review and approval were obtained at multi-national/regional centers in spring 2023
- A pilot study has been on-going in May to June 2023

PEACH in Asia study project

2. PEACH in Asia study

Peri-Anesthetic morbidity in Children in Asia (PEACH in Asia) study:

- will provide strategic framework for evidence-based policy-making, accountability and implementation guidance

- will work as a powerful roadmap to develop and implement data-driven education/training plans in Asia

The main study will start recruitment this summer

2. PEACH in Asia study

Any hospital caring neonates and children is welcome to participate!

Your participation is highly appreciated!

Let us work on this project together!

Kindly feel free to contact: Soichiro Obara

E-mail address: soichoba1975@gmail.com

Or, kindly contact the A-PEAR tem members

PEACH in Asia study project

The Future of Anesthesia-Related Neurotoxicity Studies: Update on the TREX Trial

Dean B. Andropoulos

Texas Children's Department of Anesthesiology, USA

Disclosures

- SmartTots Medical Officer: private-public partnership of U.S. FDA and International Anesthesia Research Society
- U.S. FDA IND holder for dexmedetomidine studies (#118058)
- SmartTots grant funding for U.S. centers
- Australian National Medical Research Council funding the DCC in Melbourne, Australia
- Italian Medicines Agency funding all sites in Italy
- Dexmedetomidine is not labeled for pediatric use by U.S. FDA

Learning Objectives

- Review the pharmacology and physiologic effects of dexmedetomidine
- Discuss dexmedetomidine neurodegenerative effects
- Describe human dexmedetomidine safety and pharmacokinetics in infants
- Detail the rationale and design for the TREX Trial

Premise for Dexmedetomidine Studies

- Gamma-aminobutyric acid (GABA) and N-methyl-D-aspartate (NMDA) binding anesthetic agents consistently cause increased neuroapoptosis and other neurodegeneration, and adverse long-term neurocognitive/behavioral deficits in animal models of the developing brain, including non-human primates
  - Sevoflurane (GABA) is the most commonly used inhaled general anesthetic in infants and children world-wide
- Sevoflurane anesthetics in human infants and children are associated with behavioral changes (not cognitive) after single or multiple exposures
- Dexmedetomidine does not produce the same neurodegenerative changes in animals, and could serve as an adjunct, or sole sedative, during general anesthesia in infants and children

Ing C, et al. Anesthesiology 2022;136:500-512

REVIEW ARTICLE

ANESTHESIOLOGY

Anesthesia and Developing Brains: Unanswered Questions and Proposed Paths Forward

ABSTRACT

Anesthesiology 2022; 136:500–12

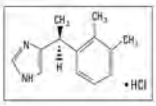
Preclinical Data from Animal Models and Translation to Humans

Table 1. Advantages and Disadvantages of Potential Research Approaches

Approach	Advantages	Disadvantages
Further randomized controlled trials	Randomized controlled trials are the gold standard for proving causal effect of anesthetic exposure	Randomized controlled trials are expensive and time consuming. Children cannot be randomized to no anesthetic, and what constitutes a "safe" anesthetic is unclear. A phenotype of injury and the ideal outcomes to evaluate are unclear. The optimal, feasible study design is not obvious.
Observational studies and causal theory	Randomized controlled trials may not be feasible in all situations. Causal theory is commonly applied to other areas such as environmental toxicity.	Observational studies are limited by the inability to distinguish effects of anesthesia from surgery and other perioperative factors, as well as issues with confounding by indication. Application of causal theory relies on well-designed observational studies.
Intermediate outcomes and biomarkers	Injury could be identified at an earlier stage. Objective pre- and postexposure testing could be performed. Endophenotypes could be identified. Translation between animal models and humans could be improved.	No consistent biomarkers have been identified. Any identified biomarker would need to be correlated to a long-term clinical outcome of interest. Intermediate outcomes and biomarkers would not be able to distinguish the effects of anesthesia from surgery and other perioperative factors.
Prenatal exposures	Children may be more vulnerable to prenatal exposures. Less confounding by indication in the child as exposure is typically due to a condition in the mother rather than underlying conditions in the child.	The effects of anesthesia from uterine perfusion, inflammation, and other fetal stressors cannot be distinguished. A randomized controlled trial is unlikely to be able to randomize a mother to general anesthesia or spinal anesthesia.
Nonhuman primate studies	This is the animal model that is most similar to humans. This model can be used to evaluate questions that cannot be studied in humans.	Translation between humans and animal models is challenging. The one study that evaluated the same outcome in humans and nonhuman primates found differences in nonhuman primates but not children, although nonhuman primates had significantly longer exposures.

Anesthesiology 2022; 136:500–12

Dexmedetomidine



- Dexmedetomidine (DEX) is a novel sedative/hypnotic/analgesic agent
  - α-2 receptors: locus ceruleus and spinal cord
  - α-2: α-1 selectivity 1600:1 (clonidine 200:1)
- Minimal respiratory depression
- Reduces post-cardiac surgical tachydysrhythmias
- Reduces doses of volatile anesthetic agents (VAA), opioids, benzodiazepines

Human Data

- Less neuroapoptosis in the developing brain
- Blocks neuroapoptosis by anesthetic agents
- Neuroprotective in hypoxia-ischemia
- Neuroprotective in inflammatory states

Animal Data

SYSTEMATIC REVIEW

WILEY

A systematic review and narrative synthesis on the histological and neurobehavioral long-term effects of dexmedetomidine

Pediatric Anesthesia. 2019;29:125-136.

Camille E. van Hoorn[1] | Sanne E. Hoeks[1] | Heleen Essink[1] | Dick Tibboel[2] | Jurgen C. de Graaff[1]

Conclusion: In animals, dexmedetomidine was found not to induce histologic injury and to show a beneficial effect when administered with another anesthetic. No clinical results on the long-term effects in children have been identified yet.

TABLE 2 Study characteristics

Article	Study design	Single dose dex (μg/kg)	Total dose dex (μg/kg)	Additional drugs	Histologic injury by dex?	Dex decreases injury caused by other anesthetic	Impaired function after dex	Less impairment after dex (behavior)
Duan 2014	dex+keta vs dex+con	25	75	keta: ip 75 mg/kg	[illegible]	[illegible]	—	[illegible]
Goyagi 2016	dex+sevo vs sevo+con	6.6-12.5-25	6.6-12.5-25	sevo: 3.0% 4 h	—	—	—	[illegible]
Han 2013	dex+iso vs iso+con vs dex	25	75	iso: 0.75%; sevo: 1.2% 4 h	—	[illegible]	—	—
Ibrahim 2015	dex+sevo vs prop+dex	3	3	sevo: 4%; prop: iv 4 mg/kg	—	[illegible]	—	—
Koo 2014	dex vs con	3.0-30	39-390	keta: 20 mg/kg, 20-50 mg/kg/h 12 h	[illegible]	—	—	—
Lee 2017	dex+sevo vs dex vs sevo	1-5-25-50-100	3-15-75-150-300	sevo: 2.5% 6 h	[illegible]	[illegible]	—	—
Li, J 2016	dex+prop vs dex+iso vs dex	2.5-5.0-10	5-10-20	prop: iv 6.0 mg/kg+1.2 mg/kg/min	[illegible]	[illegible]	—	[illegible]
Li, Y 2014	dex+iso vs iso+con vs dex	25-50-75	25-50-75	iso: 0.75% 6 h	[illegible]	[illegible]	—	—
Liao 2014	dex+iso vs iso+con	25-50-75	75-150-225	iso: 0.75%	[illegible]	[illegible]	—	—
Liu 2016	dex+keta vs dex vs con	10-25-50	50-125-250	keta: ip 20 mg/kg per dose	[illegible]	[illegible]	—	—
Lu 2017	dex+prop vs con	25-50-75	25-50-75	prop: ip 100 mg/kg	—	[illegible]	—	—
Olutoye 2015	dex+iso vs iso	1	2	iso: 1.5%-2.0% 2-3 h+ 6 h	—	[illegible]	—	—
Pancaro 2016	dex vs keta vs con	30-45	30-45	—	[illegible]	—	—	—
Perez 2017	dex+sevo vs con	1-5-10-25-50	3-15-30-75-150	sevo: 2.5% 6 h	—	[illegible]	—	—
Sanders 2009	dex+iso vs iso+con	1-10-25	3-30-75	iso: 0.75% 6 h	[illegible]	[illegible]	[illegible]	[illegible]
Sanders 2010	dex+iso vs iso+con	25-50-75	75-150-225	iso: 0.75% 6 h	[illegible]	[illegible]	—	—
Su 2015	dex+iso vs dex+O2 vs con	10	20	iso: 1.5% 4 h	[illegible]	[illegible]	[illegible]	[illegible]
Tachibana 2011	dex vs con	5-10	5-10	—	—	—	[illegible]	—
Wang 2016	dex+prop vs con	75	525	prop: ip 7 days 3x30 mg/kg/d	—	[illegible]	—	[illegible]
Zeng 2013	dex vs dex+iso vs iso	25-50-75	25-50-75	iso: 0.75% 6 h	—	[illegible]	—	—

Pediatric Anesthesia. 2019;29:125-136.

Why Dexmedetomidine?

- Clinician's perspective:
  - Familiarity
  - Feasibility for research and adoption into clinical practice
- Widely used in pediatric anesthesia and ICU
  - Post-surgical, medical ICU, premed, opioid sparing for tonsillectomy, TIVA for spines, emergence agitation, procedural sedation
- Significant body of clinical research/clinical publications in infants/children
  - 456 in infants birth-23 months
  - 1191 in children 0-18 years
- U.S. FDA labeled for adults 18+
  - ICU sedation intubated patients
  - Procedural sedation: non-intubated patients; surgical and other procedures

BJA

British Journal of Anaesthesia, 123 (6): 839–852 (2019)

doi: 10.1016/j.bja.2019.06.026
Advance Access Publication Date: 14 October 2019
Paediatric Anaesthesia

PAEDIATRIC ANAESTHESIA

Results of a phase 1 multicentre investigation of dexmedetomidine bolus and infusion in corrective infant cardiac surgery

Athena F. Zuppa[1], Susan C. Nicolson[1], Nicole S. Wilder[2], Juan C. Ibla[3], Erin A. Gottlieb[4,#], Kristin M. Burns[5], Mario Stylianou[6], Felicia Trachtenberg[7], Hua Ni[7], Tera H. Skeen[4], Dean B. Andropoulos[4,*] on behalf of Pediatric Heart Network Investigators

Methods: Subject Recruitment, N = 124

- Inclusion criteria: Neonates/Infants 0-180 days
- Stratification: Neonates 0-21 days; Infants 22-180 days
- Corrective two-ventricle surgery with CPB:
  - Arterial switch for dextrotransposition of the great arteries (D-TGA)
  - Ventricular septal defect without arch obstruction
  - Tetralogy of Fallot
- Major exclusion criteria
  - <37 weeks (neonates), <36 weeks (infants), extracardiac anomalies affecting safety/PK, previous DEX/clonidine, AV block, bradycardia, renal/liver dysfunction, cardiac arrest/ECMO
- Enrollment in 4 U.S. centers
  - Texas Children's Hospital, Children's Hospital of Philadelphia, C.S. Mott Children's Hospital, Boston Children's Hospital

Results: Safety Events

- 5 adjudicated safety events (4.1%, 95% CI 1.8-9.2%)
  - Two junctional bradycardia (65-109 BPM)
  - Two 2^{nd}-3^{rd} degree AV block (85-95 BPM)
    - All 4 with temporary pacing (30 minutes to 48 hours)
    - 3 of 4 receiving digoxin, amiodarone, or β-adrenergic blocking drugs
  - One hypotension: multifactorial etiology
- All safety outcomes in Infant age group
- No consistent relationship with DEX plasma level (126-977 pg/ml)

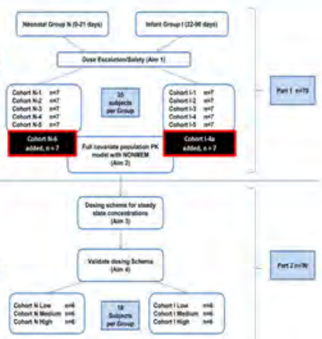
Methods: Study Protocol

Dose Escalation

PK Modeling

Dosing Schema

Model Validation



Results: PK Parameters, N=119 Subjects

	Allometric weight normalised model		Linear weight normalised model	
	AIC=16 328		AIC=16 318	
Parameter	Point estimate (NONMEM SE%)	95% CI from LLP	Point estimate (NONMEM SE%)	95% CI from LLP
CLpre (ml min^{-1} 70 kg^{-1})	1240 (14)	1030, 1470	2580 (14)	1950, 3400
CLcpb (ml min^{-1} 70 kg^{-1})	74.1 (42.1)	59, 126	142 (53.5)	130, 300
CLpost (ml min^{-1} 70 kg^{-1})	623 (7.9)	560, 670	1240 (8.39)	1020, 1400
V1pre(L 70 kg^{-1})	132 (26.4)	109, 152	139 (25.8)	94.6, 202
V1cpb (L 70 kg^{-1})	115 (14.7)	106, 136	116 (14.9)	103, 146
V1post (L 70 kg^{-1})	155 (7.61)	141, 167	159 (7.92)	129, 185
Qpre (ml min^{-1}/70 kg^{-1})	2300 (96.1)	50, 6800	4120 (107)	100, 400 000
Qcpb (ml min^{-1} 70 kg)	2980 (18.7)	2410, 3710	6160 (16.9)	4300, 8400
Qpost (ml min 70 kg^{-1})	209 (18.6)	161, 270	422 (20.3)	280, 700
V2pre(L 70 kg^{-1})	78.9 (36)	19.5, 154	69.6 (43)	5, 90
V2cpb (L 70 kg^{-1})	144 (12.4)	135, 162	147 (12.4)	101, 149
V2post (L 70 kg^{-1})	105 (9.4)	92.3, 113	97 (10.6)	78.6, 130
Age CLpost 50% mature (days)	1.77 (25.4)	1.11, 2.28	1.29 (33.9)	0.4, 2
Temp effect V1cpb	−1.6 (6.6)	−1.69, −1.41	−1.57 (6.43)	−1.73, −1.21

Results: Dosing Recommendations

Age Group	Target Plasma Concentration (pg/ml)	Initial Loading Dose (mcg/kg)	Infusion 1: pre-CPB, first 60 min CPB (mcg/kg/hr)	Loading Dose to CPB Prime (mcg/ml)	Infusion 2: after 60 min CPB until end CPB (mcg/kg/hr)	Infusion 3: 60 min after CPB (mcg/kg/hr)
Neonate	200	0.24	0.22	0.004	0.04	0.14
Neonate	500	0.6	0.55	0.01	0.1	0.35
Neonate	700	0.84	0.77	0.014	0.14	0.49
Neonate	1000	1.2	1.1	0.02	0.2	0.7
Infant	200	0.29	0.26	0.005	0.05	0.17
Infant	500	0.72	0.66	0.012	0.12	0.42
Infant	700	1.01	0.92	0.017	0.17	0.59
Infant	1000	1.44	1.32	0.024	0.24	0.84

Based on CPB low temp of 32°C and 90-minute CPB time

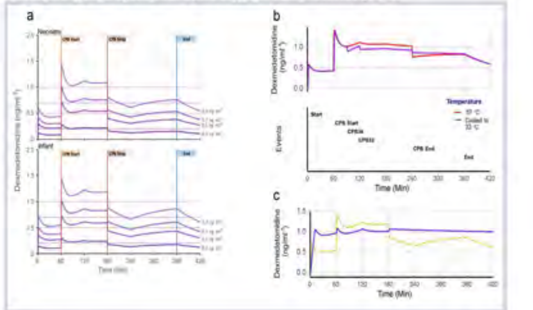
British Journal of Anaesthesia, 123 (6): 839–852 (2019)

Playing with dexmedetomidine pharmacokinetics!

Gregory Hammer[1] and Steven L. Shafer[1,2,*]

British Journal of Anaesthesia, 124 (3): 238–240 (2020)

[1]Department of Anesthesiology, Perioperative and Pain Medicine, Stanford University, Palo Alto, CA, USA and
[2]Department of Bioengineering and Therapeutic Sciences, University of California, San Francisco, CA, USA



Rationale for TREX Trial

- Opioids and alpha-2 agonists do not cause the same neurodegenerative changes seen in animal models with other GAs or sedatives
- Neurodevelopmental outcome data in longer anesthetic exposures, i.e. >2-3 hours, is lacking
  - Short single exposures, multiple exposures: behavioral but not cognitive changes
  - GAS, MASK, PANDA studies
- A pilot study of dexmedetomidine/remifentanil/combined with caudal anesthetic for anesthetics greater than 2 hours was feasible in 60 subjects less than 1 year of age
- For the randomized trial, low-dose sevoflurane was added to dexmedetomidine/remifentanil because of high rate of light anesthesia in the pilot study
- Standard dose sevoflurane is commonly utilized in daily practice for these anesthetics

TREX Pilot Study: (*T*oxicity of *R*emifentanil-D*EX*medetomidine)

Received: 16 March 2018 | Revised: 31 October 2018 | Accepted: 8 November 2018

DOI: 10.1111/pan.13544

RESEARCH REPORT

WILEY

An open label pilot study of a dexmedetomidine-remifentanil-caudal anesthetic for infant lower abdominal/lower extremity surgery: The T REX pilot study

Peter Szmuk[1,2] | Dean Andropoulos[3] | Francis McGowan[4] | Ansgar Brambrink[5] | Christopher Lee[6] | Katherine J. Lee[7] | Mary Ellen McCann[8] | Yang Liu[3] | Rita Saynhalath[1] | Choon Looi Bong[9] | Brian J. Anderson[10] | Charles Berde[8] | Jurgen C. De Graaff[11] | Nicola Disma[12,13] | Dean Kurth[4] | Andreas Loepke[4] | Beverley Orser[14] | Daniel I. Sessler[2] | Justin J. Skowno[15] | Britta S. von Ungern-Sternberg[16] | Laszlo Vutskits[17] | Andrew Davidson[18]

Pediatric Anesthesia. 2019;29:59–67.

TREX Pilot Study (*T*oxicity of *R*emifentanil-D*EX*medetomidine)

- 8 sites enrolled subjects: (1-20), N = 60, age < 1 year
- Eye-opening times about 7 minutes
- Most had excellent analgesia in PACU, most discharged <60 minutes
- No protocol abandonment in 56 subjects
- No serious adverse events: mild/moderate hypotension (25%) and bradycardia (16%)
- ***80% had "rescue" treatment for light anesthesia (movement/hypertension)***
- ***Protocol is feasible: 87.5% of patients with functioning caudal required no sevoflurane or propofol rescue***

Pediatric Anesthesia. 2019;29:59–67.

Dexmedetomidine/Remifentanil/Low Dose Sevo vs. Standard Dose Sevoflurane RCT: TREX Trial

- Children <2 years undergoing 2 hours or longer of surgery time, 2+ hours of anesthesia time
- Dexmedetomidine/remifentanil/low dose sevoflurane (0.3-0.6%ET), vs. standard higher dose sevoflurane (2.5-3.0%ET)
- Age 3 years: battery of neurodevelopmental tests
- Up to 20 sites in USA, Australia, Europe
- Weschler Full-scale IQ is primary outcome; difference of 5 points significant
- 450 needed to enroll to yield 380 evaluable subjects

TREX: *T*oxicity of *R*emifentanil-D*EX*medetomidine Trial

- Phase III randomized, active controlled, parallel group, assessor blinded, multicenter, superiority trial of:
  - Low-dose sevoflurane/DEX/remifentanil: DEX 1 mcg/kg load, 1 mcg/kg/hr infusion; remifentanil 1 mcg/kg load, 0.1 mcg/kg/min or greater infusion; sevoflurane 0.3-0.6% ET or less
  - Standard dose sevoflurane: 2.5-3.0% ET or greater
- Neuraxial/regional/local anesthesia, morphine (end of case) allowed
- Inclusion: < 2 years, surgery time of 2 hours, total anesthesia/OR time 2+ hours
  - Decreased from 2.5 hours due to slow enrollment
- Exclusion: Previous or future GA >2 hours before age 3 years; neurodevelopmental issues, cardiac or neuro disease

TREX: Primary Objective

- Determine if low dose sevoflurane/dexmedetomidine/remifentanil is superior to standard dose sevoflurane anesthesia in terms of global cognitive function assessed by the full-scale IQ score of the Weschler Preschool and Primary School Intelligence Scale assessed at 3 years of age

TREX Secondary Objectives

- A range of other neurodevelopmental tests performed at 3 years of age including subscales of general cognitive functioning, language, executive function, memory, adaptive behavior, clinical behavior and social skills
- Diagnosis of any neurodevelopment disorder at 3 years of age
- Additional secondary outcomes:
  - Incidence of intraoperative hypotension and bradycardia
  - Postoperative pain
  - Time to recovery

TREX Enrollment

- 450 subjects have been enrolled, 190 in each group required to have 90% power to detect a difference of 5 points based on 2-sided test with alpha = 0.05
  - 15% loss to follow-up anticipated
- Enrollment started August 2017
- Pandemic slowed enrollment but additional centers started, especially Italy
- 450 target enrolled on April 21, 2023
- More than 100 with 3-year follow-up completed
- Anticipate completing most all neurodevelopmental assessments end of 2025
- No serious adverse events related to the study

Participating Centers and Enrollment

- United States:
  - Children's Medical Center, Dallas: 85
  - Texas Children's Hospital, Houston: 60
  - Boston Children's Hospital: 25
  - Children's Hospital of Philadelphia: 4
  - Cleveland Clinic: 4
- Australia:
  - Perth Children's Hospital: 23
  - Queensland Children's Hospital: 25
  - Children's Hospital Westmead: 19
  - Royal Children's Hospital, Melbourne: 13
  - Flinders Medical Centre: 14
  - Women and Children's Hospital, Adelaide: 11
  - Sydney Children's Hospital: 13

Participating Centers and Enrollment (cont'd)

- Italy:
  - Istituto Giannina Gaslini: 60
  - Azienda Ospedaliero Universitaria Pisana: 12
  - Azienda Ospedaliero-Universitaria Meyer: 21
  - Ospedale Bambino Gesù: 4
  - Azienda Ospedaliero-Universitaria di Bologna: 7
  - Presidio Ospedale Infantile C.Arrigo Azienda Ospedalier, Italy: 15
  - Vittore Buzzi Children's Hospital, Italy: 29
  - Fondazione IRCCS Cà Granda Ospedale Maggiore Policlinico - Clinica Mangiagalli, Italy: 6

Conclusions

- Dexmedetomidine does not induce the same histologic injury, and ameliorates the effects of other anesthetics in pre-clinical models
- Dexmedetomidine pharmacokinetics and safety are well established in infant populations, including congenital heart disease
- A dexmedetomidine-based anesthetic, with low-dose sevoflurane is safe and feasible
- The TREX Trial enrollment is complete and will add human neurodevelopmental outcome data with a dexmedetomidine-based anesthetic vs. conventional sevoflurane anesthetic

Session 4.

Issues We Are Facing & Need to Overcome

Chair(s): Vibhavari Naik (India)
Hee-Soo Kim (Korea)

Environmental Impact of Anesthesia (Virtual)

Diane Gordon

Children's Hospital Colorado, USA

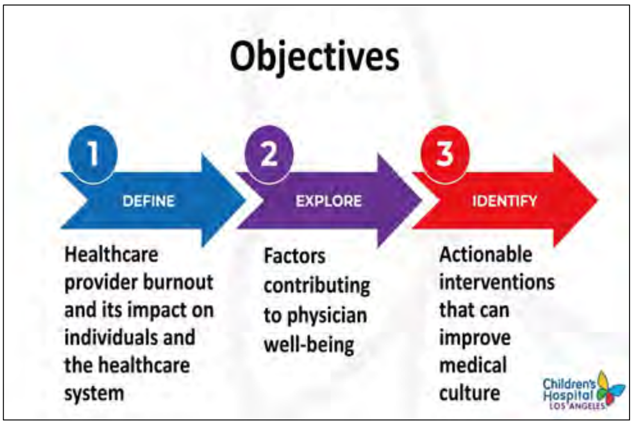
Learning Objectives

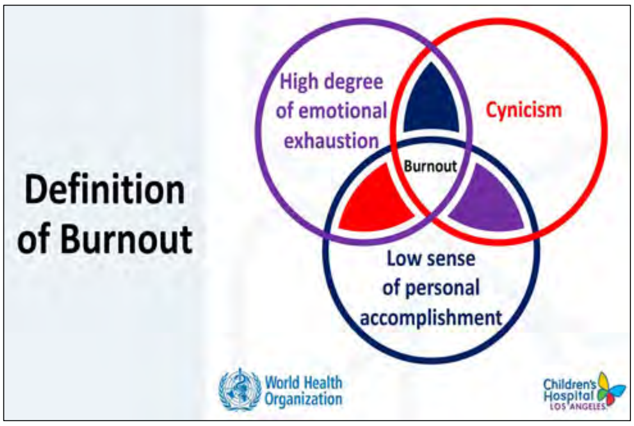
1. Describe the chemical properties of volatile anesthetic agents and nitrous oxide that are responsible for their detriment to the atmosphere
2. Summarize the arguments supporting use of low fresh gas flows when using volatile agents, including the science that refutes higher flow suggestions for sevoflurane.

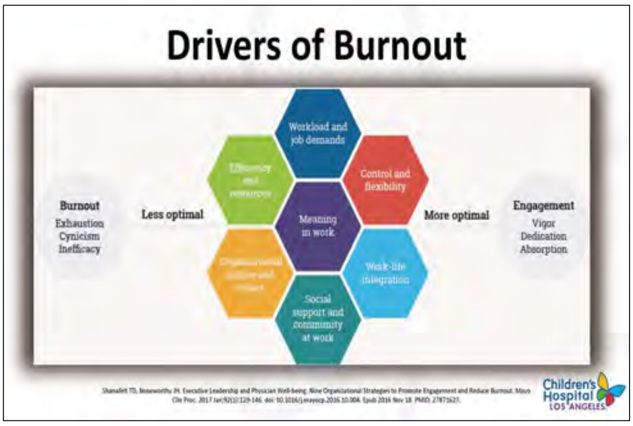
Healing the Culture of Medicine

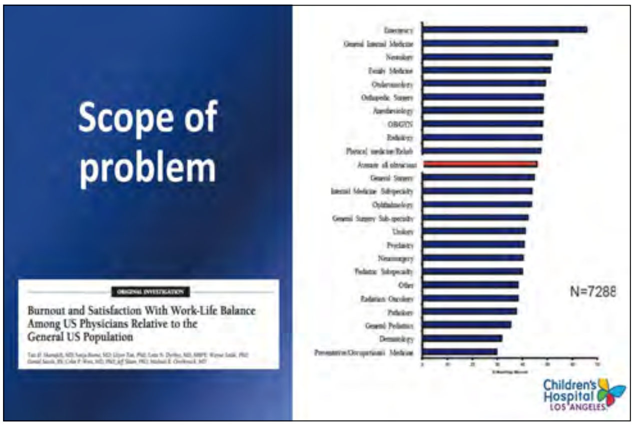
Rebecca Donovan Margolis

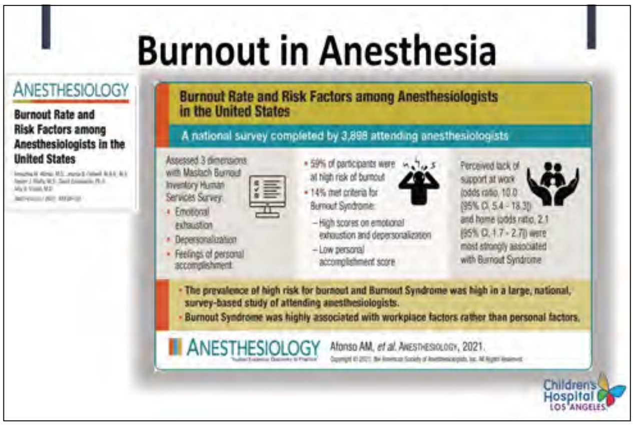
Department of Anesthesiology and Critical Care Medicine, Children's Hospital Los Angeles,
University of Southern California Keck School of Medicine, USA



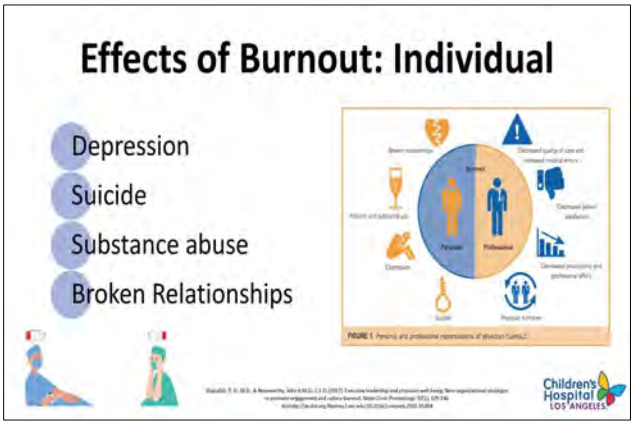


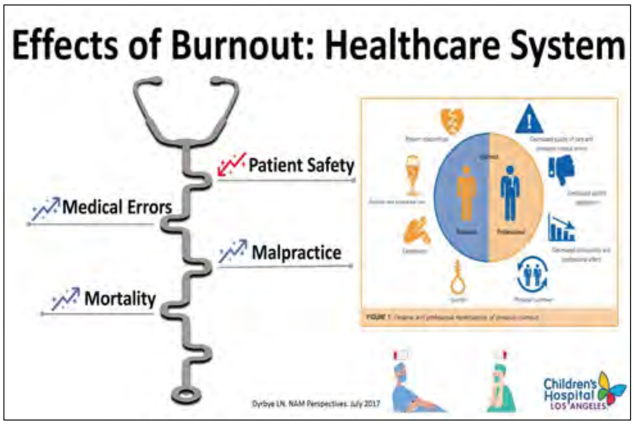





Burnout in Anesthesia
ANESTHESIOLOGY
Burnout Rate and Risk Factors among Anesthesiologists in the United States
Burnout Rate and Risk Factors among Anesthesiologists in the United States
A national survey completed by 3,898 attending anesthesiologists
Assessed 3 dimensions with Maslach Burnout Inventory Human Services Survey:
Emotional exhaustion
Depersonalization
Feelings of personal accomplishment
59% of participants were at high risk of burnout
14% met criteria for Burnout Syndrome:
– High scores on emotional exhaustion and depersonalization
– Low personal accomplishment score
Perceived lack of support at work (odds ratio, 10.0 [95% CI, 5.4 - 18.3]) and home (odds ratio, 2.1 [95% CI, 1.7 - 2.7]) were most strongly associated with Burnout Syndrome
The prevalence of high risk for burnout and Burnout Syndrome was high in a large, national, survey-based study of attending anesthesiologists.
Burnout Syndrome was highly associated with workplace factors rather than personal factors.
ANESTHESIOLOGY
Afonso AM, et al. ANESTHESIOLOGY, 2021.
Children's Hospital LOS ANGELES


Burnout: it's not just Americans
ICPH 2022
Children's Hospital LOS ANGELES


Effects of Burnout: Individual
Depression
Suicide
Substance abuse
Broken Relationships
Children's Hospital LOS ANGELES


Effects of Burnout: Healthcare System
Patient Safety
Medical Errors
Malpractice
Mortality
Dyrbye LN. NAM Perspectives. July 2017
Children's Hospital LOS ANGELES

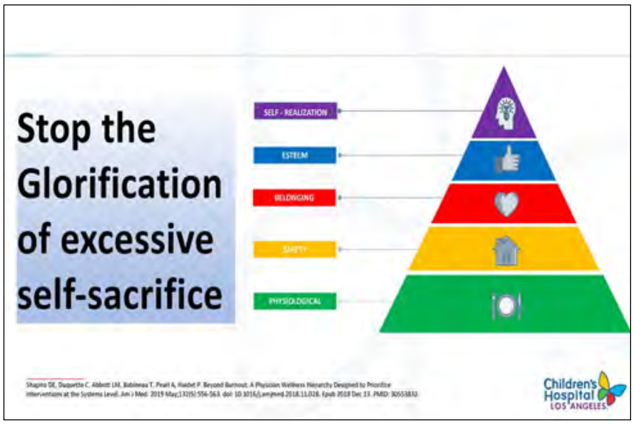

Economics, Education, and Policy
The Prevalence of Burnout and Depression and Their Association with Adherence to Safety and Practice Standards: A Survey of United States Anesthesiology Trainees
More frequent medication errors
Less vigilance about patient care
Children's Hospital LOS ANGELES


Cost of Physician Burnout
Calculate the Cost of Physician Burnout for Your Organization
80
59%
7%
$500,000
Impact of Physician Burnout in Your Organization
2 /year
$1,038,993 /year
AMA AMERICAN MEDICAL ASSOCIATION
Children's Hospital LOS ANGELES

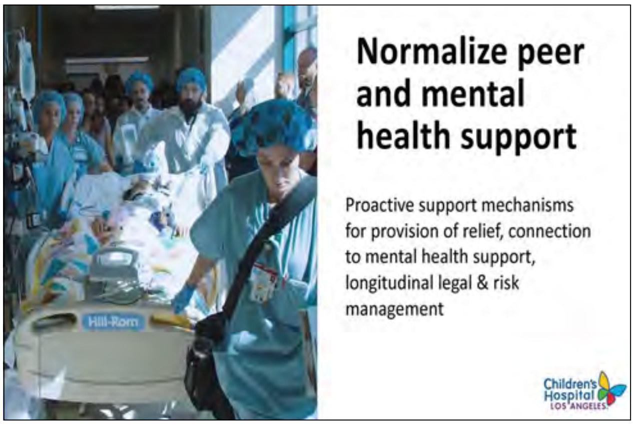

Staffing Shortages
HELP WANTED
One in five
healthcare workers have left medicine since the start of the pandemic
Children's Hospital LOS ANGELES

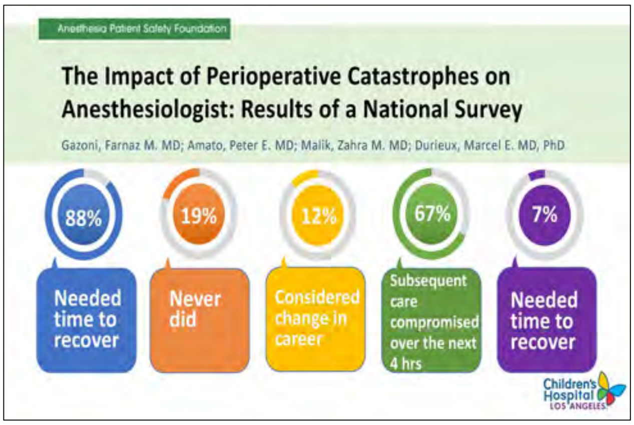

Well-Being 2.0: Sustainable Culture
Culture Change
Physician well-being
The Wicked Problem of Physician Well-Being
Children's Hospital LOS ANGELES


What can we do?
Stop the glorification of excessive self-sacrifice
Stop blaming and shaming doctors
Normalize peer and mental heath support
Stop the strip mining
Empower physicians to be the architects of their own environment
The Wicked Problem of Physician Well-Being
Children's Hospital LOS ANGELES


Stop the Glorification of excessive self-sacrifice
SELF-REALIZATION
ESTEEM
BELONGING
SAFETY
PHYSIOLOGICAL
Children's Hospital LOS ANGELES


Stop blaming and shaming doctors
Impact of lawsuits
Physicians involved in a lawsuit are at ↑ risk for stress, personal consequences, and burnout
Litigation and patient safety & quality
Litigation has not been shown to improve patient safety or quality of care
Liability reform
Liability reform is necessary to uphold patient safety while minimizing trauma to doctors
Children's Hospital LOS ANGELES


Hill-Rom
Normalize peer and mental health support
Proactive support mechanisms for provision of relief, connection to mental health support, longitudinal legal & risk management
Children's Hospital LOS ANGELES


Anesthesia Patient Safety Foundation
The Impact of Perioperative Catastrophes on Anesthesiologist: Results of a National Survey
Gazoni, Farnaz M. MD; Amato, Peter E. MD; Malik, Zahra M. MD; Durieux, Marcel E. MD, PhD
88%
Needed time to recover
19%
Never did
12%
Considered change in career
67%
Subsequent care compromised over the next 4 hrs
7%
Needed time to recover
Children's Hospital LOS ANGELES


Annals of Internal Medicine
REVIEW
Addressing Postpandemic Clinician Mental Health
A Narrative Review and Conceptual Framework
Societal
Organizational
Individual
Broad funding and policies to support enhanced mental health programs
Addressing HCWs basic needs
Specialized training for new job roles
Recognition and communication from leadership
Addressing moral injury
Programs to encourage peer support/connection
Resilience and stress reduction training
Figure. Proposed framework of clinician well-being resources
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Stop the strip mining
Harness intrinsic motivators
Clinicians are a finite resource and must be valued as such
Healthcare institutions must adopt long-term strategies focused on retention by investing in and supporting employees
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Empower physicians to be the architects of their own environment
Early leadership training
Leadership roles must come with protected time
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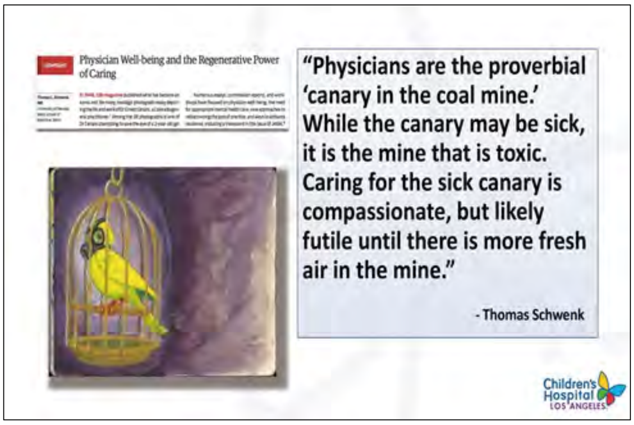
Physician Well-being and the Regenerative Power of Caring
"Physicians are the proverbial 'canary in the coal mine.' While the canary may be sick, it is the mine that is toxic. Caring for the sick canary is compassionate, but likely futile until there is more fresh air in the mine."
- Thomas Schwenk
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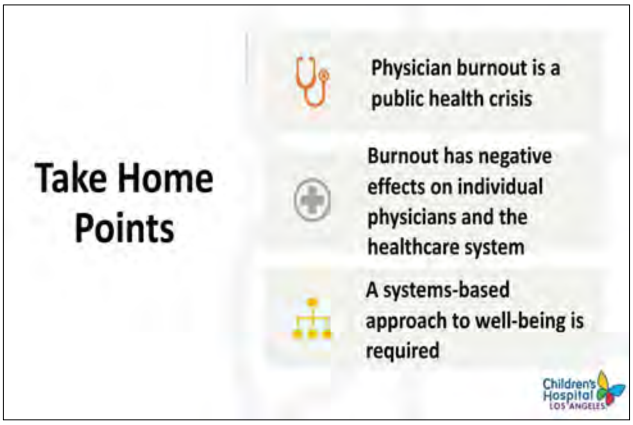
Take Home Points
Physician burnout is a public health crisis
Burnout has negative effects on individual physicians and the healthcare system
A systems-based approach to well-being is required
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Thank you! 감사합니다
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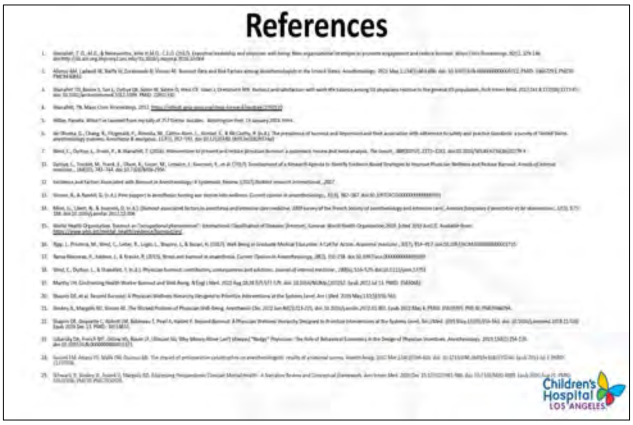

References
Children's Hospital LOS ANGELES

Challenges in providing safe anaesthesia to children in LMIC's

Rebecca Jacob

(Retired) Christian Medical College, India

Access to safe anaesthesia and surgery for patients of all ages should be considered a basic human right, but this is not available to a large segment of the world's population. Many developing and underdeveloped countries spend a very small portion of their GDP on health care, and this is the greatest barrier to providing good anaesthetic services and surgical care. Different countries have different problems and there are often regional variations within the same country. Some LIC's have very well equipped and staffed hospitals in major cities while the rural poor suffer. Often the problem is maldistribution of supplies rather than absolute shortage

Surgery is critical to the health of the population and safe anaesthesia is a mandatory component of safe surgical care. There is much that can be done to make sure that the existing resources are used efficiently. The WHO, acknowledging the fact that the global volume of surgery is significant and adverse events resulting from surgeries constitute a significant public health concern, launched the Patient Safety Initiative in 2004 and the Safe Surgery Saves Lives initiative in 2008. With these initiatives, they have set a core set of safety standards that can be applied to all countries in all settings. The Surgical Safety Check List, together with the WHO-WFSA International Standards for a Safe Practice of Anesthesia (2010) enhanced patient safety cultures but Pediatric Anaesthesia in LMIC's has not kept pace with advances made in developed countries and International standards for Safe Anaesthesia Practice adopted by the WFSA are seldom met.

The element of safety is particularly important in anaesthesia because anaesthesia is not in itself therapeutic and is intrinsically hazardous.

Problems faced in delivering safe anaesthesia in LMIC's

- The patients
- Spectrum and nature of the disease
- Personnel – staffing
- Facilities
- Equipment and supplies
- Drugs – poor supply, quality and perhaps, out dated

The patients: are often, anemic, undernourished children of economic crises, war or natural disasters. Fear, superstition, interference by 'local healers', poor understanding of medical problems, poor education and poor access to medical care often results in delayed presentation.

Spectrum and nature of the disease: Often marasmic, anemic, undernourished, riddled with tuberculosis or HIV

Personnel – staffing: Anaesthesia is not perceived as an attractive career for many undergraduates who have little or no exposure to the subject during their studies Anaesthesia does not enjoy a high profile and lacks the voice to demand access to basic resources in developing countries. Anaesthesia providers are often too busy providing clinical services to find the time to approach the 'powers that be' for basic requirements. There is a critical shortage of manpower and this proves a barrier to progress. Anaesthesia is often delivered by nurses or non-technical people. Supervision is invariably inadequate In some countries surgery is performed without the 'luxury' of an anaesthetist Access to textbooks and journals are limited and internet access is non-existent. Most 'trained' anaesthetists are afraid to deal with children especially neonates and infants because of perceived difficulty or fear Invariably a 'paediatric anaesthetist is one who shows an interest in children, likes children or is just allocated to 'do' children on a particular day. A trained Paediatric Anaesthetist is, therefore, a luxury

Facilities and Drugs

Operating Rooms are often poorly equipped, non-air conditioned, with poor facilities for sterilization of equipment. Water supply and electricity is erratic Supplies of anaesthetic gases and oxygen supplies unreliable and erratic Drugs are in short supply and are often outdated IV fluids- their choice and availability is limited. Halothane and Isoflurane are the most commonly used inhalational agents. Ketamine and paracetamol most often used analgesics. Narcotics like morphine are often unavailable or its use is restricted Choice of neuromuscular drugs is limited and often a 'reversal' drug like neostigmine is unavailable Regional anaesthesia has benefits like safety, cost savings and analgesia but is often not used in children for lack of training, fear of failure or non-availability of drugs and disposables etc.

Blood availability and safety

Fewer than 30% of developing countries have nationally coordinated blood transfusion services. Screening of donors is often not done. Many do not perform even rudimentary tests for diseases such as hepatitis and HIV Storage of blood is difficult especially as electricity supply is often erratic.

Equipment

Electricity is unreliable and reliable functional 'back up' generators are often unavailable Sterilization of re- useable equipment is the norm but availability and performance of sterilizers is unreliable Recycling of disposable equipment such as endotracheal tubes is also often relied on General facilities for infection control such as running water, disinfectants and gloves is also unreliable Essential equipment to provide safe anaesthesia for neonates and infants are in short supply from appropriately sized endotracheal tubes, small IV cannulae, appropriate airways, laryngoscopes and syringe pumps.

Monitoring is often basic – a precordial stethoscope and a finger on the pulse is often all that is available. The Global oximetry project has helped with providing reasonably priced pulse oximeters.

Anaesthesia machines are of 2 categories

1. Modern, sophisticated electronic machines. These are often donated by well meaning donors
   - They require electricity,
   - operating manuals that require to be understood (especially if in a foreign language),
   - regular maintenance by individuals trained to do so.
   - service contracts do not often hold good in remote rural locations.
   - often discarded at the first sign of trouble

   Poorly understood and poorly maintained equipment becomes hazardous and potentially life threatening

2. Simple, durable and safe
   - versatile, easily understood and easy to use
   - able to function even if there is no electricity and if there are no cylinders available
   - robust,
   - able to withstand extreme climate conditions,
   - Inexpensive, economical and easily maintained by locally available skills

3. Oxygen concentrators

Visiting Providers

Often come with no idea of the facilities or the needs of the local people or with preconceived ideas that 'they know best'. However some countries organize well staffed 'missions' to remote areas

Solutions?

Knowing that there is a dearth of qualified paediatric anaesthesia providers especially in rural areas, I would look at what measures need to be taken to bridge the 'demand/supply' gap of qualified, committed anaesthesia providers in those areas

- Can we bring about quality improvement with education?
- Establish protocol driven clinical outcomes leading to standardization of safety protocols.

But who is to ensure that these are followed?

- Can we find a way to 'match' safety policies to implementation across vast and diverse countries or diverse regions in the same country?

- How do we gauge whether these policies and protocols are working?

What 'outcome measures' would be appropriate?

Room B

ASPA 2023

Session 1.

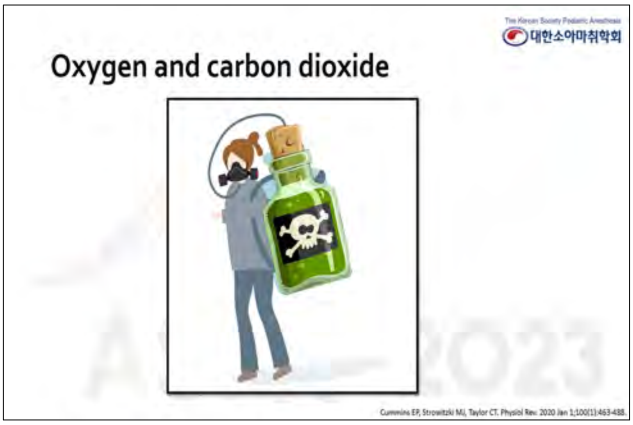
Optimization of Intraoperative Ventilation in Children

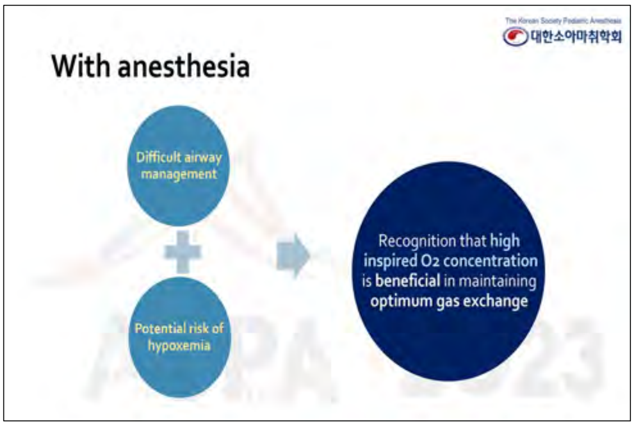
Chair(s): Ekta Rai (India)
Chul-Ho Chang (Korea)

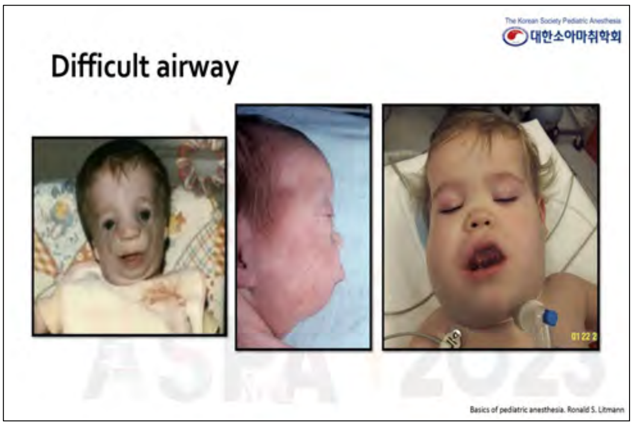
Optimal Target of O_2 and CO_2

Sung-Ae Cho

Department of Anesthesiology and Pain Medicine, College of Medicine, Konyang University, Korea







With anesthesia

- Several oxygen delivery method
  - Invasive involuntary; Intubation, LMA, bronchoscopy.....
  - noninvasive self breathing; CPAP, nasal cannular, oxygen mask....



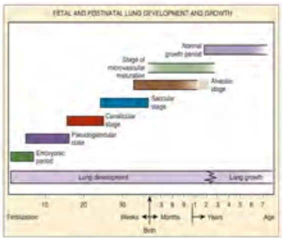
A Practice of Anesthesia for Infants and Children, sixth edition; Cote, Lerman, Anderson
Pediatric and neonatal mechanical ventilation; Rimensberger

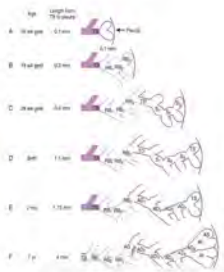
Optimal oxygen

- The Optimal Arterial Oxygen Tension (Pao2)
  at the Lowest Inspired Oxygen Concentration (Fio2)

- With ABGA – direct method
  - PaO_2, FiO_2, A-a gradient
- Without ABGA – indirect method; SpO2
  - Measure arterial oxyhemoglobin saturation, not arterial oxygen partial pressure

Prenatal Development of the Lungs





BOX 3-1 Mechanism of Continuous Neonatal Breathing

- The onset of breathing activities occurs not at birth but in utero as a part of normal fetal development.
- The clamping of the umbilical cord initiates rhythmic breathing.
- Relative hyperoxia with air breathing, compared with low fetal Pao_2, augments and maintains continuous and rhythmic breathing.
- Continuous breathing is independent of the level of $Paco_2$.
- Breathing is unaffected by carotid denervation.
- Hypoxia depresses or abolishes continuous breathing.

TABLE 3-1 Normal Blood-Gas Values

	Pao_2 (mm Hg)	Sao_2 (%)	$Paco_2$ (mm Hg)	pH
Pregnant woman at term	88*	98	32	7.40
Umbilical vein	31	72*	42	7.35
Umbilical artery	19	38*	51	7.29
1 hour of life (artery)	62	95	28	7.38
24 hours of life (artery)	68	94	29	7.37
Child and adult (artery)	99	97	41	7.40

*Estimated values.

the level of PO2 at which SaO2 is 50%, indicating the affinity of hemoglobin for oxygen

Age	P_{50} (mm Hg)	Percent Saturation at Venous Oxygen Tension of 40 mm Hg	Hemoglobin (g/100 mL)	Oxygen Unloaded* (mL/100 mL)
1 day	19.4	87	17.2	1.84
3 wk	22.7	80	13.0	2.61
6-9 wk	24.4	77	11.0	2.65
3-4 mo	26.5	73	10.5	3.10
6 mo	27.8	69	11.3	3.94
8-11 mo	30.0	65	11.8	4.74
5-8 yr	29.0	67	12.6	4.23
9-12 yr	27.9	69	13.4	4.67
Adult	27.0	71	15.0	4.92

Increase
Decrease

*Assumes arterial oxygen saturation of 95%.
Data from Oski FA. Designation of anemia on a functional basis. *J Pediatr*. 1973;83:353.

TABLE 3-5 Hemoglobin Requirements for Equivalent Tissue Oxygen Delivery

	P_{50} (mm Hg)	Hemoglobin for Equivalent O_2 Delivery (g/dL)						
Adult	27	7	8	9	10	11	12	13
Infant >6 mo	30	5.7	6.5	7.3	8.2	9.0	9.8	10.6
Neonate <2 mo	24	10.3	11.7	13.2	14.7	16.1	17.6	19.1

Data calculated from Motoyama EK, et al. Functional basis of childhood anemia [abstract]. *Am Soc Anesthesiology*. 1974;283.

Hmmmm.....

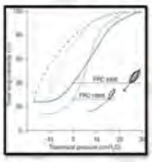
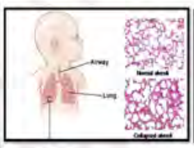

The purpose of O2 supplement

- In pediatrics
  - Indication; for correction hypoxemia (low oxygen content in the blood)

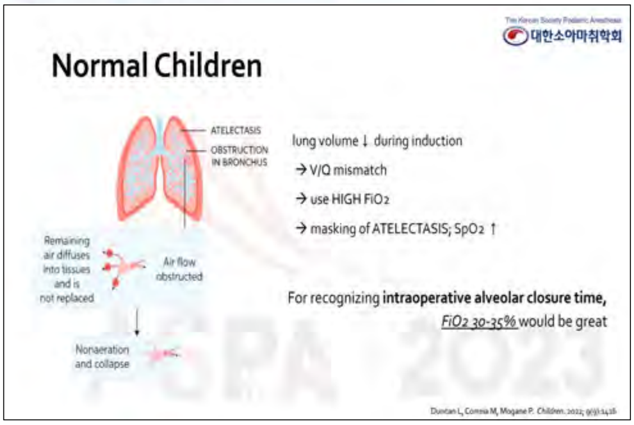
- In anesthesiology
  - Indication; for adequate tissue oxygenation during perioperative period

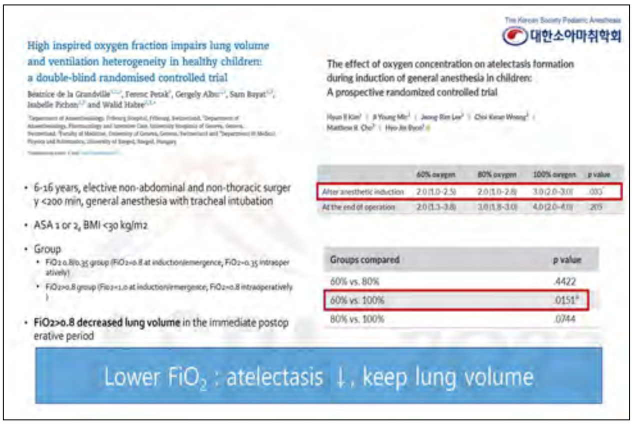
Pediatric anesthesia

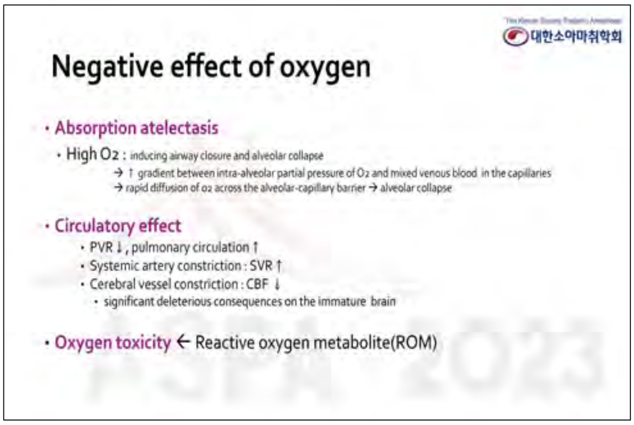
- Adequate tissue oxygenation during perioperative period
- Prevention and treatment for hypoxemia
- m/c hypoxemia during anesthesia : d/t *V/Q mismatch*
  - In this case, high FiO2 can seriously affect hypoxemia

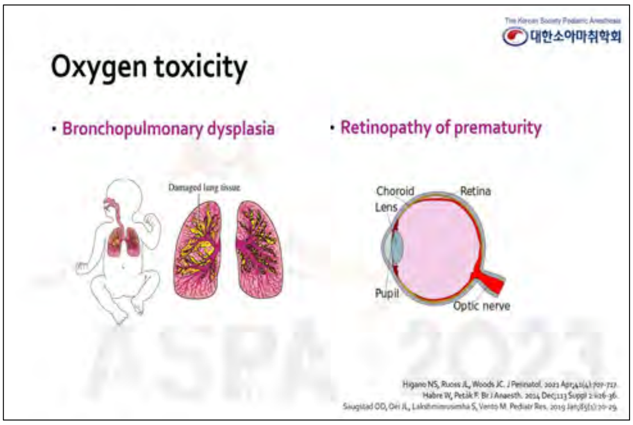



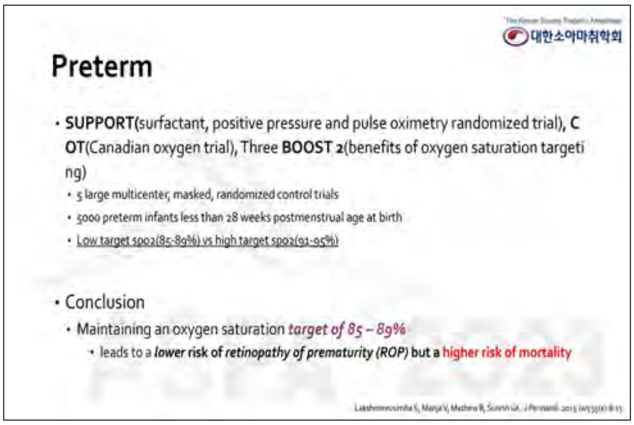
Trachsel D, Svendsen J, Erb TO, von Ungern-Sternberg BS. Br J Anaesth. 2016 Aug;117(2):151-63.

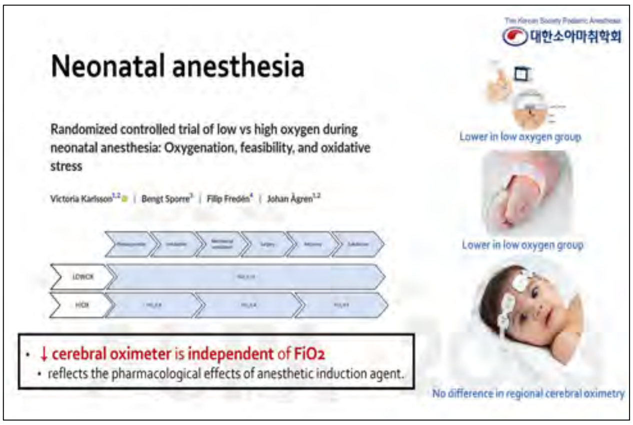

대한소아마취학회
Normal Children
ATELECTASIS
OBSTRUCTION IN BRONCHUS
Remaining air diffuses into tissues and is not replaced
Air flow obstructed
Nonaeration and collapse
lung volume ↓ during induction
→ V/Q mismatch
→ use HIGH FiO2
→ masking of ATELECTASIS; SpO2 ↑
For recognizing intraoperative alveolar closure time,
FiO2 30-35% would be great

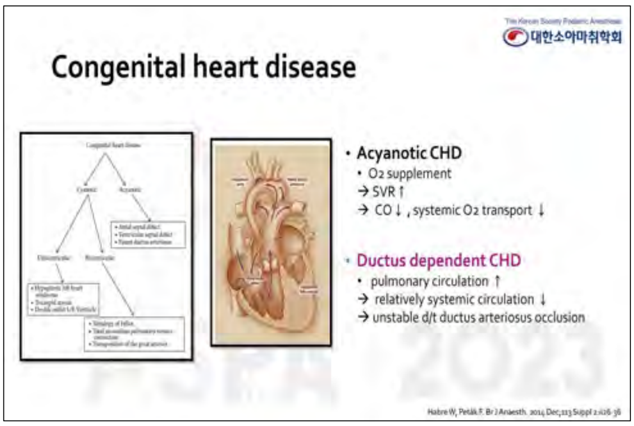

대한소아마취학회
High inspired oxygen fraction impairs lung volume and ventilation heterogeneity in healthy children: a double-blind randomised controlled trial
• 6-16 years, elective non-abdominal and non-thoracic surgery <200 min, general anesthesia with tracheal intubation
• ASA 1 or 2, BMI <30 kg/m2
• Group
• FiO2>0.8 decreased lung volume in the immediate postoperative period
The effect of oxygen concentration on atelectasis formation during induction of general anesthesia in children: A prospective randomized controlled trial
Groups compared | p value
60% vs. 80% | .4422
60% vs. 100% | .0151
80% vs. 100% | .0744
Lower FiO2 : atelectasis ↓, keep lung volume

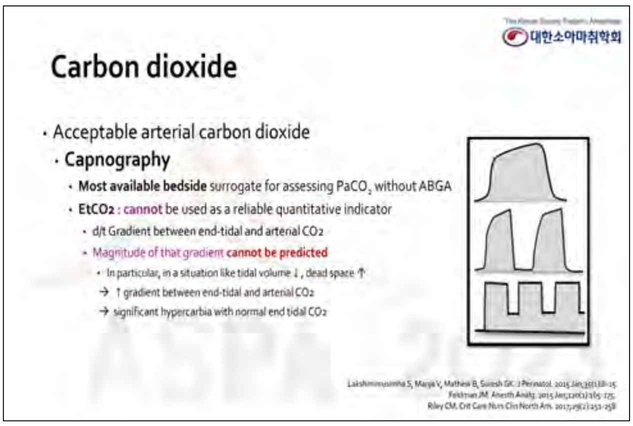

대한소아마취학회
Negative effect of oxygen
• Absorption atelectasis
• High O2 : inducing airway closure and alveolar collapse
→ ↑ gradient between intra-alveolar partial pressure of O2 and mixed venous blood in the capillaries
→ rapid diffusion of o2 across the alveolar-capillary barrier → alveolar collapse
• Circulatory effect
• PVR ↓, pulmonary circulation ↑
• Systemic artery constriction : SVR ↑
• Cerebral vessel constriction : CBF ↓
• significant deleterious consequences on the immature brain
• Oxygen toxicity ← Reactive oxygen metabolite(ROM)


대한소아마취학회
Oxygen toxicity
• Bronchopulmonary dysplasia
• Retinopathy of prematurity
Damaged lung tissue
Choroid
Retina
Lens
Pupil
Optic nerve


대한소아마취학회
Preterm
• SUPPORT(surfactant, positive pressure and pulse oximetry randomized trial), COT(Canadian oxygen trial), Three BOOST 2(benefits of oxygen saturation targeting)
• 5 large multicenter, masked, randomized control trials
• 5000 preterm infants less than 28 weeks postmenstrual age at birth
• Low target spo2(85-89%) vs high target spo2(91-95%)
• Conclusion
• Maintaining an oxygen saturation target of 85 – 89%
• leads to a lower risk of retinopathy of prematurity (ROP) but a higher risk of mortality


대한소아마취학회
Neonatal anesthesia
Randomized controlled trial of low vs high oxygen during neonatal anesthesia: Oxygenation, feasibility, and oxidative stress
Victoria Karlsson | Bengt Sporre | Filip Fredén | Johan Ågren
Lower in low oxygen group
Lower in low oxygen group
• ↓ cerebral oximeter is independent of FiO2
• reflects the pharmacological effects of anesthetic induction agent.
No difference in regional cerebral oximetry


대한소아마취학회
Congenital heart disease
• Acyanotic CHD
• O2 supplement
→ SVR ↑
→ CO ↓, systemic O2 transport ↓
• Ductus dependent CHD
• pulmonary circulation ↑
→ relatively systemic circulation ↓
→ unstable d/t ductus arteriosus occlusion


대한소아마취학회
Carbon dioxide
• Acceptable arterial carbon dioxide
• Capnography
• Most available bedside surrogate for assessing PaCO2 without ABGA
• EtCO2 : cannot be used as a reliable quantitative indicator
• d/t Gradient between end-tidal and arterial CO2
• Magnitude of that gradient cannot be predicted
• In particular, in a situation like tidal volume ↓, dead space ↑
→ ↑ gradient between end-tidal and arterial CO2
→ significant hypercarbia with normal end tidal CO2

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- **Lung-protective ventilation** in small patients
  - Risk of inadequate tidal volume or an unfavorable VD/Vt ratio, **causing a larger than normal difference between Paco2 and end tidal co2**
- Caring for patients with **immature lungs**
  - **Difficult to assess ventilation** definitively **based upon** $EtCO_2$ **alone**.
    - Accepting hypercarbia can be part of the lung protective ventilation strategy.
- When **accurate control of Paco2 is required** (e.g., increased ICP)
  - **Arterial blood gas analysis** is necessary to document effective ventilation

Feldman JM. Anesth Analg. 2015 Jan;120(1):165-175

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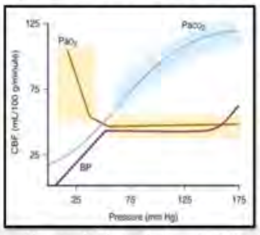
Relationship with cerebral circulation



- The influence on the cerebral circulation : **PaCO2 > PaO2**
- **↓ CBF d/t hyperoxia in children is larger** than in adults.

Habre W, Peták F. Br J Anaesth. 2014 Dec;113 Suppl 2:ii26-36
Anesthesia for congenital heartdisease 3rd edition

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Neonate

- In healthy neonates,
  - the **physiological CO2 range** is defined as **35.3–45.0 mmHg.**
- **Hyper- and hypocapnia** can both have **detrimental effects** for newborn infants.

Wong SK, Chim M, Allen J, Butler A, Tyrrell J, Hurley T, McGovern M, Omer M, Lagan N, Meehan J, Cummins EP, Molloy EJ. Carbon dioxide levels in neonates: what are safe parameters? Pediatr Res.

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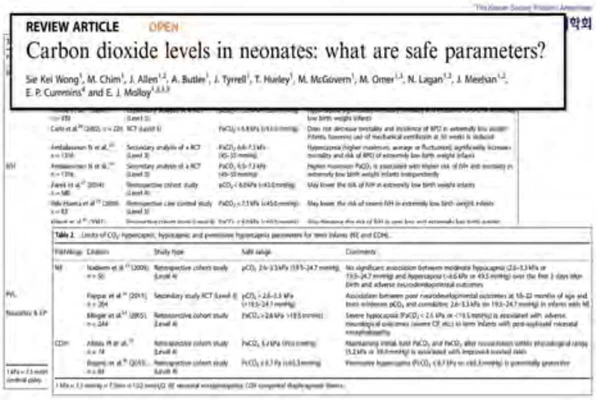

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- **Periventricular leukomalacia**: $PaCO_2$ > 35mmHg
- **Neurodevelopmental, cerebral palsy**: 35.3mmHg < $PaCO_2$ < 54.8mmHg
- **Neonatal enterocolitis**: $PaCO_2$ > 24.7mmHg

- **Bronchopulmonary dysplasia** : $PaCO_2$ < 50mmHg
- **Intraventricular hemorrhage** : $PaCO_2$ <57.8-60mmHg
- **Congenital diaphragmatic hernia** : $PaCO_2$ <39mmHg, $PcCO_2$ <65.3mmHg

Wong SK, Chim M, Allen J, Butler A, Tyrrell J, Hurley T, McGovern M, Omer M, Lagan N, Meehan J, Cummins EP, Molloy EJ. Carbon dioxide levels in neonates: what are safe parameters? Pediatr Res.

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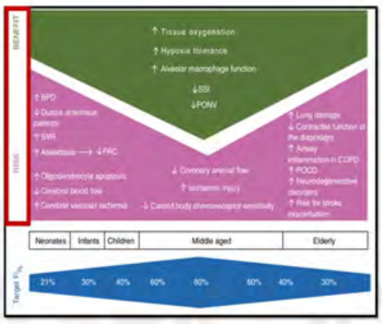

Habre W, Peták F. Br J Anaesth. 2014 Dec;113 Suppl 2:ii26-36

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So, What is optimal O2 and CO2?

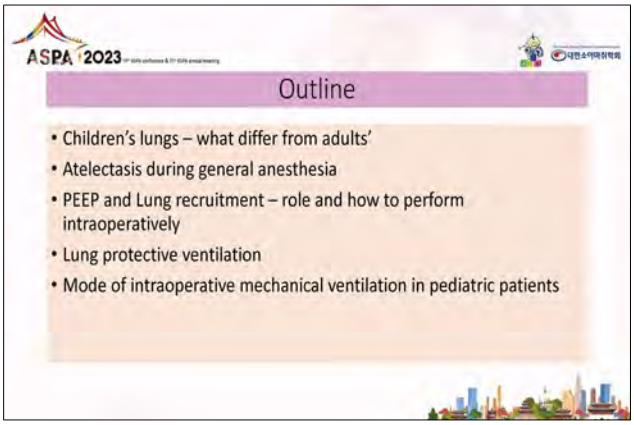
- **Avoiding both hypocapnia/hypoxia and hypercapnia/hyperoxia is optimal,** **but there is *not* a uniform range of optimal CO2/O2.**

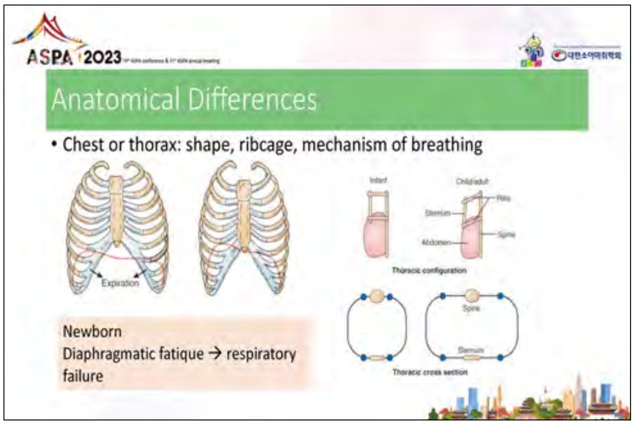
- *It depends on what you focus on most*
- *Unless the patient's condition is bad, it is better to **avoid providing high oxygen***
- *Consider patient's condition*

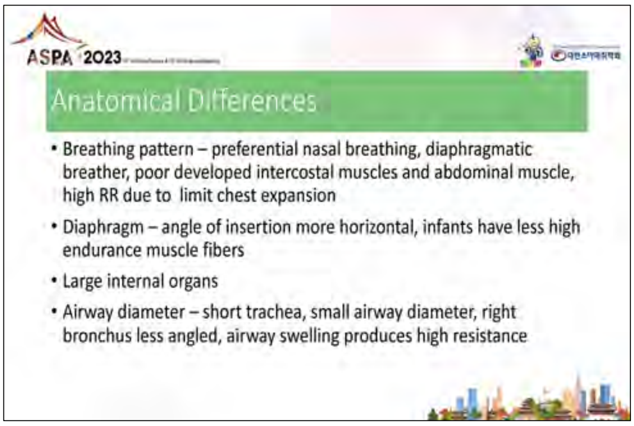
PEEP and Recruitment, Mode of Ventilation

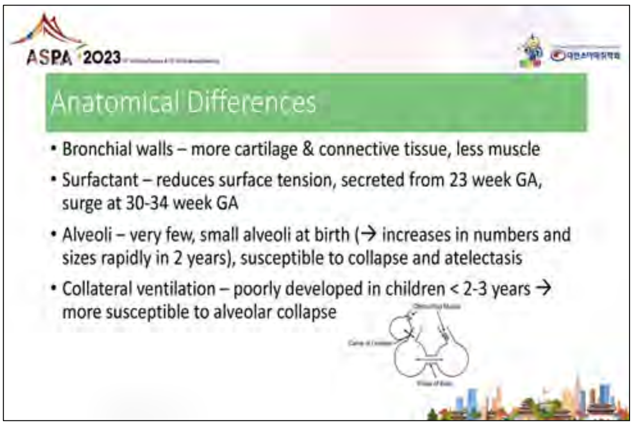
Pichaya Waitayawinyu

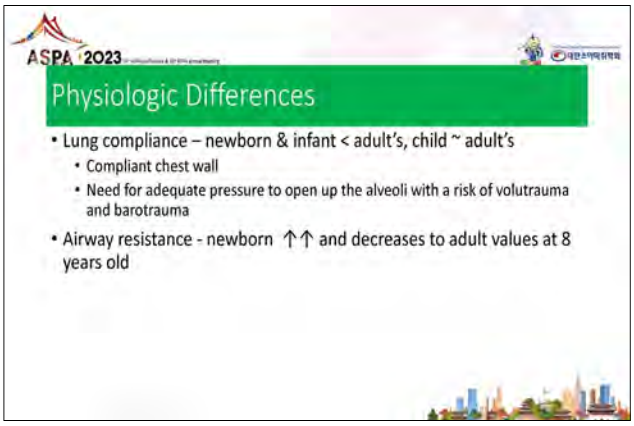
Department of Anesthesiology, Siriraj Hospital, Mahidol University, Thailand

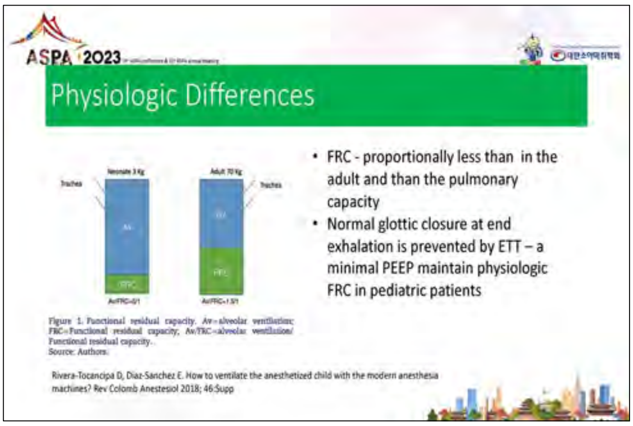


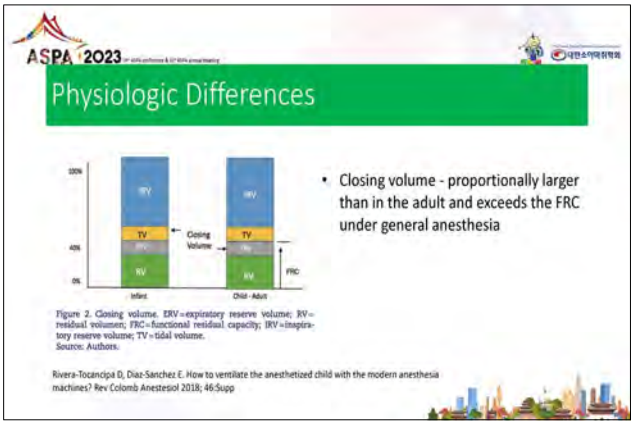


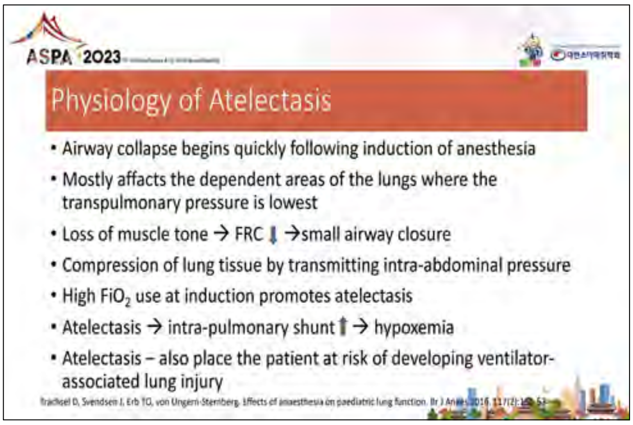


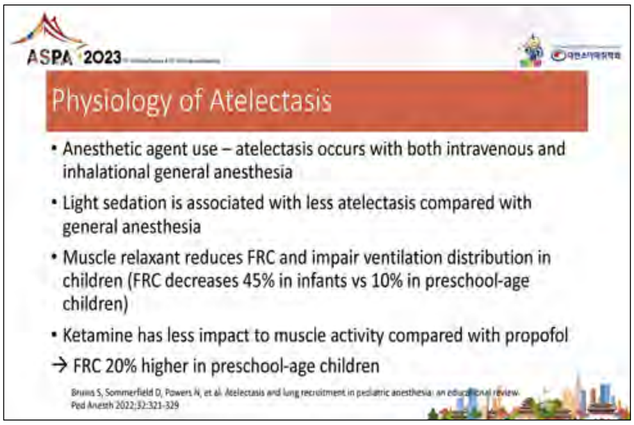


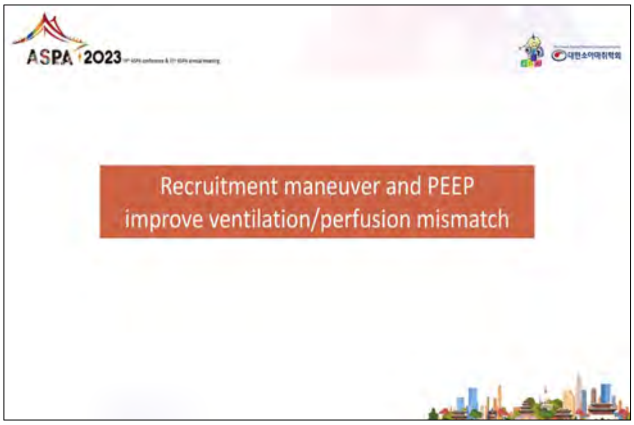


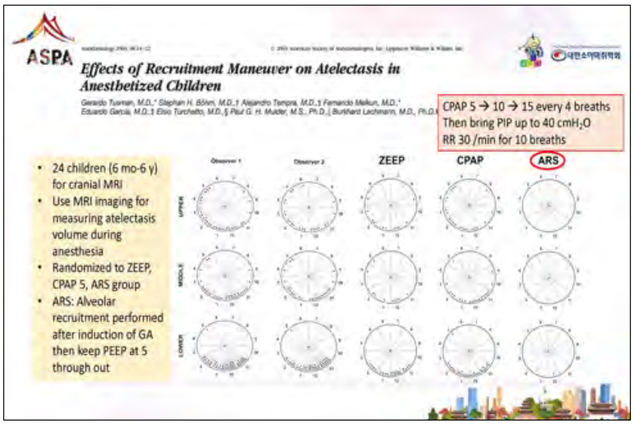


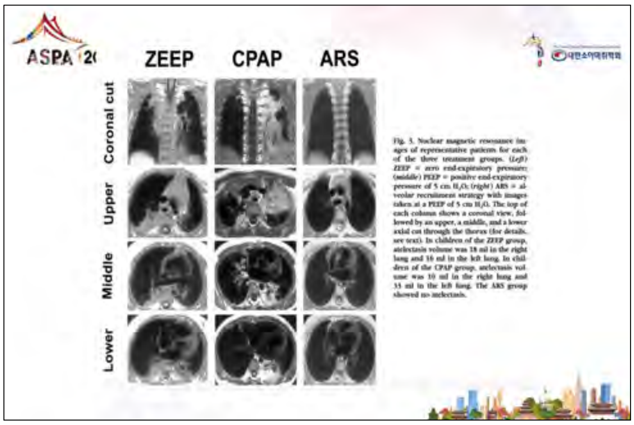

ASPA 2023
Physiologic Differences
100%
IRV
TV
ERV
RV
40%
0%
Closing Volume
FRC
Infant
Child - Adult
• Closing volume - proportionally larger than in the adult and exceeds the FRC under general anesthesia
Figure 2. Closing volume. ERV=expiratory reserve volume; RV=residual volumen; FRC=functional residual capacity; IRV=inspiratory reserve volume; TV=tidal volume.
Source: Authors.
Rivera-Tocancipa D, Díaz-Sanchez E. How to ventilate the anesthetized child with the modern anesthesia machines? Rev Colomb Anestesiol 2018; 46:Supp

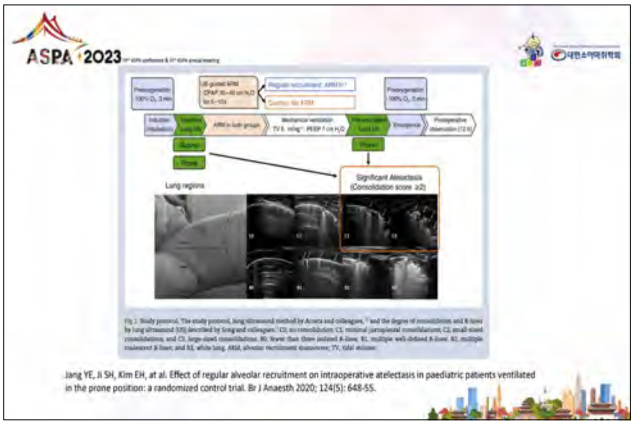

ASPA 2023
Physiology of Atelectasis
• Airway collapse begins quickly following induction of anesthesia
• Mostly affects the dependent areas of the lungs where the transpulmonary pressure is lowest
• Loss of muscle tone → FRC ⬇ →small airway closure
• Compression of lung tissue by transmitting intra-abdominal pressure
• High FiO_2 use at induction promotes atelectasis
• Atelectasis → intra-pulmonary shunt ⬆ → hypoxemia
• Atelectasis – also place the patient at risk of developing ventilator-associated lung injury
Trachsel D, Svendsen J, Erb TO, von Ungern-Sternberg. Effects of anaesthesia on paediatric lung function. Br J Anaes 2016; 117(2): 151-63

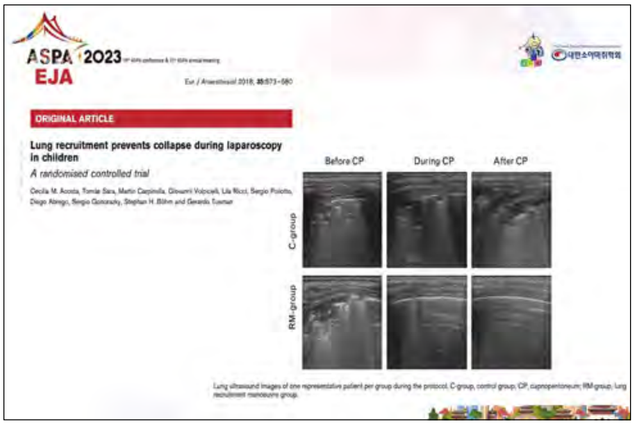

ASPA 2023
Physiology of Atelectasis
• Anesthetic agent use – atelectasis occurs with both intravenous and inhalational general anesthesia
• Light sedation is associated with less atelectasis compared with general anesthesia
• Muscle relaxant reduces FRC and impair ventilation distribution in children (FRC decreases 45% in infants vs 10% in preschool-age children)
• Ketamine has less impact to muscle activity compared with propofol
→ FRC 20% higher in preschool-age children
Bruins S, Sommerfield D, Powers N, et al. Atelectasis and lung recruitment in pediatric anesthesia: an educational review. Ped Anesth 2022;32:321-329


ASPA 2023
Recruitment maneuver and PEEP improve ventilation/perfusion mismatch


ASPA
Effects of Recruitment Maneuver on Atelectasis in Anesthetized Children
CPAP 5 → 10 → 15 every 4 breaths
Then bring PIP up to 40 cmH_2O
RR 30 /min for 10 breaths
• 24 children (6 mo-6 y) for cranial MRI
• Use MRI imaging for measuring atelectasis volume during anesthesia
• Randomized to ZEEP, CPAP 5, ARS group
• ARS: Alveolar recruitment performed after induction of GA then keep PEEP at 5 through out
Observer 1
Observer 2
ZEEP
CPAP
ARS


ASPA
ZEEP
CPAP
ARS
Coronal cut
Upper
Middle
Lower


ASPA 2023
Lung regions
Jang YE, Ji SH, Kim EH, et al. Effect of regular alveolar recruitment on intraoperative atelectasis in paediatric patients ventilated in the prone position: a randomized control trial. Br J Anaesth 2020; 124(5): 648-55.


ASPA 2023
EJA
Eur J Anaesthesiol 2018; 35:573–580
ORIGINAL ARTICLE
Lung recruitment prevents collapse during laparoscopy in children
A randomised controlled trial
Before CP
During CP
After CP
C-group
RM-group

Recruitment maneuver regimens

- Sustained application of positive airway pressure up to a set of minimum of 40 cmH_2O for 10-30 sec before returning to baseline
- Varying airway pressures during the respiratory cycle by gradually and stepwise increasing PEEP (to approximately 15-20 cmH_2O) → increase in tidal volume to a maximum PIP 40 cmH_2O → gradual lowering of PEEP to level required to prevent de-recruitment

Bruins S, Sommerfield D, Powers N, et al. Atelectasis and lung recruitment in pediatric anesthesia: an educational review. Ped Anesth 2022;32:321-329

TABLE 2 Strategies to reduce atelectasis in anesthetized children

Strategies to reduce atelectasis
• Continuous positive airway pressure (30–40 cmH_2O) for 5–10 s
• Multiple prolonged breaths of 30–40 cmH_2O of continuous pressure over PEEP
• Stepwise increase in airway pressure to max 40 cmH_2O under LUS guidance
• PCM with constant driving pressure of 15 cmH_2O and stepwise increase by 5 cmH_2O until 30–40 cmH_2O
• PEEP >4 cmH_2O
• Postural RM, particularly following thoracotomy
• Avoiding high FiO_2
• RM with cuffed ETT superior to SGA/face-mask
• Avoidance of neuromuscular blockade

Abbreviations: LUS, lung ultrasound; PCM, Pressure Controlled Mode; PEEP, positive end-expiratory pressure; RM, recruitment maneuver; SGA, supraglottic airway., ETT endotracheal tube.

Bruins S, Sommerfield D, Powers N, et al. Atelectasis and lung recruitment in pediatric anesthesia: an educational review. Ped Anesth 2022;32:321-329

What is Lung Protective Ventilation? and Why Should We Care?

- Mechanical ventilation strategies aimed at minimizing lung injury
- Avoidance of volutrauma and atelectrauma
- Most data from adults' studies
- Lower mortality rates in adult patients ventilated with a tidal volume (Vt) of 6mL/kg ideal body weight (IBW) and plateau pressures (Pplat) <30cmH_2O compared to Vt of 12mL/kg IBW and Pplat <50 cmH_2O (ARDSNet)
- In nonobese adult patients undergoing open abdominal surgery, ventilation of Vt 8 ml/kg with PEEP of 12 cmH_2O combined with recruitment maneuvers was compared with PEEP of 2 cmH_2O without recruitment maneuvers No different in postoperative pulmonary complication

Kilpatrick B, Slinger P. Lung protective strategies in anaesthesia. Br J Aaes 2010. 105(S1):i108-16
ARDSNet trial, PALIVE study, PROVHILO study
Heath C, Hauser N. Is there a role for lung-protective ventilation in healthy children?. Ped Anesth 2022. 32(2):278-85.

What is Lung Protective Ventilation? and Why Should We Care?

- Concerns with the use of low Vt - increased risk of atelectasis, development of hypercapnia, reduction in respiratory compliance.
- Specifically, in the pediatric context, lowering Vt is associated with concerns about increased dead space and hypercapnia.
- In simulated models of pediatric acute respiratory distress (PARDS) patients ventilated with Vt of 10 ml/kg, no compromise in gas exchange was demonstrated

Recommendations for Lung Protective Strategies in Healthy Pediatric Patients

1. Target Vt 6-10 mL/kg IBW, avoiding Vt > 10 mL/kg
2. Limit PIP < 30 cmH_2O and delta pressure < 10 cmH_2O. Monitor variations in Vt carefully to avoid volutrauma
3. PEEP remains an important component of LPV but the optimal level of PEEP for pediatric patients is unknown. Suggest PEEP range of 4-8 cmH_2O
4. Recruitment maneuver

Heath C, Hauser N. Is there a role for lung-protective ventilation in healthy children?. Ped Anesth 2022. 32(2):278-85.

Recommendations for Lung Protective Strategies in Healthy Pediatric Patients (cont)

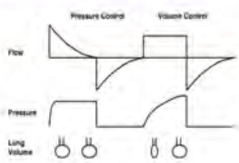
5. Avoid FiO_2 of 1.0 unless a clinical emergency occurs
6. Recruitment advised to maintain FRC – suggest either sustained inflation of 30 cmH_2O for 10-30 sec or an incremental increase in PEEP based on individual patient needs

Heath C, Hauser N. Is there a role for lung-protective ventilation in healthy children?. Ped Anesth 2022. 32(2):278-85.

Mode of Ventilation

Pressure-controlled Ventilation

- Square wave pressure waveform provides the maximum inspiratory pressure for the entire i-time favoring lung recruitment
- Maximum volume of ventilator is available to develop the rest pressure → the desired tidal volume can be delivered even small leak presents
- Provide rapid rate, high inflating pressure – suitable for patients with severe lung pathology
- Maximum PIP is limited → prevent barotrauma



Set – Inspire pressure, i-time, RR

Initial settings for pressure-controlled mechanical ventilator in children

	Infant (<1 year of age)	Toddler/Child (1-12 year)	Adolescent (>12 year)
PIP (cmH_2O)		16-25	
PEEP (cmH_2O)		3-7	
Rate (breaths/min)	20-30	15-25	12-20
Pressure support (cmH_2O)		Minimum 6-10	
Peak inspiratory flow (L/min)		Adjust to desired inspiratory time	
Inspiratory time (sec) Targeted, based upon changes to inspiratory flow	0.4-0.6	0.7-0.9	0.9-1.2
FiO_2		Start with 1.0 rapidly wean to ≤ 0.6	
Flow trigger (L/min)	0.25-0.5	0.8-2	0.8-2
Pressure support cycle		10-25% of peak flow rate	

Volume- controlled Ventilation

Set – tidal volume, i-time or I:E ratio, RR

- Square wave flow waveform, with flow rate determined by the ration of the set tidal volume to the i-time
- Ensure tidal volume to be delivered by the ventilator
- Tidal volume is delivered regardless of PIP -> risk of barotrauma (stop when maximum pressure limit is reached)
- Risk of losses from the ETT leak

Initial settings for volume-controlled mechanical ventilator in children

	Infant (<1 year of age)	Toddler/Child (1-12 year)	Adolescent (>12 year)
Tidal volume (mL)		5-8 mL/kg	
Rate (breaths/min)	20-30	15-25	12-20
PEEP (cmH_2O)		3-7	
Pressure support (cmH_2O)		Minimum 6-10	
Peak inspiratory flow (L/min)		Adjust to desired inspiratory time	
Inspiratory time (sec) Targeted, based upon changes to inspiratory flow	0.4-0.6	0.7-0.9	0.9-1.2
FiO_2		Start with 1.0 rapidly wean to ≤ 0.6	
Flow trigger (L/min)	0.25-0.5	0.8-2	0.8-2
Pressure support cycle		10-25% of peak flow rate	

Dual Ventilation

- Ensure accurate tidal volume, cycle after cycle, with a limited maximum pressure
- PCV with volume guaranteed (PVC-PG)
- Convenient for frequent and broad airway pressure changes occur; laparoscopic, thoracoscopic surgeries

Pressure Support Ventilation

- Patient initiates spontaneous breathe
- Reduce work of breathing imposed by endotracheal tube or LMA
- Need to keep PCO_2 level to maintain spontaneous breathing
- Combined SIMV and PSV to insure minute ventilation
- Potential advantages:
  - Facilitating emergence of anaesthesia
  - Improved hemodynamics due to less positive pressure needed
  - Assessing depth of anesthesia
  - Titration of opioid analgesia

Synchronized Intermittent Mandatory Ventilation

- Improve the patient-ventilator relationship
- SIMV-Pressure Control (PC) or SIMV-Volume Control (VC)
- Determine patient's 'trigger flow' in order for the ventilator to allow and assist spontaneous ventilation

To Protect the Lungs: keep an eye on

- Impact of breathing systems used for manual ventilation – use modified Jackson Rees T-piece with caution (inexperienced use)
- Impact of extubation – FRC loss, consider put non-invasive ventilation immediately in high risk patient
- Impact of CPB and cardiothoracic surgery – FRC reduction during open chest and CPB

Trachsel D, Svendsen J, Erb TO, von Ungern-Sternberg. Effects of anaesthesia on paediatric lung function. Br J Anaes 2016. 117(2):151-63

Dead Space and the Pediatric Patient

- Dead space = any portion of the breathing circuits or lungs in which there is bidirectional gas flow without gas exchange (include device that provide gas sampling)

V_D/V_T ratio increases –> exponential increases in $PaCO_2$ level

Figure 4. Typical apparatus added to the breathing circuit with internal volumes noted. Dead space volume added to the circuit can range from 9 mL for the smallest heat and moisture exchanger (HME) pictured to 55 mL for the combination of elbow, large HME, and expanded flexible extension. (From Pearsall M, Feldman JM. When does apparatus dead space matter for the pediatric patient? Anesth Analg 2014;118:776–80.)

Ventilation Monitoring

Clinical signs:
- Respiratory rate
- Physical examination – chest movement, synchrony, percussion, breath sounds
- Movement of reservoir bag

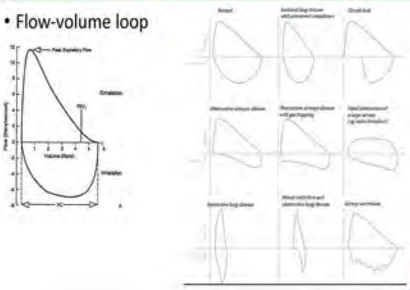
Monitoring to Achieve Optimal Ventilation

- Gold standard – Arterial blood gas analysis
- Standard
  - Oxygenation: pulse oximeters
  - Ventilation: $ETCO_2$
  - Respiratory mechanics: loops and scalars

Continuous vigilance of trained anesthesia personnel

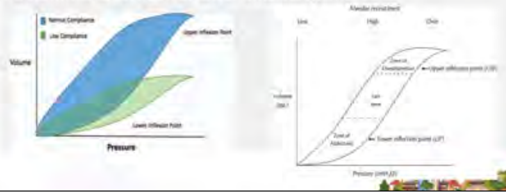
Ventilation Monitoring in the Modern Machines Spirometry:

- Flow-volume loop



Ventilation Monitoring in the Modern Machines Spirometry:

- Pressure-volume loop
- Identify the pulmonary compliance – flattened curve -> decrease pulmonary compliance
- Determine ideal PEEP at lower inflexion point



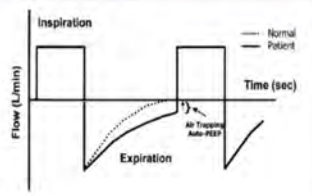
Ventilation Monitoring in the Modern Machines Pressure-time curve:

- Airway resistance – approximately 5 cmH_2O, if > 8-10 cmH_2O = high endotracheal resistance (tube kink, partial airway obstruction from secretion, very small tube)
- High PIP with normal airway resistance = high Pplat -> changes in pulmonary compliance
- Pressure drive (driving pressure) ideally < 10 cmH_2O,

should not > 14 → raise PEEP level

Ventilation Monitoring in the Modern Machines Flow-time curve:

- Determine I:E ratio



Goals for an Optimal Ventilation

- Optimal PaO_2 at the lowest inspired oxygen concentration
  - Recruitment maneuver in case of using FiO_2 < 0.25
- An acceptable $PaCO_2$
  - $ETCO_2$ less predictable in small tidal volume or increased dead space
- The desired tidal volume at the least inspiratory pressure
  - Interprete expired tidal volume with caution
  - Use pressure-volume (PV) loop as a guide
  - Add PEEP or recruitment maneuver

Be acquainted with your anesthesia machine

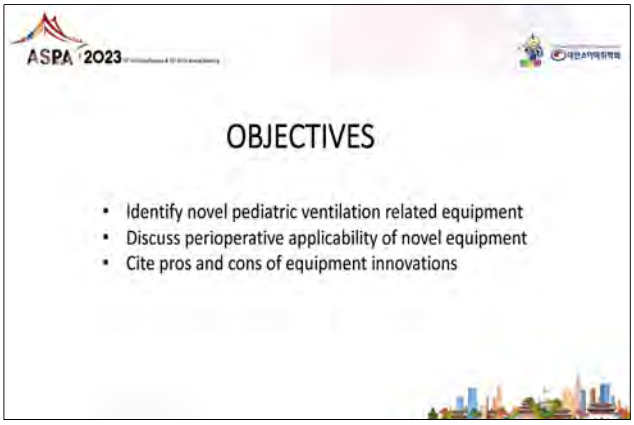
Summary

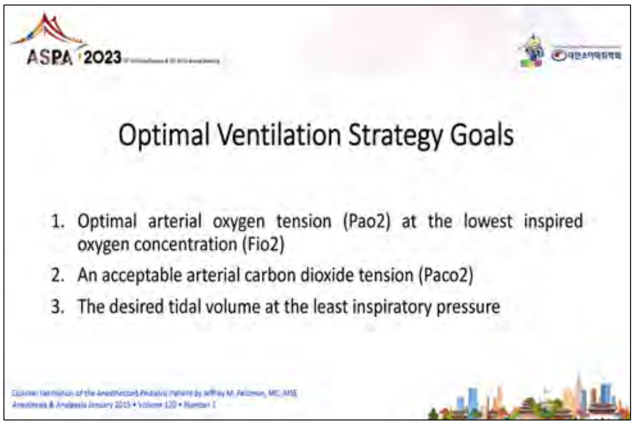
- Atelectasis develop easily in children especially during general anesthesia
- PEEP and lung recruitment shoud be performed to prevent atelectasis
- Lung protective ventilation is suggeted
- The ideal mode of intraoperative mechanical ventilation in pediatric patients is not definite.

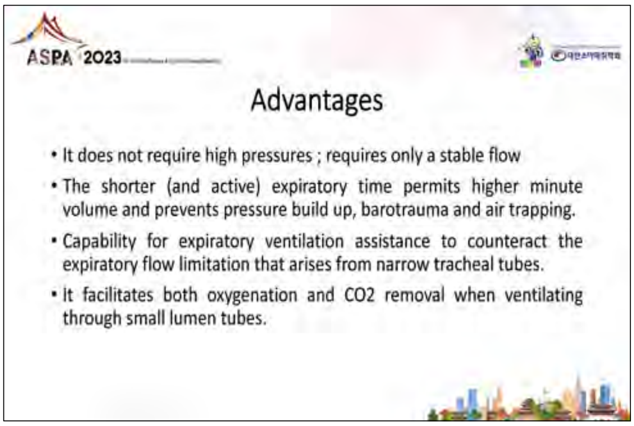
Inhale the Future Exhale the Past Smart Choice of Ventilation Equipment

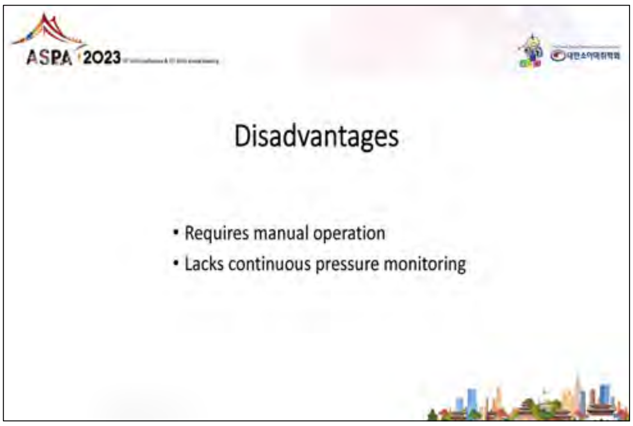
Joy E. Luat-Inciong

St. Luke's Medical Center, Philippines









Flow Controlled Ventilation

- energy dissipation that occurs during intermittent positive-pressure ventilation is one of the contributors to ventilator induced lung injury (VILI)
- to reduce energy dissipation, the flow must be held constant with an inspiratory to expiratory ratio (I:E) close to 1:1.

Evone® Flow Controlled Ventilator using Tritube®

Pros & Cons

- The use of relatively low flow rates leads to improved distribution of lung aeration and improved gas exchange compared to conventional ventilation.
- Possibility to ventilate through very narrow endotracheal tubes

- Can only be used with total intravenous anesthesia since vaporizers cannot be included in the breathing circuit.
- Lacks adaptive ventilation modes and the possibility to be triggered by the patient
- Only recommended for use with an ideal body weight of over 40 kg

Negative Pressure Ventilation

Negative Pressure Ventilation

- benefits cardiac patients by improving hemodynamics
- wean from positive-pressure ventilation or combined with it
- bridge therapy until intubation or lung transplantation is available
- used to avoid intubation in selected patients
- could be involved in physiotherapy, home care, or palliative care with better quality of end-life

- need to develop standardized ventilation strategies and protocols based on prospective and controlled studies
- determine indications and contraindications, and specific target populations

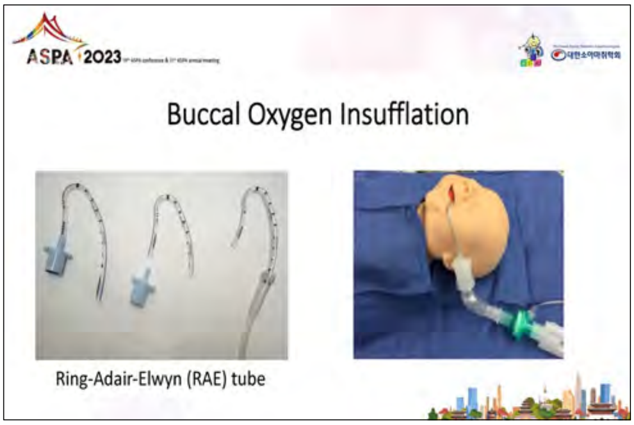
PeDI R

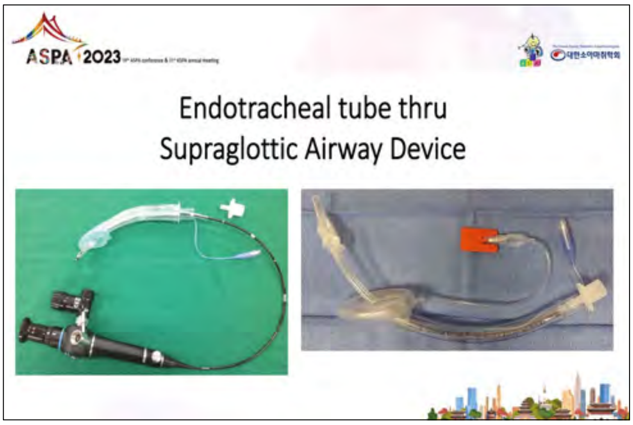
Difficult Airway Bundle Checklist

PEdiatric DIfficult Intubation Registry Group

Nasal High-Flow Oxygen

Modified Nasal Trumpet


ASPA 2023
Buccal Oxygen Insufflation
Ring-Adair-Elwyn (RAE) tube


ASPA 2023
Endotracheal tube thru
Supraglottic Airway Device

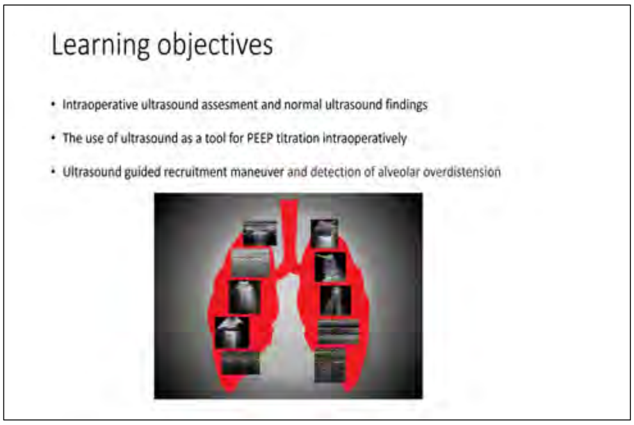

ASPA 2023
cap-ONE® mask

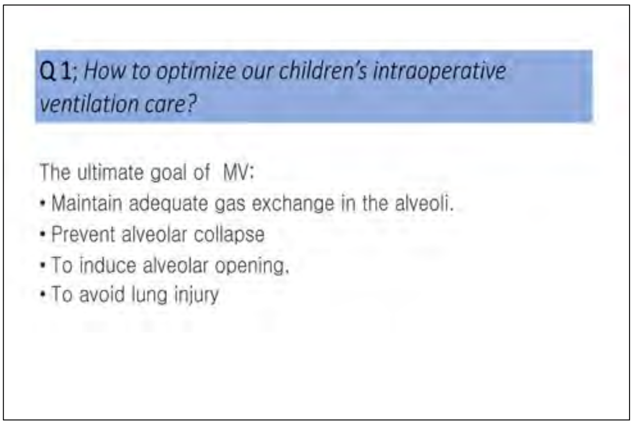

ASPA 2023
Normal Breath sound
PAO
Apnea
AccurSound Electronic Stethoscope
(Airmod)

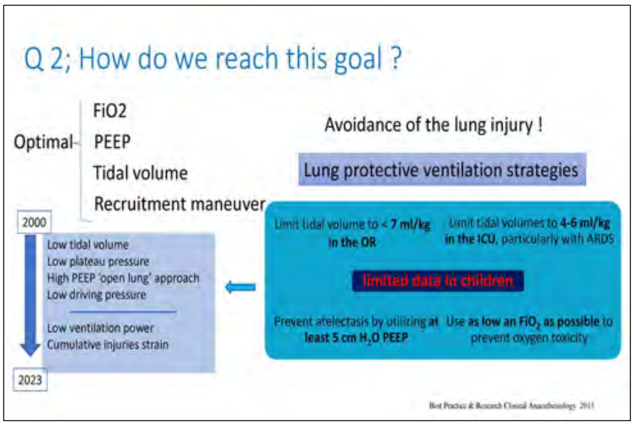
How to Optimize Our Children's Intraoperative Ventilation Care with POCUS

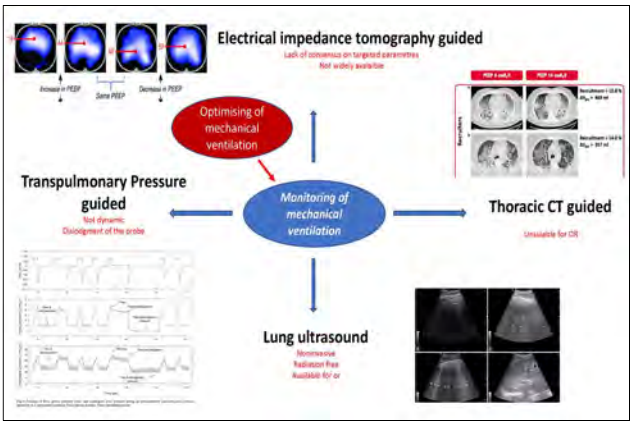
Ayse Cigdem Tutuncu

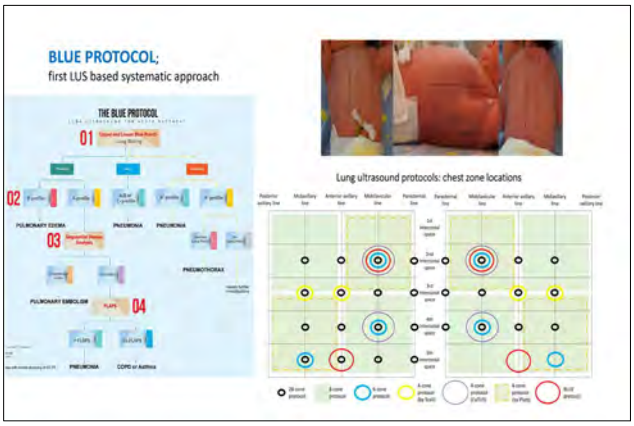
IU-Cerrahpasa University, Medicine School of Cerrahpasa, Türkiye

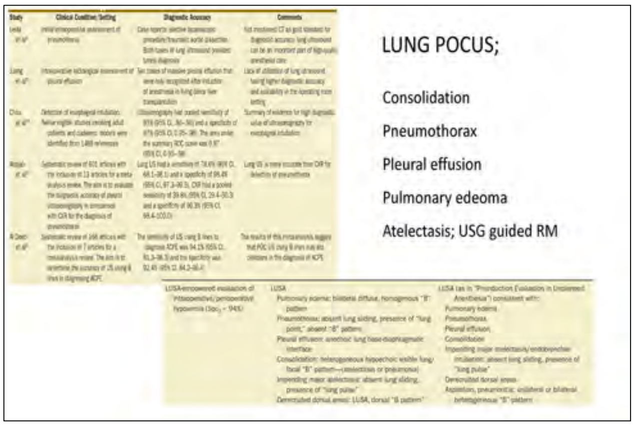


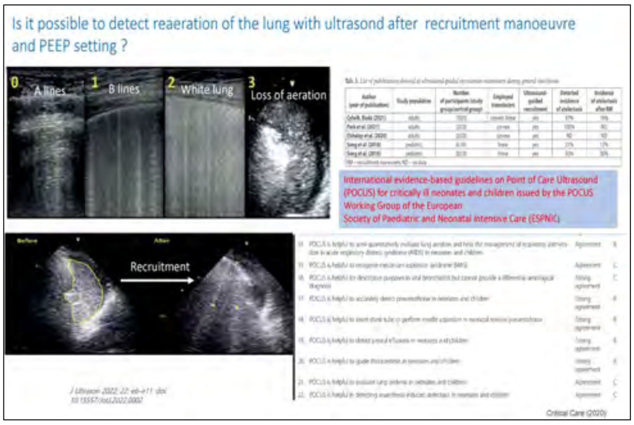


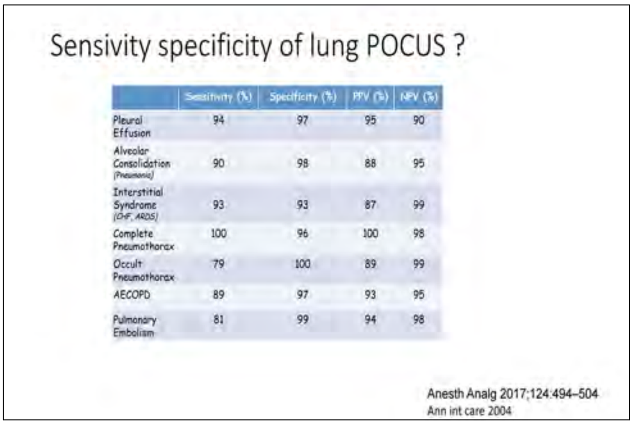




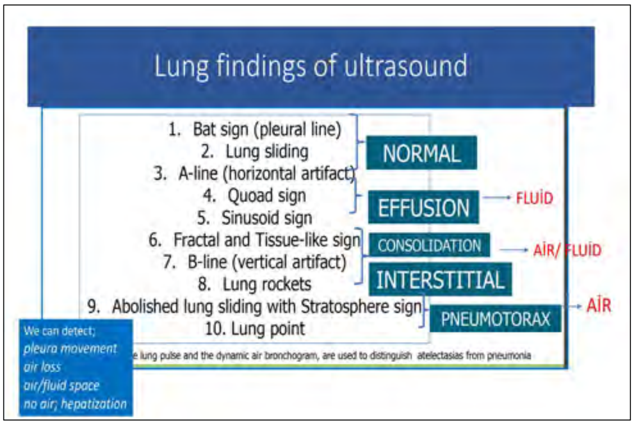


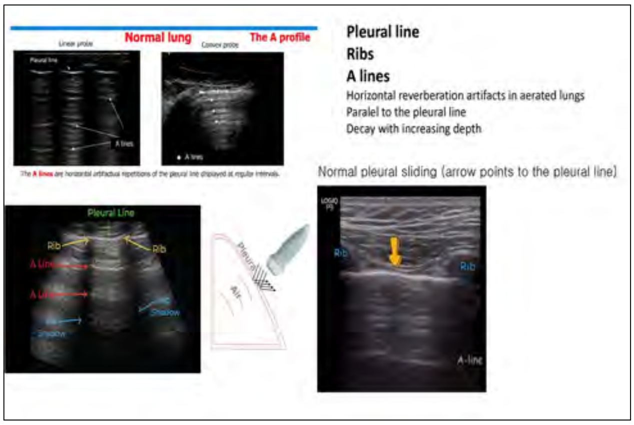


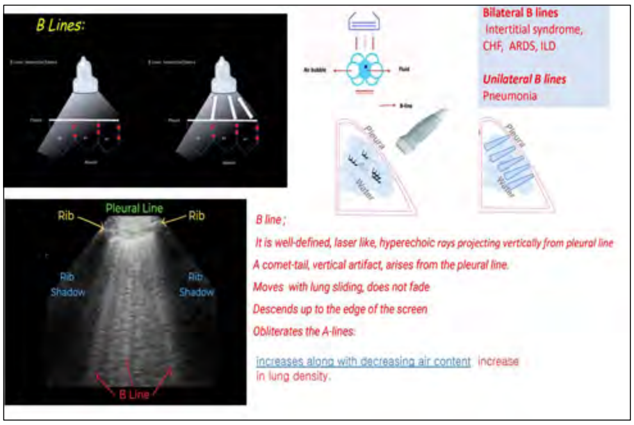


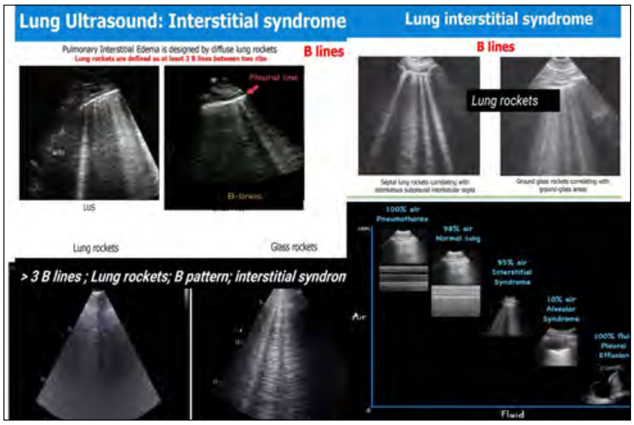


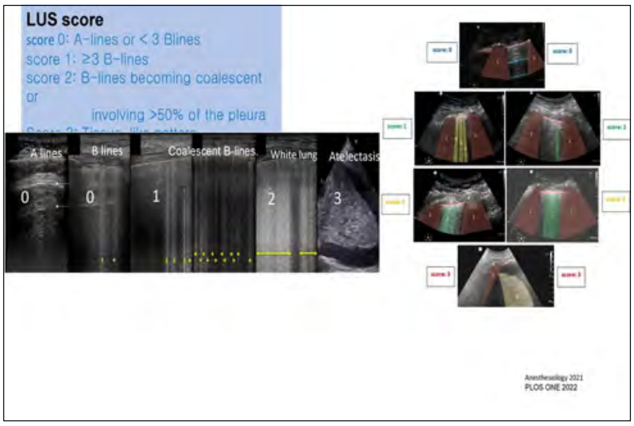
	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Pleural Effusion	94	97	95	90
Alveolar Consolidation (Pneumonia)	90	98	88	95
Interstitial Syndrome (CHF, ARDS)	93	93	87	99
Complete Pneumothorax	100	96	100	98
Occult Pneumothorax	79	100	89	99
AECOPD	89	97	93	95
Pulmonary Embolism	81	99	94	98

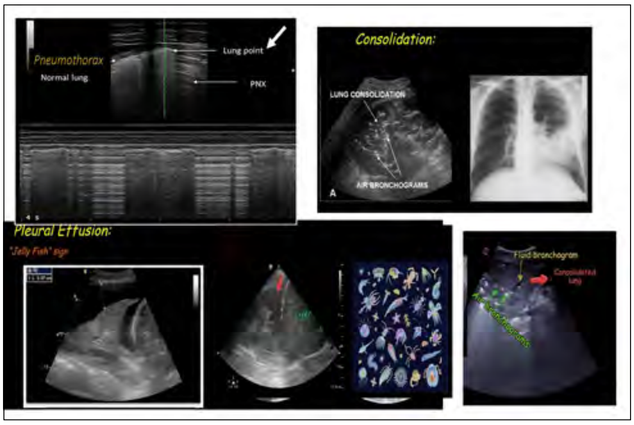


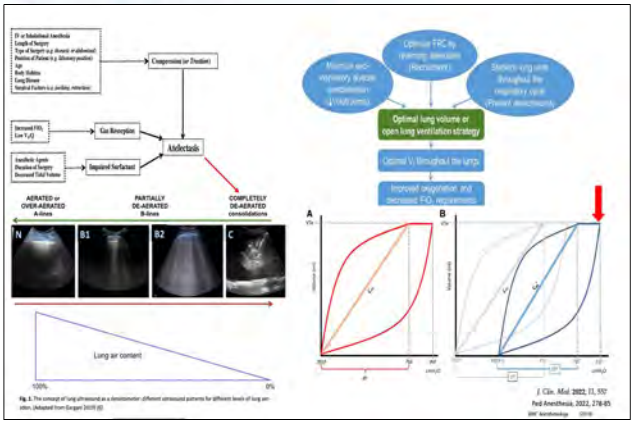


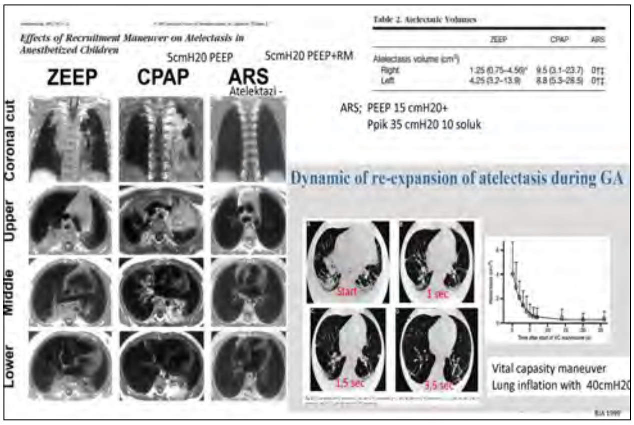


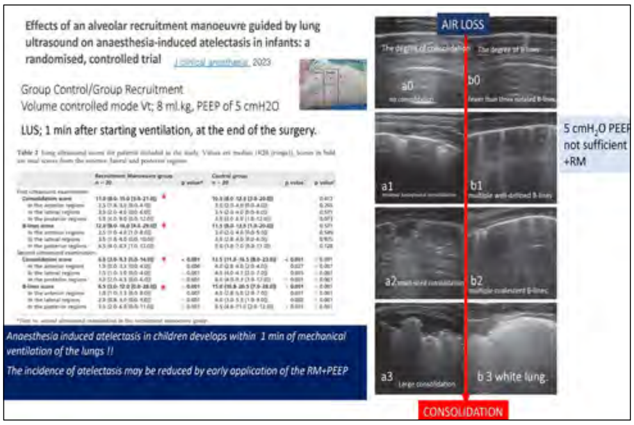


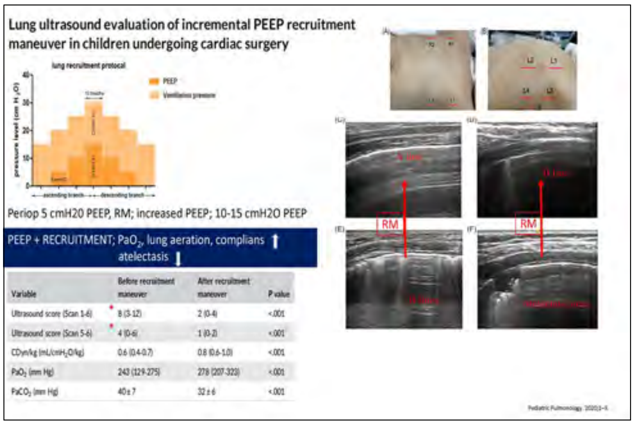


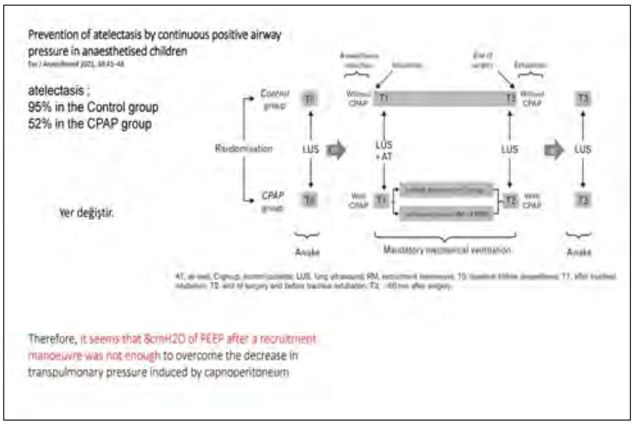


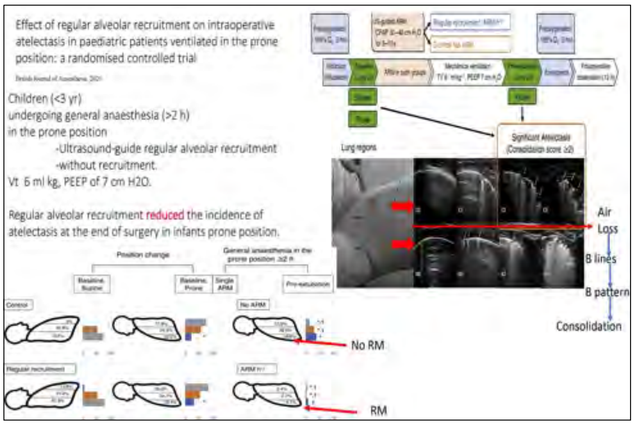

Atelectasis
Gas Resorption
Impaired Surfactant
AERATED or OVER-AERATED A-lines
PARTIALLY DE-AERATED B-lines
COMPLETELY DE-AERATED consolidations
Lung air content
Optimal lung volume or open lung ventilation strategy
J. Clin. Med. 2022, 11, 557
Ped Anesthesia, 2022, 278-85

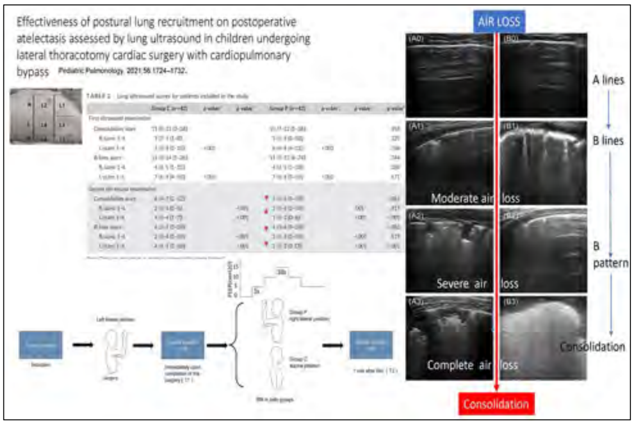

Effects of Recruitment Maneuver on Atelectasis in Anesthetized Children
5cmH20 PEEP
5cmH20 PEEP+RM
ZEEP
CPAP
ARS
Atelektazi -
Coronal cut
Upper
Middle
Lower
Table 2. Atelectatic Volumes
ARS; PEEP 15 cmH20+
Ppik 35 cmH20 10 soluk
Dynamic of re-expansion of atelectasis during GA
Start
1 sec
1,5 sec
3,5 sec
Vital capacity maneuver
Lung inflation with 40cmH20
BJA 1999

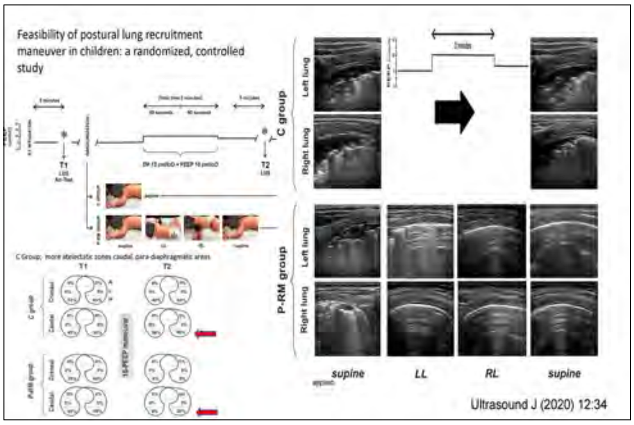

Effects of an alveolar recruitment manoeuvre guided by lung ultrasound on anaesthesia-induced atelectasis in infants: a randomised, controlled trial
J clinical anesthesia 2023
Group Control/Group Recruitment
Volume controlled mode Vt; 8 ml.kg, PEEP of 5 cmH2O
LUS; 1 min after starting ventilation, at the end of the surgery.
Anaesthesia induced atelectasis in children develops within 1 min of mechanical ventilation of the lungs !!
The incidence of atelectasis may be reduced by early application of the RM+PEEP
AIR LOSS
a0
b0
a1
b1
a2
b2
a3
b 3 white lung
5 cmH2O PEEP not sufficient +RM
CONSOLIDATION

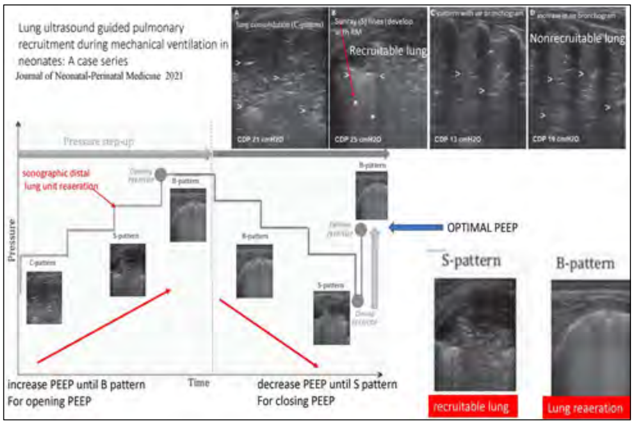

Lung ultrasound evaluation of incremental PEEP recruitment maneuver in children undergoing cardiac surgery
Periop 5 cmH20 PEEP, RM; increased PEEP; 10-15 cmH20 PEEP
PEEP + RECRUITMENT; PaO2, lung aeration, complians ↑ atelectasis ↓
RM
Pediatric Pulmonology 2021

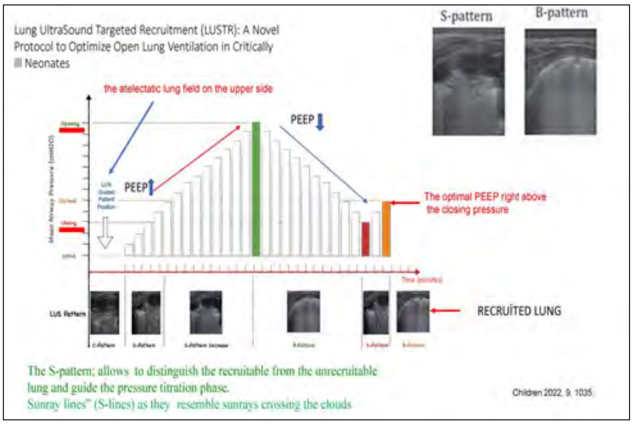

Prevention of atelectasis by continuous positive airway pressure in anaesthetised children
atelectasis ;
95% in the Control group
52% in the CPAP group
Yer değiştir.
Randomisation
LUS
Awake
Mandatory mechanical ventilation
Therefore, it seems that 8cmH2O of PEEP after a recruitment manoeuvre was not enough to overcome the decrease in transpulmonary pressure induced by capnoperitoneum

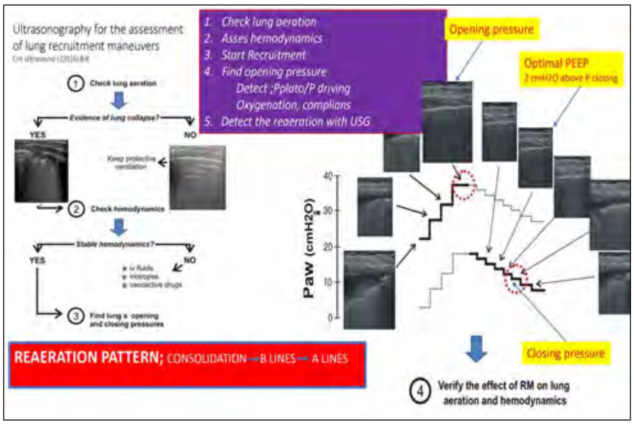

Effect of regular alveolar recruitment on intraoperative atelectasis in paediatric patients ventilated in the prone position: a randomised controlled trial
Children (<3 yr)
undergoing general anaesthesia (>2 h)
in the prone position
-Ultrasound-guide regular alveolar recruitment
-without recruitment.
Vt 6 ml kg, PEEP of 7 cm H2O.
Regular alveolar recruitment reduced the incidence of atelectasis at the end of surgery in infants prone position.
Air Loss
B lines
B pattern
Consolidation
No RM
RM

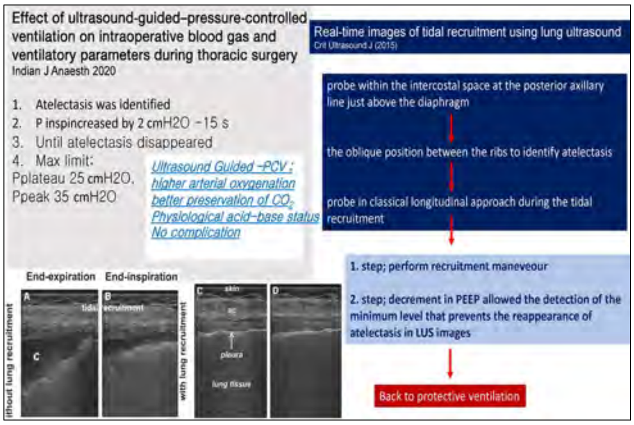

Effectiveness of postural lung recruitment on postoperative atelectasis assessed by lung ultrasound in children undergoing lateral thoracotomy cardiac surgery with cardiopulmonary bypass
Pediatric Pulmonology. 2021;56:1724–1732.
AIR LOSS
A lines
B lines
Moderate air loss
B pattern
Severe air loss
Consolidation
Complete air loss
Consolidation

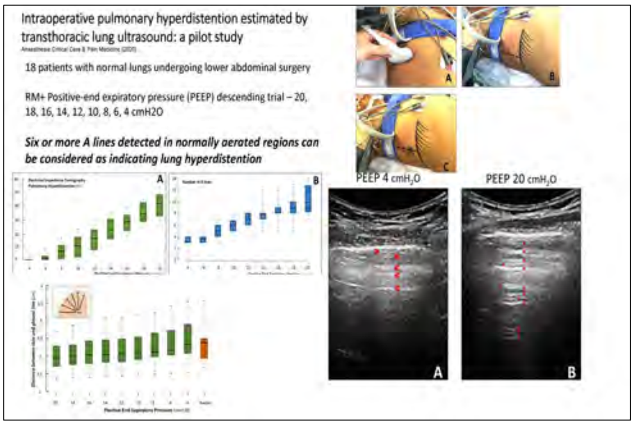

Feasibility of postural lung recruitment maneuver in children: a randomized, controlled study
C group
P-RM group
Left lung
Right lung
supine
LL
RL
supine
Ultrasound J (2020) 12:34

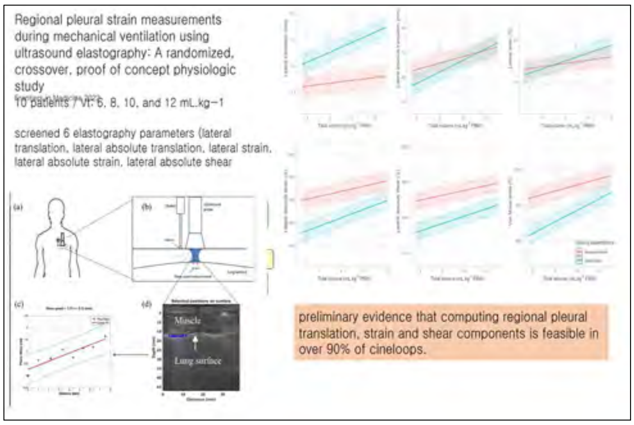

Lung ultrasound guided pulmonary recruitment during mechanical ventilation in neonates: A case series
Journal of Neonatal-Perinatal Medicine 2021
Recruitable lung
Nonrecruitable lung
Pressure step-up
sonographic distal lung unit reaeration
OPTIMAL PEEP
S-pattern
B-pattern
Pressure
Time
increase PEEP until B pattern
For opening PEEP
decrease PEEP until S pattern
For closing PEEP
recruitable lung
Lung reaeration

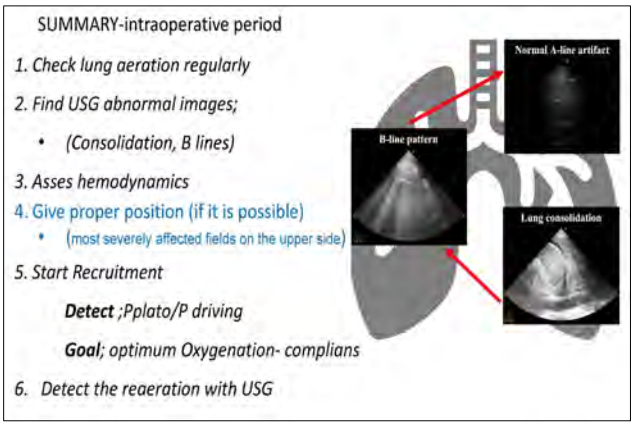

Lung UltraSound Targeted Recruitment (LUSTR): A Novel Protocol to Optimize Open Lung Ventilation in Critically Ill Neonates
S-pattern
B-pattern
the atelectatic lung field on the upper side
PEEP
The optimal PEEP right above the closing pressure
RECRUITED LUNG
The S-pattern; allows to distinguish the recruitable from the unrecruitable lung and guide the pressure titration phase.
Sunray lines" (S-lines) as they resemble sunrays crossing the clouds
Children 2022, 9, 1035

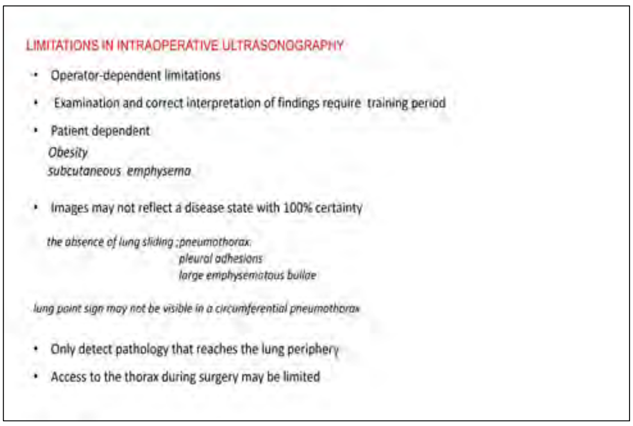

Ultrasonography for the assessment of lung recruitment maneuvers
1. Check lung aeration
2. Asses hemodynamics
3. Start Recruitment
4. Find opening pressure
Detect ;Pplato/P driving
Oxygenation, complians
5. Detect the reaeration with USG
Opening pressure
Optimal PEEP
Closing pressure
Paw (cmH2O)
REAERATION PATTERN; CONSOLIDATION→B LINES→A LINES
Verify the effect of RM on lung aeration and hemodynamics


Effect of ultrasound-guided–pressure-controlled ventilation on intraoperative blood gas and ventilatory parameters during thoracic surgery
Indian J Anaesth 2020
1. Atelectasis was identified
2. P inspincreased by 2 cmH2O -15 s
3. Until atelectasis disappeared
4. Max limit:
Pplateau 25 cmH2O,
Ppeak 35 cmH2O
Ultrasound Guided -PCV ;
higher arterial oxygenation
better preservation of CO2
Physiological acid-base status
No complication
Real-time images of tidal recruitment using lung ultrasound
Crit Ultrasound J (2015)
probe within the intercostal space at the posterior axillary line just above the diaphragm
the oblique position between the ribs to identify atelectasis
probe in classical longitudinal approach during the tidal recruitment
End-expiration
End-inspiration
1. step; perform recruitment maneveour
2. step; decrement in PEEP allowed the detection of the minimum level that prevents the reappearance of atelectasis in LUS images
Back to protective ventilation


Intraoperative pulmonary hyperdistention estimated by transthoracic lung ultrasound: a pilot study
18 patients with normal lungs undergoing lower abdominal surgery
RM+ Positive-end expiratory pressure (PEEP) descending trial – 20, 18, 16, 14, 12, 10, 8, 6, 4 cmH2O
Six or more A lines detected in normally aerated regions can be considered as indicating lung hyperdistention
PEEP 4 cmH2O
PEEP 20 cmH2O


Regional pleural strain measurements during mechanical ventilation using ultrasound elastography: A randomized, crossover, proof of concept physiologic study
10 patients / Vt: 6, 8, 10, and 12 mL.kg−1
screened 6 elastography parameters (lateral translation, lateral absolute translation, lateral strain, lateral absolute strain, lateral absolute shear
Muscle
Lung surface
preliminary evidence that computing regional pleural translation, strain and shear components is feasible in over 90% of cineloops.


SUMMARY-intraoperative period
1. Check lung aeration regularly
2. Find USG abnormal images;
(Consolidation, B lines)
3. Asses hemodynamics
4. Give proper position (if it is possible)
(most severely affected fields on the upper side)
5. Start Recruitment
Detect ;Pplato/P driving
Goal; optimum Oxygenation- complians
6. Detect the reaeration with USG
Normal A-line artifact
B-line pattern
Lung consolidation


LIMITATIONS IN INTRAOPERATIVE ULTRASONOGRAPHY
Operator-dependent limitations
Examination and correct interpretation of findings require training period
Patient dependent
Obesity
subcutaneous emphysema
Images may not reflect a disease state with 100% certainty
the absence of lung sliding ;pneumothorax.
pleural adhesions
large emphysematous bullae
lung point sign may not be visible in a circumferential pneumothorax
Only detect pathology that reaches the lung periphery
Access to the thorax during surgery may be limited

Session 2.

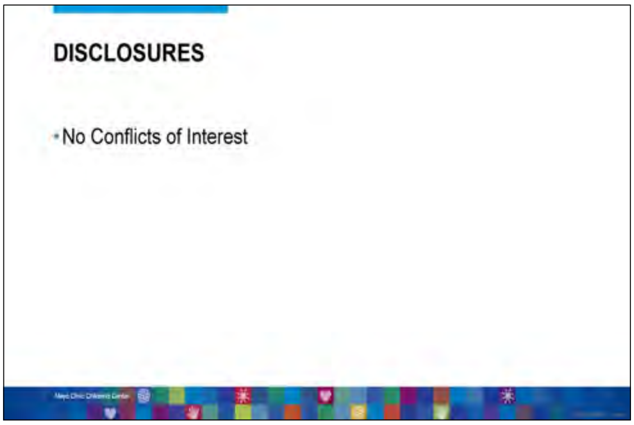
Experts' Advice of Monitoring for Better Anesthesia Care

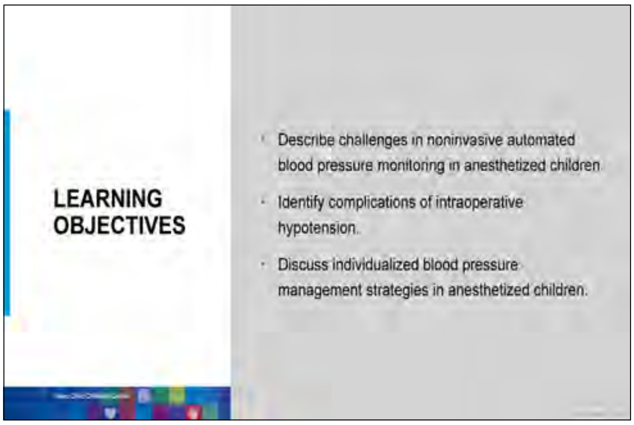
Chair(s): Joy Luat-Inciong (Philippines)
Hyo-Jin Byon (Korea)

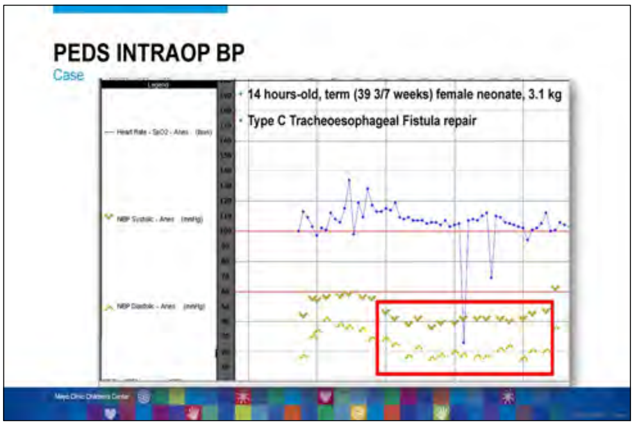
Blood Pressure Considerations in Pediatric Anesthesia: Challenges & Implications

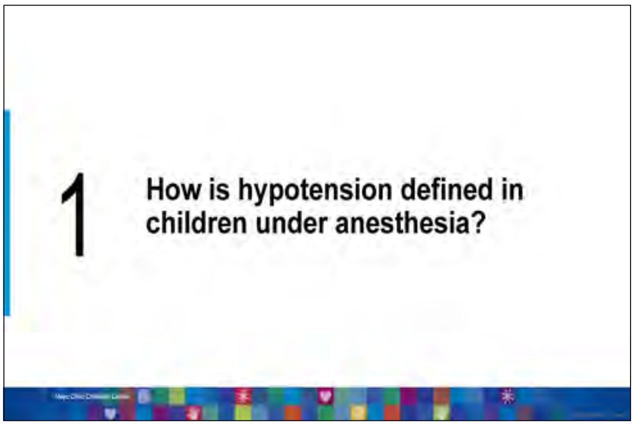
Stephen J. Gleich

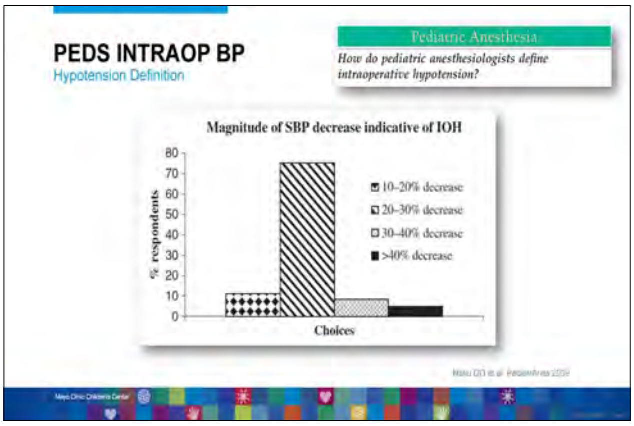
Mayo Clinic, USA

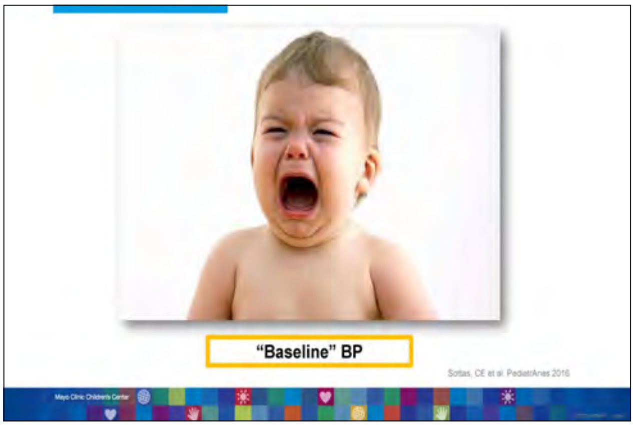


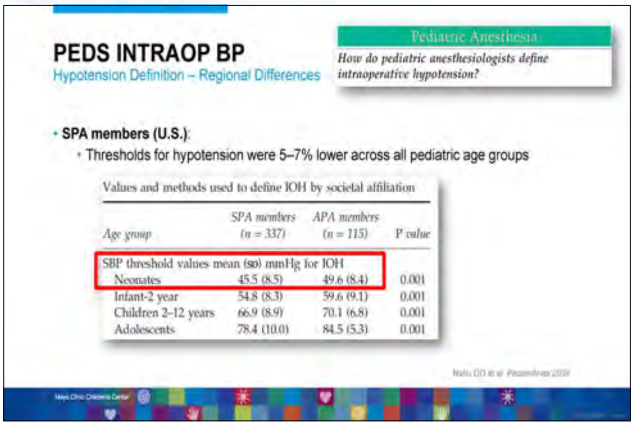


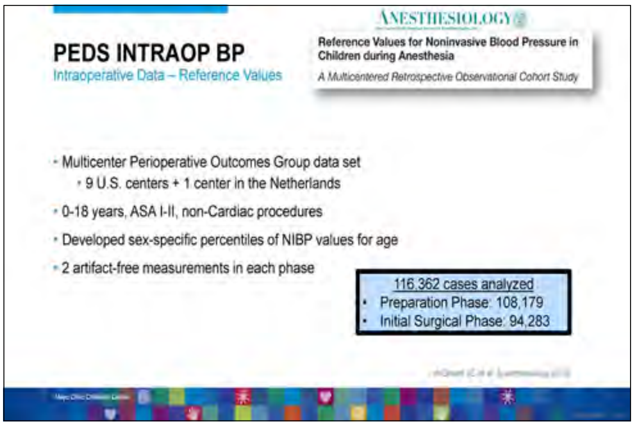


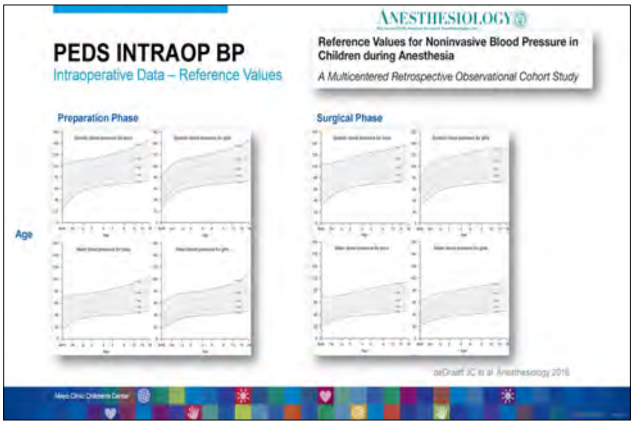


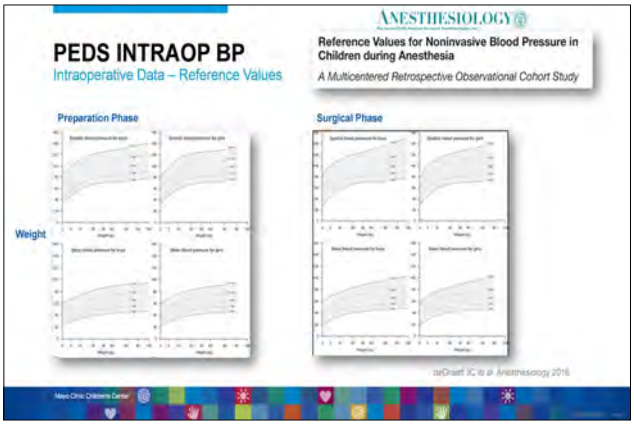


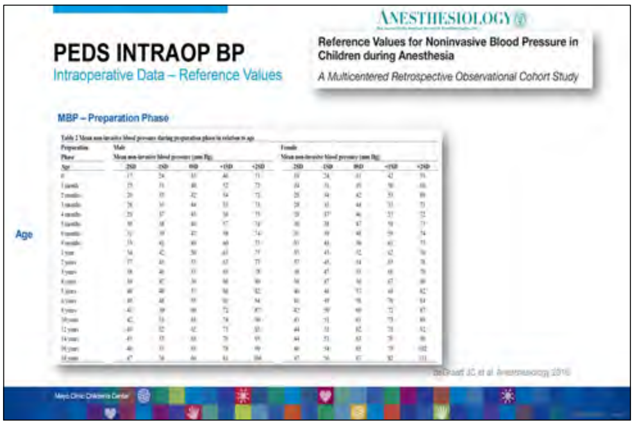


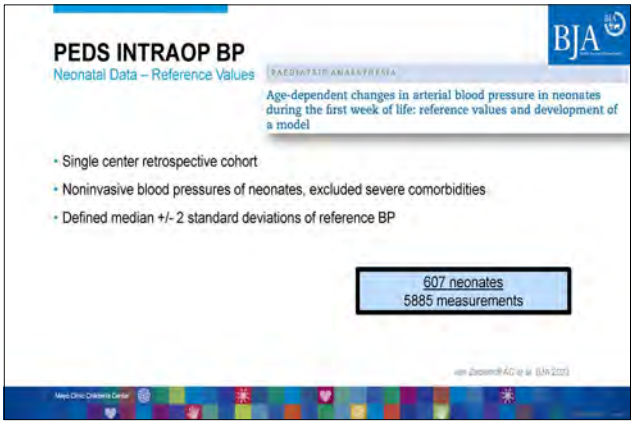

PEDS INTRAOP BP
Hypotension Definition – Regional Differences
Pediatric Anesthesia
How do pediatric anesthesiologists define intraoperative hypotension?
SPA members (U.S.):
Thresholds for hypotension were 5–7% lower across all pediatric age groups
Values and methods used to define IOH by societal affiliation
Age group | SPA members (n = 337) | APA members (n = 115) | P value
SBP threshold values mean (SD) mmHg for IOH
Neonates | 45.5 (8.5) | 49.6 (8.4) | 0.001
Infant-2 year | 54.8 (8.3) | 59.6 (9.1) | 0.001
Children 2–12 years | 66.9 (8.9) | 70.1 (6.8) | 0.001
Adolescents | 78.4 (10.0) | 84.5 (5.3) | 0.001

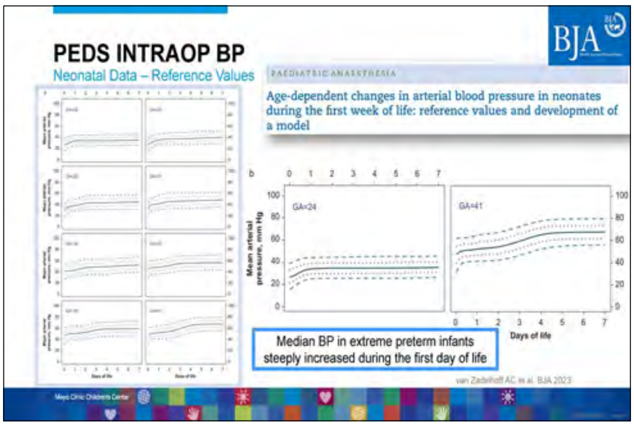

PEDS INTRAOP BP
Intraoperative Data – Reference Values
ANESTHESIOLOGY
Reference Values for Noninvasive Blood Pressure in Children during Anesthesia
A Multicentered Retrospective Observational Cohort Study
Multicenter Perioperative Outcomes Group data set
9 U.S. centers + 1 center in the Netherlands
0-18 years, ASA I-II, non-Cardiac procedures
Developed sex-specific percentiles of NIBP values for age
2 artifact-free measurements in each phase
116,362 cases analyzed
Preparation Phase: 108,179
Initial Surgical Phase: 94,283

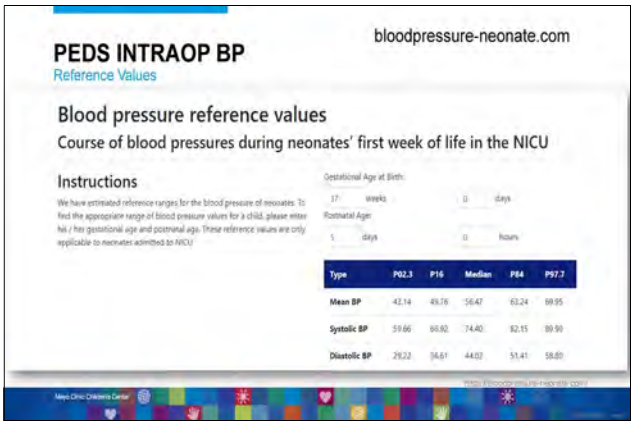

PEDS INTRAOP BP
Intraoperative Data – Reference Values
ANESTHESIOLOGY
Reference Values for Noninvasive Blood Pressure in Children during Anesthesia
A Multicentered Retrospective Observational Cohort Study
Preparation Phase
Surgical Phase
Age
deGraaff JC et al. Anesthesiology 2016

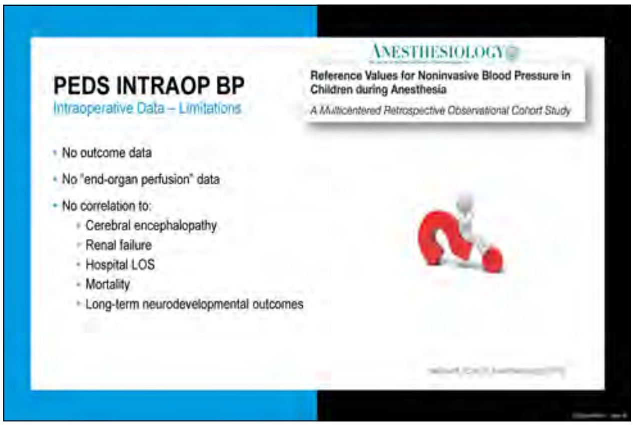

PEDS INTRAOP BP
Intraoperative Data – Reference Values
ANESTHESIOLOGY
Reference Values for Noninvasive Blood Pressure in Children during Anesthesia
A Multicentered Retrospective Observational Cohort Study
Preparation Phase
Surgical Phase
Weight
deGraaff JC et al. Anesthesiology 2016

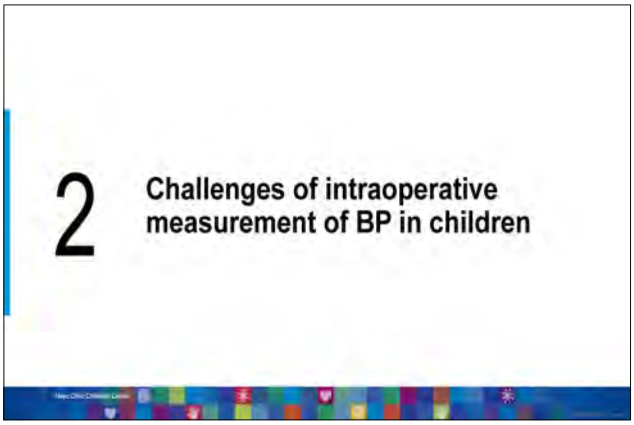

PEDS INTRAOP BP
Intraoperative Data – Reference Values
ANESTHESIOLOGY
Reference Values for Noninvasive Blood Pressure in Children during Anesthesia
A Multicentered Retrospective Observational Cohort Study
MBP – Preparation Phase
Age
deGraaff JC et al. Anesthesiology 2016


PEDS INTRAOP BP
Neonatal Data – Reference Values
BJA
PAEDIATRIC ANAESTHESIA
Age-dependent changes in arterial blood pressure in neonates during the first week of life: reference values and development of a model
Single center retrospective cohort
Noninvasive blood pressures of neonates, excluded severe comorbidities
Defined median +/- 2 standard deviations of reference BP
607 neonates
5885 measurements

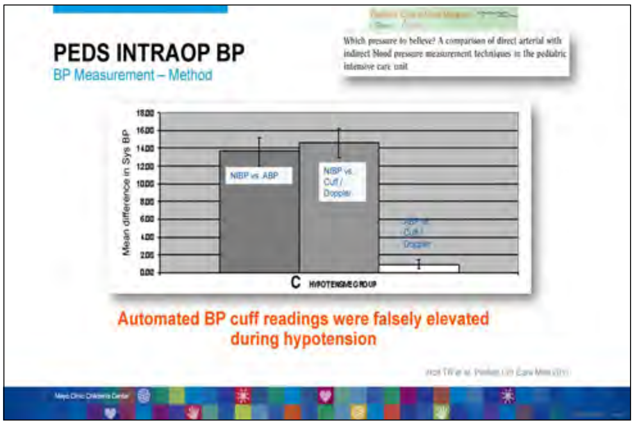

PEDS INTRAOP BP
Neonatal Data – Reference Values
BJA
PAEDIATRIC ANAESTHESIA
Age-dependent changes in arterial blood pressure in neonates during the first week of life: reference values and development of a model
GA=24
GA=41
Mean arterial pressure, mm Hg
Days of life
Median BP in extreme preterm infants steeply increased during the first day of life
van Zadelhoff AC et al. BJA 2023

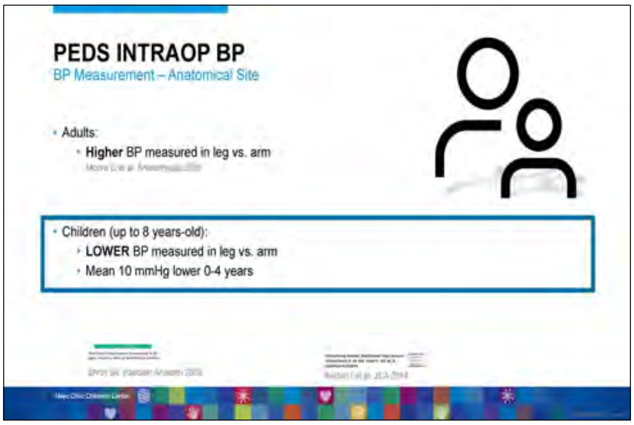

PEDS INTRAOP BP
Reference Values
bloodpressure-neonate.com
Blood pressure reference values
Course of blood pressures during neonates' first week of life in the NICU
Instructions

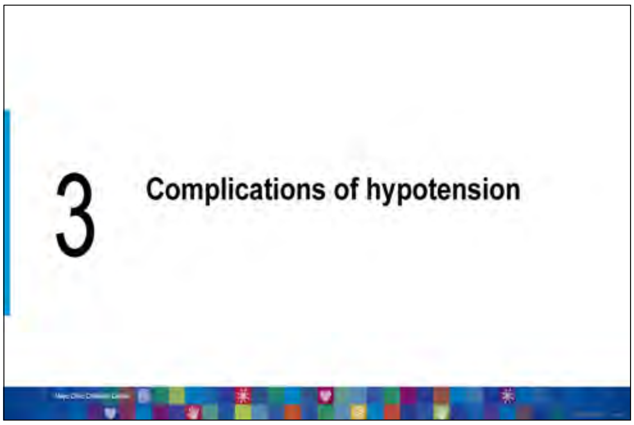

PEDS INTRAOP BP
Intraoperative Data – Limitations
No outcome data
No "end-organ perfusion" data
No correlation to:
Cerebral encephalopathy
Renal failure
Hospital LOS
Mortality
Long-term neurodevelopmental outcomes
ANESTHESIOLOGY
Reference Values for Noninvasive Blood Pressure in Children during Anesthesia
A Multicentered Retrospective Observational Cohort Study

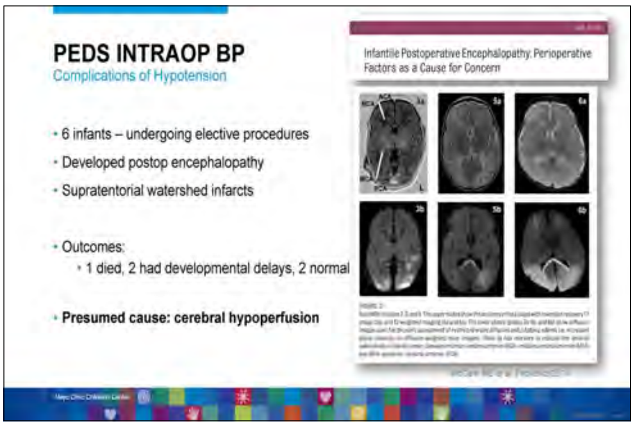

2
Challenges of intraoperative measurement of BP in children

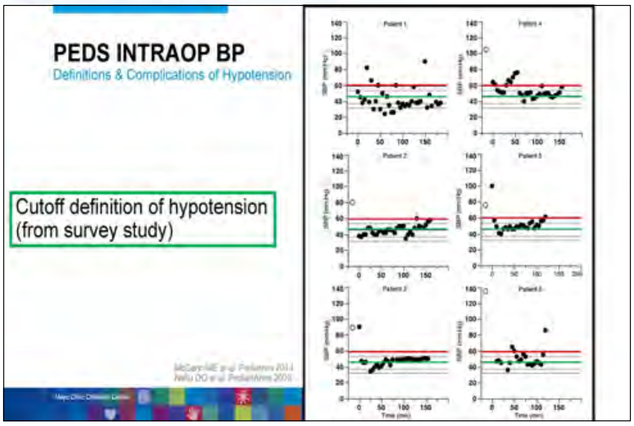

HR
110
Pulse
180
75
110
NBP Cuff 104
Auto 2.5 min
Sys.
53/15 (25)
ART
83/43
(56

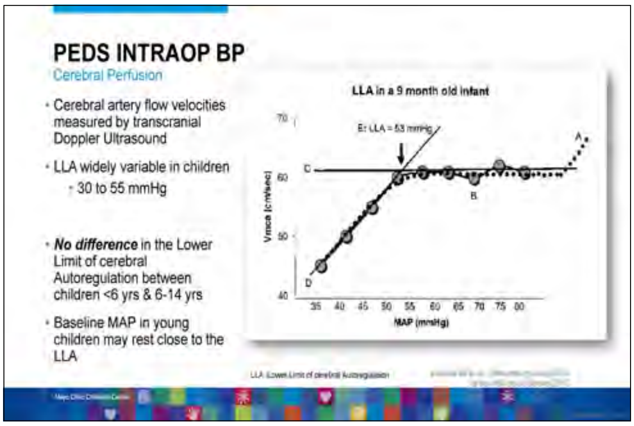

PEDS INTRAOP BP
BP Measurement – Method
Which pressure to believe? A comparison of direct arterial with indirect blood pressure measurement techniques in the pediatric intensive care unit
Mean difference in Sys BP
NBP vs. ABP
NBP vs. Cuff / Doppler
ABP vs. Cuff / Doppler
HYPOTENSIVE GROUP
Automated BP cuff readings were falsely elevated during hypotension

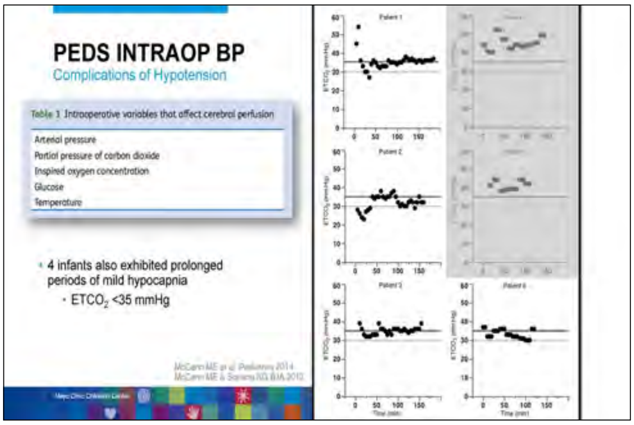

PEDS INTRAOP BP
BP Measurement – Anatomical Site
Adults:
Higher BP measured in leg vs. arm
Children (up to 8 years-old):
LOWER BP measured in leg vs. arm
Mean 10 mmHg lower 0-4 years

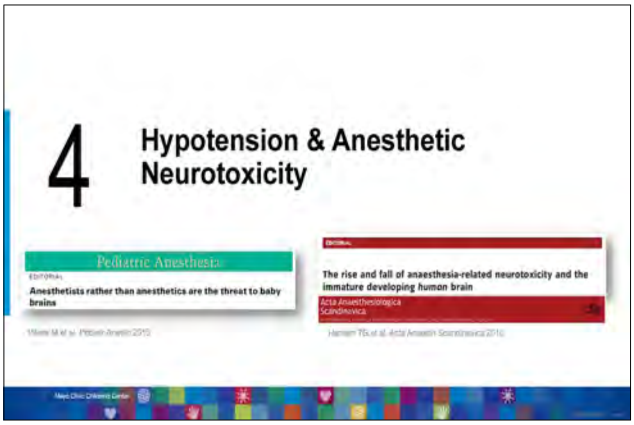

3
Complications of hypotension

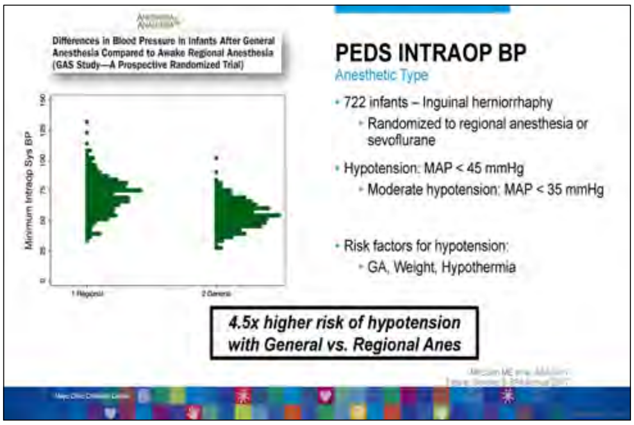

PEDS INTRAOP BP
Complications of Hypotension
6 infants – undergoing elective procedures
Developed postop encephalopathy
Supratentorial watershed infarcts
Outcomes:
1 died, 2 had developmental delays, 2 normal
Presumed cause: cerebral hypoperfusion
Infantile Postoperative Encephalopathy: Perioperative Factors as a Cause for Concern

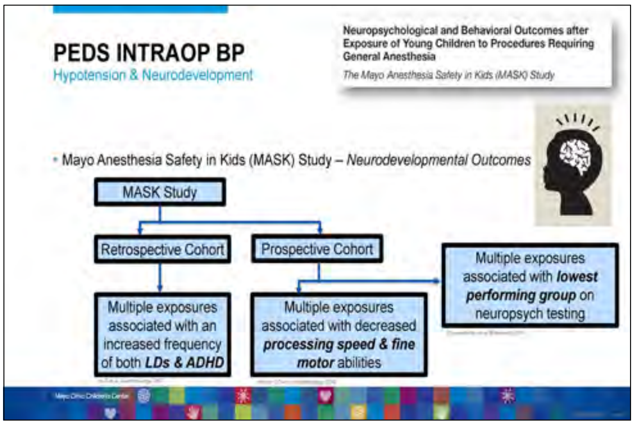

PEDS INTRAOP BP
Definitions & Complications of Hypotension
Cutoff definition of hypotension (from survey study)

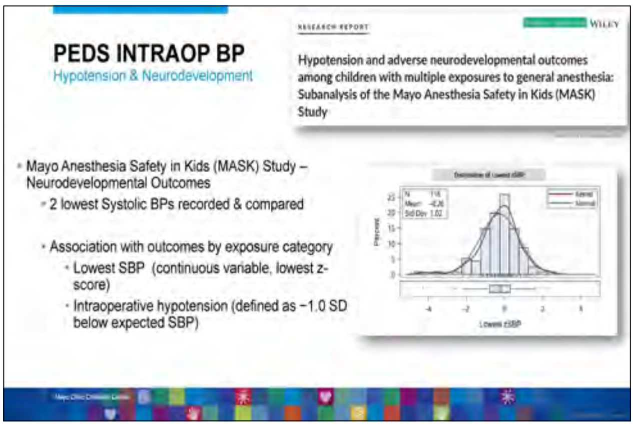

PEDS INTRAOP BP
Cerebral Perfusion
Cerebral artery flow velocities measured by transcranial Doppler Ultrasound
LLA widely variable in children
30 to 55 mmHg
No difference in the Lower Limit of cerebral Autoregulation between children <6 yrs & 6-14 yrs
Baseline MAP in young children may rest close to the LLA
LLA in a 9 month old infant
MAP (mmHg)

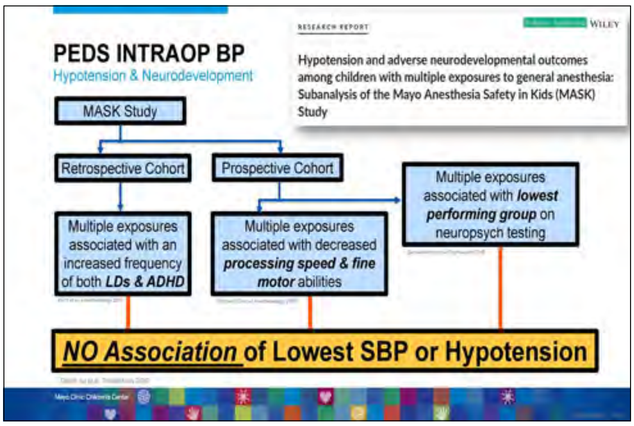

PEDS INTRAOP BP
Complications of Hypotension
Table 1 Intraoperative variables that affect cerebral perfusion
Arterial pressure
Partial pressure of carbon dioxide
Inspired oxygen concentration
Glucose
Temperature
4 infants also exhibited prolonged periods of mild hypocapnia
ETCO2 <35 mmHg

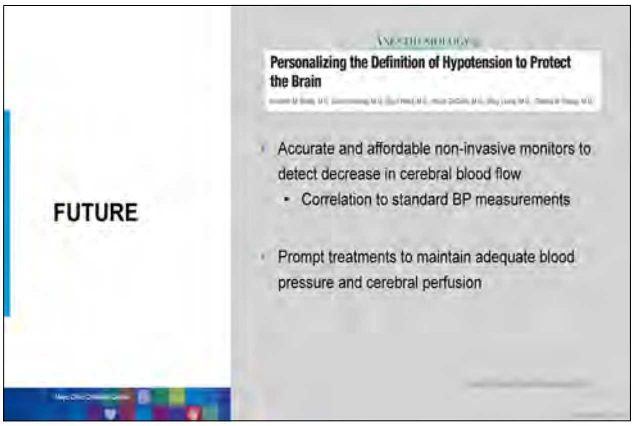

4
Hypotension & Anesthetic Neurotoxicity
Pediatric Anesthesia
Anesthetists rather than anesthetics are the threat to baby brains
The rise and fall of anaesthesia-related neurotoxicity and the immature developing human brain
Acta Anaesthesiologica Scandinavica

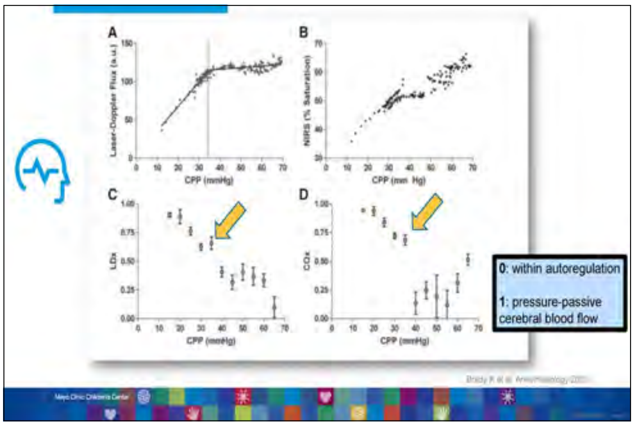

Differences in Blood Pressure in Infants After General Anesthesia Compared to Awake Regional Anesthesia (GAS Study—A Prospective Randomized Trial)
Minimum Intraop Sys BP
PEDS INTRAOP BP
Anesthetic Type
722 infants – Inguinal herniorrhaphy
Randomized to regional anesthesia or sevoflurane
Hypotension: MAP < 45 mmHg
Moderate hypotension: MAP < 35 mmHg
Risk factors for hypotension:
GA, Weight, Hypothermia
4.5x higher risk of hypotension with General vs. Regional Anes

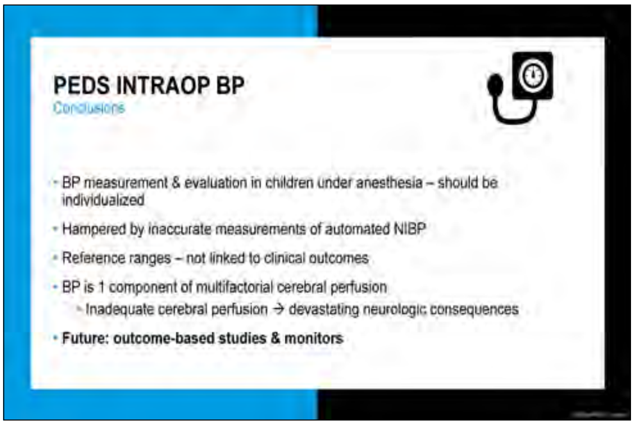

PEDS INTRAOP BP
Hypotension & Neurodevelopment
Neuropsychological and Behavioral Outcomes after Exposure of Young Children to Procedures Requiring General Anesthesia
The Mayo Anesthesia Safety in Kids (MASK) Study
Mayo Anesthesia Safety in Kids (MASK) Study – Neurodevelopmental Outcomes
MASK Study
Retrospective Cohort
Prospective Cohort
Multiple exposures associated with an increased frequency of both LDs & ADHD
Multiple exposures associated with decreased processing speed & fine motor abilities
Multiple exposures associated with lowest performing group on neuropsych testing


PEDS INTRAOP BP
Hypotension & Neurodevelopment
RESEARCH REPORT
WILEY
Hypotension and adverse neurodevelopmental outcomes among children with multiple exposures to general anesthesia: Subanalysis of the Mayo Anesthesia Safety in Kids (MASK) Study
Mayo Anesthesia Safety in Kids (MASK) Study – Neurodevelopmental Outcomes
2 lowest Systolic BPs recorded & compared
Association with outcomes by exposure category
Lowest SBP (continuous variable, lowest z-score)
Intraoperative hypotension (defined as −1.0 SD below expected SBP)
Lowest zSBP


PEDS INTRAOP BP
Hypotension & Neurodevelopment
RESEARCH REPORT
WILEY
Hypotension and adverse neurodevelopmental outcomes among children with multiple exposures to general anesthesia: Subanalysis of the Mayo Anesthesia Safety in Kids (MASK) Study
MASK Study
Retrospective Cohort
Prospective Cohort
Multiple exposures associated with an increased frequency of both LDs & ADHD
Multiple exposures associated with decreased processing speed & fine motor abilities
Multiple exposures associated with lowest performing group on neuropsych testing
NO Association of Lowest SBP or Hypotension


FUTURE
ANESTHESIOLOGY
Personalizing the Definition of Hypotension to Protect the Brain
Accurate and affordable non-invasive monitors to detect decrease in cerebral blood flow
Correlation to standard BP measurements
Prompt treatments to maintain adequate blood pressure and cerebral perfusion


A
B
C
D
Laser-Doppler Flux (a.u.)
NIRS (% Saturation)
LDx
COx
CPP (mmHg)
CPP (mm Hg)
0: within autoregulation
1: pressure-passive cerebral blood flow


PEDS INTRAOP BP
Conclusions
BP measurement & evaluation in children under anesthesia – should be individualized
Hampered by inaccurate measurements of automated NIBP
Reference ranges – not linked to clinical outcomes
BP is 1 component of multifactorial cerebral perfusion
Inadequate cerebral perfusion → devastating neurologic consequences
Future: outcome-based studies & monitors

Neuromonitoring in Neonatal Pain Assessment

Ian Yuan

Children's Hospital of Philadelphia, USA

Oldest Children's Hospital in USA

Childrens Hospital of Philadelphia (CHOP)

33,000 cases / year

75 Pediatric Anesthesiologist (9 Cardiac)

30 Nurse Anesthetists

11 Fellows

10 Residents

???

1- Hungry

2- Tired

3- In pain from surgery

Neuromonitoring in Neonatal Pain Assessment

Consequences of untreated neonatal pain

Neuromonitoring to assess neonatal pain

Near-infrared spectroscopy pain assessment

Misconceptions in Neonatal Pain

- Immature pain pathways and cannot transmit painful stimulus to brain.
- Lack context to identify experiences as painful.
- Analgesic or sedative agents cause adverse effects to the developing brain

Neonatal Pain -> Worse Postop Outcomes

THE LANCET

RANDOMISED TRIAL OF FENTANYL ANAESTHESIA IN PRETERM BABIES UNDERGOING SURGERY: EFFECTS ON THE STRESS RESPONSE

PDA ligation in babies <u>without *vs* without fentanyl</u>

↑ **stress response** (adrenaline, noradrenaline, glucagon, corticosterone, lactate)

↑ **protein catabolism** at POD#3

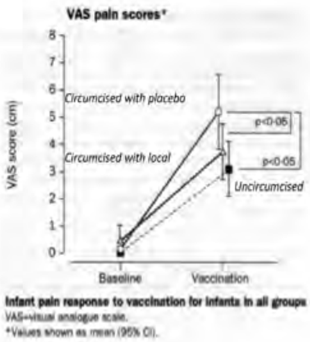
Worse outcomes: ↑ventilation requirement, bradycardia, hypotension, metabolic acidosis, intraventricular hemorrhage.

Neonatal Pain -> Increased Pain Sensitivity

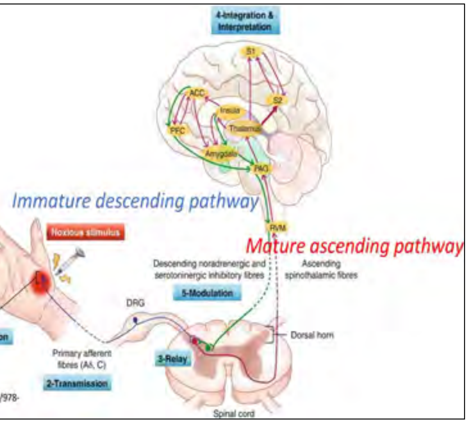
THE LANCET

Effect of neonatal circumcision on pain response during subsequent routine vaccination

Pain response at 4 or 6mo vaccinations in babies <u>circumcised with local *vs* with placebo *vs* uncircumcised</u>.



Infant pain response to vaccination for infants in all groups
VAS=visual analogue scale.
*Values shown as mean (95% CI).



https://link.springer.com/chapter/10.1007/978-3-030-87266-3_36

Neuromonitoring in Neonatal Pain Assessment

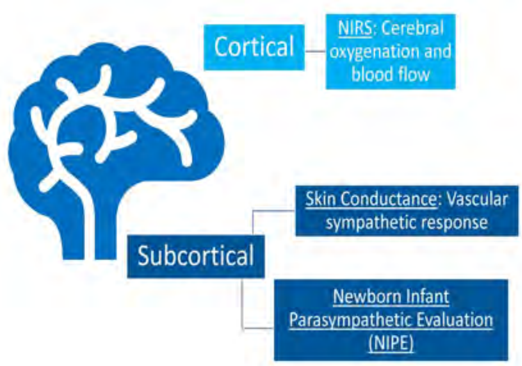
Consequences of untreated neonatal pain

Neuromonitoring to assess neonatal pain

Neuromonitoring Neonatal Nociception

- Skin conductance test
- Newborn Infant Parasympathetic Evaluation (NIPE)
- Near infrared spectroscopy
- Surgical Pleth Index
- ANI (Analgesia nociception index)
- Pupillometer

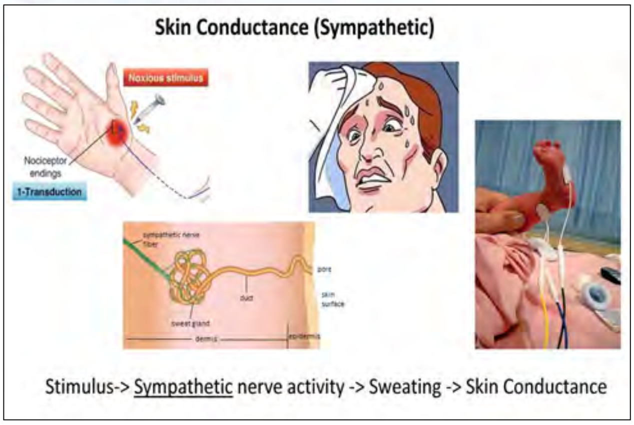
Sabourdin N, Current Opinion in Anaesthesiology. 2022

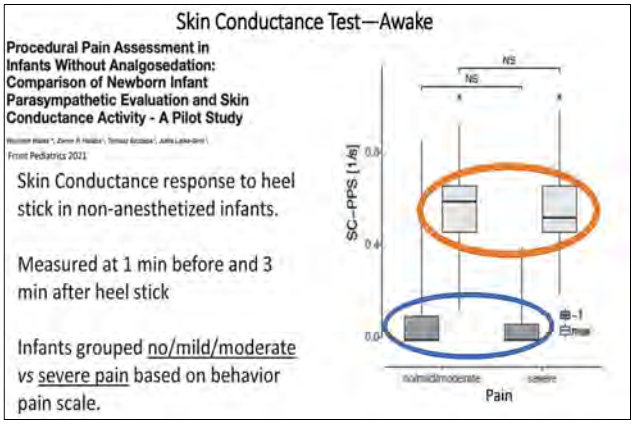


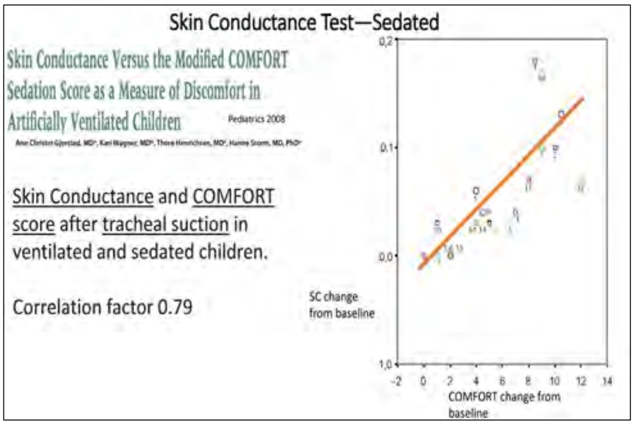
Summary of neonatal pain assessment tools

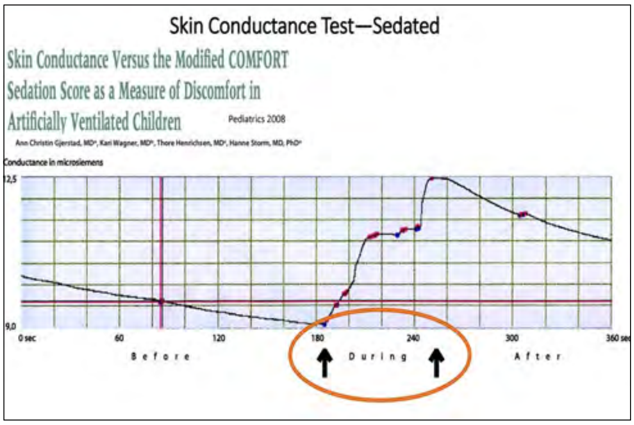
Pain Assessment Tool	Gestational Age	Physiologic Components	Behavioral Components	Type of Pain	Adjusts for Prematurity	Scale Metric
Premature Infant Pain Profile-Revised (PIPP-R)	26 wk to term	Heart rate, oxygen saturation	Alertness, brow bulge, eye squeeze, nasolabial furrow	Procedural and postoperative	Yes	0–21
Cries, Requires Oxygen, Increased Vital Signs, Expression, Sleeplessness (CRIES)	32–56 wk	Blood pressure, heart rate, oxygen saturation	Cry, expression, sleeplessness	Postoperative	No	0–10
Neonatal Infant Pain Scale (NIPS)	28–38 wk	Breathing pattern	Facial expression, cry, arms, legs, alertness	Procedural	No	0–7
COMFORT (and COMFORTneo)	0–3 y (COMFORTneo: 24–42 wk)	Respiratory response, blood pressure, heart rate	Alertness, agitation, physical movements, muscle tone, facial tension	Postoperative (COMFORTneo: prolonged)	No	8–40
Neonatal Facial Coding System (NFCS)	25 wk to term	None	Brow bulge, eye squeeze, nasolabial furrow, open lips, stretch mouth (vertical and horizontal), lip purse, taut tongue, chin quiver	Procedural	No	0–10
Neonatal Pain, Agitation and Sedation Scale (N-PASS)	0–100 d	Heart rate, respiratory rate, blood pressure, oxygen saturation	Crying or irritability, behavior state, facial expression, extremities or tone	Acute and prolonged pain Also assesses sedation	Yes	Pain: 0–10 Sedation: −10–0
Echelle de la Douleur Inconfort Noveau-Né (EDIN; Neonatal Pain and Discomfort) Scale	25–36 wk	None	Facial activity, body movements, quality of sleep, quality of contact with nurses, consolability	Prolonged	No	0–15
Bernese Pain Scale for Neonates (BPSN)	27–41 wk	Respiratory pattern, heart rate, oxygen saturation	Alertness, duration of cry, time to calm, skin color, brow bulge with eye squeeze, posture	Procedural	No	0–27

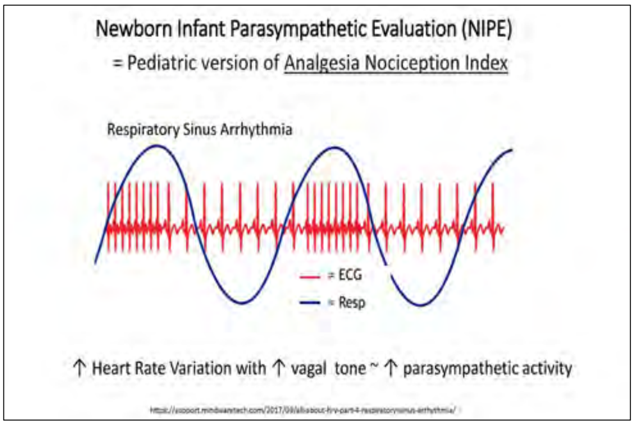
[illegible] Assessment of pain in the newborn: an update. Clinics in Perinatology. 2018

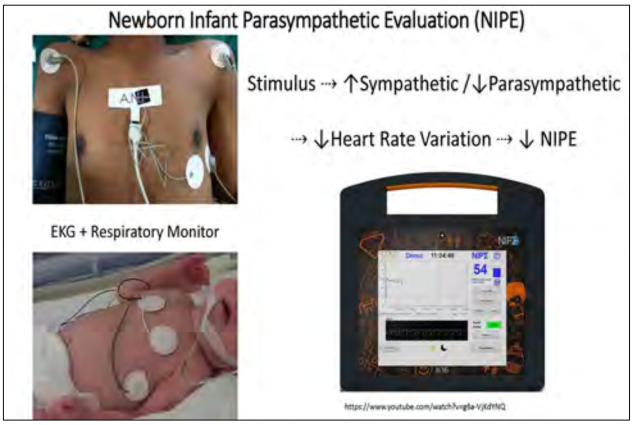

Skin Conductance (Sympathetic)
Noxious stimulus
Nociceptor endings
1-Transduction
Stimulus-> Sympathetic nerve activity -> Sweating -> Skin Conductance

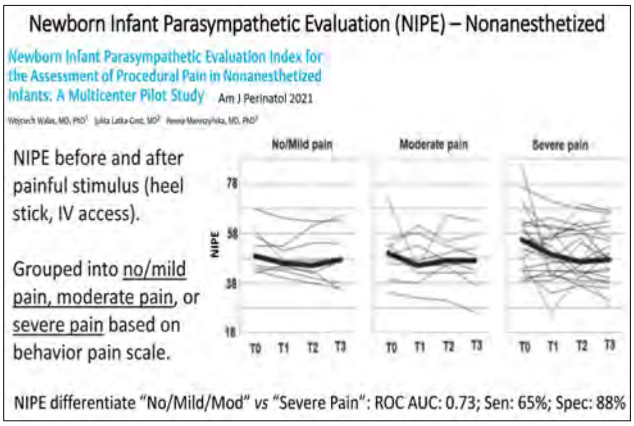

Skin Conductance Test—Awake
Procedural Pain Assessment in Infants Without Analgosedation: Comparison of Newborn Infant Parasympathetic Evaluation and Skin Conductance Activity - A Pilot Study
Front Pediatrics 2021
Skin Conductance response to heel stick in non-anesthetized infants.
Measured at 1 min before and 3 min after heel stick
Infants grouped no/mild/moderate vs severe pain based on behavior pain scale.
SC—PPS [1/s]
NS
Pain

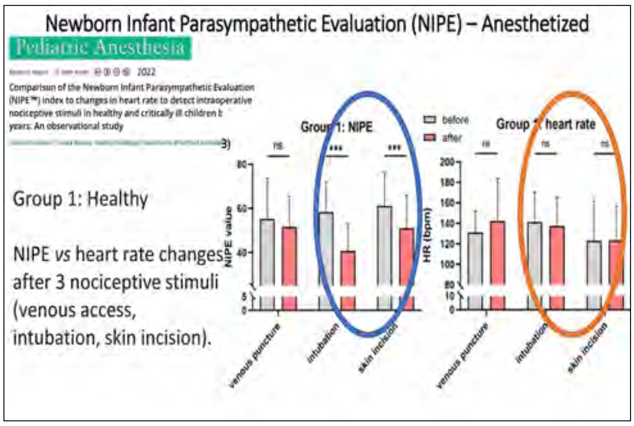

Skin Conductance Test—Sedated
Skin Conductance Versus the Modified COMFORT Sedation Score as a Measure of Discomfort in Artificially Ventilated Children
Pediatrics 2008
Skin Conductance and COMFORT score after tracheal suction in ventilated and sedated children.
Correlation factor 0.79
SC change from baseline
COMFORT change from baseline


Skin Conductance Test—Sedated
Skin Conductance Versus the Modified COMFORT Sedation Score as a Measure of Discomfort in Artificially Ventilated Children
Pediatrics 2008
Conductance in microsiemens
Before
During
After


Newborn Infant Parasympathetic Evaluation (NIPE)
= Pediatric version of Analgesia Nociception Index
Respiratory Sinus Arrhythmia
= ECG
= Resp
↑ Heart Rate Variation with ↑ vagal tone ~ ↑ parasympathetic activity


Newborn Infant Parasympathetic Evaluation (NIPE)
Stimulus ⇢ ↑Sympathetic / ↓Parasympathetic
⇢ ↓Heart Rate Variation ⇢ ↓ NIPE
EKG + Respiratory Monitor


Newborn Infant Parasympathetic Evaluation (NIPE) – Nonanesthetized
Newborn Infant Parasympathetic Evaluation Index for the Assessment of Procedural Pain in Nonanesthetized Infants: A Multicenter Pilot Study
Am J Perinatol 2021
NIPE before and after painful stimulus (heel stick, IV access).
Grouped into no/mild pain, moderate pain, or severe pain based on behavior pain scale.
No/Mild pain
Moderate pain
Severe pain
NIPE
T0 T1 T2 T3
NIPE differentiate "No/Mild/Mod" vs "Severe Pain": ROC AUC: 0.73; Sen: 65%; Spec: 88%


Newborn Infant Parasympathetic Evaluation (NIPE) – Anesthetized
Pediatric Anesthesia
2022
Group 1: Healthy
NIPE vs heart rate changes after 3 nociceptive stimuli (venous access, intubation, skin incision).
Group 1: NIPE
Group 1: heart rate
before
after
NIPE value
HR (bpm)
venous puncture
intubation
skin incision

Newborn Infant Parasympathetic Evaluation (NIPE) – Anesthetized

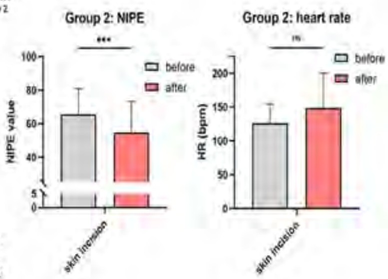
Pediatric Anesthesia 2022

Comparison of the Newborn Infant Parasympathetic Evaluation (NIPE™) index to changes in heart rate to detect intraoperative nociceptive stimuli in healthy and critically ill children below 2 years: An observational study

Group 2: Critically ill, intubated from ICU.

NIPE *vs* heart rate changes during skin incision.

ROC-AUC to detect stimulus: NIPE *vs* Heart Rate 0.9 *vs* 0.6

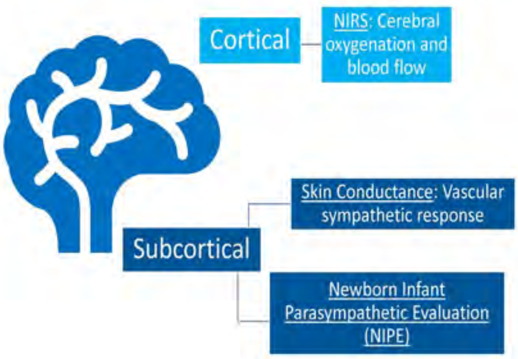


Neuromonitoring in Neonatal Pain Assessment

Consequences of untreated neonatal pain

Neuromonitoring to assess neonatal pain

Near-infrared spectroscopy pain assessment



NIRS *vs* PulseOx

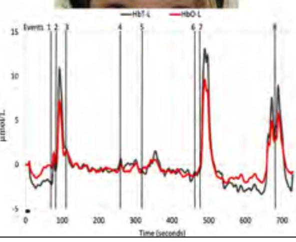
Similar

- Measure light absorption ratio of HbO/Hb.
- Subject to motion and light artifact.
- Depends on manufacturer algorithm.

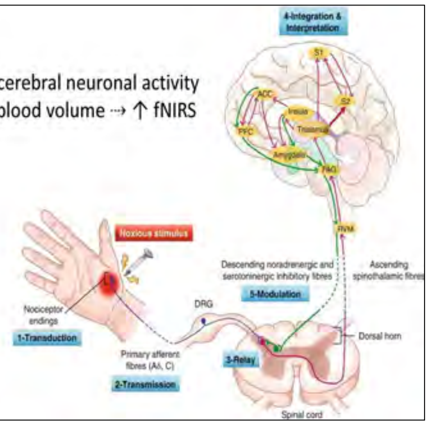
Different

- PulseOx:
  Arterial saturation and O_2 supply.
- NIRS:
  Venous saturation (~75%), O_2 supply and demand.
  Not dependent on pulsatile flow.

NIRS *vs* functional NIRS (fNIRS)



Stimulus ⇢ ↑ cerebral neuronal activity ⇢ ↑ cerebral blood volume ⇢ ↑ fNIRS



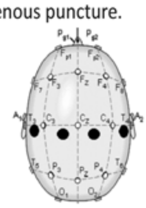
https://link.springer.com/chapter/10.1007/978-3-030-87266-3_36

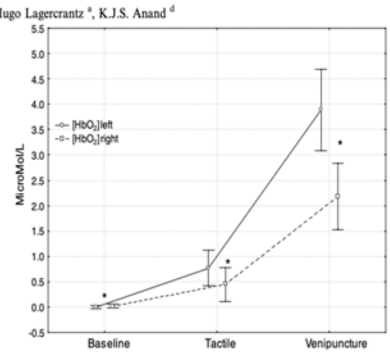
Pain (2006)

Pain activates cortical areas in the preterm newborn brain

Marco Bartocci [a,b,*], Lena L. Bergqvist [a,c], Hugo Lagercrantz [a], K.J.S. Anand [d]

Preterm neonates during venous puncture.





↑ fNIRS ~ ↑ postnatal age

↑ fNIRS ~ ↓ gestational

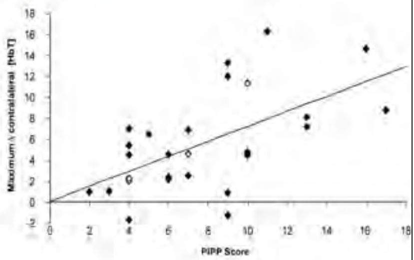
How Well Do Clinical Pain Assessment Tools Reflect Pain in Infants?

PLoS Med, 2008

Rebeccah Slater, Anne Cantarella, Linda Franck, Judith Meek and Maria Fitzgerald

fNIRS *vs* premature infant pain profile (PIPP) after heel lance

fNIRS correlation with PIPP Behavioral (0.74) *vs* PIPP Physiological (0.4)

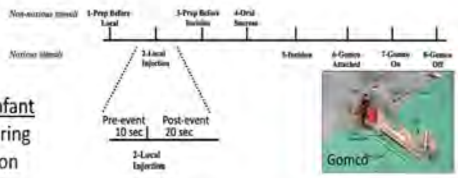


Functional near-infrared spectroscopy to assess pain in neonatal circumcisions
Pediatric Anesthesia, 2022

Ian Yuan | Olivia Nelson | Gordon A. Barr | Bingqing Zhang

fNIRS vs Neonatal Infant Pain Scale (NIPS) during newborn circumcision

fNIRS on frontal cortex

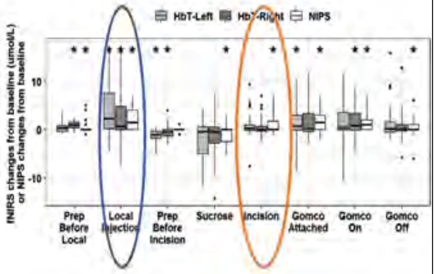


Functional near-infrared spectroscopy to assess pain in neonatal circumcisions
Pediatric Anesthesia, 2022

Ian Yuan | Olivia Nelson | Gordon A. Barr | Bingqing Zhang

During incision, local anesthetic blunted fNIRS response but not NIPS

Weak correlation between fNIRS vs NIPS



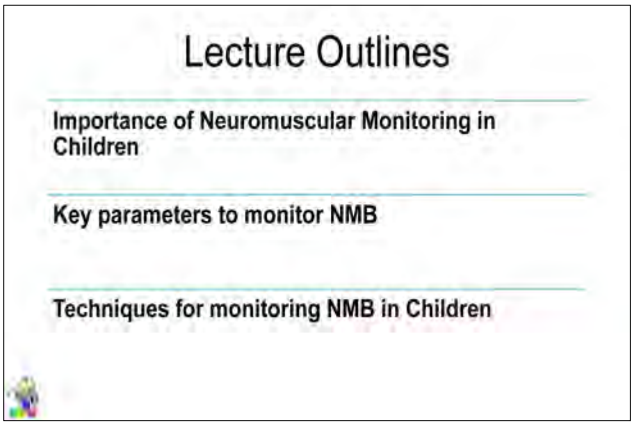
Summary

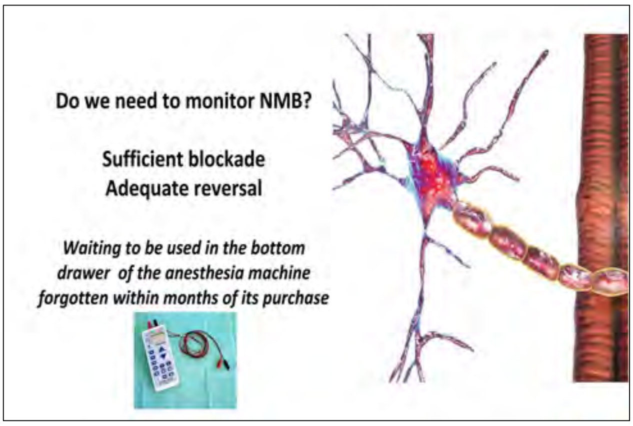
- No "gold standard" for pain assessment
- Many devices still in research stage.
- Much research still needed in neonates... (especially under anesthesia)

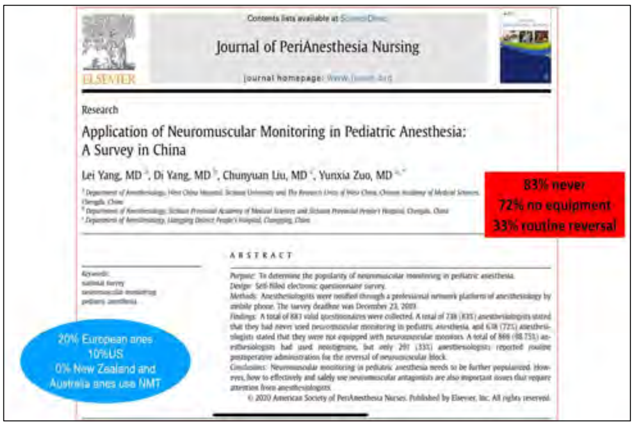
Accurate and Reliable Neuromuscular Monitoring in Children

Z Serpil Ustalar Ozgen

University of Mehmet Ali Aydinlar University, Türkiye






Contents lists available at ScienceDirect
Journal of PeriAnesthesia Nursing
journal homepage:
ELSEVIER

Research

Application of Neuromuscular Monitoring in Pediatric Anesthesia: A Survey in China

Lei Yang, MD, Di Yang, MD, Chunyuan Liu, MD, Yunxia Zuo, MD

ABSTRACT

Purpose: To determine the popularity of neuromuscular monitoring in pediatric anesthesia.
Design: Self-filled electronic questionnaire survey.

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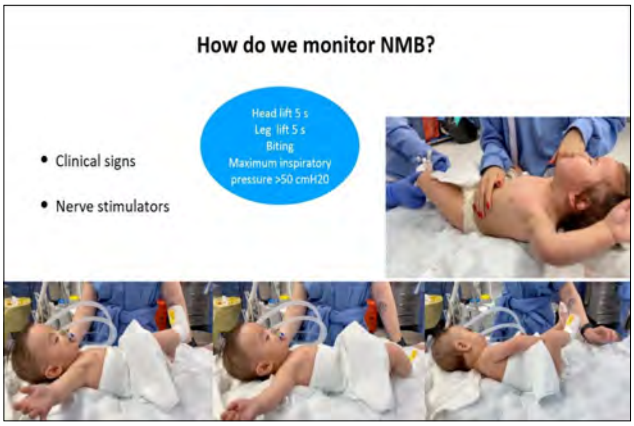
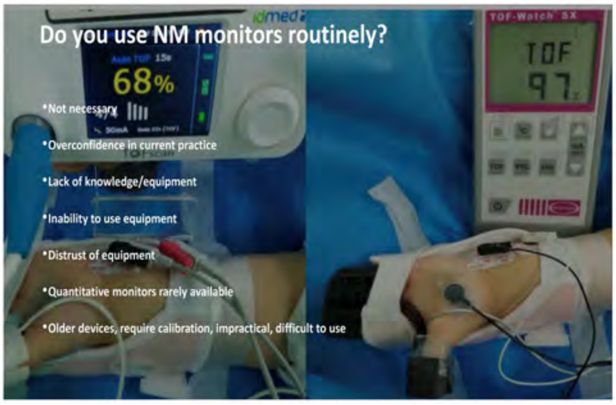
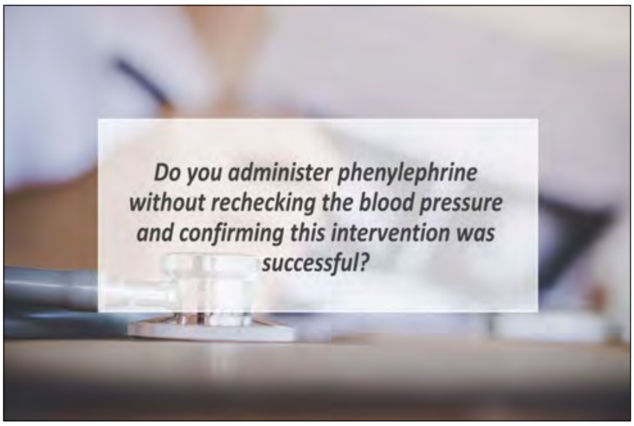






WHY?

Clinical assessment is challenging in children

- Difficulties in communication
- Non-compliance to instructions

10-28% of children experience postoperative residual block

Complications due to residual block can be detrimental

- smaller oxygen reserves
- more vulnerable to airway collapse

Limitations of NM Monitoring in Neonates

- Variability in response- gestational age, postnatal age, weight, coexisting medical conditions
- Lack of standardized guidelines
- Technical difficulties
- Influence of temperature
- Influence of coexisting conditions – prematurity, congenital anomalies, NM diseases
- Limited pharmacokinetic data- organ immaturity, altered protein binding, different rates of drug metabolism and elimination
- Relevance of monitoring data- ongoing research and debate

Why do we want to monitor NMB?

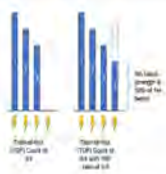
Stimulation pattern	Onset of block	Deep block (TOF=0)	Moderate block (TOF>0)	Recovery
Train-of-four(TOF)	Adequate	Not adequate	Adequate	Intermediate(a) Adequate(b)
Double burst stimulation(DBS)	Intermediate	Not adequate	Not adequate	Intermediate
Post-tetanic count(PTC)	Not adequate	Adequate	Not adequate	Not adequate
Tetanus (50/100Hz)	Not adequate	Not adequate	Not adequate	Intermediate

Single twitch

- Supramaximal stimulus frequency 0.1-1.0 Hz
- Limited value in clinical setting
- Useful for baseline assessment of NM function before the administration of NMBAs

Train-of-four (TOF)

- Stimulation pattern 4 twitches at 2 Hz
- Loss of fourth response 75-80% NMB
- Sufficient NMB for surgical procedure: until reappearance of 2-4 responses
- TOF Ratio 0.7 = adequate diaphragmatic recovery
- TOF Ratio >0.9 = adequate Pharyngeal muscle function



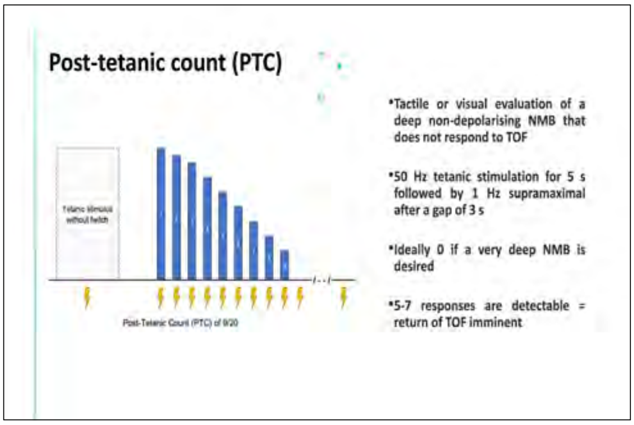
Provides information about the depth of NMB and the degree of recovery after reversal

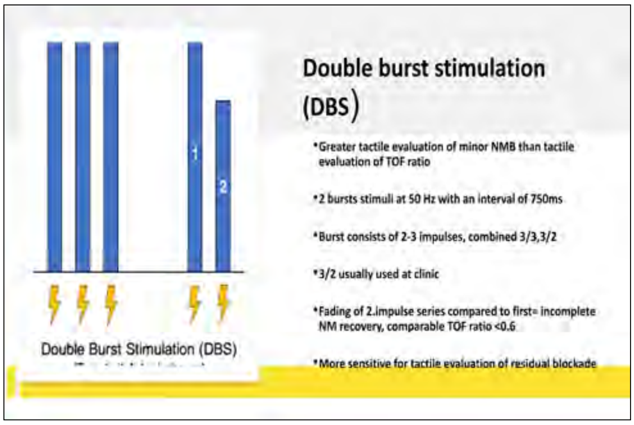
TOF ratio below 0.9 suggests the presence of residual blockade

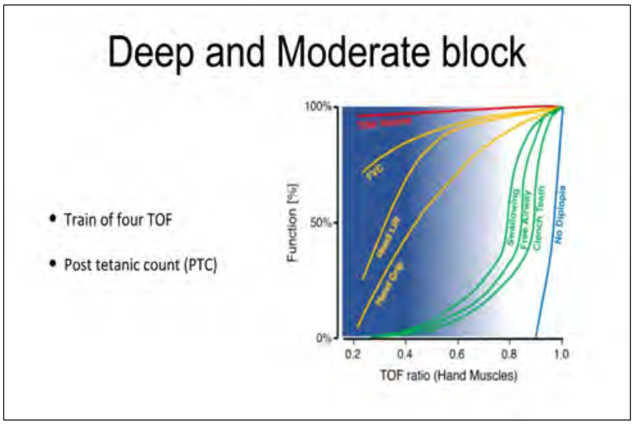
Disappearance of responses	3	2	1
NMB	85%	90%	100%

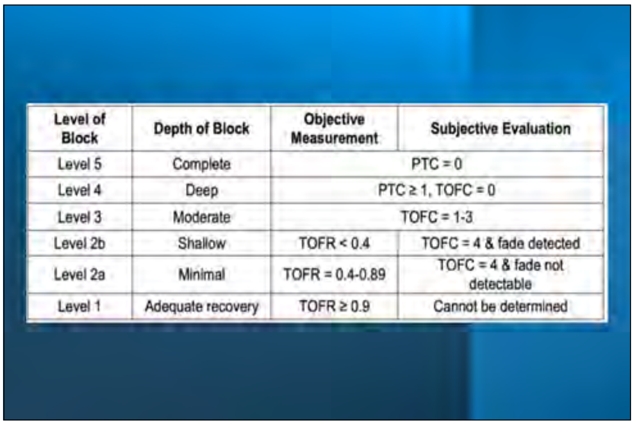
Tetanic Stimulation

- High frequency (50-200) Hz stimulation applied for 5 s
- Fade effect in incomplete NMB recovery
- Sensitivity of using TS in detecting residual curarisation 70%, specifity 50%

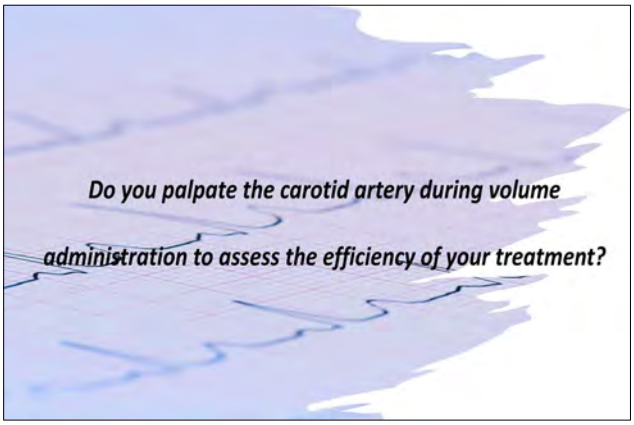


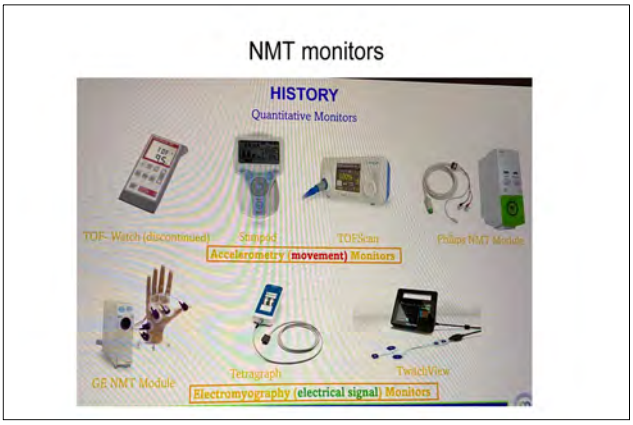


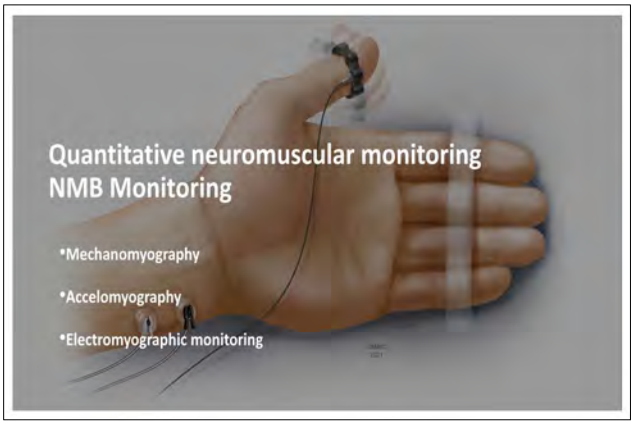


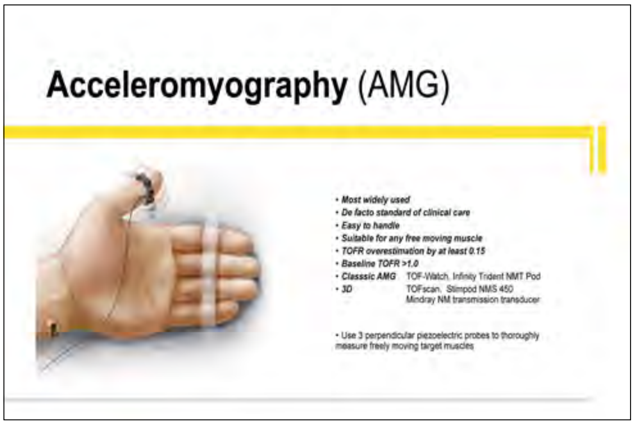


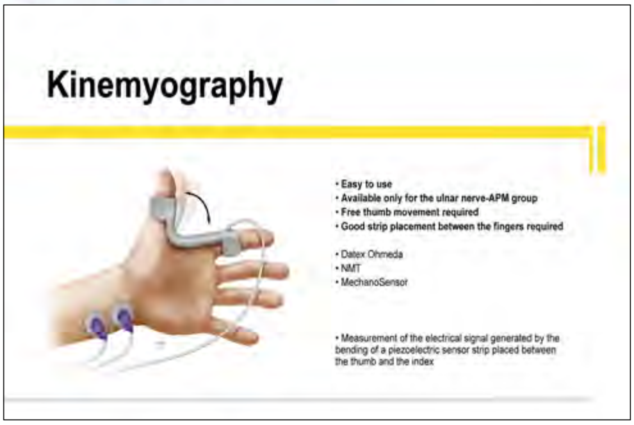
Level of Block	Depth of Block	Objective Measurement	Subjective Evaluation
Level 5	Complete	PTC = 0	
Level 4	Deep	PTC ≥ 1, TOFC = 0	
Level 3	Moderate	TOFC = 1-3	
Level 2b	Shallow	TOFR < 0.4	TOFC = 4 & fade detected
Level 2a	Minimal	TOFR = 0.4-0.89	TOFC = 4 & fade not detectable
Level 1	Adequate recovery	TOFR ≥ 0.9	Cannot be determined

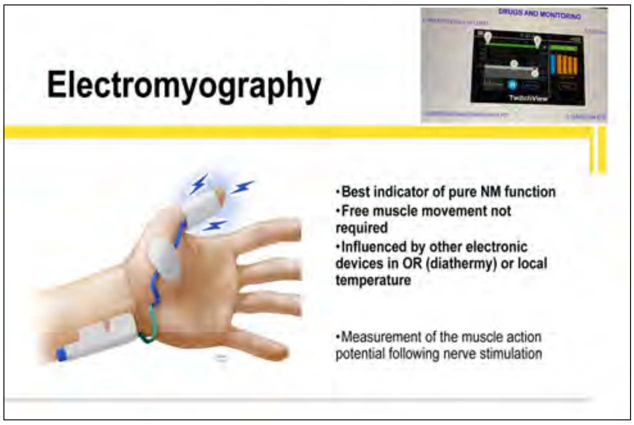


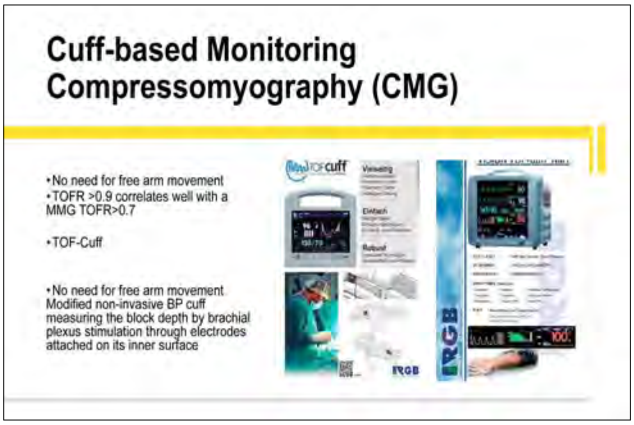


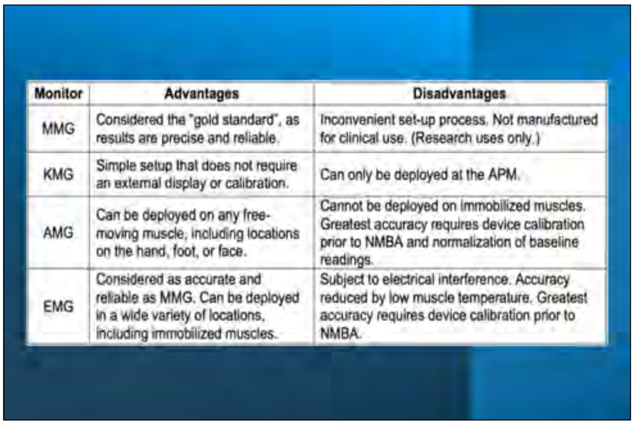




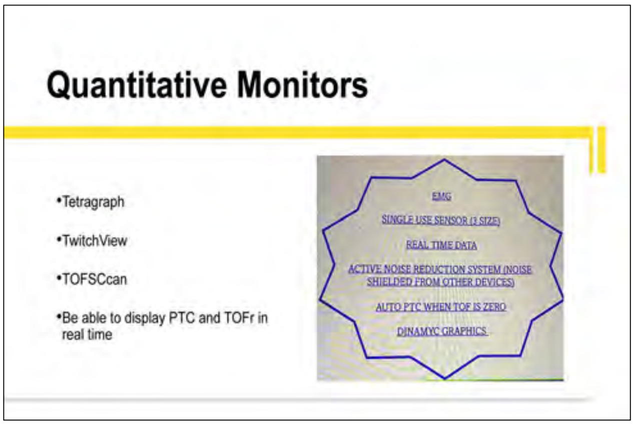


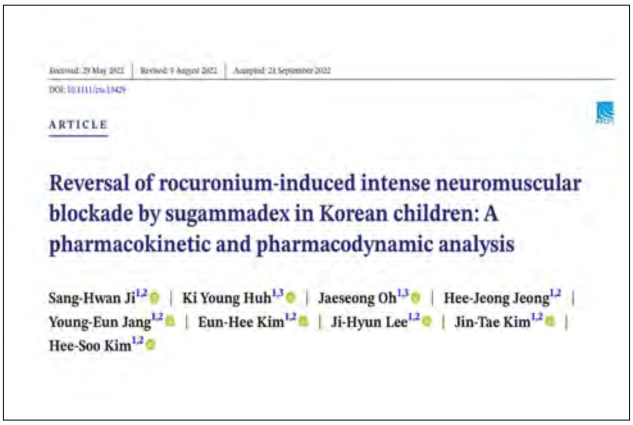






Monitor	Advantages	Disadvantages
MMG	Considered the "gold standard", as results are precise and reliable.	Inconvenient set-up process. Not manufactured for clinical use. (Research uses only.)
KMG	Simple setup that does not require an external display or calibration.	Can only be deployed at the APM.
AMG	Can be deployed on any free-moving muscle, including locations on the hand, foot, or face.	Cannot be deployed on immobilized muscles. Greatest accuracy requires device calibration prior to NMBA and normalization of baseline readings.
EMG	Considered as accurate and reliable as MMG. Can be deployed in a wide variety of locations, including immobilized muscles.	Subject to electrical interference. Accuracy reduced by low muscle temperature. Greatest accuracy requires device calibration prior to NMBA.

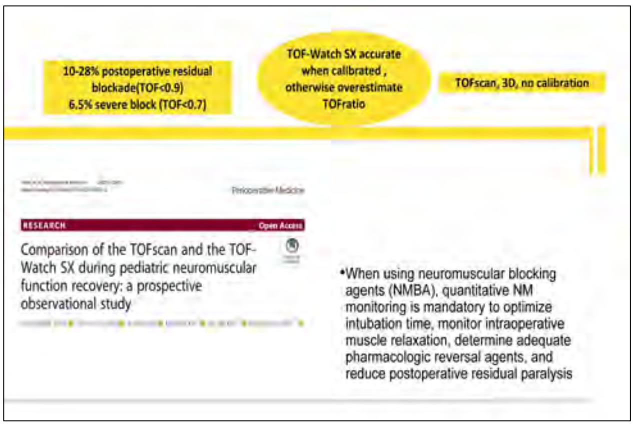




ARTICLE

Reversal of rocuronium-induced intense neuromuscular blockade by sugammadex in Korean children: A pharmacokinetic and pharmacodynamic analysis

Sang-Hwan Ji[1,2] | Ki Young Huh[1,3] | Jaeseong Oh[1,3] | Hee-Jeong Jeong[1,2] | Young-Eun Jang[1,2] | Eun-Hee Kim[1,2] | Ji-Hyun Lee[1,2] | Jin-Tae Kim[1,2] | Hee-Soo Kim[1,2]



Assessing 3D acceleration in children

- Unevitable Anatomical differences
- Shallow skin-to-nerve and nerve-to-nerve distance
- Individual differences in;
  - Distribution volume
  - Muscle mass
  - NMBA clearance
  - Age-dependent maturation of NM junction
- Contribute to differences in initial TOF raito
- Normalization adjusts the inherent TOF ratio

- Use of neostigmin to reverse deep NMB will not be effective and will not result in adequate recovery, may result in recurarization
- Inadequate antagonism, subsequent fatigue rather than recurrence of block
- Recurarization may be seen clinically after using inadequate doses of sugammadex

Keep it Simple

- Easy -to understand interface
- Greater acceptance among clinicians
- Learning curve not steep

EDITORIAL

Neuromuscular Monitoring: Keep It Simple!

Mohamed Naguib, MD, MSc, FCARCSI,* and Aaron F. Kopman, MD†

Acquring the latest and most expensive quantitative monitor is not likely to solve the problem of undetected postoperative residual NMB

Postoperative Residual Weakness

- *Observing an unacceptable number of patients encountering respiratory distress in the recovery- 20-40% even reversed*
- *Pharyngeal dysfunction, increased risk for aspiration and pneumonia, acute respiratory events (hypoxemia, airway obstruction), need of tracheal intubation, discomfort for patients and surgeons, increased stay in PACU*
- *Using quantitative NMB Monitoring whenever a non-depolarizing muscle relaxant is used and documenting train of four in the anesthetic record*

NM MONITORING IS MANDATORY TO

- Optimize intubation time
- Monitor intraoperative muscle relaxation
- Determine adequate pharmacologic reversal agents
  - ***WFSA, SFAR recommend incorporating objective NM monitoring into daily practice***

Tips and Tricks

- Choose the appropriate monitoring device
- Familiarize yourself with the equipment
- Proper electrode placement
- Optimize skin preparation
- Monitor baseline values
- Individualize monitoring approach
- Consider the effect of temperature
- Avoid electrode movement
- Interpret the data carefully
- Monitor throughout the procedure
- Maintain communication
- Stay updated with guidelines and best practices

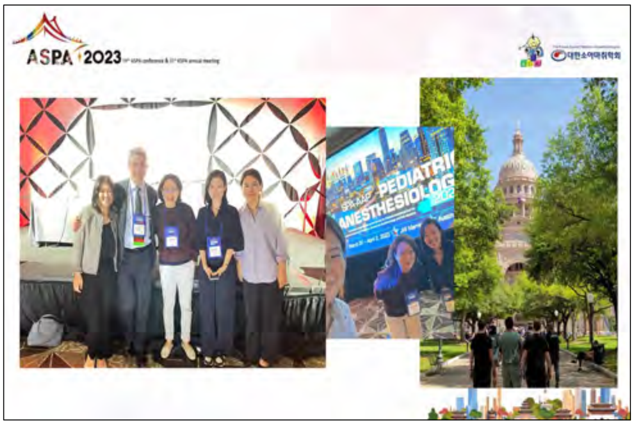
Take home

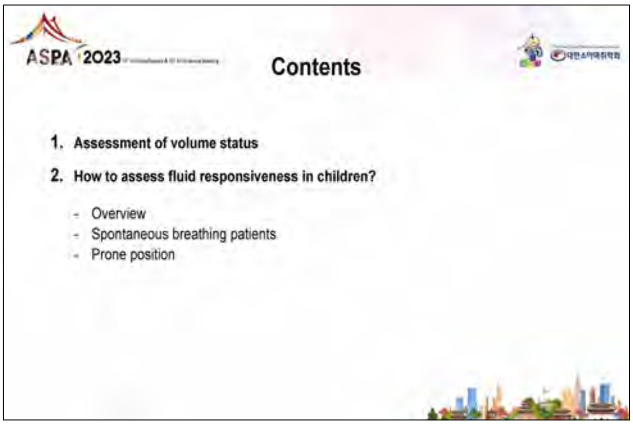
- Misconceptions
- Lack of knowledge
- Failure to follow well-established guidelines regarding the clinical use of NM drugs are commonplace
- What we need is not more complicated monitors, but the application of well- established lessons
- Rather the application of NMB and appropriate reversal

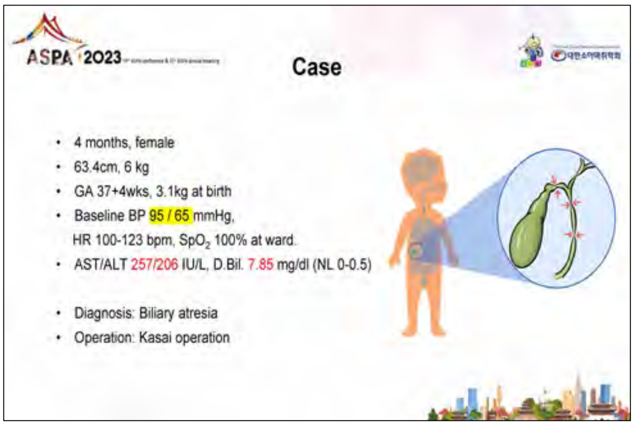
How to Assess Fluid Responsiveness in Children?

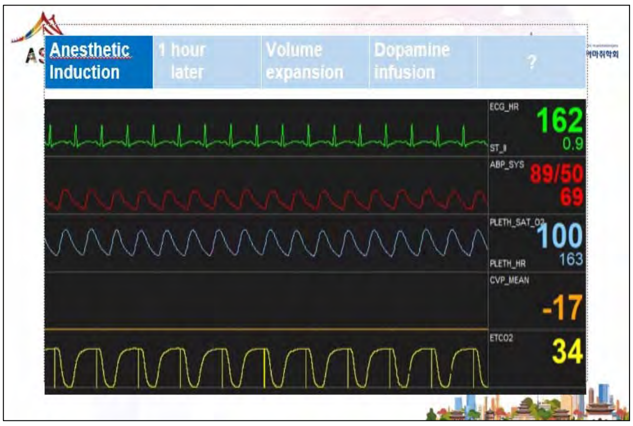
Eun-Hee Kim

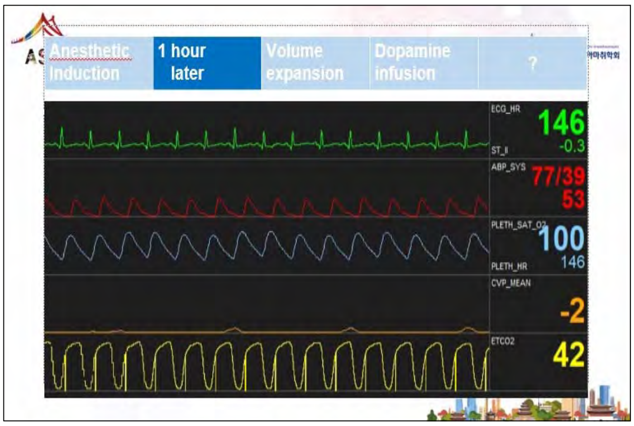
Seoul National University Hospital, Korea



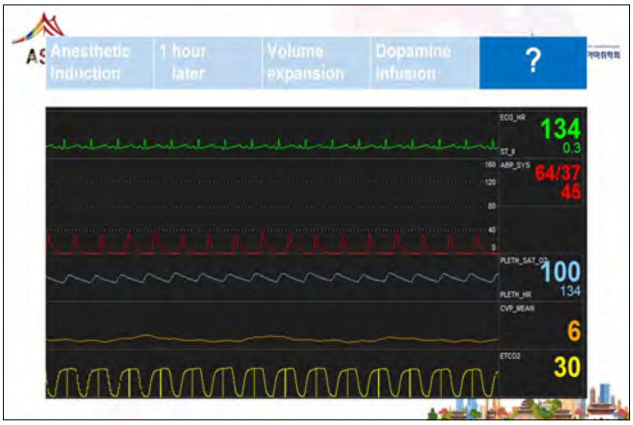


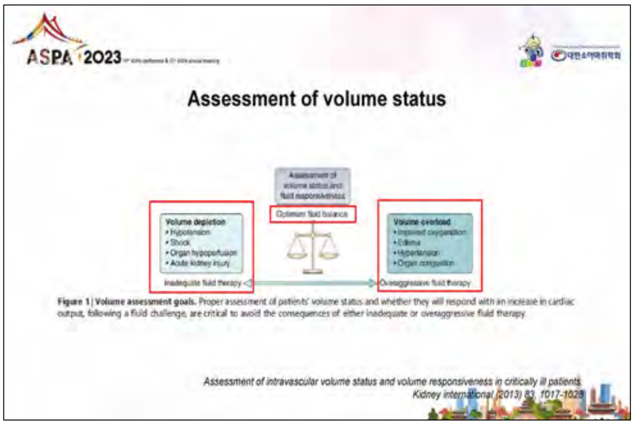


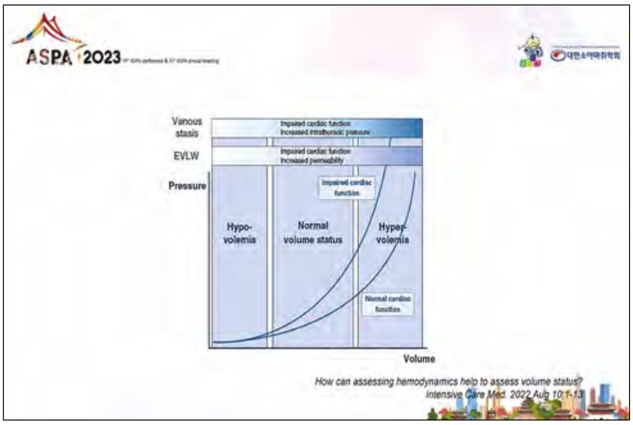


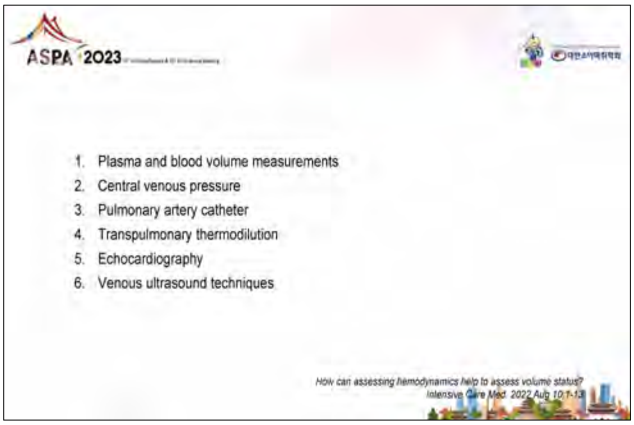



Anesthetic Induction
1 hour later
Volume expansion
Dopamine infusion
?
132
1.2
83/52
66
100
132
5
31

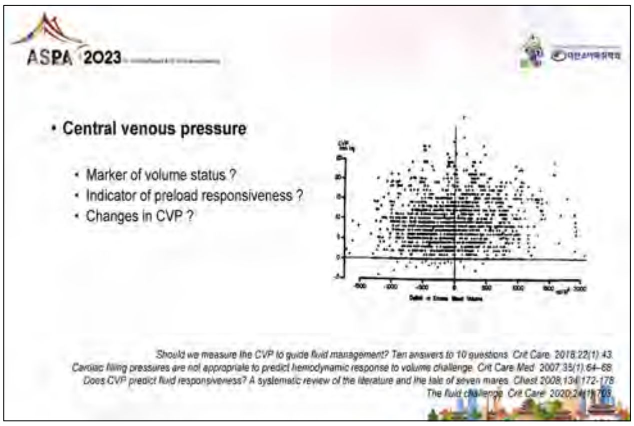

Anesthetic Induction
1 hour later
Volume expansion
Dopamine infusion
?
134
0.3
64/37
45
100
134
6
30

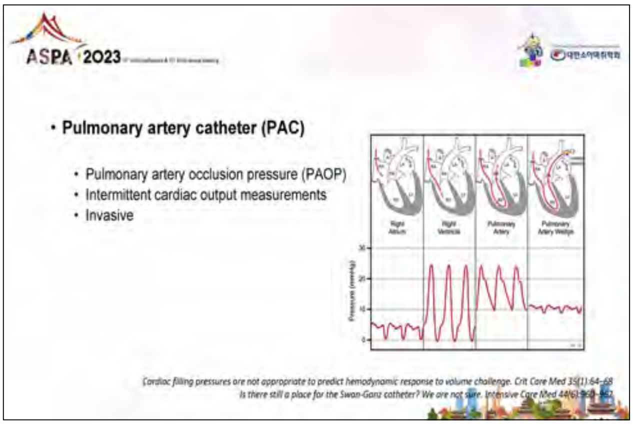

ASPA 2023
Assessment of volume status
Volume depletion
• Hypotension
• Shock
• Organ hypoperfusion
• Acute kidney injury
Optimum fluid balance
Volume overload
• Impaired oxygenation
• Edema
• Hypertension
• Organ congestion
Inadequate fluid therapy
Overaggressive fluid therapy
Figure 1 | Volume assessment goals. Proper assessment of patients' volume status and whether they will respond with an increase in cardiac output, following a fluid challenge, are critical to avoid the consequences of either inadequate or overaggressive fluid therapy.
Assessment of intravascular volume status and volume responsiveness in critically ill patients.
Kidney international (2013) 83, 1017-1028

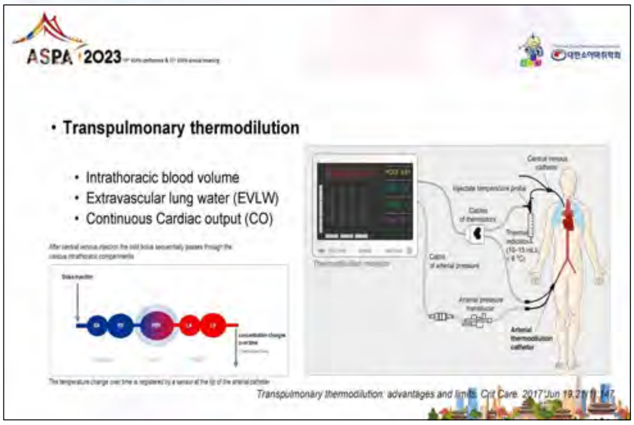

ASPA 2023
Venous stasis
EVLW
Pressure
Hypo-volemia
Normal volume status
Hyper-volemia
Volume
How can assessing hemodynamics help to assess volume status?
Intensive Care Med. 2022 Aug 10:1-13

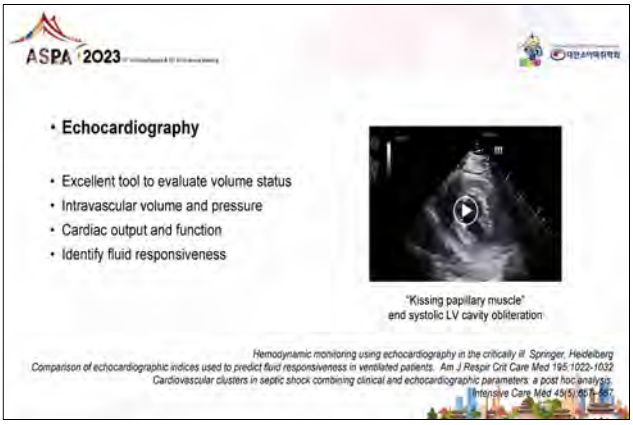

ASPA 2023
1. Plasma and blood volume measurements
2. Central venous pressure
3. Pulmonary artery catheter
4. Transpulmonary thermodilution
5. Echocardiography
6. Venous ultrasound techniques
How can assessing hemodynamics help to assess volume status?
Intensive Care Med. 2022 Aug 10:1-13

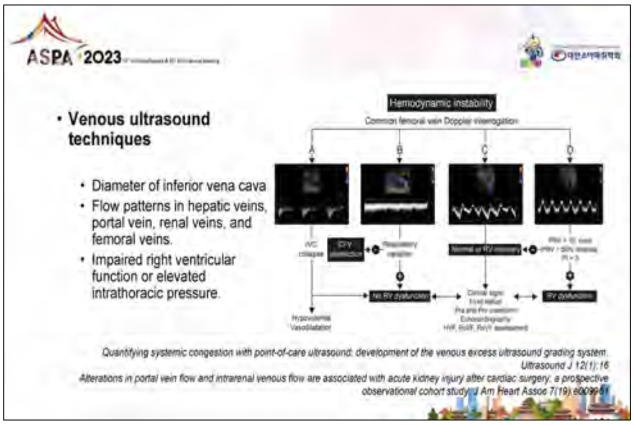

ASPA 2023
• Plasma and blood volume measurements (Indocyanine green)
Plasma volume estimation using indocyanine green. A single intravenous injection method. Anaesthesia. 1993 Jan;48(1):41-3
An efficient method for measuring plasma volume using indocyanine green dye. MethodsX. 2019 May
A modified method of measuring plasma volume with indocyanine green: reducing the frequency of blood sampling

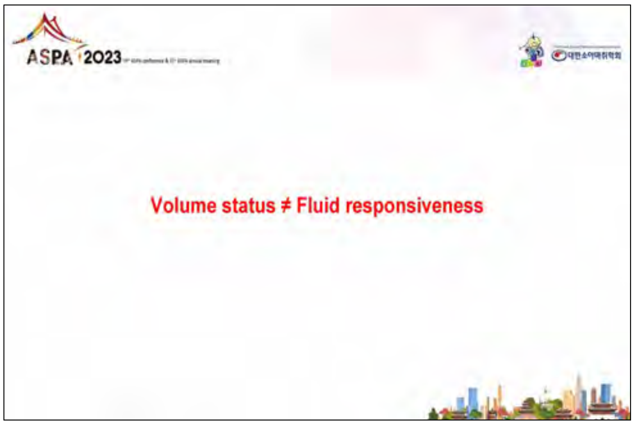

ASPA 2023
• Central venous pressure
• Marker of volume status ?
• Indicator of preload responsiveness ?
• Changes in CVP ?
Should we measure the CVP to guide fluid management? Ten answers to 10 questions. Crit Care. 2018;22(1):43.
Cardiac filling pressures are not appropriate to predict hemodynamic response to volume challenge. Crit Care Med. 2007;35(1):64–68.
Does CVP predict fluid responsiveness? A systematic review of the literature and the tale of seven mares. Chest 2008;134:172-178
The fluid challenge. Crit Care. 2020;24(1):703.

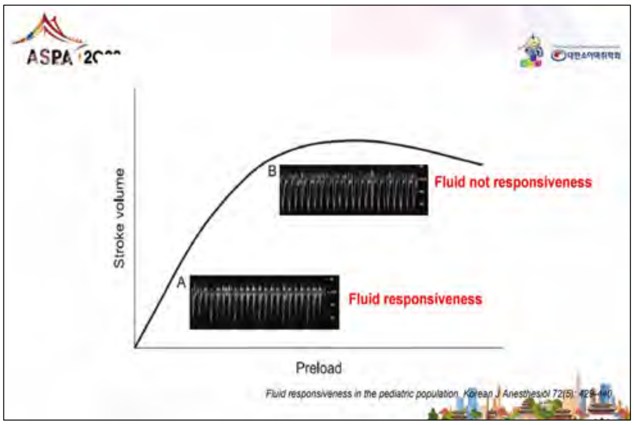

ASPA 2023
• Pulmonary artery catheter (PAC)
• Pulmonary artery occlusion pressure (PAOP)
• Intermittent cardiac output measurements
• Invasive
Right Atrium
Right Ventricle
Pulmonary Artery
Pulmonary Artery Wedge
Pressure (mmHg)
Cardiac filling pressures are not appropriate to predict hemodynamic response to volume challenge. Crit Care Med 35(1):64–68
Is there still a place for the Swan-Ganz catheter? We are not sure. Intensive Care Med

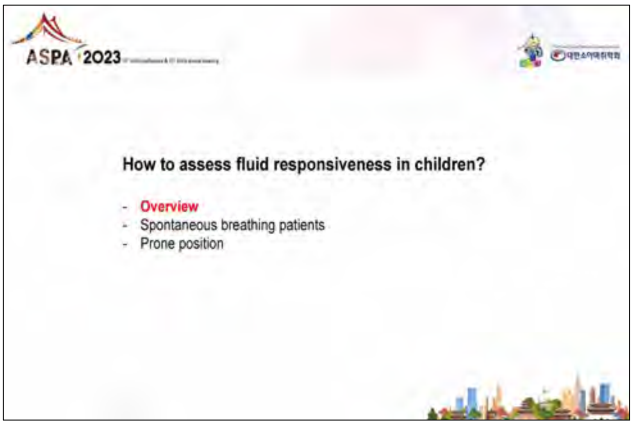

ASPA 2023
• Transpulmonary thermodilution
• Intrathoracic blood volume
• Extravascular lung water (EVLW)
• Continuous Cardiac output (CO)
Transpulmonary thermodilution: advantages and limits. Crit Care. 2017 Jun 19;21(1):147

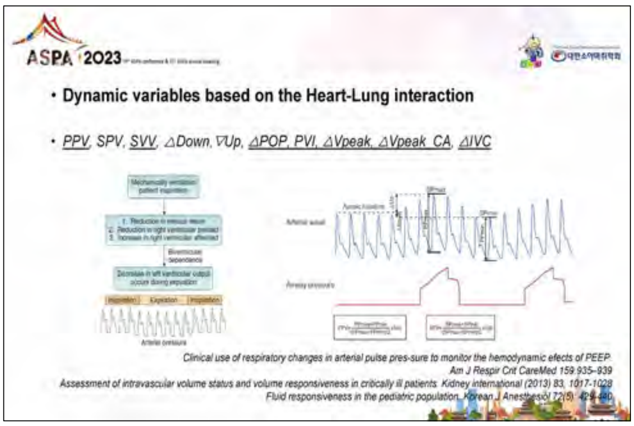

ASPA 2023
• Echocardiography
• Excellent tool to evaluate volume status
• Intravascular volume and pressure
• Cardiac output and function
• Identify fluid responsiveness
"Kissing papillary muscle"
end systolic LV cavity obliteration
Hemodynamic monitoring using echocardiography in the critically ill. Springer, Heidelberg
Comparison of echocardiographic indices used to predict fluid responsiveness in ventilated patients. Am J Respir Crit Care Med 195:1022-1032
Cardiovascular clusters in septic shock combining clinical and echocardiographic parameters: a post hoc analysis. Intensive Care Med 45(5):657-667

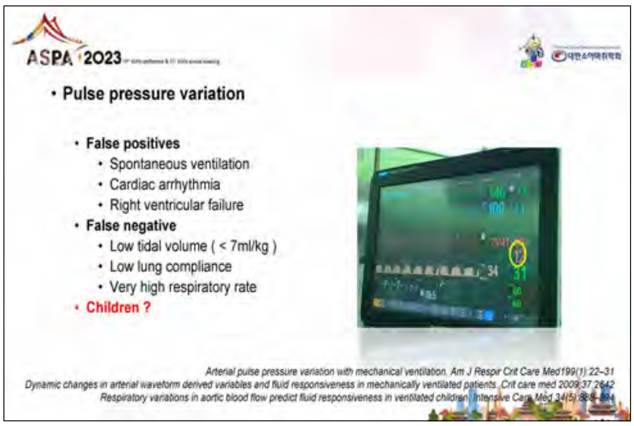

ASPA 2023
• Venous ultrasound techniques
• Diameter of inferior vena cava
• Flow patterns in hepatic veins, portal vein, renal veins, and femoral veins.
• Impaired right ventricular function or elevated intrathoracic pressure.
Hemodynamic instability
Common femoral vein Doppler interrogation
Quantifying systemic congestion with point-of-care ultrasound: development of the venous excess ultrasound grading system. Ultrasound J 12(1):16
Alterations in portal vein flow and intrarenal venous flow are associated with acute kidney injury after cardiac surgery: a prospective observational cohort study. J Am Heart Assoc 7(19):e009961

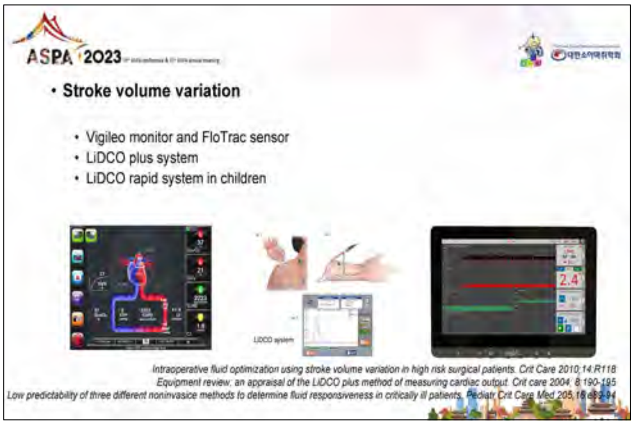

ASPA 2023
Volume status ≠ Fluid responsiveness

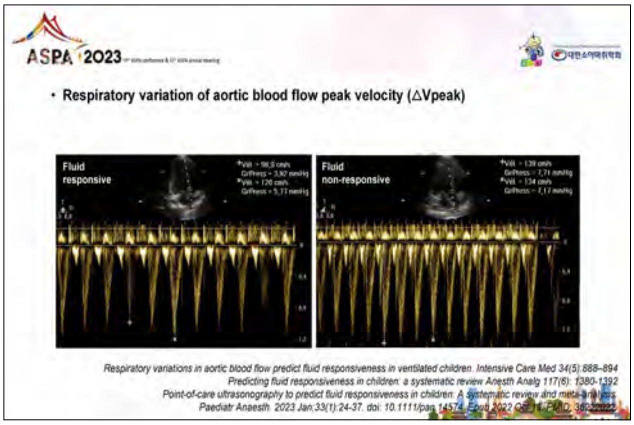

Stroke volume
B
Fluid not responsiveness
A
Fluid responsiveness
Preload
Fluid responsiveness in the pediatric population. Korean J Anesthesiol 72(5): 429-440

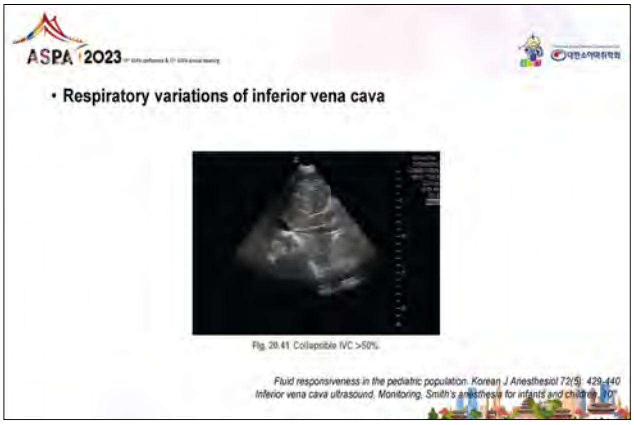

ASPA 2023
How to assess fluid responsiveness in children?
- Overview
- Spontaneous breathing patients
- Prone position

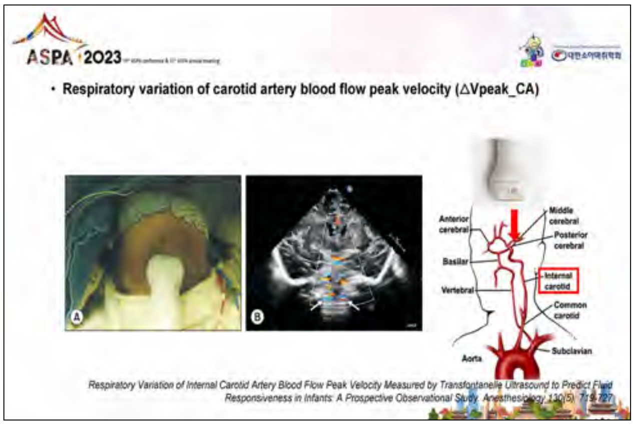

ASPA 2023
• Dynamic variables based on the Heart-Lung interaction
• PPV, SPV, SVV, △Down, ▽Up, △POP, PVI, △Vpeak, △Vpeak_CA, △IVC
Inspiration
Expiration
Inspiration
Clinical use of respiratory changes in arterial pulse pressure to monitor the hemodynamic effects of PEEP. Am J Respir Crit CareMed 159:935–939
Assessment of intravascular volume status and volume responsiveness in critically ill patients. Kidney International (2013) 83, 1017-1028
Fluid responsiveness in the pediatric population. Korean J Anesthesiol 72(5): 429-440

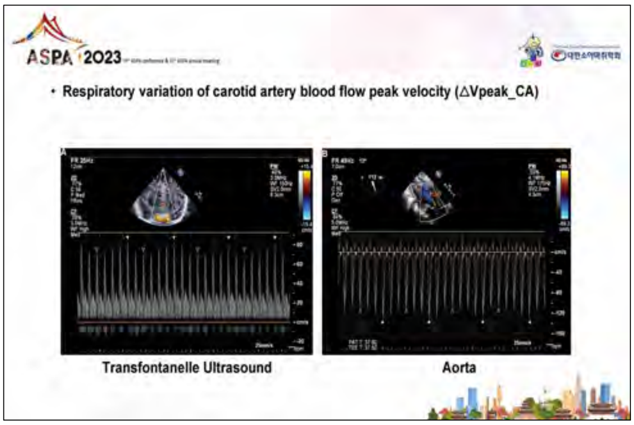

ASPA 2023
• Pulse pressure variation
• False positives
• Spontaneous ventilation
• Cardiac arrhythmia
• Right ventricular failure
• False negative
• Low tidal volume (< 7ml/kg)
• Low lung compliance
• Very high respiratory rate
• Children ?
Arterial pulse pressure variation with mechanical ventilation. Am J Respir Crit Care Med199(1):22–31
Dynamic changes in arterial waveform derived variables and fluid responsiveness in mechanically ventilated patients. Crit care med 2009;37:2642
Respiratory variations in aortic blood flow predict fluid responsiveness in ventilated children. Intensive Care Med 34(5):888-894

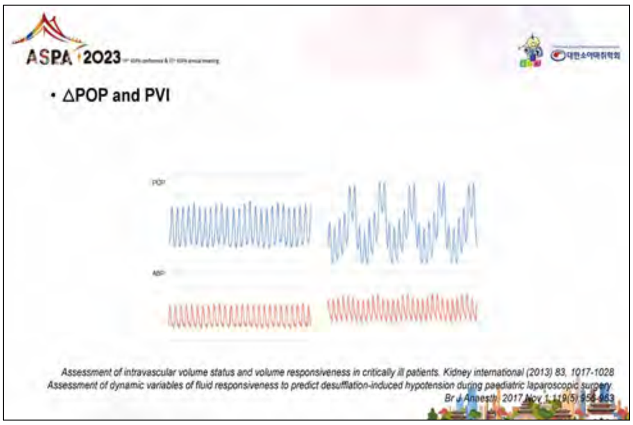

ASPA 2023
• Stroke volume variation
• Vigileo monitor and FloTrac sensor
• LiDCO plus system
• LiDCO rapid system in children
LiDCO system
2.4
Intraoperative fluid optimization using stroke volume variation in high risk surgical patients. Crit Care 2010;14:R118
Equipment review: an appraisal of the LiDCO plus method of measuring cardiac output. Crit care 2004; 8:190-195
Low predictability of three different noninvasice methods to determine fluid responsiveness in critically ill patients. Pediatr Crit Care Med 205,16 e89-94

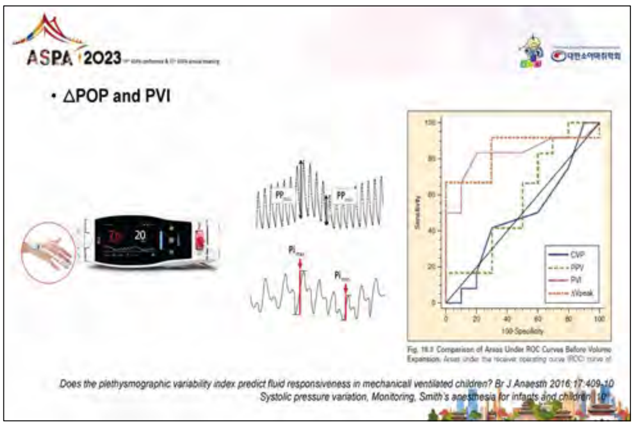

ASPA 2023
• Respiratory variation of aortic blood flow peak velocity (ΔVpeak)
Fluid responsive
Fluid non-responsive
Respiratory variations in aortic blood flow predict fluid responsiveness in ventilated children. Intensive Care Med 34(5):888–894
Predicting fluid responsiveness in children: a systematic review Anesth Analg 117(6): 1380-1392
Point-of-care ultrasonography to predict fluid responsiveness in children: A systematic review and meta-analysis.
Paediatr Anaesth. 2023 Jan;33(1):24-37. doi: 10.1111/pan.14574. Epub 2022 Oct 11. PMID: 36222022

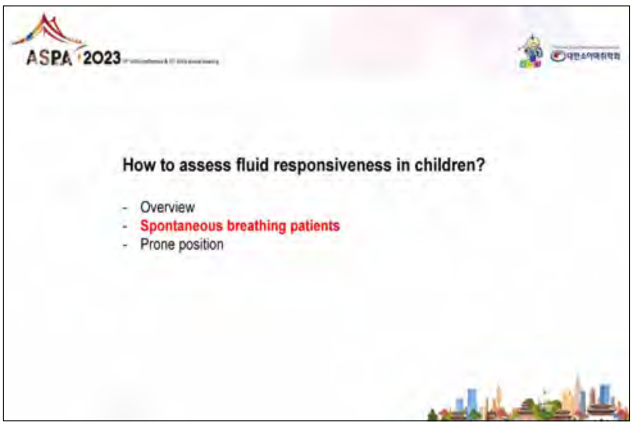

ASPA 2023
• Respiratory variations of inferior vena cava
Fig. 20.41 Collapsible IVC >50%.
Fluid responsiveness in the pediatric population. Korean J Anesthesiol 72(5): 429-440
Inferior vena cava ultrasound, Monitoring, Smith's anesthesia for infants and children, 10th

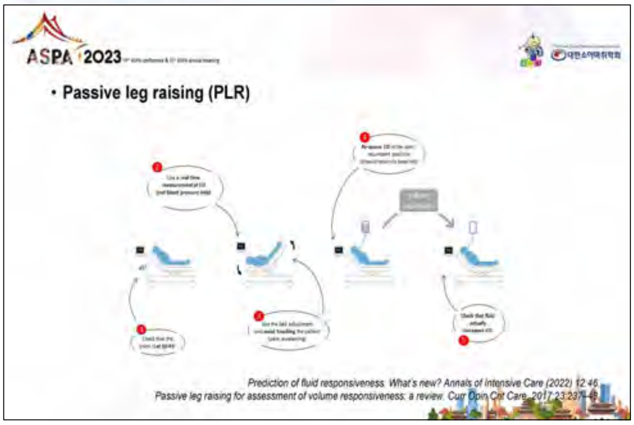

ASPA 2023
• Respiratory variation of carotid artery blood flow peak velocity (ΔVpeak_CA)
Anterior cerebral
Middle cerebral
Posterior cerebral
Basilar
Vertebral
Internal carotid
Common carotid
Subclavian
Aorta
Respiratory Variation of Internal Carotid Artery Blood Flow Peak Velocity Measured by Transfontanelle Ultrasound to Predict Fluid Responsiveness in Infants: A Prospective Observational Study. Anesthesiology 130(5): 719-727

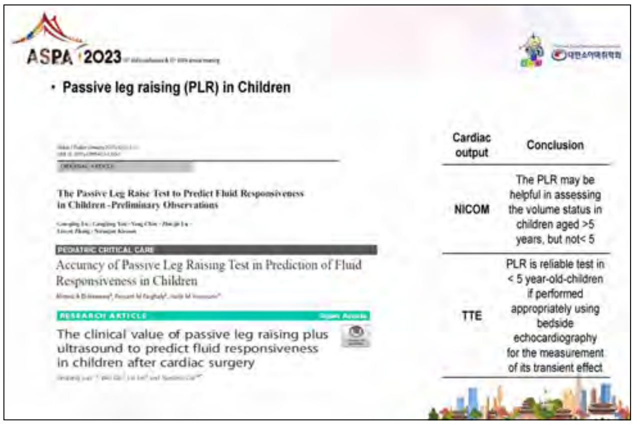

ASPA 2023
• Respiratory variation of carotid artery blood flow peak velocity (ΔVpeak_CA)
Transfontanelle Ultrasound
Aorta

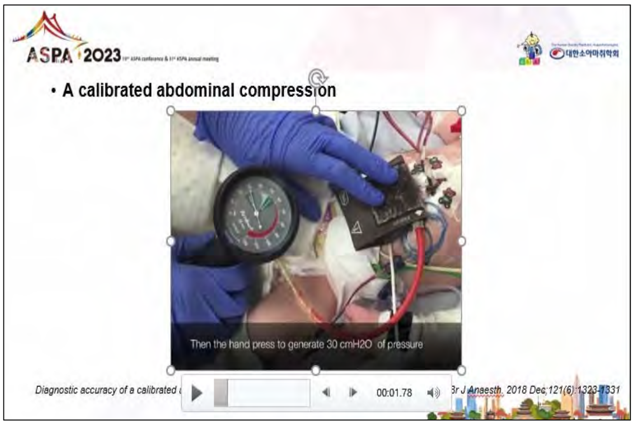

ASPA 2023
• ΔPOP and PVI
Assessment of intravascular volume status and volume responsiveness in critically ill patients. Kidney international (2013) 83, 1017-1028
Assessment of dynamic variables of fluid responsiveness to predict desufflation-induced hypotension during paediatric laparoscopic surgery.
Br J Anaesth. 2017 Nov 1;119(5):956-963

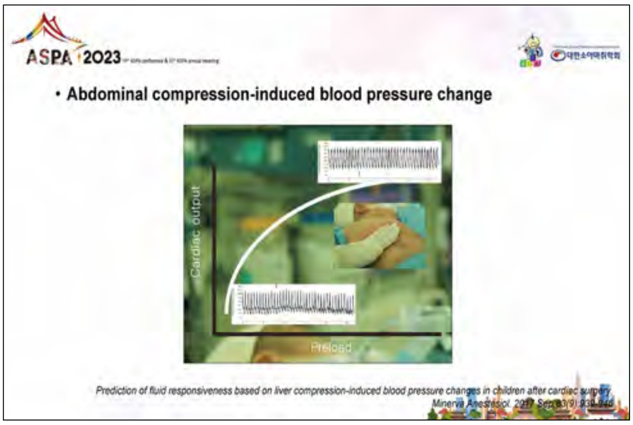

ASPA 2023
• ΔPOP and PVI
CVP
PPV
PVI
ΔVpeak
100-Specificity
Sensitivity
Fig. 16.8 Comparison of Areas Under ROC Curves Before Volume Expansion.
Does the plethysmographic variability index predict fluid responsiveness in mechanicall ventilated children? Br J Anaesth 2016;17:409-10
Systolic pressure variation, Monitoring, Smith's anesthesia for infants and children, 10th

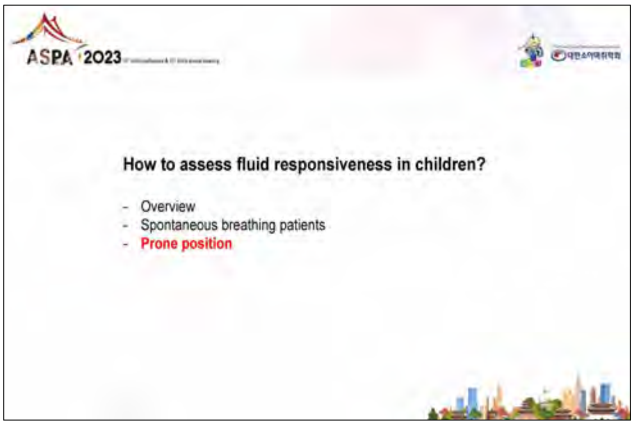

ASPA 2023
How to assess fluid responsiveness in children?
- Overview
- Spontaneous breathing patients
- Prone position

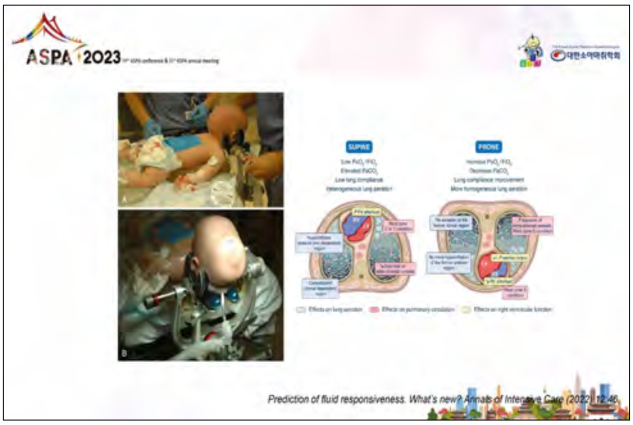

ASPA 2023
Passive leg raising (PLR)
Prediction of fluid responsiveness. What's new? Annals of Intensive Care (2022) 12:46
Passive leg raising for assessment of volume responsiveness: a review. Curr Opin Crit Care. 2017;23:237-43

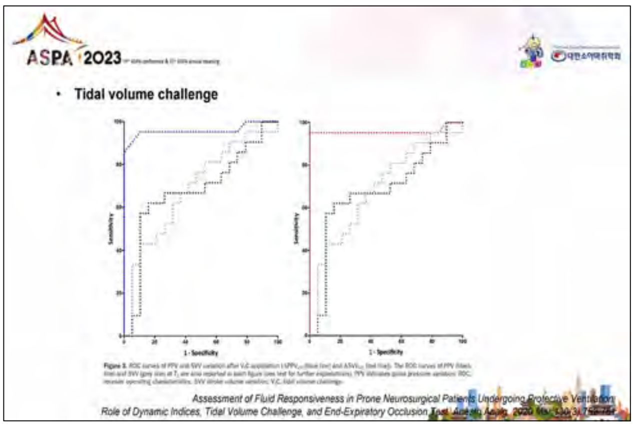

ASPA 2023
Passive leg raising (PLR) in Children
The Passive Leg Raise Test to Predict Fluid Responsiveness in Children - Preliminary Observations
PEDIATRIC CRITICAL CARE
Accuracy of Passive Leg Raising Test in Prediction of Fluid Responsiveness in Children
RESEARCH ARTICLE
The clinical value of passive leg raising plus ultrasound to predict fluid responsiveness in children after cardiac surgery
Cardiac output
Conclusion
NICOM
The PLR may be helpful in assessing the volume status in children aged >5 years, but not< 5
TTE
PLR is reliable test in < 5 year-old-children if performed appropriately using bedside echocardiography for the measurement of its transient effect


ASPA 2023
A calibrated abdominal compression
Then the hand press to generate 30 cmH2O of pressure
00:01.78
Diagnostic accuracy of a calibrated
Br J Anaesth. 2018 Dec;121(6):1323-1331


ASPA 2023
Abdominal compression-induced blood pressure change
Cardiac output
Preload
Prediction of fluid responsiveness based on liver compression-induced blood pressure changes in children after cardiac surgery
Minerva Anestesiol. 2017 Sep;83(9):938-946


ASPA 2023
How to assess fluid responsiveness in children?
- Overview
- Spontaneous breathing patients
- Prone position


ASPA 2023
SUPINE
PRONE
Prediction of fluid responsiveness. What's new? Annals of Intensive Care (2022) 12:46


ASPA 2023
Tidal volume challenge
1-Specificity
Assessment of Fluid Responsiveness in Prone Neurosurgical Patients Undergoing Protective Ventilation: Role of Dynamic Indices, Tidal Volume Challenge, and End-Expiratory Occlusion Test. Anesth Analg. 2020 Mar;130(3):752-761

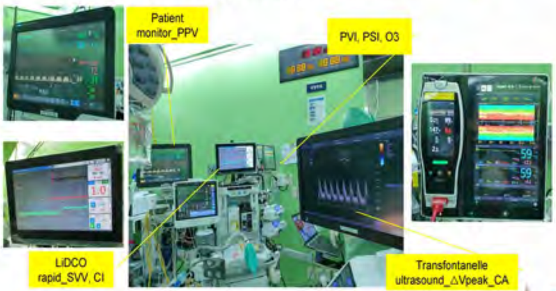

ASPA 2023
ClinicalTrials.gov
Prone Fluid Responsiveness in Children

Fluid Responsiveness Prediction ? Improve the Clinical Outcome in the Pediatric Population

Summary

- When we give a fluid to patients, two clinical questions are asked
  1. What is the current state of the patient's intravascular volume?
  2. And if the patient receives continued resuscitation or a fluid bolus, will physiological variables such as blood pressure, tissue perfusion, and urine output improve?
- Predicting fluid responsiveness is difficult in the pediatric patients
- Respiratory variation in aortic blood flow peak velocity was the most reliable parameter for predicting fluid responsiveness in pediatric patients
- Several potential parameters can be useful in clinical situations.
- Further researches on the clinical outcomes are needed.

Operating theatre in SNUH



Session 3.

Sharing the Knowledge of NORA

Chair(s): Vivian Yuen (Hong Kong)
Yong-Hee Park (Korea)

Dexmedetomidine+ Remimazolam Clinical Applications and Limitations

Keira P. Mason

Boston Children's Hospital, Harvard Medical School, USA

Learning Objectives

- Understand the pharmacology and pharmacokinetic profile of Dexmedetomidine + Remimazolam
- Understand the clinical profile
- Review the relevant literature to aid in clinical delivery
- Share my clinical pearls

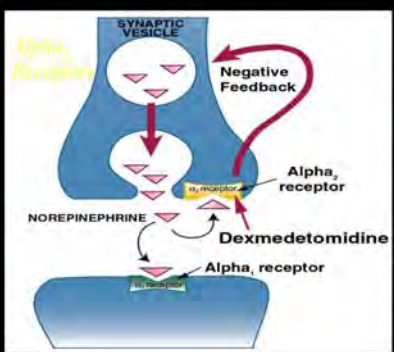
Dexmedetomidine Pharmacology

- α-2 to α-1 ratio of 1620:1
- intravenous, intramuscular, intranasal, sub cutaneous, epidural, transdermal routes
- Crosses blood-brain barrier
- CSF concentration is ~ 8% of the plasma concentration
- Inactive metabolites
- Half life 2-3 hours

DEXMEDETOMIDINE

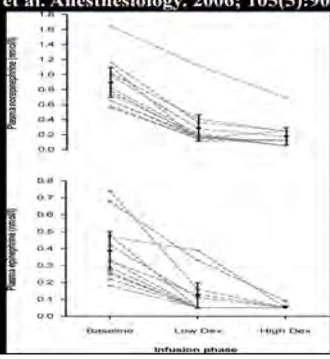
- 1999 approved for ICU
- 2008 approved for sedation
- Bolus 1 mcg/kg over 10 min
- Infusion 0.7 mcg/kg/hr
- 24 Hour Limit

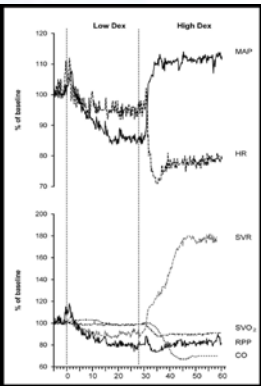
2011
DEX approved in Europe
ICU approval only
NO time limit
Infusion no Bolus- 1.4 mcg/kg/hr



DEXMEDETOMIDINE

Effect on Epinephrine & Norepinephrine levels
Snapir et al. Anesthesiology. 2006; 105(5):902-10





Snapir et al. Anesthesiology. 2006; 105(5):902-10

Tolerable Rapid Bolus DEX Dose in Children

Dawes J. Ped Anes.2014

- Healthy children (5-9 yoa)
- Hemodynamic response
- + Response: ≥ 30% Δ mean HR,MAP
- 5 second bolus
- ED50 0.49 mcg/kg
- 50 second- max dec in median HR
- 100 second-median inc in median MAP

AVOID ANTICHOLINERGICS FOR BRADYCARDIA

Mason KP et al. AnesAnalg. 108;906-8:2009
Subramanyam R. Anesth Analg 2015

- All pediatric MRI
- Bradycardia Treatment-prospective (Mason et al)
- Prophylactic Tx –retrospective (Subramanyam et al.)
- Risk transient, marked or sustained hypertension

DEXMEDETOMIDINE EEG SIMULATES NON-REM SLEEP

Mason KP et al. Paediatr Anaesth. 2009 (12):1175-83
Mason KP et al. J Pediatr. 2012 (5):927-932

- DEX Sedation
- EEG resembles Stage II Sleep

Sea Lion

IM Sedation: Dex+Butorphanol+Versed

Courtesy of: William Van Boon, DVM
Marine Mammal Center, Sausalito, CA

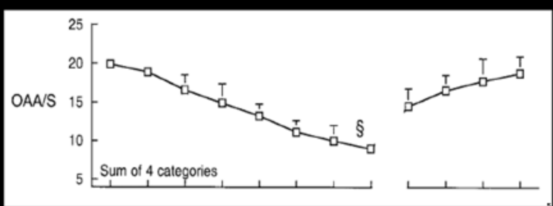
SEA LION

IM Sedation: Dex+Butorphanol+Versed

Courtesy of: William Van Bonn, DVM
Marine Mammal Center, Sausalito, CA

Depth of Sedation Increases with Increasing Dex

Ebert TJ et al. Anesth 2000



Dex is Not an Amnestic

Mason et al. BJA 2017

BJA

British Journal of Anaesthesia, 118 (2): 254–63 (2017)

doi: 10.1093/bja/aew421
Paediatrics

Feasibility of measuring memory response to increasing dexmedetomidine sedation in children

K. P. Mason[1,*], E. R. Kelhoffer[2,3], R. Prescilla[4], M. Mehta[2,3], J. C. Root[2,3,5], V. J. Young[1], F. Robinson[6] and R. A. Veselis[2,3]

BJA 2017

Dexmedetomidine pharmacodynamics in healthy volunteers: 2. Haemodynamic profile

P. J. Colin[1,2,*], L. N. Hannivoort[1], D. J. Eleveld[1], K. M. E. M. Reyntjens[1], A. R. Absalom[1], H. E. M. Vereecke[1] and M. M. R. F. Struys[1,3]

[1]Department of Anesthesiology, University of Groningen, University Medical Center Groningen, Groningen, The Netherlands, [2]Department of Bioanalysis, Faculty of Pharmaceutical Sciences, Ghent University, Ghent, Belgium and [3]Department of Anaesthesia and Peri-operative Medicine, Ghent University, Ghent, Belgium

Hemodynamics Predicted by [Dex]
HD as Marker of Sedation Depth

PJ Colin. BJA 2017

- N=18 healthy
- Step up dose of DEX (TCI)
- Hemodynamics described by serum [DEX]
- High correlation between sedation and HD
- Hemodynamics predict sedation/BIS depth
- PKPD Model for HR and MAP effects

Dexmedetomidine Sedation MRI, CT and Nuclear Medicine

Mason KP et al. Anes Analg 2006
Mason KP et al. Paediatr Anaesth. 2008
Mason KP et al. AnesAnalg. 108;906-8:2009
Mason KP et al. Paediatr Anaesth. 2009
Mason KP.AJR.2011
Mason KP et al. Radiology.2013
Mahmoud M. Pediatr Anesth 2014
Mahmoud M. J Clin Anesth 2013

- 2-3 mcg/kg bolus (10 min)-2 mcg/kg/hr
- Sedation Achieved: 8.9 ± 2.4 min
- Time to meet discharge criteria: 31.8 ± 18 min

Bioavailability

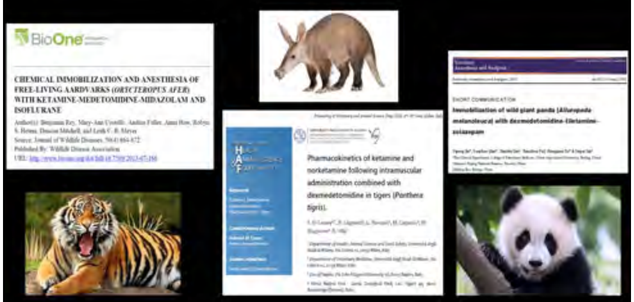
Anttila M. Br J Clinical Pharm. 2003
Iirola T. Eur J Clin Pharm 2011

- Oral- 16%
- Nasal- 65%
- Buccal- 82%
- Intramuscular-104%

DEX is Synergistic
Narcotics, Propofol, Ketamine?

1 + 1 = 5

SYNERGISM



Eur J Anaesthesiol, 2020

EJA *Eur J Anaesthesiol* 2020; **37**:1–8

ORIGINAL ARTICLE

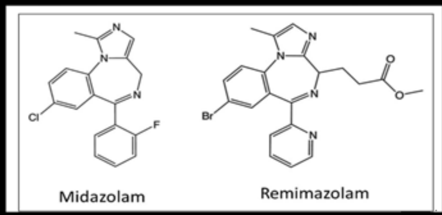
The synergistic effect of dexmedetomidine on propofol for paediatric deep sedation
A randomised trial

Keira P. Mason, Raymond Seungjoon Park, Cornelius A. Sullivan, Karina Lukovits, Erin M. Halpin, Samantha T. Imbrescia, David Cavanaugh, Randy Prescilla and Victor L. Fox

Remimazolam

- A "soft drug"
- Goal is rapid biotransformation to inactive metabolites
- Ester modified benzodiazepine analog
- Eliminate the active metabolite (alpha hydroxy midazolam) of midazolam

Ester moiety added to midazolam



January 2020
Remimaz approved in Japan

- Approved for induction and maintenance of general anesthesia
- 12 mg/kg/hr until targeted level then 1-2 mg/kg/hr infusion
- 0.2 mg/kg bolus as needed

A placebo- and Midazolam-Controlled phase I Single Descending-Dose Study Evaluating the Safety, Pharmacokinetics, and Pharmacodynamics of Remimazolam (CNS 7056): Part I. Safety, Efficacy, and Basic Pharmacokinetics.

Antonik LJ. Anesth Analg 2012

- Phase 1 clinical trial, healthy adults
- Single, ascending dose study
- .01-.3 mg/kg bolus did not cause hypotension (SBP<80)
- Dose-dependant sedation (MOAA/S) scores] with remimazolam ≥ 0.05 mg/kg in a single ascending-dose study
- IV remimazolam 0.075–0.20 mg/kg similar sedation depth to 0.075 mg/kg midazolam
- More rapid recovery (5.5–20 vs 40 min)

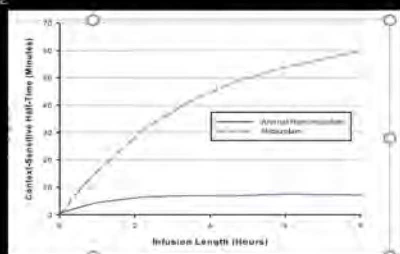
A placebo- and midazolam-controlled phase I single ascending-dose study evaluating the safety, pharmacokinetics, and pharmacodynamics of remimazolam (CNS 7056): Part II. Population pharmacokinetic and pharmacodynamic modeling and simulation

Wiltshire HR et al. Anesth Analg 2012

- A phase I, single-center, double-blind, active-controlled, randomized, single-dose escalation study
- n=54 healthy adults, 9 study groups, midaz groups and placebos
- Infusion of remimazolam (0.01–0.3 mg/kg)
- PK and PD study
- Max effect within 3 minutes

Remimaz phase 1 trials

Wiltshire HR et al. A placebo- and midazolam-controlled phase I single ascending-dose study evaluating the safety, pharmacokinetics, and pharmacodynamics of remimazolam (CNS 7056): Part II. Population pharmacokinetic and pharmacodynamic modeling and simulation. Anesth Analg 2012



Journal of Anesthesia, 2020

Efficacy and safety of remimazolam versus propofol for general anesthesia: a multicenter, single-blind, randomized, parallel-group, phase IIb/III trial

Matsuyuki Doi[1] · Kiyoshi Morita[2] · Junzo Takeda[3] · Atsuhiro Sakamoto[4] · Michiaki Yamakage[5] · Toshiyasu Suzuki[6]

Non inferiority study comparing Remimazolam to Propofol for induction and maintenance of GA

- **mean age 57**
- **6 or 12 mg/kg/hr Remimazolam until LOC then 1-2 mg/kg/hr maintenance titrated**
- **2-2.5 mg/kg propofol until LOC then 4-10 mg/kg/hr titrated**
- **Remimfentanil to both groups**
- **Primary endpoint- intraop awakening, recall, need for rescue, no body movements**

Non inferiority study comparing Remimazolam to Propofol for induction and maintenance of GA

- Efficacy rates were 100%
- Longer time to LOC (10-15 secs) and extubation (~ 6 min) in Remimazolam group
- No difference in adverse events
- Higher incidence of hypotension (20 vs 49%) with propofol
- 19% pain on injection with propofol, none with Remimazolam

Pharmacokinetics and Pharmacodynamics of Intranasal Remimazolam—a randomized controlled clinical trial

Marija Pesic, Europ j Clinical Pharm 2020

- Randomized, double-blind, 9-period cross-over design
- PK, PD, and safety
- Single intranasal doses of 10, 20, and 40 mg remimazolam (as powder or solution) vs. IN placebo and 4 mg IV remimazolam.
- IN remimazolam powder had a consistent absolute bioavailability of approximately 50%
- Tmax was 10min
- The higher doses of IN solution decreases relative bioavailability through swallowing and first-pass effect

A phase III study evaluating the efficacy and safety of remimazolam (CNS 7056) compared with placebo and midazolam in patients undergoing colonoscopy

Douglas K. Rex, GI Endoscopy 2018

- N=461 randomized patients in 12 U.S. sites
- Gastroenterologist delivered
- Less hypotension
- The primary endpoint was met for remimazolam, placebo, and midazolam in 91.3%, 1.7%, and 25.2% of patients,
- Faster recovery

Remimazolam vs Propofol in Upper Gastrointestinal Endoscopy: A Multicenter, Randomized, Non-inferiority, Phase III trial

Shao-Hui Chen, J Gastroent and Hepatology 2020

- Phase 3 trial- China
- n-384
- Longer time to sedate ~ 1 min
- Shorter recovery ~ 1 min
- Less treatment requiring hypotension (0.5 vs 5.8%)
- Less respiratory depression (1.0 vs 6.8%)
- Fewer adverse events (39 vs 60%)

Deeper Sedation Induced With Propofol

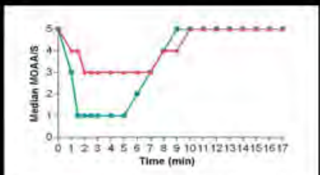


FIGURE 3 Sedation profile. MOAA/S, Modified Observer's Assessment of Alertness/Sedation; —, Remimazolam tosilate; —, Propofol

Remimazolam vs Propofol Benefits of Flumazenil

W Luo et al. BMC Anesthesiology 2023

- Prospective RCT
- N=115
- Remimazolam, Remimazolam+Flumazenil, Propofol
- Similar induction time
- Similar recovery between Propofol and Remimazolam+Flumazenil (12 min)
- Less hypotension with Remimazolam (32 vs 68%)
- Less ephedrine and phenylephrine
- Less injection pain

Journal of gastroenterology and hepatology, 2021

Effect of Remimazolam Tosilate on Early Cognitive Function in Elderly Patients undergoing Upper Gastrointestinal Endoscopy

Tan Yingjie, Ouyang Wen, Tang Yongzhong, Fang Ning, Fang Chao, Quan Chengxuan

First published: 14 December 2021 | https://doi-org.ezp-prod1.hul.harvard.edu/10.1111/jgh.15761

- 100 mcg/kg Remimazolam compared to 1-1.5 mg/kg propofol
- No difference in cognitive testing 5 minute post recovery
- Less hypotension (3% versus 48%)
- Average age 66
- Same average recovery 4 minutes

Psychomotor Recovery Following Remimazolam Induced Sedation and the Effectiveness of Flumazenil as an Antidote

Xia Chen, Clinical Therapeutics 2020

- 87 healthy Chinese
- Phase 1a and 1b trial
- Double blind randomized- midaz vs remi
- 2 hr infusions (BIS 40-60)
- subjects fully alert median 3.5 min after injection of flumazenil, compared with 35 min after

Memory Storage Affected
Xia Chen. Clinical Therapeutics 2020

- 20 min verbal word learning test
- Normal responses at 1.5-2 hrs post consciousness
- Diminished word recall at 4 hrs post
- No difference in recall with flumazenil

Dosing and Lablling Worldwide

- Europe, USA and China: procedural sedation
  – 5 mg IV bolus over 1 min and then 2.5 mg bolus rescue In Japan and
- South Korea: general anesthesia
  –infusion rate for induction of 12 mg/kg/hour (adjustable)
  –1 – 2 mg/kg/hour, maintenance

When you're curious, you find lots of interesting things to do
- **Walt Disney**

Needle Free
Procedural Sedative Techniques in Pediatric Patients

Jurgen C. de Graaff

Department of Paediatric Anesthesia, Erasmus MC University Medical Center Rotterdam, Netherlands

The main goals of safe pediatric PSA

- to reduce and minimize the child's **fear and anxiety**
- to reduce **discomfort and pain** connected with procedures
- to minimize **psychological trauma** (which may include amnesia)
- to control the child's **behavior and movement** for safe and successful completion of the procedure
- to protect the child's **safety during** the procedure and afterwards
- to ensure **safe discharge** from care

Zielinska Ped Anesth 2022; 29:583–590.

Why needle free?

Needle free? = non-invasive?

- No pain at application medication:
  - Intravenous
  - Intra muscular medication
- No use of invasive airway
  - Supraglotic airway devices: laryngeal mask of guedell/mayo
  - Tube

Needle free methods

- Non-pharmaceutical
- Pharmaceutical methods

Non-pharmaceutical interventions

Insights into Imaging

CRITICAL REVIEW — Open Access

Interventions and methods to prepare, educate or familiarise children and young people for radiological procedures: a scoping review

Non-invasive interventions

- **Information**

Prepare, educate or familiarize children

- **Distraction**

Non-invasive interventions

- **Information**

Prepare, educate or familiarize children

- **Distraction**

- Information: video, colour book, photo-diary booklet, story-book, meet staff and environment
- Technology: Music, Smartphone applications, Interactive videos, Animations, Virtual reality



Hoxhallari, Plastic and reconstructive Surgery 2019   Felemban BMC Oral Health 2021

Non-invasive interventions

- **Information**

Prepare, educate or familiarize children

- **Distraction**

- Information: video, colour book, photo-diary booklet, story-book, meet staff and environment
- Technology: Music, Smartphone applications, Interactive videos, Animations, Virtual reality: **preperation**


Eijlers Eur J Anaesthesioly 2019

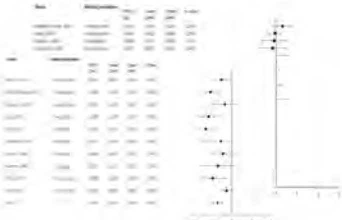
SYSTEMATIC REVIEW   WILEY

Virtual reality in pediatrics, effects on pain and anxiety: A systematic review and meta-analysis update

Floris Q. Tas* | Cynthia A. M. van Eijk* | Lonneke M. Staals | Jeroen S. Legerstee | Bram Dierckx

Reduction on

- Pain +
- Anxiety +



Non-invasive interventions

- **Information**

Prepare, educate or familiarize children

- **Distraction**

- Information: video, colour book, photo-diary booklet, story-book, meet staff and environment
- Technology: Music, Smartphone applications, Interactive videos, Animations, Virtual reality
- Facilitate play
- Provision of information: play specialists/child life specialists, nurse, paediatrician, medical social worker, volunteers, child life specialist etc.
- Opportunities to practice: Mock scanner
- **Feed and Swaddle < 6 months**

Definitions of drug-induced sedation

- **Minimal sedation** calming of the child and reduction of fear during which the patient is conscious and responds normally
- **Moderate sedation** depression of consciousness during which the patient is sleepy but responds purposefully to verbal commands or light tactile stimulation
- **Deep sedation** depression of consciousness during which the patient is asleep and cannot be easily roused but does respond to repeated or painful stimulation (may required assistance to maintain a patent airway and spontaneous ventilation)
- **General anesthesia**

Needle free sedation:

- **Minimal sedation** calming of the child and reduction of fear during which the patient is conscious and responds normally
- **Moderate sedation** depression of consciousness during which the patient is sleepy but responds purposefully to verbal commands or light tactile stimulation
- **Deep sedation** depression of consciousness during which the patient is asleep and cannot be easily roused but does respond to repeated or painful stimulation (may required assistance to maintain a patent airway and spontaneous ventilation)
- **General anesthesia**

SPECIAL INTEREST ARTICLE   WILEY

Safe pediatric procedural sedation and analgesia by anesthesiologists for elective procedures: A clinical practice statement from the European Society for Paediatric Anaesthesiology

Marzena Zielinska[1] | Alicja Bartkowska-Sniatkowska[2] | Karin Becke[3] | Claudia Höhne[4] | Nadia Najafi[5] | Eva Schaffrath[6] | Dusica Simic[7] | Maria Vittinghoff[8] | Francis Veyckemans[9] | Neil Morton[10]

Zielinska Ped Anesth 2019;29 583–590

Purpose sedation: Assess requirements?

- Cooperation
- Reduced awareness
- Lack of movement
- Duration
- Analgesia
- Anxiolysis
- Fear reduction
- Movement
- Required depth
- Emergence
- Location

Zielinska Ped Anesth 2019;29 583–590

Assessment for PSA

- Medical status and past medical history
- Current comorbidities and surgical problems
- Psychological and developmental status
- Past sedation and anesthesia history including family history
- Current and previous medication, nutraceuticals
- Allergies
- Age, weight, and height
- Focused examination of: **airways**, lungs and heart
- Increased risk for complications: **Airway**!
- Urgency of the procedure
- Fasting status: elective — 6h: solid meal; 4h: milk/light meal; 3h: breast milk; 1h (0?): clear liquids — **(not for minimal sedation: level 1)**

Zielinska Ped Anesth 2019;29:583–590
Eur J Anaesthesiol 2022; 39:4–25

Consult specialist!

- Increased intracranial pressure
- Risk of aspiration: esophageal disease, polyhandicap, duration of fasting for solids and liquids
- Difficult airway due to anatomical or functional problems! (hypotonia,obstructive sleep apnea?)
- Respiratory compromise
- ASA-PS III or greater
- Young age, especially infants (birth to age 1 year)
- Severe anxiety
- Autism spectrum disorder
- Developmental delay

Zielinska Ped Anesth 2019;29:583–590

Preperation

Information and consent
- Patient and parents
- Risks
- Benefits
- Alternatives

Psychological preparation
- Developmental stage
- Expectations from parents

Requirements healthcare professionals:

Knowledge & skils
- Pediatric PSA drug pharmacology
- Assessment of children
- Monitoring of children
- Recovery care of children!
- Pediatric PSA complications:
  - advanced pediatric life support
  - **airway management**

Practical
- Effectively delivering PSA technique
- Using, interpreting, and responding to monitoring equipment
- Managing its complications
- Observing clinical signs in children
  - airway patency, breathing rate and depth, pulse, pallor and cyanosis, and depth of sedation
- Using, interpreting, and responding to monitoring equipment

Facilities and equipment

- Pulse-oximeter
- ECG
- NIBP
- Oxygen supply and delivery equipment
- Capnography

- Oral or nasopharyngeal airway
- Face masks and other suitable supraglotic airway devices
- Bag with self-inflating reservoir
- Endotracheal tubes & laryngeal masks
- Laryngoscope

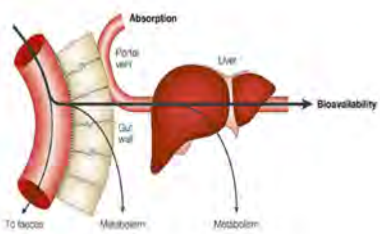
- **Suction device!**
- Emergency medication
  - atropine, epinephrine, dopamine, flumazenil, naloxone, muscle relaxant, neostigmine, local anesthetics, sugammadex, calcium, glucose 10%, balanced electrolyte solution
- Intravenous catheters/lines/infusion pumps
- Thermometer/active warming system
- **Easily available**: blood gas analysis, blood glucose measurements, intraosseous needles and defibrillator

Monitoring and documentation

Moderate sedation	Deep sedation
Pulse oximetry	Pulse oximetry
Heart rate	Heart rate
Respiratory rate	ECG
Strongly recommended:	Respiratory rate
ECG	Blood pressure
End-tidal carbon dioxide/ capnography	End-tidal carbon dioxide/ capnography

Needle free pharmaceutical methods : Routes of application

- Oral & rectal: bioavailability: 0-100%
  - Non-invasive?



Needle free pharmaceutical methods : Routes of application

- Oral & rectal
- **Nasal**
  - **Atomizer**
  - **Max: 0,3 ml per dose !!!**

Needle free pharmaceutical methods : Routes of application

- Oral & rectal
- **Nasal**
- **Buccal: swallow!**
- **Inhalation: nitrous oxide**
- Transdermal
  - Topical anesthesia for lacerations: lidocaine, adrenaline
  - Tissue adhesive for laceration repair: dermabond

Chloral hydrate (CH)

- Discovered in 1832, administered to children since 1869
- Most widely used: imaging studies
- Dose & onset time & duration of action
  - Oral & rectal: good absorption!
  - 50-100 mg/kg; 30-60 min; 2-8 h & 24 h
  - Elimination half-life:
    - Children: 4-12 h
    - Infants: 28 h
    - Preterm: 37h
- Side effects: oxygen desaturation
- Adverse event:
  - Case repots serious respiratory depression!
  - Significant motbidity and even death following procedural sedation
  - In patients with significant respiratory illness!
- Anesthesiologists: Do not use!
- Safe and short-acting alternatives

Midazolam

- **Oral, nasal, buccal**, rectal
- 0.25, 0.5, 0.75, or 1 mg/kg
- Onset time: 10-45 min
- Duration of action: 45-60 min
- Eliciting paradoxical reactions:
  - dysphoria, inconsolable violent crying, agitations, struggling needing restraint, disorientation, restlessness: 1-5%
- Non-responders, despite adequate plasma concentrations
- pH: 3.5! Acid and irritating!

  => Ozalin/ADV6209: wild orange & sucrose
  registered 2018 EU 6 – 17 yrs; 0,25 mg/kg

Williamson Drugs & Therapy Persp 2019

(Es-)Ketamine

- Bioactivity & dose:
  - Oral: 20%,
  - Rectal: 25%
  - Nasal: 50%; 0.5-2.0 - 5 mg/kg
- Analgesic!
- Side effects:
  - oxygen desaturation (90%)
- Adverse events: Hypersalivation, bradycardia, drowsiness, dysphoria/dissociation, unpleasant taste, dizziness, nausea/vomiting, vision changes, laryngospasm: 0.3%, apnea: 0.8%

Green Ann Emerg Med 2009
Alanazi Am J Emerg med 2022

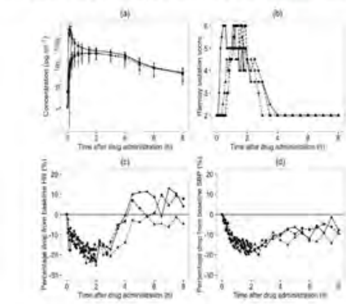
Dexmedetomidine

- Alpha 2 receptor agonist
- Bioactivity & dose & onset – duration time:
  - Oral: 16%
  - Buccal: 82%; 1-3 µg/kg; 20-40 min
  - Nasal: 65%; 1-3 µg/kg; 20-40 min
- Side effects
  - Bradycardia, desaturation,
  - Anticholinergic reactions
  - Easily wake up
- Contraindications: digoxin, beta blockers, amiodarone, calcium channel blockers or other medications predispose bradycardia or hypotension

Pharmacokinetic and pharmacodynamic study of intranasal and intravenous dexmedetomidine

A. Li, V. M. Yuen, S. Goulay-Dufay, Y. Sheng, J. F. Standing, P. C. L. Kwok, M. K. M. Leung, A. S. Leung, I. C. K. Wong and M. G. Irwin

British Journal of Anaesthesia, 120 (5): 960-968 (2018)



Nitrous oxide

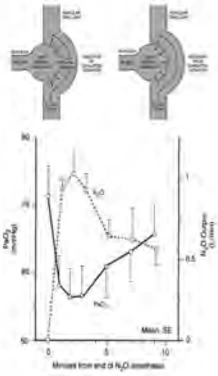
- Inhalation anesthetic: “laughing gas,”
- Discovered in 1772, first used in 1884 for dental extractions

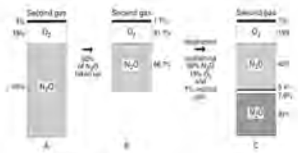
Nitrous oxide

- Inhalation anesthetic: “laughing gas,”
- Discovered in 1772, first used in 1884 for dental extractions
- Concentration effect => diffusion hypoxia!

Concentration effect (second gas effect) Diffusion hypoxia = Fink effect

Minimum: 30% oxygen & 70% N_2O
Entonox: 50% oxygen & 50% N_2O





Nitrous oxide

- Inhalation anesthetic: "laughing gas,"
- Second gas effect: diffusion hypoxia!
- Popular
  - pediatric dentists
  - Emergency room: fractures
- Success dependent on: temperament
- Lower success: mental disabilities
- Adverse events: vomiting!

Painful procedures in emergency room

- Distraction: telephone app / video/VR
- Inhalation Nitrous oxide
- (Es) ketamine: intranasal

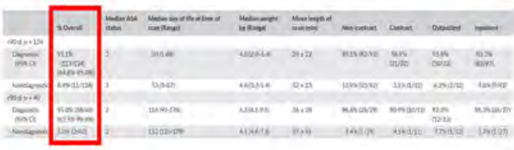
Radiologic procedures

- Distraction & education:
  - mock scanner: > 6 – 9 yrs
  - Feed and swaddle: < 6 months

ORIGINAL ARTICLE

Experience with a "Feed and Swaddle" program in infants up to six months of age

Leah B. Templeton[1] | Michael J. Norton[1] | Eduardo J. Goenaga-Díaz[1] | Douglas H. McLaughlin[1] | Michael E. Zapadka[2] | T. Wesley Templeton[1]

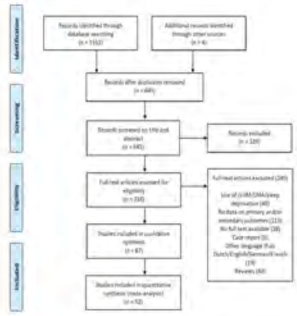


< 6 Months

Acta Anaesthesiol Scand. 2020;64:63–68.

Needle-free pharmacological sedation techniques in paediatric patients for imaging procedures: a systematic review and meta-analysis

Ingeborg de Rover, Jasper Wylleman, Jaap J. Dogger, Wichor M. Bramer, Sanne E. Hoeks and Jurgen C. de Graaff

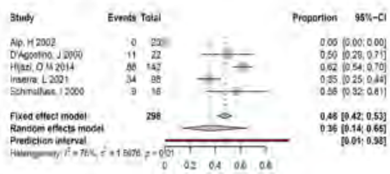


British Journal of Anaesthesia, 130 (1): 51e73 (2023)

Choral hydrate

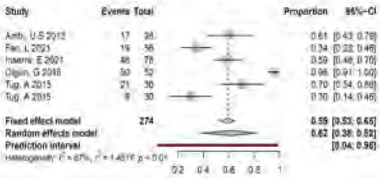
- pooled proportion of success of 0.94 (95% CI, 0.91-0.96)

Midazolam oral/IN/rectal



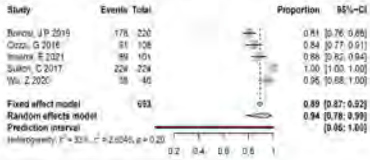
- Pooled proportion of success of 0.36 (95% CI, 0.14-0.65)
- Onset time was 53±41 minutes,
- Sedation lasted 59-76 minutes.
- Recovery time was reported as 113±48 minutes.

Dexmedetomidine IN: 2-4 µg/kg



- Pooled proportion of success of 0.62 (95% CI, 0.38-0.82)
- >20% decrease in baseline heart rate
- 10% experienced bradycardia
- 3% oxygen desaturation.

Dexmedetomidine: 3µg/kg & midazolam: 0.3mg/kg



- Pooled proportion of success: 0.94% (95% CI, 0.78-0.99)
- Onset time: 9-39 min.
- Sedation duration: 58-118 min.
- Recovery time: 61-91 min.
- Nausea and vomiting 2-5% — Hypotension: 3%
- Bradycardia in 6-8% — Oxygen desaturation: 3-5%,

Sevoflurane

- Pooled proportion of success of 0.98 (95% CI, 0.97-0.99)
- 1 MAC sevoflurane = anesthesia
- No proper airway management => not Safe

Do not use!

Conclusion Radiologic procedures

- Distraction & education: mock scanner & feed and swaddle
- Intranasal:
  - Dexmedetomidine 3µg/kg & midazolam 0.3 mg/kg
- IV contrast!
  - Selection of patients
- Parents love it!
- General anesthesia easier
  faster and 100% succes ☹

Conclusion:

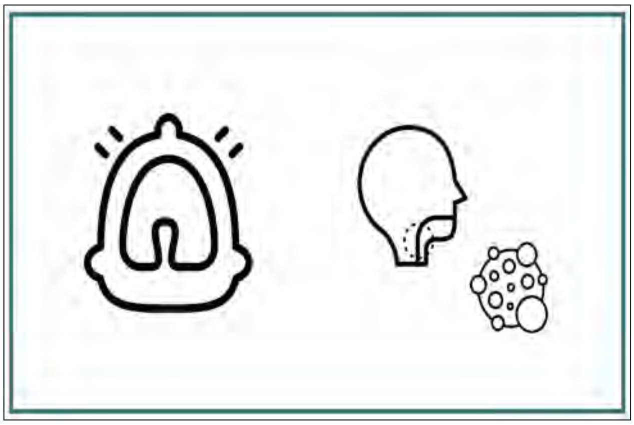
- Adequate medication
- Adequate dose
- Route of application
- Parents compliance!
- Full examination: airway
- Airway skills
- Adequate monitoring
- Adequate recovery facilities
- Adequate time

- Painful procedures
  Nitrous oxide
  IN: Esketamine 0.5-2mg/kg
- Radiologic procedures
  - < 6 months: feed & swadle
  - > 6 – 9 yrs: mock scanner
  Other ages
  - IN: Dexmedetomidine 3µg/kg & midazolam 0.3 mg/kg
  - (Sevoflurane + IV + LMA)

How to Deal with Challenging Sedation Cases

Eun-Young Joo

Asan Medical Center, Korea



CASE 1

- 15/M
- 166.5cm/50.4kg
- EEG for Epilepsy
- Known Autism
- No snoring or history of sleep apnea
- Recurrent Hx. of failed sedation
- PR 98 SpO_2 100% on Room air

- VIMA with Sevoflurane, accompanying security agents
- IM Dexmedetomidine 150mcg
- Total sedation time: 120 min
- Discharge without complication

CASE 2

- 10/M
- 124.3cm/23.5kg
- Whole body MRI for Neurofibromatosis
- s/p C2-6 Laminoplastic laminotomy
- Severe Craniovertebral and C4-5 kyphoscoliosis
- No snoring or history of sleep apnea
- 126/69 PR 48 SpO_2 96% on Room air
- Airway exam : Severely limited neck extension

- IV Dexmedetomidine 1.5mcg/kg loading for 10min
- IV Dexmedetomidine 1.5mcg/kg/hr continuous infusion
- O_2 4L/min by Oxymask
- BP, SpO_2, $ETCO_2$ monitoring
- Total scan time: 70 min
- PACU time: 20 min
- Discharge without complication

CASE 3

- 5/F
- 94cm/12.7kg
- Heart CT for FSV
- FSV s/p BCS
- OSAS considering CPAP
- Hx. of intubation failure d/t Trismus
- 99/63-84-28-82% on Room air
- Airway exam : mouth opening 1FB, retrognathia

- IV Propofol 12mg ivs
- Oral airway insertion → I-gel # 1.5 change
- BP, SpO_2, $ETCO_2$ monitoring
- Total scan time: 15min
- PACU time: 35 min (I-gel removal after 7 min of arrival)
- Discharge without complication

CASE 4

- 5/F
- 112.7cm/15.6kg
- Face MRI for Lymphangioma
- Being able to sleep only in a right-side lying position
- Hx. of failure of sedation d/t airway obstruction
- 122/82-101-24-98% on Room air
- Airway exam : Stridor (+), Mallampati's class IV

- IV Propofol 30mg + succinylcholine 30mg
- Intubation using Video laryngoscope with e-tube #4.5
- Maintenance : Sevoflurane + IV rocuronium 20mg
- BP, SpO_2, $ETCO_2$ monitoring
- Total scan time: 55 min
- Extubation at PICU (after 1hr of arrival)
- Discharge without complication

CASE 5

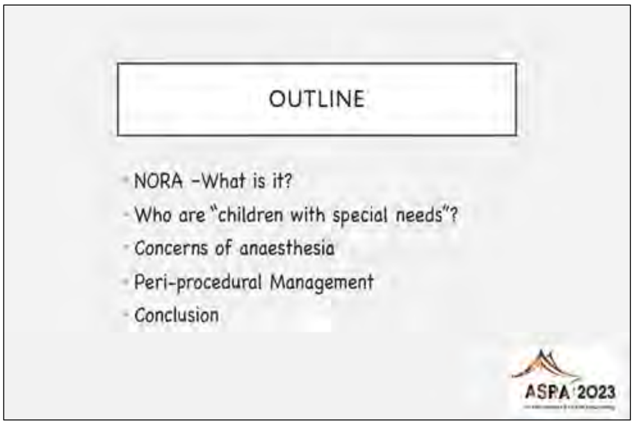
- 9/M
- 130cm/25kg
- Brain MRI for Brain abscess
- DORV, PA s/p BCS, s/p One and a half repair
- Lt. main bronchus stenosis
- SVC syndrome d/t BCS stenosis
- HF induced Protein losing enteropathy
- Home vent: Nasal iVAPS mode (EPAP 6cmH2O, O2 1L/min)
- 89/56-101-27-85%

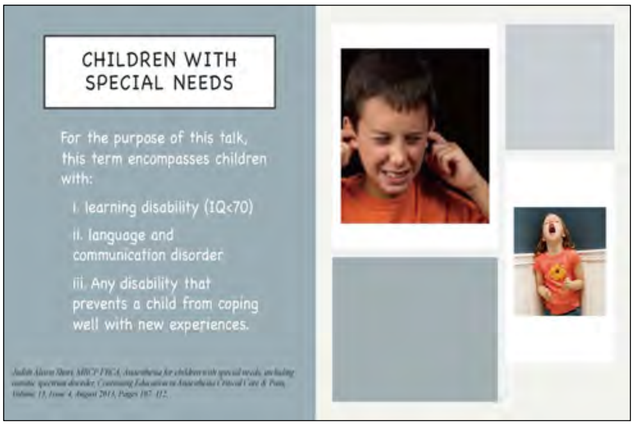
- Hx. of Apnea after sedation during Heart CT
- Performing Brain MRI without sedation
- Using Inroom Viewing Device
- Minimizing scanning time: about 15min
- Using Home vent with extended, non-magnetic device

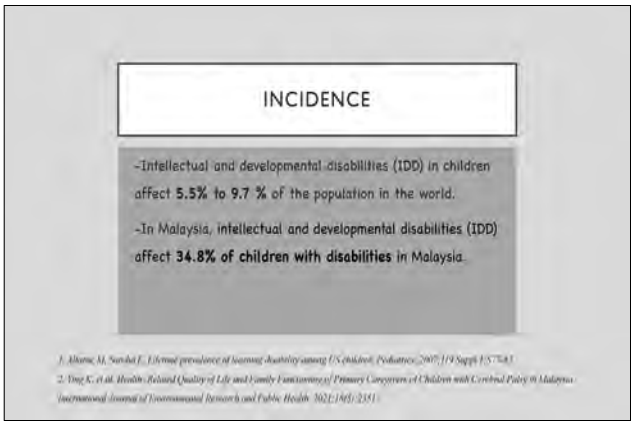
NORA for Children with Special Needs

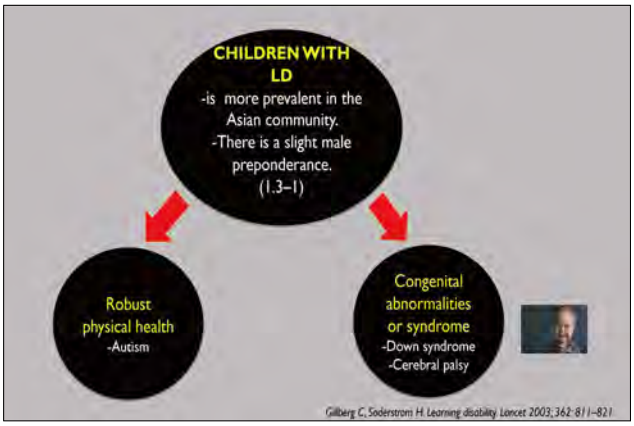
Ina Ismiarti Binti Shariffuddin

Department of Anaesthesiology, University Malaya, Malaysia









CHALENGES IN PATIENTS WITH SPECIAL NEEDS

- **Polypharmacy**
  - On stimulants and anti-psychotics.
    - Ritalin & Olanzepine
- **Psycho-social challenge:**
  - They may be very anxious
  - They may have **difficulty conforming** to the usual pattern of hospital care.

"Hospital attendance is often stressful"

ANAESTHESIA CONCERNS

Patient

- Frequently associated with multiple co-morbids that necessitates diagnostic imaging or therapeutic procedures
- Patients are often admitted as day case.

Table 4
Coexisting medical problems in learning disability

Condition	*Frequency*
Epilepsy	Up to 44% (42)
Psychiatric conditions	Up to 50% (31)
Eating disorders	– (31)
Self harming	– (31)
Attention deficit hyperactivity disorder	18% (32)
Schizophrenia	– (33)
Depression	– (34,35)
Sensory disorders	
Visual impairment	10x greater (36)
Hearing loss	40x greater (36)
Cerebral palsy	Common (5)
Miscellaneous	
Hypothyroidism	– (37)
Gastroesophageal reflux	49%(39)
Malignancies – stomach, gall-bladder, esophagus, thyroid, connective tissue	– (38)
Nonischemic cardiac disorders	– (40)
Poor dentition	– (41)

Difficult Airway

COURTMAN, S. P., & MUMBY, D. (2008). Children with learning disabilities. Pediatric Anesthesia, 18(3), 198–207.

WHO CAN BE TREATED IN NORA (DAY SURGERY SETTING)?

- The child should be well, with **only mild** and **well controlled comorbids***.
- Children with relatively complex needs, provided:
  - They are stable with **minimal cardiorespiratory problems***.
  - Do not have features of **difficult airway.**

**Royal College of Anaesthetists. Guideline for the provision of paediatric anaesthesia services. 2019. document-store/guidelines-the-provision-of-paediatric-anaesthesia-services-2019*

ANAESTHESIA CONCERNS

Environment

- Limited resuscitative and monitoring facilities.
- Cramped and congested work area.
- Low ambient temperature with risk of hypothermia in small babies.
- Inadequate space, monitoring facilities and trained staff at recovery bay.
- Unfamiliar working environment.

ANAESTHESIA CONCERNS

Personnel

- Lack of trained assistance to assist anaesthetist.
- The anaesthetist may not be familiar with the environment or the equipment provided.
- Lack of knowledge/expertise in handling patients with special needs.

PROBLEMS

Limitation of staff awareness

Inadequate training of staff about children with learning disability

Lack of suitable equipment & environment

Prolonged waiting times for operation date

Prolonged waiting on the day of operation

Lack of private space

Lack of non-invasive equipment

PRE-ADMISSION MANAGEMENT:

- Adopt a flexible and holistic approach to care
- Coordinate interventions required by multiple specialities
- Consider family's & patient's needs
- Collect Information over the phone to avoid preoperative admission anxiety

PRE-OPERATIVE MANAGEMENT:

Communication between staff and Family

-Ensure good communication

i. Clear plans & explanations

i. Staff should show empathy

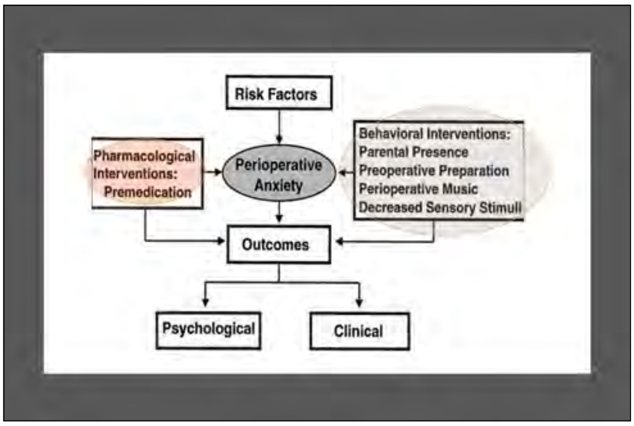
Individualized care within the hospital framework

-Health providers have to be flexible with standard protocols

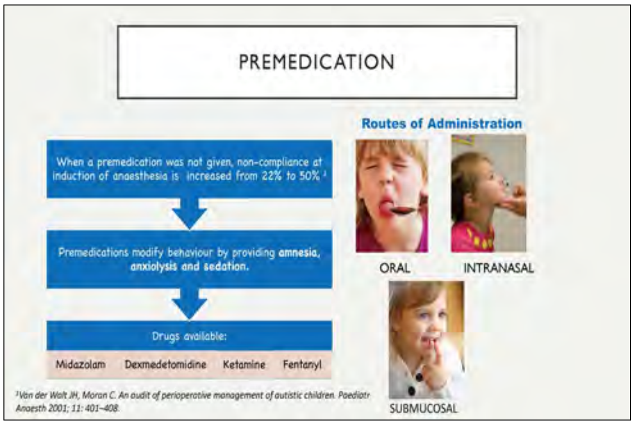
i. Avoiding unnecessary blood pressure measurements

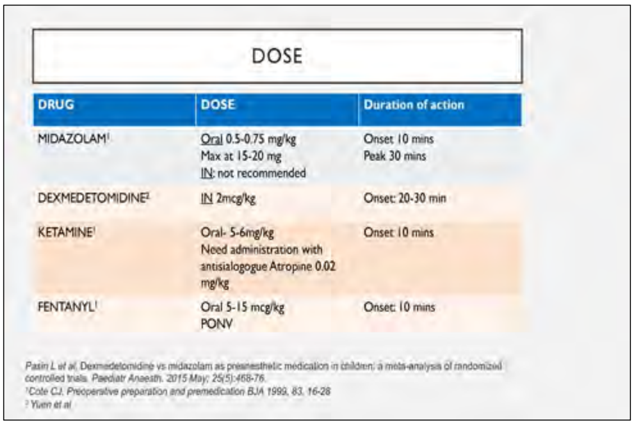
ii. Not changing into hospital gowns.

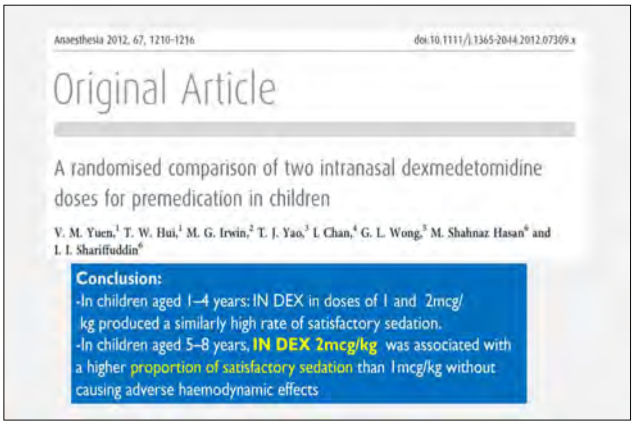

ANXIOUS IN UNFAMILIAR ENVIRONMENT

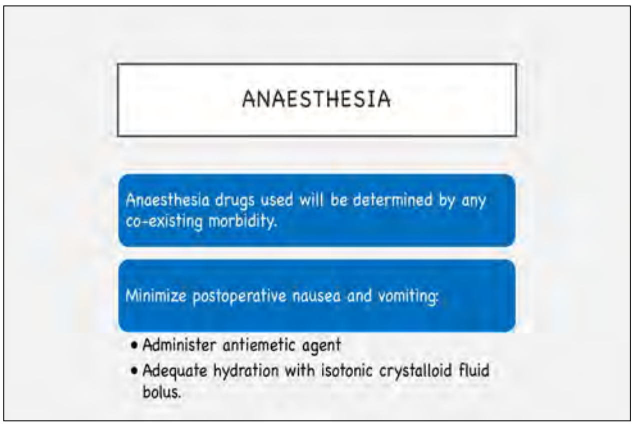

Risk Factors
Pharmacological Interventions: Premedication
Perioperative Anxiety
Behavioral Interventions:
Parental Presence
Preoperative Preparation
Perioperative Music
Decreased Sensory Stimuli
Outcomes
Psychological
Clinical


Supportive aids
Behavioral supports to calm the patients
Play therapist
Social stories

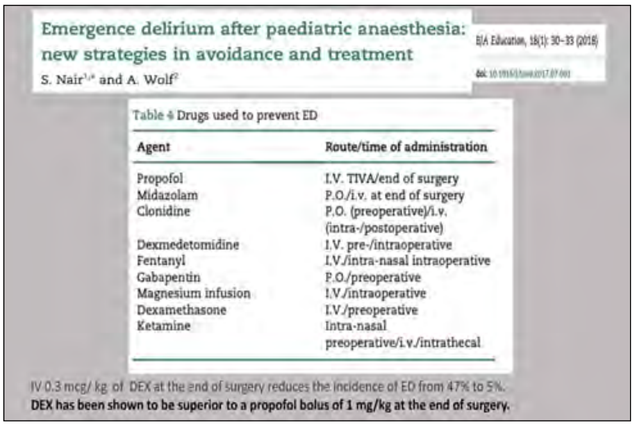

PREMEDICATION
When a premedication was not given, non-compliance at induction of anaesthesia is increased from 22% to 50% ¹
Premedications modify behaviour by providing amnesia, anxiolysis and sedation.
Drugs available:
Midazolam Dexmedetomidine Ketamine Fentanyl
¹Van der Walt JH, Moran C. An audit of perioperative management of autistic children. Paediatr Anaesth 2001; 11: 401–408.
Routes of Administration
ORAL
INTRANASAL
SUBMUCOSAL


DOSE
DRUG | DOSE | Duration of action
MIDAZOLAM¹ | Oral 0.5-0.75 mg/kg Max at 15-20 mg IN: not recommended | Onset 10 mins Peak 30 mins
DEXMEDETOMIDINE² | IN 2mcg/kg | Onset: 20-30 min
KETAMINE¹ | Oral- 5-6mg/kg Need administration with antisialogogue Atropine 0.02 mg/kg | Onset 10 mins
FENTANYL¹ | Oral 5-15 mcg/kg PONV | Onset: 10 mins
Pasin L et al. Dexmedetomidine vs midazolam as preanesthetic medication in children: a meta-analysis of randomized controlled trials. Paediatr Anaesth. 2015 May; 25(5):468-76.
¹Cote CJ. Preoperative preparation and premedication BJA 1999, 83, 16-28
² Yuen et al


Anaesthesia 2012, 67, 1210-1216
doi:10.1111/j.1365-2044.2012.07309.x
Original Article
A randomised comparison of two intranasal dexmedetomidine doses for premedication in children
V. M. Yuen,1 T. W. Hui,1 M. G. Irwin,2 T. J. Yao,3 L Chan,4 G. L. Wong,5 M. Shahnaz Hasan6 and I. I. Shariffuddin6
Conclusion:
-In children aged 1–4 years: IN DEX in doses of 1 and 2mcg/kg produced a similarly high rate of satisfactory sedation.
-In children aged 5–8 years, IN DEX 2mcg/kg was associated with a higher proportion of satisfactory sedation than 1mcg/kg without causing adverse haemodynamic effects


ANAESTHESIA
Anaesthesia drugs used will be determined by any co-existing morbidity.
Minimize postoperative nausea and vomiting:
• Administer antiemetic agent
• Adequate hydration with isotonic crystalloid fluid bolus.


ANALGESIA
Simple analgesics should be adequate.
Be aware of sensitivity of certain syndromes with opioids.
ASPA 2023


Emergence delirium after paediatric anaesthesia: new strategies in avoidance and treatment

S. Nair[1,*] and A. Wolf[2]

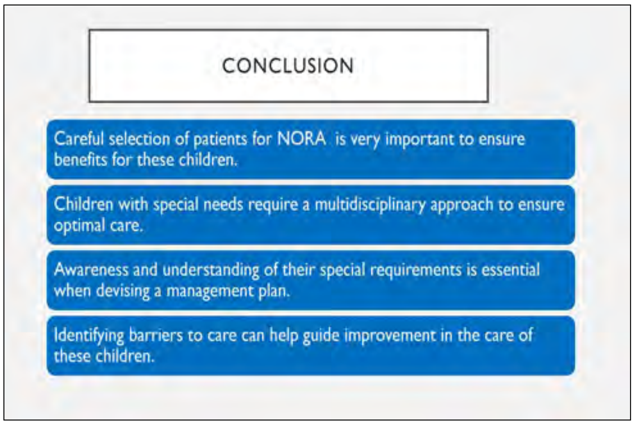
BJA Education, 18(1): 30–33 (2018)

Table 4 Drugs used to prevent ED

Agent	Route/time of administration
Propofol	I.V. TIVA/end of surgery
Midazolam	P.O./i.v. at end of surgery
Clonidine	P.O. (preoperative)/i.v. (intra-/postoperative)
Dexmedetomidine	I.V. pre-/intraoperative
Fentanyl	I.V./intra-nasal intraoperative
Gabapentin	P.O./preoperative
Magnesium infusion	I.V./intraoperative
Dexamethasone	I.V./preoperative
Ketamine	Intra-nasal preoperative/i.v./intrathecal

IV 0.3 mcg/ kg of DEX at the end of surgery reduces the incidence of ED from 47% to 5%.

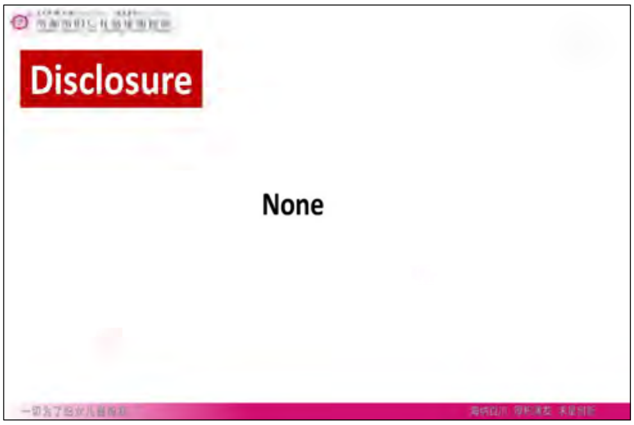
DEX has been shown to be superior to a propofol bolus of 1 mg/kg at the end of surgery.

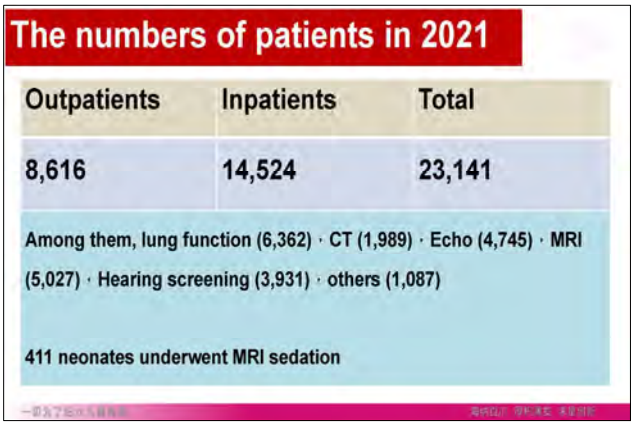


Neonatal Sedation for MRI

Yu Cui

Chengdu Women and Children's Central Hospital, China

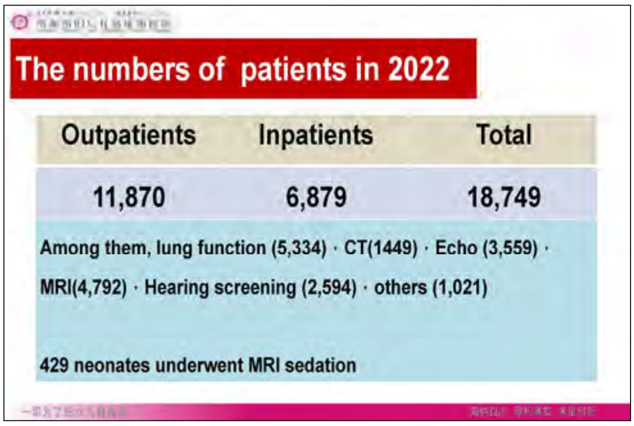




Outpatients	Inpatients	Total
8,616	14,524	23,141

Among them, lung function (6,362) · CT (1,989) · Echo (4,745) · MRI (5,027) · Hearing screening (3,931) · others (1,087)

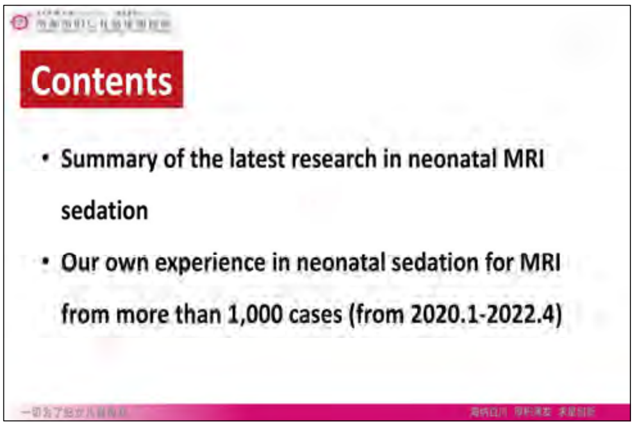
411 neonates underwent MRI sedation



Outpatients	Inpatients	Total
11,870	6,879	18,749

Among them, lung function (5,334) · CT(1449) · Echo (3,559) · MRI(4,792) · Hearing screening (2,594) · others (1,021)

429 neonates underwent MRI sedation



A survey from Italian Society of Pediatric and Neonatal Anesthesia (SARNePI)

- 106 institutions met minimal criteria for MRI procedures on pediatric patients
- To NICU neonates, 53 centers performed less than 3 MRI procedures per week, while 12 centers performed more than 3 procedures MRI per week.

Table 5 [illegible]

Sedation in NICU centers n. 65			
Drug Sedation	Yes n. 43 (66%)		None n. 22 (34%)
	[illegible]	[illegible]	
	[illegible]	[illegible]	
Pharmacological premedication	Yes n. 8 (18%)		None n. 57 (82%)
	[illegible]		
Airway devices	Endotracheal Tube n. 4 (9%)	Laringeal Mask n. 3 (7%)	External device n. 36 (84%)

[illegible]

Sbaraglia F, Spinazzola G, Adduci A, et al. Children and neonates anesthesia in magnetic resonance environment in Italy: an active call survey. BMC Anesthesiol. 2022;22(1):279. doi:10.1186/s12871-022-01821-3

A survey from North American physician members of the Society

- The final results represented 59 institutions from 26 U.S. states, the District of Columbia and three Canadian provinces.
- In neonates undergoing MRI, 46% of respondents reported attempting feed and bundle in all patients , with most (35%) using a single swaddling attempt before sedation.
- Sedation was most often used for neonatal interventional procedures (93%).
- More than half of respondents (63%) reported an average success rate of greater than 50% when using neonatal sedation for MRI.

Hwang M, Barton K, Kim JS, et al. Utilization of neonatal sedation and anesthesia: an SPR survey. Pediatr Radiol. 2022;52(13):2630-2635. doi:10.1007/s00247-022-05423-6

Can we reduce anesthesia exposure? Neonatal brain MRI: Swaddling vs. sedation, a national survey

- This is a national survey of NICUs in the United States with a Neonatology Fellowship Program.
- The questions were as follows, including sedation, GA, and swaddling without medication.

Heller BJ, et al. Can we reduce anesthesia exposure? Neonatal brain MRI: Swaddling vs. sedation, a national survey. J Clin Anesth. 2017;38:119-122. doi:10.1016/j.jclinane.2017.01.034

- In the feed and swaddle group, 81% reported that a failure to obtain useful images occurred < 25%; 11% reported that it occurred 25–75%; and 5% reported that it occurred>75%.
- In the drug sedation and GA group, 100% reported failure to obtain useful images occurred rarely.

Drug sedation

Midazolam

Sedative effect of intranasal midazolam in neonates undergoing MRI

- A total of 70 neonates were randomized into an observation group and a control group, with 35 cases in each group.
- The observation group received intranasal drops of midazolam (0.3 mg/kg), and the control group received intramuscular injection of phenobarbital sodium (10 mg/kg).
- Ramsay sedation scores are as follows.

Group	10min	20min	30min	40min	50min	60min	70min
Phenobarbital	2.8±0.6	3.0±0.6	3.4±0.6	3.4±0.8	3.4±0.8	3.3±0.9	3.2±1.0
Midazolam	3.5±0.8	3.9±0.5	3.7±0.7	3.7±0.8	3.6±0.9	3.5±1.0	3.3±1.1
P values	<0.001	<0.001	0.020	0.206	0.419	0.398	0.735

Wang FH, et al. Sedative effect of intranasal midazolam in neonates undergoing magnetic resonance imaging: a prospective single-blind randomized controlled study. Zhongguo Dang Dai Er Ke Za Zhi. 2020;22(5):441-445.

Dexmedetomidine

Intranasal administration is an alternative route explored.

53 neonates (at ≤32 weeks of gestation or with a birth weight of ≤1500 g)

The historical midazolam group received sedation with boluses of intranasal (0.1-0.2 mg/kg) or intravenous (0.05-0.1 mg/kg) midazolam.

The dexmedetomidine sedation group received a single dose of intranasal dexmedetomidine 3ug/kg, with intranasal or intravenous midazolam as rescue therapy.

The report shows that dexmedetomidine spares the use of midazolam in preterm neonates undergoing MRI at term equivalent age.

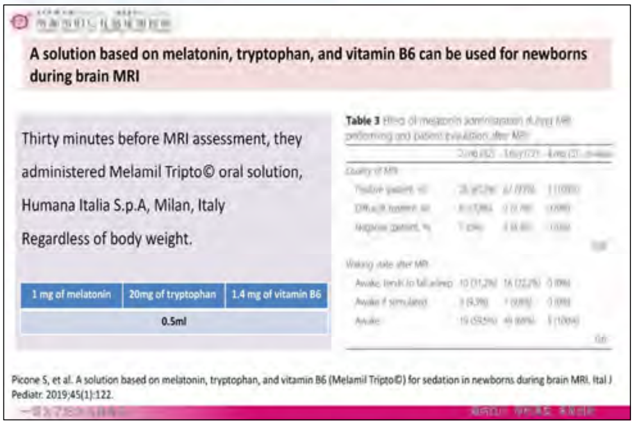
Bua J, et al. Intranasal dexmedetomidine, as midazolam-sparing drug, for MRI in preterm neonates. Paediatr Anaesth. 2018;28(8):747-748.

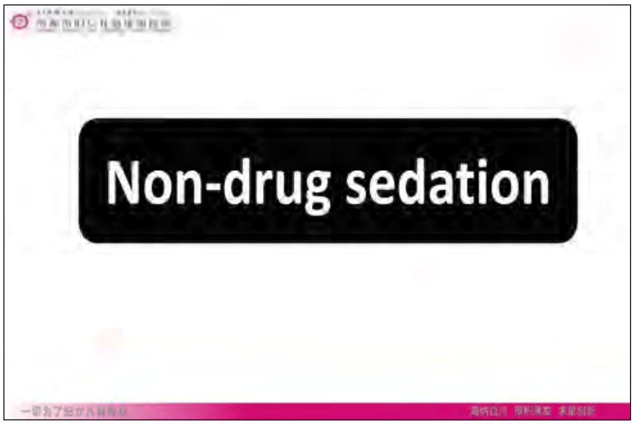
Sevoflurane

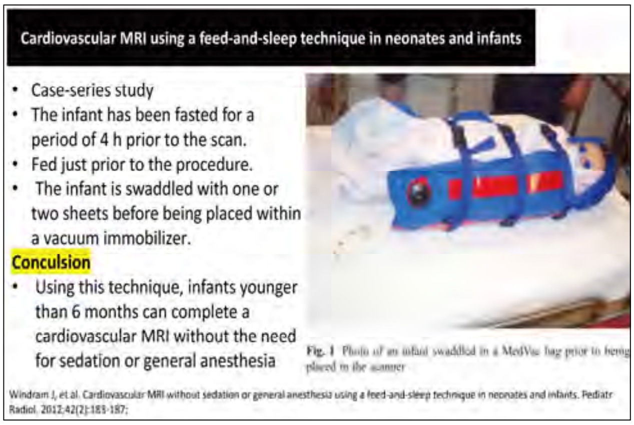
Advantages	Disadvantages
A sevoflurane concentration of approximately 1.5–2% can provide a success rate of 97.9%.	0.4% severe airway-related adverse events, and 0.2% had severe respiratory apnea.

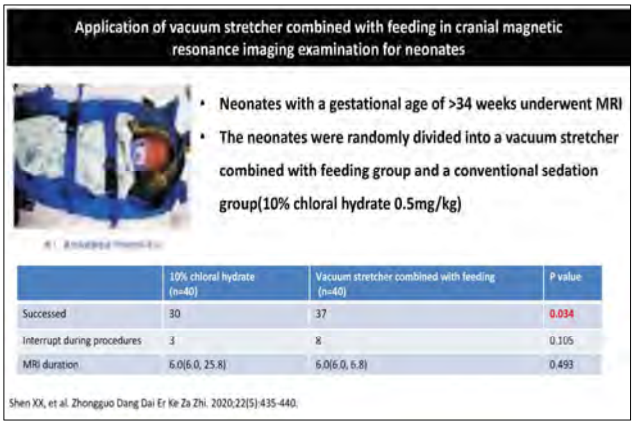
De Sanctis Briggs V. Magnetic resonance imaging under sedation in newborns and infants: a study of 640 cases using sevoflurane. Paediatr Anaesth. 2005;15(1):9-15.

Lei H, et al. Serious airway-related adverse events with sevoflurane anesthesia via facemask for magnetic resonance imaging in 7129 pediatric patients: A retrospective study. Paediatr Anaesth. 2019;29(6):635-639

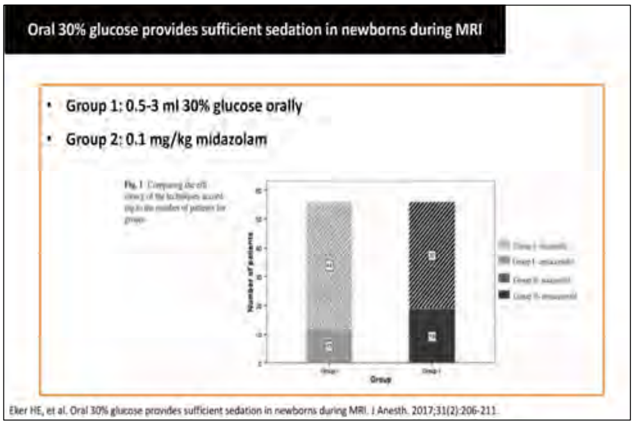


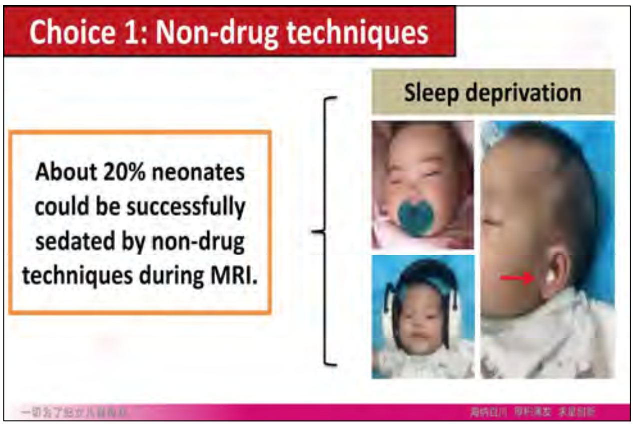


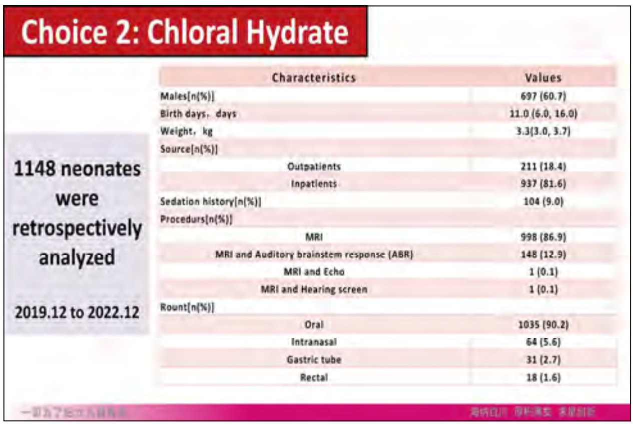




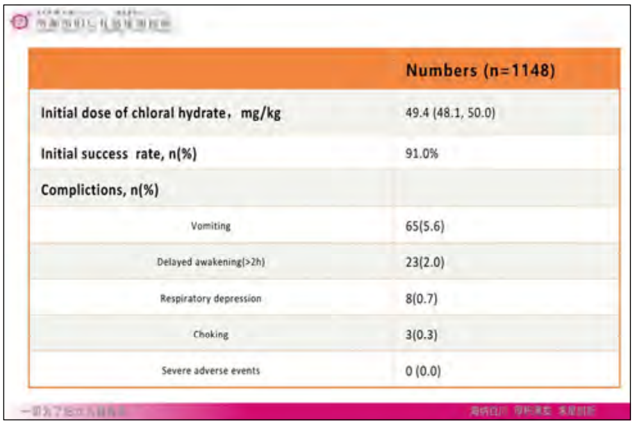
	10% chloral hydrate (n=40)	Vacuum stretcher combined with feeding (n=40)	P value
Successed	30	37	0.034
Interrupt during procedures	3	8	0.105
MRI duration	6.0(6.0, 25.8)	6.0(6.0, 6.8)	0.493



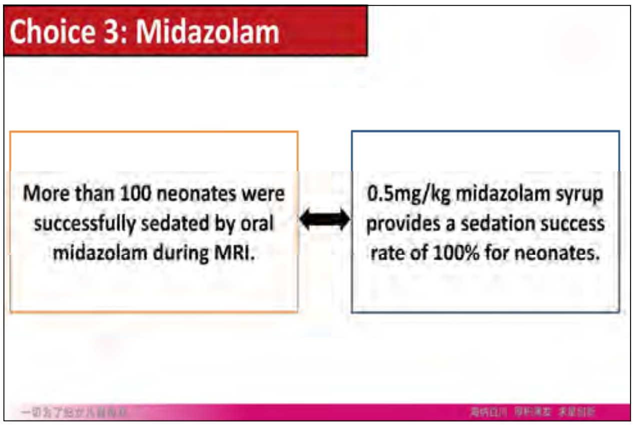




Characteristics	Values
Males[n(%)]	697 (60.7)
Birth days，days	11.0 (6.0, 16.0)
Weight，kg	3.3(3.0, 3.7)
Source[n(%)]	
Outpatients	211 (18.4)
Inpatients	937 (81.6)
Sedation history[n(%)]	104 (9.0)
Procedurs[n(%)]	
MRI	998 (86.9)
MRI and Auditory brainstem response (ABR)	148 (12.9)
MRI and Echo	1 (0.1)
MRI and Hearing screen	1 (0.1)
Rount[n(%)]	
Oral	1035 (90.2)
Intranasal	64 (5.6)
Gastric tube	31 (2.7)
Rectal	18 (1.6)



	Numbers (n=1148)
Initial dose of chloral hydrate，mg/kg	49.4 (48.1, 50.0)
Initial success rate, n(%)	91.0%
Complictions, n(%)	
Vomiting	65(5.6)
Delayed awakening(>2h)	23(2.0)
Respiratory depression	8(0.7)
Choking	3(0.3)
Severe adverse events	0 (0.0)



Session 4.

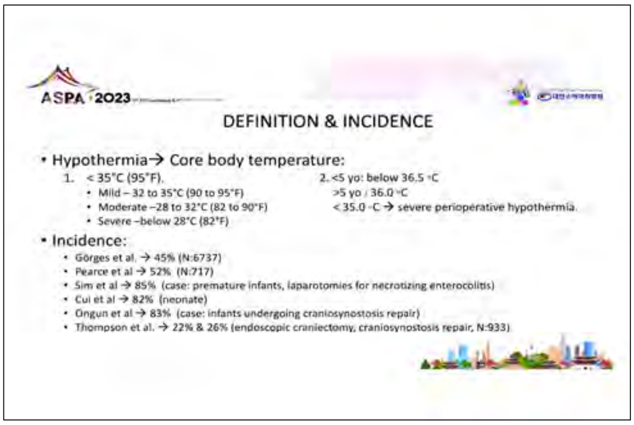
Perioperative Concerns in Pediatric Anesthesia

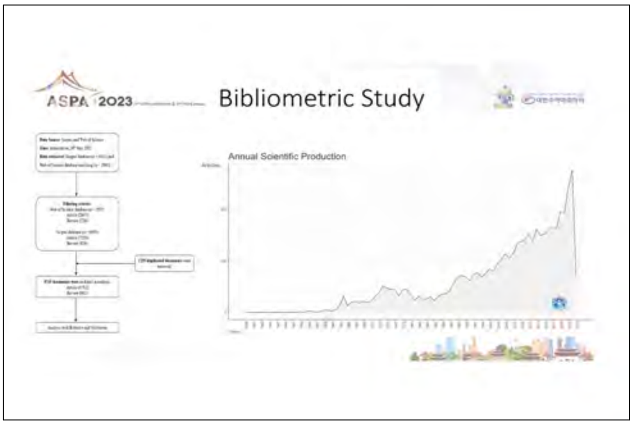
Chair(s): Tae-Hun Ahn (Korea)
Woo Suk Chung (Korea)

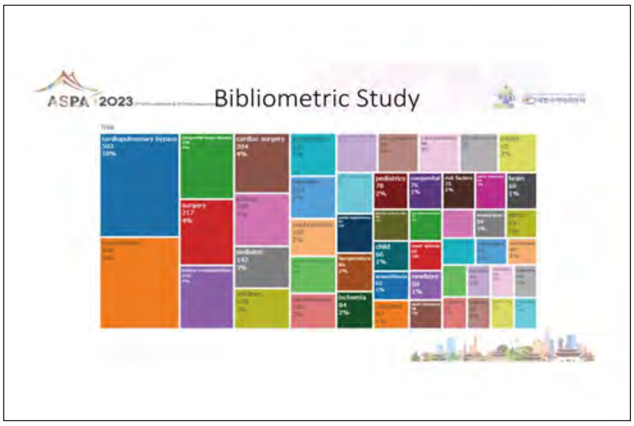
Perioperative Hypothermia in Children: Risk Factor and Preventive Strategy

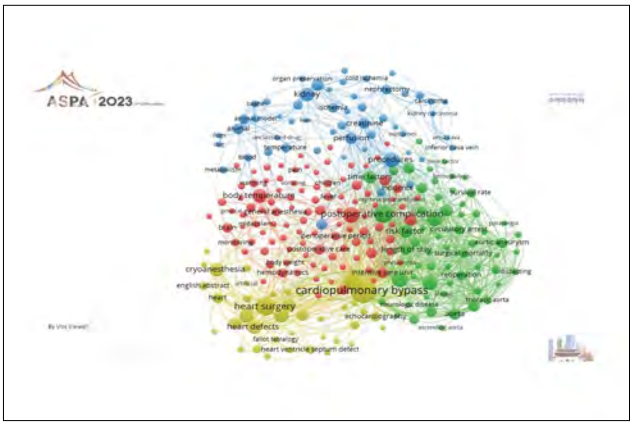
Djayanti Sari

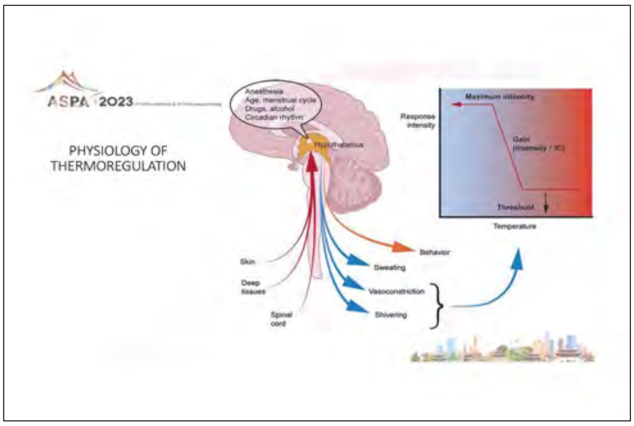
Universitas Gadjah Mada, Indonesia

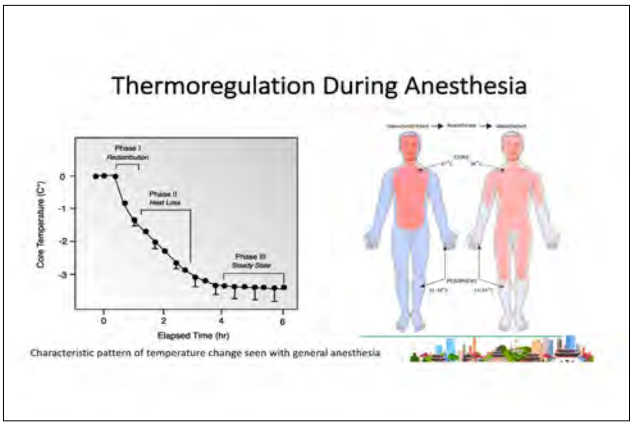


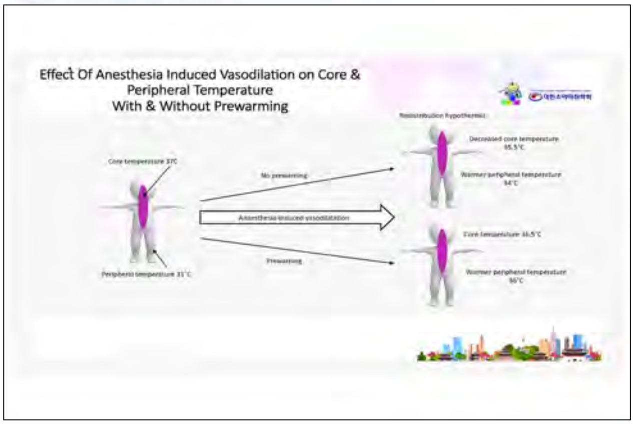


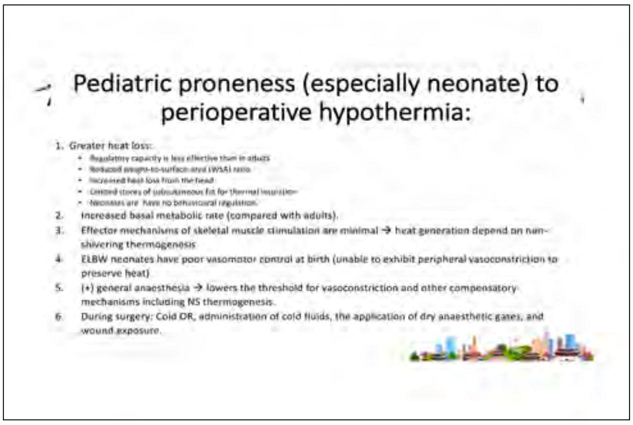


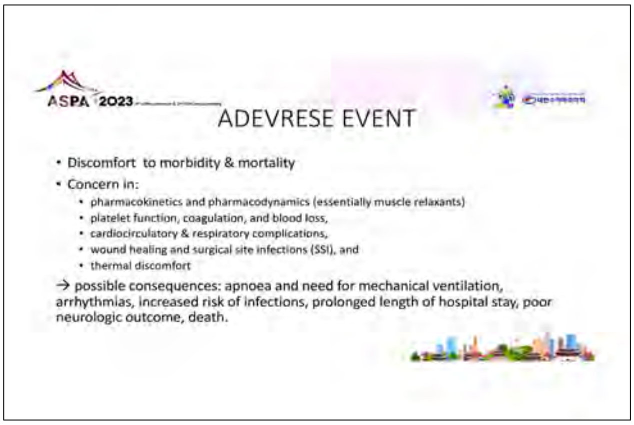


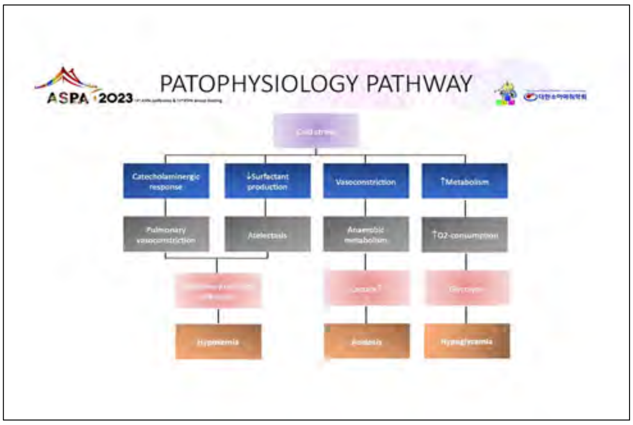


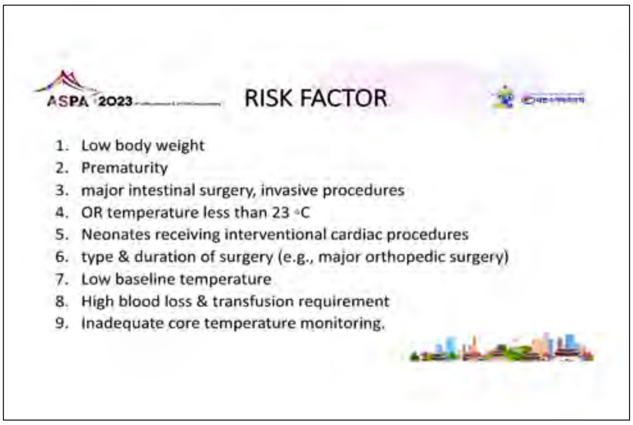












Pre-OP	Intra-OP (General Anaesthesia)	Post-OP
• Oral, axillary (rectal) • (Tympanic)	Continuous methods: • Oesophageal • Nasopharyngeal • Non-invasive methods based on ZHF technology • Bladder, rectal	Serial measurements: • Oral, axillary (rectal) • (Tympanic) • Hypothermic patients: Continuous methods, e.g., non-invasive methods based om ZHF technology • Intubated patients: see Intra-OP

Evidence-based Studies on Methods for Preventing Hypothermia

Author(s)	Study Type	Number of Cases	Method	Result
Lars Witt et al. (2013)	Prospective multicenter observational study	190	Intraoperative Hot Air Blown System	Decrease in unwanted hypothermia
Wong et al. (2007)	RCC	103	Preoperative period	Decrease unwanted hypothermia carbon polymer bed reduced blood loss
Leeth et al. (2010)	RCC	105	Postoperative period; hot air blowing system	Body temperature is the same amount of increase in thermal comfort, cost reduction
De Witte et al. (2010)	RCC	26	Preoperative period; carbonfiber blanket body temperature increase	Postoperative period; hot air blown
Hooven (2011)	Cohort	149	Postoperative period; hot air blowing system	An increase in body temperature

PREVENTION & MANAGEMENT

1. Warming Therapy during Transport
   - Dressed for as long as possible & covered with blankets, (optional) a warming pad
   - Ideally: prewarmed bed, provided with radiant heater or warming mattress.
   - Especially preterm infants & neonates → warmed incubator.
   - Keep incubator plugged in during the surgical procedure
2. Warming before Induction of Anesthesia
   - OR 'warm' enough → In general, a room temperature:
     - 32 °C for neonates
     - 24 °C and 30 °C for infants.
   - start active warming therapy before induction of anesthesia.

3. Warming Therapy during Anesthesia
   - active warming therapy must be continued
   - Irrigation solutions should be warmed to body temperature.
4. Infusion Warming
   - warm fluids and blood products with a blood and fluid warmer
   - Concern: length of the infusion tubing
5. Warming Therapy after Anesthesia
   - extubation should not be performed when children are hypothermic.
   - If hypothermic → should be rewarmed during anesthesia & then extubated.
   - Postoperative phase: core temperature should be measured regularly

CONCLUSION

- Pediatric today still often become hypothermic, due to their vulnerable physiology & insufficient perioperative hypothermia prevention/management.
- A good perioperative prevention strategy must be planned.
- With risk identification, good monitoring and prevention, It is possible to avoid perioperative hypothermia .

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Emergence Agitation & Long Term Behavioral Consequences

Agnes Ng

KK Women's and Children's Hospital, Singapore

AGITATION (symptom)
DSM-5 "excessive motor activity associated with a feeling of inner tension.

Unpleasant state of extreme arousal (stirred up or excited), increase tension and irritability

Pain, Hunger, Physiological compromise,
or
Fear or Anxiety, absence of a primary caregiver or unfamiliar surroundings

DSM-5
Diagnostic and Statistical Manual of the American Psychiatric Association (DSM-5)

A. **Disturbance in *attention*** (i.e., reduced ability to direct, focus, sustain, and shift attention) and **awareness** (reduced *orientation to the environment*).

B. The disturbance develops over a short period of time (usually hours to a few days), ***represents an acute change from baseline attention and awareness,*** and tends to fluctuate in severity during the course of a day.

C. An additional **disturbance in cognition** (e.g. memory deficit, disorientation, language, visuospatial ability, or perception).

D. [illegible]

E. [illegible]

Emergence Delirium

Mental disturbance during recovery
- Dissociated state of unconsciousness
- Altered cognitive perception
- Agitated behaviour

Incidence and Etiology of Postanesthetic Excitement: Clinical Survey
James E. Eckenhoff et al Anesthesiology 1961

Excitement: Restlessness, disorientation, crying, moaning or irrational talking,

Delirium: Wild thrashing, shouting and screaming

Incidence 5.3% in 14,436 patients; adults and children (12-13%),

Contributing factors:
- Age (3-9 yr)
- ASA 1
- Premed: barbiturate and scopolamine premed
- Cyclopropane or ether anesthesia
- Operative procedures associated with pain or emotional stress

Emergence Delirium

- Has been described with every anaesthetic agent (especially ether and cyclopropane)
- Decreased markedly with halothane
- Incidence EXPLODED with sevoflurane (& desflurane)

What parents
Say: "whatever I did, didn't help….please take him away and give me my child back"

Describe: "the devil having jumped into him – he was pitch black"

Experience: "fear and insecurity, feelings of powerlessness and guilt

Wells & Rasch Anesth Analg 1999;88:1308-10
Ringblom Scand J Caring Sci 2022;36:1104-1112

Emergence Delirium

Generally self limiting

- May result in physical harm to patient & caregiver
- Dislodgement of drains & IV sites
- Pain and bleeding of surgical sites
- Distressing to all

Why incidence varies?

PAED Scale

1 The child makes eye contact with the caretaker
2. The child's action are purposeful
3. The child is aware of his surroundings
(implies consciousness & cognition)

0= extremely
1= very much
2= quite a bit
3= just a little
4= not at all

4. *The child is restless*
5. *The child is in inconsolable*
(reflects psychomotor behaviour & emotion
e.g. pain or apprehension)

0= not at all
1= just a little
2= quite a lot
3 = very much
4 = extremely

Development and Psychometric Evaluation of the Pediatric Anesthesia Emergence Delirium Scale

Nancy Sikich, M.Sc., R.N.,* Jerrold Lerman, B.A.Sc., M.D., F.R.C.P.C., F.A.N.Z.C.A.†

Cravero Emergence Agitation scale	
Level	Description
1	Obtunded with no response to stimulation
2	Asleep but responsive to movement or stimulation
3	Awake and responsive
4	*Crying (>3 minutes)*
5	*Thrashing behaviour that requires restraint*

Watcha Behavior scale for emergence delirium	
Level	Description
1	Calm
2	Crying, but can be consoled
3	*Crying, cannot be consoled*
4	*Agitated and thrashing around*

- All three scales correlated reasonably well with each other
- PAED score >12 appears to provide greater sensitivity and specificity than a PAED score ≥10.
- Watcha scale appears to be a practical tool to use and assess ED in the PACU

Hypoactive Delirium

ICU-delirium

Quiet, confused, disorientated, no eye contact

Minimal movements when awake, non-communicative and do not respond to social interaction

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RESEARCH REPORT — WILEY

An observational study of hypoactive delirium in the post-anesthesia recovery unit of a pediatric hospital

Paul F. Lee-Archer[1,2,3] | Britta S. von Ungern-Sternberg[4,5,6] | Michael C. Reade[2] | K.C. Law[3] | Deborah Long[3,7]

Pediatric Anesthesia. 2021;31:429–435.

The Cornell Assessment of Pediatric Delirium (CAP-D) was developed as an adaptation and extension of the PAED scale and is a rapid screening tool for pediatric delirium in the hospital setting (Figure 1). The additional items that are included to assess hypoactive delirium are as follows:

1. Does the child communicate needs and wants?
2. Is the child underactive—very little movement while awake?
3. Does it take the child a long time to respond to interactions?

PAED detected 57 cases
CAP-D 74 cases 1.7%
57 cases using PAED
17 (23%) represent cases of hypoactive ED

Significance yet to be explored

Clinical implications

What is already known about this topic

What this study adds

Emergence Delirium lead to long term Psychological Harm?

- Higher risk
- Less neurocognitive reserves

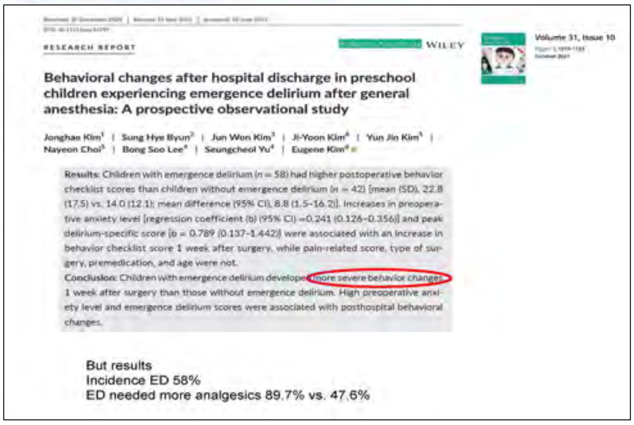
Long term effects of ED

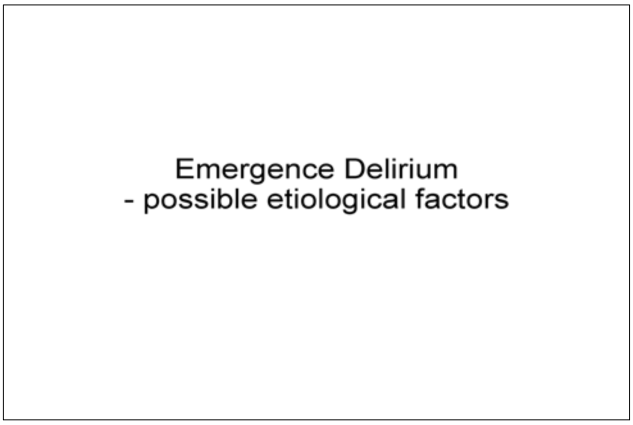
Maladaptive behaviour

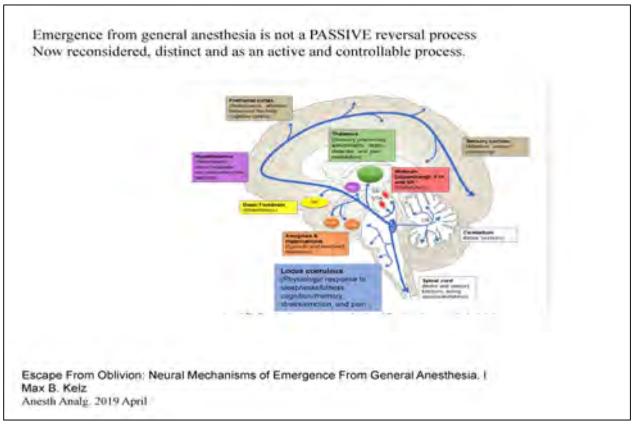
e.g. general anxiety, night-time crying, enuresis, sleeping and eating problems

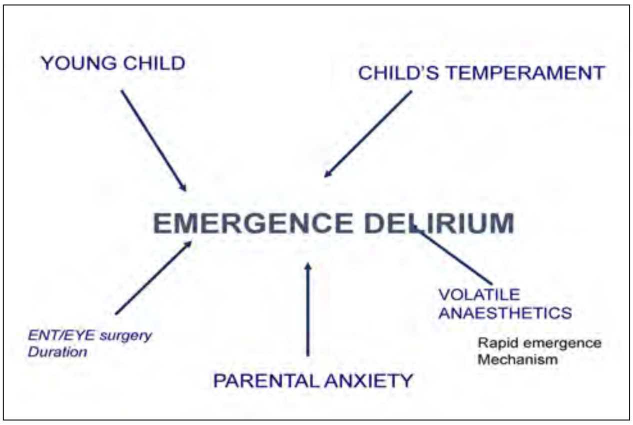
- 10 point increase of state anxiety scores increases odds by 10% of having marked ED and 12.5% one or more new onset post-op maladaptive behaviour changes
- Parents at high risk of preoperative anxiety, ED and maladaptive behaviour are more anxious in the holding area
- Children with marked ED OR 1.43 having one or more new onset post-op maladaptive behaviour changes

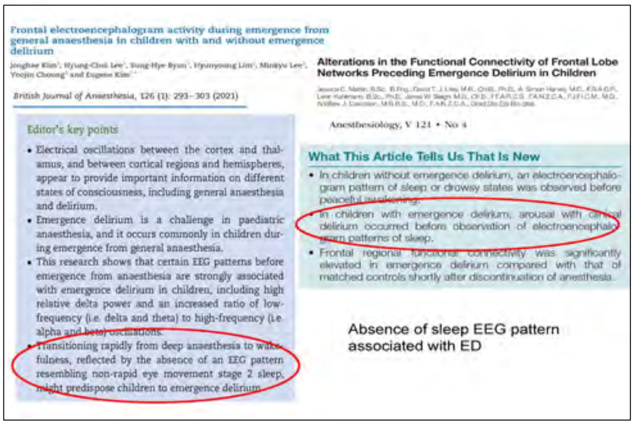
Kain et al Anesth Analg 2004;99:1648-54

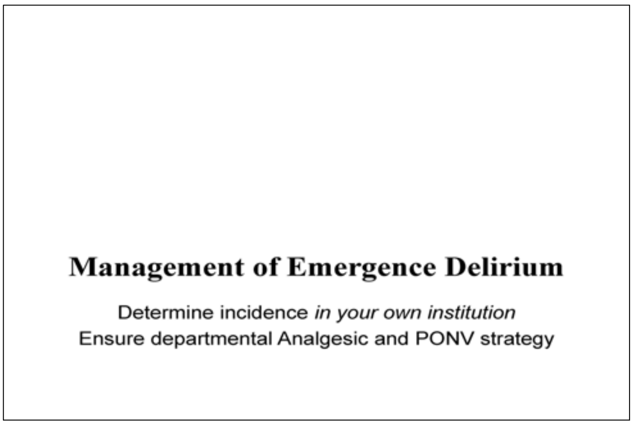

RESEARCH REPORT
WILEY
Volume 31, Issue 10
Behavioral changes after hospital discharge in preschool children experiencing emergence delirium after general anesthesia: A prospective observational study
Jonghae Kim[1] | Sung Hye Byun[2] | Jun Won Kim[3] | Ji-Yoon Kim[4] | Yun Jin Kim[5] | Nayeon Choi[5] | Bong Soo Lee[4] | Seungcheol Yu[4] | Eugene Kim[4]
Results: Children with emergence delirium (n = 58) had higher postoperative behavior checklist scores than children without emergence delirium (n = 42) [mean (SD), 22.8 (17.5) vs. 14.0 (12.1); mean difference (95% CI), 8.8 (1.5–16.2)]. Increases in preoperative anxiety level [regression coefficient (b) (95% CI) =0.241 (0.126–0.356)] and peak delirium-specific score (b = 0.789 (0.137–1.442)) were associated with an increase in behavior checklist score 1 week after surgery, while pain-related score, type of surgery, premedication, and age were not.
Conclusion: Children with emergence delirium developed more severe behavior changes 1 week after surgery than those without emergence delirium. High preoperative anxiety level and emergence delirium scores were associated with posthospital behavioral changes.
But results
Incidence ED 58%
ED needed more analgesics 89.7% vs. 47.6%

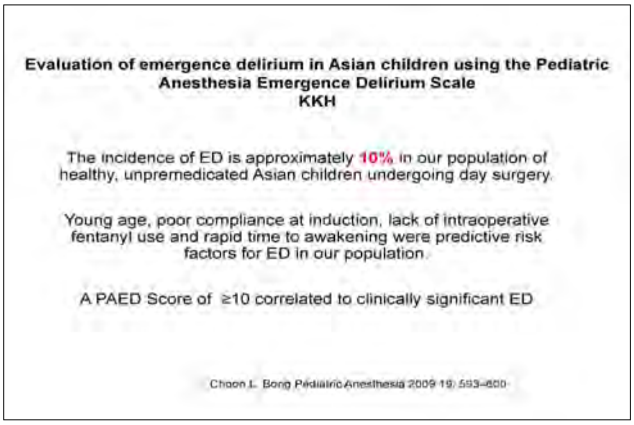

Emergence Delirium
- possible etiological factors

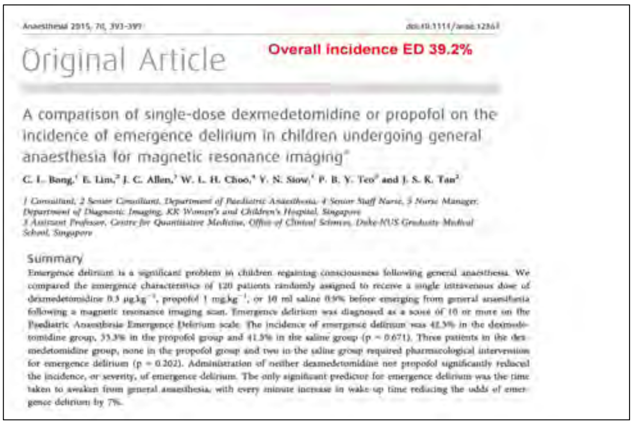

Emergence from general anesthesia is not a PASSIVE reversal process
Now reconsidered, distinct and as an active and controllable process.
Escape From Oblivion: Neural Mechanisms of Emergence From General Anesthesia. I
Max B. Kelz
Anesth Analg. 2019 April


YOUNG CHILD
CHILD'S TEMPERAMENT
EMERGENCE DELIRIUM
ENT/EYE surgery
Duration
PARENTAL ANXIETY
VOLATILE
ANAESTHETICS
Rapid emergence
Mechanism


Frontal electroencephalogram activity during emergence from general anaesthesia in children with and without emergence delirium
British Journal of Anaesthesia, 126 (1): 293–303 (2021)
Editor's key points
• Electrical oscillations between the cortex and thalamus, and between cortical regions and hemispheres, appear to provide important information on different states of consciousness, including general anaesthesia and delirium.
• Emergence delirium is a challenge in paediatric anaesthesia, and it occurs commonly in children during emergence from general anaesthesia.
• This research shows that certain EEG patterns before emergence from anaesthesia are strongly associated with emergence delirium in children, including high relative delta power and an increased ratio of low-frequency (i.e. delta and theta) to high-frequency (i.e. alpha and beta) oscillations.
• Transitioning rapidly from deep anaesthesia to wakefulness, reflected by the absence of an EEG pattern resembling non-rapid eye movement stage 2 sleep, might predispose children to emergence delirium.
Alterations in the Functional Connectivity of Frontal Lobe Networks Preceding Emergence Delirium in Children
Anesthesiology, V 121 • No 4
What This Article Tells Us That Is New
• In children without emergence delirium, an electroencephalogram pattern of sleep or drowsy states was observed before peaceful awakening.
• In children with emergence delirium, arousal with delirium occurred before observation of electroencephalogram patterns of sleep.
• Frontal regional functional connectivity was significantly elevated in emergence delirium compared with that of matched controls shortly after discontinuation of anesthesia.
Absence of sleep EEG pattern associated with ED


Management of Emergence Delirium
Determine incidence in your own institution
Ensure departmental Analgesic and PONV strategy


Evaluation of emergence delirium in Asian children using the Pediatric Anesthesia Emergence Delirium Scale
KKH
The incidence of ED is approximately 10% in our population of healthy, unpremedicated Asian children undergoing day surgery
Young age, poor compliance at induction, lack of intraoperative fentanyl use and rapid time to awakening were predictive risk factors for ED in our population
A PAED Score of ≥10 correlated to clinically significant ED
Choon L Bong Pediatric Anesthesia 2009 19: 593–600


Anaesthesia 2015, 70, 393–399
Original Article
Overall incidence ED 39.2%
A comparison of single-dose dexmedetomidine or propofol on the incidence of emergence delirium in children undergoing general anaesthesia for magnetic resonance imaging
C. L. Bong, E. Lim, J. C. Allen, W. L. H. Choo, Y. N. Siow, P. B. Y. Teo and J. S. K. Tan
Summary
Emergence delirium is a significant problem in children regaining consciousness following general anaesthesia. We compared the emergence characteristics of 120 patients randomly assigned to receive a single intravenous dose of dexmedetomidine 0.3 μg.kg⁻¹, propofol 1 mg.kg⁻¹, or 10 ml saline 0.9% before emerging from general anaesthesia following a magnetic resonance imaging scan. Emergence delirium was diagnosed as a score of 10 or more on the Paediatric Anaesthesia Emergence Delirium scale. The incidence of emergence delirium was 42.5% in the dexmedetomidine group, 33.3% in the propofol group and 41.5% in the saline group (p = 0.671). Three patients in the dexmedetomidine group, none in the propofol group and two in the saline group required pharmacological intervention for emergence delirium (p = 0.202). Administration of neither dexmedetomidine nor propofol significantly reduced the incidence, or severity, of emergence delirium. The only significant predictor for emergence delirium was the time taken to awaken from general anaesthesia, with every minute increase in wake-up time reducing the odds of emergence delirium by 7%.

Preemptive strategy

- Non pharmacologic interventions
  - Premedication
  - Parental presence, video distraction etc
  - Above measure allays anxiety but may not reduce ED
- Appropriate anaesthesia techniques
  - Good pain strategies
- Pharmacologic agents
  - Adjunct agents

Cochrane Library

Effects of sevoflurane versus other general anaesthesia on emergence agitation in children

Halothane
RR 0.51, 95% CI 0.41 to 0.63

Propofol TIVA
RR 0.35, 95% CI 0.25 to 0.51

Propofol after Sev Induction
RR 0.59, 95% CI 0.46 to 0.76

David Costi et al
Cochrane Database of Systematic Reviews, Sept 2014

TIVA only?

INTERVENTIONS
Elective adjuncts for reducing the risk of EA during sevoflurane anaesthesia

Dexmedetomidine,
851 participants
RR 0.37, 95% CI 0.29 to 0.47

Clonidine
739 participants
RR 0.45, 95% CI 0.31 to 0.66

Opioids, in particular fentanyl
1247 participants
RR 0.37, 95% CI 0.27 to 0.50

David Costi et al
Cochrane Database of Systematic Reviews, Sept 2014

Adjuncts for reducing EA during sevoflurane anaesthesia

Effective Medication	Dosage	Route/Timing of Admin
Dexmedetomidine	1-2 ug/kg 0.5-1.0 ug/kg 0.2 ug/kg/hr	IN premed IV intraop/End IV infusion
Clonidine	2 ug/kg	IV intraop/End
Fentanyl Remifentanil	1-2 ug/kg 0.05-0.015 ug/kg/min	IV intraop/End IV intraop
Propofol *	2 - 3 mg/kg	IV/End
Ketamine*	0.25mg/kg	IV/End
Melatonin	0.2 - 0.4mg/kg	Oral premed

•Costi: Paediatric Anaesth. 2015 May;25(5):517–23.

SUMMARY

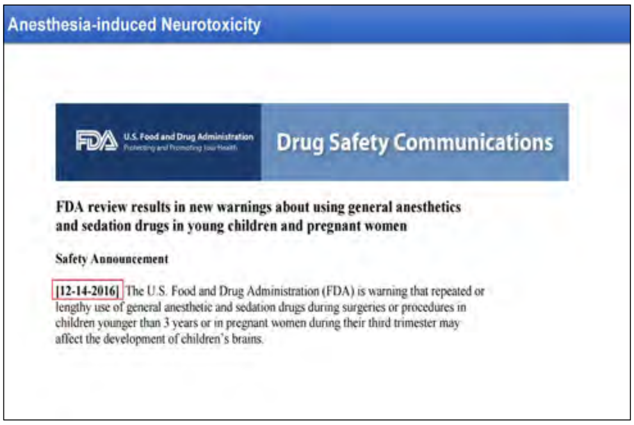
Prevention:
Identify at risk child
- Consider sedation premedication
- **EFFECTIVE** prevention of postoperative pain and nausea and vomiting
- Recover the child in a silent environment
- Avoid verbal and physical stimulation during transfer and recovery

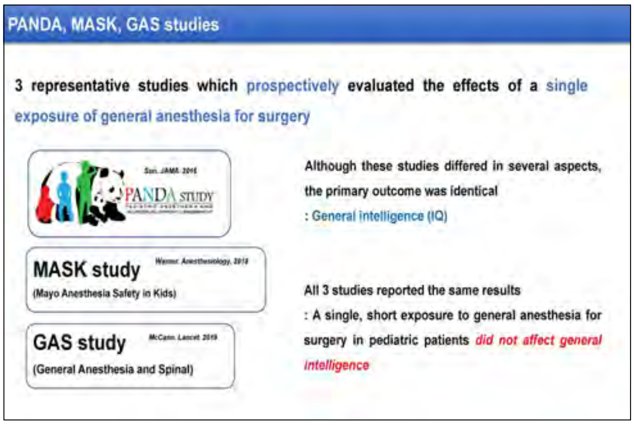
Child at risk
- Consider TIVA
- If volatiles used, use adjuncts

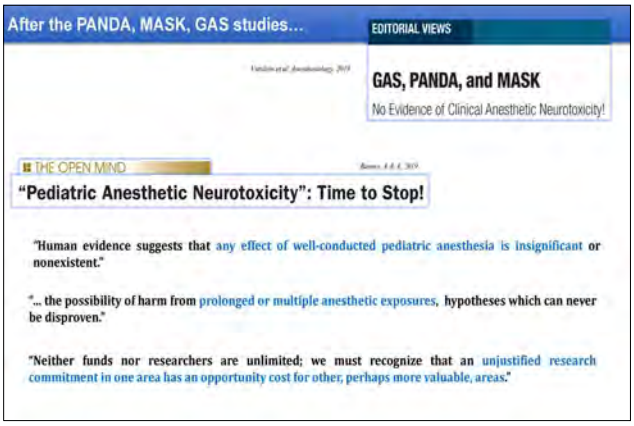
Anesthesia-induced Neurotoxicity: Recent Updates and Preclinical Research Trends

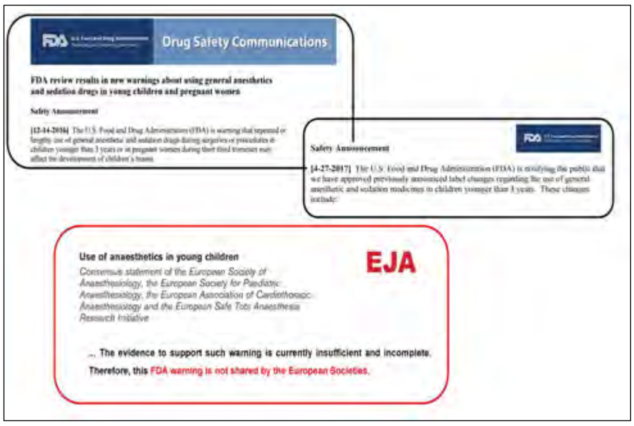
Woosuk Chung

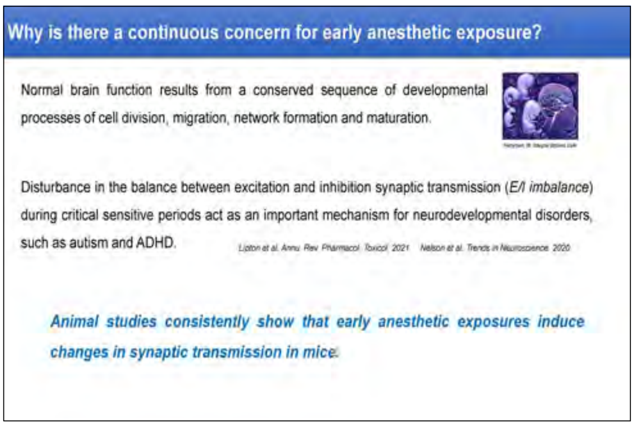
Department of Anesthesiology and Pain Medicine, Chungnam National University, Korea

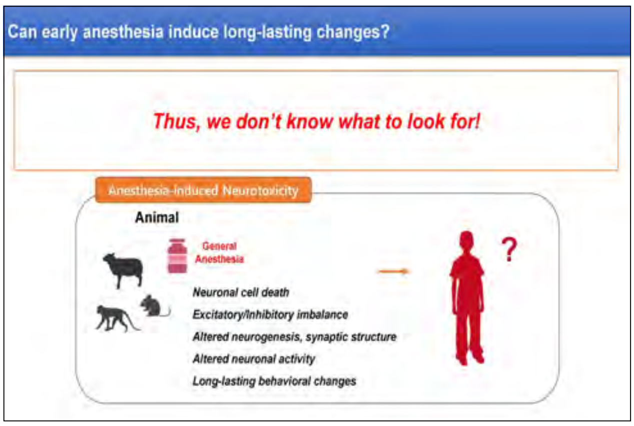












Is there a phenotype for Anesthesia-induced Neurotoxicity?

Early clinical studies mostly focused on intelligence, academic achievements (based on animal studies and general concerns).

More recent studies have performed wide-range of tests, trying to identify a possible phenotype due to early anesthetic exposure.

: Educational Outcomes, Cognitive functions, Motor abilities, Social and Behavioral outcomes, etc

Several studies suggest that although early anesthesia does not alter general cognitive function (intelligence), but it may *affect specific behaviors.* Warner. Anesthesiology. 2018 Anesthesiology. 2020. Walkden et al.

Recent studies suggest possible changes in specific behaviors

Prospectively assessed neurodevelopmental outcomes in studies of anaesthetic neurotoxicity in children: a systematic review and meta-analysis *BJA. 2021. Ing et al.*

A meta-analysis was performed using the results of PANDA, MASK, GAS

Child Behavior Checklist (CBCL)

: a checklist for the parents (118 questions), detect emotional and behavioral problems in children.

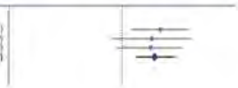
Increased behavioral problems in patients who received early anesthesia

Full-scale intelligence quotient and parentally assessed outcomes

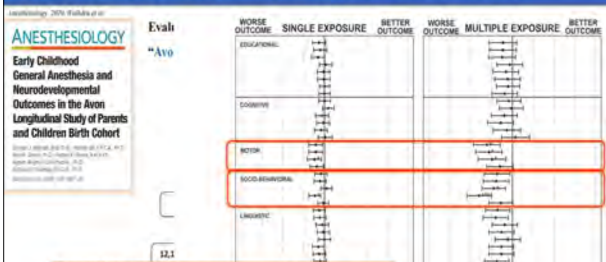
Study	Exposed n	Unexposed n	Weight (%)	Difference (95% CI)
CBCL total				
PANDA[7]	101	101	43.8	2.7 (0.6 to 4.7)
MASK[8]	380	411	23.2	2.1 (−0.7 to 4.9)
GAS[6]	356	287	33.0	2.0 (−0.4 to 4.3)
Overall	**837**	**799**	**100**	**2.3 (1.0 to 3.7)**

Cochrane's Q=0.23 df=2 P=0.89 I^2=0%

*Test for overall difference z=3.39 P=0.001**



Recent studies suggest possible changes in specific behaviors



Conclusions: Early childhood general anesthesia and surgery were not associated with a global picture of clinically and statistically significant neurodegenerative effects, providing reassurance about the neurotoxic potential of general anesthesia. Exposure to anesthesia and surgery was associated with significantly lower motor and social linguistic performance.

Based on these recent updates, what should be considered when studying anesthesia induced neurotoxicity in young animals?

1. What is the appropriate age of animals to study anesthesia-induced neurotoxicity?
2. Could there be other phenotypes caused by early anesthetic exposures?
3. Are we using an appropriate anesthetic depth in young animals?

Based on these recent updates, what should be considered when studying anesthesia induced neurotoxicity in young animals?

1. *What is the appropriate age of animals to study anesthesia-induced neurotoxicity?*
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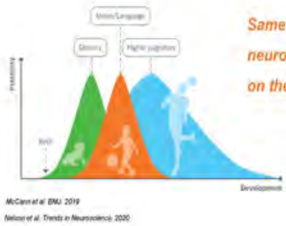
Anesthetic exposure during neurodevelopment

The effects of early anesthesia may differ depending on the developing stage of the child.



McCann et al. BMJ. 2019

Nelson et al. Trends in Neuroscience. 2020

Same anesthetic exposures may affect neurodevelopment differently depending on the age of patients.

Anesthetic exposure during neurodevelopment: What to consider?

Most concerns about anesthetic induced developmental neurotoxicity has been focused on toddlers and infants because this is a time of critical development.

Thus, it is natural that preclinical research should also study animals with similar neurodevelopment compared to human infants.

Is it possible to compare the neurodevelopment between humans and animals (mice, primates)?

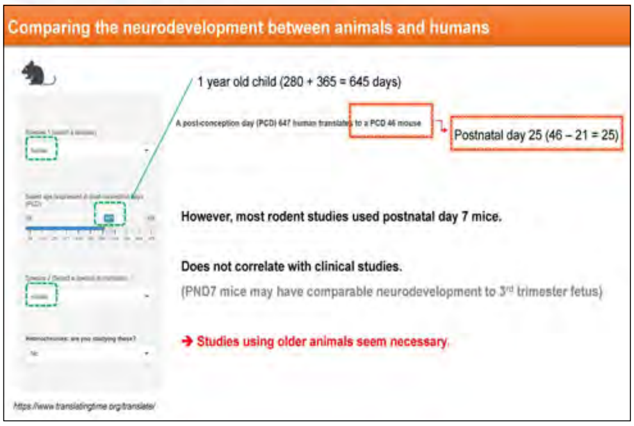
Comparing the neurodevelopment between animals and humans

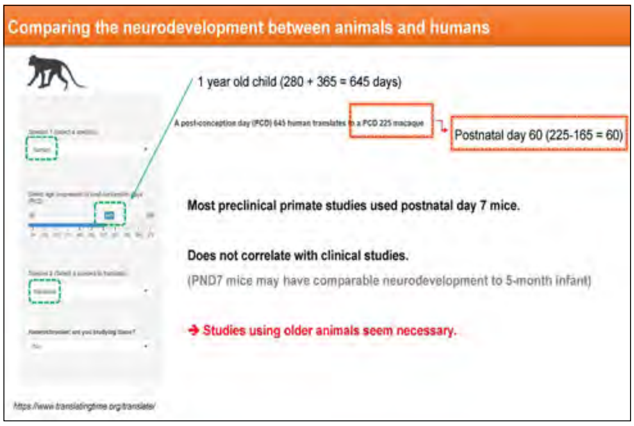
A scientific approach would be comparing important neurodevelopmental events between species...

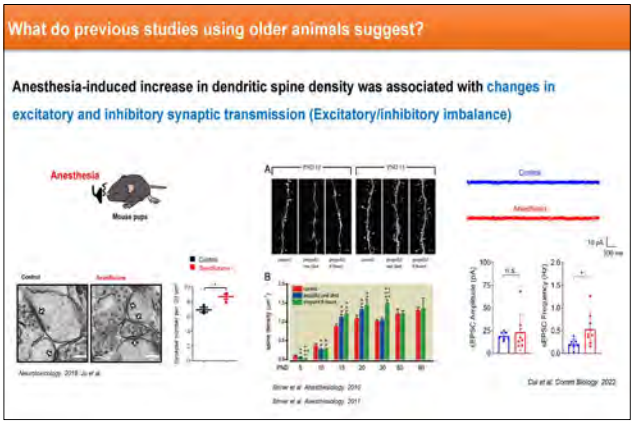
: neurogenesis, neuronal migration, axon extension, connectivity, etc

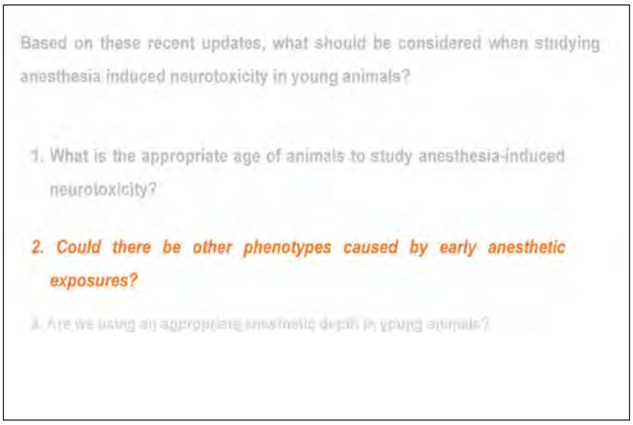
https://www.translatingtime.org/

Workman. J Neuro. 2013


Comparing the neurodevelopment between animals and humans
1 year old child (280 + 365 = 645 days)
Postnatal day 25 (46 – 21 = 25)
However, most rodent studies used postnatal day 7 mice.
Does not correlate with clinical studies.
(PND7 mice may have comparable neurodevelopment to 3rd trimester fetus)
➔ Studies using older animals seem necessary.
https://www.translatingtime.org/translate/


Comparing the neurodevelopment between animals and humans
1 year old child (280 + 365 = 645 days)
Postnatal day 60 (225-165 = 60)
Most preclinical primate studies used postnatal day 7 mice.
Does not correlate with clinical studies.
(PND7 mice may have comparable neurodevelopment to 5-month infant)
➔ Studies using older animals seem necessary.
https://www.translatingtime.org/translate/


What do previous studies using older animals suggest?
Anesthesia-induced increase in dendritic spine density was associated with changes in excitatory and inhibitory synaptic transmission (Excitatory/inhibitory imbalance)
Anesthesia
Mouse pups
Control
Sevoflurane
Dai et al. Comm Biology 2022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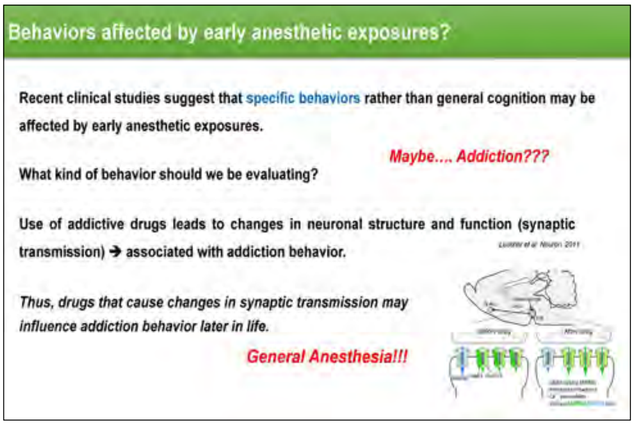
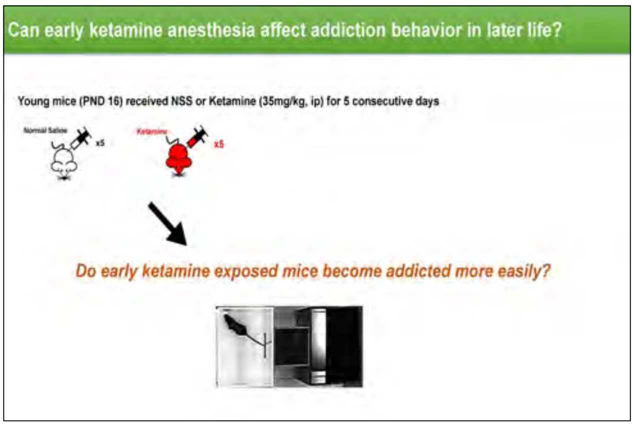
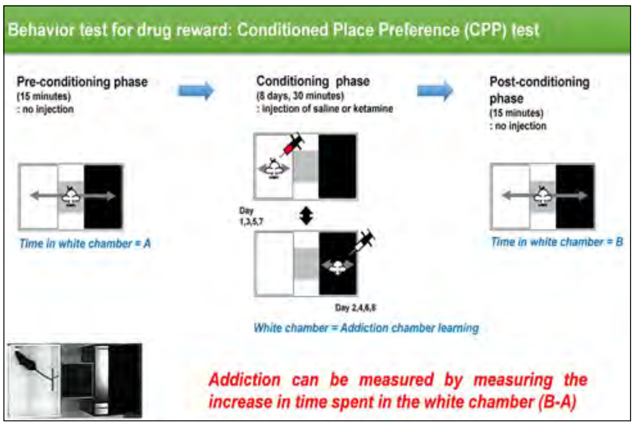
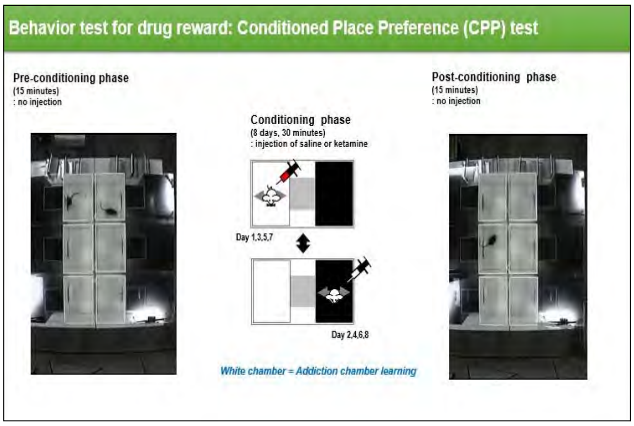

Behaviors affected by early anesthetic exposures?
Recent clinical studies suggest that specific behaviors rather than general cognition may be affected by early anesthetic exposures.
What kind of behavior should we be evaluating?
Maybe.... Addiction???
Use of addictive drugs leads to changes in neuronal structure and function (synaptic transmission) ➔ associated with addiction behavior.
Thus, drugs that cause changes in synaptic transmission may influence addiction behavior later in life.
General Anesthesia!!!


Early Anesthesia & Addiction: A possible connection?
Our hypothesis:
The synaptic changes that occur after anesthetic exposures during neurodevelopment may affect addiction behavior later in life.
Choice of drug: Ketamine
: Ketamine is often used in pediatric patients
: Ketamine induces changes in synaptic transmission
J of Anesthesia 2021 Lee et al.
: Ketamine is also a recreational drug (called special K), and abused world-wide.
Addiction 2012 Morgan et al.


Can early ketamine anesthesia affect addiction behavior in later life?
Young mice (PND 16) received NSS or Ketamine (35mg/kg, ip) for 5 consecutive days
Normal Saline
Ketamine
x5
x5
Do early ketamine exposed mice become addicted more easily?


Behavior test for drug reward: Conditioned Place Preference (CPP) test
Pre-conditioning phase
(15 minutes)
: no injection
Conditioning phase
(8 days, 30 minutes)
: injection of saline or ketamine
Post-conditioning phase
(15 minutes)
: no injection
Time in white chamber = A
Day 1,3,5,7
Day 2,4,6,8
White chamber = Addiction chamber learning
Time in white chamber = B
Addiction can be measured by measuring the increase in time spent in the white chamber (B-A)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Pre-conditioning phase
(15 minutes)
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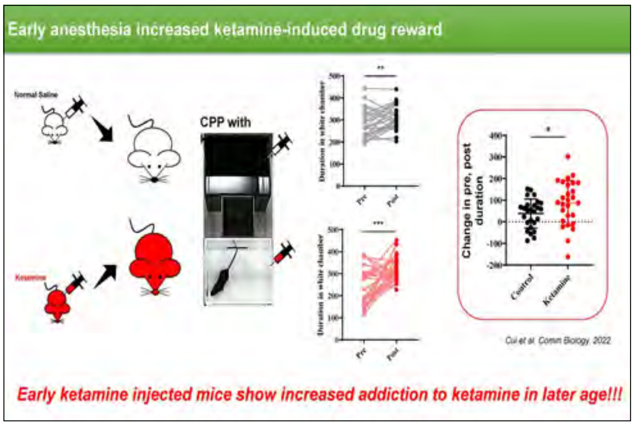
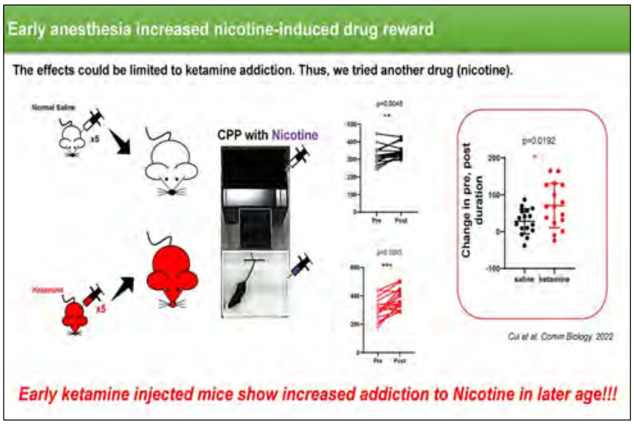
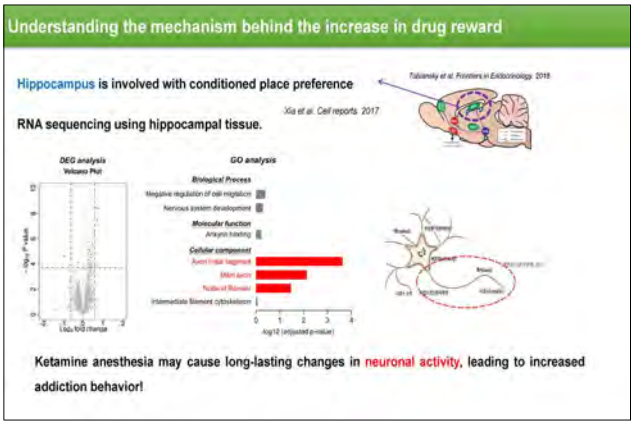
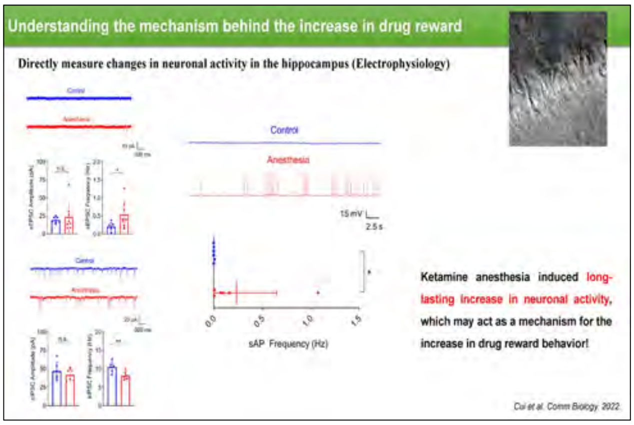
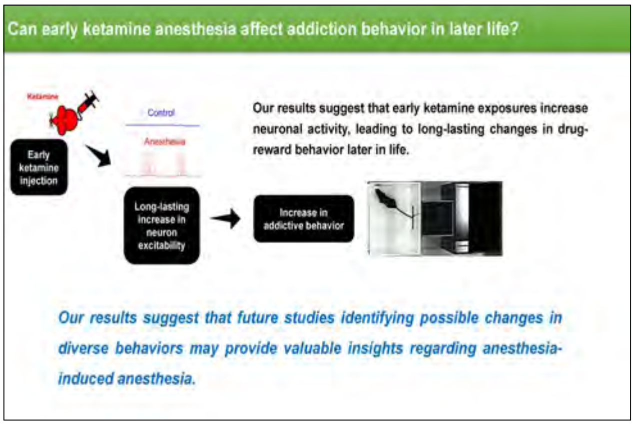
Conditioning phase
(8 days, 30 minutes)
: injection of saline or ketamine
Day 1,3,5,7
Day 2,4,6,8
Post-conditioning phase
(15 minutes)
: no injection
White chamber = Addiction chamber learning

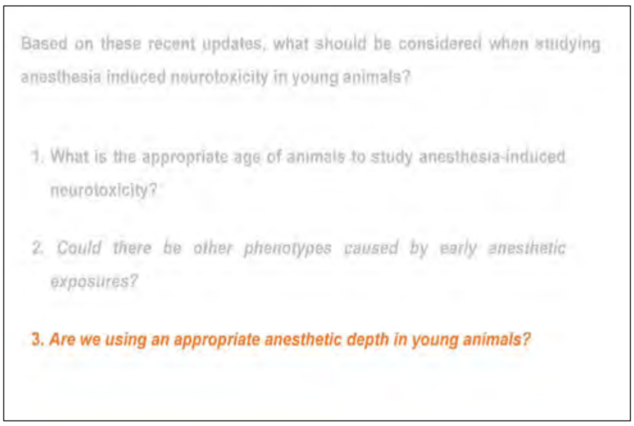

Early anesthesia increased ketamine-induced drug reward
Normal Saline
Ketamine
CPP with
Duration in white chamber
Pre
Post
Change in pre, post duration
Control
Ketamine
Cui et al. Comm Biology 2022
Early ketamine injected mice show increased addiction to ketamine in later age!!!


Early anesthesia increased nicotine-induced drug reward
The effects could be limited to ketamine addiction. Thus, we tried another drug (nicotine).
Normal Saline
Ketamine
x5
CPP with Nicotine
p=0.0192
Change in pre, post duration
saline
ketamine
Pre
Post
Cui et al. Comm Biology 2022
Early ketamine injected mice show increased addiction to Nicotine in later age!!!


Understanding the mechanism behind the increase in drug reward
Hippocampus is involved with conditioned place preference
Tabansky et al. Frontiers in Endocrinology 2018
Xia et al. Cell reports 2017
RNA sequencing using hippocampal tissue.
DEG analysis
Volcano Plot
GO analysis
Biological Process
Molecular function
Cellular component
Ketamine anesthesia may cause long-lasting changes in neuronal activity, leading to increased addiction behavior!


Understanding the mechanism behind the increase in drug reward
Directly measure changes in neuronal activity in the hippocampus (Electrophysiology)
Control
Anesthesia
15 mV
2.5 s
sAP Frequency (Hz)
Ketamine anesthesia induced long-lasting increase in neuronal activity, which may act as a mechanism for the increase in drug reward behavior!
Cui et al. Comm Biology 2022


Can early ketamine anesthesia affect addiction behavior in later life?
Ketamine
Early ketamine injection
Control
Anesthesia
Long-lasting increase in neuron excitability
Increase in addictive behavior
Our results suggest that early ketamine exposures increase neuronal activity, leading to long-lasting changes in drug-reward behavior later in life.
Our results suggest that future studies identifying possible changes in diverse behaviors may provide valuable insights regarding anesthesia-induced anesthesia.


Based on these recent updates, what should be considered when studying anesthesia induced neurotoxicity in young animals?
1. What is the appropriate age of animals to study anesthesia-induced neurotoxicity?
2. Could there be other phenotypes caused by early anesthetic exposures?
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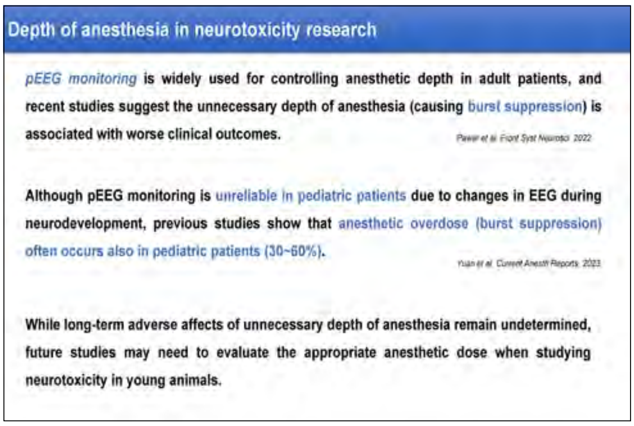
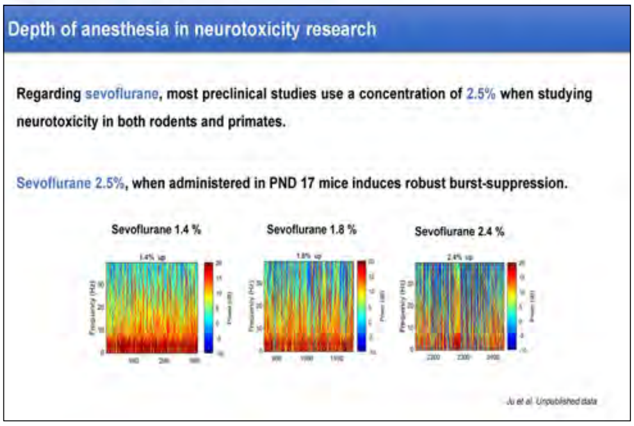
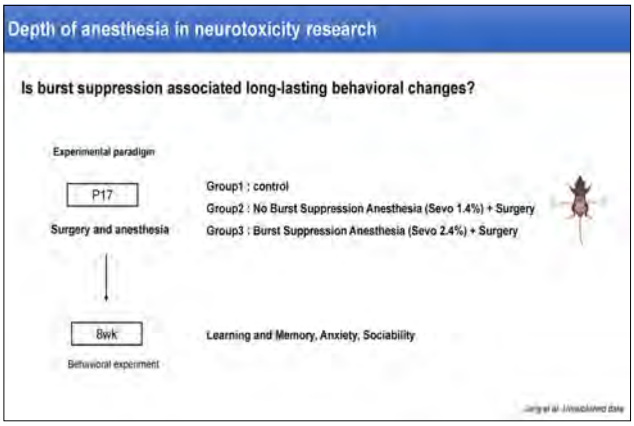
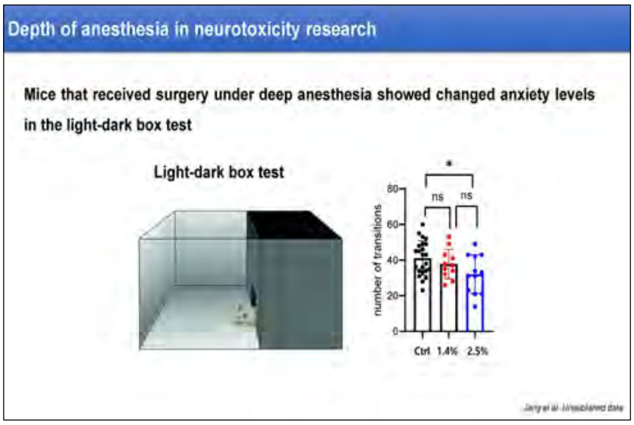
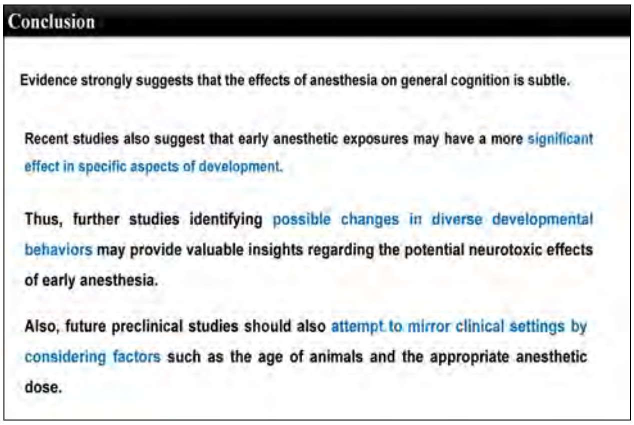

Depth of anesthesia in neurotoxicity research
pEEG monitoring is widely used for controlling anesthetic depth in adult patients, and recent studies suggest the unnecessary depth of anesthesia (causing burst suppression) is associated with worse clinical outcomes.
Pawar et al. Front Syst Neurosci 2022
Although pEEG monitoring is unreliable in pediatric patients due to changes in EEG during neurodevelopment, previous studies show that anesthetic overdose (burst suppression) often occurs also in pediatric patients (30~60%).
Yuan et al. Current Anesth Reports 2023
While long-term adverse affects of unnecessary depth of anesthesia remain undetermined, future studies may need to evaluate the appropriate anesthetic dose when studying neurotoxicity in young animals.


Depth of anesthesia in neurotoxicity research
Regarding sevoflurane, most preclinical studies use a concentration of 2.5% when studying neurotoxicity in both rodents and primates.
Sevoflurane 2.5%, when administered in PND 17 mice induces robust burst-suppression.
Sevoflurane 1.4 %
Sevoflurane 1.8 %
Sevoflurane 2.4 %
Ju et al. Unpublished data


Depth of anesthesia in neurotoxicity research
Is burst suppression associated long-lasting behavioral changes?
Experimental paradigm
P17
Surgery and anesthesia
Group1 : control
Group2 : No Burst Suppression Anesthesia (Sevo 1.4%) + Surgery
Group3 : Burst Suppression Anesthesia (Sevo 2.4%) + Surgery
8wk
Behavioral experiment
Learning and Memory, Anxiety, Sociability


Depth of anesthesia in neurotoxicity research
Mice that received surgery under deep anesthesia showed changed anxiety levels in the light-dark box test
Light-dark box test
number of transitions
80
60
40
20
0
*
ns
ns
Ctrl
1.4%
2.5%


Conclusion
Evidence strongly suggests that the effects of anesthesia on general cognition is subtle.
Recent studies also suggest that early anesthetic exposures may have a more significant effect in specific aspects of development.
Thus, further studies identifying possible changes in diverse developmental behaviors may provide valuable insights regarding the potential neurotoxic effects of early anesthesia.
Also, future preclinical studies should also attempt to mirror clinical settings by considering factors such as the age of animals and the appropriate anesthetic dose.

ASPA 2023

Day 3

18 June 2023

Room A

Session 1.

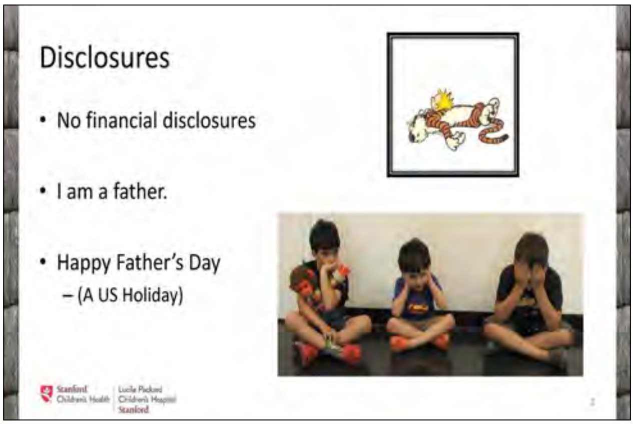
Innovation / Renovation

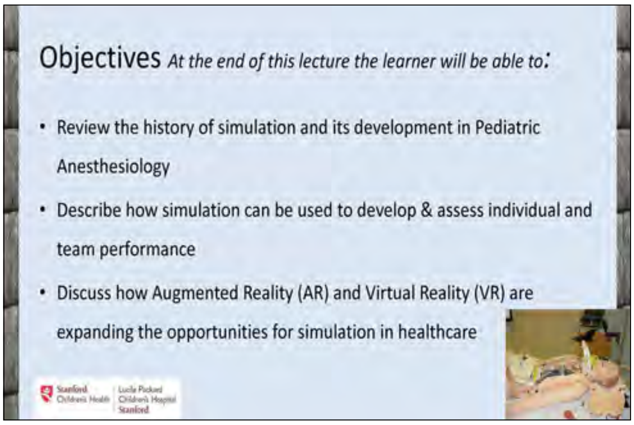
Chair(s): Ina Ismiarti Binti Shariffuddin (Malaysia)
Jeong-Rim Lee (Korea)

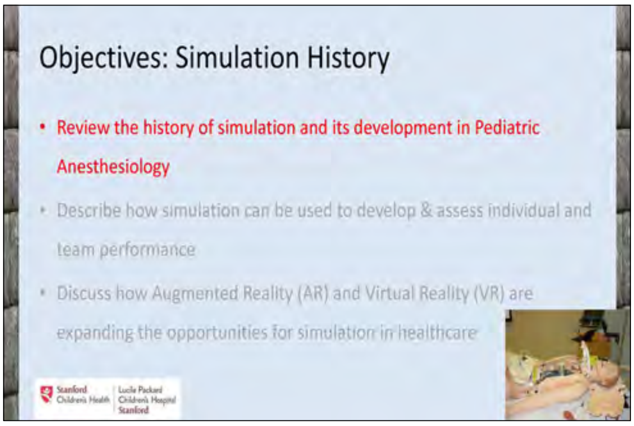
Medical Simulation, Augmented & Virtual Reality

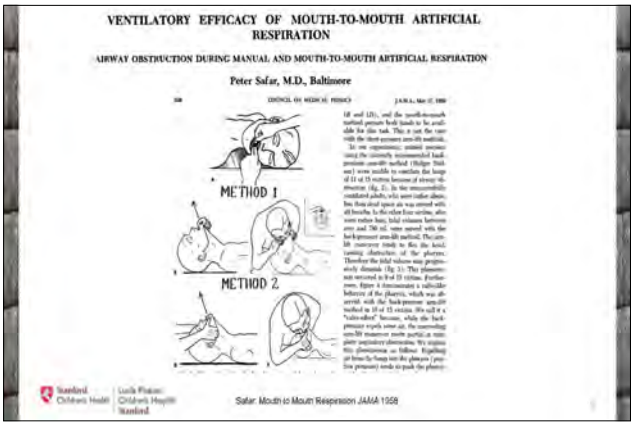
Jim Fehr

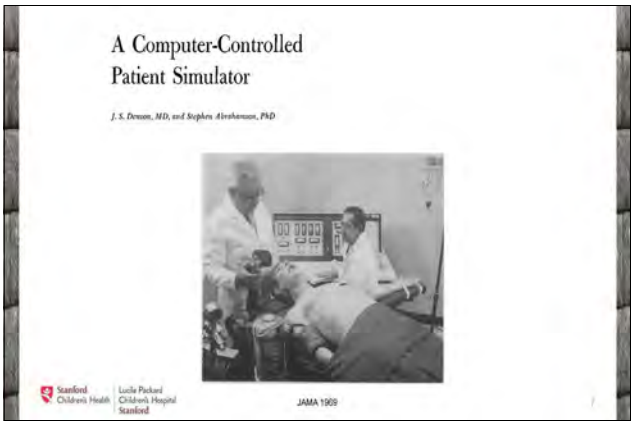
Stanford's Lucile Packard Children's Hospital, USA



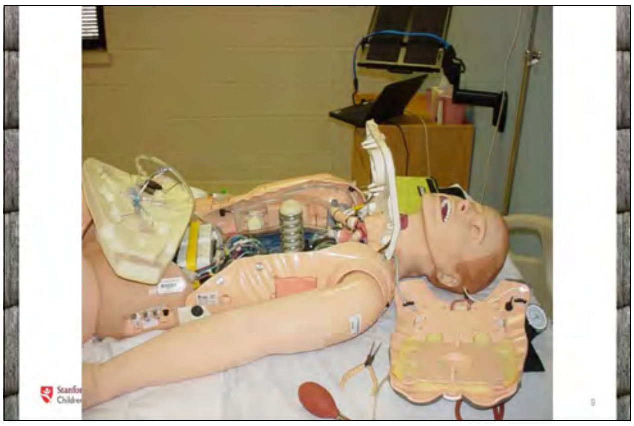


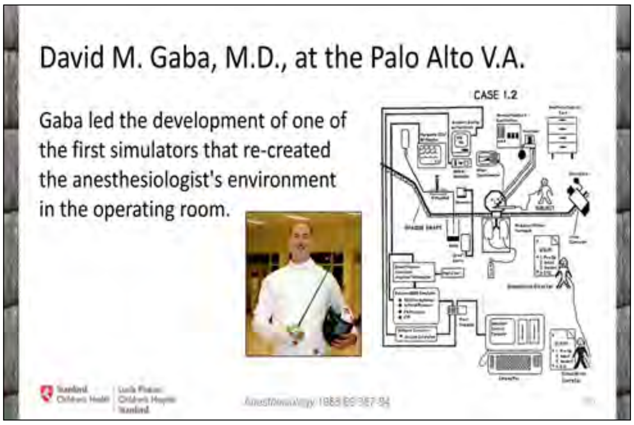


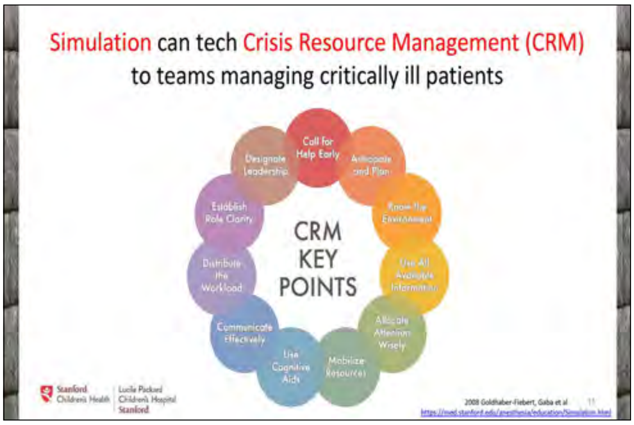


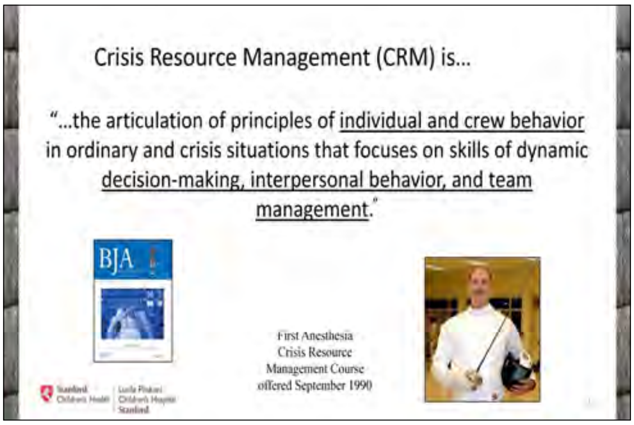



A Computer-Controlled
Patient Simulator
Simulators allow beginning students to learn basic skills without involving live patients. Thus, patients may be spared discomfort or even potential harm. Coincidentally, this must save valuable time since the beginning student's contact with patients must be very carefully supervised and frequently interrupted for the patient's safety. Extending the simulator concept from Sim One to the many other kinds of patient simulators can provide much better quality of training for all levels of health care personnel, and at the same time, markedly accelerate their training period.
Further, the use of patient simulators will make possible an analysis of time and motion details of virtually all of the manual skills required in patient care. Their use will also permit a systematic study of what training is necessary for the proper performance of the many tasks necessary in health care.
It must be emphatically understood that this kind of an education program will not replace the student's learning experience at the bedside. Rather, it will bring him to the patient with skills already developed so that he may concentrate completely on the patient's problems.
JAMA 1969

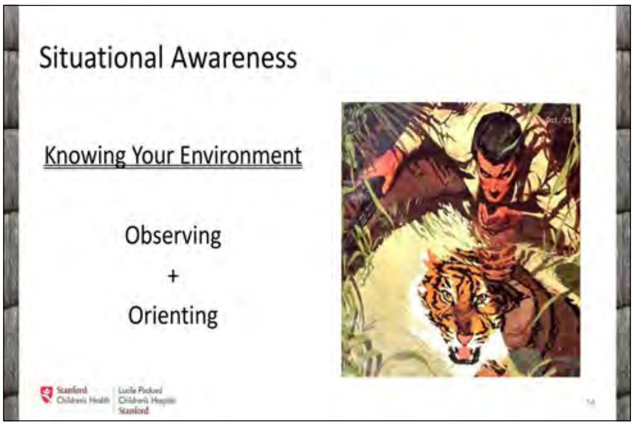



David M. Gaba, M.D., at the Palo Alto V.A.
Gaba led the development of one of the first simulators that re-created the anesthesiologist's environment in the operating room.
CASE 1.2
Anesthesiology 1988 69:387-94

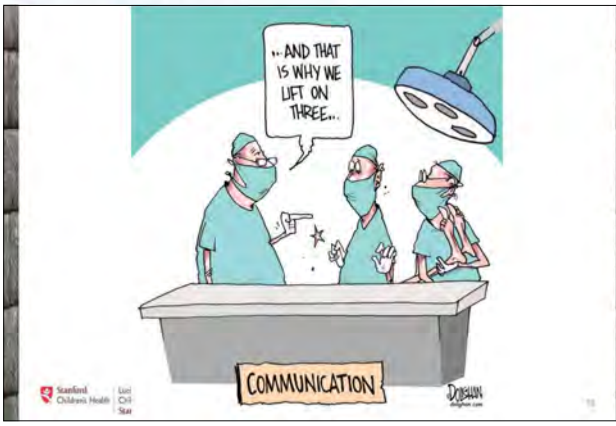

Simulation can tech Crisis Resource Management (CRM) to teams managing critically ill patients
CRM KEY POINTS
Call for Help Early
Anticipate and Plan
Know the Environment
Use All Available Information
Allocate Attention Wisely
Mobilize Resources
Use Cognitive Aids
Communicate Effectively
Distribute the Workload
Establish Role Clarity
Designate Leadership
2008 Goldhaber-Fiebert, Gaba et al


Crisis Resource Management (CRM) is…
"…the articulation of principles of individual and crew behavior in ordinary and crisis situations that focuses on skills of dynamic decision-making, interpersonal behavior, and team management."
BJA
First Anesthesia
Crisis Resource
Management Course
offered September 1990


Call for Help Early
Designate Leadership
Anticipate and Plan
Know the Environment
Establish Role Clarity
Use All Available Information
Distribute the Workload
Allocate Attention Wisely
Mobilize Resources
Communicate Effectively
Use Cognitive Aids
Crisis Resource Management
2008 Goldhaber-Fiebert, Gaba et al


Situational Awareness
Knowing Your Environment
Observing
+
Orienting


Objectives: Simulation for Assessment
Review the history of simulation and its development in Pediatric Anesthesiology
Describe how simulation can be used to develop & assess individual and team performance
Discuss how Augmented Reality (AR) and Virtual Reality (VR) are expanding the opportunities for simulation in healthcare



What characterizes effective teams?

- Clear roles and responsibilities
- Strong team leadership
- Shared mental models
- Optimize resources
- Trust
- Manage & optimize performance outcomes
- Cycle of prebrief→ performance→ debrief

Where do simulation scenarios come from?

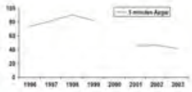
- Clinical Events
  - Quality Improvement initiatives
  - Mortality & Morbidity
  - Root Cause Analyses
- Educational initiatives
- Institutional needs
  - New clinical space, New equipment

Does training in obstetric emergencies improve neonatal outcome?

Tim Draycott,[a] Thabani Sibanda,[a] Louise Owen,[a] Valentine Akande,[a] Cathy Winter,[a] Sandra Reading,[a] Andrew Whitelaw[b]

Table 3. Apgar score and HIE (graded) for each year

Year	1996	1997	1998	1999	2000	2001	2002	2003
Low 5-minute Apgar, n (rate per 10,000)	54 (73.4)	37 (81.9)	40 (90.4)	33 (82.4)	26 (69.7)	16 (45.4)	17 (46.5)	16 (41.5)
HIE all grades, n (rate per 10,000)	N/A	N/A	13 (29.4)	10 (25.0)	8 (21.5)	5 (14.2)	5 (13.7)	5 (13.0)
Moderate/severe HIE, n (rate per 10,000)	N/A	N/A	7 (15.8)	9 (22.5)	3 (8.0)	4 (11.4)	2 (5.5)	5 (13.0)



Conclusion The introduction of obstetric emergencies training courses was associated with a significant reduction in low 5-minute Apgar scores and HIE. This improvement has been sustained as the training has continued. This is the first time an educational intervention has been shown to be associated with a clinically important, and sustained, improvement in perinatal outcome.

BJOG 2006

Pediatric Trauma Teams

Assessed the effectiveness of an educational intervention on performance of ED teams in simulated pediatric trauma resuscitations

- 17% of North Carolina EDs
- Unannounced simulated pediatric trauma
- Educational intervention
- ED return 6 months later

Hunt Ped Emergency Care 2007

Pediatric Trauma Teams

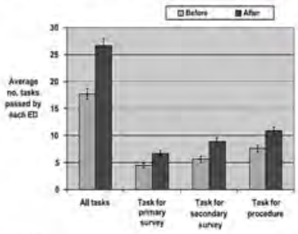


FIGURE 1. Average number of pediatric trauma management tasks passed by each ED before and after study intervention. Error bar represents standard error.

Hunt Ped Emergency Care 2007

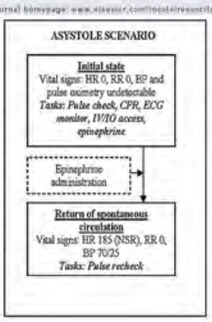
Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical paper

Reliability and validi... ...rformance during Pediatric Advanced I...

Aaron Donoghue... ...hn Boulet



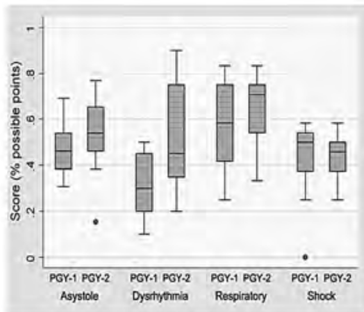


Fig. 3. Scores for four scenarios, by group.

Donoghue, Resuscitation 2010

Simulation in Pediatrics

PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

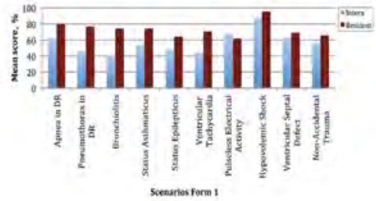
OBJECTIVE: The goal of this study was to develop an inventory of simulated scenarios that mimic pediatric crises and determine if the resident scores could be used to establish the reliability and validity of a multiple-scenario assessment. The long-term objective is to provide pediatric residents with experiences in the recognition, diagnosis, and management of a range of simulated acute conditions.

Simulation in Pediatrics: The Reliability and Validity of a Multiscenario Assessment

Mary E. McBride, William B. Waldrop, James J. Fehr, John R. Boulet and David J. Murray

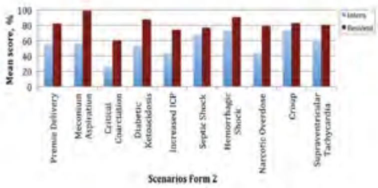
CONCLUSIONS: An inventory of critical events was designed to assess pediatric residents' diagnostic and management skills. A reliable measure of ability could be obtained provided the residents managed multiple scenarios. The residents outscored the interns, providing evidence to support the construct validity of the scores. Additional validity evidence is needed, including studies to determine if this type of training improves physicians' management of real-life critical events. *Pediatrics* 2011;128:e000

Simulation in Pediatrics



Pediatrics 2011 McBride

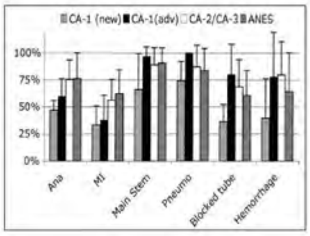
Simulation in Pediatrics



Pediatrics 2011 McBride

Performance of Residents and Anesthesiologists in a Simulation-based Skill Assessment

David J. Murray, M.D., John R. Boulet, Ph.D.,† Michael Avidan, M.D.,‡ Joseph F. Kras, M.D.,‡ Bernadette Henrichs, C.R.N.A.,§ Julie Woodhouse, R.N.,‖ Alex S. Evers, M.D.#*



ANESTHESIOLOGY

Simulation-based Assessment of Pediatric Anesthesia Skills

James J. Fehr, M.D., F.A.A.P.,* John R. Boulet, Ph.D.,† William B. Waldrop, M.D.,‡ Rebecca Snider, M.H.S., R.N.,§ Megan Brockel, M.D.,‖ David J. Murray, M.D.#

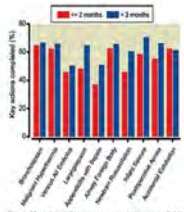


Fig. 1. Mean key action scores by scenario and pediatric anesthesia experience. The total key action scores out of 100% for the simulation scenarios for each group of trainees with either less (red bars) or more (blue bars) than 2 months of pediatric anesthesia training.

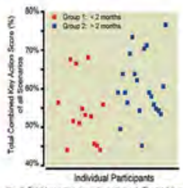


Fig. 2. Total key action score by participant. The total key action scores achieved by each trainee with either less (red squares) or more (blue squares) than 2 months of pediatric anesthesia training. Each point represents a specific trainee's percent overall score. The scores are scattered to highlight both the overlap and the score variation that occurs among individuals within and between groups.

ANESTHESIOLOGY

Anes 2011; 115:1308-15

Simulation-based Assessment of Pediatric Anesthesia Skills

- Asthma
- Laryngospasm
- Foreign Body
- Induction of septic patient
- Accidental Extubation
- Malignant Hyperthermia
- Venous Air Embolus
- Post op Apnea
- Newborn resuscitation
- Infant Seizure

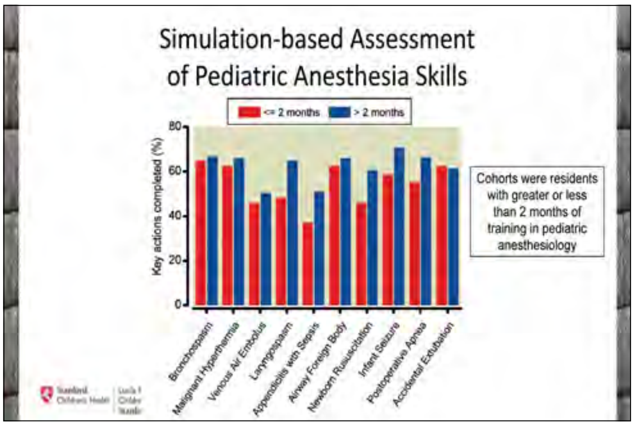
Airway Foreign Body

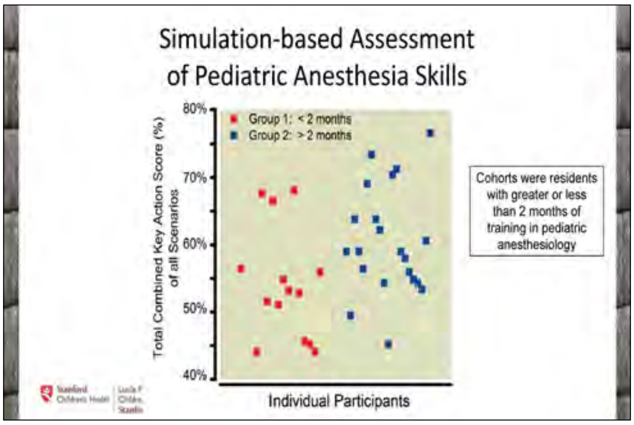
- You are called by the Same Day Surgery nurse who is concerned about a 4 year old 15 kg child who is scheduled for bilateral myringotomy tubes and has cold symptoms.
- The patient has had a runny nose, cough for several days, and no fever.
- The patient has NKDA and no medical history beyond eczema.
- The child's mother is present for any questions.

Airway Foreign Body Checklist

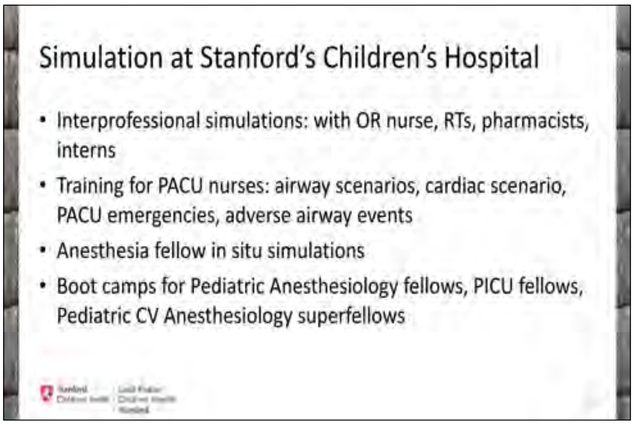
Place a checkmark by the tasks the participant completes	
	Ask for vital signs
	Apply O_2 (if SaO_2 < 94 %)
	Apply O_2 = 2 points
	Ask pertinent history about breathing (gets info about resp symptoms)
	Gets additional information about choking episode
	Auscultate (recognize decreased lung sounds on right)
	Ask for CXR
	State diagnosis
	Consult ENT
	Plan for inhalation induction and maintaining spontaneous ventilation


Airway Foreign Body
If Chest X-Ray is requested...
L
A.P. SITTING


Simulation-based Assessment of Pediatric Anesthesia Skills
<= 2 months
> 2 months
Key actions completed (%)
80
60
40
20
0
Bronchospasm
Malignant Hyperthermia
Venous Air Embolus
Laryngospasm
Appendicitis with Sepsis
Airway Foreign Body
Newborn Resuscitation
Infant Seizure
Postoperative Apnea
Accidental Extubation
Cohorts were residents with greater or less than 2 months of training in pediatric anesthesiology

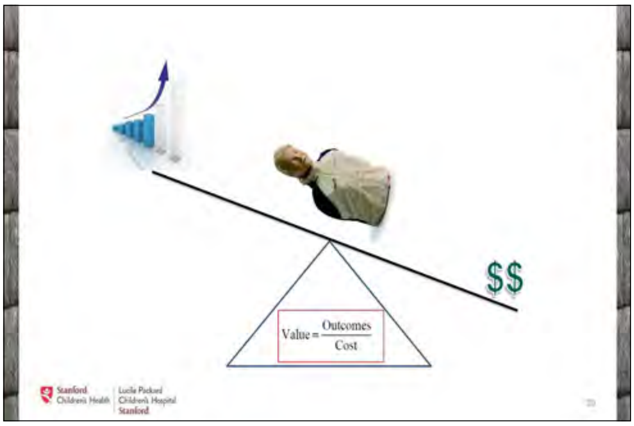

Simulation-based Assessment of Pediatric Anesthesia Skills
Group 1: < 2 months
Group 2: > 2 months
Total Combined Key Action Score (%) of all Scenarios
80%
70%
60%
50%
40%
Individual Participants
Cohorts were residents with greater or less than 2 months of training in pediatric anesthesiology

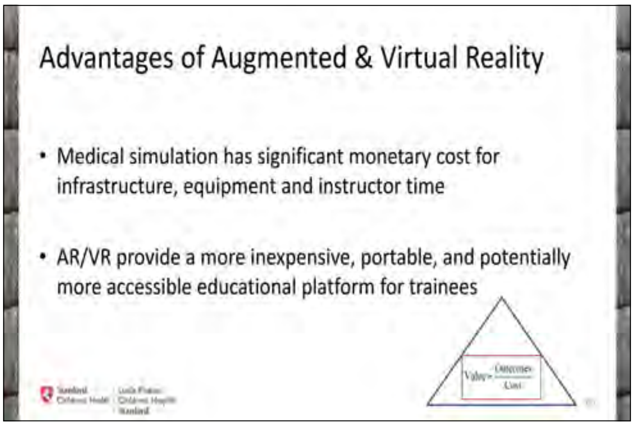

Simulation in the SPA
Society for Pediatric Anesthesia
SPA Simulation Special Interest Group https://pedsanesthesia.org/simulation/
SPA Critical Events Checklist Committee Simulations
https://pedsanesthesia.org/critical-events-checklists/
– Air Embolus, Anaphylaxis, Bradycardia, Malignant Hyperthermia Mediastinal Mass, Tension Pneumothorax


Simulation at Stanford's Children's Hospital
Interprofessional simulations: with OR nurse, RTs, pharmacists, interns
Training for PACU nurses: airway scenarios, cardiac scenario, PACU emergencies, adverse airway events
Anesthesia fellow in situ simulations
Boot camps for Pediatric Anesthesiology fellows, PICU fellows, Pediatric CV Anesthesiology superfellows

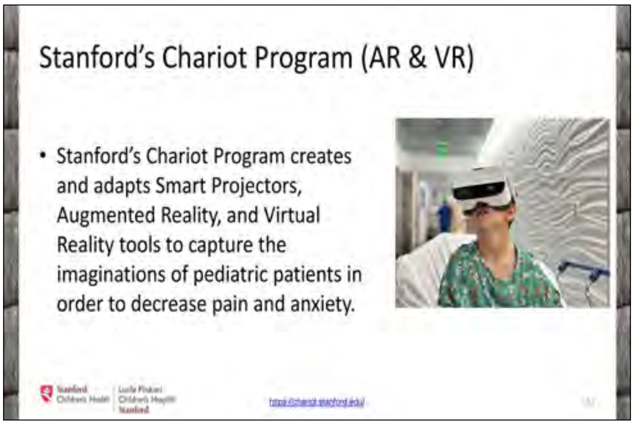

Simulation at Stanford's Children's Hospital
CODE

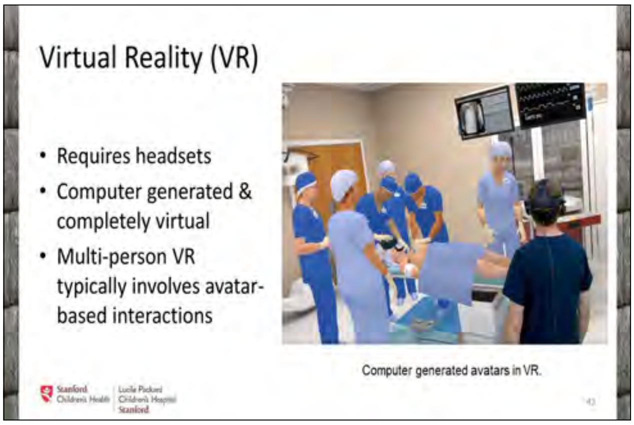

Objectives: Augmented & Virtual Reality
Review the history of simulation and its development in Pediatric Anesthesiology
Describe how simulation can be used to develop & assess individual and team performance
Discuss how Augmented Reality (AR) and Virtual Reality (VR) are expanding the opportunities for simulation in healthcare

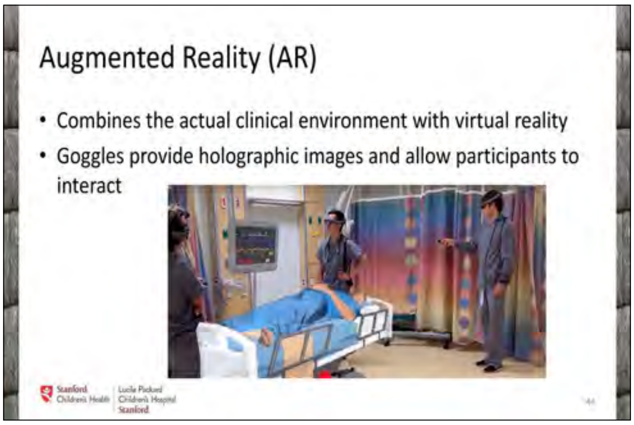

$$
Value = Outcomes / Cost


Advantages of Augmented & Virtual Reality
• Medical simulation has significant monetary cost for infrastructure, equipment and instructor time
• AR/VR provide a more inexpensive, portable, and potentially more accessible educational platform for trainees
Value = Outcomes / Cost

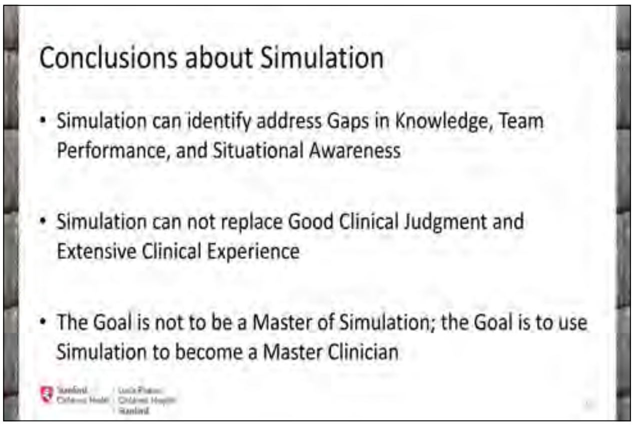

Stanford's Chariot Program (AR & VR)
• Dr. Tom Caruso and Dr. Sam Rodriguez created Stanford's Chariot Program (*Childhood Anxiety Reduction through Innovation and Technology*)
• Augmented & Virtual Reality are used to reduce patient distress in the perioperative period
https://chariot.stanford.edu/

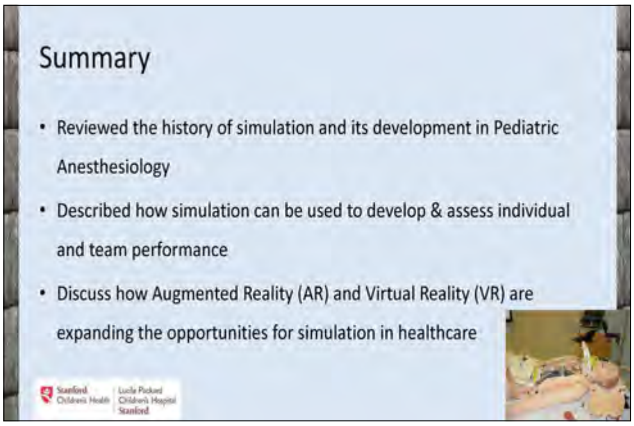

Stanford's Chariot Program (AR & VR)
• Stanford's Chariot Program creates and adapts Smart Projectors, Augmented Reality, and Virtual Reality tools to capture the imaginations of pediatric patients in order to decrease pain and anxiety.
https://chariot.stanford.edu/


Virtual Reality (VR)
• Requires headsets
• Computer generated & completely virtual
• Multi-person VR typically involves avatar-based interactions
Computer generated avatars in VR.


Augmented Reality (AR)
• Combines the actual clinical environment with virtual reality
• Goggles provide holographic images and allow participants to interact


Augmented Reality (AR)
• AR brings virtual images into the actual work environment
• Effectiveness of AR compared to traditional simulation continues to be investigated

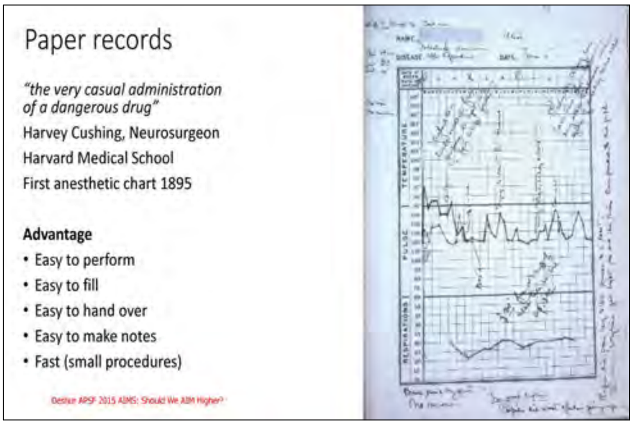

Conclusions about Simulation
• Simulation can identify address Gaps in Knowledge, Team Performance, and Situational Awareness
• Simulation can not replace Good Clinical Judgment and Extensive Clinical Experience
• The Goal is not to be a Master of Simulation; the Goal is to use Simulation to become a Master Clinician

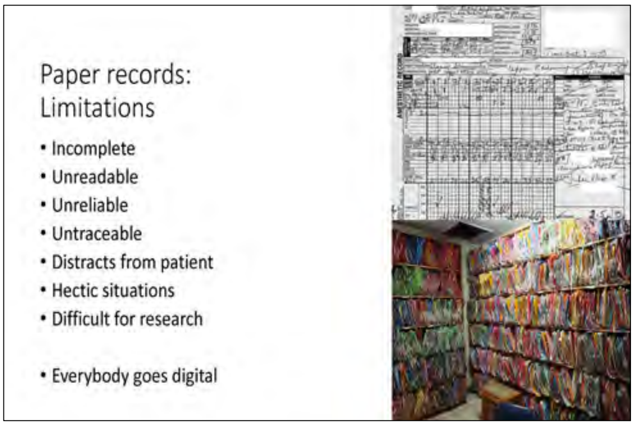

Summary
• Reviewed the history of simulation and its development in Pediatric Anesthesiology
• Described how simulation can be used to develop & assess individual and team performance
• Discuss how Augmented Reality (AR) and Virtual Reality (VR) are expanding the opportunities for simulation in healthcare

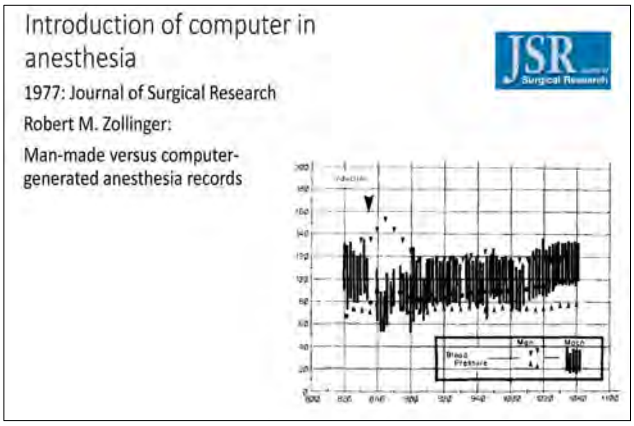
Big Data in Pediatric Anesthesia; Strengths and Pitfalls

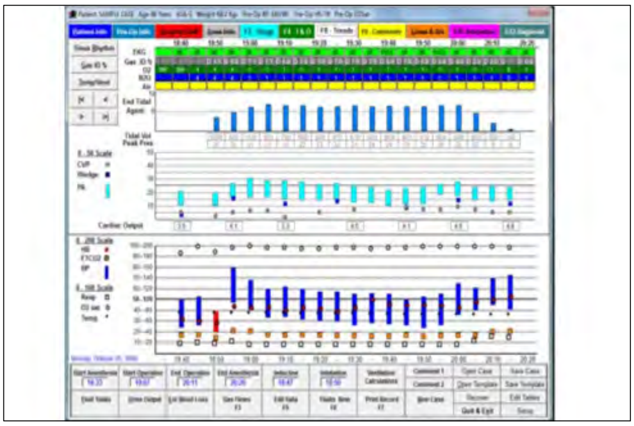
Jurgen C. de Graaff

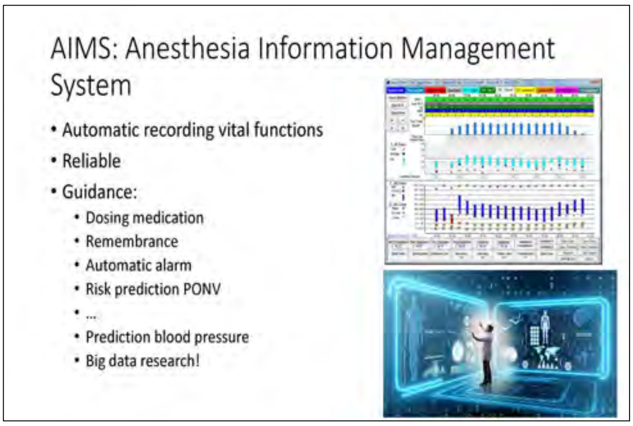
Department of Paediatric Anesthesia, Erasmus MC University Medical Center, Netherlands





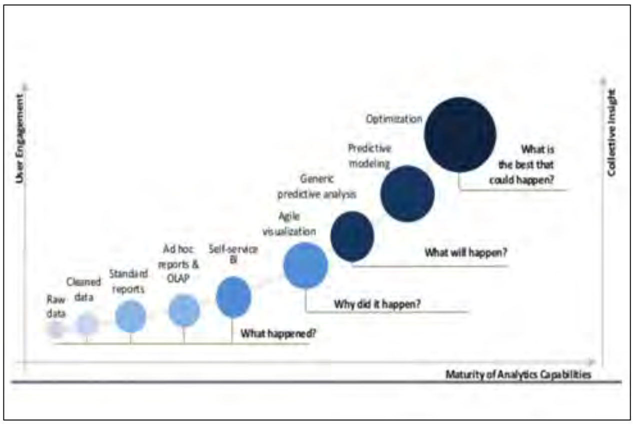


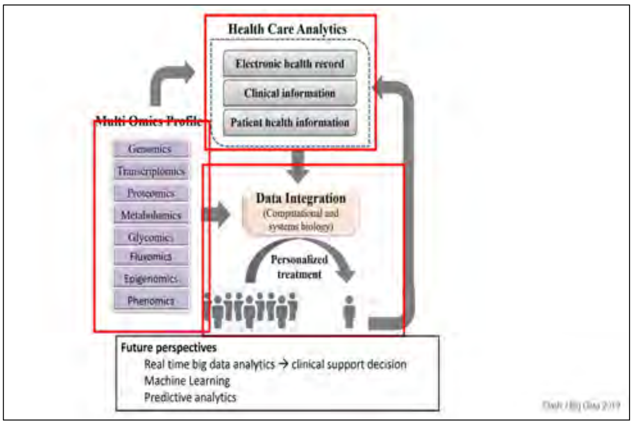


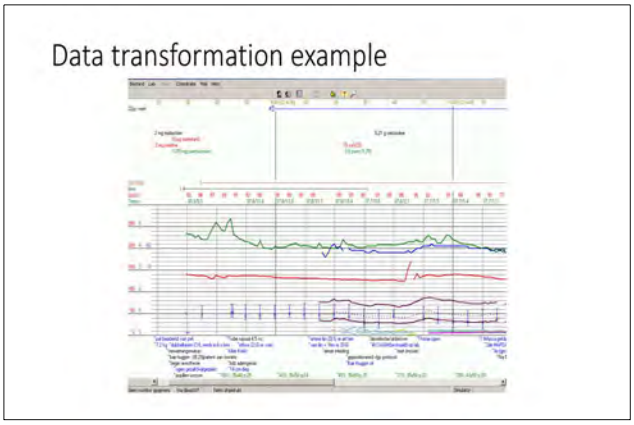


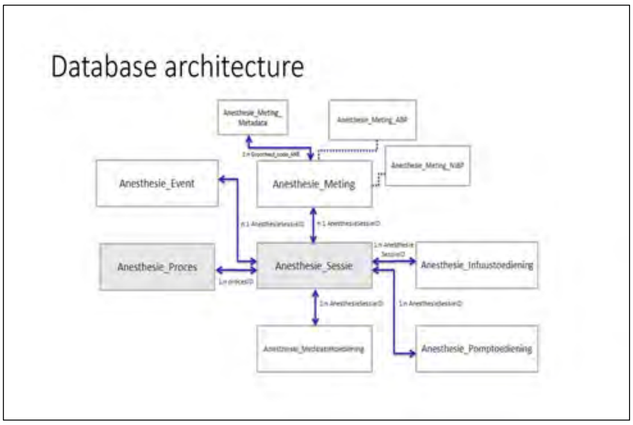

How big data shape paediatric anaesthesia
Artificial Intelligence
Artificial intelligence captures the imagination of the world
Machine learning
Machine learning starts to gain traction
Deep learning

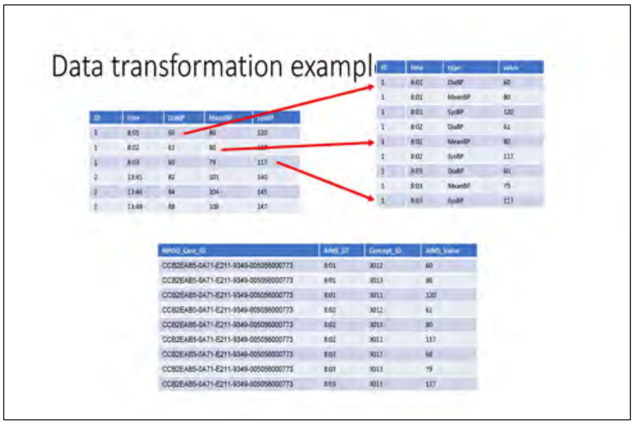

REVIEW
Curr Opin Anesthesiol 2018, 31:723–731
What we can learn from Big Data about factors influencing perioperative outcome
BIG DATA
AIMS

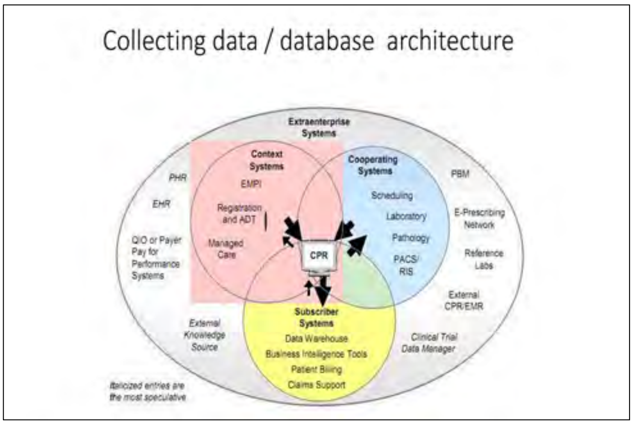

User Engagement
Collective insight
Optimization
Predictive modeling
Generic predictive analysis
Agile visualization
Ad hoc reports & OLAP
Self-service BI
Standard reports
Cleaned data
Raw data
What is the best that could happen?
What will happen?
Why did it happen?
What happened?
Maturity of Analytics Capabilities


Health Care Analytics
Electronic health record
Clinical information
Patient health information
Multi Omics Profile
Genomics
Transcriptomics
Proteomics
Metabolomics
Glycomics
Fluxomics
Epigenomics
Phenomics
Data Integration
(Computational and systems biology)
Personalized treatment
Future perspectives
Real time big data analytics → clinical support decision
Machine Learning
Predictive analytics


Data transformation example


Database architecture
Anesthesie_Meting_Metadata
Anesthesie_Meting_ABP
Anesthesie_Meting_NIBP
Anesthesie_Event
Anesthesie_Meting
Anesthesie_Proces
Anesthesie_Sessie
Anesthesie_Infuustoediening
Anesthesie_Medicatietoediening
Anesthesie_Pomptoediening


Data transformation exampl


Collecting data / database architecture
Extraenterprise Systems
Context Systems
EMPI
Registration and ADT
Managed Care
Cooperating Systems
Scheduling
Laboratory
Pathology
PACS/ RIS
CPR
Subscriber Systems
Data Warehouse
Business Intelligence Tools
Patient Billing
Claims Support
PHR
EHR
QIO or Payer Pay for Performance Systems
External Knowledge Source
PBM
E-Prescribing Network
Reference Labs
External CPR/EMR
Clinical Trial Data Manager
Italicized entries are the most speculative

Data market

Resources

- **Who do you need for (big) data research?**
  - Clinician: Idea
  - Researcher: Excecution study
  - Statistician: Correct analysis
  - Datamanager: Get correct data
  - Data engineer: Database
  - ICT departement: Software
  - Technician: Hardware

Use the data

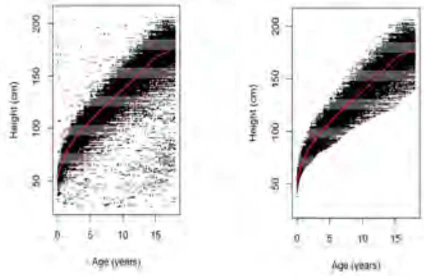
- **Processing data**
  - Usability
  - Cleaning
  - Data to determinant
- **Analysis**
  - Missing data
  - Errors in the data (artifacts)
  - Modelling

Cleaning

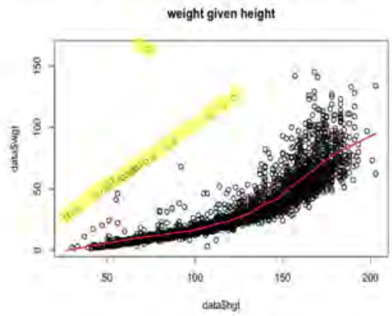
Cleaning

- **Why it is important**
  - Unstructured raw-data
  - Usability
  - Removal errors / inconsistencies

Data cleaning: Example MPOG blood pressure



Data cleaning: Example MPOG blood pressure



How to deal with missing data

- **Options**
  - Exclude records with missing data (bias)
  - Imputation techniques
  - Limit variables used (study design)
- **Understand missing data mechanism, how EHR is used**
  - Missing completely at random (MCAR)
  - Missing at random (MAR)
  - Missing not at random (MNAR)

  - Example: Missing when no

Cleaning

- **Steps**
  1. **Explore**
     - Monitor Errors
     - Wrangling
  2. **Convert**
     - Standardize
     - Validate
     - De-duplicate

JAMA Pediatrics | Original Investigation

Association of Anesthesia and Surgery During Childhood With Long-term Academic Performance

JAMA Ped 2016

Swedish Medical Birth Register:
- ***Nationwide*** cohort study among all children born in Sweden between January 1973 and December 1993
  - n= 159 619

Swedish Patient Register:
- Anesthesia and surgery before age 4 years:
  - n= 33 514

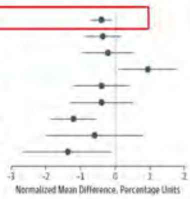
School grades & IQ test scores at military conscription:
- Academic and cognitive performance and IQ test

Association of Anesthesia and Surgery During Childhood With Long-term Academic Performance

JAMA Ped 2016

- Sch

Type of Surgery	No. of Surgical Procedures	Mean (95% CI)
All operations	32857	-0.41 (-0.70 to -0.12)
Inguinal hernia	9645	-0.36 (-0.86 to 0.15)
Abdominal	4326	-0.21 (-0.95 to 0.52)
Urology	3466	0.93 (0.12 to 1.75)
Orthopedics	3745	-0.41 (-1.20 to 0.38)
Plastic, minimal	3180	-0.40 (-1.27 to 0.47)
ENT	6212	-1.22 (-1.87 to -0.57)
Paracentesis	1155	-0.60 (-1.98 to 0.78)
Eye, minimal	1128	-1.37 (-2.67 to -0.08)

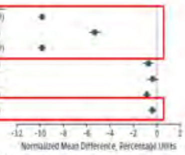


Association of Anesthesia and Surgery During Childhood With Long-term Academic Performance

JAMA Ped 2016

A Mean school grades

	Mean (95% CI)
Boys vs girls	-9.88 (-9.69 to -10.10)
Born in December vs January of the same year	-5.34 (-4.89 to -5.80)
Maternal educational level, 10-12 vs >12 y	-9.89 (-9.61 to -10.20)
Inguinal hernia, operated children vs controls[a]	-0.75 (-1.17 to -0.34)
Inguinal hernia, operated children vs controls	-0.36 (-0.86 to 0.15)
All operations, operated children vs controls[a]	-0.87 (-1.11 to -0.64)
All operations, operated children vs controls	-0.41 (-0.70 to -0.12)



Conclusion:
- Exposure to anesthesia < 4 is associated with small difference in academic performance or cognitive performance
- "The magnitude of this association should be interpreted in light of potential adverse effects of postponing surgery"

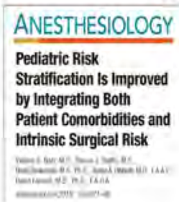
Development of a Pediatric Risk Assessment Score to Predict Perioperative Mortality in Children Undergoing Noncardiac Surgery

Anesth Analg 2017;124:1514–9

Viviane G. Nasr, MD,* James A. DiNardo, MD, FAAP,* and David Faraoni, MD, PhD, FCCP†

Prospective External Validation of the Pediatric Risk Assessment Score in Predicting Perioperative Mortality in Children Undergoing Noncardiac Surgery

Anesth Analg 2019;129:1014–20



- ACS NSQIP-Pediatric
- <18 yr & non-cardiac surgery
- 367 065 surgical cases

What is a normal blood pressure in children under anesthesia?

Reference Values for Noninvasive Blood Pressure in Children during Anesthesia

A Multicentered Retrospective Observational Cohort Study

Jurgen C. de Graaff, M.D., Ph.D., Wietze Pasma, D.V.M., Stef van Buuren, Ph.D., Jesse J. Duijghuisen, M.D., Olubukola O. Nafiu, M.D., Sachin Kheterpal, M.D., Wilton A. van Klei, M.D., Ph.D.

Anesthesiology 2016

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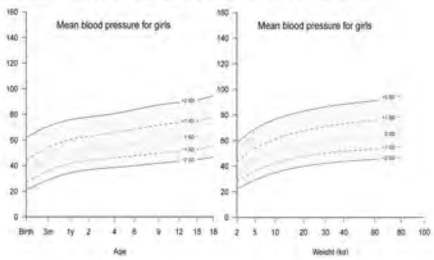
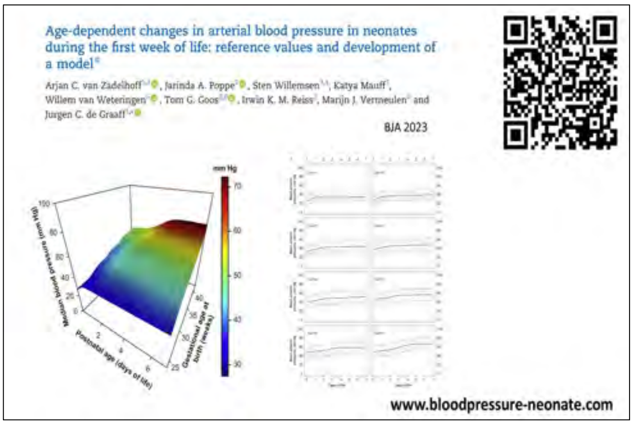
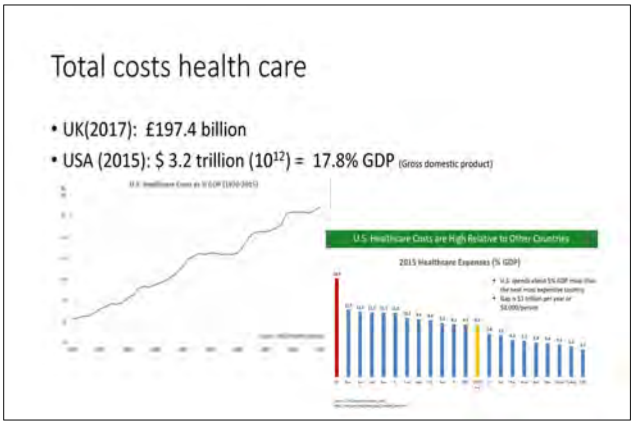


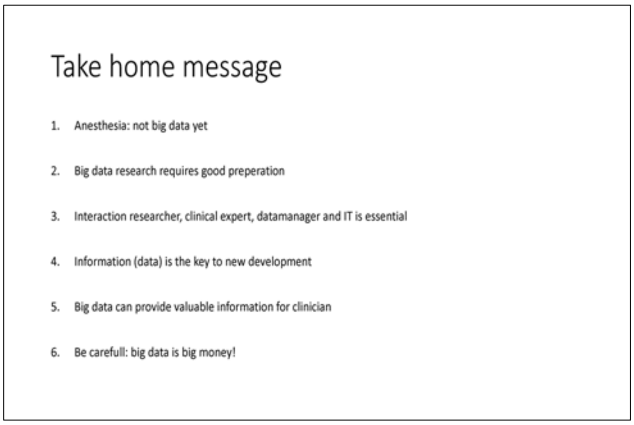
Anesthesiology 2016


Online blood pressure check:
www.pediatric-anesthesia.eu
Pediatric anesthesia
Calculator


Age-dependent changes in arterial blood pressure in neonates during the first week of life: reference values and development of a model
Arjan C. van Zadelhoff, Jarinda A. Poppe, Sten Willemsen, Katya Mauff, Willem van Weteringen, Tom G. Goos, Irwin K. M. Reiss, Marijn J. Vermeulen and Jurgen C. de Graaff
BJA 2023
www.bloodpressure-neonate.com


Total costs health care
• UK(2017): £197.4 billion
• USA (2015): $ 3.2 trillion (10^12) = 17.8% GDP (Gross domestic product)
U.S. Healthcare Costs are High Relative to Other Countries
2015 Healthcare Expenses (% GDP)


Big market!
Healthcare Information Technology market
HEALTHCARE INFORMATION TECHNOLOGY (IT) MARKET
Global Market Insights
Revenue cycle management business sector value by 2025: $114.5 BN
Telehealth sector CAGR (2019-25): 19.1%
Healthcare payer market CAGR (2019-25): 15.6%
Japan industry CAGR (2018-24) 17.2%
U.S. market value by 2025: $141.7 BN
UK market value by 2025: $24.7 BN
China market CAGR (2018-24) 19.3%
$163.3 BN
CAGR (2019-25): >15.4%
>$441.8 BN
2018
2019
2020
2021
2022
2023
2024
2025


Take home message
1. Anesthesia: not big data yet
2. Big data research requires good preperation
3. Interaction researcher, clinical expert, datamanager and IT is essential
4. Information (data) is the key to new development
5. Big data can provide valuable information for clinician
6. Be carefull: big data is big money!


ESPA CONGRESS
PRAGUE
13th European Congress for Paediatric Anaesthesiology
September 28–30, 2023
Prague, Czech Republic
www.espacongress.com | www.euroespa.com
ESPA

Reducing Our Carbon Footprint: Easy Changes to Our Practice that Reduce Cost and Carbon Emissions (Virtual)

Diane Gordon

Children's Hospital Colorado, USA

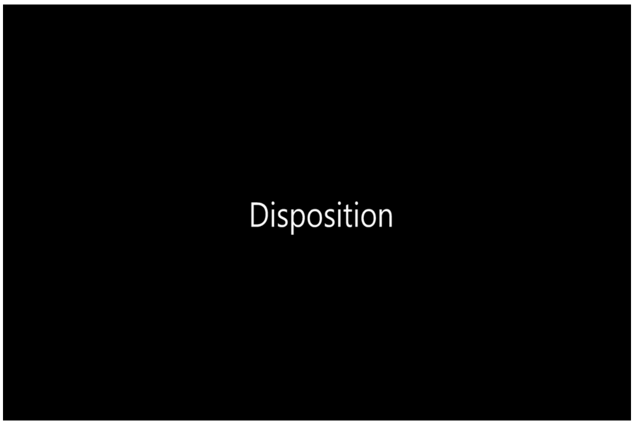
Learning Objectives

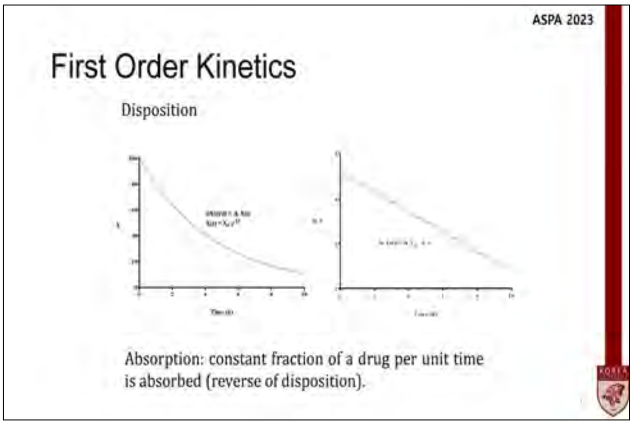
1. Explain the rationale for omitting desflurane from practice
2. Compare the benefits of removing nitrous oxide from practice to the decommissioning of the central nitrous pipeline
3. Roughly calculate metabolic oxygen requirements and lowest-possible fresh gas flows for delivery of volatile anesthetics to children

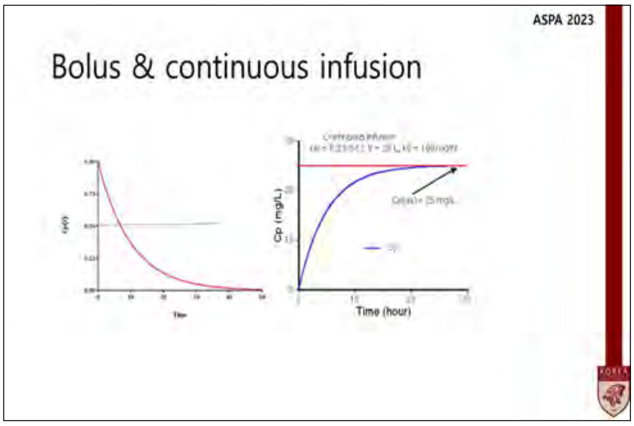
Consideration of Pharmacokinetic Models for Pediatric Patients

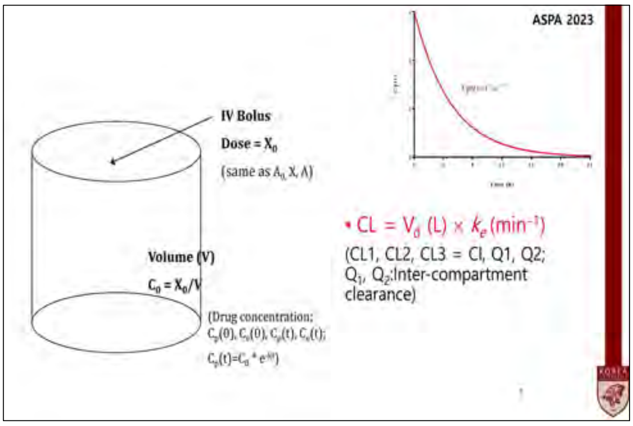
Young Sung Kim

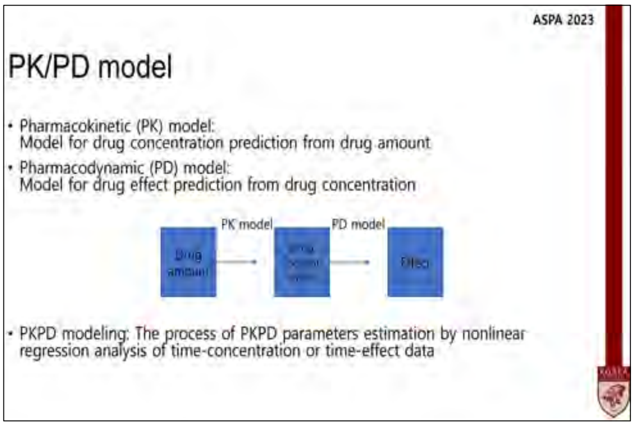
Department of Anesthesiology and Pain Medicine, Korea University Medical Center, Korea

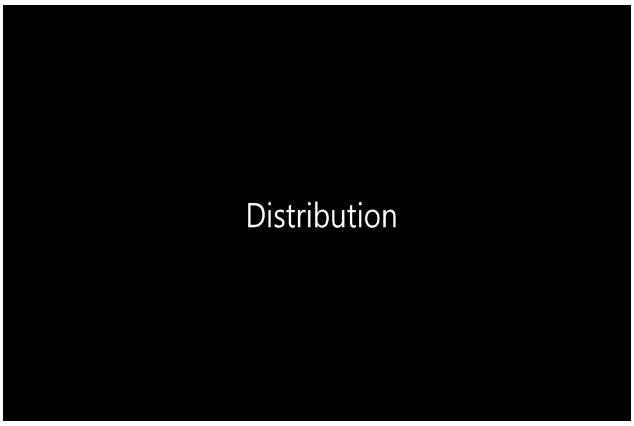


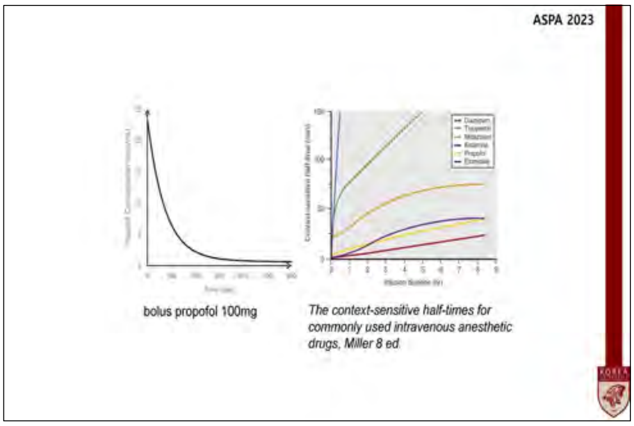


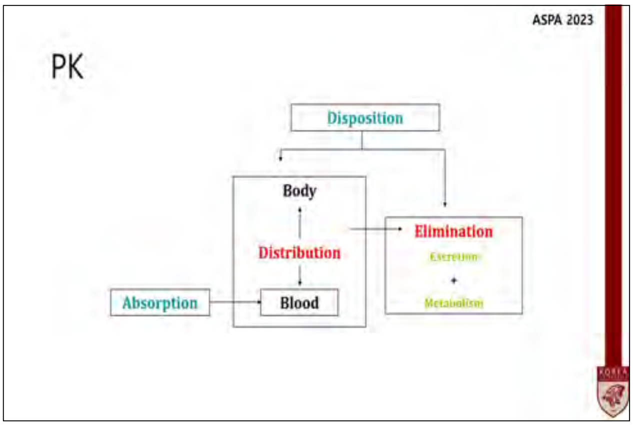


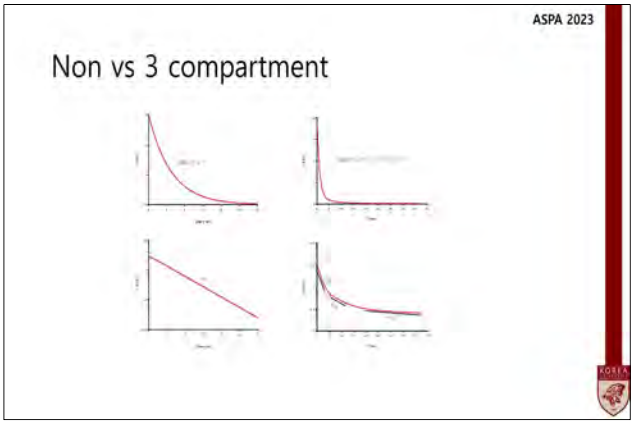


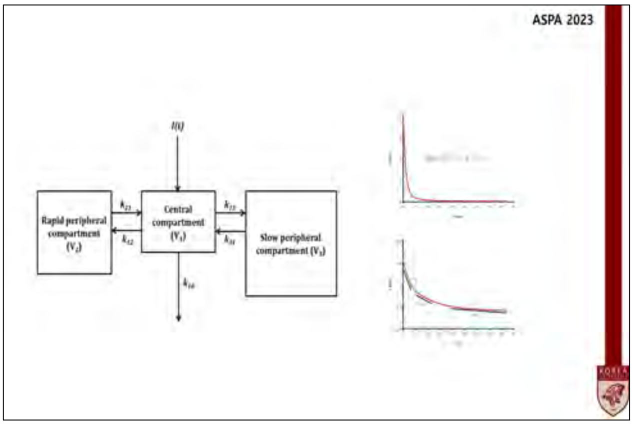


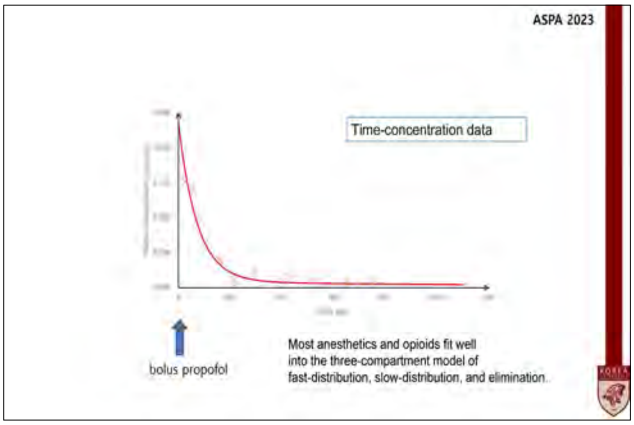


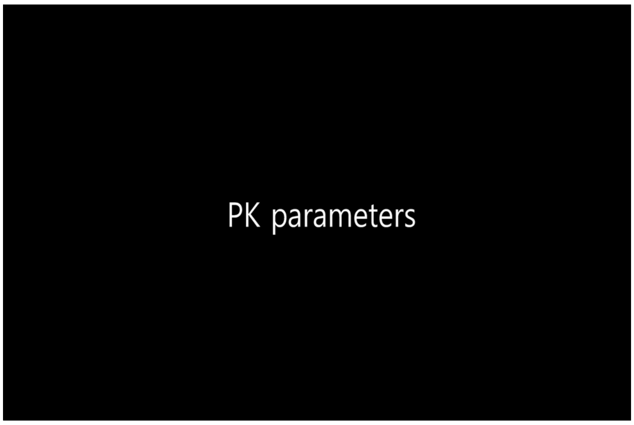

ASPA 2023
bolus propofol 100mg
The context-sensitive half-times for commonly used intravenous anesthetic drugs, Miller 8 ed.

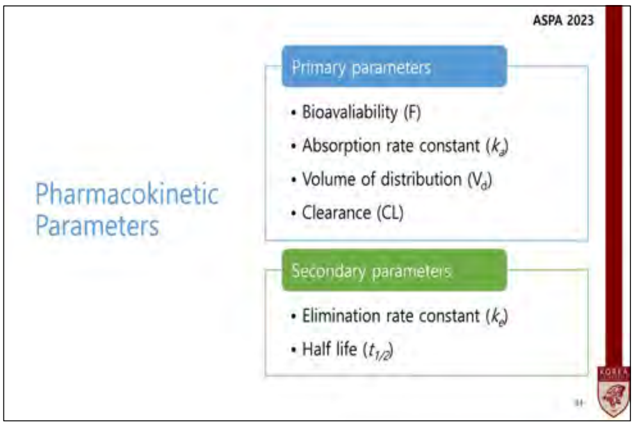

ASPA 2023
PK
Disposition
Body
Distribution
Elimination
Absorption
Blood

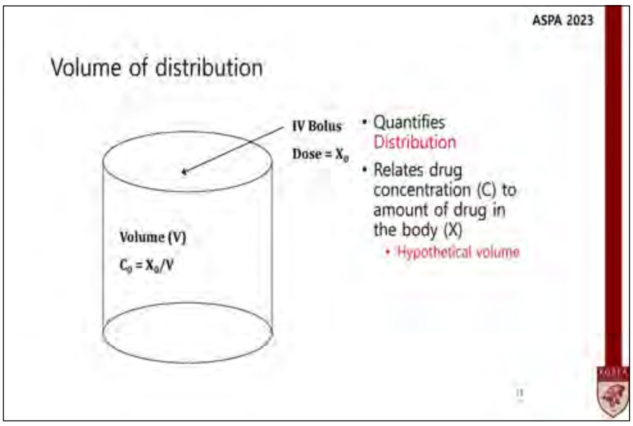

ASPA 2023
Non vs 3 compartment


ASPA 2023
Rapid peripheral compartment (V_2)
Central compartment (V_1)
Slow peripheral compartment (V_3)
k_{21}
k_{12}
k_{13}
k_{31}
k_{10}


ASPA 2023
Time-concentration data
bolus propofol
Most anesthetics and opioids fit well into the three-compartment model of fast-distribution, slow-distribution, and elimination.


PK parameters


ASPA 2023
Pharmacokinetic Parameters
Primary parameters
• Bioavaliability (F)
• Absorption rate constant (k_a)
• Volume of distribution (V_d)
• Clearance (CL)
Secondary parameters
• Elimination rate constant (k_e)
• Half life ($t_{1/2}$)


ASPA 2023
Volume of distribution
IV Bolus
Dose = X_0
Volume (V)
$C_0 = X_0/V$
• Quantifies Distribution
• Relates drug concentration (C) to amount of drug in the body (X)
• Hypothetical volume

ASPA 2023

Clearance

- Clearance (CL) = 1 L/min
- dx/dt (rate of change for drug amount in the body)

Concentration (C)	dx/dt
0	0
1 mg/L	1 mg/min
100 mg/L	100 mg/min
	dx/dt = CL·C

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Clearance

- Quantifies Elimination
- The volume of body fluid cleared per time (L/h, ml/min)
  - $CL = V_d\ (L) \times k_e\ (min^{-1})$
- Usually constant (linear PK)
- Total body clearance is the sum of the individual organ clearances
  - $CL = CL_R + CL_H + CL_{others}$

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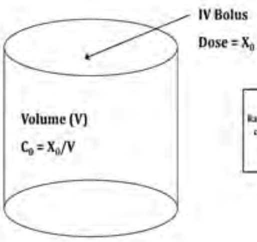

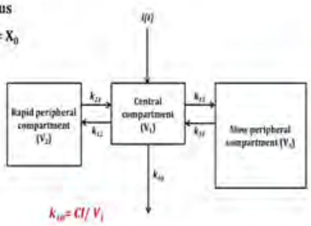

$k_{10} = Cl / V_1$

$k_{12} = Q_1 / V_1$

$k_{13} = Q_2 / V_1$

$k_{21} = Q_1 / V_2$

$k_{31} = Q_2 / V_3$

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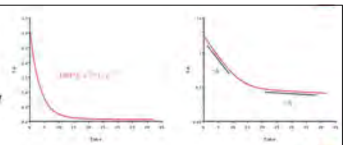
$$Cp(t) = C \cdot e^{-\lambda \cdot t}$$

$$C = \frac{1}{V}$$

$$\lambda = k$$

$$Cp(t) = C_1 \cdot e^{-\lambda_1 \cdot t} + C_2 \cdot e^{-\lambda_2 \cdot t}$$



$$C_1 = \frac{(\lambda_1 - k_{21})}{V_1 \cdot (\lambda_1 - \lambda_2)}$$

$$C_2 = \frac{(k_{21} - \lambda_2)}{V_1 \cdot (\lambda_1 - \lambda_2)}$$

$$\lambda_1 = \frac{(k_{10} + k_{12} + k_{21}) + \sqrt{(k_{10} + k_{12} + k_{21})^2 - 4k_{10}k_{21}}}{2}$$

$$\lambda_2 = k_{10} + k_{12} + k_{21} - \lambda_1 = \frac{(k_{10} + k_{12} + k_{21}) - \sqrt{(k_{10} + k_{12} + k_{21})^2 - 4k_{10}k_{21}}}{2}$$

ASPA 2023

$$Cp(t) = C_1 \cdot e^{-\lambda_1 \cdot t} + C_2 \cdot e^{-\lambda_2 \cdot t} + C_3 \cdot e^{-\lambda_3 \cdot t}$$

$$C_1 = \frac{(\lambda_1 - k_{21})(\lambda_1 - k_{31})}{V_1 \cdot (\lambda_1 - \lambda_2)(\lambda_1 - \lambda_3)}$$

$$C_2 = -\frac{(\lambda_2 - k_{21})(\lambda_2 - k_{31})}{V_1 \cdot (\lambda_1 - \lambda_2)(\lambda_2 - \lambda_3)}$$

$$C_3 = \frac{(\lambda_3 - k_{21})(\lambda_3 - k_{31})}{V_1 \cdot (\lambda_1 - \lambda_3)(\lambda_2 - \lambda_3)}$$

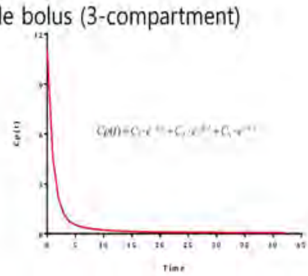
$$s^3 + (k_{10} + k_{12} + k_{13} + k_{21} + k_{31})s^2 + (k_{10}k_{21} + k_{13}k_{21} + k_{10}k_{31} + k_{12}k_{31} + k_{21}k_{31})s + k_{10}k_{21}k_{31}$$

$$(s + \lambda_1)(s + \lambda_2)(s + \lambda_3)$$

$$= s^3 + (\lambda_1 + \lambda_2 + \lambda_3)s^2 + (\lambda_1\lambda_2 + \lambda_1\lambda_3 + \lambda_2\lambda_3)s + \lambda_1\lambda_2\lambda_3$$

ASPA 2023

Single bolus (3-compartment)



$Cp(0) = C_1 + C_2 + C_3$

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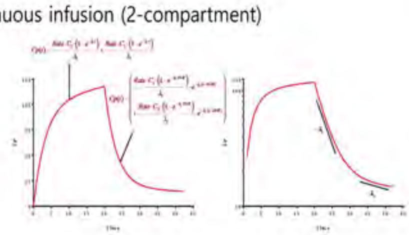
Continuous infusion (2-compartment)



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Summary for PK parameters

$$Cp(t) = C_1 \cdot e^{-\lambda_1 \cdot t} + C_2 \cdot e^{-\lambda_2 \cdot t} + C_3 \cdot e^{-\lambda_3 \cdot t}$$

- $C_1, C_2, C_3, \lambda_1, \lambda_2, \lambda_3$: PK parameters for coefficients domain or exponents domain

$$C_1 = \frac{(\lambda_1 - k_{21})(\lambda_1 - k_{31})}{V_1 \cdot (\lambda_1 - \lambda_2)(\lambda_1 - \lambda_3)}$$

$$C_2 = -\frac{(\lambda_2 - k_{21})(\lambda_2 - k_{31})}{V_1 \cdot (\lambda_1 - \lambda_2)(\lambda_2 - \lambda_3)}$$

$$C_3 = \frac{(\lambda_3 - k_{21})(\lambda_3 - k_{31})}{V_1 \cdot (\lambda_1 - \lambda_3)(\lambda_2 - \lambda_3)}$$

- *PK models are expressed as volume of distribution and micro-rate constants ($V_1, k_{10}, k_{12}, k_{21}, k_{13}, k_{31}$)* or volumes and clearances ($V_1, V_2, V_3, Cl, Q_1, Q_2$)
- $CL_1 = V_1 \times k_{10}$
- $CL_2 = V_1 \times k_{12} = V_2 \times k_{21}$
- $CL_3 = V_1 \times k_{13} = V_3 \times k_{31}$

K_{e0} and PD

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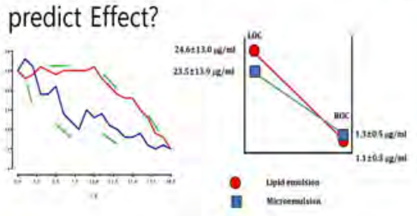
Can Cp predict Effect?

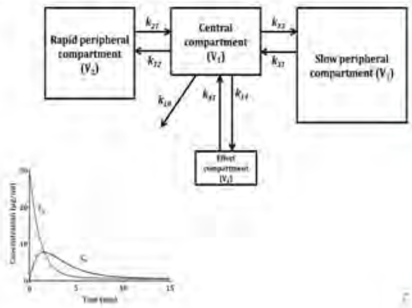


- Hysteresis curve

Anesthesiology 2007; 106: 924-34

ASPA 2023

Effect compartment



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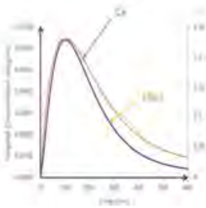
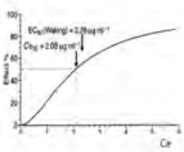
Effect site concentration (Ce)



- Sigmoid Emax curve represent 1:1 relationship with Ce and effect



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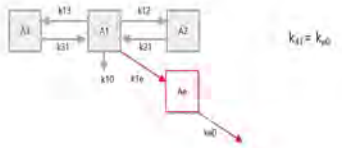
Addition of Effect compartment

$$Cp(t) = C_1 \cdot e^{-\lambda_1 \cdot t} + C_2 \cdot e^{-\lambda_2 \cdot t} + C_3 \cdot e^{-\lambda_3 \cdot t}$$

$$Ce(t) = \frac{k_{41}}{k_{41} - \lambda_1} \cdot C_1 \cdot e^{-\lambda_1 t} + \frac{k_{41}}{k_{41} - \lambda_2} \cdot C_2 \cdot e^{-\lambda_2 t} + \frac{k_{41}}{k_{41} - \lambda_3} \cdot C_3 \cdot e^{-\lambda_3 t} + \frac{k_{41}}{k_{41} - \lambda_4} \cdot C_4 \cdot e^{-\lambda_4 t}$$



$k_{41} = k_{e0}$

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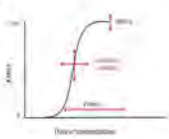
PD

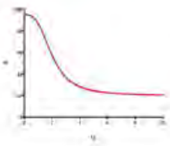


- E0: baseline effect

  Emax: maximal effect (efficacy)

  Ce50: potency (Drug concentration that induces an effect corresponding to the average value of E0 and Emax)

  gamma: sigmoidicity factor (The slope of the linear part of the concentration-effect curve)



$$E = E_0 + (E_{max} - E_0)\frac{Ce^{\gamma}}{Ce_{50}^{\gamma} + Ce^{\gamma}}$$

$$BIS = BIS_0 + (BIS_{MIN} - BIS_0) \cdot \frac{Ce^{\gamma}}{Ce_{50}^{\gamma} + Ce^{\gamma}}$$

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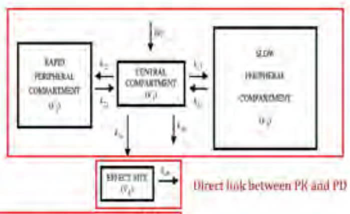
PKPD Modeling

PK



Direct link between PK and PD

PD

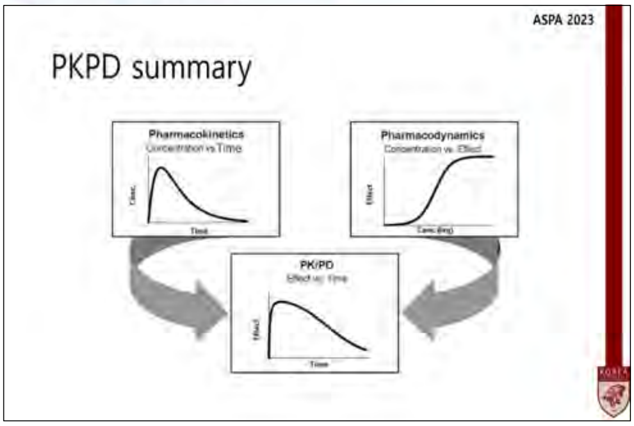
$$BIS = BIS_0 + (BIS_{MIN} - BIS_0) \cdot \frac{Ce^{\gamma}}{Ce_{50}^{\gamma} + Ce^{\gamma}}$$

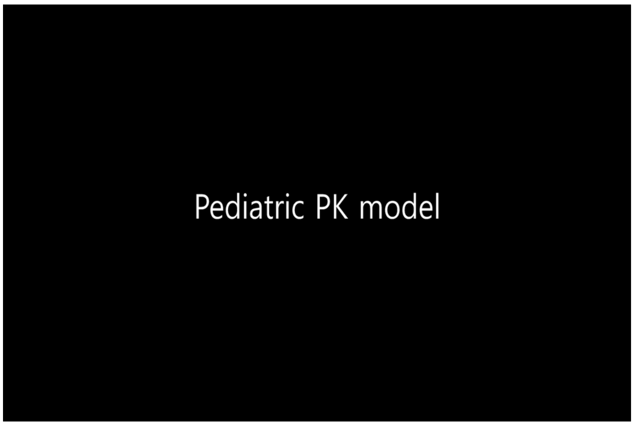
$$SBP = SBP_0 + (SBP_{MIN} - SBP_0) \cdot \frac{Ce^{\gamma}}{Ce_{50}^{\gamma} + Ce^{\gamma}}$$

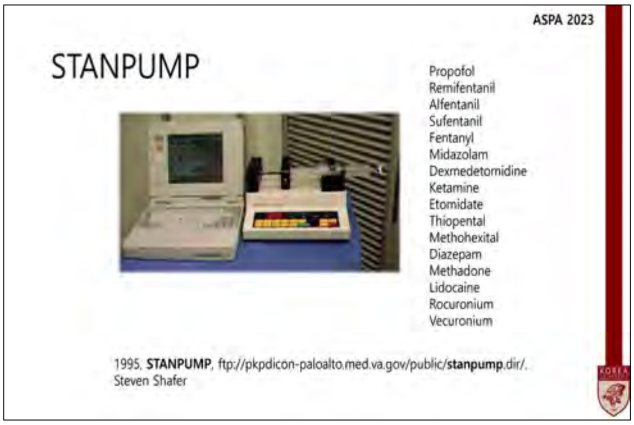
k_{e0}: onset of effect

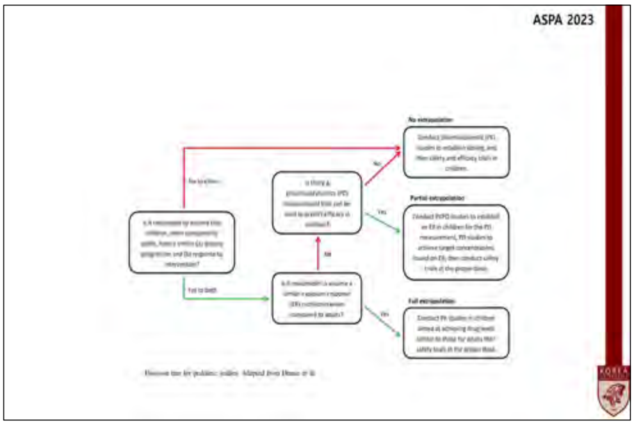
$t_{1/2}k_{e0} = 0.693/k_{e0}$

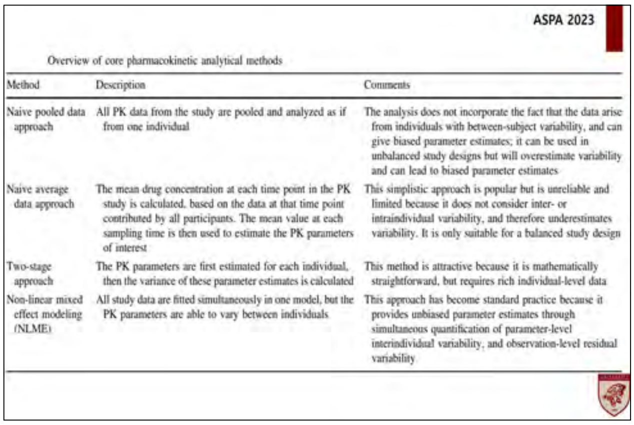
Ce_{50}: potency







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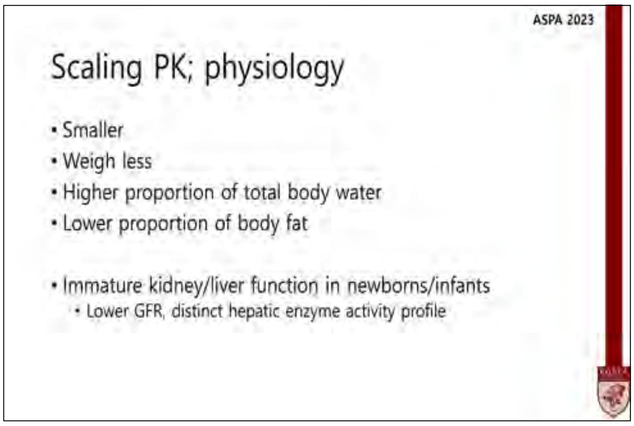
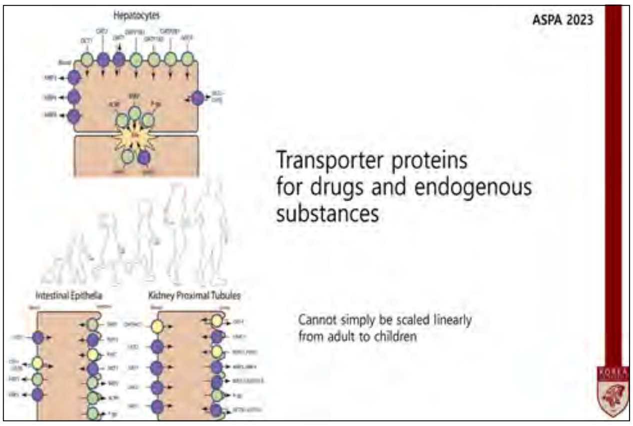
Overview of core pharmacokinetic analytical methods

Method	Description	Comments
Naive pooled data approach	All PK data from the study are pooled and analyzed as if from one individual	The analysis does not incorporate the fact that the data arise from individuals with between-subject variability, and can give biased parameter estimates; it can be used in unbalanced study designs but will overestimate variability and can lead to biased parameter estimates
Naive average data approach	The mean drug concentration at each time point in the PK study is calculated, based on the data at that time point contributed by all participants. The mean value at each sampling time is then used to estimate the PK parameters of interest	This simplistic approach is popular but is unreliable and limited because it does not consider inter- or intraindividual variability, and therefore underestimates variability. It is only suitable for a balanced study design
Two-stage approach	The PK parameters are first estimated for each individual, then the variance of these parameter estimates is calculated	This method is attractive because it is mathematically straightforward, but requires rich individual-level data
Non-linear mixed effect modeling (NLME)	All study data are fitted simultaneously in one model, but the PK parameters are able to vary between individuals	This approach has become standard practice because it provides unbiased parameter estimates through simultaneous quantification of parameter-level interindividual variability, and observation-level residual variability

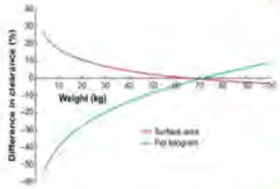


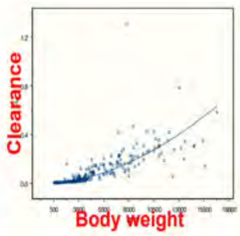


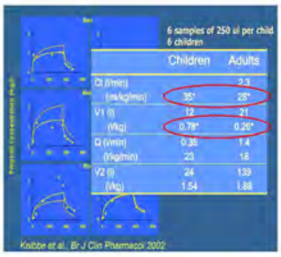
How to dose

- Population; same dose for everyone
- Group (covariate guided);
  - Small dose for similar group (ex. CLcr, genotype)
- Individual
  - Determined by individual response (ex. BP, INR, blood conc)

- Body size
  - Linear weight > body surface area
- Clearance
  - Low for neonates/infants







6 samples of 250 ul per child
6 children

	Children	Adults
Cl (l/min)		2.3
(ml/kg/min)	35*	28*
V1 (l)	12	21
(l/kg)	0.78*	0.26*
Q (l/min)	0.35	1.4
(l/kg/min)	23	18
V2 (l)	24	139
(l/kg)	1.54	1.88

Knibbe et al., Br J Clin Pharmacol 2002

Weight

The effective dose of propofol for loss of lash reflex was significantly lower in obese paediatric patients (ED95 2.0mg kg−1) in comparison with non-obese patients (3.2mg kg−1)

Selected Weight Scalars

Weight Scalar	Comments	Formula
Total body weight (TBW)	The total weight of an individual	None
[illegible]	[illegible]	None
Ideal body weight (IBW)	[illegible]	[illegible]
Lean body weight (LBW)	[illegible]	[illegible]
Fat-free mass (FFM)	[illegible]	[illegible]
Adjusted body weight (ABW)	[illegible]	[illegible]
Pharmacokinetic mass (PK mass)	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

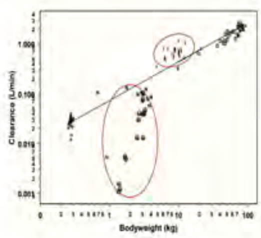
Scaled Weights and Induction Doses of Common Intravenous Anesthetics for a Lean and Obese Male Individual of the Same Height

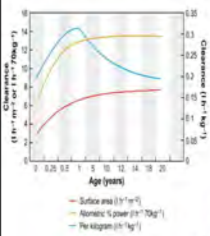
	Scaled weight (kg)		Propofol		Fentanyl		Rocuronium	
	Lean	Obese	Lean	Obese	Lean	Obese	Lean	Obese
Total body weight	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Ideal body weight	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lean body weight	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Fat-free mass	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Adjusted body weight	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pharmacokinetic mass	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Cf. unique property~ various recommendation

Drug	Bolus	Infusion
Sedatives		
Propofol	Loading dose titrated to target processed EEG level	ABW
Midazolam	TBW	IBW
Etomidate		IBW
Opioids		
Fentanyl	PK mass	PK mass
Remifentanil	FFM	FFM
Sufentanil	TBW	
Hydromorphone	LBW	
Morphine	LBW	
Neuromuscular Blocking Agents and Reversals		
Succinylcholine	TBW	
Rocuronium	IBW	
Vecuronium	IBW	
Cisatracurium	IBW	
Sugammadex	IBW	

Neonates ≠ young infants





$$CL_{PREDICTED} = CL_{STD} \cdot \left(\frac{WT}{WT_{STD}}\right)^{3/4} \cdot MF \cdot OF$$

Size

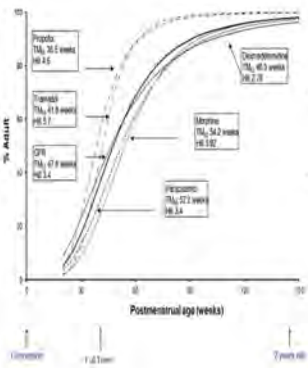
Maturation

Organ Function

$CL_{PREDICTED}$=Group CL CL_{STD}=Population standard CL

WT =Total Body Weight WT_{STD}=Standard weight e.g. 70 kg

Tod M, Jullien V, Pons G. Facilitation of drug evaluation in children by population methods and modelling. Clin Pharmacokinet. 2008;47(4):231-43.



- Maturation complete by age 2 yr
- Size is then the main predictor of drug clearance

Propofol models

ASPA 2023

Propofol Marsh PK model

$$V_1\ (l) = 0.228 \cdot \text{weight}$$
$$k_{10}\ (\text{min}^{-1}) = 0.119$$
$$k_{12}\ (\text{min}^{-1}) = \text{~~0.112~~}\ 0.114$$
$$k_{13}\ (\text{min}^{-1}) = 0.0419$$
$$k_{21}\ (\text{min}^{-1}) = 0.055$$
$$k_{31}\ (\text{min}^{-1}) = 0.0033$$

Propofol Schnider PK model

$$V_1\ (l) = 4.27$$
$$V_2\ (l) = 18.9 - 0.391 \cdot (\text{age} - 53)$$
$$V_3\ (l) = 238$$
$$Cl_1\ (l \cdot \text{min}^{-1}) = 1.89 + 0.0456 \cdot (\text{weight} - 77) + 0.0264 \cdot (\text{height} - 177) - 0.0681 \cdot (\text{LBM} - 59)$$
$$Cl_2\ (l \cdot \text{min}^{-1}) = 1.29 - 0.024 \cdot (\text{age} - 53)$$
$$Cl_3\ (l \cdot \text{min}^{-1}) = 0.836$$

Values not presented can be easily obtained by using Clearance = V * k.

V1 * k12 = V2 * k21
V1 * k13 = V3 * k31

Cl1 = V1 * k10
Cl2 = V1 * k12
Cl3 = V1 * k13

ASPA 2023

Marsh PK model

- 1987 presented
- Rate constants from Gepts, V1 from marsh, ke0 from Schnider

(Coefficients obtained in different populations)

V_1 (L)	0.228 * weight (kg): "obtained from our own pilot studies" - no data given
k_{10} (min^{-1})	0.119
k_{12} (min^{-1})	0.112: 0.114 in Gepts
k_{13} (min^{-1})	0.0419
k_{21} (min^{-1})	0.055
k_{31} (min^{-1})	0.0033

ASPA 2023

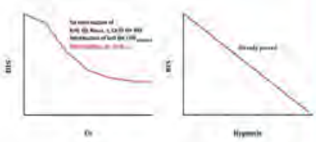
Marsh Model with k_{e0} used for effect-site targeting

- Marsh model in Stelpump and Diprifusor
  - Marsh PK
  - k_{e0}: 0.26 min^{-1}
    - Reference: unknown (maybe Billard et al.)
    - Surrogate measure: unknown (maybe BIS)
- Marsh model in Stanpump and Orchestra
  - Marsh PK
  - k_{e0}: 1.2193 min^{-1} (Orchestra: 1.210 min^{-1})
    - t_{peak} algorithm proposed by Schnider et al.
      - Observed t_{peak} of propofol assessed by CUP of propofol=1.6 min (not BIS)

ASPA 2023

Ce in Modified Marsh Model

- Just hypothetical concentration without a time delay to some effects(?) of propofol on the CNS



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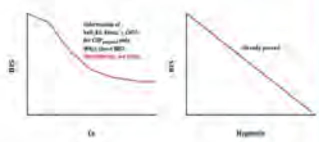
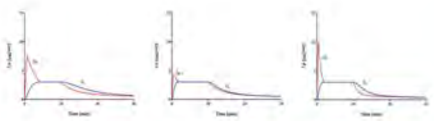
Ce in Schnider Model

- Just hypothetical concentration without a time delay to $CUP_{propofol}$ as long as we monitor BIS during surgery.



ASPA 2023



Marsh (Diprifusor), k_{e0} = 0.26
V_1 = 14.82
Total dose = 180 mg

Modified Marsh, k_{e0} = 1.21
V_1 = 14.82
Total dose = 157 mg

Schnider, k_{e0} = 0.46
V_1 = 4.27
Total dose = 130 mg

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Pediatric PK models

- Kataria model

V1 (L)	Weight*0.41	Weight*0.38
V2 (L)	Weight*0.78+3.1*Age-15.5	Weight*0.59+3.1*Age-13
V3 (L)	Weight*6.9	Weight*6.1
CL1 (L/min)	Weight*0.035	Weight*0.037
CL2 (L/min)	Weight*0.077	Weight*0.063
CL3 (L/min)	Weight*0.026	Weight*0.025

Pediatric PK models

- Paedfusor model

(5year, 20kg)	Kataria	Paedfusor
V1 (L)	10.4	9.16
V2	20.2	18.98
V3	164	116.58
CL1 (L/min)	0.68	0.568
CL2	1.16	1.044
CL3	0.52	0.384

Colombian Journal of Anesthesiology 41(3):205-214 (2013)
Anesthesiology 80:104-122 (1994)
British Journal of Anaesthesia 95(1): 110-13 (2005)

'Paedfusor' propofol pharmacokinetic data set

Age 1–12 yr		
V1=458.4×weight	$V2=V1 \times k_{12}/k_{21}$	$V3=V1 \times k_{13}/k_{31}$
k_{10}=0.1527×weight$^{-0.3}$	k_{12}=0.114	k_{13}=0.0419
k_{21}=0.055	k_{31}=0.0033	k_{e0}=0.26
Age 13 yr		
V1=400.0×weight	k_{10}=0.0678	
Other constants as above		
Age 14 yr		
V1=342.0×weight	k_{10}=0.0792	
Other constants as above		
Age 15 yr		
V1=284.0×weight	k_{10}=0.0954	
Other constants as above		
Age 16 yr		
V1=228.57×weight	k_{10}=0.119	
Other constants as above		
Maximum bolus size		
Weight <15 kg=3 mg	Weight <30 kg=6 mg	Weight >30 kg=12 mg

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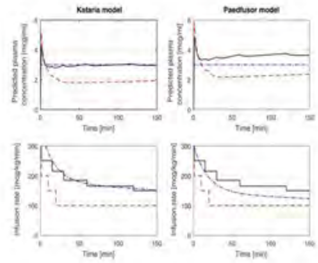

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Our center data (scoliosis)

	Kataria (N=27)	Paedfusor (N=43)	Schneider (N=26)
Intraoperative mean BIS	41.78 (7.32)*	50.00 (7.81)	44.69 (8.60)
Operation time	258.59 (108.64)	229.09 (105.77)	301 (72.38)
Anesthesia time	380.00 (125.67)	355.51 (109.90)	417.00 (84.70)
Recovery time	29.96 (21.19)*	21.14 (14.21)	25.92 (16.55)
ICU admission (Y/N)	4 / 23	6 / 37	2 / 24

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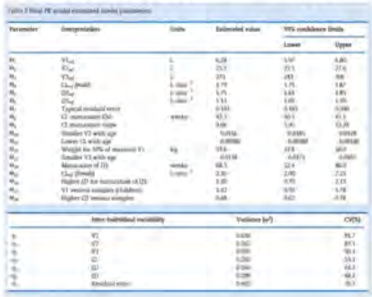
Eleveld model (27 wks to 88 yr)



ASPA 2023

Variables	Parameters	Estimate
PK	V_1, L	1.69
	V_2, L	27.2 + 0.93 × (weight − 25)
	Cl, L/min	0.89 × (weight/23.6)$^{0.97}$
	Q, L/min	1.3
PD (intermediate)	E_0	76.9
	E_{max}	35.4
	C_{e50}, μg/mL	3.78 − 0.183 × AGE
	γ	3.02
	k_{e0}, /min	0.557
PD (final)	E_0	79.9
	E_{max}	30.6
	C_{e50}, μg/mL	3.65 − 0.102 × AGE − 1.72 × REMI
	γ	3.02
	k_{e0}, /min	0.557

PKPD parameters of the Kim model

Population pharmacokinetic and pharmacodynamic model of propofol externally validated in children. J Pharmacokinet Pharmacodyn. 2015; 42(2):163–177

ASPA 2023

Summary

- PK parameters including volume, clearance, rate constant explains drug concentration prediction.
- Each PK model reflects the characteristics of each population.
- Get used to TCI-TIVA with various PK models.
- Appropriate selection, interpretation and application.

Session 2.

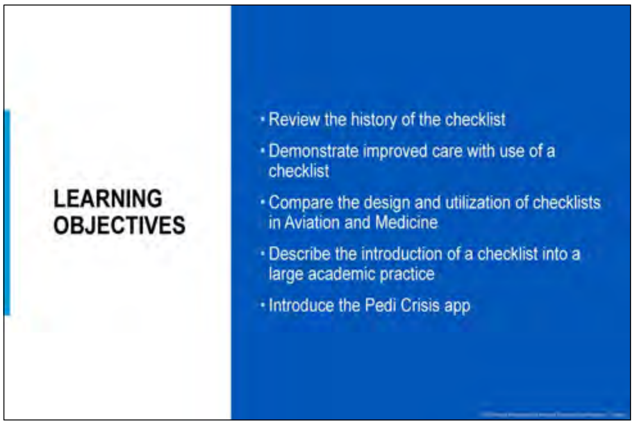
Quality Improvement

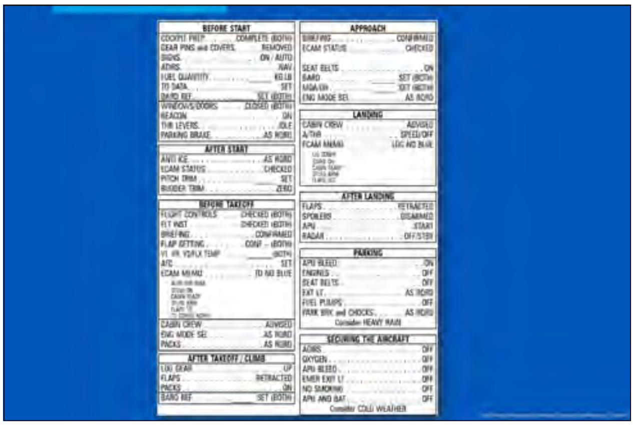
Chair(s): Erlinda Oracion (Philippines)
Sungsik Park (Korea)

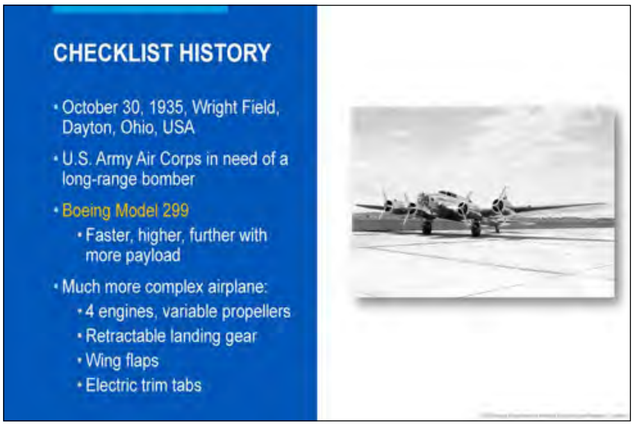
Crisis Checklists in Perioperative Care: Flying into Medicine

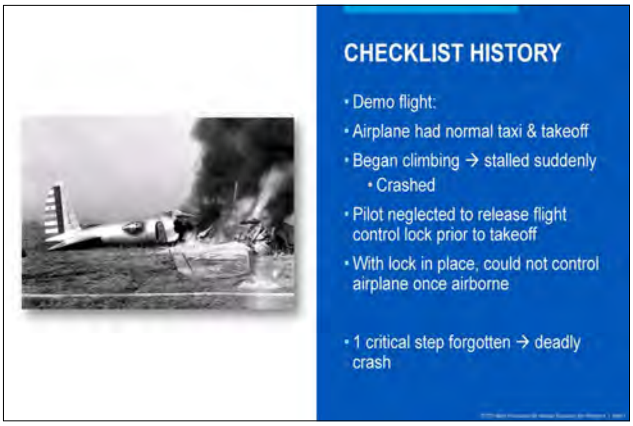
Stephen J. Gleich

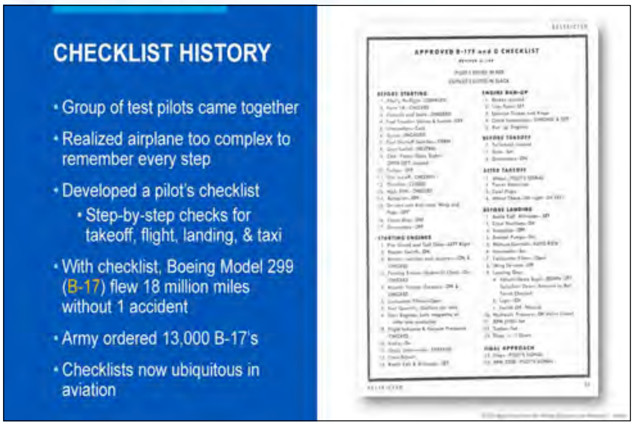
Mayo Clinic, USA

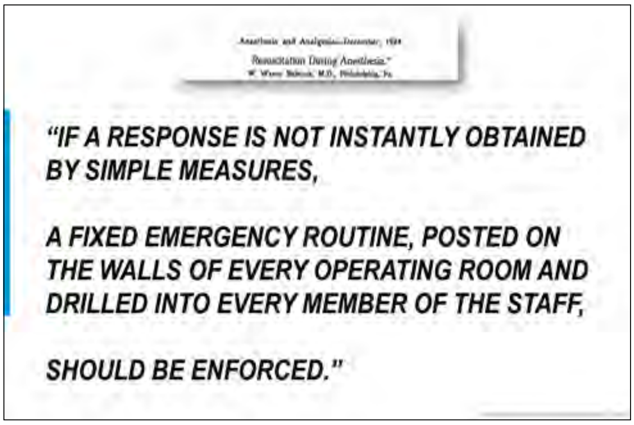


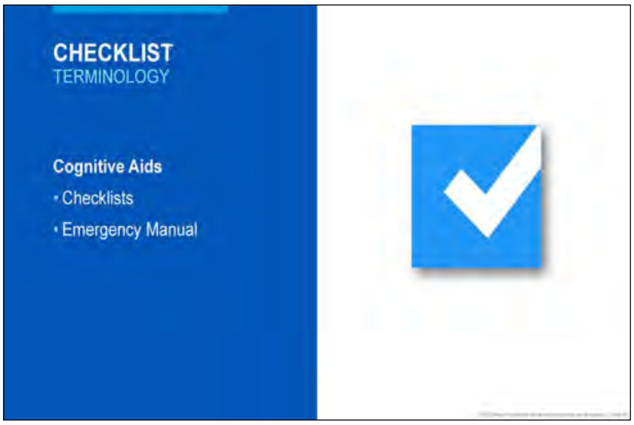


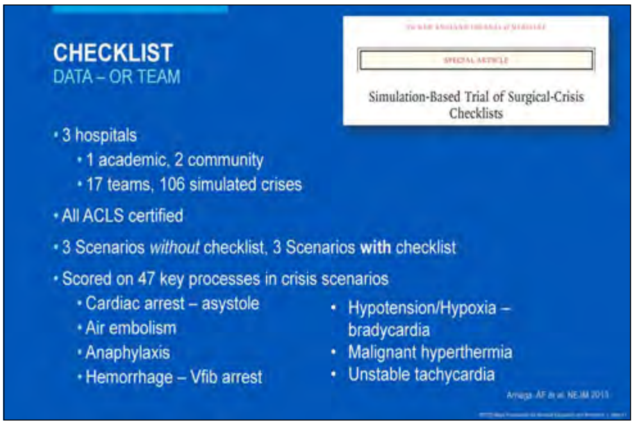


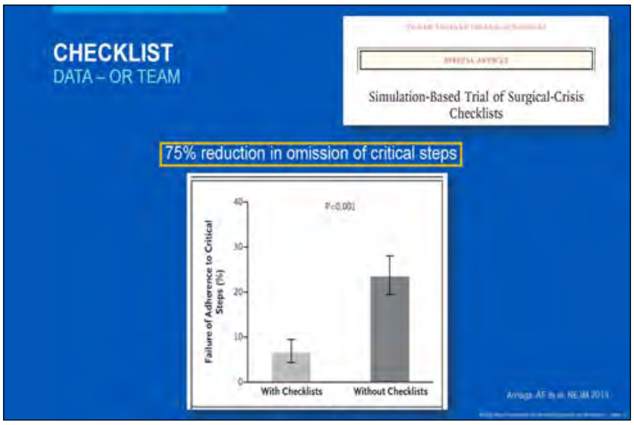


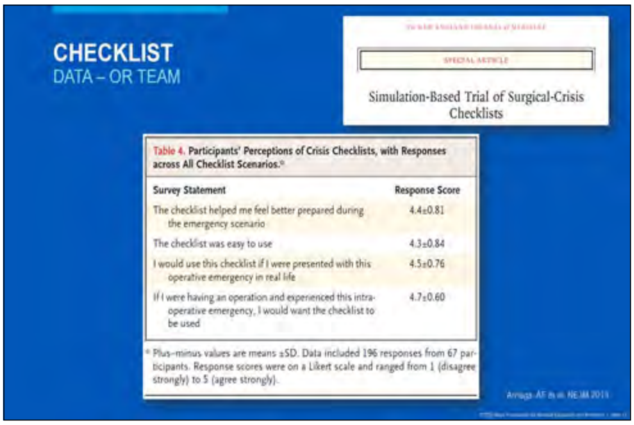

CHECKLIST HISTORY
• Group of test pilots came together
• Realized airplane too complex to remember every step
• Developed a pilot's checklist
• Step-by-step checks for takeoff, flight, landing, & taxi
• With checklist, Boeing Model 299 (B-17) flew 18 million miles without 1 accident
• Army ordered 13,000 B-17's
• Checklists now ubiquitous in aviation
APPROVED B-17F and G CHECKLIST

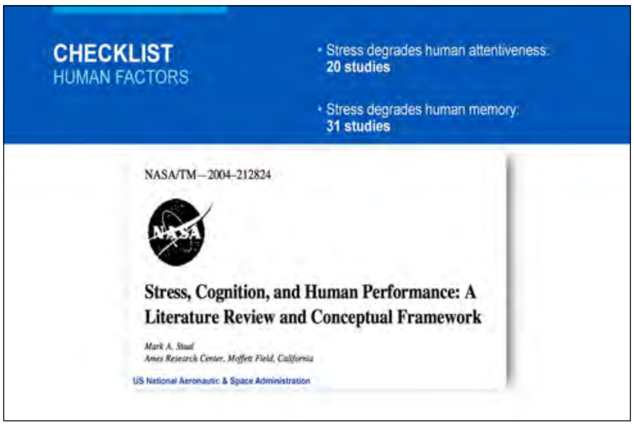

"IF A RESPONSE IS NOT INSTANTLY OBTAINED BY SIMPLE MEASURES,
A FIXED EMERGENCY ROUTINE, POSTED ON THE WALLS OF EVERY OPERATING ROOM AND DRILLED INTO EVERY MEMBER OF THE STAFF,
SHOULD BE ENFORCED."

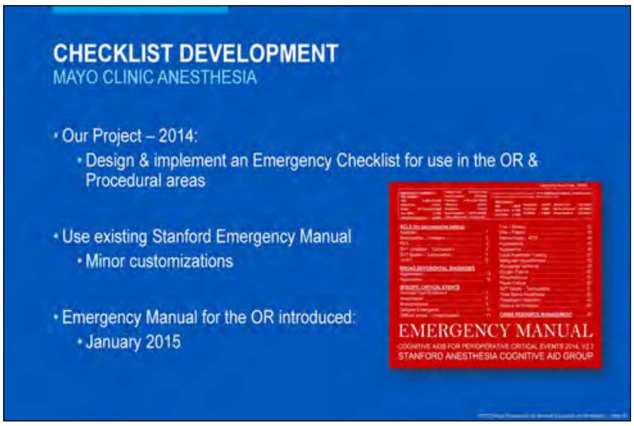

CHECKLIST
TERMINOLOGY
Cognitive Aids
• Checklists
• Emergency Manual


CHECKLIST
DATA – OR TEAM
SPECIAL ARTICLE
Simulation-Based Trial of Surgical-Crisis Checklists
• 3 hospitals
• 1 academic, 2 community
• 17 teams, 106 simulated crises
• All ACLS certified
• 3 Scenarios without checklist, 3 Scenarios with checklist
• Scored on 47 key processes in crisis scenarios
• Cardiac arrest – asystole
• Air embolism
• Anaphylaxis
• Hemorrhage – Vfib arrest
• Hypotension/Hypoxia – bradycardia
• Malignant hyperthermia
• Unstable tachycardia
Arriaga AF et al. NEJM 2013


CHECKLIST
DATA – OR TEAM
SPECIAL ARTICLE
Simulation-Based Trial of Surgical-Crisis Checklists
75% reduction in omission of critical steps
P<0.001
Failure of Adherence to Critical Steps (%)
0
10
20
30
40
With Checklists
Without Checklists
Arriaga AF et al. NEJM 2013


CHECKLIST
DATA – OR TEAM
SPECIAL ARTICLE
Simulation-Based Trial of Surgical-Crisis Checklists
Table 4. Participants' Perceptions of Crisis Checklists, with Responses across All Checklist Scenarios.*
Survey Statement | Response Score
The checklist helped me feel better prepared during the emergency scenario | 4.4±0.81
The checklist was easy to use | 4.3±0.84
I would use this checklist if I were presented with this operative emergency in real life | 4.5±0.76
If I were having an operation and experienced this intraoperative emergency, I would want the checklist to be used | 4.7±0.60
* Plus–minus values are means ±SD. Data included 196 responses from 67 participants. Response scores were on a Likert scale and ranged from 1 (disagree strongly) to 5 (agree strongly).
Arriaga AF et al. NEJM 2013


CHECKLIST
HUMAN FACTORS
• Stress degrades human attentiveness: 20 studies
• Stress degrades human memory: 31 studies
NASA/TM—2004–212824
Stress, Cognition, and Human Performance: A Literature Review and Conceptual Framework
Mark A. Staal
Ames Research Center, Moffett Field, California
US National Aeronautic & Space Administration


CHECKLIST DEVELOPMENT
MAYO CLINIC ANESTHESIA
• Our Project – 2014:
• Design & implement an Emergency Checklist for use in the OR & Procedural areas
• Use existing Stanford Emergency Manual
• Minor customizations
• Emergency Manual for the OR introduced:
• January 2015
EMERGENCY MANUAL
STANFORD ANESTHESIA COGNITIVE AID GROUP

CHECKLIST DEVELOPMENT
MAYO CLINIC ANESTHESIA

- Emergency Manual for the OR introduced:
  - January 2015

Standardized location

CHECKLIST IMPLEMENTATION
MAYO CLINIC ANESTHESIA

Emergency Manual Implementation in a Large Academic Anesthesia Practice: Strategy and Improvement in Performance on Critical Steps

ANESTHESIA & ANALGESIA

Methods

- Utilization of the EM tested in a regular clinical environment with all available resources
- Standardized verbal simulation of 3 crisis events
  - Pre-implementation
  - 6 months post-implementation
- Individual members of the anesthesia team asked to verbalize interventions for specific crisis events over 60 seconds

Crisis Events
1. Local anesthetic toxicity
2. Airway fire
3. Myocardial ischemia

CHECKLIST IMPLEMENTATION
MAYO CLINIC ANESTHESIA

Emergency Manual Implementation in a Large Academic Anesthesia Practice: Strategy and Improvement in Performance on Critical Steps

ANESTHESIA & ANALGESIA

Results

- 120 subjects
  - 60 pre, 60 post
- 42% used Emergency Manual
- Those who used EM performed better
  - 21 critical steps (70%) *vs.* 18 (60%)

CHECKLIST IMPLEMENTATION
MAYO CLINIC ANESTHESIA

Based on aviation design "step by step"

CHECKLIST
NEW DATA

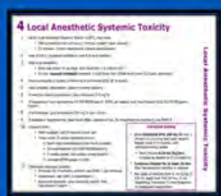
- In aviation → checklists proceed "step-by-step"
- New data suggest that OR staff:

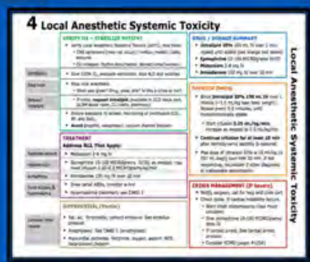
"often do not respond to critical events in such a linear manner"

- Instead, checklist used for specific purpose:
  - Look up drug dose
  - Additional info after treatment initiated
- Term: "Sampling"

Burian BK et al. Anesth Analg. 2018

Matching design to use: a task analysis comparison of three cognitive aid designs used during simulated crisis management



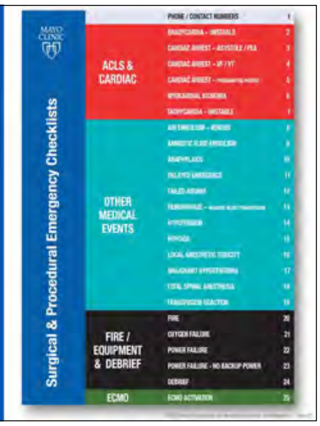


50% reduction in time to find key info

CHECKLIST IMPLEMENTATION
MAYO CLINIC ANESTHESIA

Surgical & Procedural Emergency Checklist

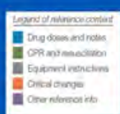
- Ariadane Labs design
- Customizable
  - Add individual events
  - Local content
  - Local phone numbers

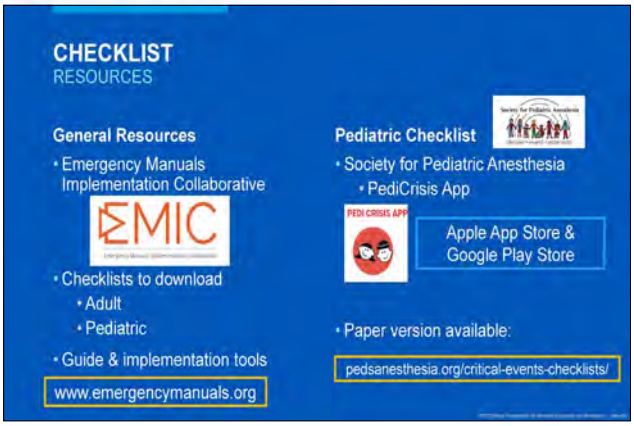


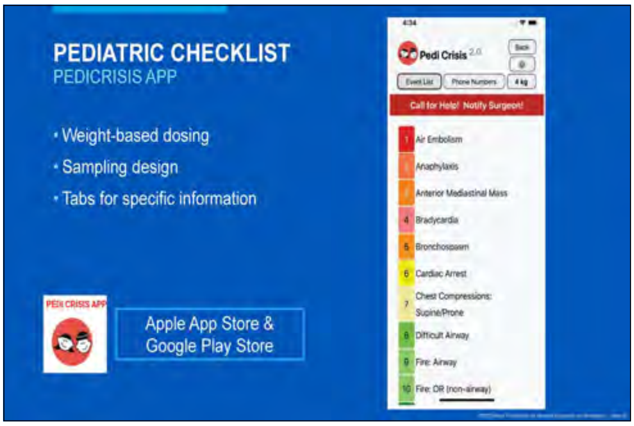
CHECKLIST IMPLEMENTATION
MAYO CLINIC ANESTHESIA

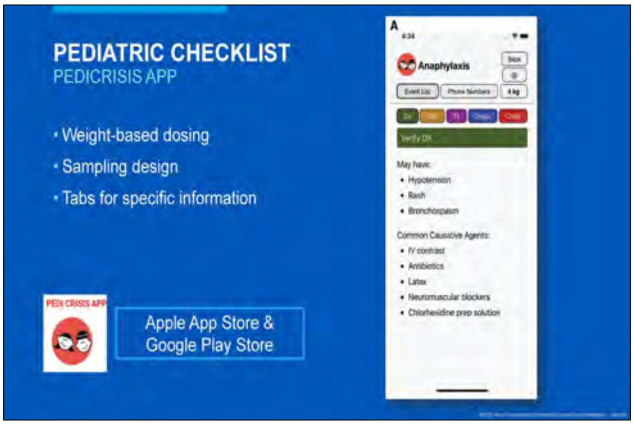
Surgical & Procedural Emergency Checklist

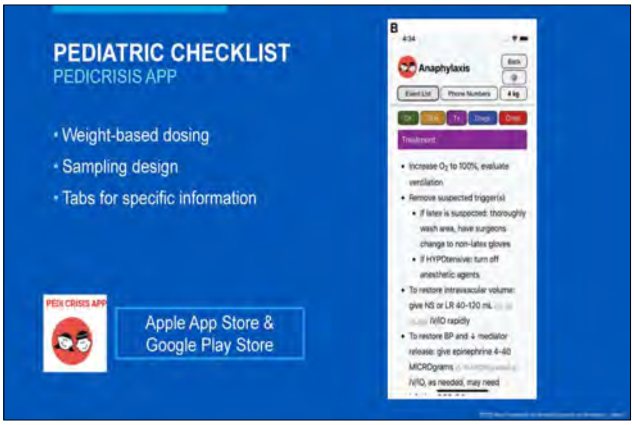
- Ariadane Labs design
- Easier access to "quick reference" info – drug doses, equipment, etc.

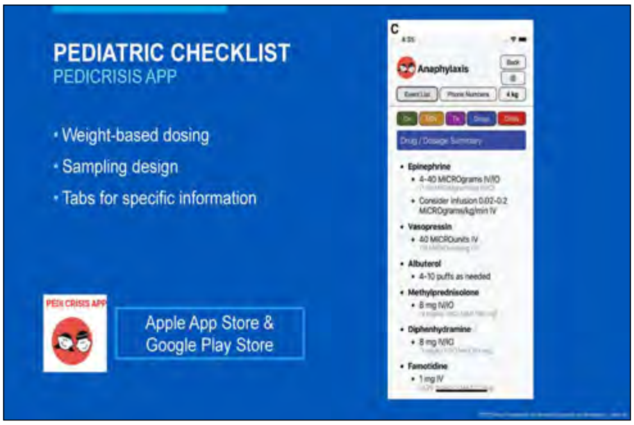


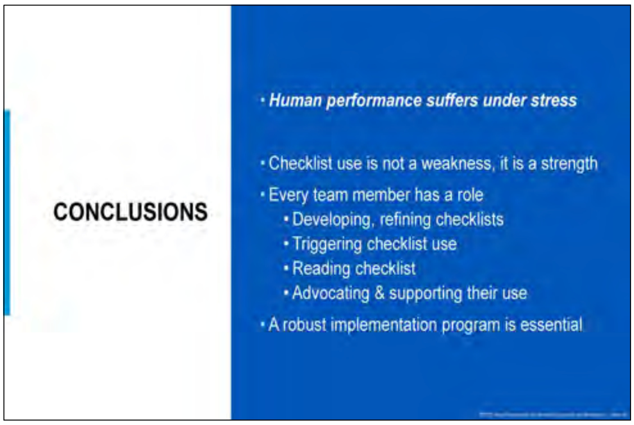

CHECKLIST
RESOURCES
General Resources
Emergency Manuals Implementation Collaborative
EMIC
Checklists to download
Adult
Pediatric
Guide & implementation tools
www.emergencymanuals.org
Pediatric Checklist
Society for Pediatric Anesthesia
PediCrisis App
PEDI CRISIS APP
Apple App Store & Google Play Store
Paper version available:
pedsanesthesia.org/critical-events-checklists/


PEDIATRIC CHECKLIST
PEDICRISIS APP
Weight-based dosing
Sampling design
Tabs for specific information
PEDI CRISIS APP
Apple App Store & Google Play Store
Pedi Crisis
Call for Help! Notify Surgeon!
Air Embolism
Anaphylaxis
Anterior Mediastinal Mass
Bradycardia
Bronchospasm
Cardiac Arrest
Chest Compressions: Supine/Prone
Difficult Airway
Fire: Airway
Fire: OR (non-airway)


PEDIATRIC CHECKLIST
PEDICRISIS APP
Weight-based dosing
Sampling design
Tabs for specific information
PEDI CRISIS APP
Apple App Store & Google Play Store
A
Anaphylaxis
Verify DX
May have:
Hypotension
Rash
Bronchospasm
Common Causative Agents:
IV contrast
Antibiotics
Latex
Neuromuscular blockers
Chlorhexidine prep solution


PEDIATRIC CHECKLIST
PEDICRISIS APP
Weight-based dosing
Sampling design
Tabs for specific information
PEDI CRISIS APP
Apple App Store & Google Play Store
B
Anaphylaxis
Treatment

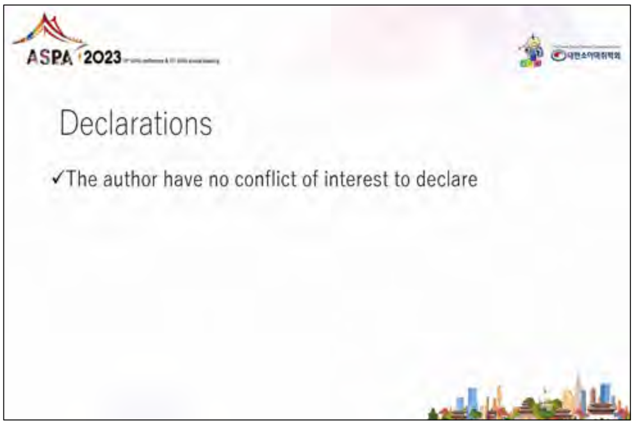

PEDIATRIC CHECKLIST
PEDICRISIS APP
Weight-based dosing
Sampling design
Tabs for specific information
PEDI CRISIS APP
Apple App Store & Google Play Store
C
Anaphylaxis
Drug / Dosage Summary
Epinephrine
Vasopressin
Albuterol
Methylprednisolone
Diphenhydramine
Famotidine

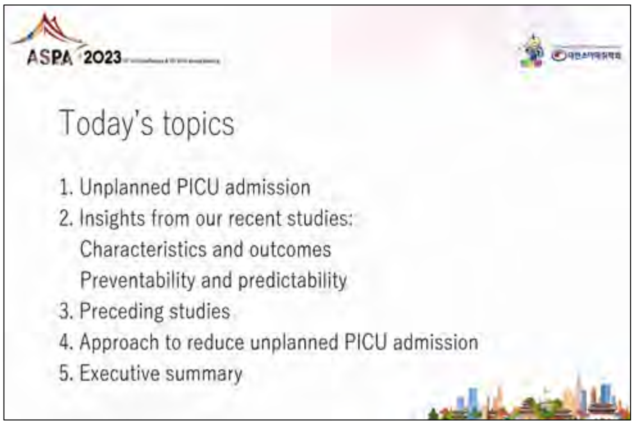

CONCLUSIONS
Human performance suffers under stress
Checklist use is not a weakness, it is a strength
Every team member has a role
Developing, refining checklists
Triggering checklist use
Reading checklist
Advocating & supporting their use
A robust implementation program is essential

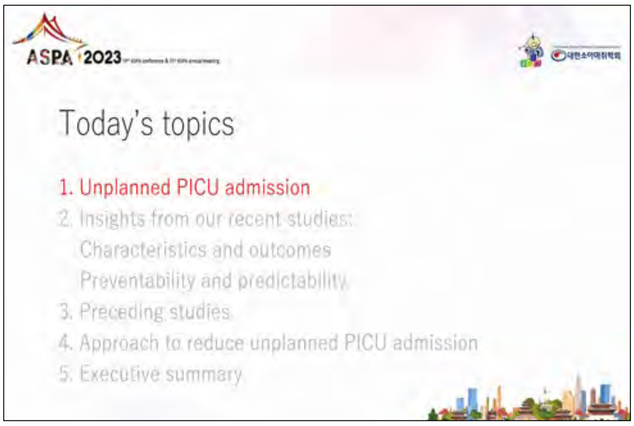
Unplanned ICU Administration: Characteristics and Outcomes

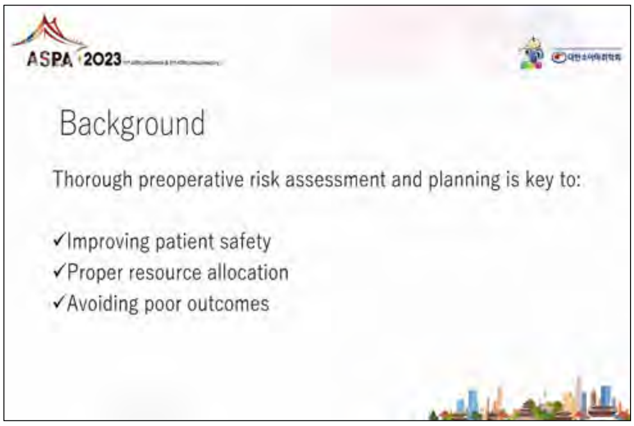
Kaoru Tsuboi

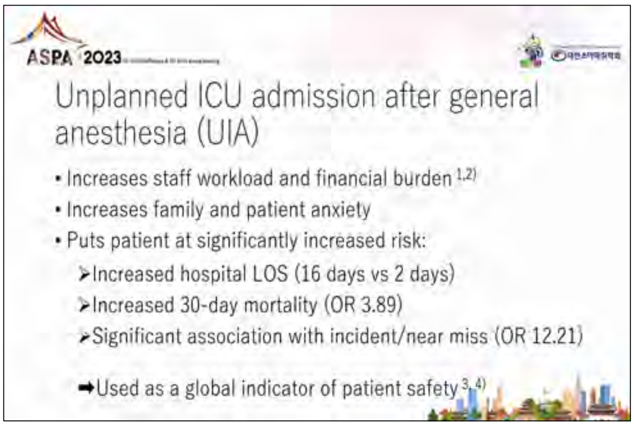
Department of Critical Care and Anesthesia, National Center for Child Health and Development, Japan









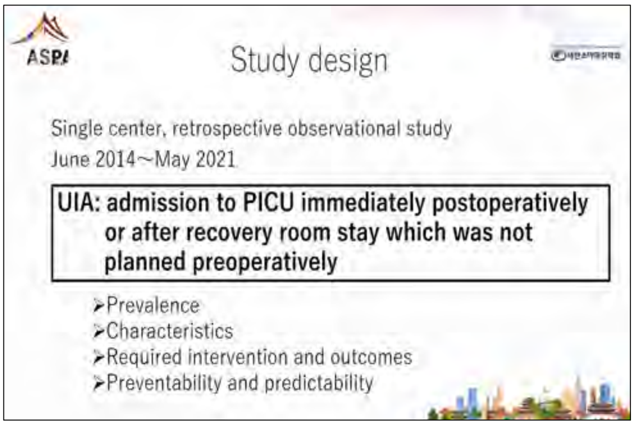


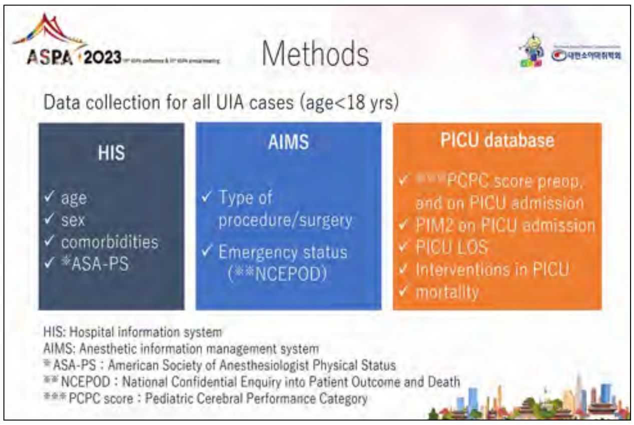

ASPA 2023
Pediatric patients?

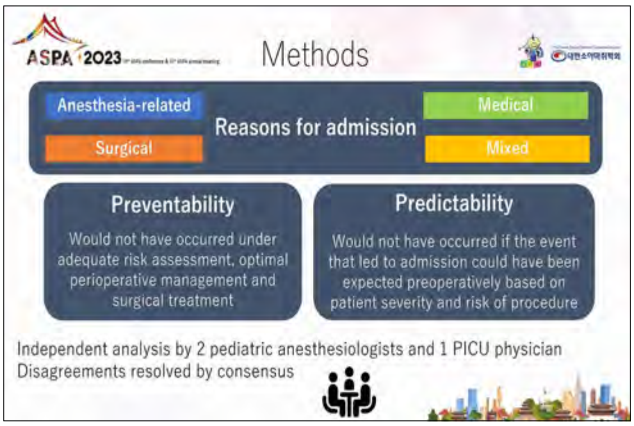

ASPA 2023
Today's topics
1. Unplanned PICU admission
2. Insights from our recent studies:
Characteristics and outcomes
Preventability and predictability
3. Preceding studies
4. Approach to reduce unplanned PICU admission
5. Executive summary

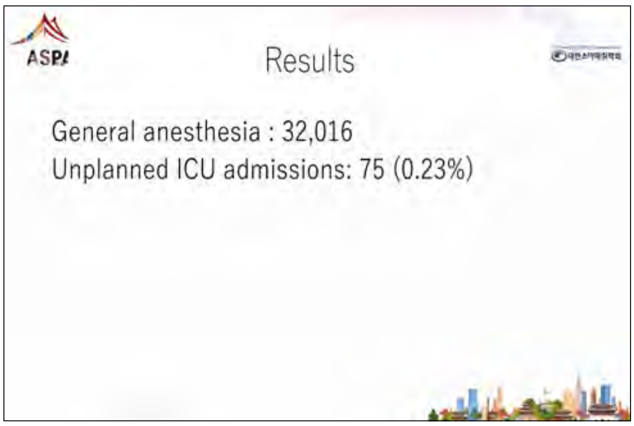

ASPA 2023
RESEARCH REPORT
Pediatric Anesthesia WILEY
Unplanned admission to pediatric intensive care after general anesthesia: A seven-year retrospective cohort study in a tertiary children's hospital
Kaoru Tsuboi | Jun Ninagawa | Norihiko Tsuboi | Satoshi Nakagawa | Yasuyuki Suzuki


ASPA
National Center for Child Health and Development, Tokyo, Japan
• Tertiary children's hospital, 490 beds
• Approximately 4,560 GA cases per year (age < 18 yrs)
• All surgical specialties performed
• Attending pediatric anesthesiologists directly take care of every child, all hours
• PICU: 20 beds, 1,000 admissions per year


ASPA
Study design
Single center, retrospective observational study
June 2014~May 2021
UIA: admission to PICU immediately postoperatively or after recovery room stay which was not planned preoperatively
➢Prevalence
➢Characteristics
➢Required intervention and outcomes
➢Preventability and predictability


ASPA 2023
Methods
Data collection for all UIA cases (age<18 yrs)
HIS
✓ age
✓ sex
✓ comorbidities
✓ *ASA-PS
AIMS
✓ Type of procedure/surgery
✓ Emergency status (**NCEPOD)
PICU database
✓ ***PCPC score preop, and on PICU admission
✓ PIM2 on PICU admission
✓ PICU LOS
✓ Interventions in PICU
✓ mortality
HIS: Hospital information system
AIMS: Anesthetic information management system
* ASA-PS : American Society of Anesthesiologist Physical Status
** NCEPOD : National Confidential Enquiry into Patient Outcome and Death
*** PCPC score : Pediatric Cerebral Performance Category


ASPA 2023
Methods
Anesthesia-related
Surgical
Reasons for admission
Medical
Mixed
Preventability
Would not have occurred under adequate risk assessment, optimal perioperative management and surgical treatment
Predictability
Would not have occurred if the event that led to admission could have been expected preoperatively based on patient severity and risk of procedure
Independent analysis by 2 pediatric anesthesiologists and 1 PICU physician
Disagreements resolved by consensus


ASPA
Results
General anesthesia : 32,016
Unplanned ICU admissions: 75 (0.23%)

Patient Demographics

Patient demographics	n=75
Age (month), median (IQR)	18 (9-69)
Sex, male	49 (65)
ASA PS	
1	20 (27)
2	31 (41)
3	24 (32)
PCPC on PICU admission	
1	49 (65)
2	8 (11)
3	14 (19)
4	4 (5)

Values are n(%)

<1 yr: 22 (29%)
<5 yrs: 53 (71%)

PCPC
1 : Normal
2 : Mild disability
3 : Moderate disability
4 : Severe disability
5 : Coma or vegetative state
6 : Death

Type of procedure/surgery

Type of procedure/surgery	n=75
Cardiac catheterization	**16 (22)**
Ophthalmology	10 (13)
Orthopedics	9 (12)
Perineal	7 (9)
Abdominal	6 (8)
Central line placement	4 (5)
ENT	4 (5)
Spine	4 (5)
Others	15 (19)

Values are n(%)

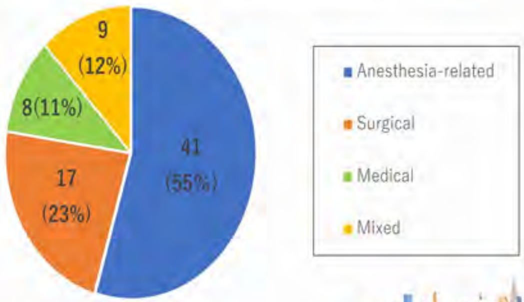
Emergency status

NCEPOD	n=75
Immediate	0 (0)
Urgent	8 (11)
Expedited	30 (40)
Elective	37 (49)

Values are n(%)

NCEPOD
Immediate: within **minutes** of decision to operate.
Urgent: within **hours** of decision to operate.
Expedited: within **days** of decision to operate.
Elective: Timing to suit patient, hospital and staff.

Reasons for admission



Anesthesia-related

Reasons for admission	n=41
Postextubation stridor	**16 (39)**
Hypoxia	**7 (17)**
Anaphylaxis	4 (10)
Drug error	3 (7)
Insufficient fluid management	2 (5)
Postoperative apnea	2 (5)
Prolonged emergence	2 (5)
Uncontrollable ED	2 (5)
Bronchial spasm	2 (5)
Aspiration	1 (2)

Values are n(%)

Anesthesia-related

Intervention in PICU	n=41	PICU LOS, median (IQR)
Observation only	19 (46)	2 (2-2)
Sedation only	3 (7)	2 (2-2)
NHFT as maximum support	6 (15)	2 (2-2)
NPPV as maximum support	1 (2)	3
IMV as maximum support	12 (27)	3 (2.75-4)

Values are n(%)

Overall PICU LOS: 2(2-3)

Mean PIM2: 1.1%

Surgical

Reasons for admission	n=17
Surgical complications	8 (47)
Excessive bleeding	7 (41)
Prolonged surgery	2 (12)

Values are n(%)

Surgical

Intervention in PICU	N=17	PICU LOS, median (IQR)
Surgical intervention	6 (35)	10.5 (7.75-12.5)
Observation	11 (65)	3 (2-3)

Values are n(%)

Overall PICU LOS: 3 (2-7)

Mean PIM2: 9.1%

Medical

Ex) Bronchial asthma exacerbation after intubation

Reasons for admission	n=8
Exacerbation of pre-existing medical conditions	5 (63)
Newly identified medical condition (undefined pre-operatively)	3 (38)

Values are n(%)

Ex) paroxysmal hypertension and tachycardia during biopsy of retroperitoneal tumor

8(11%)

Medical

Intervention in PICU	n=8	PICU LOS, median (IQR)
Surgical Intervention	2 (25)	16.5 (16.25-16.75)
Nonsurgical intervention	5 (63)	6 (4-6)
Observation only	1 (13)	1

Values are n(%)

8(11%)

Overall PICU LOS: 6 (4-16.3)

Mean PIM2: 4.8%

Mixed

Intervention in PICU	n=9	PICU LOS, median (IQR)
Observation only	3 (33)	2 (2-3.5)
Sedation only	2 (22)	2 (2-2)
HFNT as maximum support	2 (22)	3 (3-3)
IMV as maximum support	2 (22)	3 (3-3)

Values are n(%)

9 (12%)

Overall PICU LOS: 2 (2-16.3)

Mean PIM2: 1.2%

Brief summary of outcomes

Reasons for admission	n=75	PICU LOS (median, IQR)	Mean PIM2 (%)
Anesthesia-related	41 (55)	2 (2-3)	1.1
Surgical	17 (23)	3 (2-7)	9.1
Medical	8 (11)	6 (4-16.3)	4.8
Mixed	9 (12)	2 (2-3)	1.2

Values are n(%)

- ✓ Intraoperative CPR: 7
- ✓ Death: 1 Overall mortality rate 1.3%
- ✓ Survival: 74 ΔPCPC = 0

Preventability

Preventable :14 cases (19%)

Anesthesia-related preventable admission	n=13
Recent upper airway infection ➡ PRAE	9
Drug error	2
...erative apnea	1
...age...	1

4 postextubation stridor
4 postoperative hypoxia
1 bronchospasm

6 elective
3 expedited

These cases should have been canceled

Predictability

Predictable: 25 cases (33%)

- ✓ Recent upper airway infection ➡ PRAE
- ✓ **Exacerbation of pre-existing medical conditions**
- ✓ **Severe comorbidity**
- ✓ **High risk surgery**

Majority was high-risk patient and/or high-risk surgery

➡ **PICU admission should have been scheduled**

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Preceding studies

Unplanned PICU admission after anesthesia

Prevalence:
0.1-0.6% of all general anesthesia cases

Risk factors:
- Younger age (<5yrs, especially <1 yr)
- Higher ASA-PS
- Comorbidities
- Surgical complexity
- Cardiac catheterization

High risk patient group:
- ✓ Underlying cardiac disease
- ✓ Young
- ✓ Underweighted

Characteristics

The most common reason for admission:
Anesthesia-related (50%) > Surgical > Medical

Leading reasons for anesthesia-related admissions:
1. Airway events :47%-56% [9,10]
2. Respiratory events:25%-29% [9,10]

Outcomes

Deaths: unspecified - 0% [9-12]

Average PICU LOS: 2.65 - 4.5 days [11, 12]

Preventability and predictability

✓Preventability: 20%-25.5% [8, 11]
Current study: 19%
Optimal risk stratification and perioperative management are required

✓Predictability: 35.7% -71% [8, 11]
Current study: 33%
Mostly high-risk patient and/or surgery
Shared preoperative decision making with the surgical team should be improved

Limitations

- ✓Lack of consistent definition among studies
- ✓Difference in patient population, local policies, skills of medical staff
- ✓Most are single-center, retrospective studies
- ✓Interpretation may be biased

Today's topics

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Approach to reduce UIA

Approach to reduce UIA

BMJ Open Modified paediatric preoperative risk prediction score to predict postoperative ICU admission in children: a retrospective cohort study

Chunwei Lian,[1] Pei Wang,[1,2] Qingxia Fu,[1] Xudong Du,[3] Junzheng Wu,[4] Qingquan Lian,[1] Wangning ShangGuan[1]

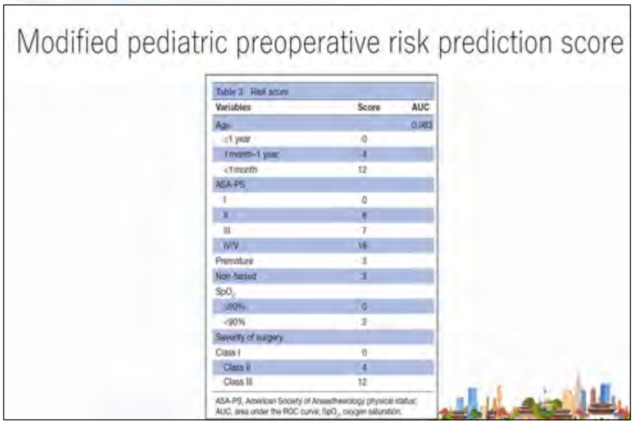


Table 3 Risk score

Variables	Score	AUC
Age		0.983
≥1 year	0	
1 month–1 year	4	
<1 month	12	
ASA-PS		
I	0	
II	6	
III	7	
IV/V	16	
Premature	3	
Non-fasted	3	
SpO_2		
≥90%	0	
<90%	3	
Severity of surgery		
Class I	0	
Class II	4	
Class III	12	

ASA-PS, American Society of Anaesthesiology physical status; AUC, area under the ROC curve; SpO_2, oxygen saturation.

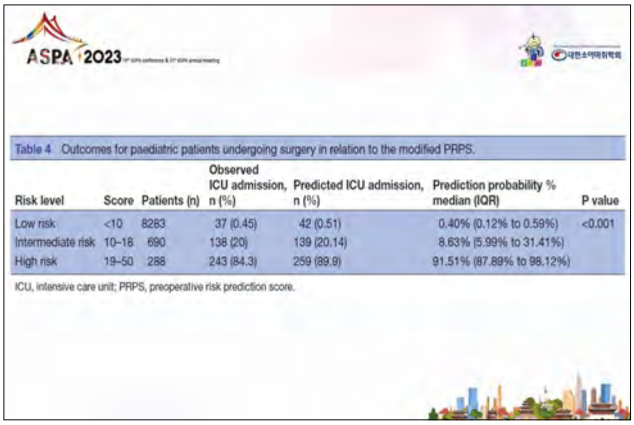
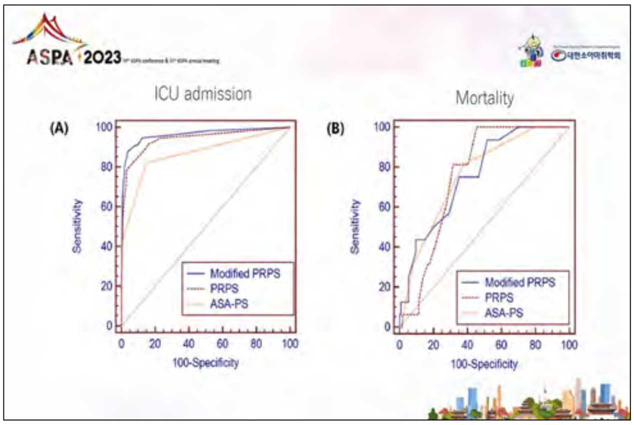
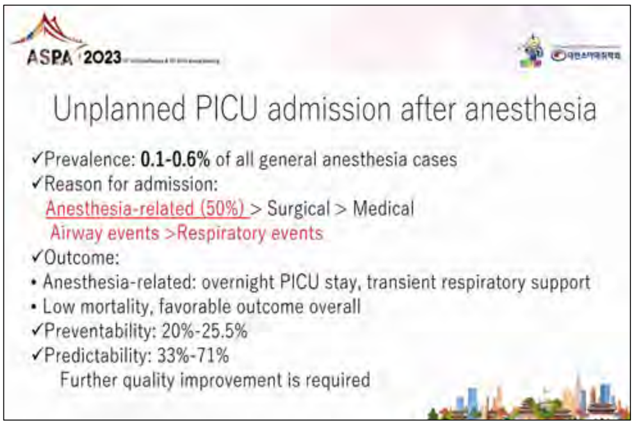


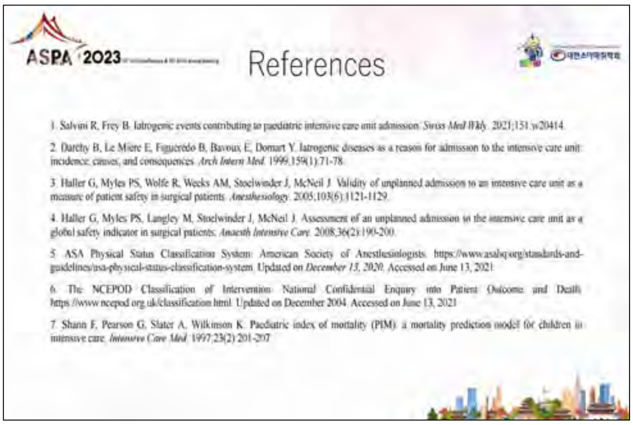
Table 4 Outcomes for paediatric patients undergoing surgery in relation to the modified PRPS.

Risk level	Score	Patients (n)	Observed ICU admission, n (%)	Predicted ICU admission, n (%)	Prediction probability % median (IQR)	P value
Low risk	<10	8283	37 (0.45)	42 (0.51)	0.40% (0.12% to 0.59%)	<0.001
Intermediate risk	10–18	690	138 (20)	139 (20.14)	8.63% (5.99% to 31.41%)	
High risk	19–50	288	243 (84.3)	259 (89.9)	91.51% (87.89% to 98.12%)	

ICU, intensive care unit; PRPS, preoperative risk prediction score.







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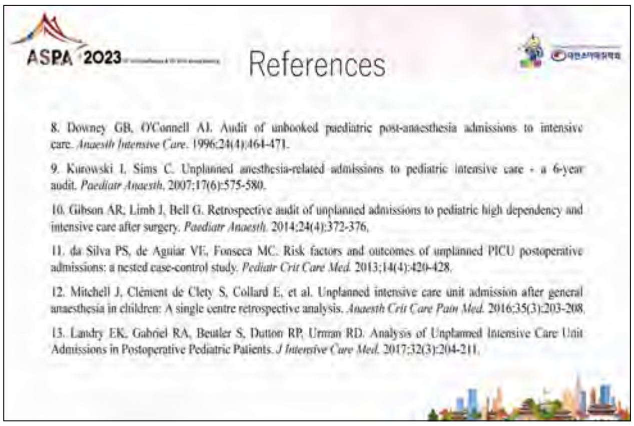

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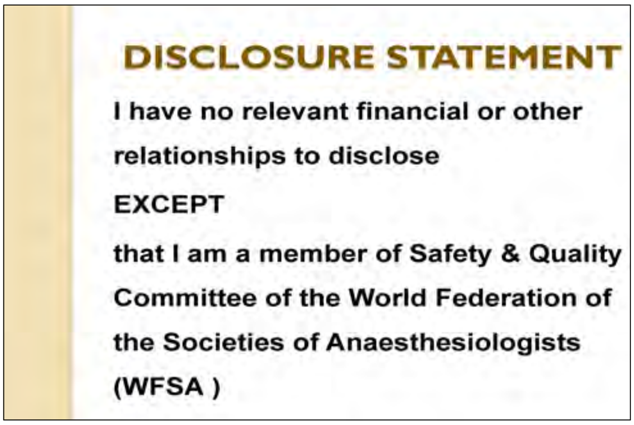
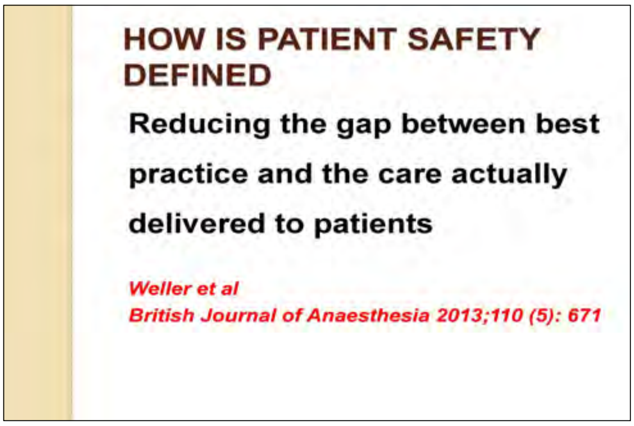
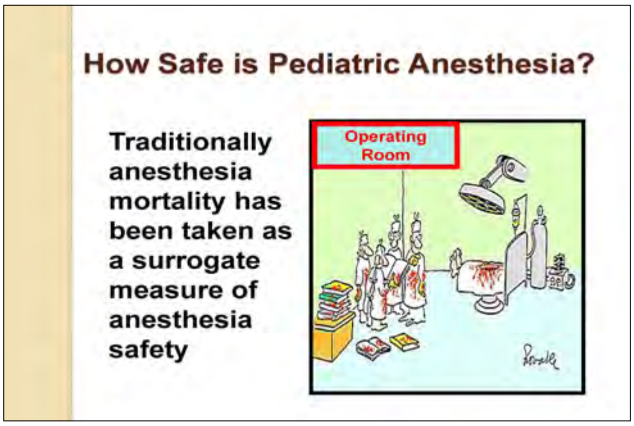
Improving Pediatric Anesthesia Safety In Low Resource Setting

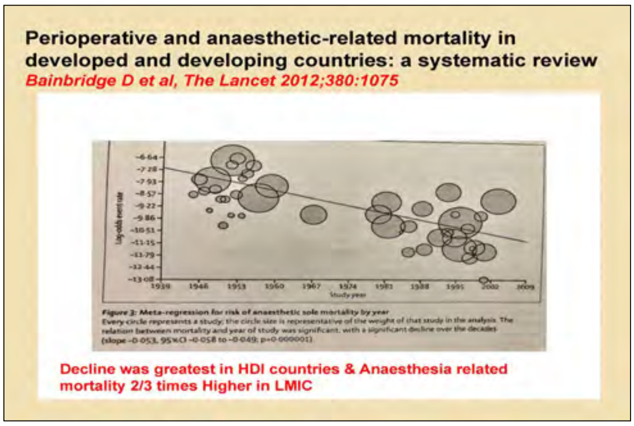
Fauzia Anis Khan

Department of Anaesthesiology, Aga Khan University, Pakistan









Perioperative morbidity and mortality in the first year of life: a systematic review (1997-2012) .
RevistaBrasileiraDeAnestesiologiahttp://dx.doi.org/10.1016/j.bjane.2013.03.025

Publication	Timing	Incidence /10000 anesthetics
Morita. Japan	First 7 days	74.1
Morita. Japan	First 7 days	26.9
Chan. Brazil	First 24 hrs	288
Fick. USA	OR & PACU	144.7
Bunchung. Thailand	First 24 hrs	35.1
Ahmed. Pakistan	OR & PACU	11.4
Bharti. India	First 2 days	18.5
Van der Griend Australia	First 24 hrs	59.7

Mortality in Children < 1 Year

KEY FINDINGS

- Higher incidences of mortality and morbidity in children under one year of age undergoing general anesthesia compared with older children
- Increased risk in incidences in children undergoing surgery in the neonatal period
- High frequency of cardiac arrests in patients under one year of age
- Lack of studies centered in the neonatal period and first year of age
- Great variability of methodologies for the study of the same concepts

A review of paediatric anaesthetic-related mortality, serious adverse events and critical incidents

Southern African Journal of Anaesthesia and Analgesia 2015; 21(6):147–153

L Cronjé

Table 3: Twenty-four hour anaesthetic-related and 24-hour perioperative mortality per 10 000 anaesthetics

Era	24-hour anaesthetic related mortality			24-hour perioperative mortality		
Date of data	< 18 years	< 1 year	< 30 days	< 18 years	< 1 year	< 30 days
1947–1983						
High-income* (n = 47111)	1.57–2.9	NR	NR	4.9	NR	NR
1980–1999						
High-income* (n = 1374750)	0–0.42	NR	NR	1.23–3.8 or	6.63**	74.1–83.1**
Middle-income* (n = 37420)	NR	NR	NR	0.33–5.4	NR	NR
Low-income*	ND	ND	ND	ND	ND	ND
2000–2015						
High-income* (n = 1190486)	0–1.19	0–3.51**	0–0.8	0.41–13.4**	5.91–32.2	26.9–180.1
Middle-income* (n = 62519)	2.4–3.3***	3.7–4.7	NR	10.7–15.9***	18.5–65	78
Low-income* (n = 26057)	37–60	NR	NR	7.7****	NR	NR

n: Number of cases recorded; ND: no data [illegible]

*Income categories are as per the World Bank classification

**One study with operating room only data

***Includes studies with data until post-anaesthesia recovery only

****Data from an externally funded hospital

Importance of Pediatric Anesthesia Safety in Low Resource Settings

- In many low- and middle-income countries, children <15 yrs make up 40% to 50% of the population
- Two thirds of the world's children (1.7 billion) lack access to appropriate surgical and anesthesia care
- Injuries alone kill more children globally than human immunodeficiency virus, tuberculosis, and malaria combined

King et al. Bull World Health Organ 2019; 97:254–8

ANAESTHESIA SAFETY CHALLENGES IN LMIC

SAFE-T

- Manpower issues
- Essential drugs
- Equipment
- Lack of national standards
- Lack of data
- Administrative problems
- Lack of political will

Khan et al. WFSA : Safe -T Newsletter #2 ,2017 June 2017

Pediatric Anaesthesia Safety:Where are the High Income Countries(HIC)

Safety has improved by

- Creation of a specialty societies
- Quality and safety committees
- Large multi-institutional research efforts
- Quality improvement initiatives
- Common pediatric perioperative events are monitored with multi-institution and organization collaborative efforts

Society for Pediatric Anesthesia

National Pediatric Anesthesia Safety Quality Improvement Program in the United States

Kurth CD.Anesthesia & Analgesia, July 2014 • Volume 119 • Number 1

the development of a multiinstitutional program in the United States, known as Wake-Up Safe (WUS), to determine the rate of serious adverse events (SAE) in pediatric anesthesia and to apply SA and QI in the pediatric anesthesia departments to decrease the SAE rate.

METHODS: QI was used to design and implement WUS in 2008. The key drivers in the design were an organizational structure; an information system for the SAE; SA to characterize the SAE; QI to imbed high-reliability care; communications to disseminate the learnings; and engaged leadership in each department. Interventions for the key drivers, included Participation

There are costs associated with improving safety and providing quality care

- Personals
- Development of materials
- Training & communication
- Time cost of participants in these progs
- Expenses associated with meetings

Perrelle et al.BMC Health Services Research 2020

"IT STARTED AS A TEAM-BUILDING EXERCISE."

The Cost of Quality: An Academic Health Center's Annual Costs for Its Quality and Patient Safety Infrastructure

Bonnie B Blanchfield et al. Jt Comm J Qual Patient Saf. 2018 Oct.

$30 million of direct costs-

Conclusion: Indisputable good for patients and providers has resulted from organizational investments in quality and safety. But policy makers must be cognizant of potential trade-offs and explicitly recognize the incremental costs of additional measurement, improvement, and mandated reporting in their decision making.

WHAT TO DO IF THE RESOURCES ARE SCARCE

- Accept status quo
- Settle on trade offs
- Experiment to find novel ways of improving safety

Low Cost Measures To Improve Safety

- Have baseline safety data to determine perioperative risks
- Studying anesthesia mortality, anesthesia morbidity, adverse events &critical incidents
- Medication safety
- Role of check lists

HOW CAN ANAESTHESIA SAFETY BE IMPROVED FURTHER IN LMICs

- Anesthesia providers
- Robust and cheap equipment
- Information on infrastructure
- Implementation of safety standards

Information on Infrastructure

- An essential requirement to tackle safety issues but such information is often non-existent in LMICs
- There is lack of information on the number of anaesthesia providers, equipment and medication availability in anesthesia practice in several LMIC countries
- Need collaboration to collect this kind of data

Our Survey

Anesthesia & Analgesia 2022; 134:653-660

Khan F, Haider S, Abbas N et.al.

Mapping of Anaesthesia services for Maternal and Child Health in the Sind province of Pakistan

Pakistan is a lower middle–income country located in South Asia with a population of nearly 208 million. Sindh is its second largest province

WFSA

A PROJECT SPONSERED BY THE WORLD FEDERATION OF THE SOCIETIES OF ANAESTHESIOLOGISTS (WFSA)

The AIM of this survey was to identify the current setup of pediatric services, staffing, equipment, medications and training infrastructure in the teaching hospitals of Sindh province. No previous information was available on this issue

DATA COLLECTION

- Preoperative assessment
- Routine preoperative testing
- Organisation of pediatric operating room
- Staffing
- Monitoring
- Equipment
- Medications
- Regional anesthesia
- Post anesthesia recovery management
- Pain management intra and postop

Availability of Monitors

Table 2. Availability of Monitors in Surveyed Institutions

Monitors	Government-run institutions (total No. 7) n (%)	Private-run institutions (total No. 5) n (%)
Pulse oximeters	6 (86)	5 (100)
O_2 analyzers	2 (28.5)	3 (60)
$Etco_2$ monitors	3 (43.8)	5 (100)
Temperature probes (pediatric)	2 (28.5)	3 (60)
Peripheral nerve stimulators	2 (28.5)	2 (40)
BIS monitor	0	1 (20)
Foley catheters (pediatric size)	7 (100)	4 (80)
Pediatric central lines	1 (14)	5 (100)
Invasive arterial monitoring lines	0	4 (80)

n is the number of hospitals where this monitoring was available.
Abbreviations: BIS, bispectral index; $Etco_2$, end-tidal carbon dioxide.

Availability of Equipment

Anesthesia Machines & Circuits

Anesthesia machines and circuits with provision for pediatric/neonatal ventilation were available in only 66.6% institutions (4 government and 4 private).T piece circuit was available in 91.6% of the hospitals

Airway Equipment

Disposable ETT & LMA available in pediatric sizes. Pediatric video-laryngoscopes present in only 2 institutions (16.6%): I public and I private

CHALLENGES IN PEDIATRIC ANESTHESIA SERVICES

- Basic essential equipment missing in some hospitals
- Variation in surgical workload among institutions
- Pediatric services are mixed with adult services
- No standardization of practice even in same institutions
- Lack of Guidelines
- Poor postoperative pain control
- Day care services underutilized

CHALLENGES WITH PEDIATRIC ANESTHESIA TRAINING STRUCTURE

- Variation in patient load
- Shortage of faculty
- Fragmented training structure and insufficient supervision in some institutions
- Variation in availability of equipment and advanced monitoring

SOLUTIONS?

Multipronged Approach needed

- Institutions
- Training bodies (e.g. CPSP)
- Professional societies
- Government
- International collaborations

Peri-operative cardiac arrests

Pediatric Anesthesia

Perioperative cardiac arrests in children at a university teaching hospital of a developing country over 15 years

ALIYA AHMED FFARCSI, MOHAMMAD ALI FCPS, MUEENULLAH KHAN FCPS, FAUZIA KHAN FRCA

Ten cardiac arrests occurred among 20,216 patients
Incidence: 4.95 per 10,000
Seven patients died
Conclusion: Perioperative cardiac arrests were higher in patients with poor physical status, in those under 1 year of age, and in female patients
Anesthesia primarily responsible in 4 cases and these were mainly due to medication- or airway-related causes. The majority were avoidable

CRITICAL INCIDENTS

J Anaesthesiol Clin Pharmacol. 2018 Jan-Mar;34(1):78-83. doi: 10.4103/joacp.JOACP_240_16

Pediatric critical incidents reported over 15 years at a tertiary care teaching hospital of a developing country

Shemila Abbasi, Fauzia Anis Khan, Sobia Khan

Results: A total of 451 pediatric CIs were included. Thirty-four percent of the incidents were reported in infants. Ninety-six percent of the reported incidents took place during elective surgery

Conclusion: Medication and equipment are the clinical areas that need to be looked at more closely. We also recommend quality improvement projects in both these areas as well as training of residents and staff in managing airway-related problems in pediatric patients.

Pediatric Anesthesia Severe Adverse Events Leading to Anesthetic Morbidity and Mortality in a Tertiary Care Center in a Low- and Middle-Income Country: A 25-Year Audit

Nasir Khoso, FCPS, Waleed B. Ghaffar, MBBS, Shemila Abassi, FCPS, and Fauzia A. Khan, FRCA

Anesth Analg 2021;132:217–22

CONCLUSIONS:

Respiratory complications were the most frequent (33%)

Infants with CHD, were identified as at a higher risk for perioperative cardiac arrest

Twenty-eight percent of the patients who suffered events died within 48 hours

Increased access to anesthesia drugs and practice improvements resulted in a decline in perioperative cardiac arrests

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MEDICATION ERRORS

scientific reports

www.nature.com/reprints.

A retrospective analysis of peri-operative medication errors from a low-middle income country

Shemila Abbasi, Saima Rashid & Fauzia Anis Khan

311 MEs were identified in (CIRS) database over the last 15 years (2004–2018)

ADEs were found in 86 (28%) reports

The majority of errors involved neuromuscular blockers (32%) and opioids (13%) & were more frequent during administration.

Sharing of CI and a lesson to be learnt e-mail, colour coded labels, change in medication trolley lay out, decrease in floor stock and high alert labels were the low-cost steps taken to reduce incidents

---

Perioperative Medication Error in Pediatric Anesthesia at a tertiary care hospital over a period of 20 years; a retrospective review

Medication errors were more frequent during administration. ADEs were occurred in 13.8% MEs.

- Color coded labels, change in medication trolley lay out, decrease in floor stock and high alert labels were the low-cost steps taken to reduce incidents.

Habre et al. Incidence of severe critical events in paediatric anaesthesia (APRICOT): a prospective multicenter observational study in 261 hospitals in Europe. Lancet Respir Med. 2017;5:412-425.

The APRICOT study is a pan-European prospective 2-week "snap-shot" of paediatric practice across 261 participating hospitals from 33 European countries and comprising 31 127 anaesthetic procedures in 30 874 children. The study recorded in detail all serious adverse events

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PEACH IN ASIA

November 3rd, 2022 (by the principal investigator, Sochiro Obara, Japan)

PEACH in Asia: PEri-Anesthetic morbidity in CHildren in Asia

A prospective multinational multicenter observational study to investigate epidemiology of severe critical events in pediatric anesthesia in Asia

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Implementation of International Standards (WHO & WFSA)

Can J Anesth/J Can Anesth
https://doi.org/10.1007/s12630-018-1111-5

SPECIAL ARTICLE

World Health Organization-World Federation of Societies of Anaesthesiologists (WHO-WFSA) International Standards for a Safe Practice of Anesthesia

Normes internationales pour une pratique sécuritaire de l'anesthésie de l'Organisation mondiale de la santé et de la Fédération mondiale des sociétés d'anesthésiologie (OMS-FMSA)

Adrian W. Gelb, MBChB, FRCPC · Wayne W. Morriss, MBChB, FANZCA · Walter Johnson, MD · Alan F. Merry, MBChB, FANZCA, FFPMANZCA, FRCA on behalf of the International Standards for a Safe Practice of Anesthesia Workgroup

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Pediatric Anesthesia

Setting a universal standard: Should we benchmark quality outcomes for pediatric anesthesia care?

Dimensions	Suggested measures
Safety	Intraoperative cardiac arrest. Unplanned tracheal reintubation within 24 h of anesthesia. Unplanned intensive care unit (ICU) admission within 24 h of anesthesia. Unplanned hospital readmission for outpatient surgery. Activation of rapid response team within 24 h of anesthesia. Death within 72 h of anesthesia. Medication error.

Vanessa A. Olbrecht et al. Pediatric Anesthesia. 2022;32:892–898.

CONCLUSION

Although measures to improve patient safety and implementation and organization of QIC activities does have an additional cost but this should not be used as an excuse for maintaining status quo.

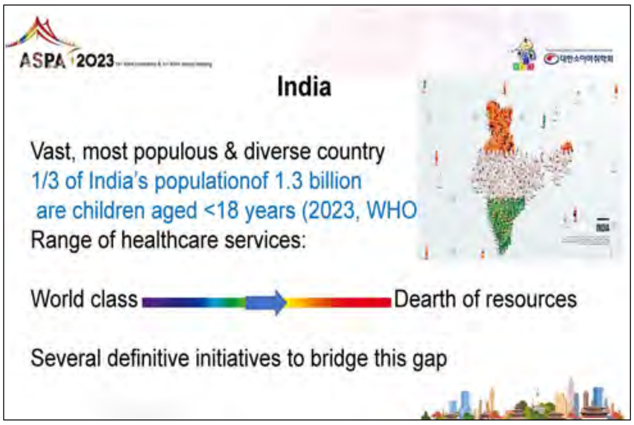
There are many simple measures that are not too expensive

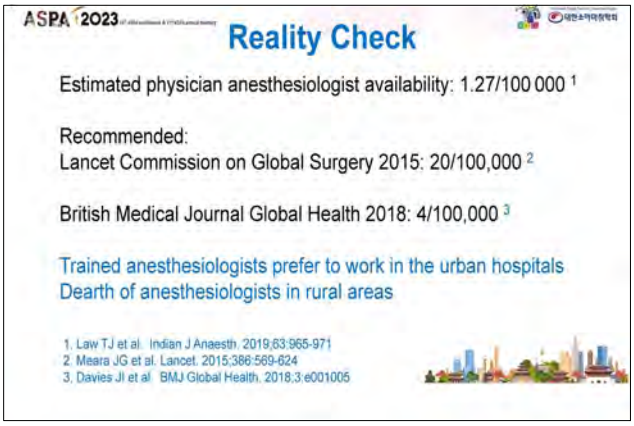

CONCLUSION cont
It also requires commitment, dedication, change in behaviour and practice of not just anaesthesiologists but also by organizations, patients, policy makers and other providers
Pachie's Place
No I Won't and You Can't Make Me!"

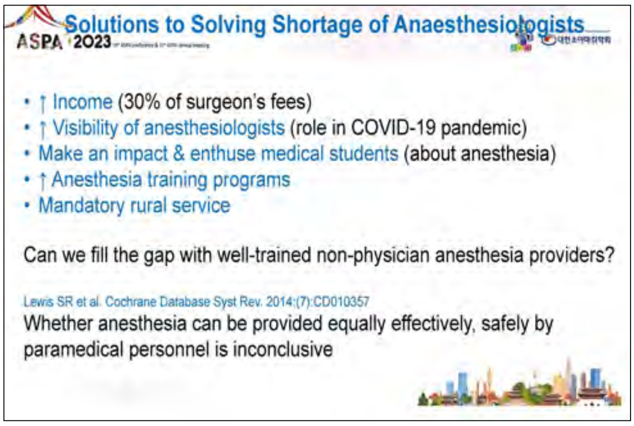
Quality Improvement of Pediatric Anesthesia in India

Elsa Varghese

Kasturba Medical College Manipal, India







Pediatric Anesthesia Training in India

- Basic anesthesia training includes pediatric anesthesiology
  - Varies widely between institutions
- Need for specialized workforce to provide safer anesthesia delivery to children
  - 25 one-year pediatric fellowship programmes (<50 trained/year)
  - IAPA pediatric fellowships in 10 accredited institutions
    - On line masterclass lectures, centralized examination
  - 3-year DM course in 2 premier institutions

Pediatric Anesthesia Training in India

Indian Association of Paediatric Anaesthesiologists (IAPA)

- Guidelines & advisories suitable for local conditions to improve pediatric perioperative care
- COVID-19 advisory prior to the pandemic
- IAPA state chapters have conducted webinars on a regular basis since the onset of the pandemic
- Regular continuing medical education programs
- Small-group workshops on airway management, cardiopulmonary resuscitation (CPR), safe conduct of regional blocks, mechanical ventilation, and research methodology.

ASPA "Paediatric Perioperative Life Support (PPLS)"

- Pediatric Crisis management workshops
- Train the Trainer" courses since 2019
- ePPLS courses for the virtual format

WFSA and IAPA

Since 2018, a pediatric anesthesia course "Safer Anaesthesia From Education" (SAFE)

Smile Train" and "Operation Smile India

- Sponsor free cleft lip and palate surgeries
- 140 partner hospitals
- Safety and quality protocols stringently adhered to
- All sentinel events reported / analyzed and recommendations made in an effort to improve clinical outcomes

Reality Check

Little or no data available from India with regard to anesthesia-related complications

Risk of dying during anesthesia is 100–1000 X higher in some low-income countries compared with high-income countries

Anderson et al. PLoS One. 2018;13:e0194622

Authors	Year published	Denominator / period	No of Critical incidents	Cardiac arrest	Deaths	Causes
Dias R, Dave N et al	2016 Prospective	1206/ 1 year	108 (8.9%) Moderate/ Severe harm 64/10	4	1	Respiratory 60/108 Majority in recovery
Bharti N et al	2006 Prospective	12158 / 5 year (2003–2008)		27	11	< 1 yr age ASAPS III or > Resp events 56% Cardiac events 33%
Gupta et al	2009 prospective	14134 (adults + children)/ I year	112 (>1-10 yr ages)		32	Anesthesia related 48 (10 deaths) Inexperienced anesthetist 32%
Jindal P et al	Retrospective	2917/2007-2010 Smile Train	33.7%		nil	<2 yr age Anemia, URI CHD Laryngospasm, difficult intubation

Bridging the Gaps to Improve Quality and Safety in Anesthesia

- Minimum monitoring standards (2001)
- Mandatory CME credits, required for medical council registration every 5 years
- Rising public expectations
- Strict medico legal laws (consumer courts 1990s)
- Proliferation of private / corporate tertiary hospitals created professional competition
- Initiatives by WakeUpSafe and ASPA to establish data base for critical incidents

Government of India Initiatives to Improve Quality & Safety

Individual state governments are responsible for health-related issues & required to implement, sustain central government initiatives

Some states are more effective in implementing improving healthcare services than others

- Quality Council of India: (2006) set up standards for improvement, guidelines for healthcare organizations
- National Accreditation Board for Hospitals and Healthcare Providers (NABH)

NABH

Monitor anesthesia services by quality indicators

Anesthesiologist to

- Pre-anesthesia check-up, informed consent,
- Document anesthesia plan, anesthetic, medications, monitoring, post op details, discharge criterion prior to transfer
- Document adverse anesthesia events, root cause analysis, preventive and corrective actions to avert similar incidents is mandatory

- Required revamping of hospital systems
- Improved standards of care
- Raised the bar across the country
- Health insurance companies list NABH accredited hospitals for reimbursement

Government Initiatives

National Quality Assurance Standards (NQAS, 2013)

- Measure the "process component" (structure, process, outcome) of existing National Heath Programs
- Designed for local conditions & requirements to incorporate best practices where practically applicable
- Patient safety protocol programs for HCW for injection safety, prevention of re-use of syringes, biomedical waste management process required for safe anesthesia practices

National Heath System Resource Centre - designated nodal agency at the national and state level to ensure implementation and sustenance of these standards

Government Initiatives

Public Health facilities certified by NQAS as off June 2022

Nationally: 1639

State level: 2922

Pharmacovigilance Program in 2010

to improve the situation of adverse drug reactions and safe administration of medications

> 250 adverse drug reaction monitoring centers have been established so far

Materiovigilance Program 2015

Helped generate data on issues related to safety of medical devices

Number of reported adverse events: 2015 - 40 events

2019 - 897 events

MvPI appears to be robust on paper, yet the annual performance report of MvPI and monitoring centers regarding collection and submission of data is not published

Conclusion

- Need to develop a structured and systematic approach to quality improvement
- Develop a culture that supports its implementation
- Importance of getting started and sustaining the effort of performing audits is a work in progress
- With a population of 1.3 billion, is this a Utopian dream?

Conclusion

The COVID-19 pandemic helped highlight shortcomings of the health system across the globe

India was no exception

Government & private healthcare systems are initiating concerted efforts to make a difference

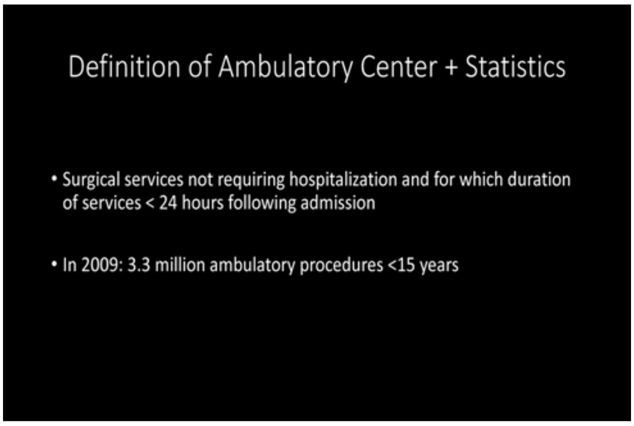
Awareness and recognition for uniform safety measures across India with regard to training, education, implementation of quality care is gaining impetus

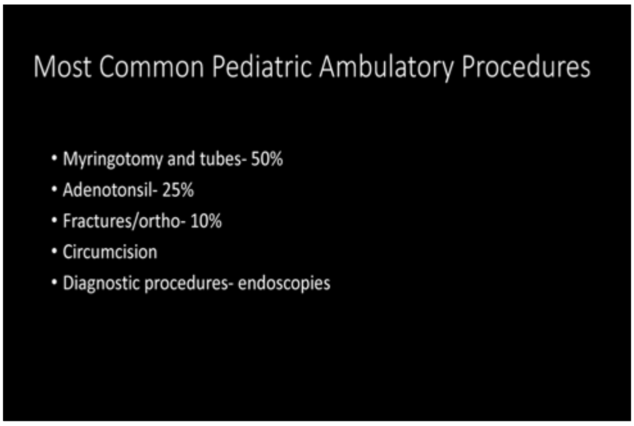
Individuals, professional medical societies, national institutions can help make a difference

New Considerations for Optimizing Pediatric Ambulatory Anesthesia

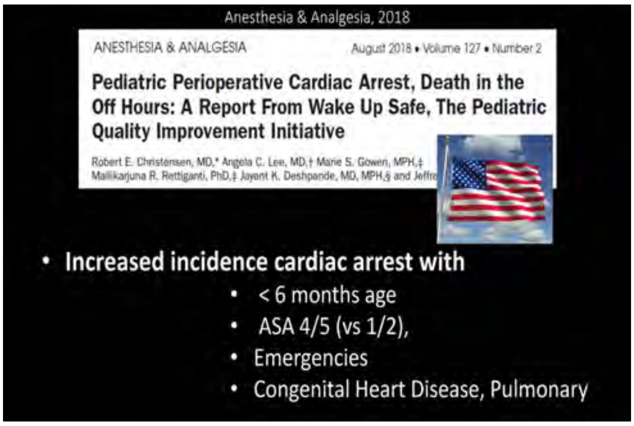
Keira P. Mason

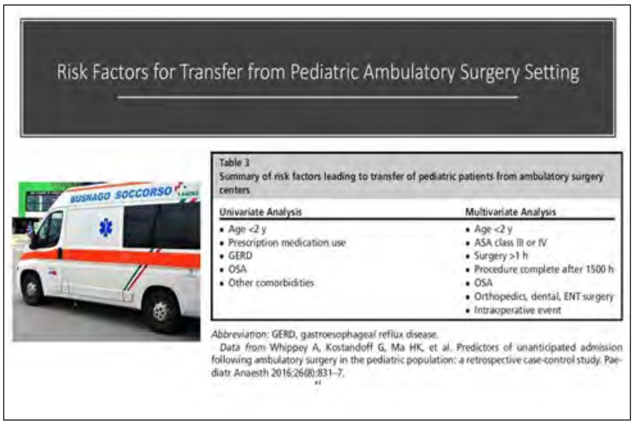
Boston Children's Hospital, Harvard Medical School, USA



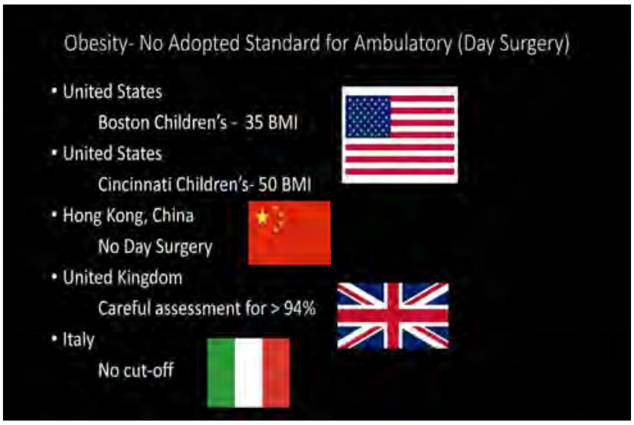


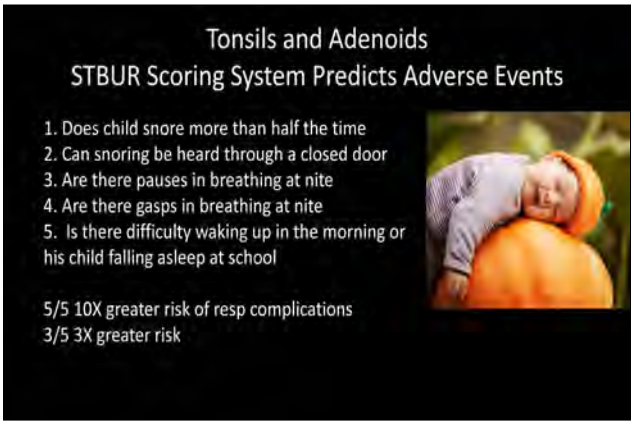

Lancet 2017
Incidence of severe critical events in paediatric anaesthesia (APRICOT): a prospective multicentre observational study in 261 hospitals in Europe
Walid Habre, Nicola Disma, Katalin Virag, Karin Becke, Tom G Hansen, Martin Jöhr, Brigitte Leva, Neil S Morton, Petronella M Vermeulen, Marzena Zielinska, Krisztina Boda, Francis Veyckemans, for the APRICOT Group of the European Society of Anaesthesiology Clinical Trial Network*
• RISK FACTORS
• Respiratory disease- acute and chronic
• ASA ≥ 3
• Premature
• Snoring
• Asthma, wheezing in past 12 months
• Passive smoking
• Lack of "team familiarity"
Europe
At a glance

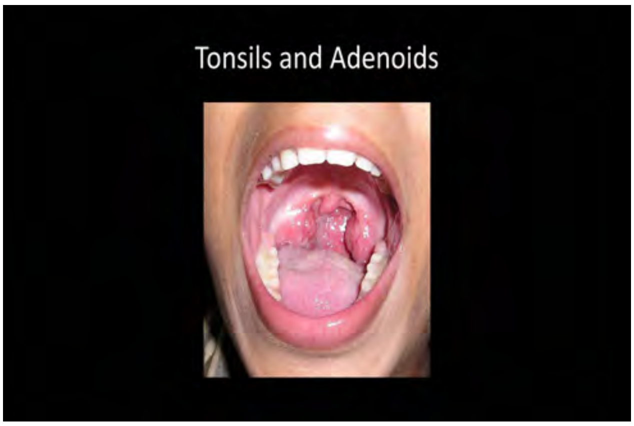

Anesthesia & Analgesia, 2018
ANESTHESIA & ANALGESIA
August 2018 • Volume 127 • Number 2
Pediatric Perioperative Cardiac Arrest, Death in the Off Hours: A Report From Wake Up Safe, The Pediatric Quality Improvement Initiative
Robert E. Christensen, MD,* Angela C. Lee, MD,† Marie S. Gowen, MPH,‡
Mallikarjuna R. Rettiganti, PhD,‡ Jayant K. Deshpande, MD, MPH,§ and Jeffre
• Increased incidence cardiac arrest with
• < 6 months age
• ASA 4/5 (vs 1/2),
• Emergencies
• Congenital Heart Disease, Pulmonary

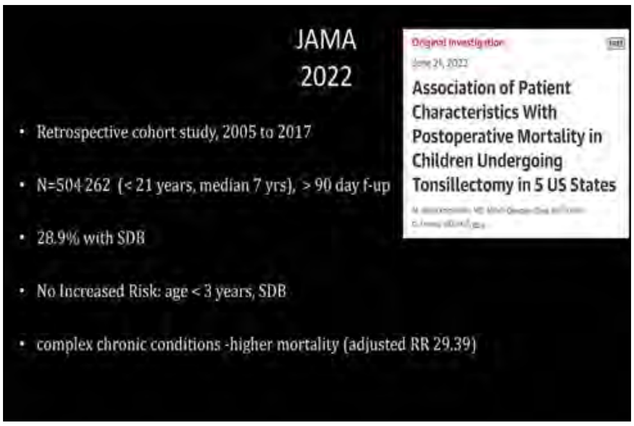

Risk Factors for Transfer from Pediatric Ambulatory Surgery Setting
Table 3
Summary of risk factors leading to transfer of pediatric patients from ambulatory surgery centers
Univariate Analysis
• Age <2 y
• Prescription medication use
• GERD
• OSA
• Other comorbidities
Multivariate Analysis
• Age <2 y
• ASA class III or IV
• Surgery >1 h
• Procedure complete after 1500 h
• OSA
• Orthopedics, dental, ENT surgery
• Intraoperative event
Abbreviation: GERD, gastroesophageal reflux disease.
Data from Whippey A, Kostandoff G, Ma HK, et al. Predictors of unanticipated admission following ambulatory surgery in the pediatric population: a retrospective case-control study. Paediatr Anaesth 2016;26(8):831–7.


CHILDHOOD OBESITY
World Health Organization Definition
• In 2020, 39 million children < 5 yrs overweight/obese
Childhood obesity
43 million preschool children of the world are overweight or obese
30%
20% 50% 37% 20%
obesity rate in the world
2005 2010 2015 2016
World Health Organization


Obesity- No Adopted Standard for Ambulatory (Day Surgery)
• United States
Boston Children's - 35 BMI
• United States
Cincinnati Children's- 50 BMI
• Hong Kong, China
No Day Surgery
• United Kingdom
Careful assessment for > 94%
• Italy
No cut-off


Tonsils and Adenoids
STBUR Scoring System Predicts Adverse Events
1. Does child snore more than half the time
2. Can snoring be heard through a closed door
3. Are there pauses in breathing at nite
4. Are there gasps in breathing at nite
5. Is there difficulty waking up in the morning or his child falling asleep at school
5/5 10X greater risk of resp complications
3/5 3X greater risk


Tonsils and Adenoids


JAMA
2022
• Retrospective cohort study, 2005 to 2017
• N=504 262 (< 21 years, median 7 yrs), > 90 day f-up
• 28.9% with SDB
• No Increased Risk: age < 3 years, SDB
• complex chronic conditions -higher mortality (adjusted RR 29.39)
Original Investigation
Association of Patient Characteristics With Postoperative Mortality in Children Undergoing Tonsillectomy in 5 US States

SLEEP DISORDERED BREATHING

- SDB can range from frequent loud snoring to Obstructive Sleep Apnea (OSA)
- OSA involves repeated episodes of partial or complete blockage of the airway during sleep
- ~10 percent of children snore regularly
- ~ 2-4 % of the pediatric population has OSA.

JAMA 2022

Original Investigation

June 21, 2022

Association of Patient Characteristics With Postoperative Mortality in Children Undergoing Tonsillectomy in 5 US States

Children with complex chronic conditions accounted for 2.8% of tonsillectomies but 44% of postoperative deaths

Most deaths associated with complex chronic conditions occurred in children with neurologic/neuromuscular or congenital/genetic disorders.

Anesthesia Analgesia, 2021

Pro-Con Debate: 1- vs 2-Hour Fast for Clear Liquids Before Anesthesia in Children

Nicola Disma, MD,* Peter Frykholm, MD,† Scott D. Cook-Sather, MD, FCPP,‡ and Jerrold Lerman, MD, FRCPC, FANZCA§

European Journal of Anaesthesiology, 2022

Pre-operative fasting in children

A guideline from the European Society of Anaesthesiology and Intensive Care

Peter Frykholm, Nicola Disma, Hanna Andersson, Christiane Beck, Lionel Bouvet, Eloise Cercueil, Elizabeth Elliott, Jan Hofmann, Rebecca Isserman, Anna Klaucane, Fabian Kuhn, Mathilde de Queiroz Siqueira, David Rosen, Diana Rudolph, Alexander R. Schmidt, Achim Schmitz, Daniel Stocki, Robert Sümpelmann, Paul A. Stricker, Mark Thomas, Francis Veyckemans and Arash Afshari

Anesthesiology March 2017

Practice Guidelines for Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration: Application to Healthy Patients Undergoing Elective Procedures:
An Updated Report by the American Society of Anesthesiologists Task Force on Preoperative Fasting and the Use of Pharmacologic Agents to Reduce the Risk of Pulmonary Aspiration

A. Fasting Recommendations

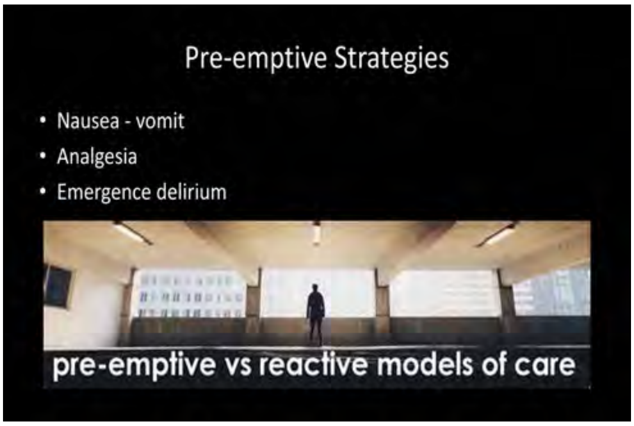
Ingested Material	Minimum Fasting Period†
• Clear liquids‡	2h
• Breast milk	4h
• Infant formula	6h
• Nonhuman milk§	6h
• Light meal**	6h
• Fried foods, fatty foods, or meat	Additional fasting time (e.g., 8 or more hours) may be needed

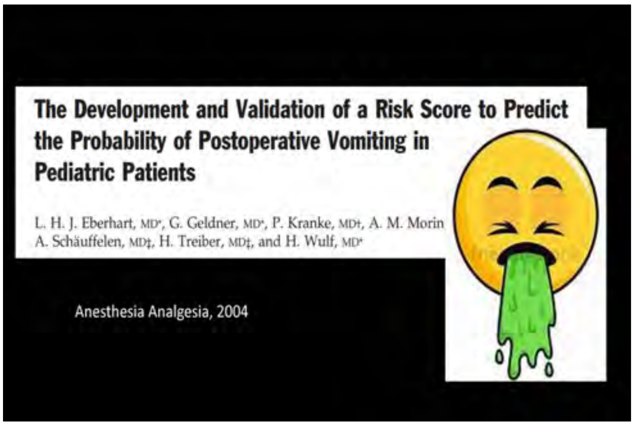
Anesthesiology February 2023

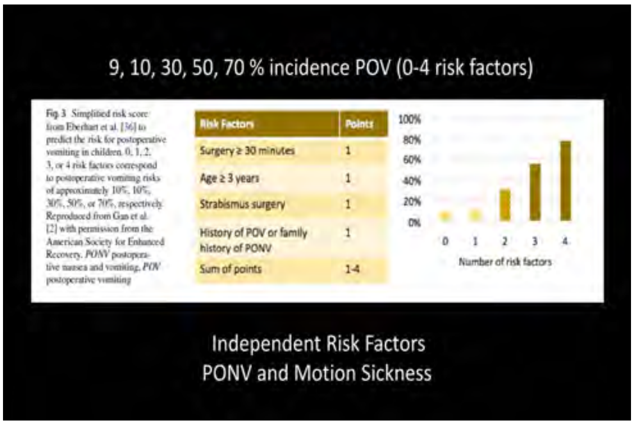
Practice Parameter | February 2023

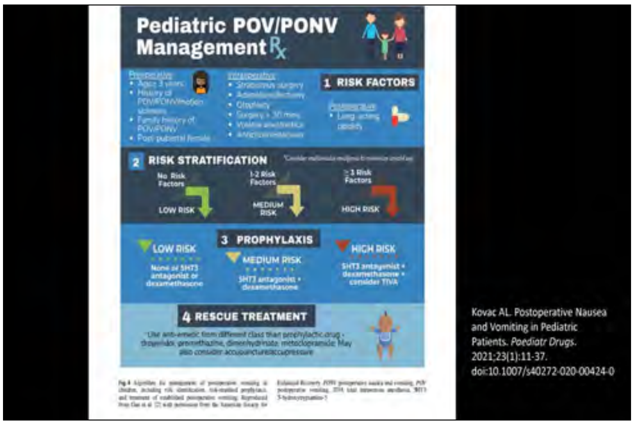
2023 American Society of Anesthesiologists Practice Guidelines for Preoperative Fasting: Carbohydrate-containing Clear Liquids with or without Protein, Chewing Gum, and Pediatric Fasting Duration—A Modular Update of the 2017 American Society of Anesthesiologists Practice Guidelines for Preoperative Fasting

- 2 hr clear
- carbohydrate-containing clear liquids ± protein
- Chewing gum (adults)

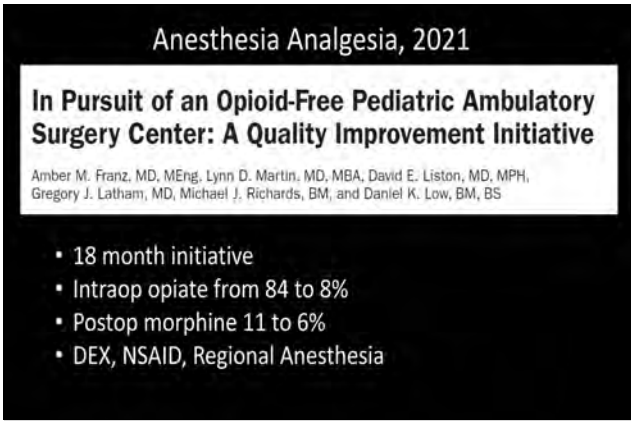

Pre-emptive Strategies
Nausea - vomit
Analgesia
Emergence delirium
pre-emptive vs reactive models of care

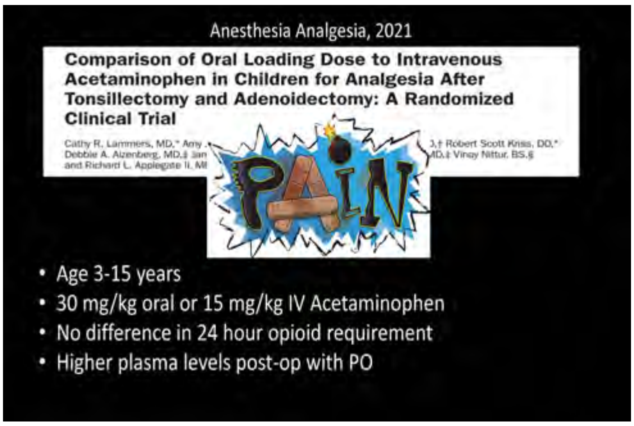

The Development and Validation of a Risk Score to Predict the Probability of Postoperative Vomiting in Pediatric Patients
L. H. J. Eberhart, MD, G. Geldner, MD, P. Kranke, MD, A. M. Morin
A. Schäuffelen, MD, H. Treiber, MD, and H. Wulf, MD
Anesthesia Analgesia, 2004


9, 10, 30, 50, 70 % incidence POV (0-4 risk factors)
Risk Factors | Points
Surgery ≥ 30 minutes | 1
Age ≥ 3 years | 1
Strabismus surgery | 1
History of POV or family history of PONV | 1
Sum of points | 1-4
Number of risk factors
Independent Risk Factors
PONV and Motion Sickness

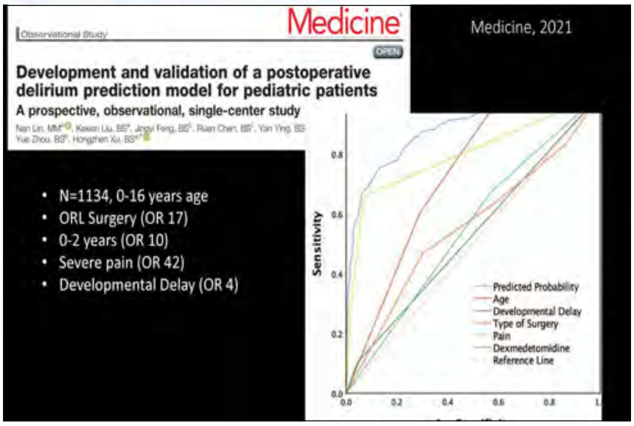

Pediatric POV/PONV Management
1 RISK FACTORS
2 RISK STRATIFICATION
LOW RISK
MEDIUM RISK
HIGH RISK
3 PROPHYLAXIS
4 RESCUE TREATMENT
Kovac AL. Postoperative Nausea and Vomiting in Pediatric Patients. Paediatr Drugs. 2021;23(1):11-37. doi:10.1007/s40272-020-00424-0

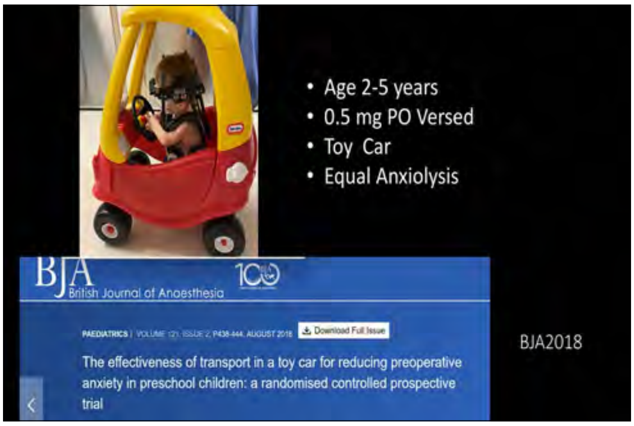

Pre-Emptive Analgesia

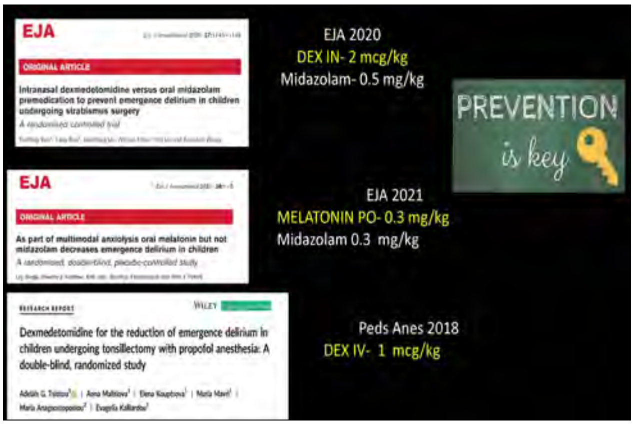

Anesthesia Analgesia, 2021
In Pursuit of an Opioid-Free Pediatric Ambulatory Surgery Center: A Quality Improvement Initiative
Amber M. Franz, MD, MEng, Lynn D. Martin, MD, MBA, David E. Liston, MD, MPH, Gregory J. Latham, MD, Michael J. Richards, BM, and Daniel K. Low, BM, BS
18 month initiative
Intraop opiate from 84 to 8%
Postop morphine 11 to 6%
DEX, NSAID, Regional Anesthesia


Anesthesia Analgesia, 2021
Comparison of Oral Loading Dose to Intravenous Acetaminophen in Children for Analgesia After Tonsillectomy and Adenoidectomy: A Randomized Clinical Trial
PAIN
Age 3-15 years
30 mg/kg oral or 15 mg/kg IV Acetaminophen
No difference in 24 hour opioid requirement
Higher plasma levels post-op with PO


Pre-Emptive Avoidance of Emergence Delirium

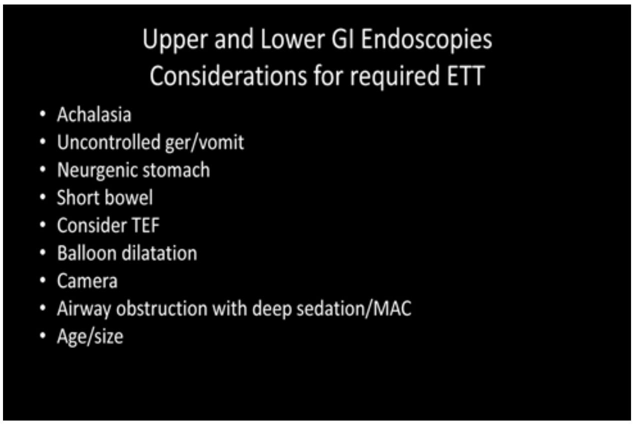

Observational Study
Medicine
OPEN
Development and validation of a postoperative delirium prediction model for pediatric patients
A prospective, observational, single-center study
Medicine, 2021
N=1134, 0-16 years age
ORL Surgery (OR 17)
0-2 years (OR 10)
Severe pain (OR 42)
Developmental Delay (OR 4)
Sensitivity
Predicted Probability
Age
Developmental Delay
Type of Surgery
Pain
Dexmedetomidine
Reference Line


Age 2-5 years
0.5 mg PO Versed
Toy Car
Equal Anxiolysis
BJA British Journal of Anaesthesia
The effectiveness of transport in a toy car for reducing preoperative anxiety in preschool children: a randomised controlled prospective trial
BJA2018

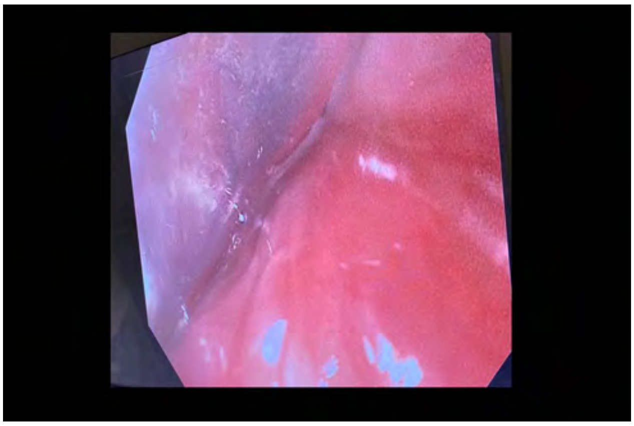

EJA
ORIGINAL ARTICLE
Intranasal dexmedetomidine versus oral midazolam premedication to prevent emergence delirium in children undergoing strabismus surgery
A randomised controlled trial
EJA 2020
DEX IN- 2 mcg/kg
Midazolam- 0.5 mg/kg
PREVENTION
is key
EJA
ORIGINAL ARTICLE
As part of multimodal anxiolysis oral melatonin but not midazolam decreases emergence delirium in children
A randomised, double-blind, placebo-controlled study
EJA 2021
MELATONIN PO- 0.3 mg/kg
Midazolam 0.3 mg/kg
RESEARCH REPORT
WILEY
Dexmedetomidine for the reduction of emergence delirium in children undergoing tonsillectomy with propofol anesthesia: A double-blind, randomized study
Peds Anes 2018
DEX IV- 1 mcg/kg

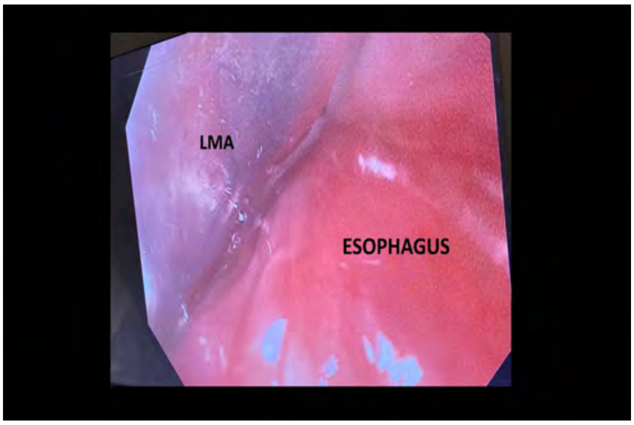

Treatment
Pediatric Anesthesia
Single bolus dexmedetomidine versus propofol for treatment of pediatric emergence delirium following general anesthesia
DEX IV 0.5 mcg/kg
Propofol 1 mg/kg
A Comparison of Dexmedetomidine and Propofol on Emergence Delirium in Children Undergoing Cleft Palate Surgery With Sevoflurane-Based Anesthesia
DEX IV 0.5 mcg/kg/hr
Propofol 2 mg/kg/hr
Journal of Craniofacial Surgery. 2022

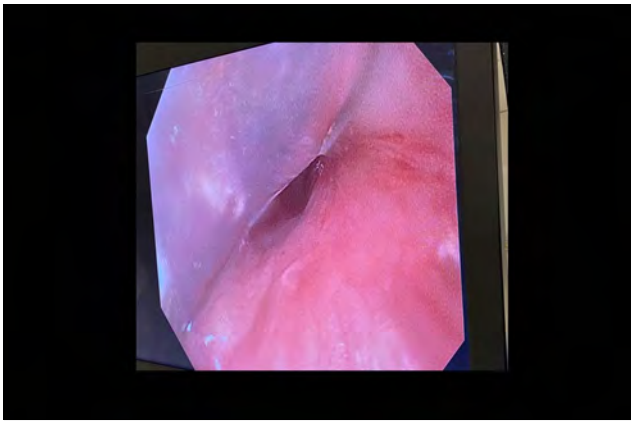

Challenging Ambulatory Cases
WE ALL FEEL AFRAID FROM TIME TO TIME. IT IS OFTEN HOW WE DEAL WITH THIS FEAR THAT CAN DEFINE HOW WE LIVE OUR LIVES.
Virgin

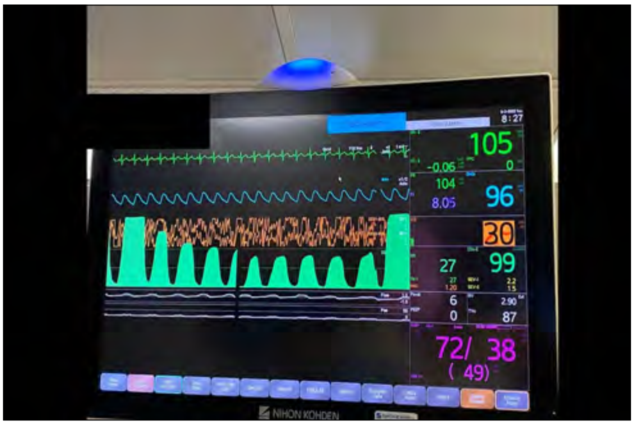

Upper and Lower GI Endoscopies
Considerations for required ETT
Achalasia
Uncontrolled ger/vomit
Neurgenic stomach
Short bowel
Consider TEF
Balloon dilatation
Camera
Airway obstruction with deep sedation/MAC
Age/size


18 month old
0.5 mcg/kg DEX bolus,
150mcg/kg/min
Propofol
EJA
ORIGINAL ARTICLE
The synergistic effect of dexmedetomidine on propofol for paediatric deep sedation
A randomised trial









Pediatric Anesthesia, 2016

Predictors of unanticipated admission following ambulatory surgery in the pediatric population: a retrospective case–control study

Amanda Whippey, Gregory Kostandoff, Heung K. Ma, Ji Cheng, Lehana Thabane & James Paul

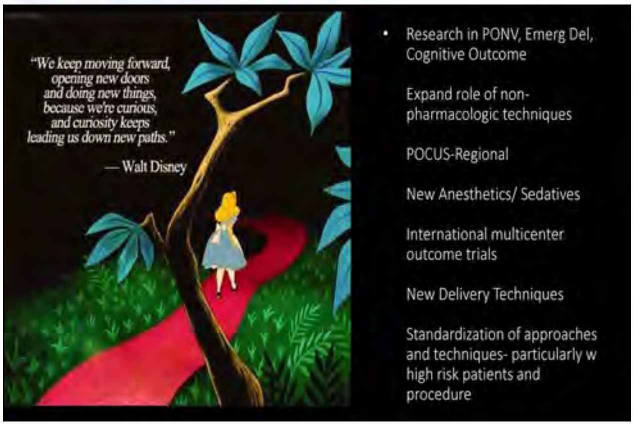
- 2005–2013
- 0.97% unanticipated admission
- 47% anesthesia related
- Age <2 years (odds ratio 4.26)
- ASA 3 class (OR 3.77)
- duration of surgery >1 h (OR 6.54)
- completion of surgery >3 pm (OR 2.17)

Pediatric Anesthesia, 2016

Predictors of unanticipated admission following ambulatory surgery in the pediatric population: a retrospective case–control study

Amanda Whippey, Gregory Kostandoff, Heung K. Ma, Ji Cheng, Lehana Thabane & James Paul

- orthopedic (OR 2.52)
- dental (OR 0.21)
- ENT (OR 6.47) surgery
- intraoperative events (OR 4.45)
- OSA (OR 6.32)


"We keep moving forward, opening new doors and doing new things, because we're curious, and curiosity keeps leading us down new paths."
— Walt Disney
Research in PONV, Emerg Del, Cognitive Outcome
Expand role of non-pharmacologic techniques
POCUS-Regional
New Anesthetics/ Sedatives
International multicenter outcome trials
New Delivery Techniques
Standardization of approaches and techniques- particularly w high risk patients and procedure

Luncheon Symposium

Chair(s): Ah Young Oh (Korea)

Sugammadex: Game Changer of NM Reversal

Nicola Disma

Department of Paediatric Anaesthesia, Istituto Giannina Gaslini, Italy

Outline

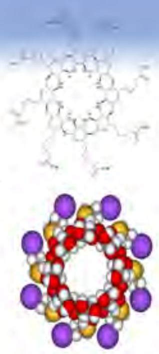
- Regulatory
- Pharmacology
- Dosing in children
- Efficacy
- Future perspectives

APPROVAL

- 'Su-' for 'sugar' and '-gammadex' for gamma-cyclodextrin.
- Sugammadex was first synthesized in 1999 and later approved for use by the EMA in 2008. The United States Food and Drug Administration (FDA) did not approve the drug immediately (concerns about hypersensitivity, surgical bleeding, and QTc prolongation). It was approved for adults use in December of 2015.
- It is not approved for use in children in the United States, but administered as off label medication.
- In Europe, sugammadex is approved for use in children 2 – 17 years of age for 'routine reversal' only.

PHARMACOLOGY

- Donut-shaped cyclodextrin molecule.
- Half-life of 2h in patients with normal renal function.
- It has not hepatic metabolism.
- No binding with plasma proteins or red blood cells.
- It is excreted unchanged by the ***kidneys***.



SIDE EFFECTS

- Hypersensitivity and anaphylaxis: flushing, urticaria, erythematous rash, (severe) hypotension, tachycardia, swelling of tongue, swelling of pharynx, bronchospasm and pulmonary obstructive events.
- Bradycardia

- Vomiting
- Hypotension
- Headache
- Pain
- Nausea

DOSAGE

Sugammadex dosing guidelines for reversing rocuronium

	Neuromuscular block depth	Sugammadex dose (mg/kg)	Time to recovery of T_4/T_1 ratio 0.9 (minutes)
Routine reversal	T_2	2	2
	One to two posttetanic counts	4	3
Immediate reversal	No tetany	16	1.5

Following a single intraoperative dose of rocuronium (0.6 mg/kg), sugammadex was administered within 2 minutes of reappearance of **T2** of the TOF. The median time from the administration of sugammadex to return of the **TOF ratio to 0.9** was 0.6 (n=1), 1.2 (n=4), 1.1 (n=6), and 1.2 (n=5) minutes, respectively, in infants (28days – 23months), children (2 – 11 years), adolescents (12 – 17 years), and adults (>17 years).

- *Simonini et al.* retrospectively looked at 423 pediatric patients to compare postoperative adverse effects between patients who received **sugammadex 2 *vs* 4mg/kg**.
  - No difference for delirium, laryngospasm, bradycardia, or nausea within 30 min post-extubation
- *Matsui et al.* looked at 72 patients between 2 and 24 months old and randomized them to **1, 2, or 4 mg/kg doses of sugammadex**, and the time to TOF 0.9 was compared after receiving rocuronium.
  - The 2 and 4mg/kg groups had similar outcomes [70.3 (26.7)s and 68.2 (34.5)s], but the 1mg/kg groups took significantly longer 129.1 (83.5)s with three failed reversals

RESIDUAL WEAKNESS: A CASE SERIES

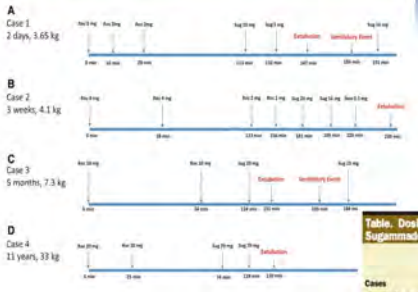


Table. Dosing Timeline for Rocuronium and Sugammadex

Cases	Total Rocuronium mg (mg/kg)	Time Between Last Dose of Rocuronium and Initial Reversal (min)	Total Sugammadex mg (mg/kg)
Case 1: 2 d, 3.65 kg	7 (1.92)	84	31 (8.49)
Case 2: 3wk, 4.1 kg	11 (2.68)	25	36 (8.78)
Case 3: 5 mo, 7.3 kg	20 (2.74)	70	35 (4.79)
Case 4: 11 y, 33 kg	40 (1.2)	49	140 (4.24)

Reversal with sugammadex **(4mg/kg)** in profound residual neuromuscular blockade in neonates.

	Total Rocuronium dose (mg)	Recovery time (min)	Final TOF
1 day (n=8)			
Mean (SD)	1.6 (0.1)	1.4 (0.1)	105 (20)
Median (range)	1.7 (1.5-1.7)	1.3 (0.6-3.0)	90-152
1day–7days (n=15)			
Mean (SD)	1.4 (0.5)	1.2 (0.5)	103 (8.2)
Median (range)	1.6 (0.5-0.8)	1.2 (0.4-2.2)	97-112

REINTUBATION AFTER SUGAMMADEX

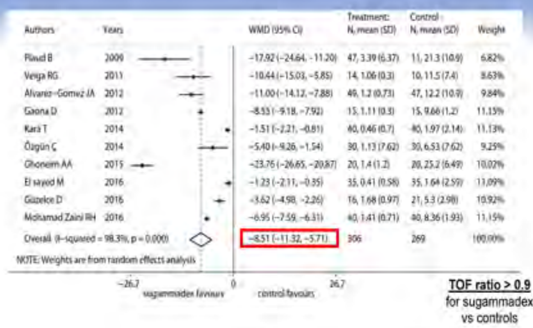
How to reparalyze after sugammadex 4 mg/kg	
Time	**Medication**
< 30 mins	Succinylcholine or cisatracurium
30 min to 4 h	Rocuronium 1.2 mg/kg
> 4 h	Any typical muscle relaxant/dose

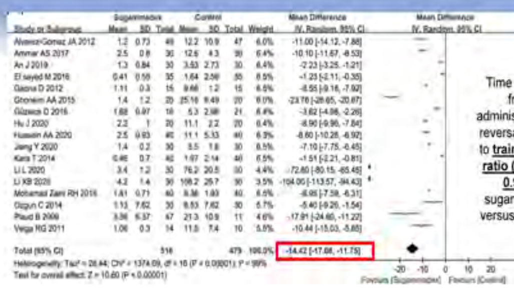
When **rocuronium 1.2 mg/kg** is administered **within 30 minutes** after reversal with sugammadex, the onset of neuromuscular blockade may be **delayed** up to approximately 4 minutes and the duration of neuromuscular blockade may be **shortened** up to approximately 15 minutes

For re-administration of rocuronium or administration of vecuronium after reversal of rocuronium with **16 mg/kg sugammadex**, waiting 24 hours is recommended.

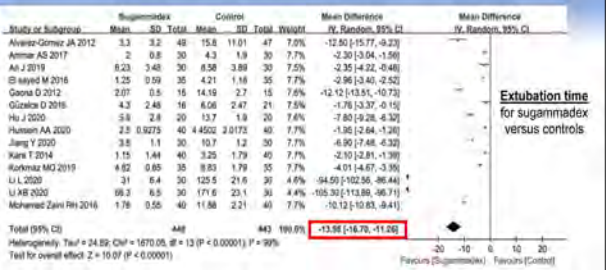
SUGAMMADEX *vs* NEOSTIGMINE

- Sugammadex provides a **faster and more complete reversal** with a lower risk of residual curarization.
- Sugammadex also has a **lower rate of postoperative respiratory complications**.
- Gaver et al. performed a retrospective analysis of 968 patients from birth to 18 years old who received sugammadex and matched neostigmine controls. The cohort included 18 neonates and 137 1-year- olds. The number of minutes between administration of reversal agent to time **out of the operating room** was significantly shorter in the sugammadex group (*mean difference 2.8; 95% CI, 1.85–3.77; P < 0.001*).





Time interval from administration of reversal agents to **train-of-four ratio (TOFr) > 0.9** for sugammadex versus controls



Adverse effects	Number of studies (Reference no.)	Patients in Sugammadex group (Incidence, %)	Patients in Control group (Incidence, %)	I^2 (%)	Risk ratio with [95% CI]	P value
PONV	13 (23,25,28,29,32–40)	33/431 (7.66%)	69/393 (17.56%)	21	0.30 [0.20, 0.46]	< 0.00001*
Bradycardia	4 (25,26,33,40)	0/124 (0%)	15/122 (12.30%)	0	0.09 [0.02, 0.46]	0.004*
Pain	2 (23,39)	8/67 (11.94%)	5/31 (16.13%)	0	1.21 [0.46, 3.17]	0.70
Bronchospasm/ Laryngospasm	5 (25,28,34)	1/114 (0.88%)	4/112 (3.57%)	0	0.45 [0.10, 1.96]	0.29
Dry mouth	2 (33,35)	3/60 (5%)	25/60 (41.67%)	0	0.14 [0.05, 0.38]	0.0001*
Apnea	2 (34,40)	0/65 (0%)	2/65 (3.08%)	0	0.33 [0.04, 3.12]	0.34
Oxygen desaturation	3 (34,35,38)	3/95 (3.16%)	8/95 (8.42%)	0	0.41 [0.12, 1.37]	0.15

*Significant difference between groups (P < 0.05)

PONV postoperative nausea and vomiting, CI confidence intervals

SUGAMMADEX *vs* SUCCINYLCHOLINE

- In a difficult ventilation scenario, patients can recover neuromuscular function more quickly with sugammadex reversal than the spontaneous metabolism of succinylcholine. In one study, patients regained T1 90% in 6.2 min with sugammadex versus 10.9 min with succinylcholine.
- Sugammadex does not have the side effects of increased serum potassium, fasciculations, increases in intraocular or intracranial pressure, and there is no risk of malignant hyperthermia

SPECIAL CONSIDERATIONS

- Cardiac surgery
- Neuro-myopathic conditions (muscular dystrophies, myotonic dystrophies, spinal muscular atrophy and myasthenia gravis)
- Renal failure (up to 24h) ⟶ dialysis ?
- CICV (*can not intubate can not ventilate*)
- Toremifene (antiestrogen agent) and hormonal contraception

CONCLUSIONS

- Sugammadex is a novel agent able to reverse deep neuromuscular blockade.
- Data regarding safety and efficacy in pediatrics is limited.
- Current literature suggests that sugammadex is well tolerated and effective in patients older than 2 years.
- Sugammadex can be used in neonates, but with caution *(4mg/kg)*
- Hypersensitivity, anaphylaxis and bradycardia are described, but rare.

Abstract

Aims: The aim of this study was to investigate the effectiveness, safety and pharmacokinetics of adamgammadex in surgical patients.

Methods: Forty-eight patients aged 18-64 years old were randomized to receive adamgammadex (2, 4, 6, and 8 mg.kg^{-1}) or placebo at a ratio of 10:2 for reversal of 0.6 mg.kg^{-1} rocuronium-induced neuromuscular block. Neuromuscular function was monitored by TOF-Watch® SX. When the T_2 of train-of-four (TOF) reappeared at the end of surgery, patients received an intravenous administration of adamgammadex or placebo.

Results: The recovery time of the TOF ratio to 0.9 decreased significantly from 39.3 [29.5, 50.2] minutes in the group that received placebo to 3.0 [2.3, 3.9] minutes, P < .0001; 2.1 [1.5, 3.0] minutes, P < .0001; 2.1 [1.6, 3.3] minutes, P < .0001; and 1.8 [1.5, 2.2] minutes, P < .0001 in the 2, 4, 6 and 8 mg.kg^{-1} adamgammadex groups, respectively. Then, adamgammadex also showed a shortened recovery time for the TOF ratio recovered to 0.8 and 0.7. Adamgammadex was well tolerated, and no cases of anaphylactic reactions, post-operative bleeding, recurarization, abnormal basic vital signs and prolonged QT intervals were observed. The pharmacokinetics of adamgammadex in plasma increased in dose-dependent manner. The 24-hour cumulative fraction of adamgammadex in urine was 65-83%, and that of rocuronium was increased after using adamgammadex from 15% to about 25-30%.

Conclusion: Adamgammadex was found to be effective for reversal of rocuronium-induced neuromuscular block, and it was safe and well tolerated in patients.

Session 3.

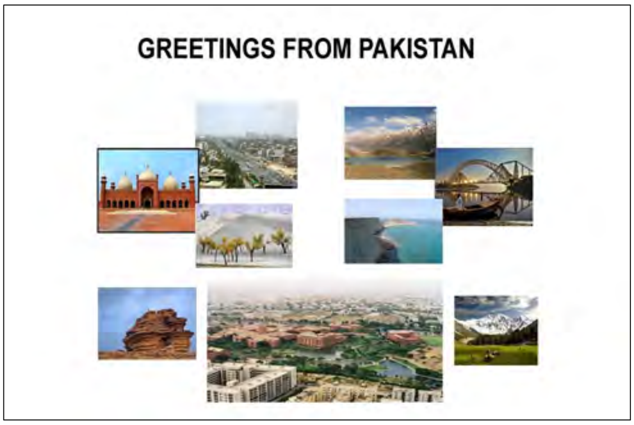
From Design to Publication: Special Tips for Young and New Asian Researchers

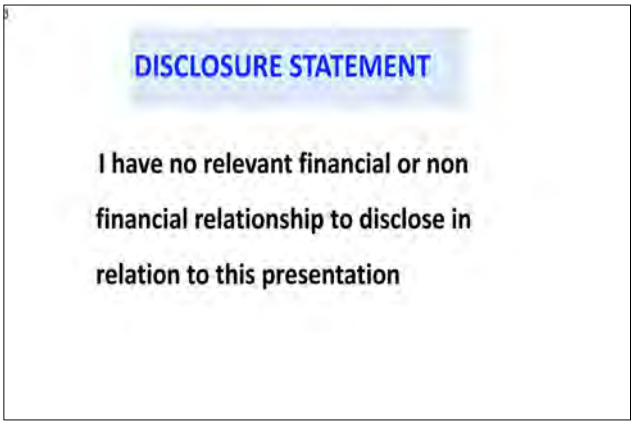
Chair(s): Soichiro Obara (Japan)
Hyun Kang (Korea)

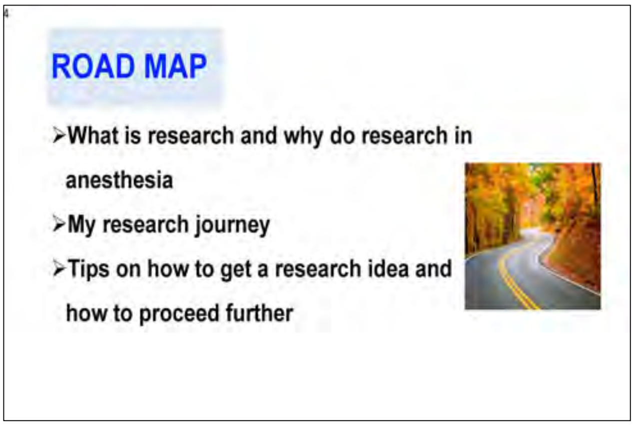
Where and How I Get My Research Ideas

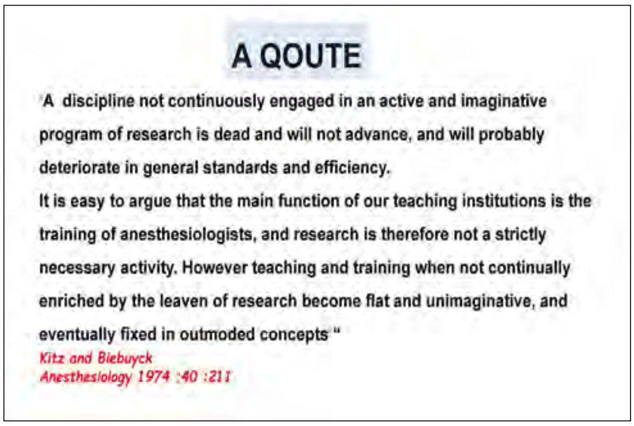
Fauzia Anis Khan

Department of Anaesthesiology, Aga Khan University, Pakistan









IS RESEARCH NEEDED IN RESORCE POOR SETTINGS ?

- Academic future of teaching institutions
- We rely on data from the west for setting our priorities
- There are more chances of research done at local level for being translated into national policies

ANAESTHESIA RESEARCH IN LMIC

Gets diluted in bigger issues like

- Urbanization
- Poverty
- Water scarcity
- Food safety
- Infectious diseases

EXISTING BARRIERS TO RESEARCH IN LMIC

- Lack of basic research skills
- Time constraints
- Lack of mentors/role models
- Lack of financial /other institutional support
- Lack of infrastructure
- Lack of appreciation
- Limited access to health informatics
- Individualism and ability to work in groups
- Lack of collaboration between scientists as well as institutions in LMIC

Lack of Monitory Resources

- In industrialized nations 30-50% of research is funded by private industry but non existent in LMIC
- UNESCO recommends that 2 % of GDP should be dedicated to research and development

UNESCO Information manual

- In developing countries students and researchers in most scientific institutes carry out their research with very little or no funding , no budget for publication of scientific researchers

Ahmed YF .Problems of scientific publishing in developing countries, J Veterinar Sci Technol3.2012

Problems of doing research in developing countries

Developed countries	Developing countries
Research is supported from government and various scientific organizations which provide huge budgets for research and publications	Students and researchers in most scientific institutes carry out their research with very little or no funding , no budget for publication of scientific researchers

INITIAL STEPS IN CONDUCTING RESEARCH

- FIRST STEP – Choosing the research idea
- SECOND STEP – Brief literature review
- THIRD STEP – Identifying the research question
- FOURTH STEP – Extensive literature review
- FIFTH STEP – Hypothesis generation
- SIXTH STEP – Objective

MY STORY

MY RESEARCH JOURNEY

- MB BS Pakistan, training & Fellowship (FRCA) UK 1983
- No research training during MB BS, basic statistics during FRCA training
- My initial papers as an author were a survey that I conducted when I was an intern at a university hospital in Saudi Arabia & a case report from my last training year in UK

Khan FA. Endotracheal intubation with a Carlens tube via a tracheostomy. Journal of Anaesthesiology, Lahore. 1986;111:48-52.

Khan FA, Kamal RS and Khurshid M. The value of preoperative haemoglobin. Pakistan Journal of Surgery, 1987;Vol. 1 & 2:17.

MY RESEARCH JOURNEY1986-2023

- Peer reviewed publications exceed 200
- Includes publications (RCTs, systematic reviews & meta-analysis, surveys, case reports etc) in Anaesthesia (UK), Anesthesia & Analgesia (USA), European Journal of Anaesthesia, Scandinavian J Anaesthesia, Canadian J Anaesthesia, Pediatric Anesthesia, Turkish J Anaesthesia, Middle East J Anaesthesia and in regional and local journals

I will share some of my experience on where to get research ideas

- Case reports
- Review of existing practice
- Investigate geographical variations
- Challenge conflicting ideas/ Look for conflicting views
- Let your Imagination run
- Look at the current trends

Start with Case Reports

- Khan FA. Endotracheal intubation with a Carlens tube via a tracheostomy. **Journal of Anaesthesiology**, Lahore. 1986;111:48-52

Common and rare cases as long as there is something new to learn from these and clinical information is presented in a manner that optimises learning. It is essential that the clinical evidence is presented in full and supports the conclusions and learning points made. Information should be presented in a manner that maximises learning

BMJ

Review of existing practice

Practicing in Pakistan (LMIC)

- Khan FA and Kamal RS. Effect of buprenorphine on the cardiovascular response to tracheal intubation. Anaesthesia (U.K), 1989;44:394-7.
- Khan FA and Kamal RS. A comparison of buprenorphine and pethidine in analgesic supplemented anaesthesia with reference to anaesthesia in developing countries. Singapore Medical Journal, 1990;31; No.4:345-9.
- Kamal RS, Khan FA and Khan FH. Total intravenous anaesthesia with propofol and buprenorphine. Anaesthesia(U.K), 1990;Vol. 45;No.10: 865-70
- Khan FA, Zaidi A, Kamal RS. 1997. Comparison of nalbuphine and buprenorphine in total intravenous anaesthesia. Anaesthesia (UK). 52:1090-1113.

Investigate Geographical Variations

- Khan FA, Saqib N, Chohan U, Bhatti TJ and Kamal RS. Minimum induction dose of thiopentone in Pakistani patients. J Pak Med Assoc 1991;41 No.4:83-85.
- Ahmed N, and Khan FA. Evaluation of oral midazolam as a premedication in day care Pakistani patients. J Pak Med Assoc 1995; 45: 233-257.

Challenge conflicting ideas/Look for conflicting views

- Khan FA, Aziz ul Haq. Effect of Cricoid pressure on the incidence of nausea and vomiting in the immediate postoperative period Anaesthesia (UK) 2000; 55: 163-83
- Khan FA, Memon GA. Comparison of spontaneous with controlled mode of ventilation in tonsillectomy. Paediatric Anaesthesia (UK) 2001; 1:185-190
- Khan FA, Memon GA, Kamal RS. Effect of route of buprenorphine on recovery and postoperative analgesic requirement in paediatric patients. Paediatric Anaesthesia (UK) 2002; 12: 786-790

Cinderella Topics

Let your imagination run wild

Look at the current trends

Some Current Trends in Pediatric Anesthesia

- Outcome and safety studies
- POCUS & Regional techniques
- Hemoglobin thresholds
- Pre- oxygenation & apneic oxygenation
- ERAS
- Anesthesia & neurodevelopment
- PALS
- Pain management

Pediatric Studies Published

- Abbasi S, Khan F A, and Khan S. **Pediatric critical incidents** reported over 15 years at a tertiary care teaching hospital of a developing country. **J Anaesthesiol Clin Pharmacol.** 2018 Jan-Mar; 34(1): 78–83.
- Hussain A,Khan FA.Effect of 2 techniques of **parental interaction** on childrens anxiety at induction of general anaesthesia.A randomized controlled trial.**Turkish Jourenal of Anaesthesiology & Reanimation** 2018.
- Aman,A. Salim B. Munshi,K. Raza,S.A. Khan FA. Effect on **neonatal outcome** of pharmacological interventions for attenuation of the maternal haemodynamic response to tracheal intubation: a systematic review. **Anaesthesia & Intensive Care** . 2018, Vol. 46 :258-271
- Butt MN, Salim B, Khan FA. Pharmacological agents for prevetion of haemodynamic response and arrhythmia related to **tracheal intubation in paedaitric patients (A systematic review)**. A systematic review. **Anaesthesia and Intensive Care**. 2016;44(6):681-91.

Pediatric Studies Published

- Yousaf S ,Dogar S, Hamid M, Khan A, Shamim F, Khan FA. Anaesthetic management of **thoraco-omphalopagus twins** with congenital heart disease for separation surgery. April 2017 (Case report).**Anesthesia and Analgesia.(USA)**
- Yousuf MS, Shamim F, Dogar SA, Khan FA. Anaesthetic management of **conjoint twins for CT scan** (Case Report). **Anesthesia & Analgesia**. 2016;7(8).
- Shamim F, Ullah H, Khan FA. Postoperative **pain assessment** using four behavioral scales in Pakistani children undergoing elective surgery. **Saudi J Anesth**. 2015;9(2):174-78.

Pediatric Studies Published

- Khan FA, Haider S, Abbas N, et al. Challenges of Pediatric Anesthesia **Services and Training Infrastructure** in Tertiary Care Teaching Institutions in Pakistan: A Perspective from the Province of Sindh. **Anesth Analg.** 2022;134(3):653-660.
- Afzal R, Rashid S, Khan FA. The Role of Preoperative **Educational Intervention** in Reducing Parental Anxiety. **Cureus.** 2022;14(7): e26548.
- Khoso, Nasir; Ghaffar, Waleed B.; Abassi, Shemila; Khan, Fauzia A. Pediatric Anesthesia **Severe Adverse Events** Leading to Anesthetic Morbidity and Mortality in a Tertiary Care Center in a Low- and Middle-Income Country: A 25-Year Audit. **Anesthesia & Analgesia**. 132(1):217-222, January 2021.

Some nice quotes

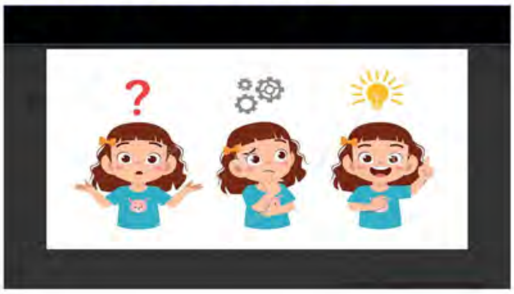
Scientists do not usually start from hypotheses that are nicely formulated "out of the blue", but instead start from previous knowledge and experience; when they are challenged by anomalies, scientists seek new explanations

Hanson NR. J Philosophy. 1958;55(25):1073

. **Scientists should "retire" from a field as soon as they become "experts". When you are too long in a field, you will no longer see the anomalies, and you may even obstruct newcomers with new explanations.**

Sackett DL. J Chronic Dis. 1983;36(7):545–547

Cultivating your thoughts



Keeping Track of your Ideas

- Write down your thoughts (My experience)
- Review this file regularly
- From such files, new research projects are born
- Ask yourself ,what data you might need to prove a certain proposition, and how you might get those data in the easiest way possible

What worked for me

I kept a small note book and wrote down any research idea I had, any time of the day. I also wrote about my research progress from time to time. This also helps to keep in sight how things change over time

How Much To Read To Find An Idea?

- Do not start by reading too much. You will quickly drown in the ideas of others
- Read a few general reviews that identify unanswered problems.
- Return to the literature after you have defined your research question and provisionally your study design

Do Systematic Reviews have a place in the initial research ?

It is argued that before embarking on a new piece of research, one should first do a systematic review and/or meta-analysis, because this may help to define the gaps in knowledge more precisely, and guide new research – or may show that the question has been solved

Focus your thoughts

There are differences between scientists: some roam across various fields and others stick to a problem area that they explore with increasing depth – then the increasing depth and the new techniques that one needs for advancing one's thoughts will be like a "new field"

Vandenbroucke, Clinical Epidemiology 2018:10

Prune your idea

Pruning a research question

means cutting away anything

that is unnecessary, so that only

the essence remains

Prune your idea (cont)

Refine your research question into something that is feasible

- It should be limited to a question that can be solved with the resources at hand
- Something specific
- Something that was overlooked by others
- Some new twist to a general question, so that you can make your own contribution

HOW TO JUDGE A BUDDING RESEARCH IDEA

FINER : Different aspects that one should consider to judge a budding research proposal

- F Feasible
- I Interesting
- N Novel
- E Ethical
- R Relevant

Hulley and Cummings, In: Designing Clinical Research, an Epidemiological Approach. Baltimore, MD: Williams & Wilkins; 1988:12–17.

What comes next

The first decision

Whether you should pursue the idea at all. There might be several reasons to decide not to pursue it. One might be that arriving at a satisfactory design will be impossible, because of biases that you are unable to solve

Miettinen 1985

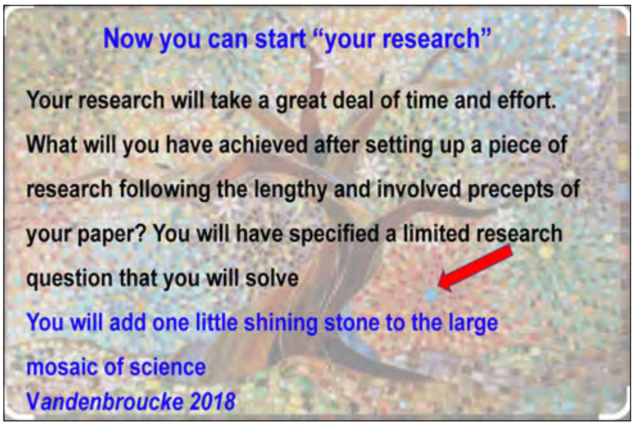
Theoretical Epidemiology. Principles of Occurrence. Research in Medicine. New York, NY: John Wiley and Sons; 1985:62.

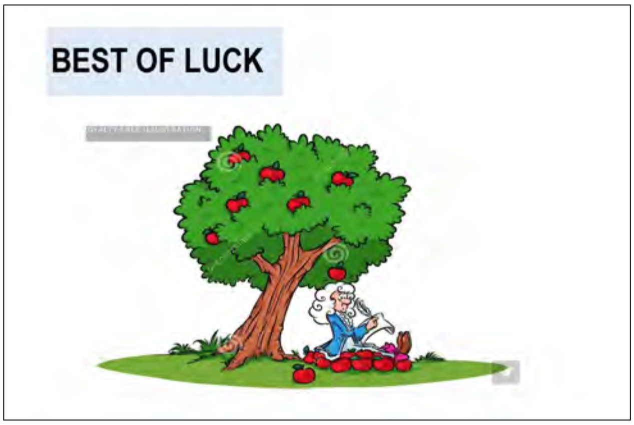
All studies have imperfections, but you need to be aware which ones you can tolerate

It is not a good use of your time to chase something completely improbable or futile

Schriger DL. Suggestions for improving the reporting of clinical research: the role of narrative. Ann Emerg Med. 2005;45(4):437–443


Is there a Role of a Mentor ?
An essential strategy for a young investigator is to apprentice himself to an experienced senior scientist who has the time and interest to work with her/him regularly
"I'd like to mentor you. We can start by you getting me some coffee."

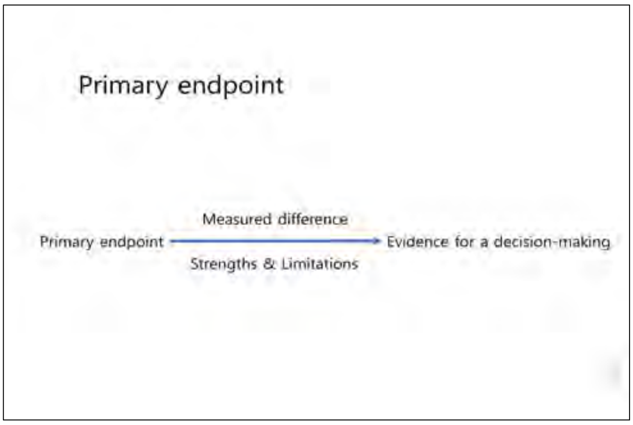

Now you can start "your research"
Your research will take a great deal of time and effort.
What will you have achieved after setting up a piece of research following the lengthy and involved precepts of your paper? You will have specified a limited research question that you will solve
You will add one little shining stone to the large mosaic of science
Vandenbroucke 2018

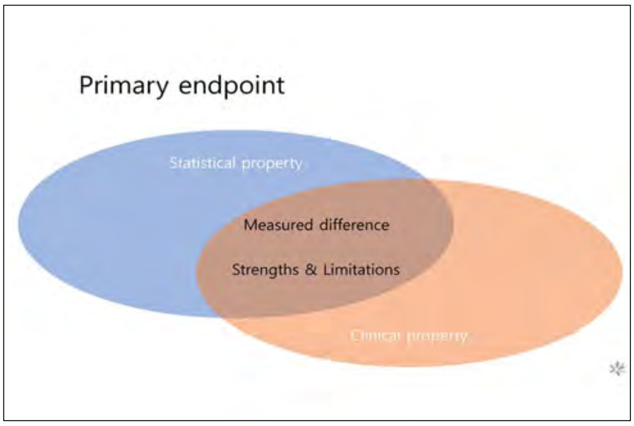

BEST OF LUCK

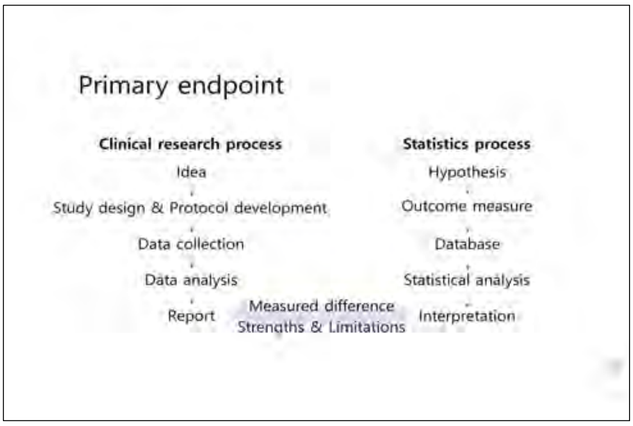
How to Build a Primary Endpoint: Statistical and Clinical Solutions

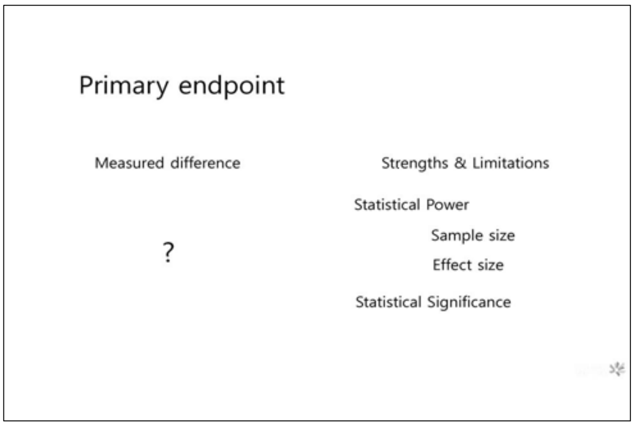
Dong Kyu Lee

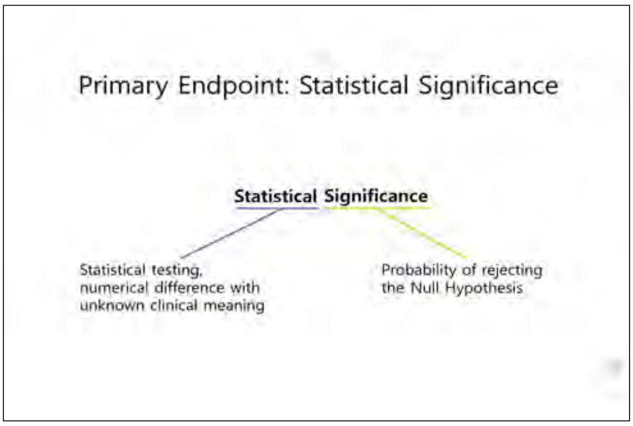
Department of Anesthesiology and Pain Medicine, Dongguk University Ilsan Hospital, Korea









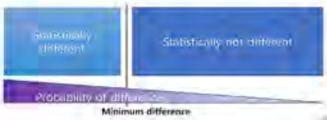


Primary Endpoint: Statistical Significance

Null Hypothesis Significance test

Before statistical analysis, set "<u>MINIMUM Effect Size</u>" of interest
└── α & β error rate, Power (Sample size)

Dichotomous decision only.



Primary Endpoint: Statistical Significance

Null Hypothesis Significance test

Hypothesis : A is different with B
Null hypothesis : A is same with B

Get P value.
If P value > Critical limit value: ~~No, A is same with B~~ Less different than MES
If P value < Critical limit value: ~~Yes, A is different with B~~ At least, different as MES

Primary Endpoint: Statistical Significance

Null Hypothesis Significance test

P = 0.04 : Less effect ?
P = 0.01 : More effect?

~~Yes~~ No (violate NHST assumption due to different power)

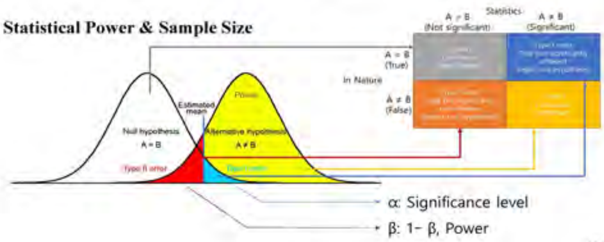
Primary Endpoint: Power

Statistical Power & Sample Size

Null hypothesis: A = B

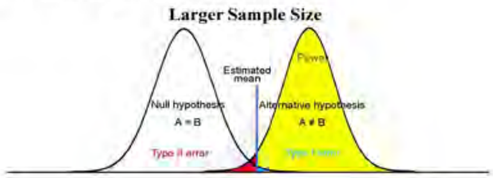
Primary Endpoint: Power

Statistical Power & Sample Size



Primary Endpoint: Power

Statistical Power & Sample Size



Primary endpoint: Effect size

Effect size : Standardized estimates of measured treatment effects

$$Cohen's\ d = \frac{Mean\ difference}{Pooled\ standard\ deviation}$$

$$Pooled\ SD = \sqrt{\frac{(N_A - 1)SD_A^2 + (N_B - 1)SD_B^2}{N_A + N_B - 2}}$$

Standardized form	No unit!	Statistical inference
Easy to interpretation	Enables comparing between other studies (Meta-analysis)	Simultaneously expresses "Statistically significance" + "How large of its effect"

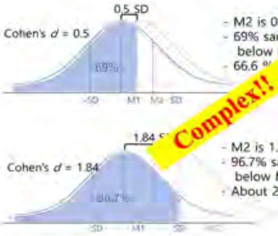
Primary endpoint: Effect size

Effect size : Standardized estimates of measured treatment effects

Statistical testing methods	Effect sizes
Student's t-test	Cohen's *d*
Nonparametric rank sum test	*Cliff's delta*
ANOVA	η^2 (eta –squared) Hay's ω^2 Cohen's f^2
Correlation analysis	Pearson's *r*
Regression analysis	r^2, R^2 Cohen's f^2
Contingency tables	*Odds ratio, Relative risk*
Chi-square test	*Φ(phi)*, Cramer's *V*
Ratio comparison	Cohen's *h*

Primary endpoint : Effect size

Effect size
Interpretations



- M2 is 0.5 SD above M1
- 69% samples in group 1 would be below M2
- 66.6 % data overlap

- M2 is 1.84 SD above M1
- 96.7% samples in group 1 would be below M2
- About 22% data overlap

Primary endpoint : Effect size

Effect size
Interpretations

Table 1: Illustrative Interpretations of Cohen's d

Estimated values	Proportion of control group which would be below the mean of the treatment group	Size of effect
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]
1.2	[illegible]	
1.6	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	

Primary endpoint : Effect size

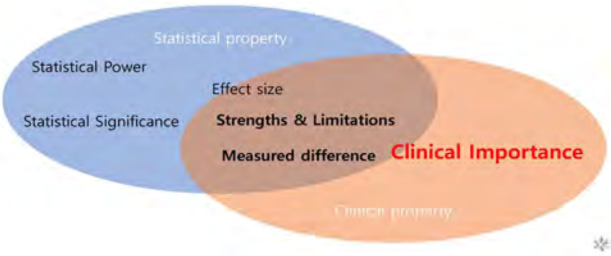
Effect size
Interpretations

"Large effect size" means...

More significant differences between groups (X)

Larger differences between groups (O)

Primary endpoint



Primary endpoint: Clinical Importance

Clinical Importance

MCID (Minimal Clinical Important Difference)
CMD (Clinically Meaningful Difference)
MIC (Minimally Important Changes)
MCII (Minimal Clinical Important Improvement)

Statement of treatment-induced change, *a priori*
: The SMALLEST change in an outcome that an *individual patient* would identify as important and which would indicate a change in *the patient's management*. https://en.wikipedia.org/wiki/Minimal_important_difference

Primary endpoint: Clinical Importance

Clinical Importance

Sample size calculation
Effect size
Significance level (α error rate)
Power (1 − β)
1 − vs. 2 − sided analysis

Primary endpoint: Clinical Importance

Clinical Importance

Sample size calculation
Effect size — Determined by
Significance level (α error rate)
Power (1 − β)
1 − vs. 2 − sided analysis

Determined by:
Researcher's intension (small, medium, large)
Researcher's intension (arbitrary difference)
Previous research (mean, SD)
Pilot test

Primary endpoint: Clinical Importance

Clinical Importance

Sample size calculation
Effect size — Determined by

Researcher's intension (small, medium, large)
Researcher's intension (arbitrary difference)
Previous research (mean, SD)
Pilot test

Evidence?

Primary endpoint: Clinical Importance

Clinical Importance

Researcher's intension (small, medium, large)	"We set a large effect size for pain reduction by a new medication"
Researcher's intension (arbitrary difference)	"We set a VAS <4 for pain reduction by a new medication"
Previous research (mean, SD)	"Regarding a previous study by OOO et al., 3 or more VAS reduction is considered as a significant change"
Pilot test	"According to our pilot test, 4 or more VAS reduction is considered as a significant change"

Evidence?

Primary endpoint: Clinical Importance

Clinical Importance

MCID (Minimal Clinical Important Difference)

Define the minimal relevant changes by the intervention (e.g., "better" or " much better;" distribution-based, anchor)

Statistical validation: sensitivity, specificity, accuracy

Evidence!

Primary endpoint: Clinical Importance

Clinical Importance : MCID (Minimal Clinical Important Difference)

You can also find MCID examples in the anesthesiology and Pain area.

Primary endpoint: Clinical Importance

Clinical Importance : How to determine the MCID?

Distribution-based method: From statistically measured data spread (SD, SEM, Effect size)

Anchor-based method: Compare changes in scores with an anchor which is reported by the patients (Patient-reported outcome (PRO))

Delphi method: Refer to a panel of experts, an objective and systematic approach with statistical analysis and opinion reconciliation based on anonymity.

Triangulation method: Combination of distribution-based and anchor-based methods

Primary endpoint: Clinical Importance

Clinical Importance : How to determine the MCID?

Example: Anchor-based method

1. Obtain a representative sample
2. Confirm the relationship between MCID and the anchor (high correlation coefficient between VAS and "better" response)
3. Compute sensitivity, specificity, accuracy, Youden index
4. Select MCID

James FM et al., A Standard Method for Determining the Minimal Clinically Important Difference for Rehabilitation Measures. Archives of Physical Medicine and Rehabilitation 2020;101:1090-4. https://doi.org/10.1016/j.apmr.2019.12.008

Primary endpoint: Clinical Importance

Clinical Importance : Limitations of MCID

Subjectivity Based on subjective assessment

Heterogeneity The different populations would produce a different interpretation

Precision Applying statistical method: sample size, measurement error or bias

Context-sensitive The same MCID value may not be applicable across different clinical situations

Summary

The primary endpoint serves as an evidence for decision-making

The primary endpoint represents a specific outcome supported by both statistical significance and clinical importance.

Statistical significance is a binary decision-making process that involves accepting or rejecting the null hypothesis, which states that there is no difference or no effect.

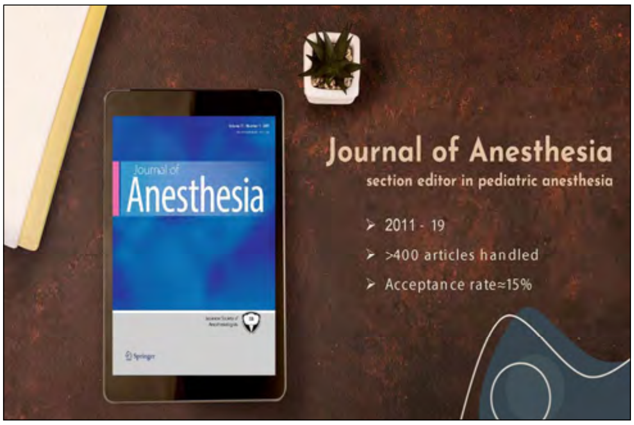
Effect size refers to a standardized estimate of the measured treatment effect, providing information about the magnitude and direction of changes observed in a study.

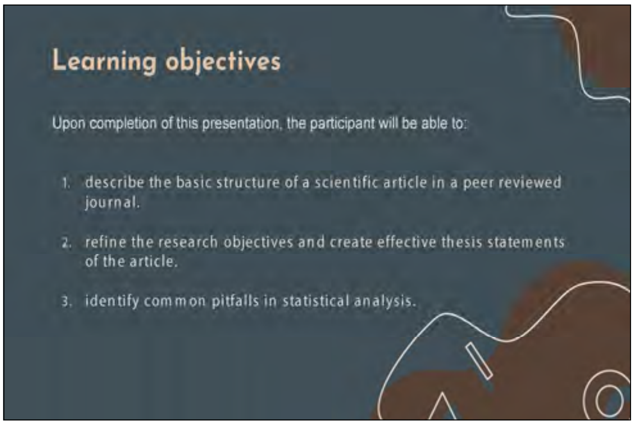
MCID is a robust threshold for determining clinical significance, but its limitations and context-specific nature should be considered when interpreting and applying it in clinical practice and decision-making.

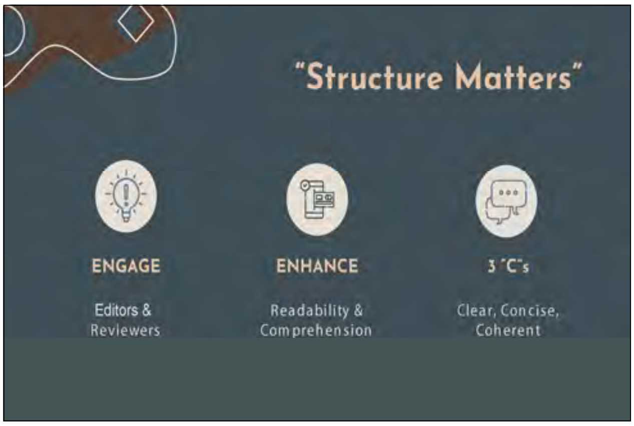
How to Improve Weak Points: From Editor's Perspectives

Norifumi Kuratani

Saitama Children's Medical Center, Japan

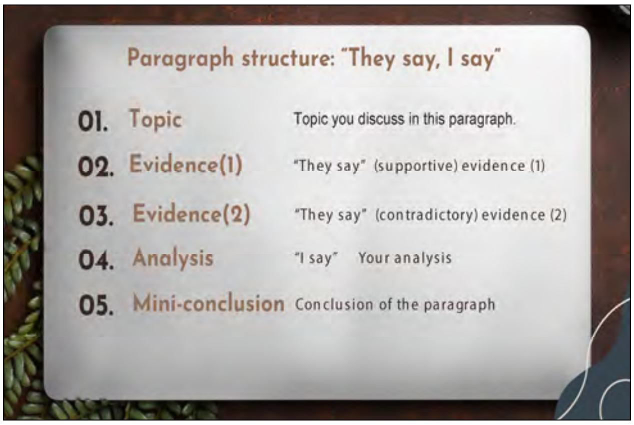


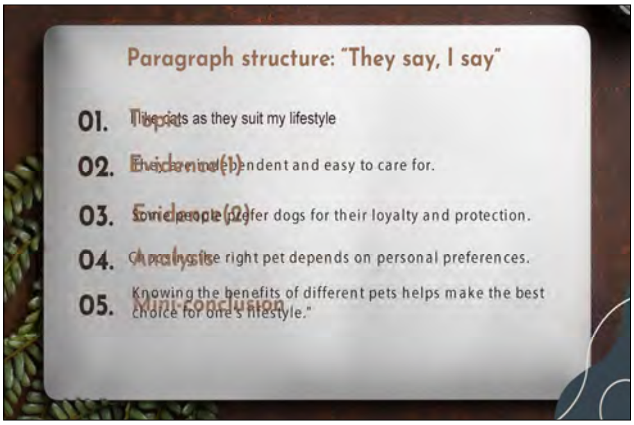


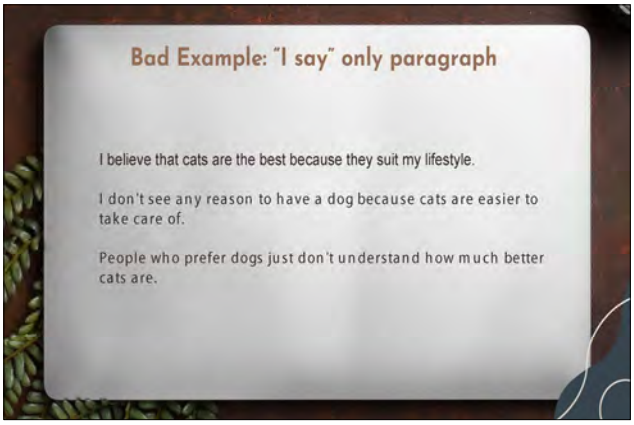


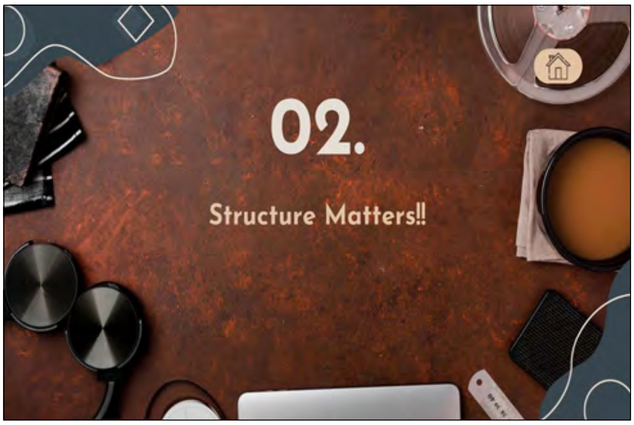

A. Introduction
B. Materials and Methods
C. Results
D. Discussion
E. Conclusion
Gross Anatomy


Micro-Anatomy of Research Article
Use writing style for argumentation
(Invereted) Pyramid writing style
Begin with broad context, then narrow down to specifics
Helps readers understand the relevance and focus of the study
Engages readers from the start and maintains interest
"They say, I say" approach
Acknowledge and summarize existing literature ("They Say")
Present your unique contributions and arguments ("I Say")
Foster critical thinking and meaningful dialogue (Analysis and argu
THEY SAY I SAY


Paragraph structure: "They say, I say"
01. Topic
Topic you discuss in this paragraph.
02. Evidence(1)
"They say" (supportive) evidence (1)
03. Evidence(2)
"They say" (contradictory) evidence (2)
04. Analysis
"I say" Your analysis
05. Mini-conclusion
Conclusion of the paragraph

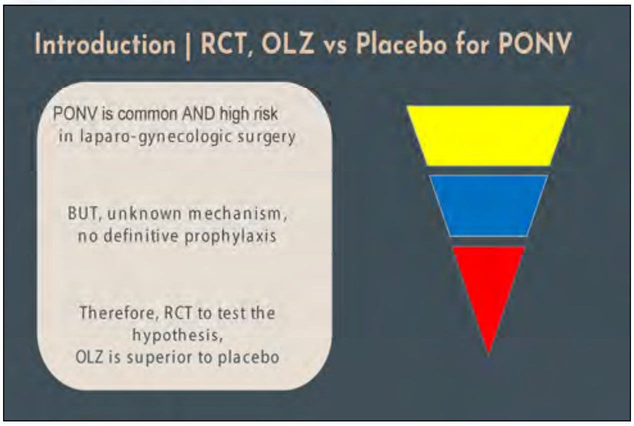

Paragraph structure: "They say, I say"
01.
as they suit my lifestyle
02.
endent and easy to care for.
03.
fer dogs for their loyalty and protection.
04.
right pet depends on personal preferences.
05.
Knowing the benefits of different pets helps make the best

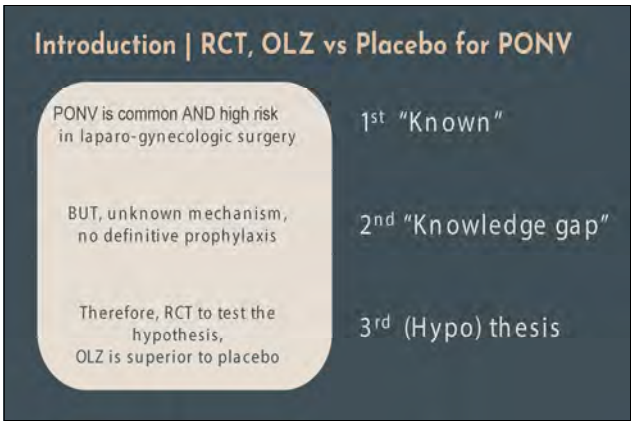

Bad Example: "I say" only paragraph
I believe that cats are the best because they suit my lifestyle.
I don't see any reason to have a dog because cats are easier to take care of.
People who prefer dogs just don't understand how much better cats are.


02.
Structure Matters!!


A. Introduction
B. Materials and Methods
C. Results
D. Discussion
E. Conclusion
Gross Anatomy

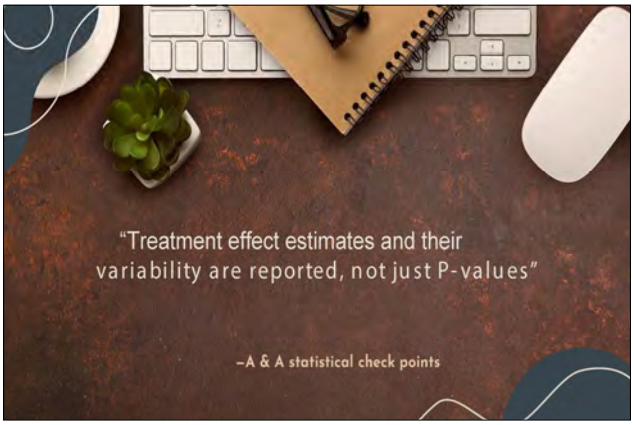

Introduction "Sharpen your Focus"
Tell Your Story
Knowledge gap and motivation for the study
Inverted Pyramid
From Broad context to Specific topics
3 Paragraphs
And, But, Therefore

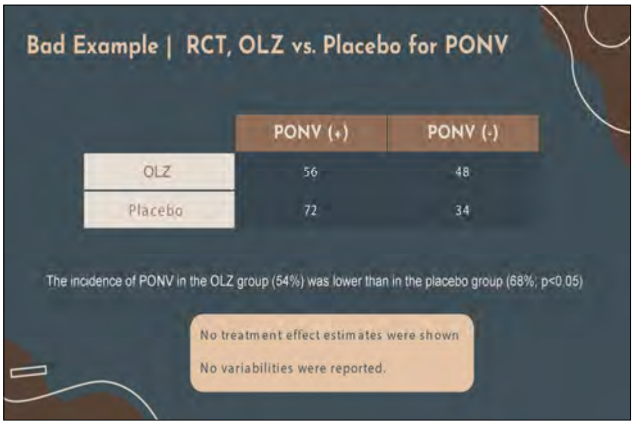

Introduction | RCT, OLZ vs Placebo for PONV
PONV is common AND high risk in laparo-gynecologic surgery
BUT, unknown mechanism, no definitive prophylaxis
Therefore, RCT to test the hypothesis, OLZ is superior to placebo

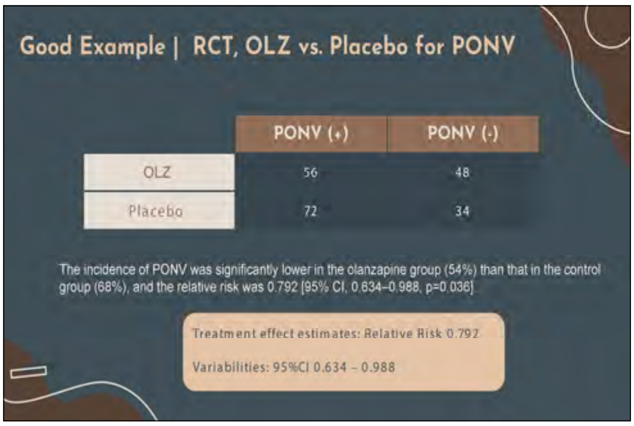

Introduction | RCT, OLZ vs Placebo for PONV
PONV is common AND high risk in laparo-gynecologic surgery
BUT, unknown mechanism, no definitive prophylaxis
Therefore, RCT to test the hypothesis, OLZ is superior to placebo
1st "Known"
2nd "Knowledge gap"
3rd (Hypo) thesis


A. Introduction
B. Methods
C. Results
D. Discussion
E. Conclusion
Gross Anatomy


Statistical Traps and How to Avoid Them
–A & A statistical check points
Abstract clearly and accurately states the study objectives/hypotheses and clearly describes data analysis and study findings
Study objectives and/or hypotheses clearly stated
Study design is appropriate for the stated aims
Primary and secondary outcomes clearly identified and defined
Statistical methods appropriate and clearly described
Baseline comparisons for randomized trial assessed with standardized difference, not P-values
Assumptions of the statistical analyses appropriately assessed
Type I error/multiple testing adequately addressed
Missing data and potential sampling bias appropriately described and handled
Sample size justified
Results section follows clearly from the study objectives and statistical methods
Study data and outcomes are presented consistently and accurately in Abstract, Body of Manuscript, and Tables/figures
Tables and Figures clear and self-explanatory
Precision of numbers reported with appropriate decimal places, avoiding use of too many decimal places
Treatment effect estimates and their variability are reported, not just P-values
Confounding is carefully addressed for observational studies
Limitations of design and statistical methods clearly described
Conclusions and interpretations justified by the design and results
Causation/association – use words connoting association for observational studies
Say "Non-significant" instead of "similar/equivalent"
Make inference on population not sample
Trend -- Do not say "trend" for non-significant findings
P-values appropriately reported
"Multivariable" instead of "multivariate" when multiple independent variables

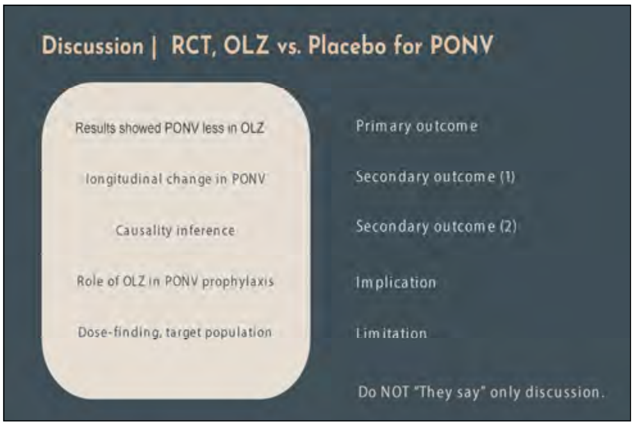

"Treatment effect estimates and their variability are reported, not just P-values"
–A & A statistical check points

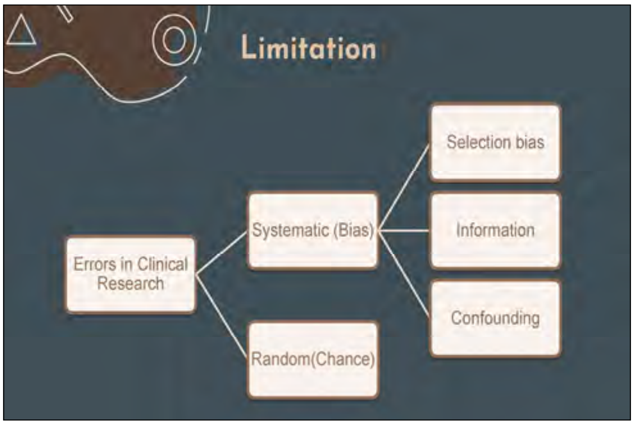

Bad Example | RCT, OLZ vs. Placebo for PONV
PONV (+)
PONV (-)
OLZ 56 48
Placebo 72 34
The incidence of PONV in the OLZ group (54%) was lower than in the placebo group (68%; p<0.05)
No treatment effect estimates were shown
No variabilities were reported.

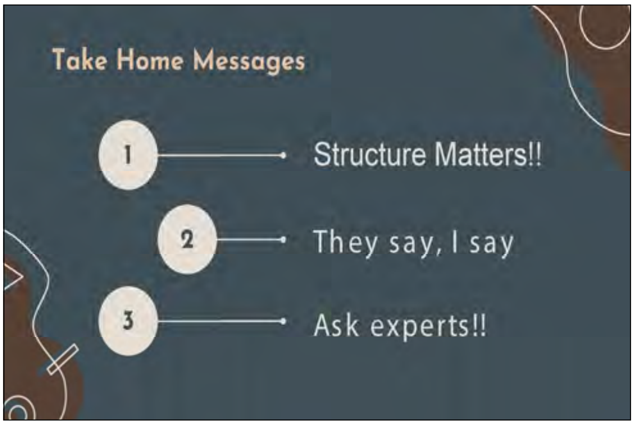

Good Example | RCT, OLZ vs. Placebo for PONV
PONV (+)
PONV (-)
OLZ 56 48
Placebo 72 34
The incidence of PONV was significantly lower in the olanzapine group (54%) than that in the control group (68%), and the relative risk was 0.792 [95% CI, 0.634–0.988, p=0.036]
Treatment effect estimates: Relative Risk 0.792
Variabilities: 95%CI 0.634 – 0.988


A. Introduction
B. Materials and Methods
C. Results
D. Discussion
E. Conclusion
Gross Anatomy


Discussion: "Entering Academic Conversation"
A. Apply Pyramid structure
B. "They say, I say"
C. Address implication
D. Limitation


Discussion | RCT, OLZ vs. Placebo for PONV
Results showed PONV less in OLZ
longitudinal change in PONV
Causality inference
Role of OLZ in PONV prophylaxis
Dose-finding, target population
Primary outcome
Secondary outcome (1)
Secondary outcome (2)
Implication
Limitation
Do NOT "They say" only discussion.

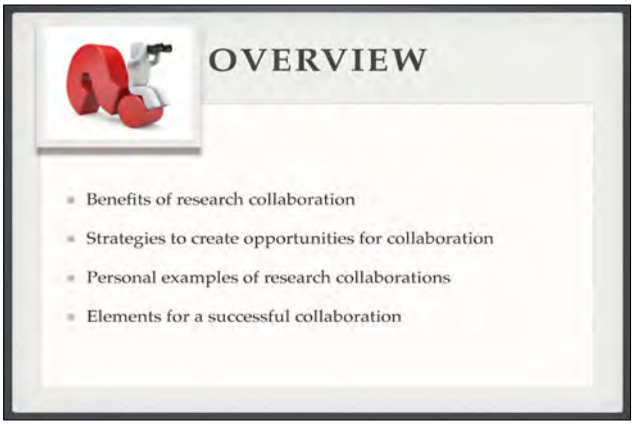

Limitation
Errors in Clinical Research
Systematic (Bias)
Random(Chance)
Selection bias
Information
Confounding

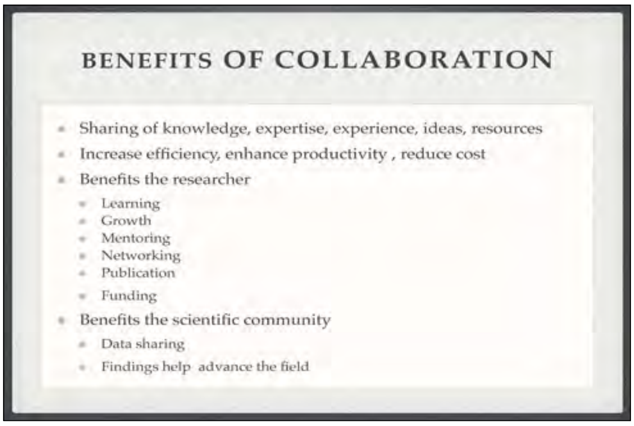

Take Home Messages
1
Structure Matters!!
2
They say, I say
3
Ask experts!!

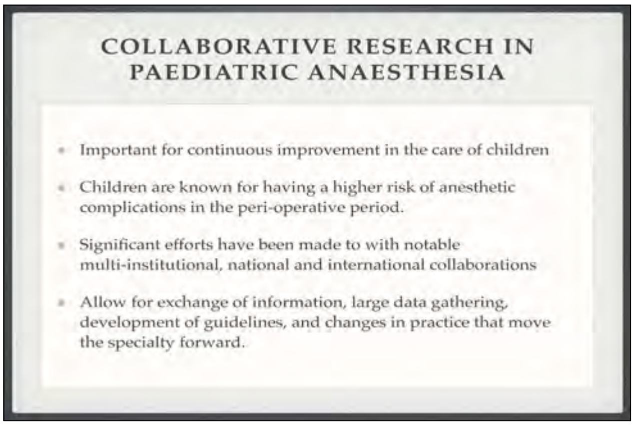
How to Collaborate with Other Researchers

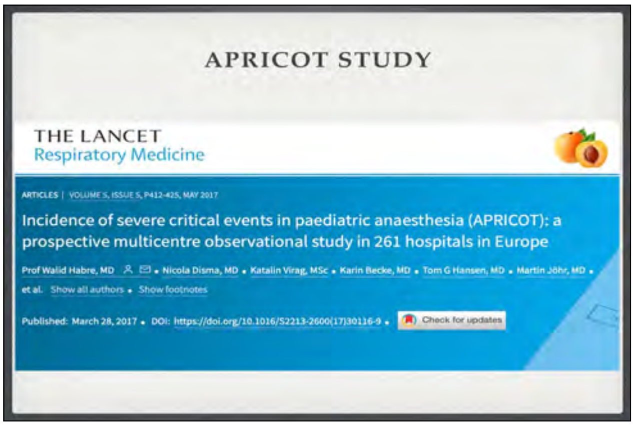
Choon Looi Bong

KK Women's and Children's Hospital, Singapore

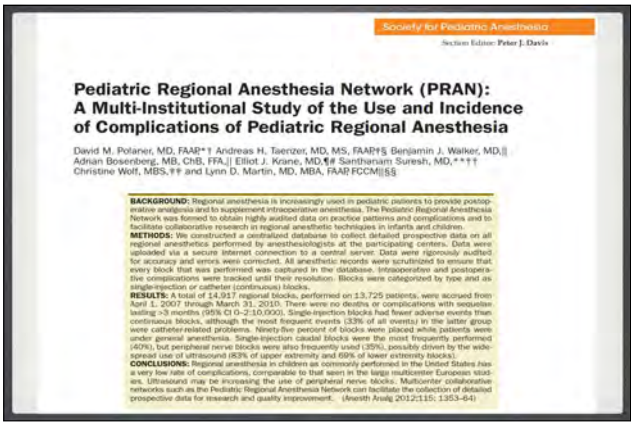


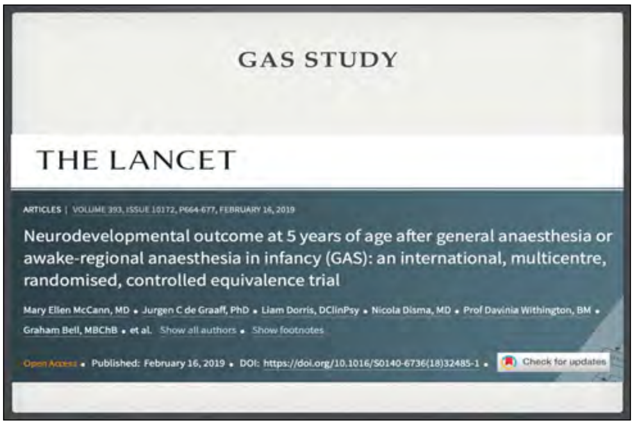


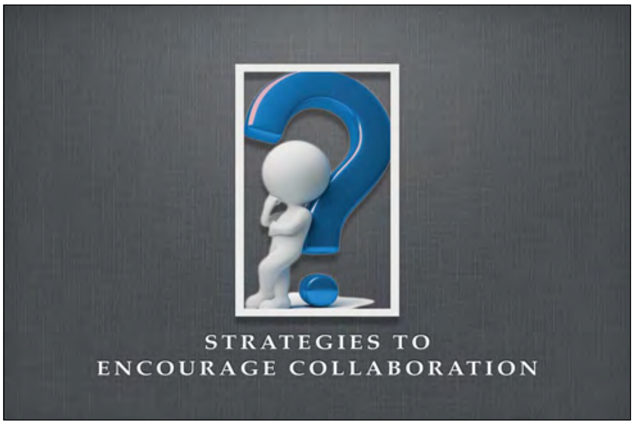


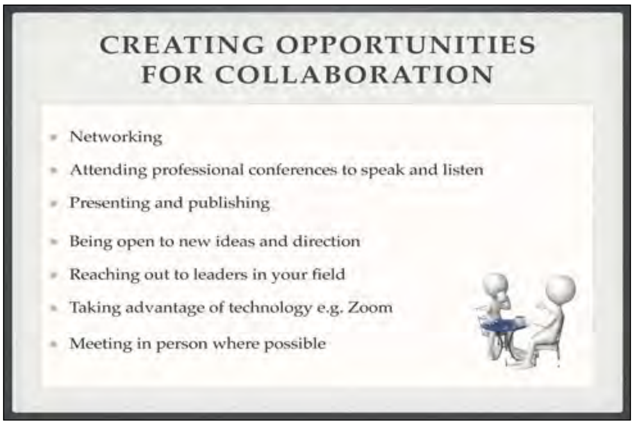


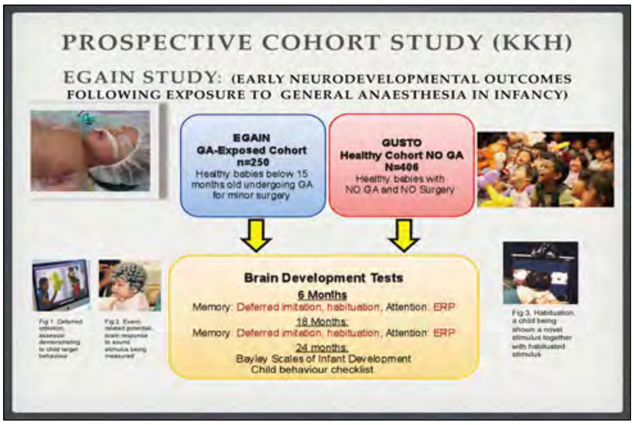

WakeUp Safe
The Pediatric Anesthesia Quality Improvement Initiative
Society for Pediatric Anesthesia
education • research • patient safety
Pediatric Anesthesia
RESEARCH REPORT
Outcomes from wake up safe, the pediatric anesthesia quality improvement initiative
Manon Haché, Lena S. Sun, Ghadah Gadi, Jennifer Busse, Angela C. Lee, Amanda Lorinc, Sally Rampersad
First published: 20 October 2020 | https://doi.org/10.1111/pan.14044 | Citations: 10
Section Editor: Joseph Cravero

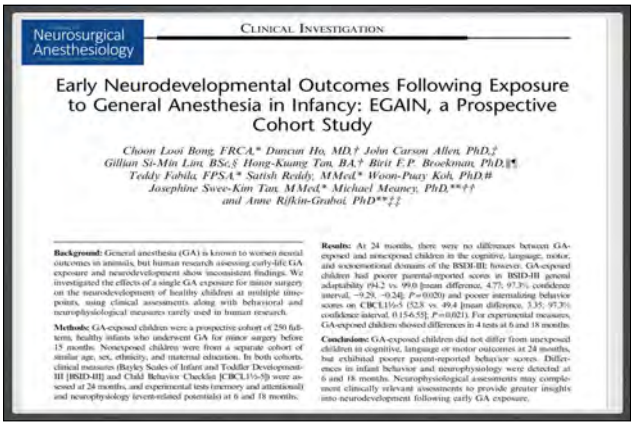

Society for Pediatric Anesthesia
Section Editor: Peter J. Davis
Pediatric Regional Anesthesia Network (PRAN): A Multi-Institutional Study of the Use and Incidence of Complications of Pediatric Regional Anesthesia
(Anesth Analg 2012;115: 1353–64)

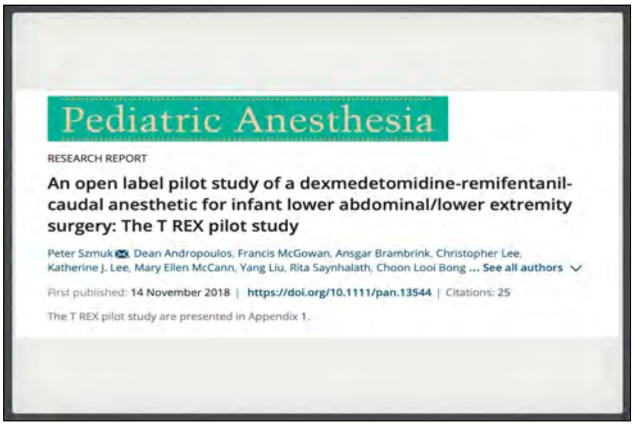

GAS STUDY
THE LANCET
ARTICLES | VOLUME 393, ISSUE 10172, P664-677, FEBRUARY 16, 2019
Neurodevelopmental outcome at 5 years of age after general anaesthesia or awake-regional anaesthesia in infancy (GAS): an international, multicentre, randomised, controlled equivalence trial
Mary Ellen McCann, MD • Jurgen C de Graaff, PhD • Liam Dorris, DClinPsy • Nicola Disma, MD • Prof Davinia Withington, BM • Graham Bell, MBChB • et al. Show all authors • Show footnotes
Open Access • Published: February 16, 2019 • DOI: https://doi.org/10.1016/S0140-6736(18)32485-1 • Check for updates


STRATEGIES TO
ENCOURAGE COLLABORATION


CREATING OPPORTUNITIES FOR COLLABORATION
Networking
Attending professional conferences to speak and listen
Presenting and publishing
Being open to new ideas and direction
Reaching out to leaders in your field
Taking advantage of technology e.g. Zoom
Meeting in person where possible


PROSPECTIVE COHORT STUDY (KKH)
EGAIN STUDY: (EARLY NEURODEVELOPMENTAL OUTCOMES FOLLOWING EXPOSURE TO GENERAL ANAESTHESIA IN INFANCY)
EGAIN
GA-Exposed Cohort
n=250
Healthy babies below 15 months old undergoing GA for minor surgery
GUSTO
Healthy Cohort NO GA
N=406
Healthy babies with NO GA and NO Surgery
Brain Development Tests
6 Months
Memory: Deferred imitation, habituation, Attention: ERP
18 Months:
Memory: Deferred imitation, habituation, Attention: ERP
24 months:
Bayley Scales of Infant Development
Child behaviour checklist


Neurosurgical Anesthesiology
CLINICAL INVESTIGATION
Early Neurodevelopmental Outcomes Following Exposure to General Anesthesia in Infancy: EGAIN, a Prospective Cohort Study


Pediatric Anesthesia
RESEARCH REPORT
An open label pilot study of a dexmedetomidine-remifentanil-caudal anesthetic for infant lower abdominal/lower extremity surgery: The T REX pilot study
Peter Szmuk, Dean Andropoulos, Francis McGowan, Ansgar Brambrink, Christopher Lee, Katherine J. Lee, Mary Ellen McCann, Yang Liu, Rita Saynhalath, Choon Looi Bong ... See all authors
First published: 14 November 2018 | https://doi.org/10.1111/pan.13544 | Citations: 25
The T REX pilot study are presented in Appendix 1.


Contents lists available at ScienceDirect

Journal of Clinical Anesthesia

Original Contribution

Sevoflurane requirements during electroencephalogram (EEG)-guided vs standard anesthesia Care in Children: A randomized controlled trial

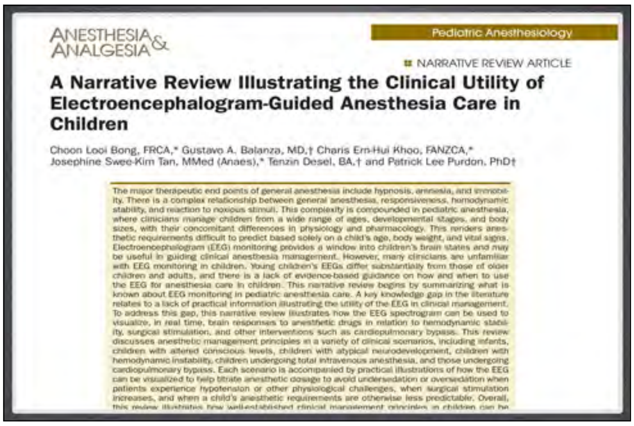
Melody H.Y. Long (MMed Anaes), Evangeline H.L. Lim (MMed Anaes), Gustavo A. Balanza, MD, John C. Allen Jr, PhD, Patrick L. Purdon, PhD, Choon Looi Bong, FRCA

ARTICLE INFO

ABSTRACT

Design: Randomized controlled trial.

Setting: Tertiary pediatric hospital.


ANESTHESIA & ANALGESIA

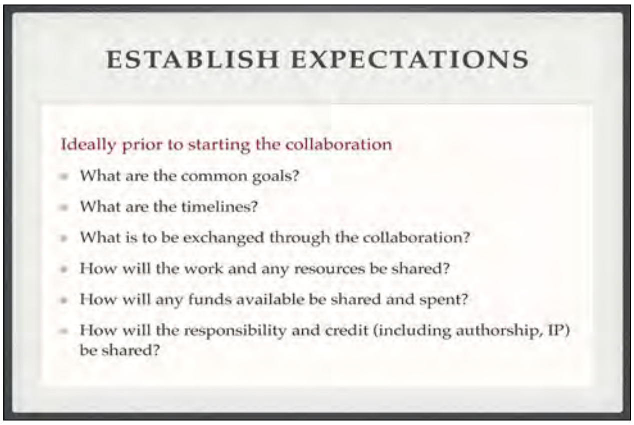
Pediatric Anesthesiology

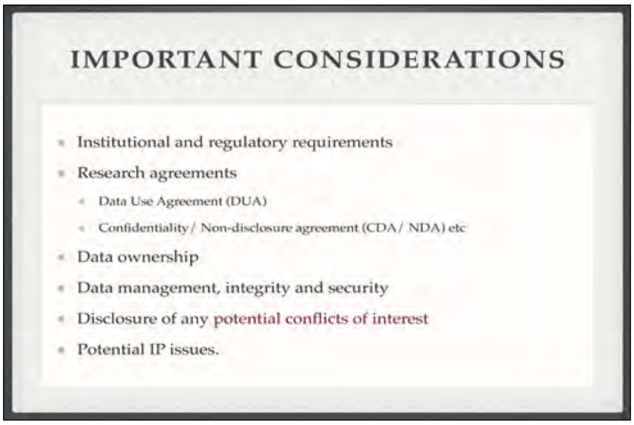
NARRATIVE REVIEW ARTICLE

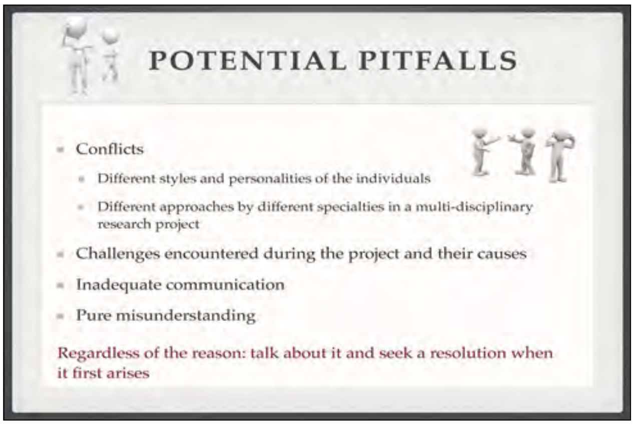
A Narrative Review Illustrating the Clinical Utility of Electroencephalogram-Guided Anesthesia Care in Children

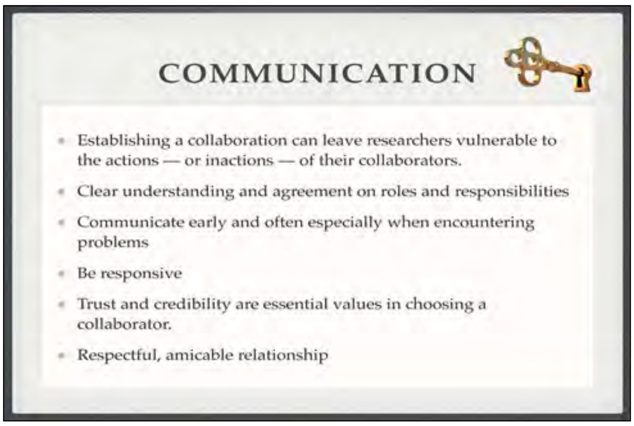
Choon Looi Bong, FRCA,* Gustavo A. Balanza, MD,† Charis Ern-Hui Khoo, FANZCA,* Josephine Swee-Kim Tan, MMed (Anaes),* Tenzin Desel, BA,† and Patrick Lee Purdon, PhD†

The major therapeutic end points of general anesthesia include hypnosis, amnesia, and immobility. There is a complex relationship between general anesthesia, responsiveness, hemodynamic stability, and reaction to noxious stimuli. This complexity is compounded in pediatric anesthesia, where clinicians manage children from a wide range of ages, developmental stages, and body sizes, with their concomitant differences in physiology and pharmacology. This renders anesthetic requirements difficult to predict based solely on a child's age, body weight, and vital signs. Electroencephalogram (EEG) monitoring provides a window into children's brain states and may be useful in guiding clinical anesthesia management. However, many clinicians are unfamiliar with EEG monitoring in children. Young children's EEGs differ substantially from those of older children and adults, and there is a lack of evidence-based guidance on how and when to use the EEG for anesthesia care in children. This narrative review begins by summarizing what is known about EEG monitoring in pediatric anesthesia care. A key knowledge gap in the literature relates to a lack of practical information illustrating the utility of the EEG in clinical management. To address this gap, this narrative review illustrates how the EEG spectrogram can be used to visualize, in real time, brain responses to anesthetic drugs in relation to hemodynamic stability, surgical stimulation, and other interventions such as cardiopulmonary bypass. This review discusses anesthetic management principles in a variety of clinical scenarios, including infants, children with altered conscious levels, children with atypical neurodevelopment, children with hemodynamic instability, children undergoing total intravenous anesthesia, and those undergoing cardiopulmonary bypass. Each scenario is accompanied by practical illustrations of how the EEG can be visualized to help titrate anesthetic dosage to avoid undersedation or oversedation when patients experience hypotension or other physiological challenges, when surgical stimulation increases, and when a child's anesthetic requirements are otherwise less predictable. Overall,










bong.choon.looi@singhealth.com.sg

Session 4.

Best Abstracts Presentation and Awards

Chair(s): Rufinah Teo (Malaysia)
Byung Gun Lim (Korea)

BAP-1

A Randomised Controlled Trial to Compare the Blockbuster™ and Air-Q® Supraglottic Airway Devices as a Conduit to Blind Endotracheal Intubation in Pediatric Patients (Virtual)

Arunima Pattanayak[1], Abhyuday Kumar[2], Chandni Sinha[2], Neeraj Kumar[2]

[1]Department of Anaesthesiology and Critical Care, All India Institute of Medical Sciences, Bhubaneswar, India
[2]Department of Anaesthesiology, All India Institute of Medical Sciences, Patna, India

Background: Although some paediatric supraglottic airway devices (SADs) have been validated for fiber-optic-guided intubation, there is a scarcity of literature recommending their use as conduit for blind endotracheal intubation. This study was conducted to compare the efficacy of two SADs (Blockbuster and air-Q) in acting as a conduit for blind endotracheal intubation in paediatric patients undergoing non emergency surgeries under general anaesthesia.

Methods: This randomised controlled trial was carried out in a tertiary care hospital in India from March 2021 to October 2021. Eighty paediatric patients aged between six months to 10 years with normal airways planned for elective surgery under general anaesthesia were included in the study and randomised into 2 groups of 40 each. After induction of anaesthesia, SAD selected as per randomisation (Blockbuster or air-Q) was inserted followed by endotracheal intubation through them, with the aid of a flexible endoscope railroaded within the endotracheal tube. The tip of the endoscope was fixed proximal to the tip of the tracheal tube (visualised blind intubation). The primary outcome was the percentage of successful blind endotracheal intubation in a single attempt. Secondary outcomes were: the number of attempts required for the successful placement of SAD; the oropharyngeal leak pressure (OLP); the glottic view through a fiberoptic bronchoscope; the time needed to intubate the patient successfully; the incidence of peri and post-procedural complications.

Results: The success rate of endotracheal intubation with BlockBuster was statistically significant compared to air-Q (77.5% vs 52.5%; p value = .034). OLPs (in cm of H2O) were significantly higher with BlockBuster as compared to air-Q [25.9 (22-32) vs 12 (11-20.2); p value= 0.001]. Fiberoptic visualization of vocal cords (Grades 2/3/4) in patients with BlockBuster was significantly better as compared to air-Q [84.6% vs 62.5% (p value=.026)].

Discussion: Both air-Q and Blockbuster have a more than 50% success rate of first-attempt blind intubation through SAD. Blockbuster having a significantly greater success rate of 77.5% compared to air-Q, can be recommended as a suitable SAD for blind intubation in situations where fiberoptic is unavailable or its use is limited by bleeding or secretion. Blockbuster having better OLP can also be preferred as a ventilating device in patients requiring high airway pressures like laparoscopic surgery and obese patients.

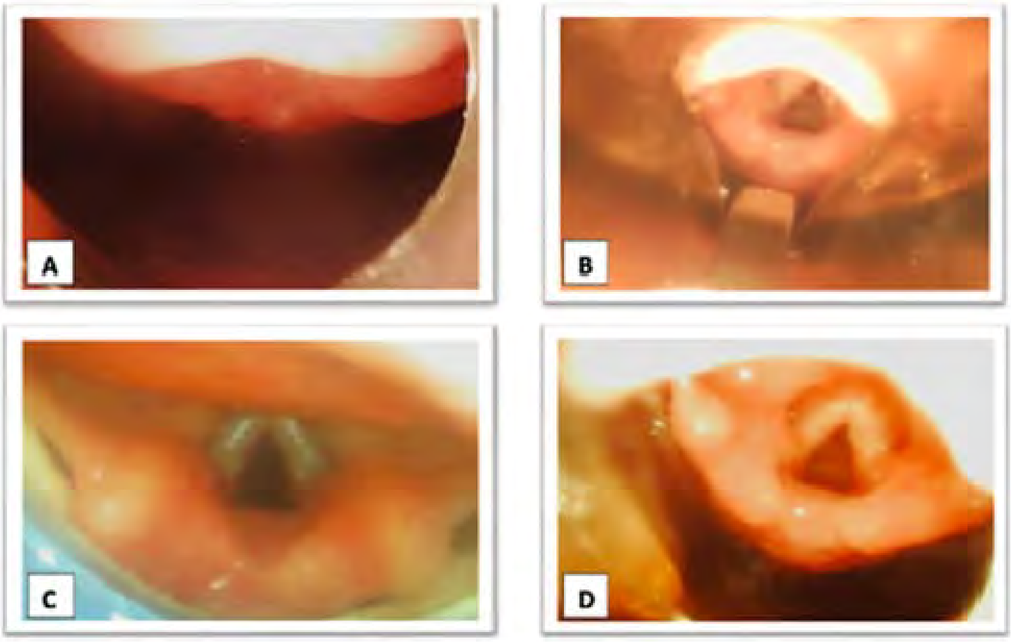


Figure 11: Grades of Glottic view by FOB through the SAD.
A- grade 1; B- Grade 2; C- Grade 3; D- Grade 4

Table 2: Device characteristics

	air-Q	Blockbuster	P value
Successful / Unsuccessful	21/19	31/9	0.034†
OLP (cm of H_2O)	12 (11-20.25)	25.89(22-32)	0.001‡
FOB visualization (Grade 1 / 2-4)	15/25	6/33	0.026†
Corrective manoeuvers	27	17	0.032†
Success of ETI with manoeuvers	8	9	0.122†
Time for SAD insertion (seconds)	24 ±7	23 ±9	0.672§
Time for SAD removal (seconds)	27 (22-32)	24 (21-36)	0.484‡
Time for successful ETI (seconds)	60 (53-60)	50 (39-60)	0.019‡
Tidal volume leak in percentage	4 (0-6)	0 (0-0)	0.118‡

Values are presented as mean ± SD; median (IQR). P < 0.05 = Significant; †Chi square test, §Independent sample t-test, ‡Mann whitney U test. OLP: oropharyngeal leak pressure, FOB: fiberoptic bronchoscopy, ETI: Endotracheal Intubation, SAD: Supraglottic Airway Device.

BAP-2

Changes in Diaphragmatic Ultrasonography Findings and Their Association with Postoperative Complications in Children Undergoing Pulmonary Resection: A Single-Center Prospective Observational Study

Pyoyoon Kang, Ji-Hyun Lee, Jin-Tae Kim

Department of Anesthesiology and Pain Medicine, Seoul National University Hospital,
Seoul National University College of Medicine, Seoul, Republic of Korea

Background: Few studies have investigated changes in diaphragm function after lung resection surgery and their association with postoperative complications in pediatric patients. This study aimed to evaluate diaphragm function using ultrasound after lung resection surgery and determine the relationship between ultrasound parameters for diaphragm function and postoperative pulmonary complications in children.

Methods: Children aged ≤ 6 years who were scheduled for video-assisted thoracoscopic lung resection were enrolled in a tertiary children's hospital. Ultrasonographic measurement of diaphragm excursion (DE) and thickening fraction (TF) was performed for three epochs: before anesthesia induction (T0), 1 h postoperatively (T1), and 24 h postoperatively (T2). DET1 or T2/DET0 and TFT1 or T2/TFT0 (%) were calculated. Lung ultrasound was performed at T1 and T2. The incidence of postoperative pulmonary complications (PPC) was assessed. The primary outcome was changes in diaphragm DE and TF over time, from T0 to T2, and the secondary outcome was the association between ultrasound parameters of diaphragm function and the occurrence of early PPC, within 3 days.

Results: Data from 74 children were analyzed. On the operated side, both DE and TF decreased at T1 and recovered slightly at T2, and were significantly lower than the T0 values. Children with PPC had significantly lower DET2/DET0 and TFT2/TFT0 scores than those without PPC. Worse lung ultrasound findings (higher B-line and consolidation scores) were observed in children with PPC than in those without PPC at T2. According to ROC analysis, DET2/DET0 (< 61.1%) was associated with PPC with an AUC of 0.764.

Discussion: Perioperative diaphragm function assessed by ultrasonography changed after lung resection surgery in children. DE and TF decreased postoperatively, and a prolonged decrease in DE or TF was associated with pulmonary complications after lung surgery in children.

Table 1. Changes in diaphragm and lung ultrasound parameters over time in all children.

Values	Preoperative (T0)	1hr after surgery (T1)	24hr after surgery (T2)	P value
Diaphragm ultrasound				
TEI (mm)				
Operated side	1.15 [0.90 to 1.40]	1.00 [0.80 to 1.20]*	1.00 [0.90 to 1.00]	0.001
Non-operated side	1.20 [1.00 to 1.50]	1.10 [1.00 to 1.20]*	1.10 [1.00 to 1.30]	0.002
TEE (mm)				
Operated side	0.80 [0.60 to 1.10]	0.80 [0.70 to 0.90]	0.80 [0.70 to 0.90]	0.542
Non-operated side	0.80 [0.70 to 0.90]	0.80 [0.70 to 0.90]	0.75 [0.70 to 0.80]	0.525
TF				
Operated side	0.50 [0.33 to 0.63]	0.17 [0.13 to 0.29]*	0.33 [0.20 to 0.44]*†	< 0.001
Non-operated side	0.56 [0.46 to 0.71]	0.43 [0.25 to 0.60]*	0.50 [0.40 to 0.67]†	< 0.001
DE (mm)				
Operated side	11.00 [8.00 to 12.00]	5.00 [4.00 to 6.00]*	7.00 [5.50 to 9.00]*†	< 0.001
Non-operated side	11.50 [10.00 to 13.00]	8.00 [7.00 to 10.50]*	10.00 [8.00 to 11.00]*†	< 0.001
postoperative TF/TF$_{T0}$(%)				
Operated side		37.51 [24.98 to 72.15]	74.98 [50.00 to 100.00]	<0.001
Non-operated side side		68.75 [44.44 to 100.00]	87.75 [75.00 to 120.00]	<0.001
postoperative DE/DE$_{T0}$(%)				
Operated side		53.48 [43.64 to 63.64]	68.99 [55.56 to 81.82]	<0.001
Non-operated side		77.32 ± 21.75	85.22 ± 16.49	<0.001
Lung ultrasound				
B-line score				
Operated side		4.00 [2.00 to 5.00]	1.00 [0.00 to 2.00]	< 0.001
Non-operated side		4.00 [1.00 to 5.00]	0.00 [0.00 to 1.00]	< 0.001
Consolidation score				
Operated side		3.00 [2.00 to 5.00]	0.00 [0.00 to 2.00]	< 0.001
Non-operated side		2.50 [1.00 to 4.00]	0.00 [0.00 to 1.00]	< 0.001

Data are presented as median [IQR] or mean ± SD

*P<0.017 when compared to T0 after Bonferroni correction

†P<0.017 when compared to T1 after Bonferroni correction

TEI, diaphragm thickness at end-inspiration; TEE, diaphragm thickness at end-expiration, TF, thickening fraction; DE, diaphragm excursion

Table 2. Comparison of baseline characteristics between PPC and no-PPC groups

	No PPC group (n=48)	PPC group (n=26)	Effect size	P value
Age (yr)	1.9 [1.4 to 2.0]	2.0 [1.5 to 2.2]	0.08 (-0.08 to 0.34)	0.355
Sex (M/F)	24/24 (50/50%)	14/12 (53.9/46.1%)	3.9% (-19.0 to 26.0%)	0.750
Height (cm)	87.5 [82.1 to 91.0]	87.4 [82.7 to 90.0]	0.20 (-2.70 to 3.20)	0.865
Weight (kg)	11.8 [10.7 to 13.7]	11.6 [10.9 to 13.2]	0.00 (-1.00 to 1.00)	0.941
BMI (kg/m^2)	16.2 ± 2.0	16.1 ± 1.7	-0.10 (-1.02 to 0.82)	0.824
Operation site (left/right)	26/22 (54.2/45.8%)	11/15 (42.3/57.7%)	11.9% (-11.4 to 33.3%)	0.465
Operation type				0.586
Wedge resection	2 (4.2%)	2 (7.7%)		
Segmentectomy	25 (52.1%)	9 (34.6%)		
Lobectomy	20 (41.7%)	15 (57.7%)		
Lobectomy with segmentectomy	1 (2.1%)	0		
Operation time (min)	60.0 [42.5 to 72.5]	52.5 [45.0 to 65.0]	-5.00 (-15.00 to 5.00)	0.581
Anesthesia time (min)	105.0 [90.0 to 120.0]	100.0 [85.0 to 120.0]	-5.00 (-15.00 to 5.00)	0.437
Peak airway pressure during two lung ventilation (cmH_2O)	15.00 [14.00 to 16.00]	15.00 [14.00 to 16.00]	0.00 (-1.00 to 1.00)	0.635
Peak airway pressure during one lung ventilation (cmH_2O)	20.52 ± 2.88	20.81 ± 2.67	0.29 (-1.08 to 1.65)	0.694
PaO_2/FiO_2 during one lung ventilation	285.71 ± 73.95	283.89 (54.49)	-1.82 (-34.75 to 31.10)	0.102
Moderate to severe pain (FLACC>3) (n)				
1hr after surgery	36 (76.6%)	17 (68%)	8.6% (-11.7 to 30.5%)	0.431
24hr after surgery	0 (0%)	0 (0%)		1.00
Oxygen supply (n)				
POD 0 – 1	7 (14.6%)	6 (23.1%)	8.5% (-8.9 to 28.9%)	0.363
POD 2 – 7	1 (2.1%)	4 (15.4%)	13.3% (0.52 to 31.5%)	0.031
POD 0 – 7	7 (14.6%)	6 (23.1%)	8.5% (-8.9 to 28.9%)	0.363
Hospital stay (days)	3.0 [3.0 to 3.5]	3.0 [3.0 to 3.0]	0.00 (0.00 – 0.00)	0.611

Data are presented as median [IQR], mean ± SD or number (percentage)

BMI, body mass index; FLACC, Face-Legs-Activity-Cry-Consolability Scale; POD, postoperative day; PPC, postoperative pulmonary complication

BAP-3

Damage-Associated Molecular Patterns (DAMPs) as a Mechanism of Sevoflurane-Induced Neuroinflammation in Neonatal Rodents

Yongmin Lee[1], Young-Eun Joe[1], Ju Eun Oh[2], Jeong-Rim Lee[1]

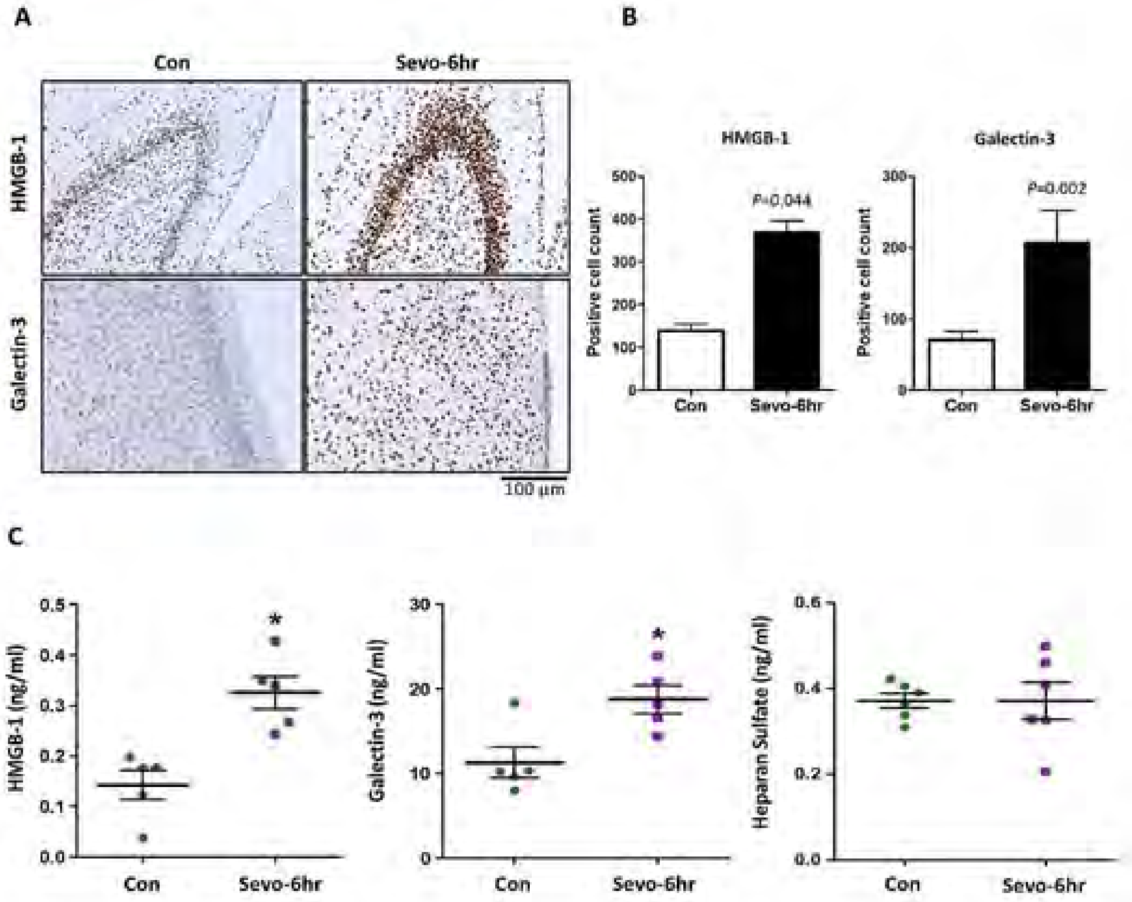
[1]Department of Anesthesiology and Pain Medicine, Anesthesia and Pain Research Institute, Yonsei University College of Medicine, [2]Anesthesia and Pain Research Institute, Yonsei University College

Background: General anesthesia is necessary for pediatric surgery, though volatile anesthetic agents may cause neuroinflammation and neurodevelopmental impairment; however, the underlying pathophysiology remains unclear. We hypothesized that HMGB-1 and galectin-3, which are specific damage-associated molecular patterns (DAMPs), play significant roles in sevoflurane-induced neuroinflammation. Therefore, we aimed to investigate the mechanism of neuroinflammation in developing rat brains and their association with sevoflurane exposure time, identify the specific DAMP pathway, and evaluate the effects of non-steroidal anti-inflammatory drugs in alleviating neuroinflammation.

Methods: We conducted three-step experiment to investigate neuroinflammation induced by sevoflurane. The first step involved determining the exposure time required for sevoflurane to cause neuroinflammation. In the second step, we identified the specific pathway of damage-associated molecular patterns (DAMPs) that were involved. Finally, in the third step, we investigate the effects of non-steroidal anti-inflammatory drugs (NSAIDs) on sevoflurane-induced neuroinflammation. We assessed the expression of various molecules in the rat brain and serum using immunohistochemistry, immunofluorescence, quantitative PCR, western blotting, and ELISA.

Results: We utilized a total of 112 P7 rats for our study, out of which six rats were passed away during the experiment, resulting in a mortality rate of 5.3%. We observed a significant increase in the expression of CD68; HMGB-1 and galectin-3; and TLR4, TLR9, and phosphorylated NF-kB upon 6-hr sevoflurane exposure. Conversely, the transcriptional levels of TNF-a and IL-6 significantly increased, and IFN-g significantly decreased after 6hr of sevoflurane exposure. Co-administration of ibuprofen significantly attenuated TNF-a and IL-6 levels and restored IFN-g levels. We validated the protective effect of ibuprofen using western blot analysis and serum ELISA.

Discussion: Collectively, our findings suggest that 6-hr sevoflurane exposure induces neuroinflammation through the DAMP pathway neuropeptides, HMGB-1 and galectin-3, in neonatal rat brains. The co-administration of ibuprofen reduced this sevoflurane-induced neuroinflammation.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HMGB-1
Galectin-3
100 μm
B
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P=0.044
Con
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Galectin-3
Positive cell count
P=0.002
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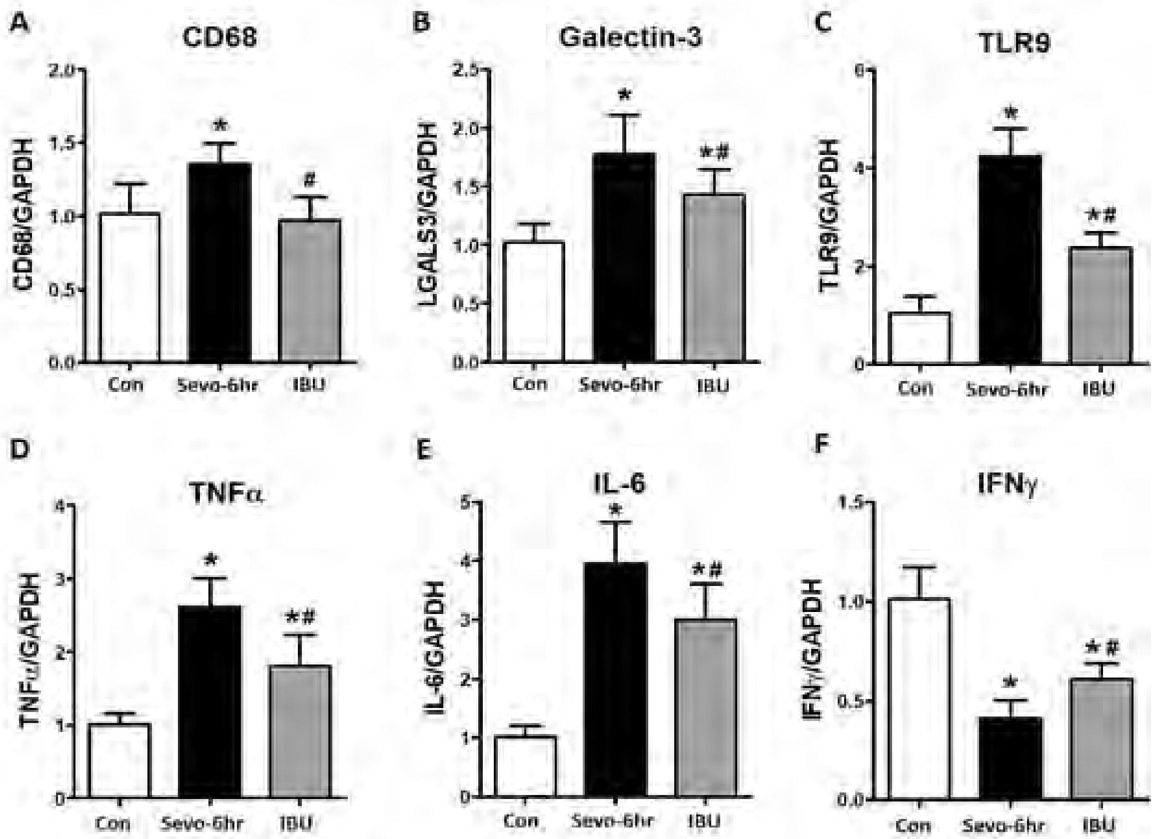
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Con
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F
IFNγ
IFNγ/GAPDH
Con
Sevo-6hr
IBU

BAP-4

Effect of Oxygen Reserve Index Monitoring for Preventing Hypoxemia in Pediatric Airway Surgery: A Randomized Controlled Trial

Honghyeon Kim, Eun-hee Kim, Pyoyoon Kang, Jung-bin Park, Sang-hwan Ji, Young-eun Jang, Ji-Hyun Lee, Hee-Soo Kim, Jin-Tae Kim

Department of Anesthesiology and Pain Medicine, Seoul National University Hospital, Seoul National University College of Medicine, Seoul, Republic of Korea

Background: During pediatric laryngeal microsurgery, hypoxemia frequently occurs. We investigated whether adding monitoring of the oxygen reserve index to pulse oximetry, in addition to monitoring pulse oximetry alone, can reduce the occurrence of oxygen desaturation below 90% during pediatric airway surgery.

Methods: This is an open-label stratified randomized controlled trial. We enrolled pediatric patients aged less than 18 years who were scheduled to undergo laryngeal microsurgery. Patients were randomly allocated to either the oxygen reserve index or control group, with stratification performed based on the presence of tracheostomy. In the control group, pulse oximetry was monitored, and if oxygen desaturation below 94% occurred, the procedure was stopped, and rescue ventilation was initiated. In the oxygen reserve index monitoring group, management decisions were made based on the oxygen reserve index value during the surgery. The primary outcome was the occurrence of oxygen desaturation below 90% during the surgery.

Results: After excluding 4 patients with a baseline oxygen reserve index of 0, a total of 84 patients were analyzed. The occurrence of $SpO_2 < 90\%$ was not significantly different between the oxygen reserve index (ORI) and control groups ($P = 0.12$, 10/40, 25% and 18/44, 41%, relative risk and 95% CI, 1.27 and 0.94 to 1.72). However, the number of $SpO_2 < 90\%$ events per patient was lower in the ORI group (mean 0.4, SD 0.9, minimum 0, maximum 4) compared to the control group (mean 1.0, SD 1.6, minimum 0, maximum 8) ($P = 0.04$). In the subgroup analysis, the overall occurrence of $SpO_2 < 90\%$ was higher in patients without tracheostomy (6/40, 15% and 22/44, 50%, $P = 0.001$, relative risk 1.7, 95% CI 1.23 to 2.34) compared to patients with tracheostomy. However, ORI monitoring did not reduce the occurrence of oxygen desaturation in both subgroups.

Conclusions: Additional monitoring of the oxygen reserve index did not reduce the occurrence of oxygen desaturation below 90% in pediatric patients undergoing laryngeal microsurgery.

BAP-5

Sevoflurane-Induced Burst Suppression is Associated with Long-Term Behavioral Changes in Late Postnatal Mice Undergoing Laparotomy

Tao Zhang, Jun young Heo, Woosuk Chung

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Background: Although recent clinical studies strongly suggest that early surgical treatment under general anesthesia during development does not affect general intelligence, the same studies also report the possibility of behavioral problems based on parent reports. While many previous preclinical studies have attempted to understand the effects of early anesthesia, the results of these studies may have limited value considering the absence of a surgical stimulus which is always present in the clinical scenario. Thus, we further evaluated the possibility of long-term behavioral changes in young mice who received exploratory laparotomy under general anesthesia with sevoflurane.

Methods: Postnatal day 17 mice received exploratory laparotomy under general anesthesia with sevoflurane (Fig1. A). Surgical procedures were performed within 10 minutes. To evaluate the combined effects of general anesthesia and surgery, mice received additional sevoflurane for 80 minutes using 2 different anesthesia protocols (Light Anesthesia group [LA] vs Deep anesthesia group [DA]) (Fig1.A). Sevoflurane 2.5% was considered deep anesthesia as we confirmed robust burst suppression using EEG monitoring (>40%) in a separate cohort of young mice (Fig1.B). Mice in the control group were isolated for 2 hours without any treatment. After 6 weeks (8 weeks of age), diverse aspects of behavior were measured.

Results: There was no difference in weight gain compared to control mice in both LA and DA mice (Fig2. A). We found no difference in general activity (open field test, Fig2. B), sociability (3 chamber test, Fig2. C), learning and memory (Fear chamber test, Fig2. D). However, although there was no difference in chamber time, we discovered a decrease in the number of transitions in the DA group in the light-dark box test (Fig2. E), indicating an increased level of anxiety.

Conclusion: Surgical stimulus combined with deep anesthesia capable of causing burst suppression may cause long-lasting behavioral consequences. However, our results also suggest that such changes can be prevented by simply avoiding unnecessary depth of anesthesia (burst suppression).

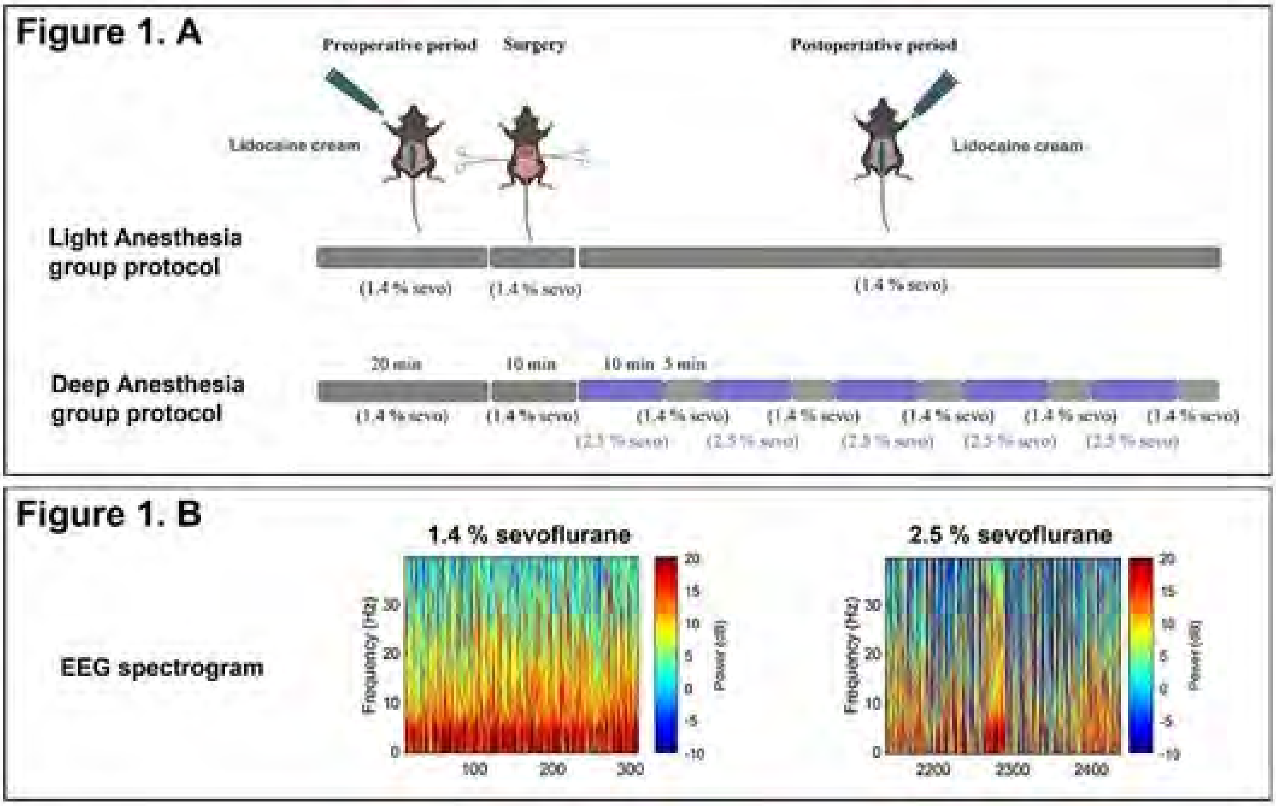


Figure 1. A
Preoperative period
Surgery
Postopertative period
Lidocaine cream
Lidocaine cream
Light Anesthesia group protocol
(1.4 % sevo)
(1.4 % sevo)
(1.4 % sevo)
Deep Anesthesia group protocol
20 min
10 min
10 min 5 min
(1.4 % sevo)
(2.5 % sevo)
Figure 1. B
EEG spectrogram
1.4 % sevoflurane
2.5 % sevoflurane
Frequency (Hz)
Power (dB)

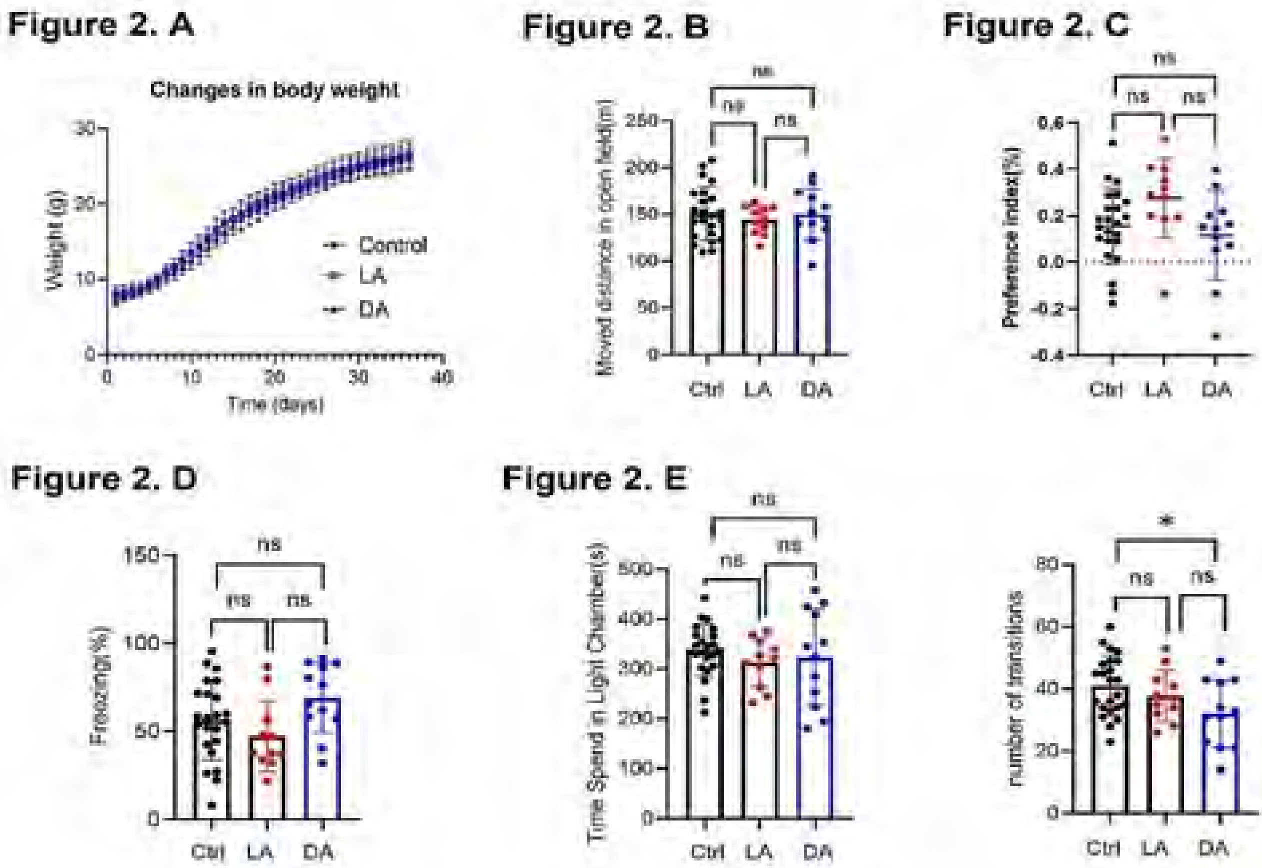


Figure 2. A
Changes in body weight
Weight (g)
Time (days)
Control
LA
DA
Figure 2. B
Moved distance in open field(m)
Figure 2. C
Preference index(%)
Figure 2. D
Freezing(%)
Figure 2. E
Time Spend in Light Chamber(s)
number of transitions
ns
*
Ctrl
LA
DA

BAP-6

Comparison of Lateral and Supine Positions for Tracheal Extubation in Infants: Preliminary Results of a Randomized Clinical Trial (Virtual)

Kammoun Manel[1], Faiza Grati[2], Imen Zouche[2], Ameni Chtourou[1], Salma Ketata[2], Anouar Jarraya[1]

[1]Department of anesthesiology, Hedi Chaker Hospital, Sfax, [2]Department of Anesthesiology, Habib Bourguiba, Sfax, Tunisia

Background: The lateral position is known to be advantageous for maintaining airway patency and for avoiding aspiration. We compared the lateral and supine position for tracheal extubation in infants aged less than 2 years when performing awake extubation.

Methods: This was a prospective randomized trial that was performed in a Tunisian university hospital and included 54 inafants (≤ 2 years old) undergoing digestive surgery under general anesthesisa with intubation. The anesthesia protocol was randomized. The patients were randomly divided into two groups: awakeextubation in the supine position (group S) versus awake extubation in the lateral position (group L). Oxygen saturation (SpO2) and the incidence of stridor, laryngospasm, and coughing after tracheal extubation were assessed.

Results: Demographic parameters were comparable between the two groups of the study. The mean±standard deviation of the lowest SpO2 values within 5 min after extubation was significantly higher in group L (98.3±2.1%) than in group S (95.8±2.2%) with (OR=1.26; 95% CI: 0.9-2.5, p=0.003). The incidences of a perioperative respiratory adverse events such as stridor and laryngospasm of group L were significantly lower than those of group S (1/27, 3.7% vs. 5/27, 18.5%, respectively with OR= 1.9; 95% CI :1.4-2.7, p=0.05). The incidence of desaturation and coughing were not significantly different between groups.

Conclusion: In pediatric patients awake extubation in the lateral position improved SpO2 five minutes after extubation and reduced the incidence of perioperative respiratory adverse events in the early period after extubationwhen compared to extubation in the supine position.

BAP-7

The Utility of Difficult IntraVenous Access (DIVA) Score ≥ 4 in Predicting Failure of the First Attempt of Intravenous Access in Children Aged 0 to 12 Years at a Tertiary Care, Teaching Hospital (Virtual)

Perumalla Suma, Bernice Theodore, Anita Shirley Joselyn, Ekta Rai, Aparna Williams

Department of Anesthesiology, Christian Medical College, Vellore, Tamil Nadu, India

Background: The Difficult IntraVenous Access (DIVA) score predicts difficult intravenous (IV) cannulation in children. We studied the validity of DIVA score cut-off of ≥ 4 in predicting failure of the first attempt at establishing IV access.

Methods: Prospective cohort study in children aged 0 to 12 years undergoing planned surgery at tertiary care, teaching hospital. Institutional Review Board, ethics committee approval (IRB no: 12904) and written, informed consent from the parents were obtained before recruitment of participants. Demographic data and data related to the intravenous access (DIVA score of the site of cannulation, number of attempts, time for cannulation) were collected from August, 2020 to January, 2021. The validity statistics such as sensitivity, specificity and predictive values for DIVA score ≥4 were calculated using the SPSS version 21.0.

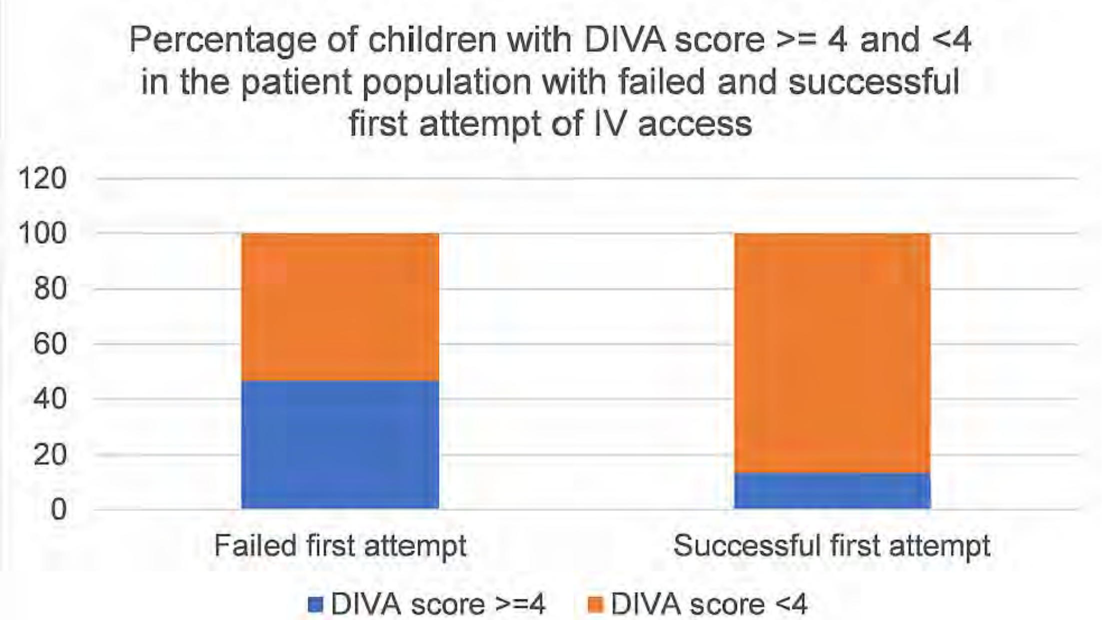
Results: Among 170 children, 34% failed the first attempt of IV cannulation. The sensitivity and specificity of the DIVA score ≥4 to detect failure of the first IV attempt were 46.5% and 86.6%, respectively. The Positive Predictive Value (PPV) and Negative Predictive Value (NPV) for DIVA score ≥4 were 64.3% and 75.8%, respectively (Table 1). A significantly greater proportion of children with DIVA score ≥4 had failure of the first attempt at establishing the IV access (P-value 0.0000) (Figure 1).

Discussion: The low sensitivity of a DIVA score cut-off of ≥4 may be due to multiple factors (apart from the factors used in calculating the DIVA score) affecting the difficulty of the IV access in our patient population. The DIVA score ≥4 may have greater utility in children with higher prevalence of failed IV access (premature, neonates and infants) as the PPV would increase. Although easy to implement as a screening tool, a DIVA score ≥ 4 predicted the failure of the first attempt at IV cannulation in children aged 0 to 12 years presenting for elective procedures, with low sensitivity and moderate specificity.

Table 1: Number of children with DIVA score (≥ 4 or < 4) in the groups with failure or success of the first attempt of establishing the intravenous access

DIVA score	Outcome of first IV access attempt		
	Failure	Success	Total (row)
	n	n	
≥ 4	27	15	42
< 4	31	97	128
Total (column)	58	112	170
Statistic	**Value**	**95% CI**	
Sensitivity	46.5%	33.3% - 60.1%	
Specificity	86.6%	78.8% - 92.3%	
Prevalence of failed IV cannulation	34%		
PPV	64.3%	48.0% – 78.4%	
NPV	75.8%	67.4% - 82.9%	

Figure 1: Comparison of the groups with failed or successful first attempt of IV cannulation based on the percentage of children with DIVA score ≥ 4 and <4 in each group



Room B

Session 1.

All Things Considered for Best Postoperative Analgesia

Chair(s): Teddy Fabila (Philippines)
Won Uk Koh (Korea)

Oldies Revisited: Caudal Block & Pudendal Nerve Block

Jae Hoon Lee

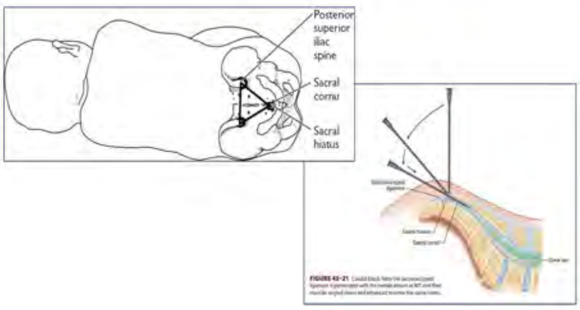
Department of Anesthesiology and Pain Medicine, Anesthesia and Pain Research Institute,
Yonsei University Health System, Seoul, Korea

Caudal Block

Introduction

- **Meredith Campbell in 1933**
  - The 1st author describe caudal anesthesia in children undergoing urological surgical procedures.
- **Single-injection Caudal Block**
  - 2010-2012 data
  - 34-40% in pediatric regional anesthesia.
  - Among pediatric central blocks,
    - 80% in European centers and 97% in the USA.

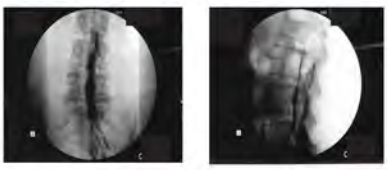
Introduction



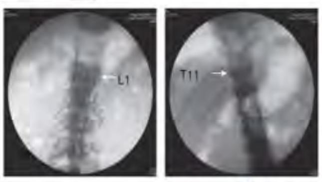
Anatomy and Physiology

- Spinal cord: L3 at birth, L1/L2 at 1 year
- *Dura: S4 at birth, S2 at 1 year*
- In younger children
  - *thoracic spread of local anesthetics (due to loose epidural fat)*
- In older children (>7 years or >20 kg)
  - thoracic spread is more difficult to achieve
- Hemodynamic changes
  - even a high spinal or epidural block
  - *minimal cardiovascular changes*
  - relatively low basal sympathetic tone in this age range

Introduction



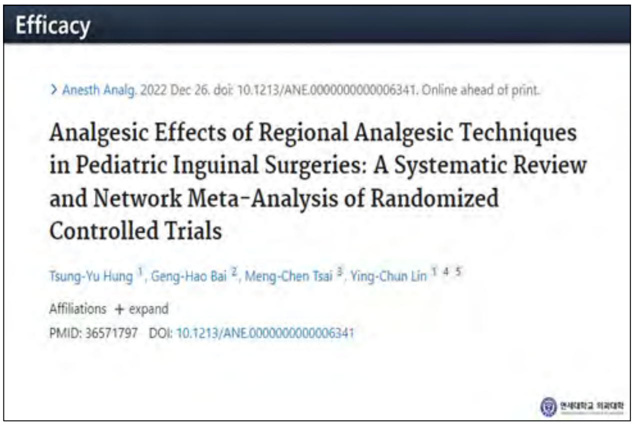
Pain Physician. 2004;7:81-92

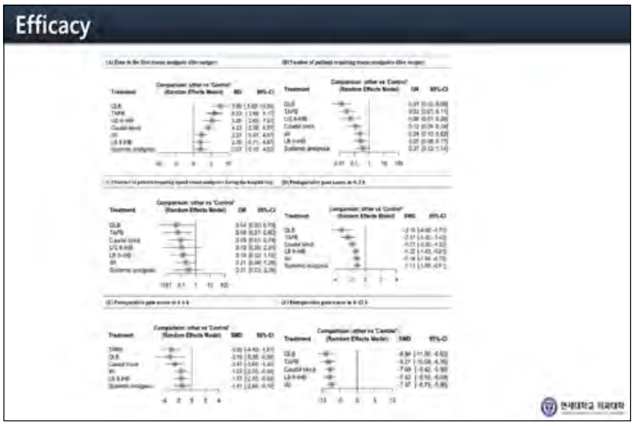


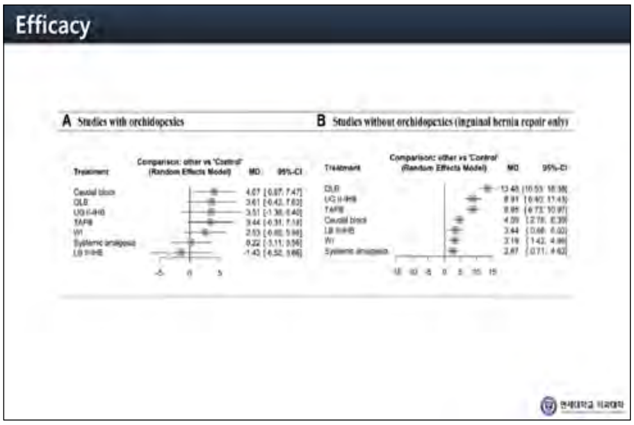
Acta Anaesthesiol Scand 2010; 54: 562–565

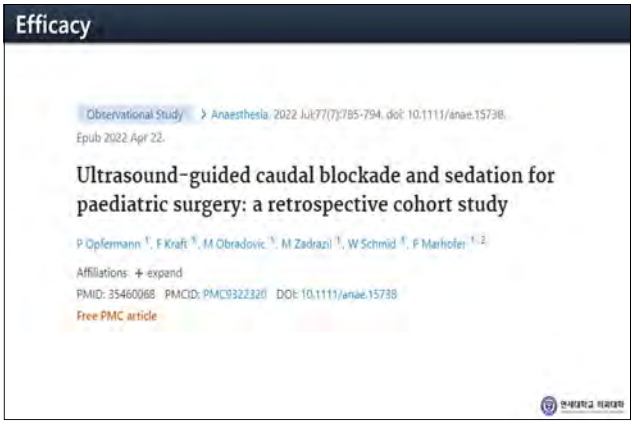
Indications and Contraindications

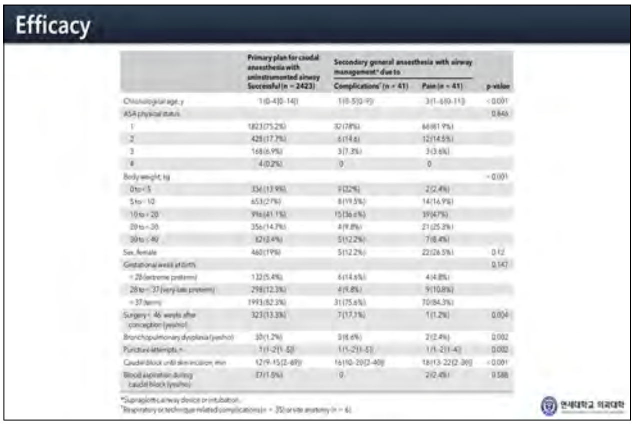
- **Indications**
  - Sub-umbilical (inguinal hernia repair, cystoscopy/transurethral, penile, hip/lower limb procedures etc.) vs.
  - Mid-abdominal (umbilical hernia repair)
- **Contraindications**
  - Local site infection
  - Pilonidal cyst
  - Spinal dysraphism such as tethered cord syndrome
  - Congenital or therapeutic anti-coagulation











Neo										
1.61 (-0.62,3.83)	Dexm									
3.02 (0.50,5.53)	1.41 (-0.75,3.57)	Dexa								
3.27 (0.52,6.02)	1.66 (-0.93,4.25)	0.25 (-2.65,3.15)	Mid							
3.80 (1.71,5.90)	2.20 (0.51,3.88)	0.79 (-1.33,2.90)	0.54 (-1.92,3.00)	Clo						
4.18 (1.86,6.50)	2.57 (0.53,4.62)	1.16 (-1.25,3.58)	0.91 (-1.66,3.48)	0.38 (-1.50,2.25)	Ket					
4.36 (1.13,7.58)	2.75 (-0.14,5.64)	1.34 (-1.90,4.58)	1.09 (-2.29,4.47)	0.55 (-2.17,3.28)	0.17 (-2.92,3.27)	Mor				
4.56 (2.31,6.82)	2.96 (1.06,4.85)	1.55 (-0.74,3.83)	1.30 (-1.35,3.94)	0.76 (-1.05,2.57)	0.38 (-1.62,2.39)	0.21 (-2.84,3.26)	Tra			
5.18 (1.65,8.72)	3.58 (0.34,6.82)	2.17 (-1.26,5.59)	1.92 (-1.85,5.68)	1.38 (-1.86,4.62)	1.00 (-2.28,4.29)	0.83 (-3.23,4.89)	0.62 (-2.73,3.97)	Mag		
7.04 (4.39,9.70)	5.44 (3.05,7.83)	4.03 (1.33,6.72)	3.78 (0.76,6.80)	3.24 (1.00,5.48)	2.86 (0.33,5.40)	2.69 (-0.46,5.84)	2.48 (-0.03,4.99)	1.86 (-1.81,5.53)	Fen	
8.91 (7.09,10.73)	7.31 (6.00,8.61)	5.89 (4.04,7.75)	5.64 (3.39,7.90)	5.11 (3.95,6.27)	4.73 (3.12,6.34)	4.56 (1.84,7.27)	4.35 (2.90,5.80)	3.73 (0.67,6.79)	1.87 (-0.21,3.95)	Pla

Efficacy

- Local anesthetics
  - (levo)bupivacaine 0.125-0.25% or ropivacaine 0.1-0.375% at a volume of 0.5-1.5 ml/kg
  - ropivacaine 0.2% vs. bupivacaine 0.125%
    - similar duration of analgesia, reduced incidence of motor blockade
    - probable lower toxicity

Table 1 Dosage for caudal anesthesia

Site of incision	Dosage (ml·kg⁻¹)	Drug
Penile or anal surgery	0.5-0.75	Ropivacaine 0.2% or
Lower extremity	1.0	(bupivacaine/
Abdominal incision	1.0-1.25	levobupivacaine
		0.125-0.175%)

Pediatric Anesthesia 2012; 22: 44-50

Efficacy

Randomized Controlled Trial > Anesth Analg. 2009 Oct;109(4):1073-8.
doi: 10.1213/ane.0b013e3181b20c52.

A comparison of high volume/low concentration and low volume/high concentration ropivacaine in caudal analgesia for pediatric orchiopexy

Jeong-Yeon Hong [1], Sang W Han, Won O Kim, Jin S Cho, Hae K Kil

Affiliations + expand

PMID: 19762734 DOI: 10.1213/ane.0b013e3181b20c52

Efficacy

A total dose of 2.25 mg/kg of ropivacaine - 1.0 mL/kg of 0.225% (LVHC) vs. 1.5 mL/kg of 0.15% solution (HVLC)

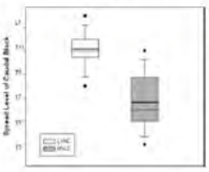
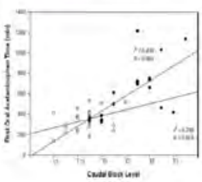


Table 2. Postoperative Data

	LVHC group (n = 37)	HVLC group (n = 36)	P
Time to recovery (min)			
Oral intake	59.6 ± 26.8	63.6 ± 27.8	0.532
Voiding	128.1 ± 56.8	134.6 ± 51.8	[illegible]
Discharge	192.4 ± 43.2	191.3 ± 52.0	0.922
Side effects in RR			
Vomiting	2 (5.4%)	3 (8.3%)	[illegible]
Facial flushing	2 (5.4%)	4 (11.1%)	[illegible]
Sedation	[illegible]	[illegible]	[illegible]
Motor weakness	[illegible]	[illegible]	[illegible]
Rescue analgesics after discharge			
First acetaminophen time (min)*	[illegible]	[illegible]	[illegible]
Number of patients*	[illegible]	[illegible]	[illegible]



Efficacy

Randomized Controlled Trial > Br J Anaesth. 2014 May;112(5):885-91. doi: 10.1093/bja/aet484.
Epub 2014 Feb 2.

Analgesic efficacy of caudal dexamethasone combined with ropivacaine in children undergoing orchiopexy

E M Kim [1], J R Lee, B N Koo, Y J Im, H J Oh, J H Lee

Affiliations + expand

PMID: 24491414 DOI: 10.1093/bja/aet484

Efficacy

Group C (1.5 ml/kg of 0.15% ropivacaine) vs Group D (1.5 ml/kg of 0.15% ropivacaine + 0.1 mg dexamethasone)

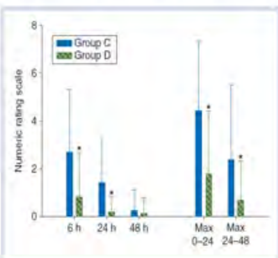


Table 3 Consumption of oral analgesics at postoperative 48 h. Data are shown as number of subjects (proportion, %)

	Group C (n=37)	Group D (n=38)	P-value
Number of subjects who had oral analgesic	20 (54%)	11 (28%)	0.027
Number of oral analgesic administrations for postoperative 48 h			0.013
0	17 (46%)	27 (71%)	
1	11 (29%)	10 (26%)	
2	3 (8%)	1 (2.6%)	
3	3 (8%)	0 (0%)	
≥4	3 (8%)	0 (0%)	

Technique

Review > Paediatr Anaesth. 2022 Jan;32(1):35-42. doi: 10.1111/pan.14332. Epub 2021 Nov 16.

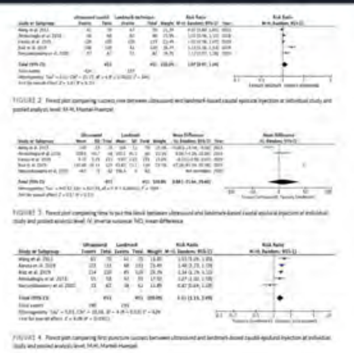
Comparative evaluation of landmark technique and ultrasound-guided caudal epidural injection in pediatric population: A systematic review and meta-analysis

Dhruv Jain [1], Sana Yasmin Hussain [2], Arshad Ayub [1]

Affiliations + expand

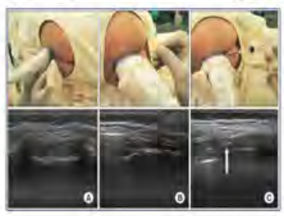
PMID: 34752689 DOI: 10.1111/pan.14332

Technique



Ultrasound-guided Caudal Block

- **The success rate of caudal block**
  - Highly dependent on operator skill
  - Not clearly improved by real-time ultrasound-guidance
- **Ultrasound-guided caudal block**
  - The success rate of needle insertion at the first attempt ↑
  - Complications such as vascular puncture and subcutaneous bulging ↓



KJA 2018; 71(6): 430-439

Pudendal Nerve Block

Introduction

- **King R in 1916**
  - the 1st American report of pudendal nerve block for obstetric pain relief
- **Pudendal nerve block**
  - the method of choice utilized for the initial diagnosis and management of chronic pelvic pain caused by pudendal neuralgia
  - a widely used regional anesthesia technique performed for gynecologic, obstetrical, anorectal, and pediatric penoscrotal procedures.

Efficacy

Randomized Controlled Trial > Reg Anesth Pain Med. 2016 Sep-Oct;41(5):610-5.
doi: 10.1097/AAP.0000000000000447.

Pudendal Versus Caudal Block in Children Undergoing Hypospadias Surgery: A Randomized Controlled Trial

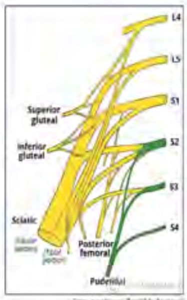
Pinar Kendigelen [1], Ayse Cigdem Tutuncu, Senol Emre, Fatis Altindas, Guner Kaya

Affiliations + expand

PMID: 27501015 DOI: 10.1097/AAP.0000000000000447

Pudendal Nerve Anatomy and Physiology

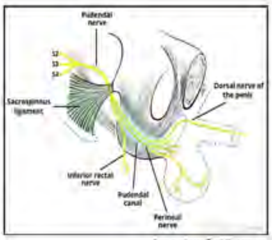
- Nerve roots – S2-S4
- Sensory – external genitalia, skin around anus and perineum
- Motor – pelvic muscles, urethral sphincter and anal sphincter.
- Autonomic – sympathetic nerve fibers to the skin of S2-S4 dermatomal region.



From a webpage TeachMe Anatomy

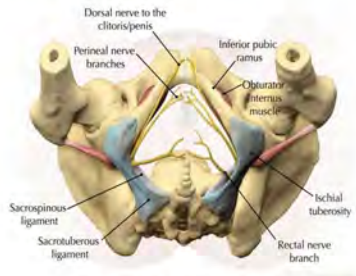
Pudendal Nerve Anatomy and Physiology

- **Three terminal branches**
  - Inferior rectal nerve
  - Perineal nerve
  - Dorsal nerve of the penis/clitoris
- **Alcock's canal**
  - Below the ischial spine
  - Medial to ischial tuberosity.
  - Lies in the distal part of the ischioanal fossa.



From a webpage TeachMe Anatomy

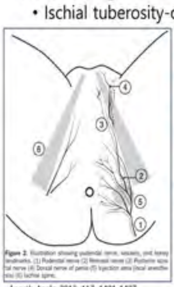
Pudendal Nerve Anatomy and Physiology



From a webpage (https://kevinlmd.com/pudendal-nerve-block-for-perineal-pain/)

Technique

- **Positioning**
  - Ischial tuberosity-consistent guidance across different age group



Anesth Analg 2013; 117: 1401-1407

Figure 1. Illustration showing the landmark and patient's positioning during pudendal nerve block.

Anesth Analg 2013; 117: 1401-1407

Chapter 76, Miller's Anesthesia, 9th Edition

Technique

- **Positioning**
  - Lithotomy + "Frog leg position"
- **Reference points**
  - Bilateral ischial tuberosities
  - 3 and 9 o'clock from the anus

Technique

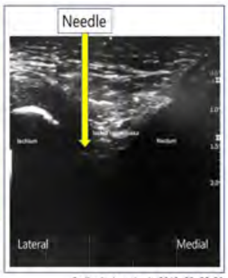
- **Puncture points**
  - immediately medial to ischial tuberosity, perpendicular to skin
- **Nerve stimulation**
  - Observe motor response
  - Start at intensity of 1.5 - 2.0 mA → 0.5 - 0.8 mA

Chapter 76, Miller's Anesthesia, 9th Edition

Technique

- Ultrasound-guided Pudendal Nerve Block

Urology 2018; 113: 192-196



Pediatric Anesthesia 2018; 28: 53-58

Drugs, Dosage and Safety

- **Local Anesthetics**
  - 0.25% bupivacaine or 0.20% ropivacaine
  - 0.1 mL/kg: limited to the stimulated branch
  - 0.3-0.4 mL/kg: all division branches of pudendal nerve
- **Potential Complications**
  - Rectal puncture
  - Pudendal vessel puncture or intravascular injection

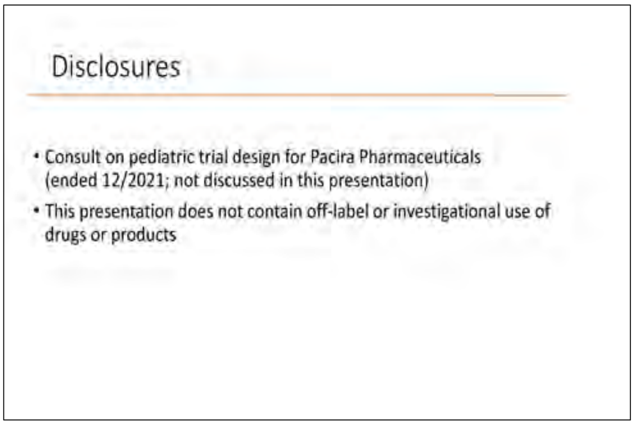
Closing Remarks

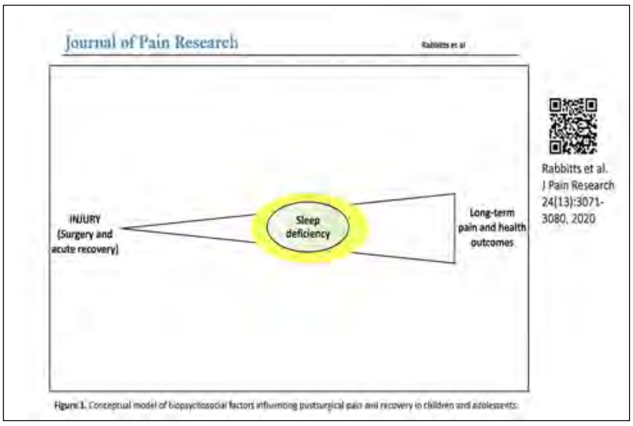
- Caudal blocks are a safe and efficient way to offer perioperative analgesia in a variety of pediatric surgical procedures. However, the efficacy of single injection caudal block seems to be limited to perioperative pain of mild to moderate degree.
- Pudendal nerve block is a simple and potent analgesic technique for pediatric penoscrotal procedures.

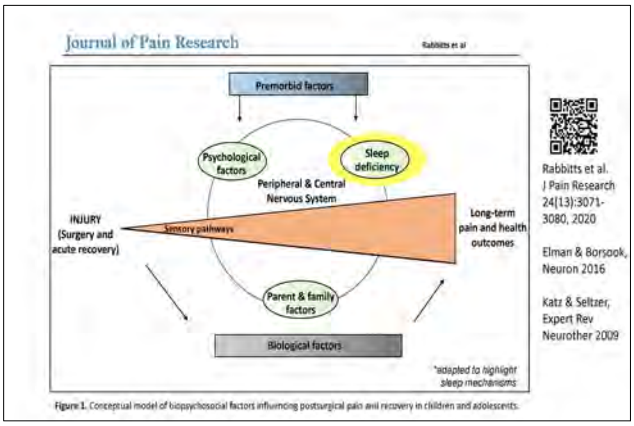
Impact of Sleep on Adolescents' Pain and Recovery after Surgery

Jennifer A. Rabbitts

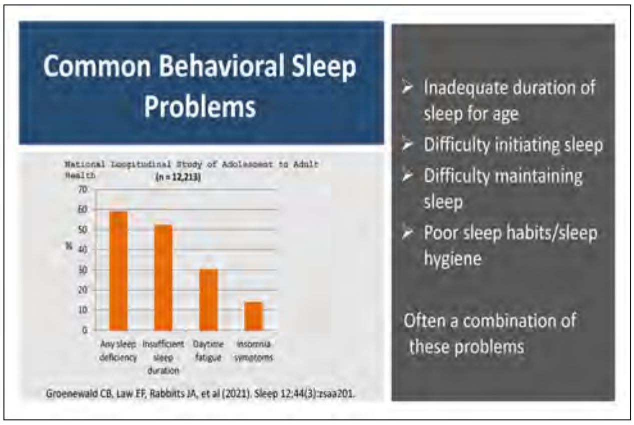
Department of Anesthesiology & Pain Medicine, University of Washington, Seattle Children's Hospital, USA





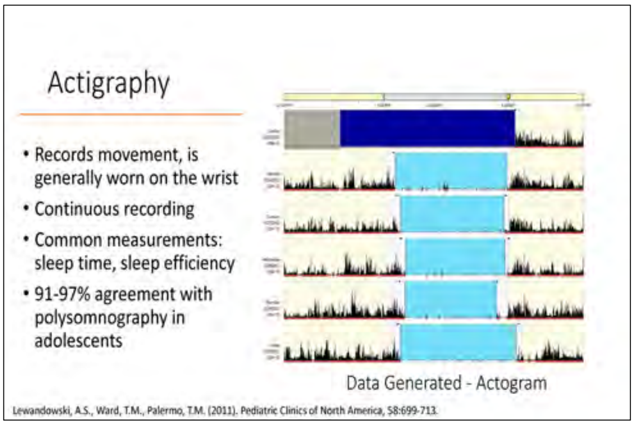


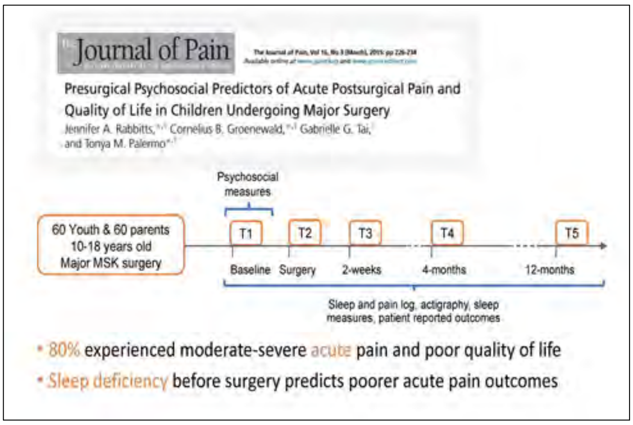

Biological and Psychosocial Changes affecting Adolescent Sleep
• Delayed circadian phases with puberty ~2 hrs
• Evening activities
• Academic demands
• Early school start times
• Increased independence
• Electronics and social media
• "Social jet lag"
Jenni, et al. Sleep. 2005;28(11):1446-54;
Hansen et al. Pediatrics. 2005;115(6):1555-61.
Baiden et al, Psych res 2019;281:112586.

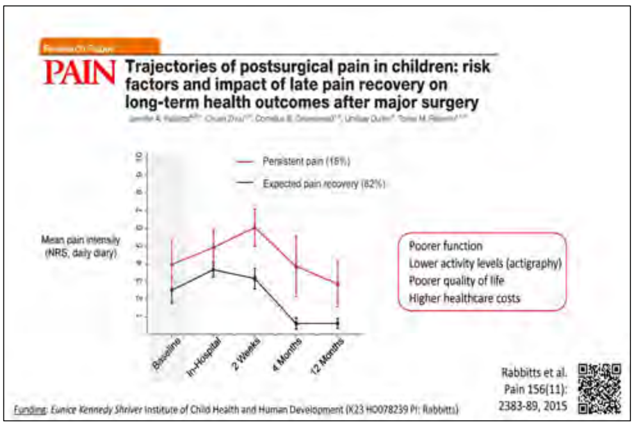

Common Behavioral Sleep Problems
National Longitudinal Study of Adolescent to Adult Health
(n = 12,213)
Any sleep deficiency
Insufficient sleep duration
Daytime fatigue
Insomnia symptoms
Groenewald CB, Law EF, Rabbitts JA, et al (2021). Sleep 12;44(3):zsaa201.
➤ Inadequate duration of sleep for age
➤ Difficulty initiating sleep
➤ Difficulty maintaining sleep
➤ Poor sleep habits/sleep hygiene
Often a combination of these problems

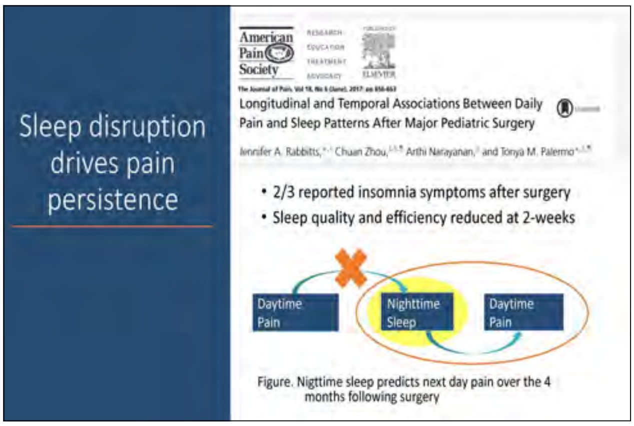

What about after surgery?
• Impacted by anesthesia, pain, opioids, and hospitalization
• Anesthesia and surgery acutely delays onset of nocturnal melatonin secretion
• Tightly linked to autonomic and immune pathways
• Insufficient sleep alters pain sensitivity and pain modulation
Sivertsen et al, Pain 2015
Finan et al, J Pain 2013
Kärkelä et al, Acta Anaesth Scand 2002


How do we assess sleep?
• Sleep quality
• Measures
• Insomnia symptoms
• Nocturnal behaviors
• Daytime behaviors
• Sleep habits and physical environment
• Sleep patterns (actigraphy)
• Sleep time
• Sleep efficiency
Lewandowski, A.S., Ward, T.M., Palermo, T.M. (2011). Pediatric Clinics of North America, 58:699-713.


Actigraphy
• Records movement, is generally worn on the wrist
• Continuous recording
• Common measurements: sleep time, sleep efficiency
• 91-97% agreement with polysomnography in adolescents
Data Generated - Actogram
Lewandowski, A.S., Ward, T.M., Palermo, T.M. (2011). Pediatric Clinics of North America, 58:699-713.


Journal of Pain
Presurgical Psychosocial Predictors of Acute Postsurgical Pain and Quality of Life in Children Undergoing Major Surgery
Jennifer A. Rabbitts, Cornelius B. Groenewald, Gabrielle G. Tai, and Tonya M. Palermo
Psychosocial measures
60 Youth & 60 parents
10-18 years old
Major MSK surgery
T1 T2 T3 T4 T5
Baseline Surgery 2-weeks 4-months 12-months
Sleep and pain log, actigraphy, sleep measures, patient reported outcomes
• 80% experienced moderate-severe acute pain and poor quality of life
• Sleep deficiency before surgery predicts poorer acute pain outcomes


PAIN
Trajectories of postsurgical pain in children: risk factors and impact of late pain recovery on long-term health outcomes after major surgery
Persistent pain (18%)
Expected pain recovery (82%)
Mean pain intensity (NRS, daily diary)
Baseline
In-Hospital
2 Weeks
4 Months
12 Months
Poorer function
Lower activity levels (actigraphy)
Poorer quality of life
Higher healthcare costs
Rabbitts et al. Pain 156(11): 2383-89, 2015
Funding: Eunice Kennedy Shriver Institute of Child Health and Human Development (K23 HD078239 PI: Rabbitts)


Sleep disruption drives pain persistence
American Pain Society
Longitudinal and Temporal Associations Between Daily Pain and Sleep Patterns After Major Pediatric Surgery
Jennifer A. Rabbitts, Chuan Zhou, Arthi Narayanan, and Tonya M. Palermo
• 2/3 reported insomnia symptoms after surgery
• Sleep quality and efficiency reduced at 2-weeks
Daytime Pain
Nighttime Sleep
Daytime Pain
Figure. Nigttime sleep predicts next day pain over the 4 months following surgery

Treatment of behavioral sleep disturbances

Non-pharmacological treatments

- Behavioral interventions
- Sleep hygiene
- Complementary treatments

Example of Sleep Hygiene Interventions

- Make a schedule to allow for 9 hours of nightly sleep
- Remove television and electronics from bedroom
- Establish positive bedtime routine and waking routine
- Use alarm clock to awaken in the a.m.
- Keep a consistent weekend/weekday sleep schedule (≤1-2 hr variation)

SurgeryPal

Objective: Examine effectiveness of a behavioral program targeting sleep and anxiety to improve acute and chronic pain and health outcomes in adolescent spinal fusion

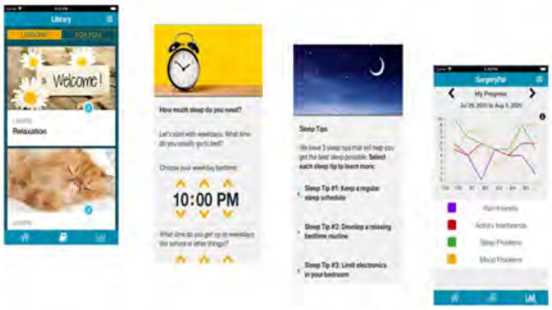
Study Design: Multisite RCT testing mHealth behavioral intervention (SurgeryPal) in 500 adolescents scheduled for spine surgery

T1: baseline — Pre-surgery intervention phase — T2: acute outcomes — Post-surgery intervention phase — T3: Chronic outcomes — T4: Final follow-up

4-8 weeks pre-surgery | Surgery | 3 weeks post-surgery | 3-months post-surgery | 6-months post-surgery

ClinicalTrials.gov Identifier: NCT04637802 | Rabbitts et al (2021), Trials 22(1):506

*RCT, Randomized Clinical Trial



SurgeryPal

Mobile App Behavioral Program for Adolescents

Primary Outcomes

- **Acute pain**: Pain intensity and interference over 14 days post-discharge.
- **Chronic pain**: Pain intensity and interference at 3- and 6- months.

Secondary Outcomes

- Opioid use; quality of life; teen and parent anxiety; rates of chronic pain.

Implications

- Sleep deficiency is common in adolescents and may be exacerbated after surgery.
- Disrupted sleep is an important factor driving pain persistence and poor QOL after surgery.
- Behavioral interventions targeting psychosocial distress and sleep disturbance may improve postsurgical pain and recovery.

Pediatric Pain and Sleep Innovations Lab

Seattle Children's

Acknowledgments

NIH National Institute of Child Health and Human Development (NICHD): K23HD078239 (PI- Rabbitts)

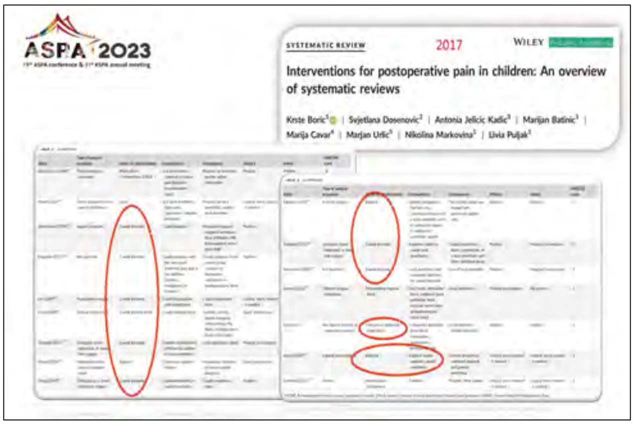
NIH National Institute of Arthritis, Musculoskeletal and Skin Disease (NIAMS) R01AR073780 (PI- Rabbitts)

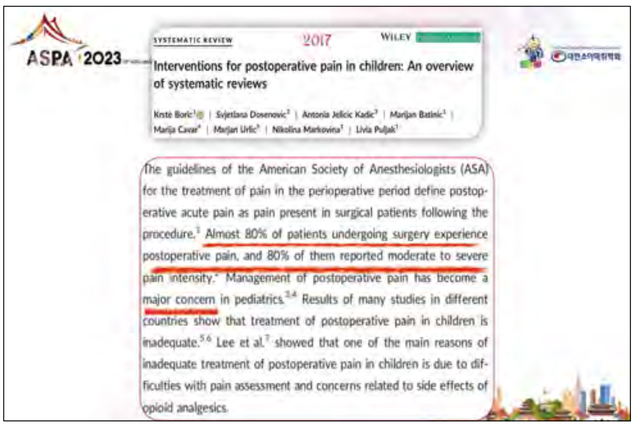
NIH NICHD & Helping to End Addiction Long-term (HEAL) and NICHD: UG3HD102038 and UH3HD102038-02S1 (SurgeryPal RCT; MPI- Rabbitts, Palermo)

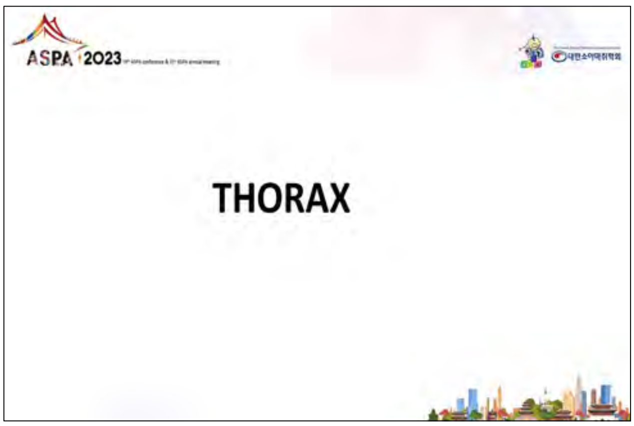
ESP or Those Trunk Blocks for Children

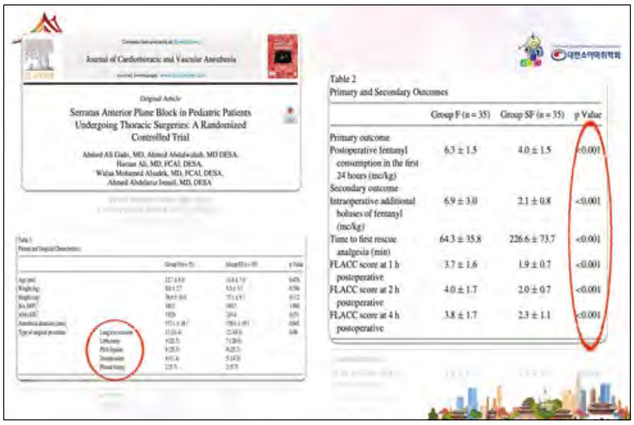
Pınar Kendigelen

Anesthesiology and Intensive Care at Istanbul University-Cerrahpasa, Türkiye

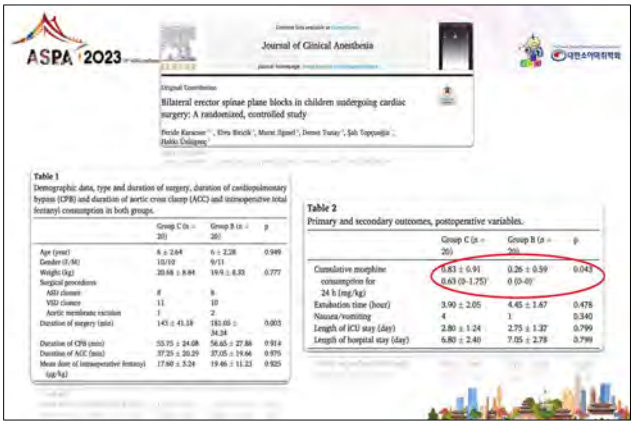


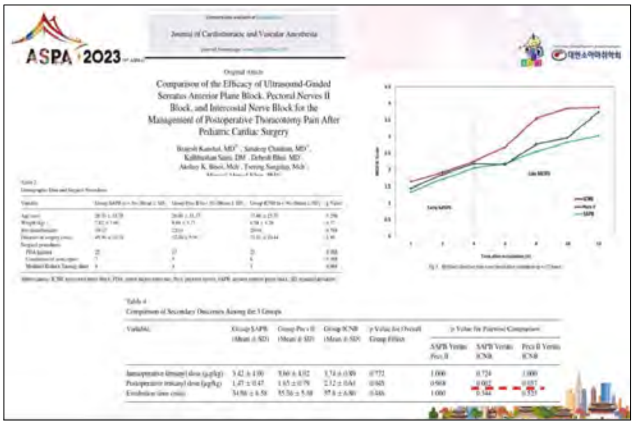




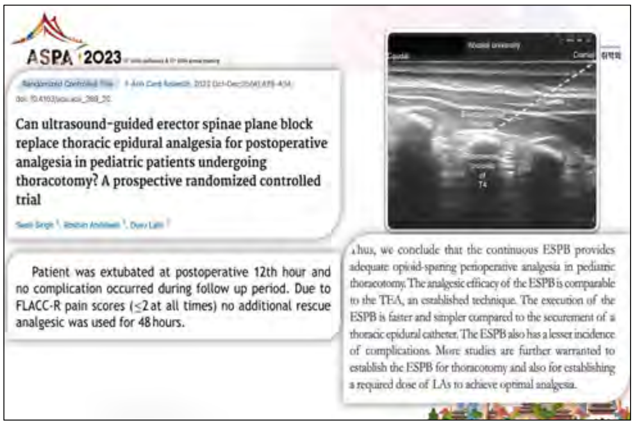

Journal of Cardiothoracic and Vascular Anesthesia
Original Article
Serratus Anterior Plane Block in Pediatric Patients Undergoing Thoracic Surgeries: A Randomized Controlled Trial
Table 2
Primary and Secondary Outcomes
Group F (n = 35) Group SF (n = 35) p Value
Primary outcome
Postoperative fentanyl consumption in the first 24 hours (mcg/kg) 6.3 ± 1.5 4.0 ± 1.5 <0.001
Secondary outcome
Intraoperative additional boluses of fentanyl (mcg/kg) 6.9 ± 3.0 2.1 ± 0.8 <0.001
Time to first rescue analgesia (min) 64.3 ± 35.8 226.6 ± 73.7 <0.001
FLACC score at 1 h postoperative 3.7 ± 1.6 1.9 ± 0.7 <0.001
FLACC score at 2 h postoperative 4.0 ± 1.7 2.0 ± 0.7 <0.001
FLACC score at 4 h postoperative 3.8 ± 1.7 2.3 ± 1.1 <0.001

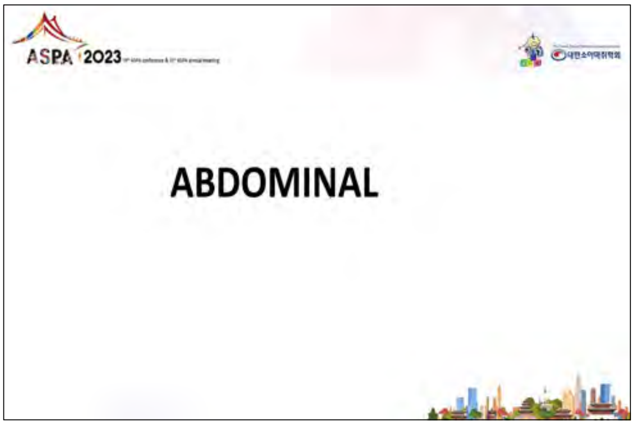

Journal of Cardiothoracic and Vascular Anesthesia
Original Research
Transversus Thoracic Muscle Plane Block for Analgesia After Pediatric Cardiac Surgery
Meltem Cakmak, MD, Onur Isik, MD

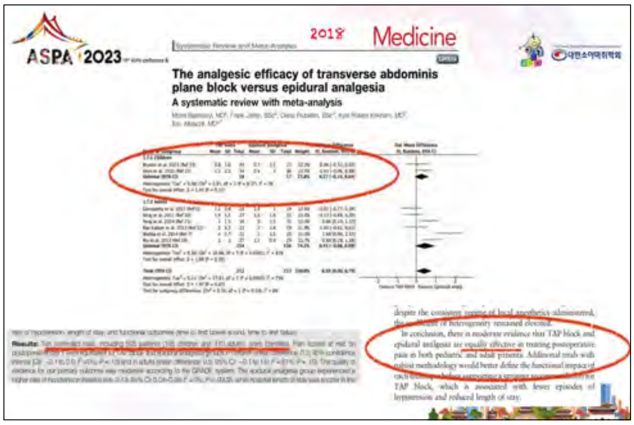

ASPA 2023
Journal of Clinical Anesthesia
Original Contribution
Bilateral erector spinae plane blocks in children undergoing cardiac surgery: A randomized, controlled study
Table 1
Demographic data, type and duration of surgery, duration of cardiopulmonary bypass (CPB) and duration of aortic cross clamp (ACC) and intraoperative total fentanyl consumption in both groups.
Table 2
Primary and secondary outcomes, postoperative variables.
Cumulative morphine consumption for 24 h (mg/kg) 0.83 ± 0.91 0.63 (0–1.75) 0.26 ± 0.59 0 (0–0) 0.043
Extubation time (hour) 3.90 ± 2.05 4.45 ± 1.67 0.478
Length of ICU stay (day) 2.80 ± 1.24 2.75 ± 1.37 0.799
Length of hospital stay (day) 6.80 ± 2.40 7.05 ± 2.78 0.799

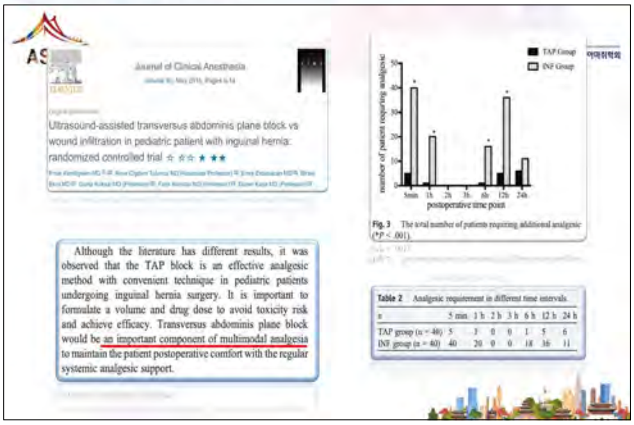

ASPA 2023
Journal of Cardiothoracic and Vascular Anesthesia
Comparison of the Efficacy of Ultrasound-Guided Serratus Anterior Plane Block, Pectoral Nerves II Block, and Intercostal Nerve Block for the Management of Postoperative Thoracotomy Pain After Pediatric Cardiac Surgery

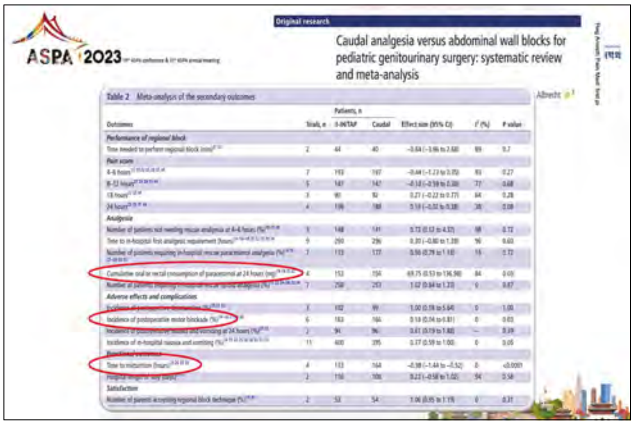

CASE REPORT
Continuous Erector Spinae Plane Catheter for Analgesia After Infant Thoracotomy: A Case Report
In addition to providing outstanding analgesia, the ESP catheter might have a safety benefit in this population, because the block has a low degree of technical difficulty, is superficial, and potentially avoids the risks associated with epidural or paravertebral placement. In infants, the
Revista Española de Anestesiología y Reanimación
Bilateral single shot erector spinae plane block for pectus excavatum and pectus carinatum surgery in 2 pediatric patients
Conclusions
Bilateral single shot ESP block provided effective intraoperative and postoperative analgesia in pectus excavatum and pectus carinatum surgery in adolescents, with no need for long term opioids.

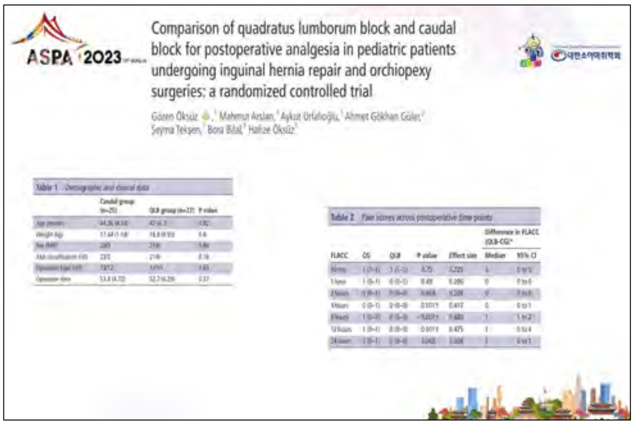

ASPA 2023
Can ultrasound-guided erector spinae plane block replace thoracic epidural analgesia for postoperative analgesia in pediatric patients undergoing thoracotomy? A prospective randomized controlled trial
Patient was extubated at postoperative 12th hour and no complication occurred during follow up period. Due to FLACC-R pain scores (≤2 at all times) no additional rescue analgesic was used for 48 hours.
Thus, we conclude that the continuous ESPB provides adequate opioid-sparing perioperative analgesia in pediatric thoracotomy. The analgesic efficacy of the ESPB is comparable to the TEA, an established technique. The execution of the ESPB is faster and simpler compared to the securement of a thoracic epidural catheter. The ESPB also has a lesser incidence of complications. More studies are further warranted to establish the ESPB for thoracotomy and also for establishing a required dose of LAs to achieve optimal analgesia.

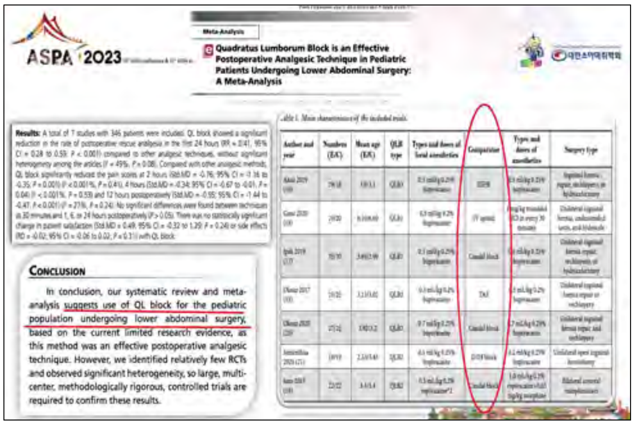

ASPA 2023
ABDOMINAL

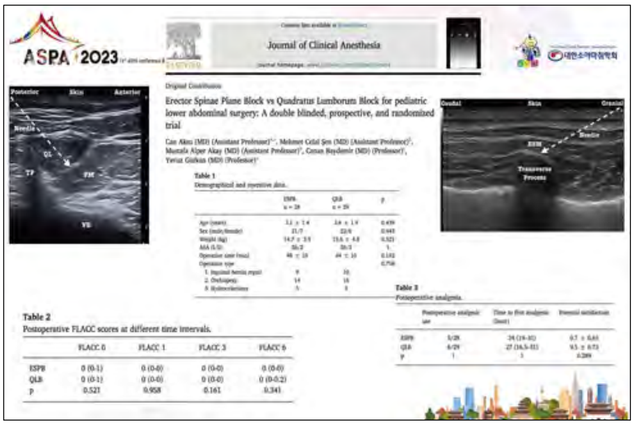

ASPA 2023
2018 Medicine
The analgesic efficacy of transverse abdominis plane block versus epidural analgesia
A systematic review with meta-analysis
In conclusion, there is moderate evidence that TAP block and epidural analgesia are equally effective at treating postoperative pain in both pediatric and adult patients.

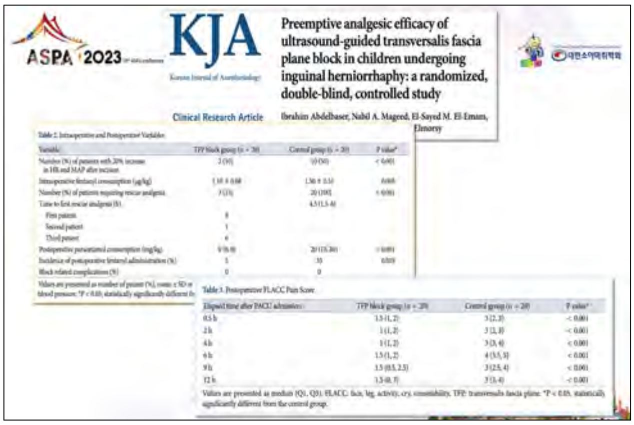

Journal of Clinical Anesthesia
Ultrasound-assisted transversus abdominis plane block vs wound infiltration in pediatric patient with inguinal hernia: randomized controlled trial
Although the literature has different results, it was observed that the TAP block is an effective analgesic method with convenient technique in pediatric patients undergoing inguinal hernia surgery. It is important to formulate a volume and drug dose to avoid toxicity risk and achieve efficacy. Transversus abdominis plane block would be an important component of multimodal analgesia to maintain the patient postoperative comfort with the regular systemic analgesic support.
TAP Group
INF Group
postoperative time point
Fig. 3 The total number of patients requiring additional analgesic
Table 2 Analgesic requirement in different time intervals


ASPA 2023
Original research
Caudal analgesia versus abdominal wall blocks for pediatric genitourinary surgery: systematic review and meta-analysis
Table 2 Meta-analysis of the secondary outcomes


ASPA 2023
Comparison of quadratus lumborum block and caudal block for postoperative analgesia in pediatric patients undergoing inguinal hernia repair and orchiopexy surgeries: a randomized controlled trial
Table 1 Demographic and clinical data
Table 2 Pain scores across postoperative time points

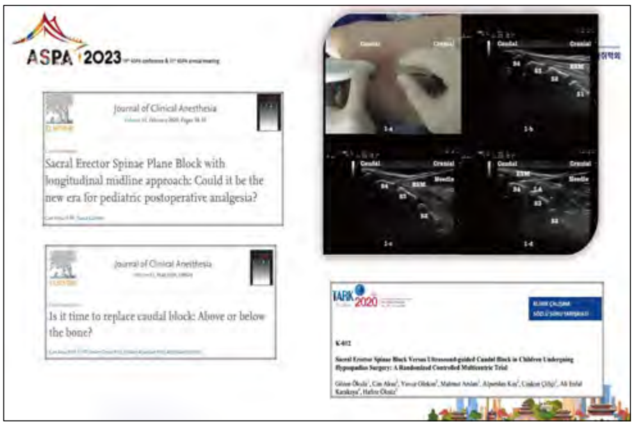

ASPA 2023
Meta-Analysis
Quadratus Lumborum Block is an Effective Postoperative Analgesic Technique in Pediatric Patients Undergoing Lower Abdominal Surgery: A Meta-Analysis
Conclusion
In conclusion, our systematic review and meta-analysis suggests use of QL block for the pediatric population undergoing lower abdominal surgery, based on the current limited research evidence, as this method was an effective postoperative analgesic technique. However, we identified relatively few RCTs and observed significant heterogeneity, so large, multi-center, methodologically rigorous, controlled trials are required to confirm these results.


ASPA 2023
Journal of Clinical Anesthesia
Erector Spinae Plane Block vs Quadratus Lumborum Block for pediatric lower abdominal surgery: A double blinded, prospective, and randomized trial
Table 1
Table 2
Postoperative FLACC scores at different time intervals.
Table 3
Postoperative analgesia.


ASPA 2023
KJA
Korean Journal of Anesthesiology
Preemptive analgesic efficacy of ultrasound-guided transversalis fascia plane block in children undergoing inguinal herniorrhaphy: a randomized, double-blind, controlled study
Clinical Research Article
Table 2. Intraoperative and Postoperative Variables
Table 3. Postoperative FLACC Pain Score


ASPA 2023
Journal of Clinical Anesthesia
The use of continuous Erector Spinae Plane blockade for analgesia following major abdominal surgery in a one-day old neonate
Needle
Catheter
Local
Erector Spinae
Transverse Process


Defining the Indications and Levels of Erector Spinae Plane Block in Pediatric Patients: A Retrospective Study of Our Current Experience
141 Case
Early experience with erector spinae plane blocks in children
164 Case


ASPA 2023
Journal of Clinical Anesthesia
Sacral Erector Spinae Plane Block with longitudinal midline approach: Could it be the new era for pediatric postoperative analgesia?
Journal of Clinical Anesthesia
Is it time to replace caudal block: Above or below the bone?
Caudal
Cranial
ESM
Needle
TARK 2020
Sacral Erector Spinae Block Versus Ultrasound-guided Caudal Block in Children Undergoing Hypospadias Surgery: A Randomized Controlled Multicentric Trial

Experts Tips on RA in Neonates and Infants

Vrushali Ponde

Bhatia Hospital, India

Learning Objectives

1. Understand the scope and benefits of regional anesthesia in the vulnerable neonatal population.
2. Comprehend the sparing effect of general anesthesia (GA).
3. Gain knowledge of the pharmacokinetics and dynamics of local anesthesia (LA) and its impact on both single-shot and continuous blocks.
4. Develop an understanding of neonatal anatomy, particularly the termination of the dural sac and the conus medullaris, and its clinical implications.
5. Compare and contrast the equipment used for neonatal regional anesthesia.
6. Learn effective communication strategies when discussing regional anesthesia with neonatologists, surgeons, and parents.
7. Address specific considerations related to obtaining consent for neonatal regional anesthesia.
8. Develop skills in selecting the appropriate block for neonates.
9. Various modalities.
10. Identify potential complications associated with neonatal regional anesthesia and learn how to manage them.
11. Acquire techniques to improve proficiency in performing neonatal regional anesthesia.

Session 2.

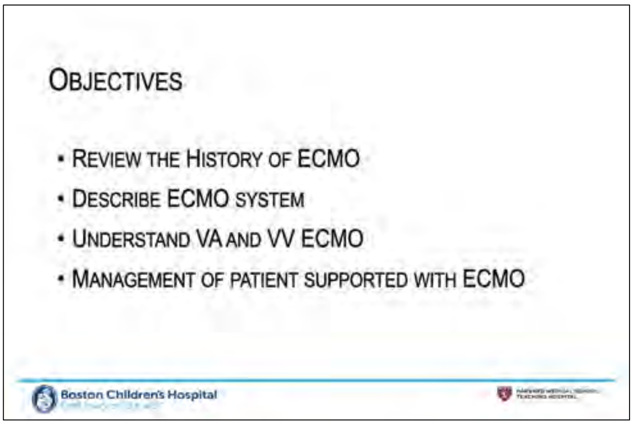
Cardiac Anesthesia

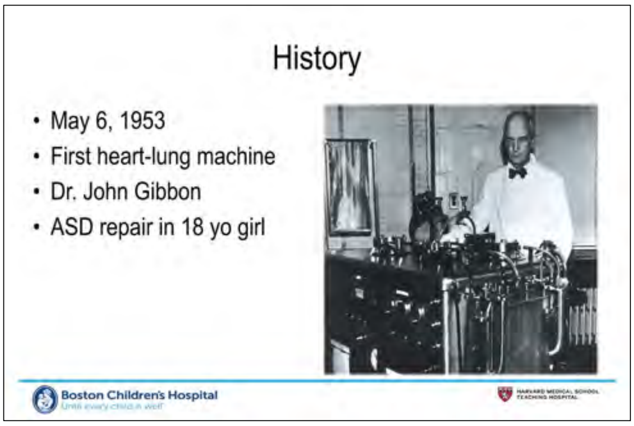
Chair(s): Jong Wha Lee (Korea)
Won-Jung Shin (Korea)

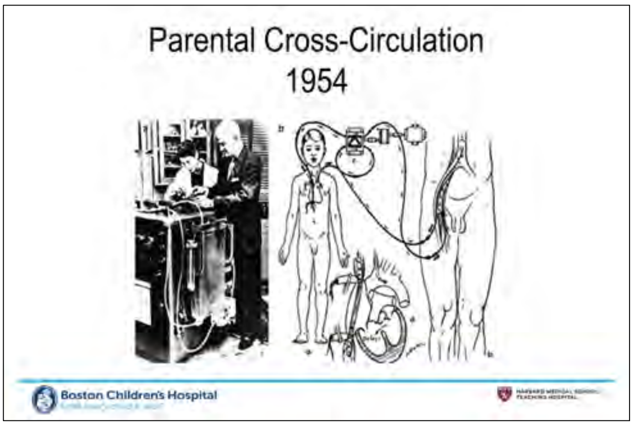
ECMO: What Should We Anesthesiologists Know?

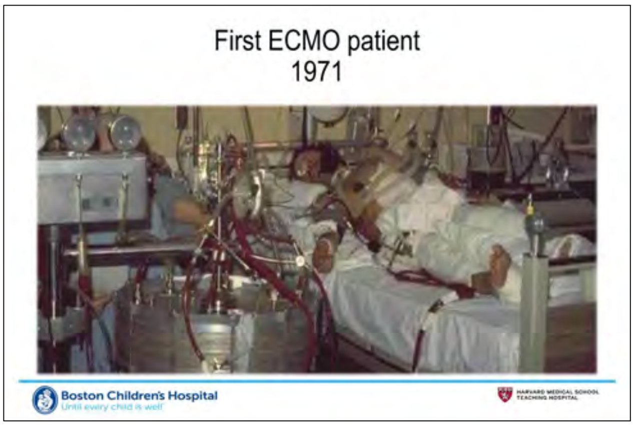
Viviane G . Nasr

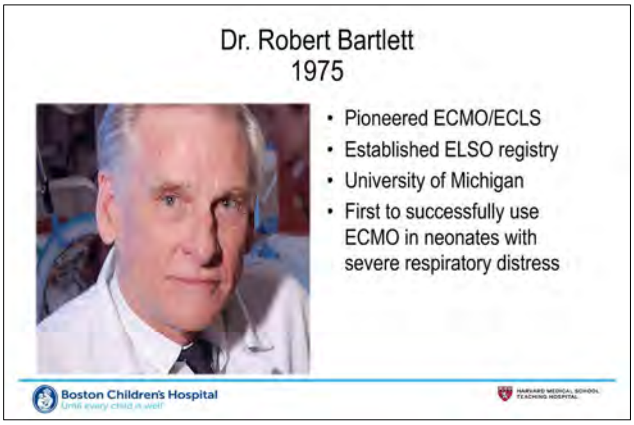
Department of Anaesthesia, Harvard Medical School, Division of Cardiac Anesthesia, Boston Children's Hospital, USA

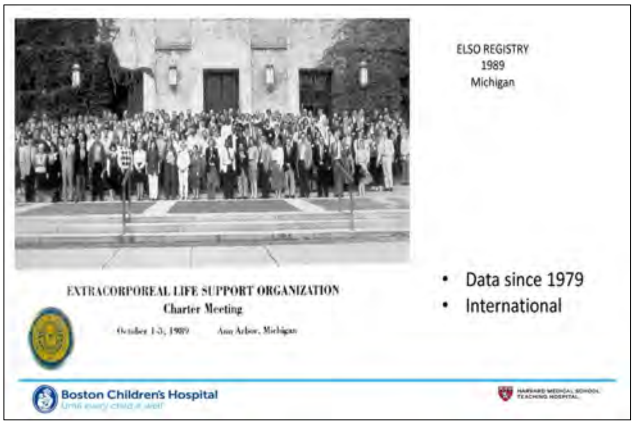


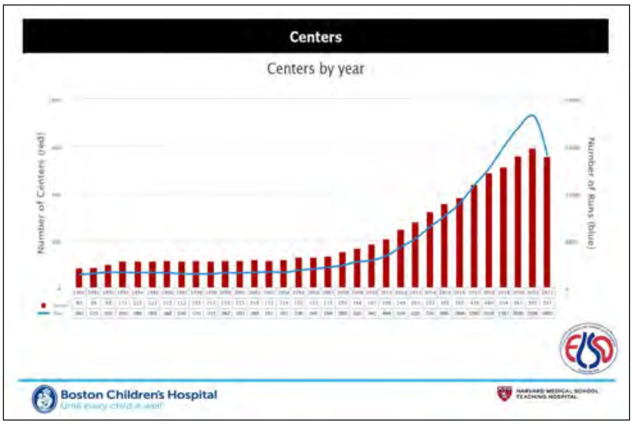


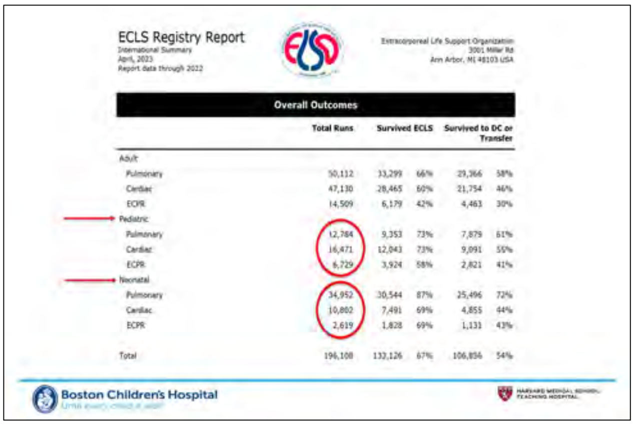








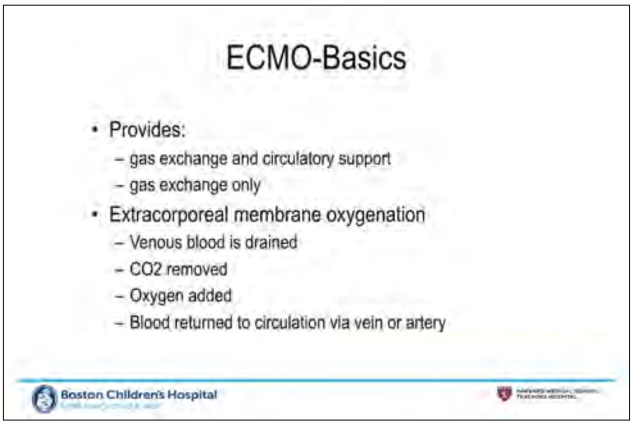


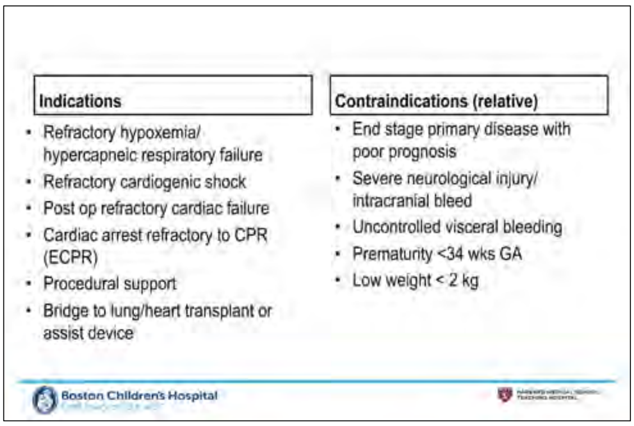

ECLS Registry Report
International Summary
April, 2023
Report data through 2022

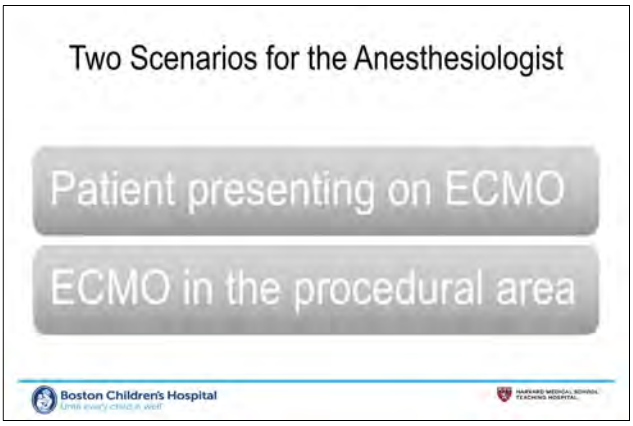
Extracorporeal Life Support Organization
3001 Miller Rd
Ann Arbor, MI 48103 USA

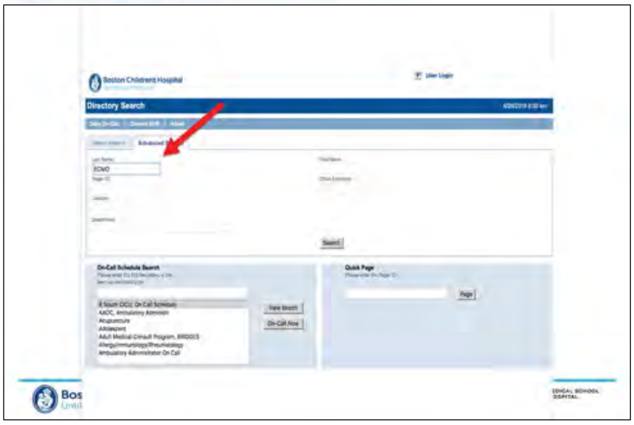
Overall Outcomes

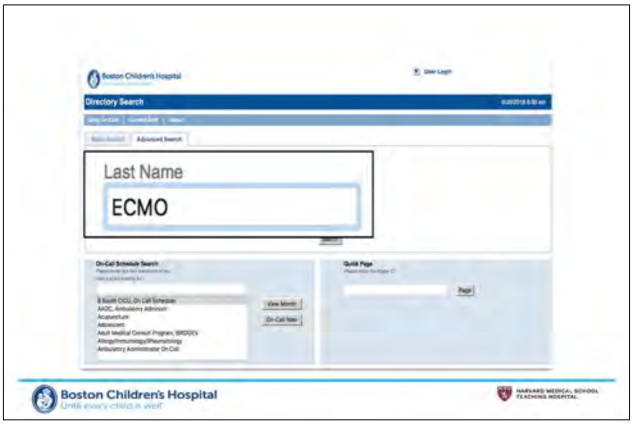
	Total Runs	Survived ECLS		Survived to DC or Transfer	
Adult					
Pulmonary	50,112	33,299	66%	29,366	58%
Cardiac	47,130	28,465	60%	21,754	46%
ECPR	14,509	6,179	42%	4,463	30%
Pediatric					
Pulmonary	12,784	9,353	73%	7,879	61%
Cardiac	16,471	12,043	73%	9,091	55%
ECPR	6,729	3,924	58%	2,821	41%
Neonatal					
Pulmonary	34,952	30,544	87%	25,496	72%
Cardiac	10,802	7,491	69%	4,855	44%
ECPR	2,619	1,828	69%	1,131	43%
Total	196,108	132,126	67%	106,856	54%



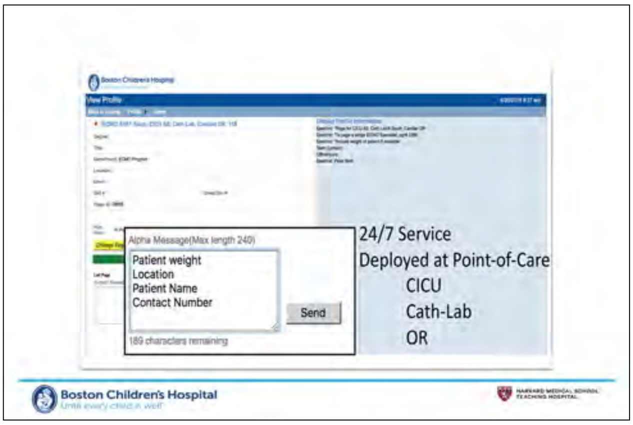


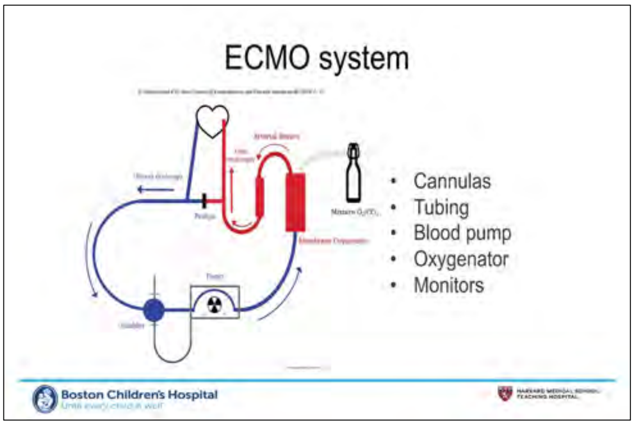


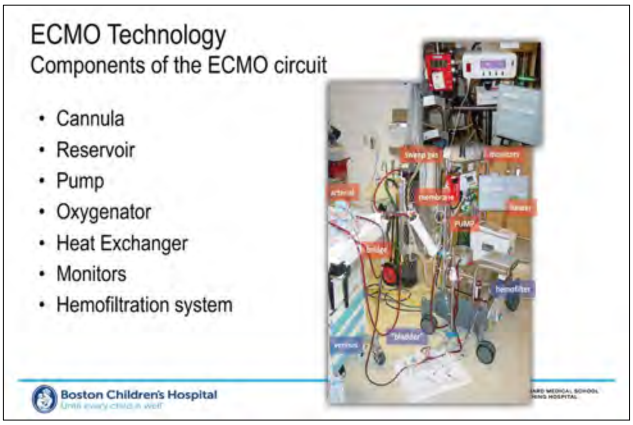

Directory Search
Boston Children's Hospital

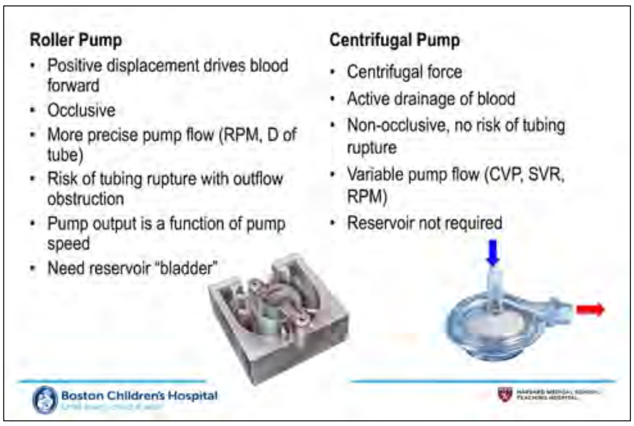

Directory Search
Last Name
ECMO
Boston Children's Hospital
Until every child is well

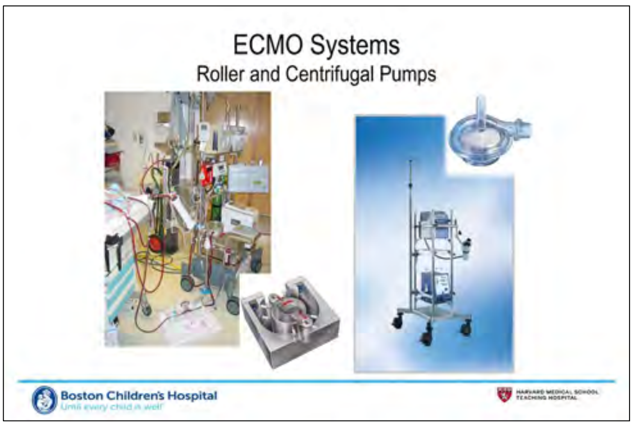

View Profile
Boston Children's Hospital
Until every child is well


Alpha Message(Max length 240)
Patient weight
Location
Patient Name
Contact Number
Send
189 characters remaining
24/7 Service
Deployed at Point-of-Care
CICU
Cath-Lab
OR
Boston Children's Hospital
Until every child is well


ECMO system
Cannulas
Tubing
Blood pump
Oxygenator
Monitors
Boston Children's Hospital
Until every child is well


ECMO Technology
Components of the ECMO circuit
Cannula
Reservoir
Pump
Oxygenator
Heat Exchanger
Monitors
Hemofiltration system
Boston Children's Hospital
Until every child is well


Roller Pump
Positive displacement drives blood forward
Occlusive
More precise pump flow (RPM, D of tube)
Risk of tubing rupture with outflow obstruction
Pump output is a function of pump speed
Need reservoir "bladder"
Centrifugal Pump
Centrifugal force
Active drainage of blood
Non-occlusive, no risk of tubing rupture
Variable pump flow (CVP, SVR, RPM)
Reservoir not required
Boston Children's Hospital


ECMO Systems
Roller and Centrifugal Pumps
Boston Children's Hospital
Until every child is well

Cannulas/ Tubing

- Different types/sizes of cannulas
- Cut-down, percutaneous techniques
- PVC Tubing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Until every child is well

ECMO Oxygenators

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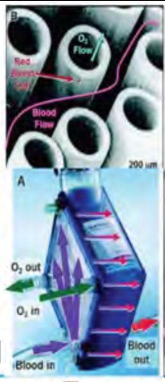
ECMO Oxygenators

- Hollow Fiber
- PMP
- Easy to prime
- Easy to de-air
- Low resistance
- Low pressure drop
- Heat exchanger
- 15 -21 days Duration



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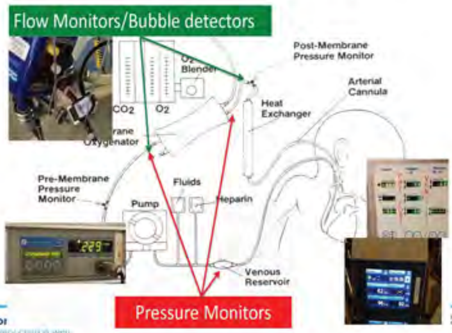
ECMO Circuit Monitors



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Troubleshooting the ECMO Circuit

Monitor	Detects
Servo Pressure	↓Volume status Venous Obstruction
Post-Membrane Pressure	Arterial Obstruction
Pre – Post Membrane Pressure Difference	Oxygenator Function/Clots
Flow Monitor	Actual Flow
Bubble Detector	Air bubbles in Circuit

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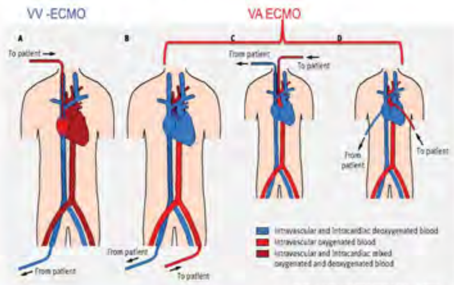
VA & VV ECMO



Gaffney A M et al. BMJ 2010;341:bmj.c5317

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Modes of ECMO support

Modes of ECMO Support

Mode	Indication	Outflow Cannula(e)	Inflow Cannula(e)
Venoarterial (VA)	Primary cardiac failure ± respiratory failure	V	A
Venovenous (VV)	Primary respiratory failure without refractory cardiovascular compromise	V	V
Venovenous arterial (VVA)	Primary respiratory failure with subsequent refractory cardiovascular compromise	V	V, A
Venoarterial venous (VAV)	Primary cardiac and respiratory failure with subsequent North South syndrome	V	A, V
	Inadequate venous drainage	V, V	A
Venovenous venous (VVV)	Inadequate venous drainage	V, V	V

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VA vs VV ECMO

	VA	VV
Cannulation	V+A	V / V+V
Perfusion	ECMO Flow + Native CO	Native CO
CVP	Not Helpful	Accurate
Pulmonary Blood Flow	Bypassed	Maintained
ECMO Flow (mL/kg/min)	80-100	100-120
PA pressures	Decreased	Elevated
Arterial side SpO_2	Controlled by ECMO Flow	80-95%
Pulse Contour	Damped	Normal

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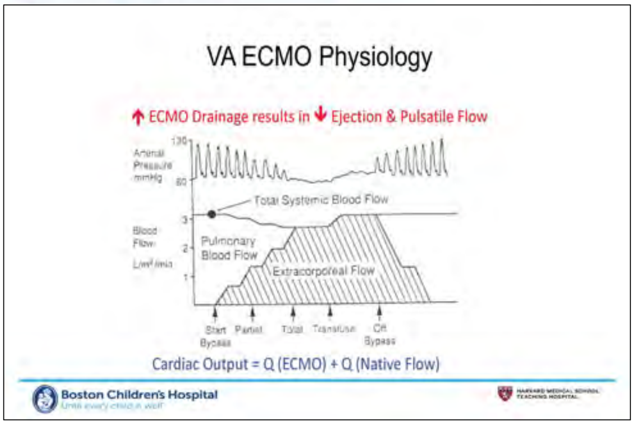
VA ECMO Physiology
↑ ECMO Drainage results in ↓ Ejection & Pulsatile Flow
Arterial Pressure mmHg
Total Systemic Blood Flow
Blood Flow L/m²/min
Pulmonary Blood Flow
Extracorporeal Flow
Start Bypass
Partial
Total
Transition
Off Bypass
Cardiac Output = Q (ECMO) + Q (Native Flow)
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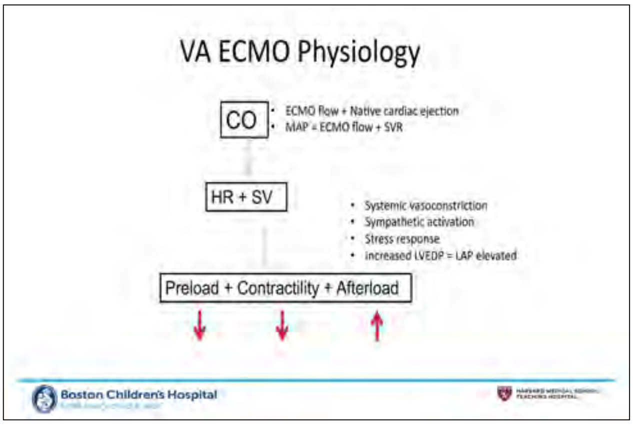
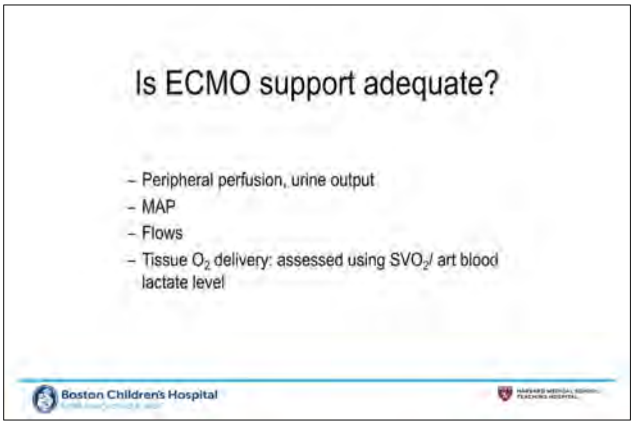
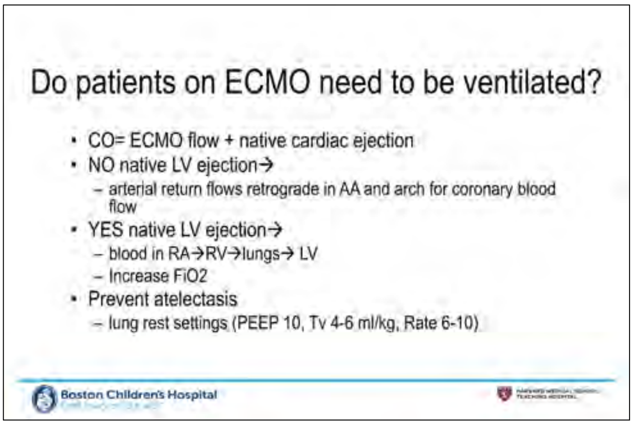
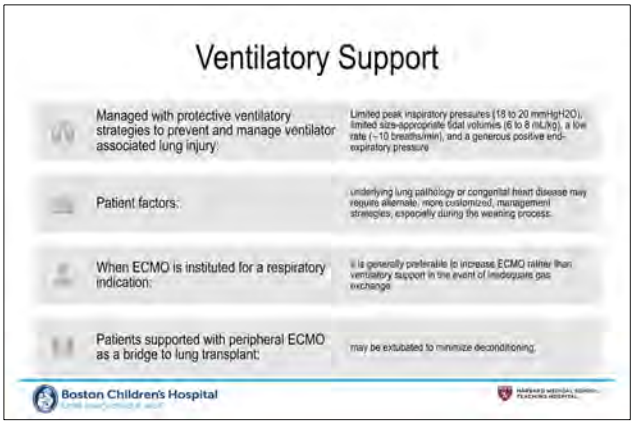
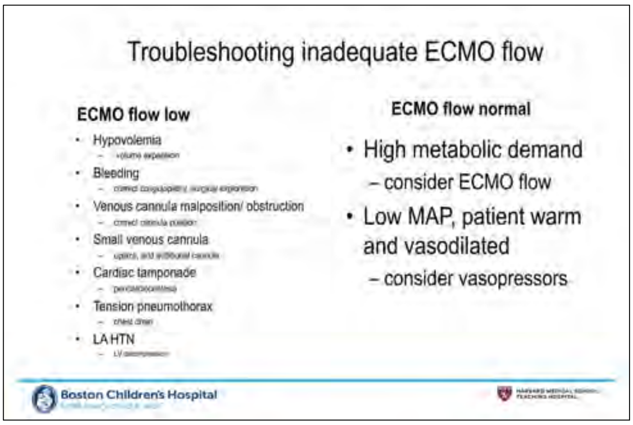

VA ECMO Physiology
CO
ECMO flow + Native cardiac ejection
MAP = ECMO flow + SVR
HR + SV
Systemic vasoconstriction
Sympathetic activation
Stress response
Increased LVEDP = LAP elevated
Preload + Contractility + Afterload
Boston Children's Hospital


Is ECMO support adequate?
– Peripheral perfusion, urine output
– MAP
– Flows
– Tissue O_2 delivery: assessed using SVO_2/ art blood lactate level
Boston Children's Hospital


Do patients on ECMO need to be ventilated?
• CO= ECMO flow + native cardiac ejection
• NO native LV ejection→
– arterial return flows retrograde in AA and arch for coronary blood flow
• YES native LV ejection→
– blood in RA→RV→lungs→ LV
– Increase FiO2
• Prevent atelectasis
– lung rest settings (PEEP 10, Tv 4-6 ml/kg, Rate 6-10)
Boston Children's Hospital


Ventilatory Support
Managed with protective ventilatory strategies to prevent and manage ventilator associated lung injury:
Limited peak inspiratory pressures (18 to 20 mmHgH2O), limited size-appropriate tidal volumes (6 to 8 mL/kg), a low rate (~10 breaths/min), and a generous positive end-expiratory pressure
Patient factors:
underlying lung pathology or congenital heart disease may require alternate, more customized, management strategies, especially during the weaning process.
When ECMO is instituted for a respiratory indication:
it is generally preferable to increase ECMO rather than ventilatory support in the event of inadequate gas exchange
Patients supported with peripheral ECMO as a bridge to lung transplant:
may be extubated to minimize deconditioning.
Boston Children's Hospital


Troubleshooting inadequate ECMO flow
ECMO flow low
• Hypovolemia
• Bleeding
• Venous cannula malposition/ obstruction
• Small venous cannula
• Cardiac tamponade
• Tension pneumothorax
• LA HTN
ECMO flow normal
• High metabolic demand
– consider ECMO flow
• Low MAP, patient warm and vasodilated
– consider vasopressors
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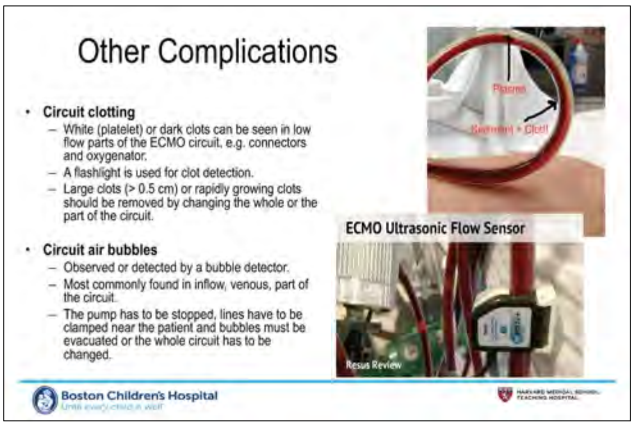
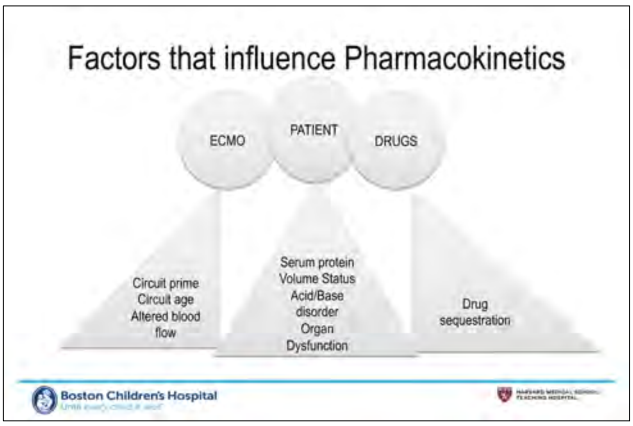
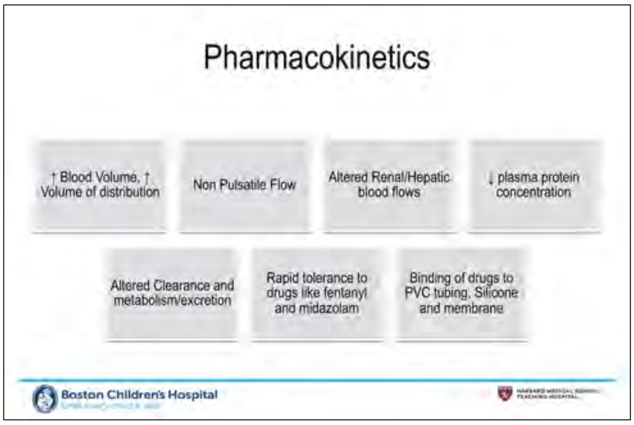

Other Complications
• Circuit clotting
– White (platelet) or dark clots can be seen in low flow parts of the ECMO circuit, e.g. connectors and oxygenator.
– A flashlight is used for clot detection.
– Large clots (> 0.5 cm) or rapidly growing clots should be removed by changing the whole or the part of the circuit.
• Circuit air bubbles
– Observed or detected by a bubble detector.
– Most commonly found in inflow, venous, part of the circuit.
– The pump has to be stopped, lines have to be clamped near the patient and bubbles must be evacuated or the whole circuit has to be changed.
Plasma
Sediment + Clot
ECMO Ultrasonic Flow Sensor
Resus Review
Boston Children's Hospital


Factors that influence Pharmacokinetics
ECMO
PATIENT
DRUGS
Circuit prime
Circuit age
Altered blood flow
Serum protein
Volume Status
Acid/Base disorder
Organ Dysfunction
Drug sequestration
Boston Children's Hospital


Pharmacokinetics
↑ Blood Volume, ↑ Volume of distribution
Non Pulsatile Flow
Altered Renal/Hepatic blood flows
↓ plasma protein concentration
Altered Clearance and metabolism/excretion
Rapid tolerance to drugs like fentanyl and midazolam
Binding of drugs to PVC tubing, Silicone and membrane
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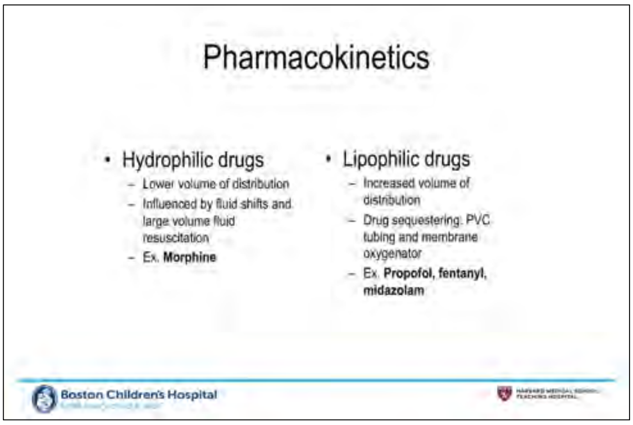
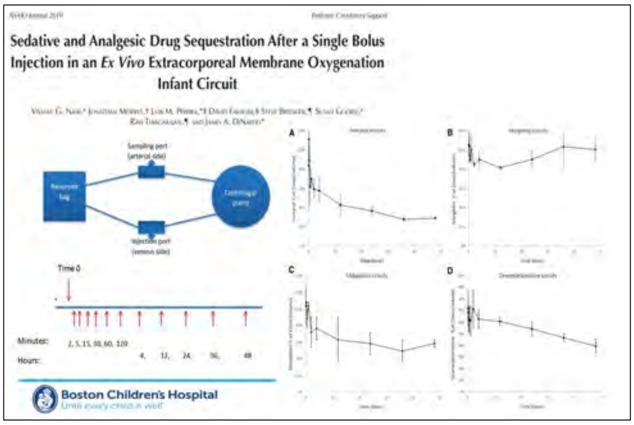
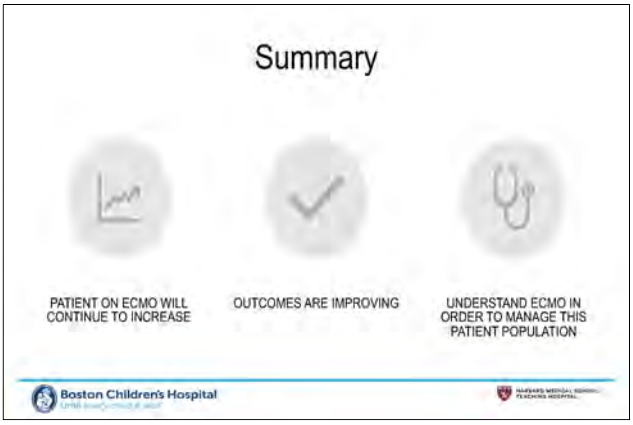

Pharmacokinetics
• Hydrophilic drugs
– Lower volume of distribution
– Influenced by fluid shifts and large volume fluid resuscitation
– Ex. Morphine
• Lipophilic drugs
– Increased volume of distribution
– Drug sequestering: PVC tubing and membrane oxygenator
– Ex. Propofol, fentanyl, midazolam
Boston Children's Hospital


Sedative and Analgesic Drug Sequestration After a Single Bolus Injection in an Ex Vivo Extracorporeal Membrane Oxygenation Infant Circuit
Sampling port (arterial side)
Centrifugal pump
Injection port (venous side)
Time 0
Minutes: 2, 5, 15, 30, 60, 120
Hours: 4, 12, 24, 36, 48
A
B
C
D
Boston Children's Hospital


Summary
PATIENT ON ECMO WILL CONTINUE TO INCREASE
OUTCOMES ARE IMPROVING
UNDERSTAND ECMO IN ORDER TO MANAGE THIS PATIENT POPULATION
Boston Children's Hospital

Anesthesia for Patients with Transposition of the Great Arteries

Dean B. Andropoulos

Department of Anesthesiology, Perioperative and Pain Medicine at Texas Children's Hospital,
Department of Anesthesiology at Baylor College of Medicine, USA

Disclosures

- No financial disclosures
- Dexmedetomidine is not labeled for pediatric use by U.S. Food and Drug Administration

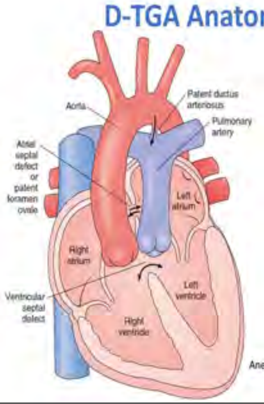
Learning Objectives

- Explain anatomy and physiology of D-transposition of the great vessels
- Review surgical techniques for the arterial switch operation
- Discuss anesthetic management for the arterial switch
- Describe the feasibility of early tracheal extubation

* = Most important points

Textbook References

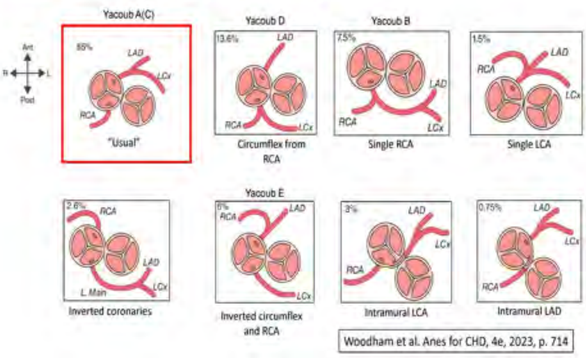
D-TGA Anatomy



- D-looping of heart
- Aorta rightward and anterior from RV
- VSD in 15-25%
- 3.6% of all CHD
- 10.3% of neonatal surgeries

Andropoulos et al; Congenital Heart Disease, Anesthesia and Uncommon Diseases, 6th Ed., Fleisher L, (ed.) 2012, p. 116

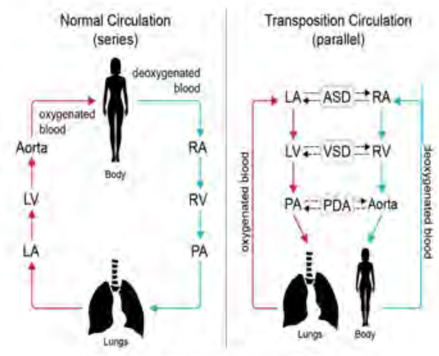
Coronary Artery Anatomy



Woodham et al. Anes for CHD, 4e, 2023, p. 714

Transposition Physiology

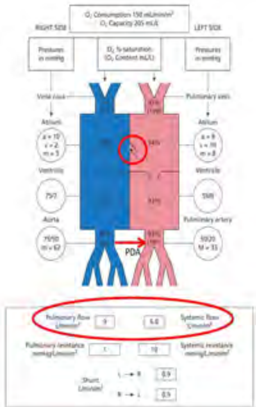
- D-transposition of the great vessels
  - D-looping of the heart
  - Atrioventicular concordance
  - Ventriculo-arterial discordance
  - Aorta rightward and anterior to the pulmonary artery
- Parallel circulation
  - Systemic venous return to right atrium, right ventricle, *aorta*
  - Pulmonary venous return to left atrium, left ventricle, *pulmonary artery*
  - Systemic oxygenation dependent on mixing at PDA, atrial septum, or ventricular septum levels (15-25% of patients have VSD)



Woodham et al. Anes for CHD, 4e, 2023, p. 715

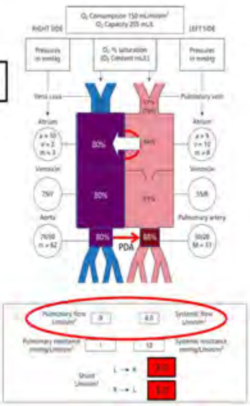
Before Balloon Atrial Septostomy

Nadas and Fyler, Pediatric Cardiology, 1972

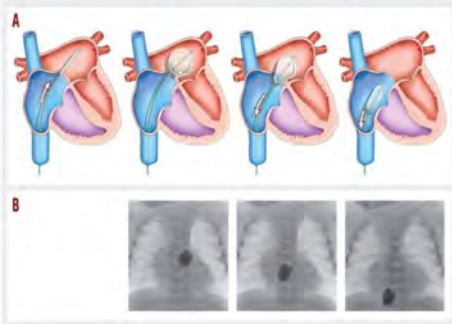


After Balloon Atrial Septostomy

Nadas and Fyler, Pediatric Cardiology, 1972



Balloon Atrial Septostomy



Woodham et al. Anes for CHD, 4e, 2023, p. 718

Anesthesia for Balloon Atrial Septostomy

- Indications
  - PaO_2 <40 mm Hg; SpO_2 <75% despite PGE_1 infusion
  - "Elective" to allow improved atrial mixing, discontinuance PGE_1, and later surgery after feeding established and PVR decreases
- Location
  - ICU at bedside: intubation, light sedation
  - Cath lab for thick atrial septum, small PFO
- Access:
  - Femoral vein
  - Umbilical vein
- Anesthesia
  - Small dose synthetic opioid (fentanyl 5-10 mcg/kg), benzodiazepine (midazolam, 0.25-0.5 mg/kg), muscle relaxation with non-depolarizing agent—rocuronium, vecuronium
  - Tracheal intubation, FiO_2 1.0
  - * *Avoid deep anesthesia*: will suppress endogenous catecholamines, reduce cardiac output, flows L and R sides, and decrease mixing leading to desaturation

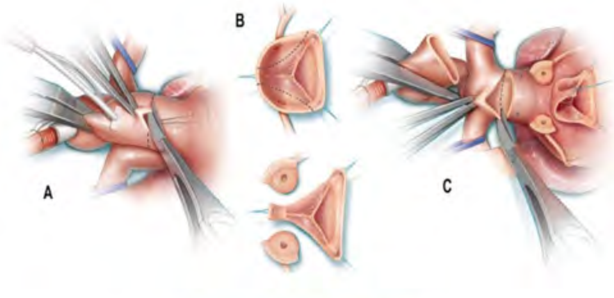
BAS/Preoperative MRI Brain Injury at Texas Children's Hospital

- 68 patients:
  - BAS in 18 of 21 TGA patients

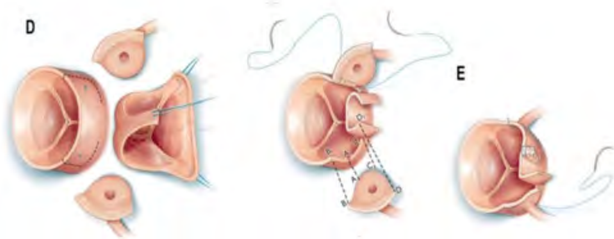
--- NO association with BAS and MRI brain injury on multivariate analysis

--- Associations with preoperative MRI brain injury:
  - Structural brain immaturity

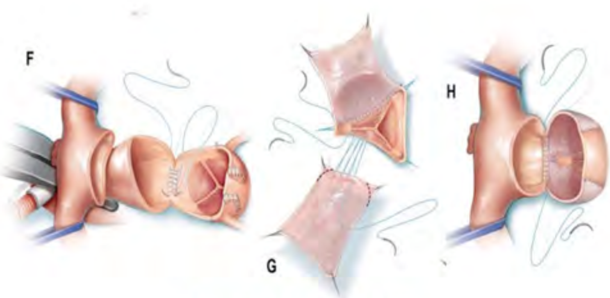
- J Thorac Cardiovasc Surg 2010;139:543



TCH Handbook of CHD, 2020, p. 123



TCH Handbook of CHD, 2020, p. 123



TCH Handbook of CHD, 2020, p. 123

Anesthesia for Arterial Switch Operation

- Airway Management
  - Nasotracheal intubation with cuffed ETT (3.0-3.5 mm) to minimize leak and facilitate ventilation with TEE probe
- Vascular Access
  - UAC and UVC if properly positioned
  - Never use 2 fr neo-PICC for CVP in major neonatal surgery
  - IR-placed larger PICC is suitable for CVP
  - Percutaneous radial or femoral artery catheter 22g or 2.5 Fr
  - Percutaneous CVP: femoral vein double lumen 4 Fr
  - May use transthoracic RA catheter
  - Adequate PIV 22g
  - LA catheter in all; no routine PA catheter

Anesthesia for Arterial Switch Operation

- Timing of Surgery:
  - LV deconditioning with IVS after 2-4 wks(?): position of intraventricular septum, LVEDV, LVEF, LV thickness, LV stress, LV mass
  - Pulmonary hypertension with large VSD, PDA
- Anesthetics:
  - Synthetic opioids: fentanyl 50-100 mcg/kg total dose
  - Benzodiazepines: midazolam 0.5-1 mg/kg total dose
  - Dexmedetomidine frequently added after CPB: 0.5 mcg/kg/hr infusion
  - Halogenated anesthetic gas: isoflurane 0.2-1% end-tidal
  - Non-depolarizing muscle relaxants: vecuronium

Anesthesia for Arterial Switch Operation

- Neurological Monitoring:
  - Near-infrared spectroscopy: bilateral, baseline recorded on room air before/after induction
- Echocardiography:
  - Transesophageal if over 3.5 kg, or if 2.5-3.5 kg with microprobe
  - Epicardial
  - Monitor global and segmental ventricular wall motion, residual defects: VSD, outflow tracts, aortic or pulmonary regurgitation, coronary flow (?)

Pre-CPB Period Anesthetic Management

- Avoid excessive levels of anesthesia
  - Will decrease catecholamines, cardiac output, flow, and mixing
- Maintain PGE_1 if used preoperatively for inadequate mixing
- FiO_2 1.0 for arterial desaturation
- Inotropic support (low dose epinephrine, vasopressin) if needed for cardiac output, desaturation
- Increase hemoglobin if necessary for desaturation
  - Transfuse to maintain hematocrit 35-45%
- Limit FiO_2 in cases of excessive pulmonary blood flow
- ε-aminocaproic acid loading dose to patient plus infusion

CPB Management (TCH)

- Maximize oxygen delivery at all times
- Prime with reconstituted whole blood; adjust pH
- Maintain 150 ml/kg/min flows
- Vasodilation with phentolamine
- MAP 40-45 mm Hg (lower limit autoregulation)
- Anesthesia, vasodilation with isoflurane
- Use pH stat management entire CPB period
- Hypothermia to 25-32° C
- Hematocrit 30-35%
- NIRS monitoring to maintain rSO_2 >50%
- Continuous zero-balanced hemofiltration during CPB
- ε-aminocaproic acid loading dose to CPB prime

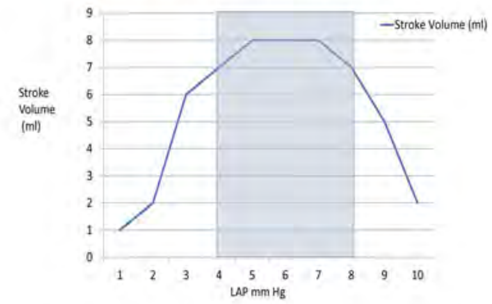
DiBardino et al. Ann Surg 2004; 239:588

Post-CPB Anesthetic Management

- Standard hemodynamic infusions: low dose epinephrine, NTG, $CaCl_2$, ± milrinone
  - T3, vasopressin, corticosteroids for severe LV dysfunction
  - iNO for pulmonary hypertension
- CPB weaning: untrained LV intolerant of excessive preload or afterload
  - Gradual, wean with near empty ventricle
  - Separate from CPB, then add volume after separation
  - Maintain LAP 4-6 mm Hg, systolic BP 60-70 mm Hg
  - HR 120-150 with A-V synchrony; atrial pacing if needed

ASO Starling Curve

3.2 kg, HR 150, optimal C.I. 4 L/min/m², LVEF 50%



Post-CPB Anesthetic Management

- After protamine, platelets and cryoprecipitate will correct most coagulopathic bleeding
  - * Avoid excessive preload; *remove blood if needed*
- Use point-of-care coagulation testing as needed: ROTEM®, TEG®
- Maintain mild hyperventilation, FiO_2 1.0 to prevent PH crisis
- Maintain rSO_2 >50%
- Prothrombin Complex Concentrate (PCC) or activated factor VIIa(?) if needed for severe persistent bleeding after 2 rounds of platelets, cryoprecipitate, fresh frozen plasma, search for surgical bleeding sites

Micro TEE Probe for > 2.5 kg

TEE probe	Recommended minimal patient weight (kg)
Adult TEE (3D)	30
Adult multiplane (2D)	25
Pediatric mini-multiplane	3.5
Pediatric micro-multiplane	2.5

Miller-Hance et al., Anes CHD 4e, p. 335

Segmental Wall-Motion Abnormalities After an Arterial Switch Operation Indicate Ischemia

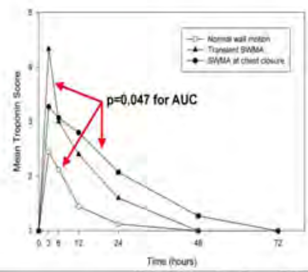
Anesth Analg 2006;103:1139–46

Kathryn Rouine-Rapp, MD; Kenneth P. Rouillard, MD; Wanda Miller-Hance, MD; Norman H. Silverman, MD; Kathryn K. Collins, MD; Michael K. Cahalan, MD; Alan Bostrom, PhD; Isobel A. Russell, MD, PhD

- Prospective study of 29 consecutive neonates undergoing ASO
- TEE analysis before sternotomy, after protamine, and at sternal closure
- 8 LV segments analyzed using multiple views
- ECG and 24 hour Holter for ischemia
- Cardiac TnI at baseline, 6,12, 24, 48, 72 h
- Clinical outcomes: inotropes, mechanical ventilation, sternal closure, ICU and hospital LOS

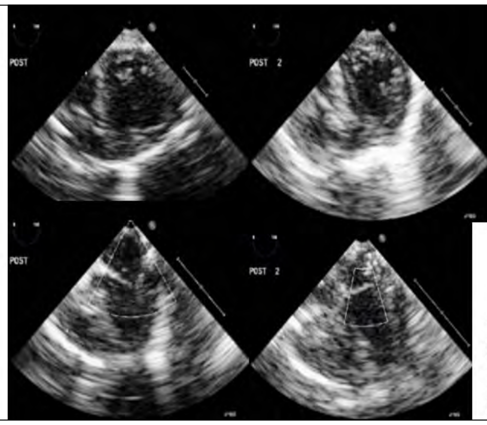
Results:

- 9 no SWMA, 5 transient SWMA, 15 SWMA at sternal closure
- ECG changes correlated with SWMA



	Dopamine	Epinephrine	Mechanical ventilation	Sternal closure POD	PICU LOS	Hospital LOS
Normal wall motion (N = 9)	4.7 ± 1.6	3.2 ± 1.2	3.2 ± 1.6	4 ± 1.3	6 ± 1.7	13 ± 4.2
Transient SWMA (N = 5)	3.4 ± 1.9	2 ± 2.5	3.3 ± 1.6	1.2 ± 1.7	6 ± 3.5	12.4 ± 4.7
SWMA at chest closure (N = 15)	4.7 ± 1.7	3 ± 2.3	5.1 ± 3.5	1.2 ± 1.7	9 ± 4.6	17 ± 10.7

Anesth Analg 2006;103:1139



TEE courtesy Wanda Miller-Hance, M.D.

ASO Outcomes: Society of Thoracic Surgeons 2019-22

Data courtesy David Vener, M.D.

Intraoperative Extubation Post Arterial Switch Operation for Transposition of the Great Arteries With Intact Ventricular Septum: A One-Year, Single Center Experience

Semin Thorac Cardiovasc Surg 2021;33:134-141

Rosh Samuel, MBBS, DCh, FRACP; Norbert Froese, MD, FRCPC; Kim Betts, PhD, MBiostats, MPH; and Sanjiv Gandhi, MD, FRCS(C)

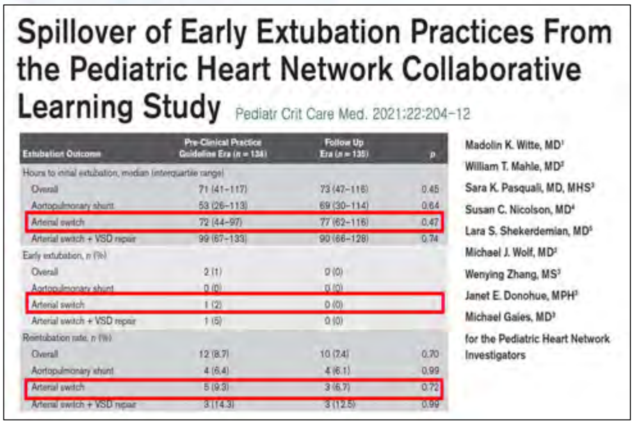
IE post-ASO for dTGA/IVS

Variable	Non-IE (n10)	IE (n10)	Fisher p-value
Intraoperative Extubation (n)	0	10	-
Reintubation (n)	1	0	1.0
ICU LOS (Days)	2	2	0.278
Hospital LOS (Days)	5.5	4	0.103

All 10 ASO extubated in OR, no reintubation, no difference in clinical, monitoring, biochemical outcomes

Table 4 Postoperative Hemodynamics

Variable	Non-IE 25th	Non-IE Median	Non-IE 75th	IE 25th	IE Median	IE 75th	Rank-Sum P Value
Postoperative first lactate (mmol/L)	1.5	1.7	1.8	1.4	1.5	1.8	0.147
Postoperative peak lactate (mmol/L)	1.8	2.3	4.9	1.7	2.0	2.4	0.172
Postoperative first MVSpO2	57.5	66.4	73.9	63.9	71.4	78.7	0.226
Postoperative trough MVSpO2	47.5	59.6	64.0	54.4	63.1	67.3	0.344
Postoperative first NIRS	64.0	68.5	74.5	71.0	73.0	74.8	0.210
Postoperative trough NIRS	48.3	63.0	66.0	60.0	66.5	69.5	0.080
Postoperative inotrope duration (hours)	19.0	21.8	23.0	26.0	30.5	32.5	0.077


Spillover of Early Extubation Practices From the Pediatric Heart Network Collaborative Learning Study Pediatr Crit Care Med. 2021;22:204–12

Extubation Outcome	Pre-Clinical Practice Guideline Era (n = 134)	Follow Up Era (n = 135)	p
Hours to initial extubation, median (interquartile range)			
Overall	71 (41–117)	73 (47–116)	0.45
Aortopulmonary shunt	53 (26–113)	69 (30–114)	0.64
Arterial switch	72 (44–97)	77 (62–116)	0.47
Arterial switch + VSD repair	99 (67–133)	90 (66–128)	0.74
Early extubation, n (%)			
Overall	2 (1)	0 (0)	
Aortopulmonary shunt	0 (0)	0 (0)	
Arterial switch	1 (2)	0 (0)	
Arterial switch + VSD repair	1 (5)	0 (0)	
Reintubation rate, n (%)			
Overall	12 (8.7)	10 (7.4)	0.70
Aortopulmonary shunt	4 (6.4)	4 (6.1)	0.99
Arterial switch	5 (9.3)	3 (6.7)	0.72
Arterial switch + VSD repair	3 (14.3)	3 (12.5)	0.99

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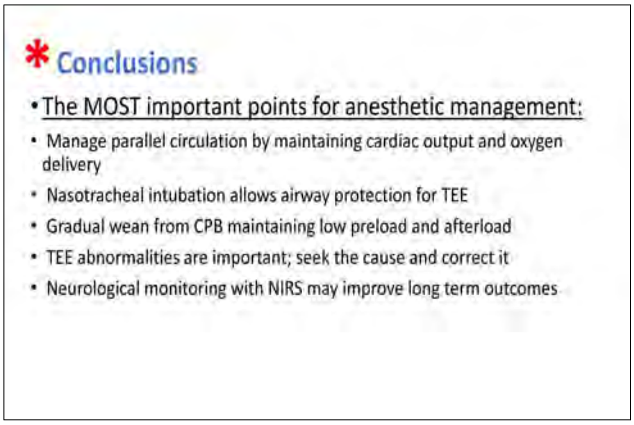
for the Pediatric Heart Network Investigators



Anaesthesia for Children Who Go Through Journeys to Fontan

Tracy Tan

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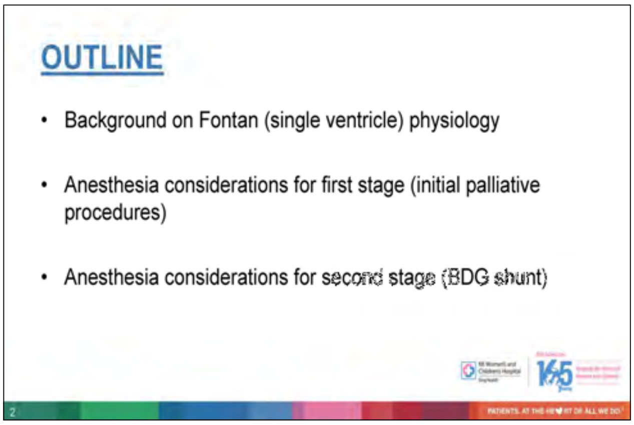
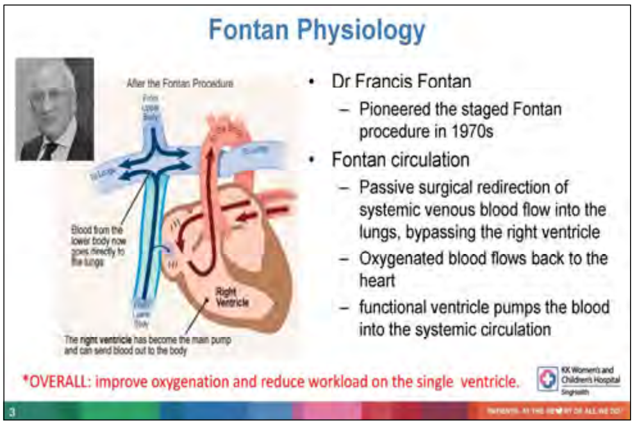
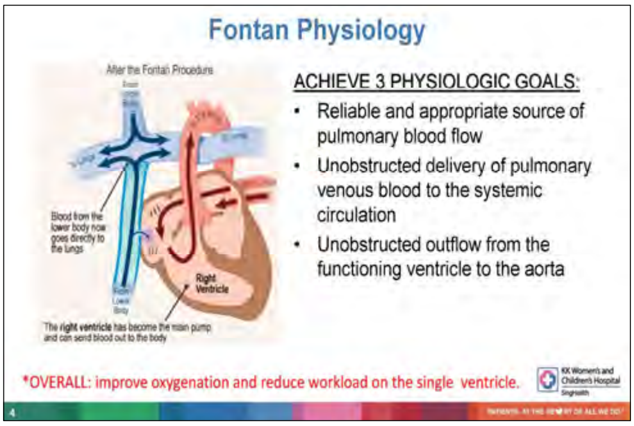
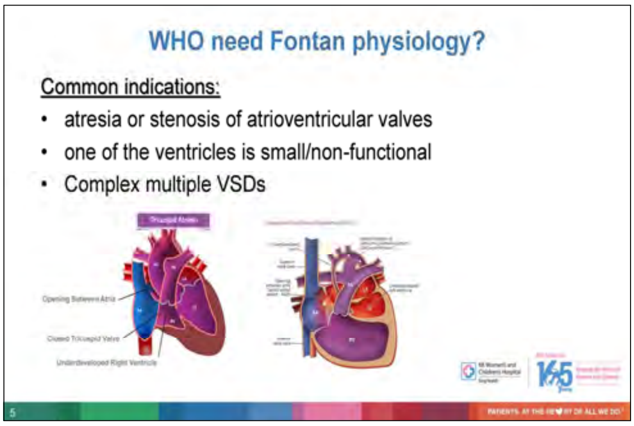
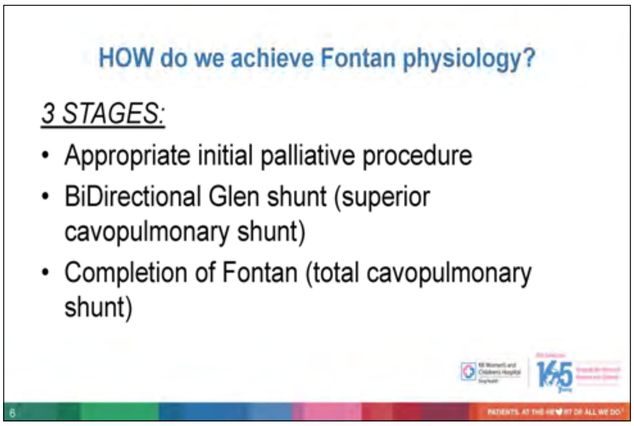
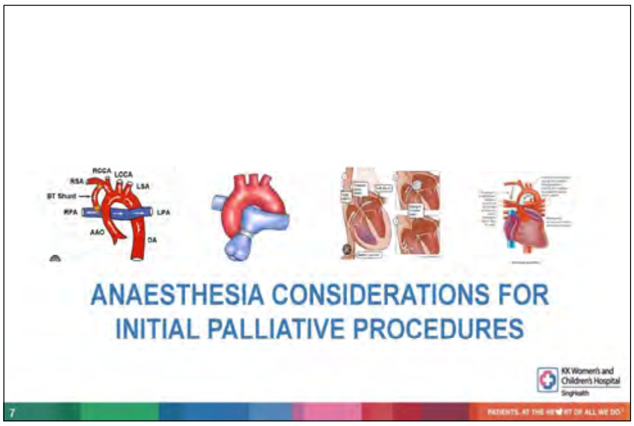


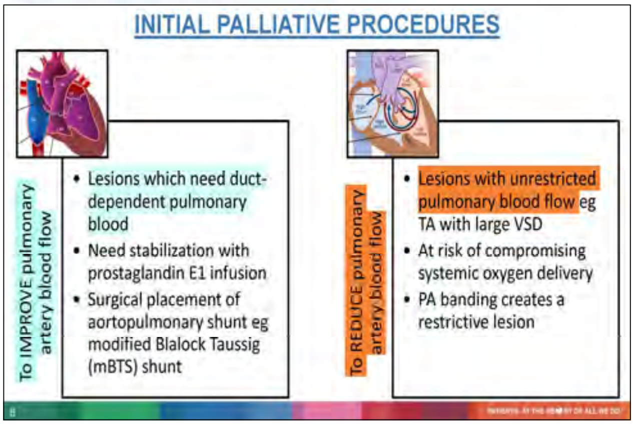


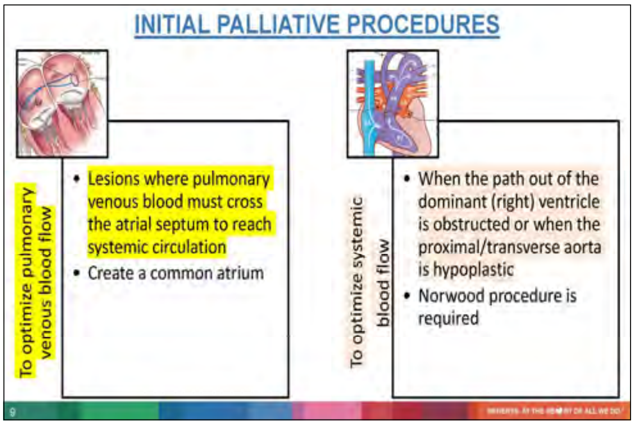


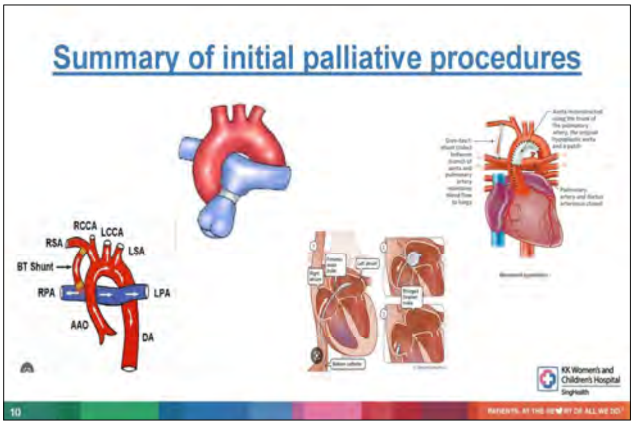


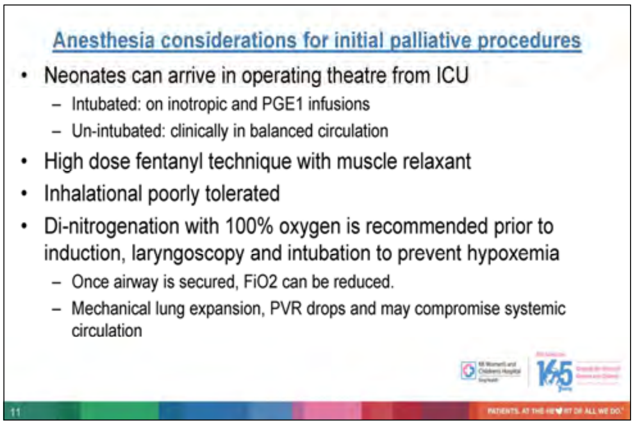


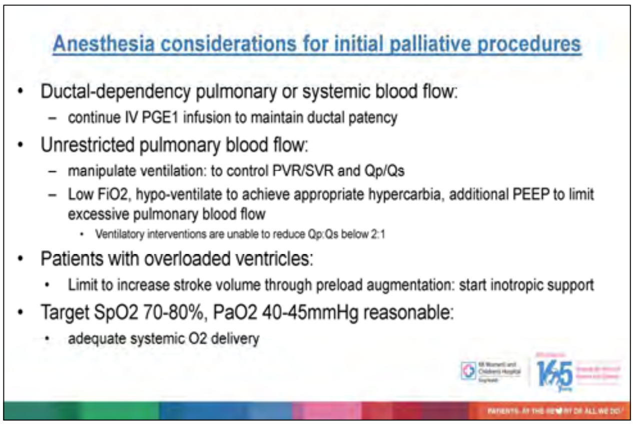


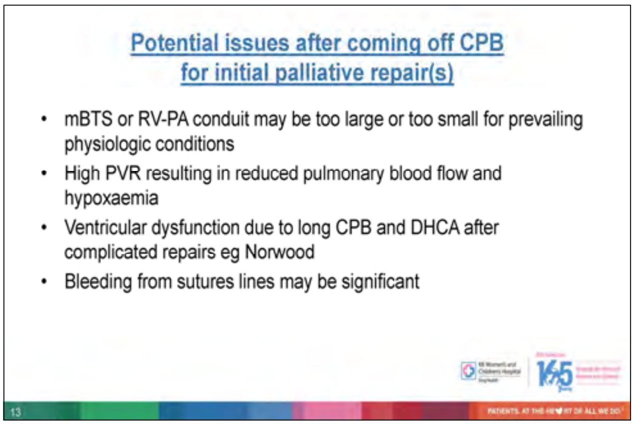


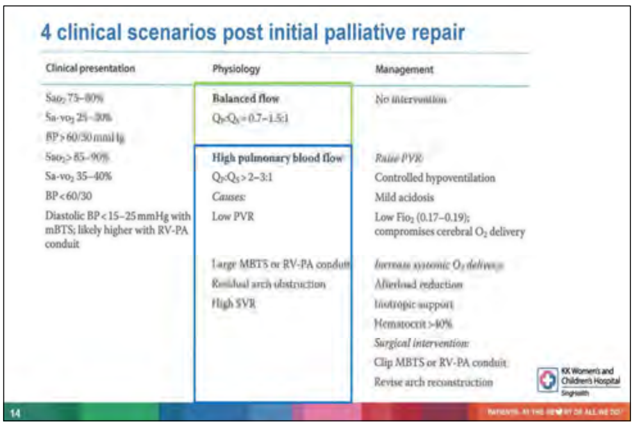




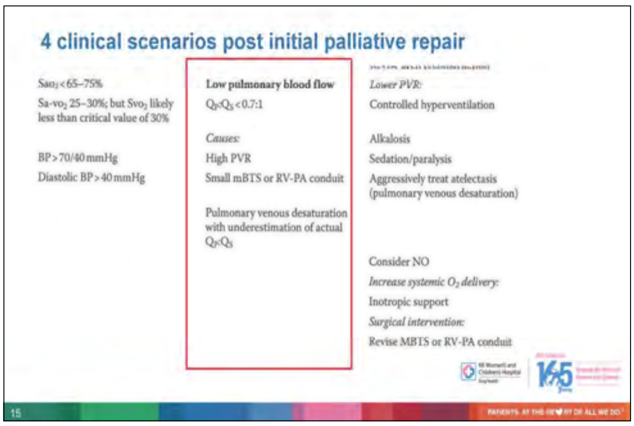







4 clinical scenarios post initial palliative repair

Clinical presentation	Physiology	Management
Sa_{O_2} 75–80% Sa-v_{O_2} 25–30% BP > 60/30 mmHg	**Balanced flow** $Q_P:Q_S$ = 0.7–1.5:1	No intervention
Sa_{O_2} > 85–90% Sa-v_{O_2} 35–40% BP < 60/30 Diastolic BP < 15–25 mmHg with mBTS; likely higher with RV-PA conduit	**High pulmonary blood flow** $Q_P:Q_S$ > 2–3:1 *Causes:* Low PVR Large MBTS or RV-PA conduit Residual arch obstruction High SVR	*Raise PVR:* Controlled hypoventilation Mild acidosis Low Fi_{O_2} (0.17–0.19); compromises cerebral O_2 delivery *Increase systemic O_2 delivery:* Afterload reduction Inotropic support Hematocrit >40% *Surgical intervention:* Clip MBTS or RV-PA conduit Revise arch reconstruction


4 clinical scenarios post initial palliative repair

Sa_{O_2} < 65–75% Sa-v_{O_2} 25–30%; but Sv_{O_2} likely less than critical value of 30% BP > 70/40 mmHg Diastolic BP > 40 mmHg	**Low pulmonary blood flow** $Q_P:Q_S$ < 0.7:1 *Causes:* High PVR Small mBTS or RV-PA conduit Pulmonary venous desaturation with underestimation of actual $Q_P:Q_S$	*Lower PVR:* Controlled hyperventilation Alkalosis Sedation/paralysis Aggressively treat atelectasis (pulmonary venous desaturation) Consider NO *Increase systemic O_2 delivery:* Inotropic support *Surgical intervention:* Revise MBTS or RV-PA conduit

4 clinical scenarios post initial palliative repair

		Revise mBTS or RV-PA conduit
Sao₂ < 70–75%	**Low cardiac output**	*Minimize O₂ consumption:*
Sa-svo₂ 35–40% and Svo₂ likely less than critical value of 30%	Causes:	Sedation/paralysis
	Ventricular dysfunction	Inotropic support/afterload reduction
BP < 60/30 mmHg	• Myocardial ischemia	
	• Depressed contractility	
	• Afterload mismatch (residual arch obstruction)	*Surgical intervention*
	• AV valve regurgitation	Repair AV valve
		Revise arch
		Consider mechanical support:
		• Post-cardiotomy support
		• Bridge-to-transplantation

AV, atrioventricular; BP, blood pressure; mBTS, modified Blalock–Taussig shunt; PVR, pulmonary vascular resistance; RV-PA, right ventricle-pulmonary artery; SVR, systemic vascular resistance.

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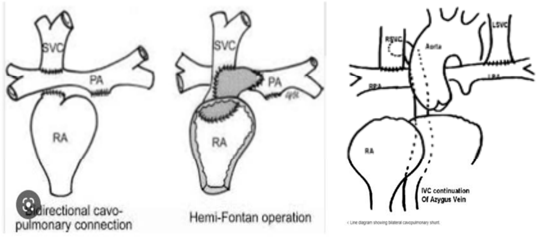
ANAESTHESIA CONSIDERATIONS FOR BIDIRECTIONAL GLEN (BDG) SHUNT

17

Bi-Directional Glenn Shunt

- Undertaken usually around **3-6 months of age**
  - PVR has decreased
  - systemic venous pressure in the SVC is the driving pressure to provide for pulmonary blood flow
- BDG may occur earlier if patients have poor saturation
  - Outgrown the PA band, mBTS, RV-PA conduit
  - Loose PA band or large mBTS and not tolerating the additional volume load on their ventricle

Variation of the BDG(s)



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BDG Physiology

- Upper extremity and cerebral venous drainages reach the SVC → pulmonary circulation **passively (non-pulsatile)**
  - Qp:Qs ranges 0.5-0.7:1
  - Reduction in volume load on the systemic ventricle
  - Elevated SVC pressure and ICP→ initial systemic hypertension and postoperative irritability

20

BDG Physiology

- Mixing of IVC and pulmonary venous blood in a common atrium→ reduce arterial saturation
- Systemic arterial oxygenation dependent on
  - pulmonary artery blood flow (equal to pressure in SVC)
  - Pulmonary vascular resistance
  - Pulmonary venous pressure

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Anesthesia considerations for BDG

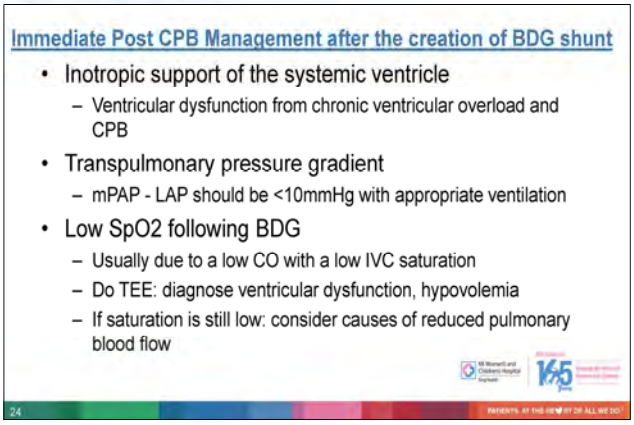
- Potential difficult IV access in the infant
- CVL usually inserted in R internal jugular vein
  - measures the SVC pressure
  - Equals to the mean pulmonary artery pressure after BDG creation
- Arterial line
- Good peripheral IV access
  - Redo surgery (risk of massive bleeding during redo sternotomy)
- TEE

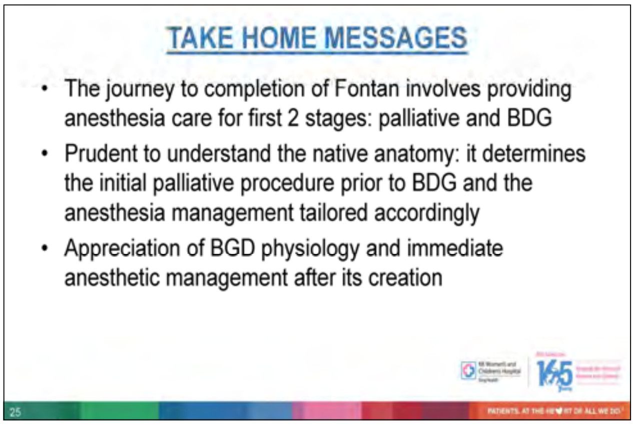
22

Immediate Post CPB Management after the creation of BDG shunt

- Maintain cardiac output
  - HR, contractility and preload
  - Ensure adequate intra-vascular volume to promote pulmonary blood flow
- High-ish FiO2
  - to reduce V/Q mismatch and intrapulmonary shunt
  - Low pulmonary venous oxygen saturation→ low SaO2
- Ventilatory strategy: Larger TV (10-12ml/kg), lower RR (10-15/min), short inspiratory time (IE 1:3), use PEEP with cautio
  - Keep mean airway pressure to a minimum
    - High mean airway pressure limits non-pulsatility of pulmonary blood flow
  - Allows normocarbia or mild hypercarbia
  - Avoid hyperventilation to reduce PVR: may reduce CBF and cerebal venous drainage

23


Immediate Post CPB Management after the creation of BDG shunt
• Inotropic support of the systemic ventricle
– Ventricular dysfunction from chronic ventricular overload and CPB
• Transpulmonary pressure gradient
– mPAP - LAP should be <10mmHg with appropriate ventilation
• Low SpO2 following BDG
– Usually due to a low CO with a low IVC saturation
– Do TEE: diagnose ventricular dysfunction, hypovolemia
– If saturation is still low: consider causes of reduced pulmonary blood flow
24

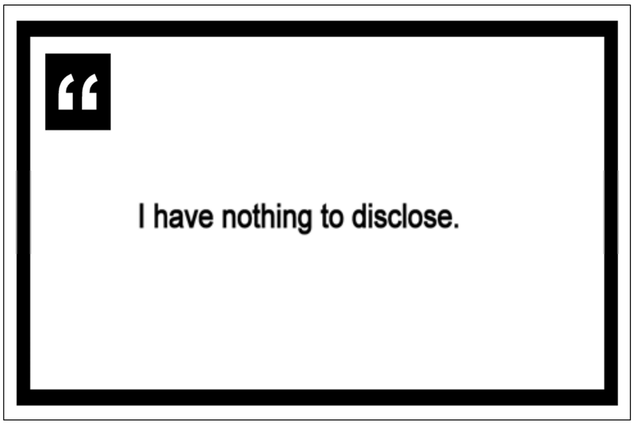

TAKE HOME MESSAGES
• The journey to completion of Fontan involves providing anesthesia care for first 2 stages: palliative and BDG
• Prudent to understand the native anatomy: it determines the initial palliative procedure prior to BDG and the anesthesia management tailored accordingly
• Appreciation of BGD physiology and immediate anesthetic management after its creation
25

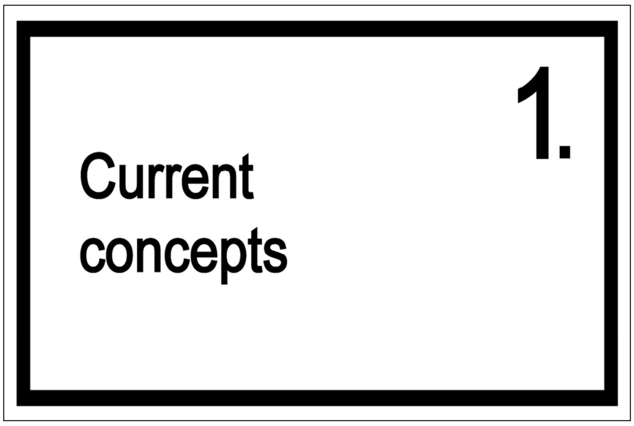

Asian Society of Paediatric Anaesthesiologist
Cardiac
Special Interest Group
Cardiac SIG Sign Up
Paediatric cardiac anaesthesiologists are a small group. Some centres do more, others not as much
Collective knowledge and group wisdom is the way forward
The Vision:
A platform to share insights and expertise with the vision of improving standards of paediatric cardiac care in the region.
KK Women's and Children's Hospital
26

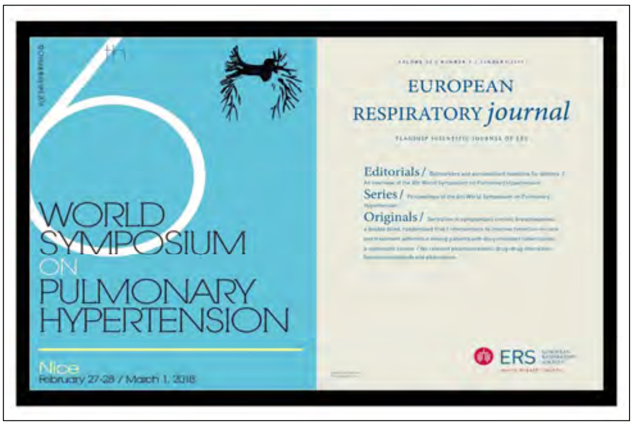
How to Mend a Broken Heart: An Approach to the Failing RV in CHD Patients

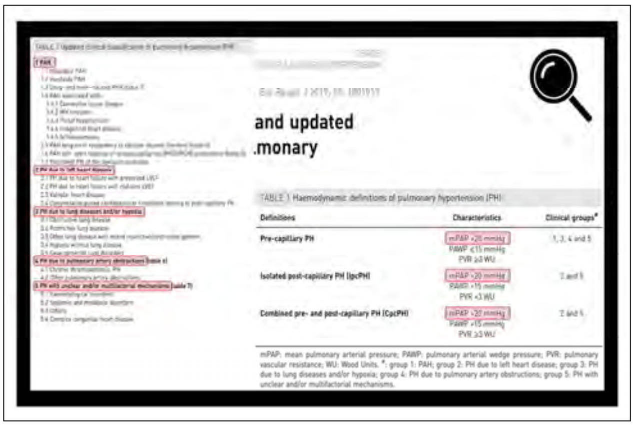
In-Kyung Song

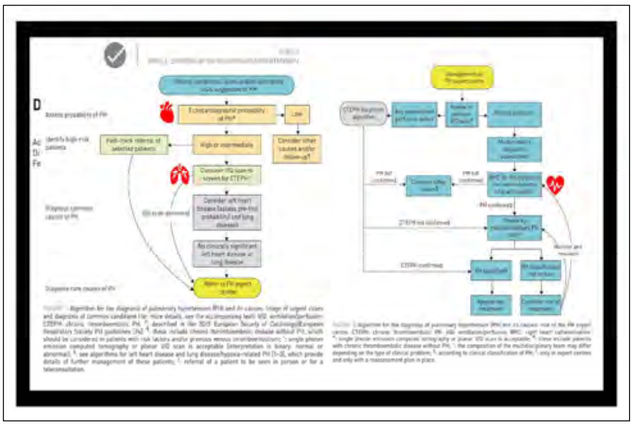
Department of Anesthesiology and Pain Medicine, Asan Medical Center, University of Ulsan College of Medicine, Korea

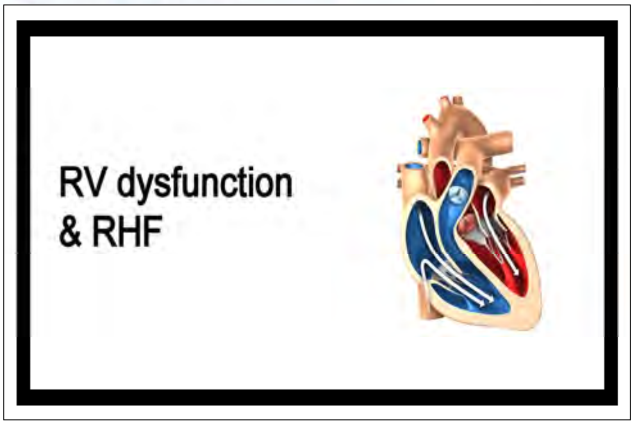


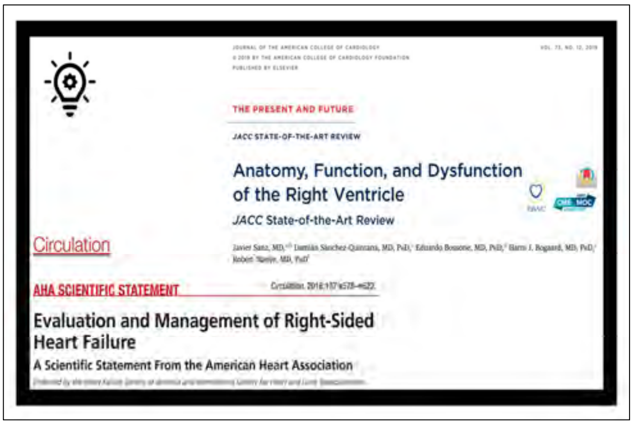


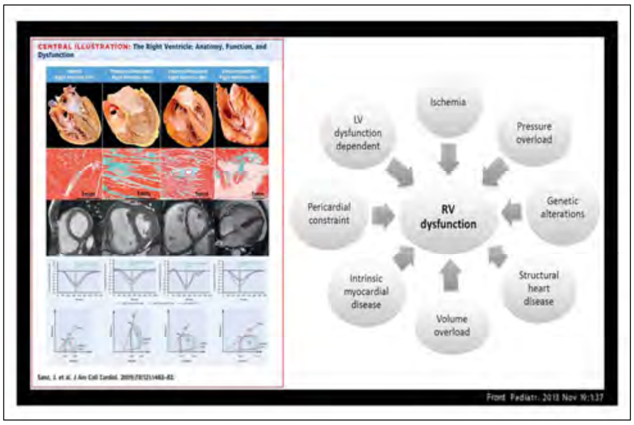


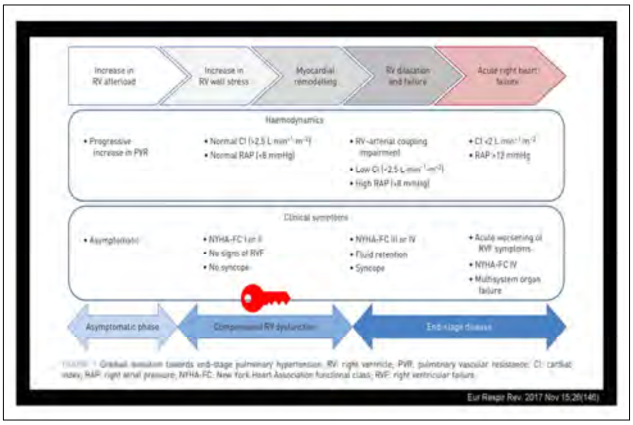





RV dysfunction
& RHF

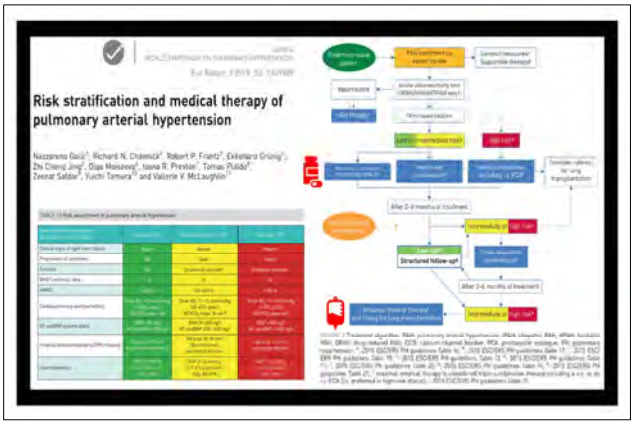

THE PRESENT AND FUTURE
JACC STATE-OF-THE-ART REVIEW
Anatomy, Function, and Dysfunction of the Right Ventricle
JACC State-of-the-Art Review
Circulation
AHA SCIENTIFIC STATEMENT
Evaluation and Management of Right-Sided Heart Failure
A Scientific Statement From the American Heart Association

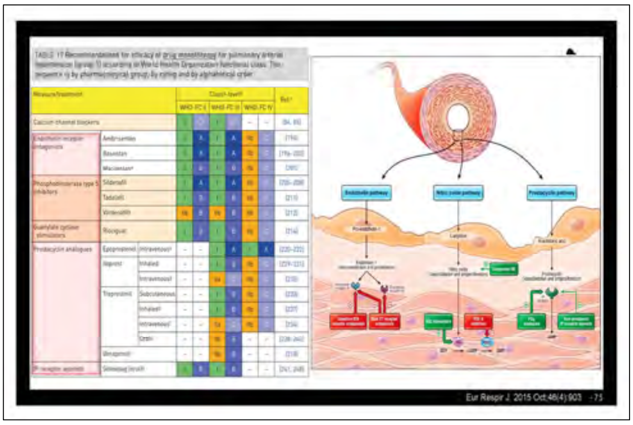

CENTRAL ILLUSTRATION: The Right Ventricle: Anatomy, Function, and Dysfunction
Ischemia
LV dysfunction dependent
Pressure overload
Pericardial constraint
RV dysfunction
Genetic alterations
Intrinsic myocardial disease
Structural heart disease
Volume overload
Front Pediatr. 2018 Nov 9;137


Increase in RV afterload
Increase in RV wall stress
Myocardial remodelling
RV dilatation and failure
Acute right heart failure
Haemodynamics
Clinical symptoms
Asymptomatic phase
Compensated RV dysfunction
End-stage disease
Eur Respir Rev. 2017 Nov 15;26(146)


Progression of Right Ventricular Function from Adaption to Failure in Pulmonary Hypertension
NORMAL
HOMEOMETRIC
HETEROMETRIC
Compensated
Decompensated
J Am Coll Cardiol. 2019 Apr 2;73(12):1463-1482


2.
Treatment strategies


Risk stratification and medical therapy of pulmonary arterial hypertension


Eur Respir J. 2015 Oct;46(4):903-75


Cochrane Library
Prostacyclin for pulmonary arterial hypertension (Review)
Cochrane Library
Phosphodiesterase 5 inhibitors for pulmonary hypertension (Review)

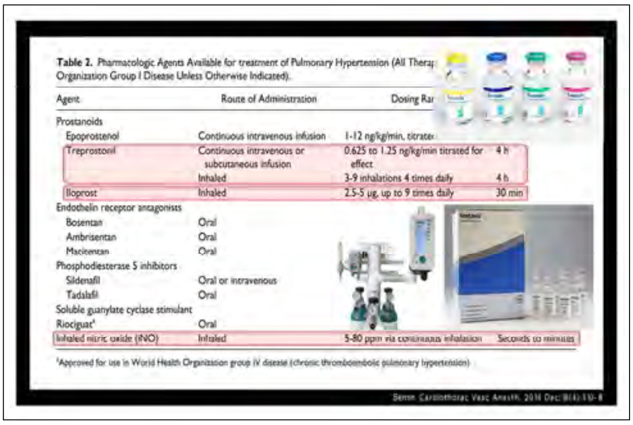
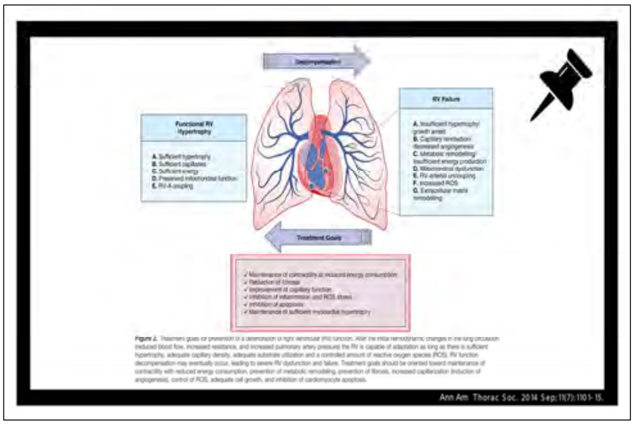
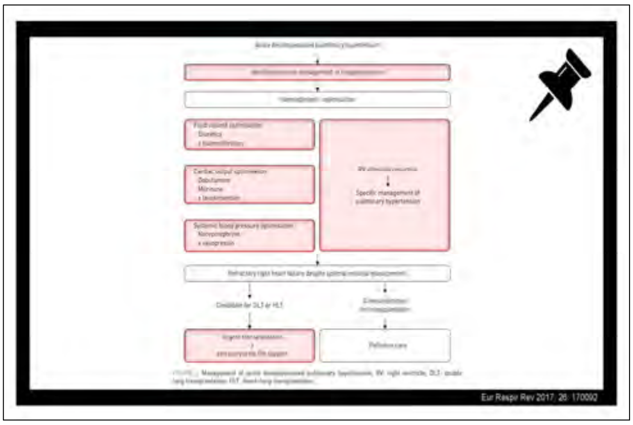
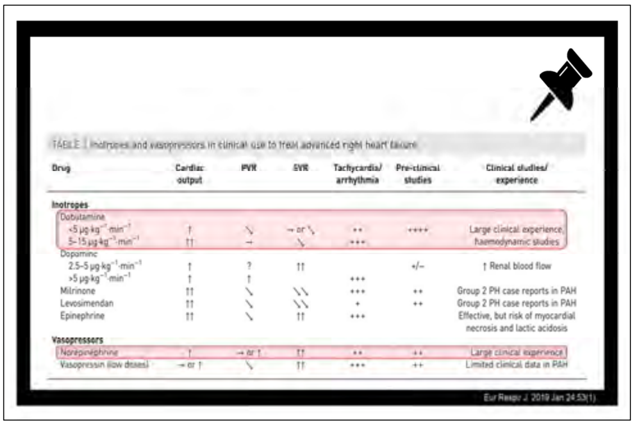
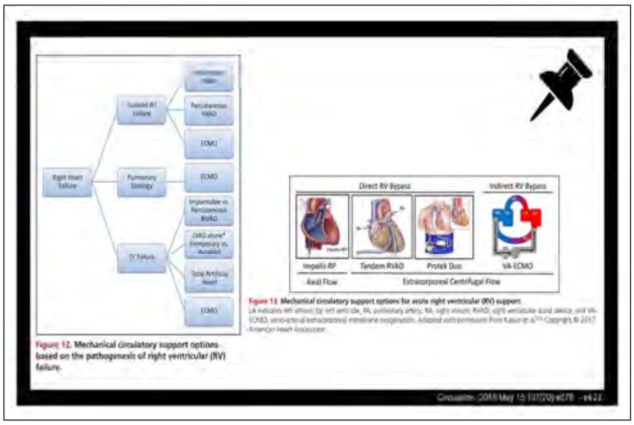


Table 2. Pharmacologic Agents Available for treatment of Pulmonary Hypertension (All Therapy Organization Group I Disease Unless Otherwise Indicated).
Agent
Route of Administration
Dosing Rate
Prostanoids
Epoprostenol
Continuous intravenous infusion
1-12 ng/kg/min, titrated
Treprostinil
Continuous intravenous or subcutaneous infusion
0.625 to 1.25 ng/kg/min titrated for effect
4 h
Inhaled
3-9 inhalations 4 times daily
4 h
Iloprost
Inhaled
2.5-5 μg, up to 9 times daily
30 min
Endothelin receptor antagonists
Bosentan
Oral
Ambrisentan
Oral
Macitentan
Oral
Phosphodiesterase 5 inhibitors
Sildenafil
Oral or intravenous
Tadalafil
Oral
Soluble guanylate cyclase stimulant
Riociguat
Oral
Inhaled nitric oxide (iNO)
Inhaled
5-80 ppm via continuous inhalation
Seconds to minutes
Semin Cardiothorac Vasc Anesth. 2014 Dec;18(4):310-8

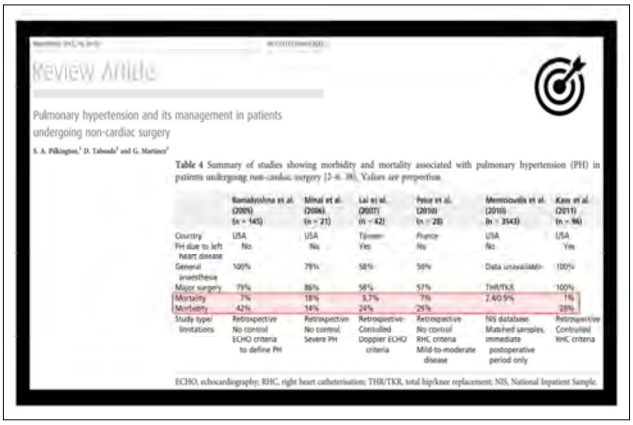

Functional RV Hypertrophy
RV Failure
Treatment Goals
Ann Am Thorac Soc. 2014 Sep;11(7):1101-15.

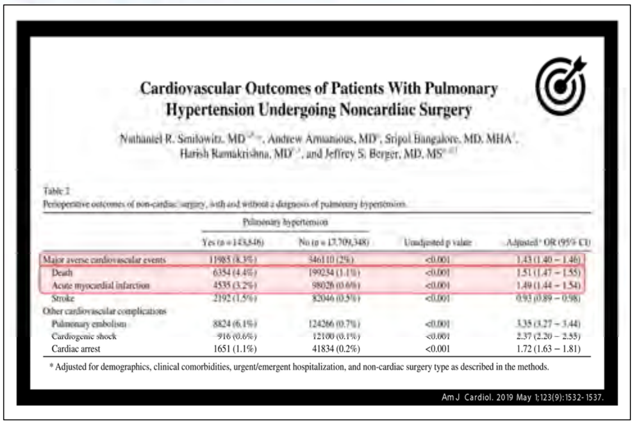

Eur Respir Rev 2017; 26: 170092


Drug
Cardiac output
PVR
SVR
Tachycardia/ arrhythmia
Pre-clinical studies
Clinical studies/ experience
Inotropes
Dobutamine
Large clinical experience, haemodynamic studies
Dopamine
Renal blood flow
Milrinone
Levosimendan
Epinephrine
Group 2 PH case reports in PAH
Group 2 PH case reports in PAH
Effective, but risk of myocardial necrosis and lactic acidosis
Vasopressors
Norepinephrine
Large clinical experience
Vasopressin (low doses)
Limited clinical data in PAH
Eur Respir J. 2019 Jan 24;53(1).


Direct RV Bypass
Indirect RV Bypass
Impella RP
Tandem RVAD
Protek Duo
VA-ECMO
Axial Flow
Extracorporeal Centrifugal Flow
Figure 12. Mechanical circulatory support options based on the pathogenesis of right ventricular (RV) failure.


3.
Perioperative management


Review Article
Pulmonary hypertension and its management in patients undergoing non-cardiac surgery
Table 4 Summary of studies showing morbidity and mortality associated with pulmonary hypertension (PH) in patients undergoing non-cardiac surgery
Country
Mortality
Morbidity
Study type/ limitations



Cardiovascular Outcomes of Patients With Pulmonary Hypertension Undergoing Noncardiac Surgery

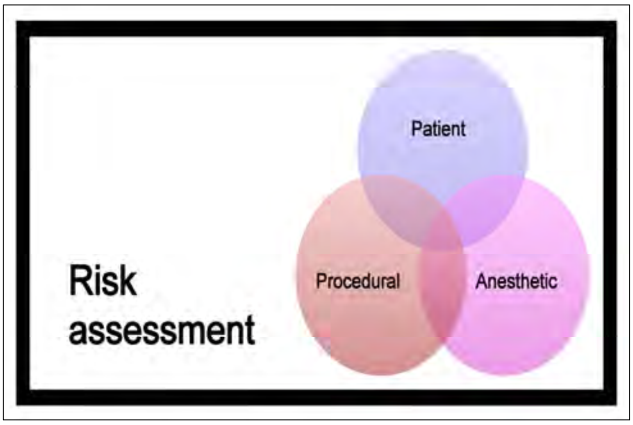
Nathaniel R. Smilowitz, MD, Andrew Armanious, MD, Sripal Bangalore, MD, MHA, Harish Ramakrishna, MD, and Jeffrey S. Berger, MD, MS

Table 2
Perioperative outcomes of non-cardiac surgery, with and without a diagnosis of pulmonary hypertension

	Pulmonary hypertension			
	Yes (n = 143,846)	No (n = 17,709,348)	Unadjusted p value	Adjusted* OR (95% CI)
Major averse cardiovascular events	11985 (8.3%)	346110 (2%)	<0.001	1.43 (1.40 – 1.46)
Death	6354 (4.4%)	199234 (1.1%)	<0.001	1.51 (1.47 – 1.55)
Acute myocardial infarction	4535 (3.2%)	98026 (0.6%)	<0.001	1.49 (1.44 – 1.54)
Stroke	2192 (1.5%)	82046 (0.5%)	<0.001	0.93 (0.89 – 0.98)
Other cardiovascular complications				
Pulmonary embolism	8824 (6.1%)	124266 (0.7%)	<0.001	3.35 (3.27 – 3.44)
Cardiogenic shock	916 (0.6%)	12100 (0.1%)	<0.001	2.37 (2.20 – 2.55)
Cardiac arrest	1651 (1.1%)	41834 (0.2%)	<0.001	1.72 (1.63 – 1.81)

* Adjusted for demographics, clinical comorbidities, urgent/emergent hospitalization, and non-cardiac surgery type as described in the methods.

Am J Cardiol. 2019 May 1;123(9):1532-1537.



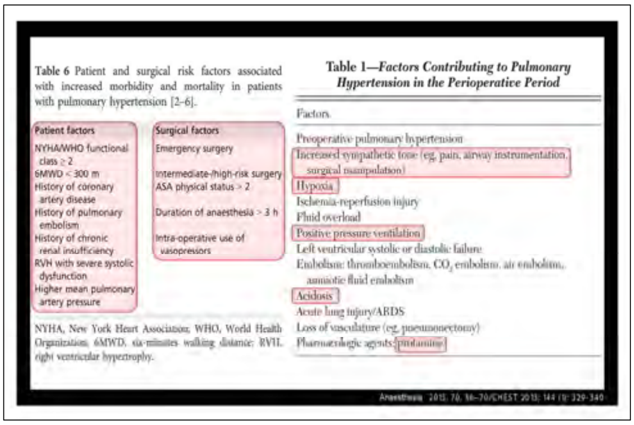


Table 6 Patient and surgical risk factors associated with increased morbidity and mortality in patients with pulmonary hypertension [2–6].

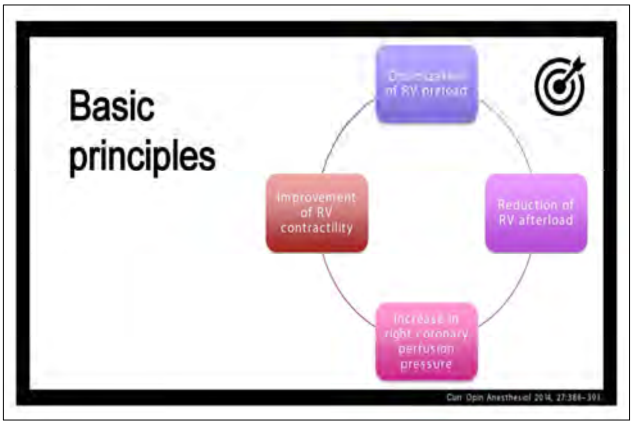
Patient factors	Surgical factors
NYHA/WHO functional class ≥ 2	Emergency surgery
6MWD < 300 m	Intermediate-/high-risk surgery
History of coronary artery disease	ASA physical status > 2
History of pulmonary embolism	Duration of anaesthesia > 3 h
History of chronic renal insufficiency	Intra-operative use of vasopressors
RVH with severe systolic dysfunction	
Higher mean pulmonary artery pressure	

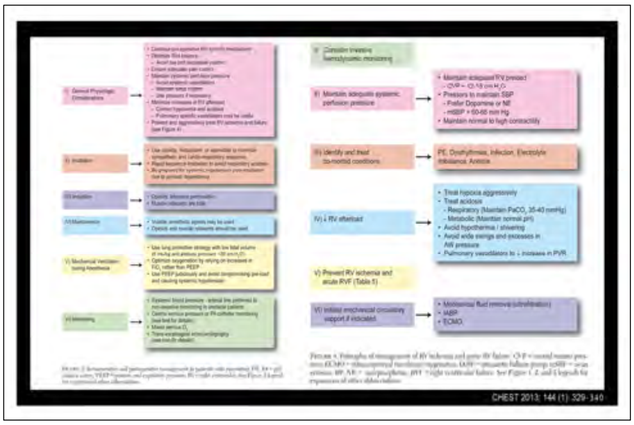
NYHA, New York Heart Association; WHO, World Health Organization; 6MWD, six-minutes walking distance; RVH, right ventricular hypertrophy.

Table 1—*Factors Contributing to Pulmonary Hypertension in the Perioperative Period*

Factors
Preoperative pulmonary hypertension
Increased sympathetic tone (eg, pain, airway instrumentation, surgical manipulation)
Hypoxia
Ischemia-reperfusion injury
Fluid overload
Positive pressure ventilation
Left ventricular systolic or diastolic failure
Embolism: thromboembolism, CO_2 embolism, air embolism, amniotic fluid embolism
Acidosis
Acute lung injury/ARDS
Loss of vasculature (eg, pneumonectomy)
Pharmacologic agents: protamine

Anaesthesia 2015; 70, 56–70/CHEST 2013; 144 (1): 329-340





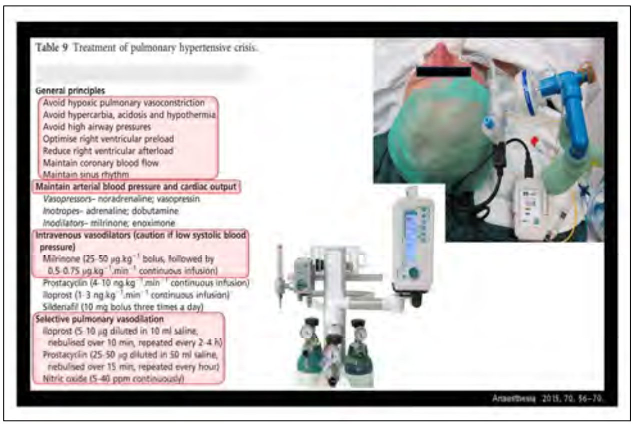


Table 9 Treatment of pulmonary hypertensive crisis.

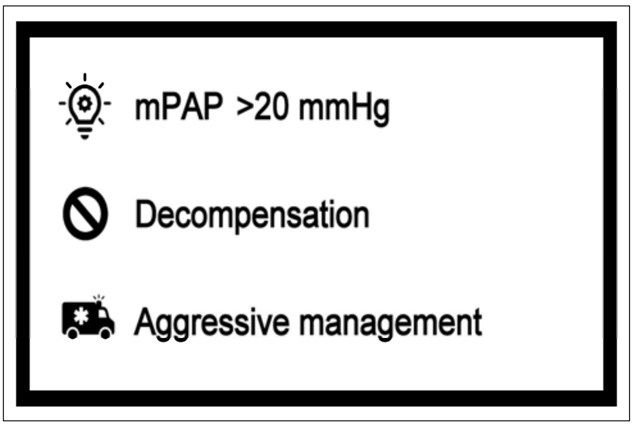
General principles
- Avoid hypoxic pulmonary vasoconstriction
- Avoid hypercarbia, acidosis and hypothermia
- Avoid high airway pressures
- Optimise right ventricular preload
- Reduce right ventricular afterload
- Maintain coronary blood flow
- Maintain sinus rhythm

Maintain arterial blood pressure and cardiac output
- *Vasopressors*– noradrenaline; vasopressin
- *Inotropes*– adrenaline; dobutamine
- *Inodilators*– milrinone; enoximone

Intravenous vasodilators (caution if low systolic blood pressure)
- Milrinone (25-50 μg.kg^{-1} bolus, followed by 0.5-0.75 μg.kg^{-1}.min^{-1} continuous infusion)
- Prostacyclin (4-10 ng.kg^{-1}.min^{-1} continuous infusion)
- Iloprost (1-3 ng.kg^{-1}.min^{-1} continuous infusion)
- Sildenafil (10 mg bolus three times a day)

Selective pulmonary vasodilation
- Iloprost (5-10 μg diluted in 10 ml saline, nebulised over 10 min, repeated every 2-4 h)
- Prostacyclin (25-50 μg diluted in 50 ml saline, nebulised over 15 min, repeated every hour)
- Nitric oxide (5-40 ppm continuously)

Anaesthesia 2015, 70, 56–70



To Extubate or Not to Extubate after Simple Cardiac Surgery

Evangeline Lim

Department of Paediatric Anaesthesia, KK Women's and Children's Hospital, Singapore

2 questions

- Simple cardiac surgery is for simple congenital heart disease
  - What does simple entail?
- Early extubation
  - How soon after operation are we talking about?

Early extubation

- Not a new concept
- On table/ immediate extubation
- Within 6-8 h after surgery
- Part of ultra fast track surgery for congenital heart disease

Scope of talk

- Physiology of post extubation
- Advantages of early/ immediate extubation
- Disadvantages of early/ immediate extubation
- Risk factors for failure
- Guidelines and implementation

Physiology of extubation

- Decrease in intrathoracic pressure
  - single- ventricle physiology after superior cavopulmonary anastomosis (Glenn) and total cavopulmonary anastomosis (Fontan)
  - Lower pulmonary arterial pressure
  - Lower common common pressure
  - Higher cardiac index
  - Higher blood pressure

Resulting advantages

- Reduced sedation requirements
- Decrease in overall ventilation time and ventilator associated complications/ prolonged intubation
- Early start to feeding
- Decrease in fluid requirements on first operative day
- Decrease in inotropic requirements
- Early interaction with parents

What needs to be considered if you want to extubate early

- Patient factors
  - Need for post extubation ventilatory support
  - Inotropic/ vasopressor
  - Bleeding concerns
- Anaesthetic factors
  - Post operative nausea/ vomiting
  - Early awakening
  - Adequate pain management
- Surgical factors
- Others
  - Turn over time
  - Level of ICU support

Rate of reintubation

- Based on virtual pediatric intensive care 0-27%
- Of 25% extubated on table, 9% reintubated

Risk factors for failure to extubate

- Chromosomal disorders
- Neonates and young infants
- Airway anomalies
- Longer bypass time
- Low volume cardiac centres
- The lack of a dedicated cardiac ICU

Protocol implementation can reduce time to extubation

- 10 Pediatric Heart Network centers engaged in a collaborative learning initiative. Four hospitals were considered active sites, and 5 were considered control sites
- 322 patients
- Fallot's tetralogy/ isolated coarctation of the aorta
- Extubation within 6 hours of surgery increased from 11.7 to 66.9%
- Median duration of extubation decreased from 21.2 to 4.5 hours at active sites
- Decrease in duration of ICU stay 44.2 vs 51.8h
- no significant decrease in length of hospital stay
- Issues with sustainability

Conclusion

- Prolonged mechanical ventilation more than 6h in reasonably stable patients can no longer be considered good anaesthetic practice
- Successful extubation requires multidisciplinary support and decision making in your institution

ASPA 2023

Session 3.

Neonates and Infants Need Special Anesthetic Care

Chair(s): Serpil Ozgen (Türkiye)
Ji-Hyun Lee (Korea)

Key Anesthesia Concepts for Each Neonatal Emergency

Yunxia Zuo

West China Hospital of Sichuan University, China

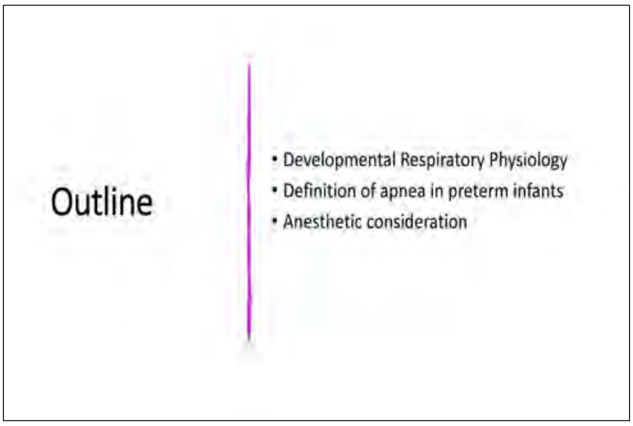
Learning Objectives

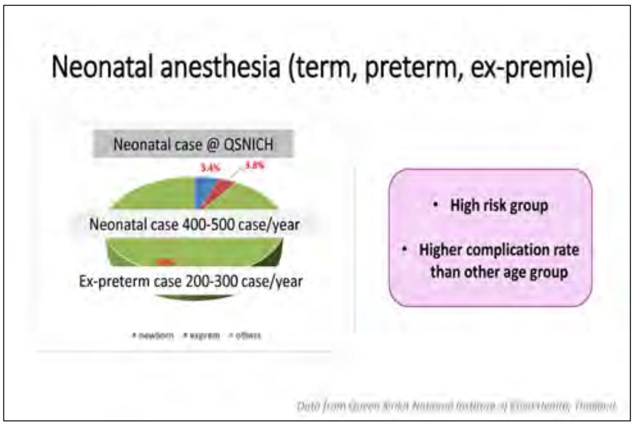
1. Understand the challenges of neonatal emergencies based on intresting clinical cases.
2. How to deal with respiratory and circulatory emergencies related to high abdominal pressure in neonates.
3. How to treat and prevent transfusion related emergency in neonates.

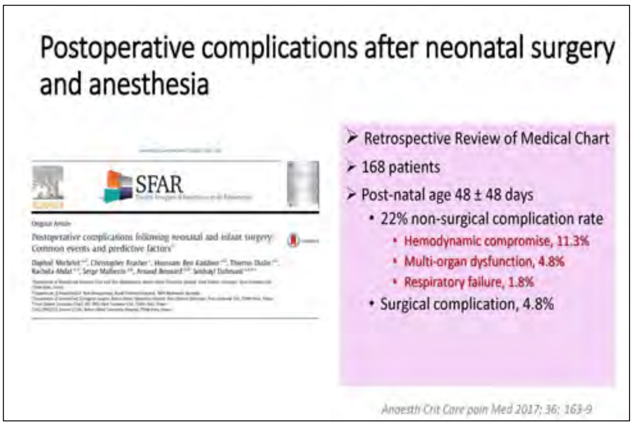
Postoperative Apnea in Preterm Infants: Updated

Duenpen Horatanaruang

Anesthesiology Department, Queen Sirikit National Institute of Child Health, Thailand







Postoperative complications after neonatal surgery and anesthesia

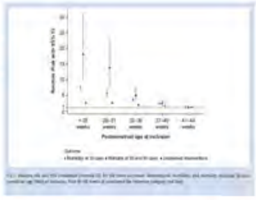

BJA

British Journal of Anaesthesia, 128 (6): 1050–1070 (2022)

PAEDIATRIC ANAESTHESIA

Morbidity and mortality after anaesthesia in early life: results of the European prospective multicentre observational study, neonate and children audit of anaesthesia practice in Europe (NECTARINE)

Nicola Disma, Francis Veyckemans, Katalin Virag, Tom G. Hansen, Karin Becke, Pierre Harlet, Laszlo Vutskits, Suellen M. Walker, Jurgen C. de Graaff, Marzena Zielinska, Dusica Simic, Thomas Engelhardt and Walid Habre, for the NECTARINE Group of the European Society of Anaesthesiology Clinical Trial Network



Critical events ➔ higher proportion in younger patients

Neonatal surgery and anesthesia

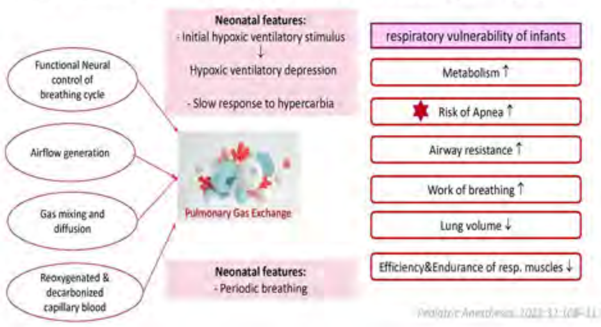
- Common procedures:
  - Neonatal period: cong. anomalies, NEC
  - Outside neonatal period: inguinal hernia repair and ophthalmologic procedures (often due to underlying retinopathy of prematurity)
- Neonates and infants ➔ physiological reserve ➔ greater risk of complications with general anaesthesia

Premature neonates are at highest risk

Respiratory physiology in neonate & infant

- Immature respiratory control
- More compliant pharynx, larynx, trachea and bronchial tree
- Small airway diameter
- Immature antioxidative system
- Low lung elasticity, high compliant thorax
- Respiratory muscles more susceptible to fatigue
- Less functional residual capacity (FRC)

Developmental Respiratory Physiology



Pathogenesis of Apnea of Prematurity

Central mechanisms	Peripheral reflex pathways
• ↓ Central chemosensitivity • Hypoxic ventilatory depression • Upregulated inhibitory neurotransmitters • Delayed CNS development	• ↓ Carotid body activity • ↑ Carotid body activity • Laryngeal chemoreflex • Excessive bradycardic response

Apnea of the newborn
Apnea of prematurity
Apneic spell
etc.

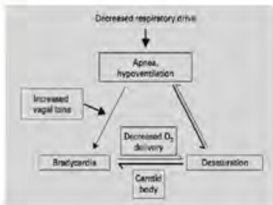


Fig. 2.15 A schematic representation of the sequence of events whereby apnea (or hypoventilation) results in various combinations of desaturation and bradycardia (from Martin and Abu-Shaweesh [365])

J. Lerman (ed.), Neonatal Anesthesia 2015, DOI 10.1007/978-1-4419-6041-2_1

Definition of Apnea of prematurity

Apnea of prematurity	Apnea of infancy
• a sudden cessation of breathing lasts for at least 20 seconds **or** accompanied by bradycardia/ oxygen desaturation (cyanosis) • infant younger than 37 weeks' gestational age	• an unexplained episode of cessation of breathing for 20 seconds or longer **or** a shorter respiratory pause associated with bradycardia, cyanosis, pallor, and/or marked hypotonia

Apnea may be central, obstructive, or mixed

Apnea of prematurity

In general (for neonatal care):

- All infants born at ≤28 wks GA were diagnosed with apnea
- > 28 wks GA;
  - apnea ↓ from 85% in infants 30 wks GA to 20% in 34 wks GA
- By 40 wks PCA;
  - apnea stops in 98% of infants, routine monitor after 43 wks PCA is not recommended
- Preterm infants with resolved apnea may have clinically unapparent intermittent hypoxia events

Anesthetic considerations: Apnea in Infants

Immaturity of breathing control & reflex control ➔

- Consider risk of apnea postoperatively up to 12 h postintervention in newborns and premature infants (up to 60 PCA)
- Expect apnea and bradycardia from forceful face mask application in preterm born babies (trigemino-cardiac reflex; TCR)
- Expect hypoxic respiratory depression & bradycardia

Anesthetic considerations: Apnea in Infants

- Large variability in the incidence of apneas is reported

The incidence and risk factors of apnea in premature infants underwent general anesthesia for cryotherapy or laser photocoagulation for treatment of retinopathy of prematurity at Queen Sirikit

- ○ Retrospective cohort, 167 infants, retinopathy of prematurity
- ○ Incidence of apnea after GA => 24%
- ○ Major risk factors ➔ PCA > 35 wks (95%CI 1.59-20.45)
  ➔ prior history of apnea

RESULTS: Forty of 167 (24%) premature infants had apnea after general anesthesia for treatment of ROP. The risk factors were post-conceptual age and history of apnea. The risk of apnea in patients with post-conceptual age less than 35 weeks was 5.7 times higher than in patients with post-conceptual age more than 37 weeks (95% CI 1.59-20.45). Patients with a prior history of apnea had a 6.42 times greater risk of postoperative apnea compared to patients without a prior history of apnea (95% CI 2.01-20.50). No other serious complications were reported during the study period.

CONCLUSION: The incidence of apnea after general anesthesia in infants with ROP treated with cryotherapy or laser photocoagulation was 24%. The risk factors of postoperative apnea were post-conceptual age less than 35 weeks and prior history of apnea. Patients with risk factors should be closely monitored.

J Med Assoc Thai Vol. 97 Suppl. 6 2014

Apnea after Awake Regional and General Anesthesia in Infants

The General Anesthesia Compared to Spinal Anesthesia Study—Comparing Apnea and Neurodevelopmental Outcomes, a Randomized Controlled Trial

GAS study 2015

- ○ RCT, inguinal hernia repair, 363 infants RA gr., 359 infants GA gr.
- ○ Incidence of apnea ➔ 3% RA gr., 4% GA gr.
  (OR 0.63, 95% CI: 0.31-1.40)
- ○ Incidence of early apnea (in 30 mins): RA < GA
  (1% vs. 3%, OR 0.2, 95% CI: 0.05-0.91)
- ○ Incidence of late apnea: 2% in both gr.
- ○ High rate of RA failure
- ○ Strongest predictor of apnea: prematurity

Anesthesiology 2015; 123:38-54

Anesthetic considerations: Apnea in Infants

- Risk identification
- Appropriate anesthesia technique
- Postoperative monitoring and management

Anesthetic considerations

Postoperative Apnea in Former Preterm Infants after Inguinal Herniorrhaphy
A Combined Analysis

- 8 studies, 384 patients, 4 institutions
- Risk factors: gestational age, PCA, continuing apnea at home, Hx of chronic lung dis, CNS morbidity, **anemia**

In non anemic infants;
- ❑ Risk of apnea is not less than 5% until 48 wks (GA 35 wks), 50 wks (GA 32 wks)
- ❑ Risk of apnea is not less than 1% until PCA 54 wks (GA 35 wks), 56 wks (GA 32 wks)

Cote CJ, Zaslavsky A, Downes JJ, Kurth CD, Wellborn LG, Warner LO, et al. Postoperative apnoea in former preterm infants after inguinal herniorrhaphy.Anesthesiology 1995; 82: 809–22.

Anesthetic considerations

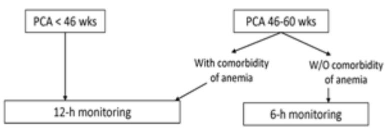
- Identified individual risk factors

Patient factors	• Prematurity: GA at birth/Postconceptual age (<60 wks), Anemia, Coexisting dis.: BPD, Neurological, cardiovascular etc, Hx of apnea
Metabolic	• Hypo/hyperthermia, hypo/hyperglycemia, hypo/hypercalcemia etc.
Anesthesia	• General anesthesia, opioids, IV anesthetics etc.

There is no evidence that transfusion of red blood cells will lower the incidence of postoperative apnea

Anesthetic considerations

- Larsen 2006; recommendation
  - Postpone surg. as appropriate
  - Postop. care for preterm infants
    - PCA > 60 wks, healthy ➔ discharge home, standard criteria
    - PCA 44-60 wks ➔ individualized care, risk factors
    - PCA < 44 – 46 wks ➔ admit postop. for monitoring > 12 hrs



PCA; postconceptual age
Co-morbidity; CFD, continuing apnea or neurological disease
Anemia; Hct < 30%

Acta Anaesthesiol Scand 2006; 50: 888–893

Anesthetic considerations

- Anesthetic technique GA or Regional ?

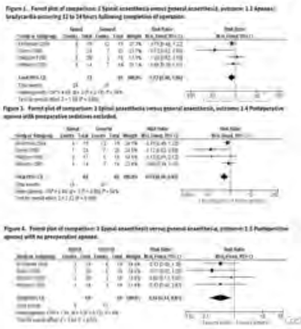
Cochrane Library

Regional (spinal, epidural, caudal) versus general anaesthesia in preterm infants undergoing inguinal herniorrhaphy in early infancy (Review)

Jones LJ, Craven PD, Lakkundi A, Foster JP, Badawi N

- 5 studies included
- Moderate quality evidence
- "GAS" Study not included

Anesthetic technique GA or Regional ?



no statistically significant difference in the risk of postoperative apnea/bradycardia: Spinal vs. GA

47% risk reduction of postoperative apnea when sedation excluded: Spinal vs. GA (w/o sedation)
NNT = 4

reduced risk in infants with no history of apnea

Apnea after Awake Regional and General Anesthesia in Infants

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- Incidence of late apnea: 2% in both gr.
- High rate of RA failure
- Strongest predictor of apnea: prematurity

Anesthesiology 2015; 123:38-54

Are term infants at risk?

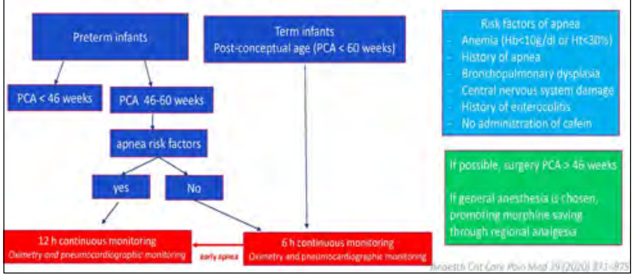
- Little data regarding term infants
- Massoud retrospective study 2019; inguinal hernia repair
  - Retrospective review: preterm < 60 wks PCA, term < 3 months
  - Incidence of postop. respiratory complications (desaturation , apnea)

Preterm < 45 wks PCA N=76	Preterm 45-60 wks PCA N=221	Term < 3 months N=188
39%	5.9%	1.6% (none in age > 1 month)

- postoperative respiratory complications is lower in term born infants than in prematurely born infants. It cannot be excluded

Anesthetic considerations

- Jean-Philippe Salaun 2020; proposed new protocol



Anaesth Crit Care Pain Med 39(2020) 871-875

Monitoring for apnea

- Detection of apnea is related to the level of monitoring

- Impedance monitoring
  - prone to artifact attributable to body movement or cardiac activity
  - unable to detect obstructive apnea
- Capnography – limitations in neonate
- Combination of nursing observation, pulse oximetry and ECG/impedance – pneumocardiographic

Management

- Reduced risk
- Postpone surgery?
- Drug prophylaxis
  - Caffeine
- Postoperative monitoring and management
  - Apnea monitoring
  - Postoperative ventilatory support: intubation, Noninvasive ventilation
  - Standard neonatal care

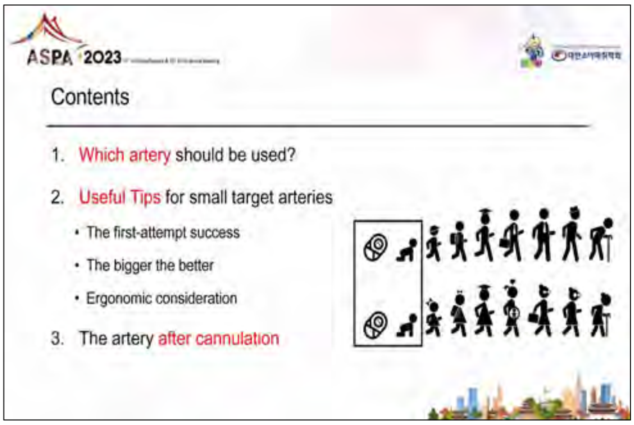
Conclusion

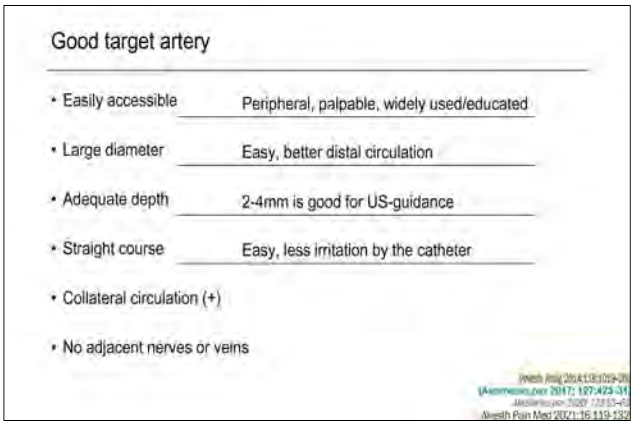
- Preterm infants ➔ Vulnerable group
- Post-operative Apnea
  - Risk identification/modify
  - Appropriate anesthesia technique
  - Postoperative monitoring and management
- Future information and research are needed

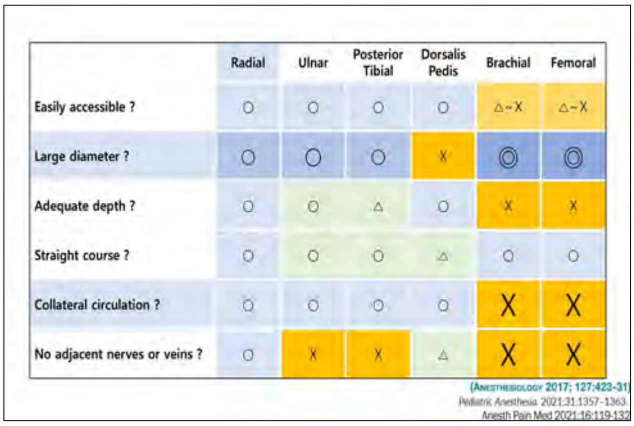
How to Improve the Success Rate of Small Vessel Cannulation

Young-Eun Jang

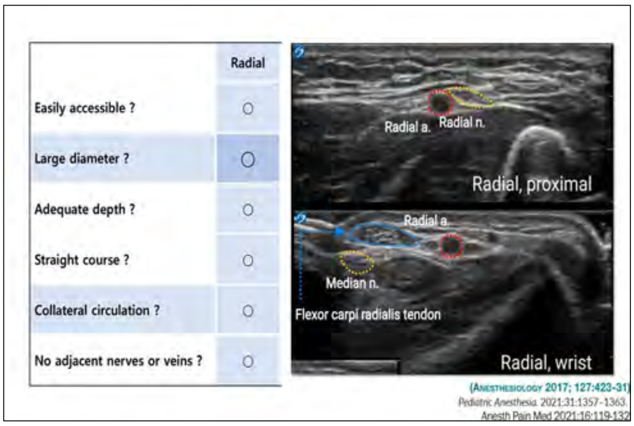
Seoul National University Children's Hospital, Korea



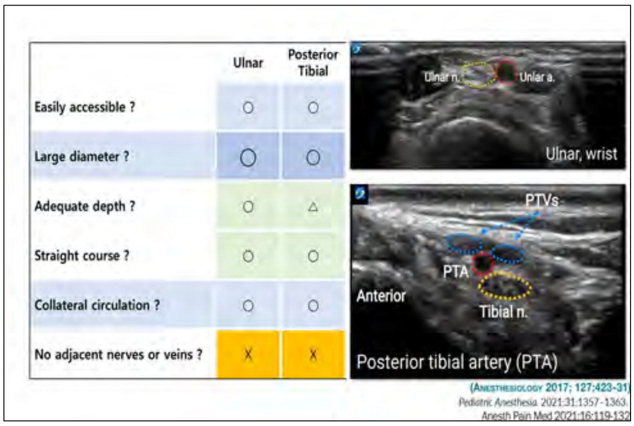




	Radial	Ulnar	Posterior Tibial	Dorsalis Pedis	Brachial	Femoral
Easily accessible ?	○	○	○	○	△~X	△~X
Large diameter ?	○	○	○	X	◎	◎
Adequate depth ?	○	○	△	○	X	X
Straight course ?	○	○	○	△	○	○
Collateral circulation ?	○	○	○	○	X	X
No adjacent nerves or veins ?	○	X	X	△	X	X

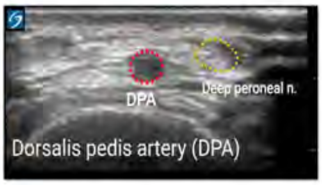


	Radial
Easily accessible ?	○
Large diameter ?	○
Adequate depth ?	○
Straight course ?	○
Collateral circulation ?	○
No adjacent nerves or veins ?	○



	Ulnar	Posterior Tibial
Easily accessible ?	○	○
Large diameter ?	○	○
Adequate depth ?	○	△
Straight course ?	○	○
Collateral circulation ?	○	○
No adjacent nerves or veins ?	X	X

	Dorsalis Pedis
Easily accessible ?	O
Large diameter ?	X
Adequate depth ?	O
Straight course ?	△
Collateral circulation ?	O
No adjacent nerves or veins ?	△



(Anesthesiology 2017; 127:423-31)
Pediatric Anesthesia 2021:31:1357-1363.
Anesth Pain Med 2021:16:119-132

	Brachial	Femoral
Easily accessible ?	△~X	△~X
Large diameter ?	◎	◎
Adequate depth ?	X	X
Straight course ?	O	O
Collateral circulation ?	X	X
No adjacent nerves or veins ?	X	X

(Anesthesiology 2017; 127:423-31)
Pediatric Anesthesia 2021:31:1357-1363.
Anesth Pain Med 2021:16:119-132

	Radial	Ulnar	Posterior Tibial	Dorsalis Pedis	Brachial	Femoral
Easily accessible ?	O	O	O	O	△~X	△~X
Large diameter ?	O	O	O	X	◎	◎
Adequate depth ?	O	O	△	O	X	X
Straight course ?	O	O	O	△	O	O
Collateral circulation ?	O	O	O	O	X	X
No adjacent nerves or veins ?	O	X	X	△	X	X

(Anesthesiology 2017; 127:423-31)
Pediatric Anesthesia 2021:31:1357-1363.
Anesth Pain Med 2021:16:119-132

Posterior Tibial Artery as an Alternative to the Radial Artery for Arterial Cannulation Site in Small Children

A Randomized Controlled Study

Eun-Hee Kim, M.D., Ji-Hyun Lee, M.D., In-Kyung Song, M.D., Jin-Tae Kim, M.D., Ph.D., Won-Jong Lee, M.D., Hee-Soo Kim, M.D., Ph.D.

(Anesthesiology 2017; 127:423-31)

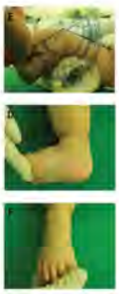


Table 1. Parameters of Arteries

		Mean	SD	Minimum	Maximum
Radial artery (wrist dorsiflexion up to 45°) (n = 60)					
Diameter short-axis view (mm)	Large	1.5	0.30	0.9	2.2
Diameter longitudinal view (mm)		1.5	0.24	0.9	2.1
Cross-sectional area (mm²)		2.3	0.84	1.0	5.0
Depth short-axis view (mm)	Not Deep	2.5	0.69	1.2	4.5
Depth longitudinal view (mm)		2.6	0.72	1.1	4.0
Posterior tibial artery (ankle dorsiflexion and eversion) (n = 60)					
Diameter short-axis view (mm)	Large	1.6	0.29	1.0	2.4
Diameter longitudinal view (mm)		1.5	0.27	1.0	2.2
Cross-sectional area (mm²)		2.7	1.05	1.0	6.0
Depth short-axis view (mm)	Deep	4.2	1.01	2.2	6.7
Depth longitudinal view (mm)		4.0	0.97	2.3	7.4
Dorsalis pedis artery (ankle plantar flexion) (n = 58)					
Diameter short-axis view (mm)	Small	1.1	0.24	0.6	1.7
Diameter longitudinal view (mm)		1.1	0.18	0.8	1.8
Cross-sectional area (mm²)		1.6	0.57	1.0	3.0
Depth short-axis view (mm)	Not Deep	2.9	0.69	1.6	5.7
Depth longitudinal view (mm)		2.8	0.69	1.8	5.3

(Anesthesiology 2017; 127:423-31)

1st Attempt success

What We Already Know about This Topic

- Arterial cannulation in pediatric patients is challenging, and artery size and depth from the skin are important determinants of success
- The radial artery is generally recommended, but alternative sites may be needed, and there is no standard alternative

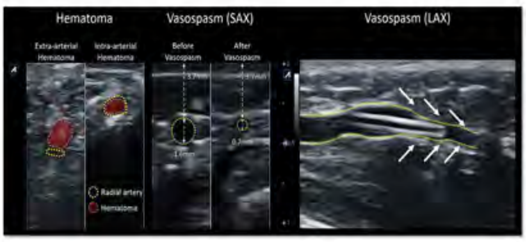
What This Article Tells Us That Is New

- In an observational study of 60 children (median age, 13 months), radial, dorsalis pedis, and posterior tibial artery diameters averaged 1.5, 1.2, and 1.6mm, respectively
- In a prospective randomized study in 234 children (median age, 6 months), arterial cannulation first-attempt rate of success was 83, 45, and 75% for radial, dorsalis pedis, and posterior tibial arteries, respectively
- For ultrasound-guided arterial cannulation in small children, the posterior tibial artery is a reasonable alternative to the radial artery

(Anesthesiology 2017; 127:423-31)

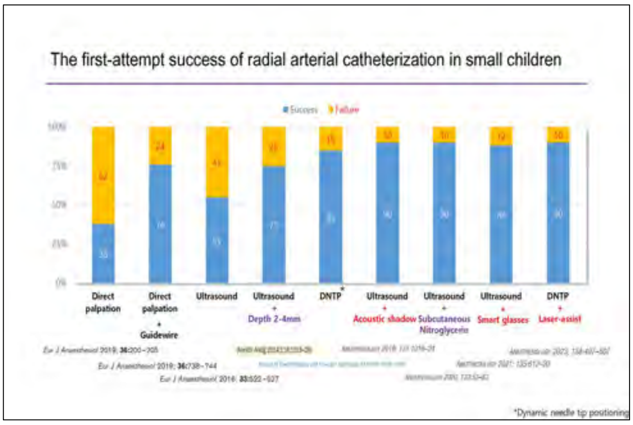
Radial artery after arterial cannulation

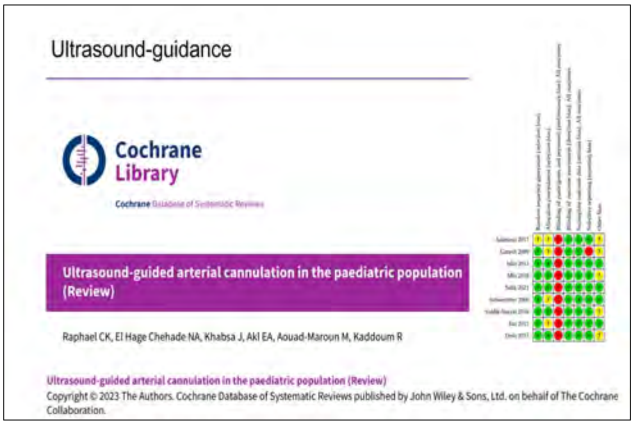
- Extra-/Intra-arterial hematoma, Vasospasm



Anesthesiology 2020; 133:53–63


Tips
2. Useful tips for
small target arteries


The first-attempt success of radial arterial catheterization in small children
Success
Failure
Direct palpation
Direct palpation + Guidewire
Ultrasound
Ultrasound + Depth 2-4mm
DNTP*
Ultrasound + Acoustic shadow
Ultrasound + Subcutaneous Nitroglycerin
Ultrasound + Smart glasses
DNTP + Laser-assist
Eur J Anaesthesiol 2019; 36:200–205
Eur J Anaesthesiol 2019; 36:738–744
Eur J Anaesthesiol 2016; 33:522–527
*Dynamic needle tip positioning


Ultrasound-guidance
Cochrane Library
Cochrane Database of Systematic Reviews
Ultrasound-guided arterial cannulation in the paediatric population (Review)
Raphael CK, El Hage Chehade NA, Khabsa J, Akl EA, Aouad-Maroun M, Kaddoum R
Ultrasound-guided arterial cannulation in the paediatric population (Review)
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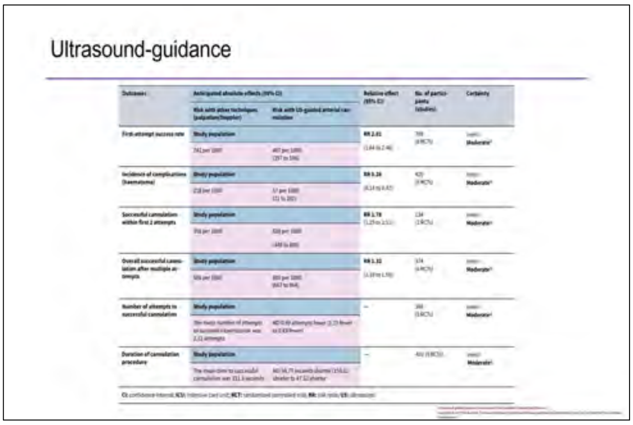
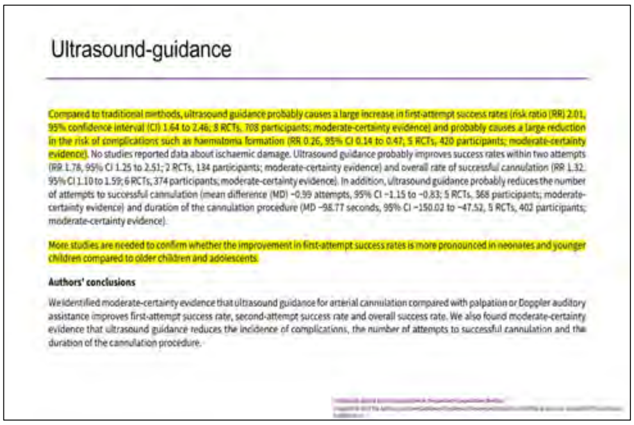
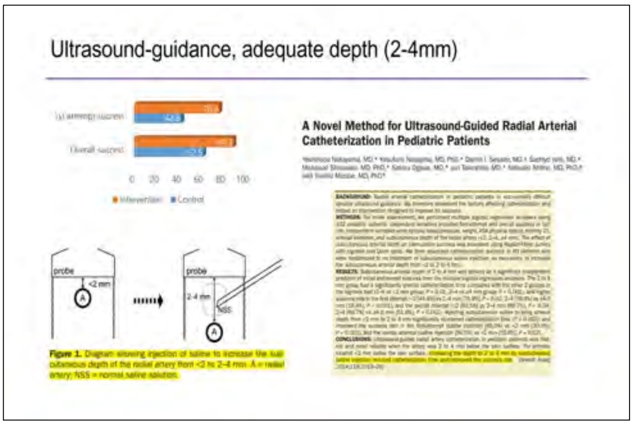
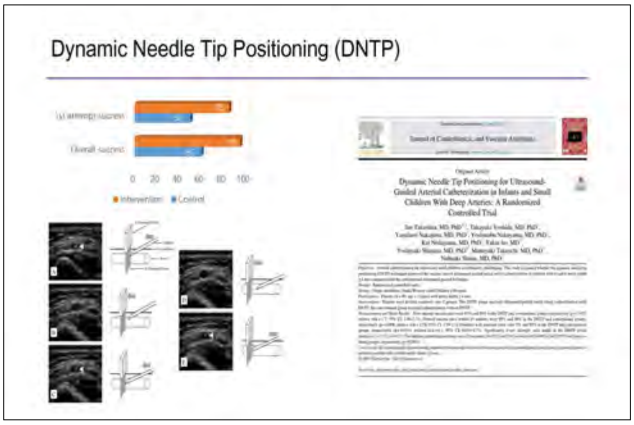
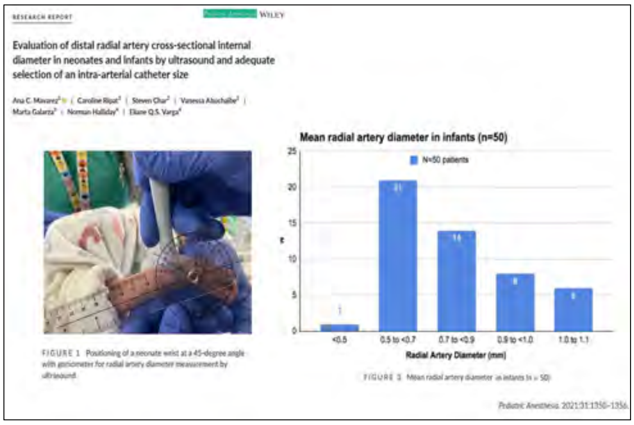
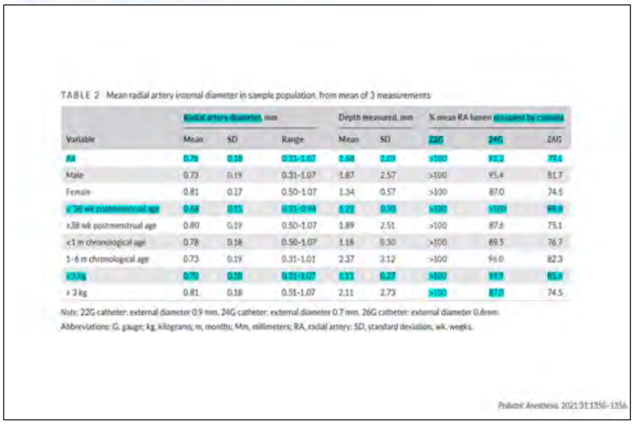

Ultrasound-guidance


Ultrasound-guidance
Compared to traditional methods, ultrasound guidance probably causes a large increase in first-attempt success rates (risk ratio (RR) 2.01, 95% confidence interval (CI) 1.64 to 2.46; 8 RCTs, 708 participants; moderate-certainty evidence) and probably causes a large reduction in the risk of complications such as haematoma formation (RR 0.26, 95% CI 0.14 to 0.47; 5 RCTs, 420 participants; moderate-certainty evidence). No studies reported data about ischaemic damage. Ultrasound guidance probably improves success rates within two attempts (RR 1.78, 95% CI 1.25 to 2.51; 2 RCTs, 134 participants; moderate-certainty evidence) and overall rate of successful cannulation (RR 1.32, 95% CI 1.10 to 1.59; 6 RCTs, 374 participants; moderate-certainty evidence). In addition, ultrasound guidance probably reduces the number of attempts to successful cannulation (mean difference (MD) −0.99 attempts, 95% CI −1.15 to −0.83; 5 RCTs, 368 participants; moderate-certainty evidence) and duration of the cannulation procedure (MD −98.77 seconds, 95% CI −150.02 to −47.52, 5 RCTs, 402 participants; moderate-certainty evidence).
More studies are needed to confirm whether the improvement in first-attempt success rates is more pronounced in neonates and younger children compared to older children and adolescents.
Authors' conclusions
We identified moderate-certainty evidence that ultrasound guidance for arterial cannulation compared with palpation or Doppler auditory assistance improves first-attempt success rate, second-attempt success rate and overall success rate. We also found moderate-certainty evidence that ultrasound guidance reduces the incidence of complications, the number of attempts to successful cannulation and the duration of the cannulation procedure.


Ultrasound-guidance, adequate depth (2-4mm)
1st attempt success
Overall success
0 20 40 60 80 100
Intervention Control
A Novel Method for Ultrasound-Guided Radial Arterial Catheterization in Pediatric Patients
probe
<2 mm
A
probe
2-4 mm
NSS
A
Figure 1. Diagram showing injection of saline to increase the subcutaneous depth of the radial artery from <2 to 2-4 mm. A = radial artery; NSS = normal saline solution.

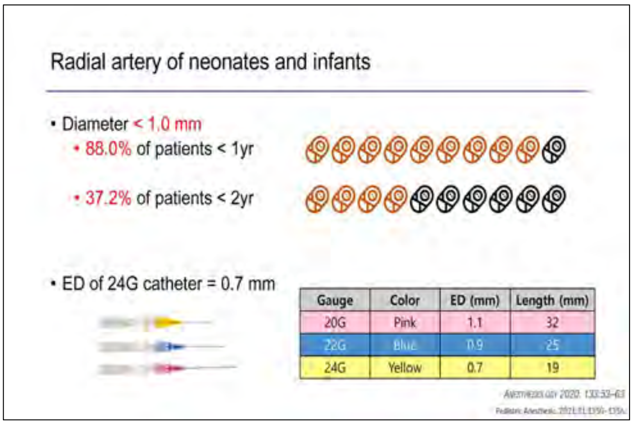

Dynamic Needle Tip Positioning (DNTP)
1st attempt success
Overall success
0 20 40 60 80 100
Intervention Control
Dynamic Needle Tip Positioning for Ultrasound-Guided Arterial Catheterization in Infants and Small Children With Deep Arteries: A Randomized Controlled Trial


RESEARCH REPORT
WILEY
Evaluation of distal radial artery cross-sectional internal diameter in neonates and infants by ultrasound and adequate selection of an intra-arterial catheter size
Mean radial artery diameter in infants (n=50)
N=50 patients
Radial Artery Diameter (mm)
FIGURE 1 Positioning of a neonate wrist at a 45-degree angle with goniometer for radial artery diameter measurement by ultrasound
Paediatr Anaesthesia. 2021;31:1350–1356

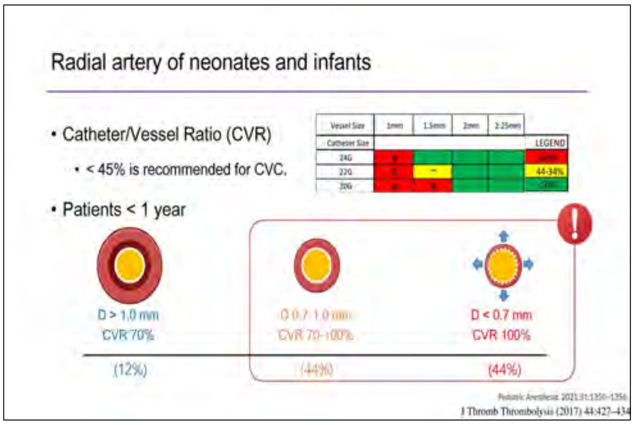


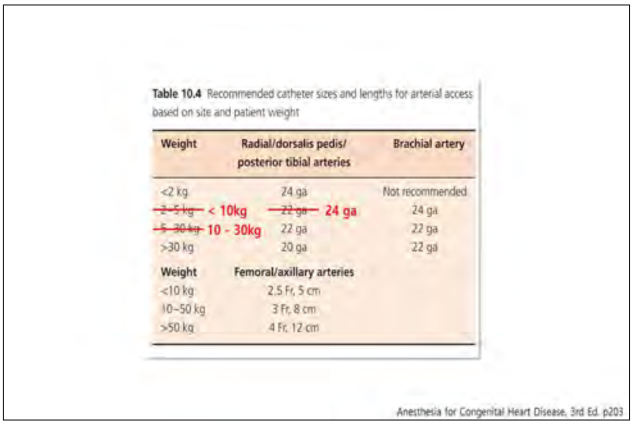
	Radial artery diameter, mm			Depth measured, mm		% mean RA lumen occupied by cannula		
Variable	Mean	SD	Range	Mean	SD	22G	24G	26G
All	0.76	0.18	0.31-1.07	1.68	2.09	>100	93.2	79.4
Male	0.73	0.19	0.31-1.07	1.87	2.57	>100	95.4	81.7
Female	0.81	0.17	0.50-1.07	1.34	0.57	>100	87.0	74.5
< 38 wk postmenstrual age	0.68	0.15	0.31-0.98	1.22	0.30	>100	>100	98.9
≥38 wk postmenstrual age	0.80	0.19	0.50-1.07	1.89	2.51	>100	87.6	75.1
<1 m chronological age	0.78	0.18	0.50-1.07	1.16	0.30	>100	89.5	76.7
1-6 m chronological age	0.73	0.19	0.31-1.01	2.37	3.12	>100	96.0	82.3
≤3 kg	0.70	0.18	0.31-1.07	1.11	0.27	>100	99.9	85.6
> 3 kg	0.81	0.18	0.51-1.07	2.11	2.73	>100	87.0	74.5

Note: 22G catheter: external diameter 0.9 mm. 24G catheter: external diameter 0.7 mm. 26G catheter: external diameter 0.6mm.
Abbreviations: G, gauge; kg, kilograms; m, months; Mm, millimeters; RA, radial artery; SD, standard deviation, wk, weeks.

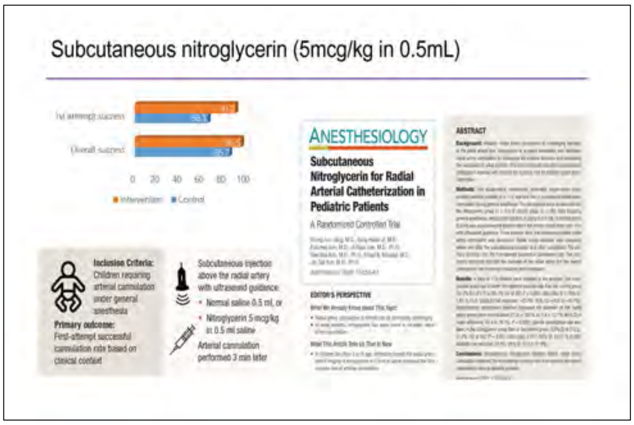


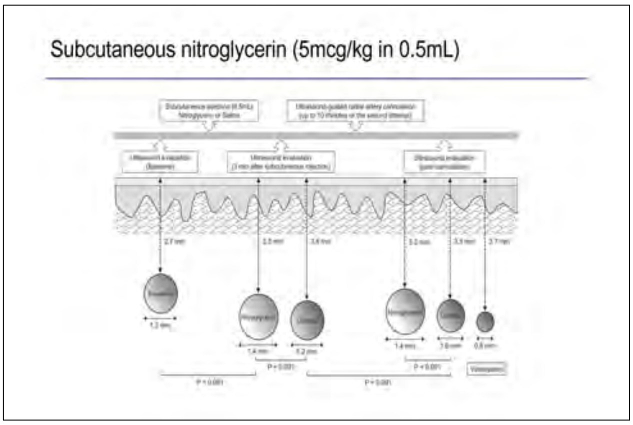
Gauge	Color	ED (mm)	Length (mm)
20G	Pink	1.1	32
22G	Blue	0.9	25
24G	Yellow	0.7	19

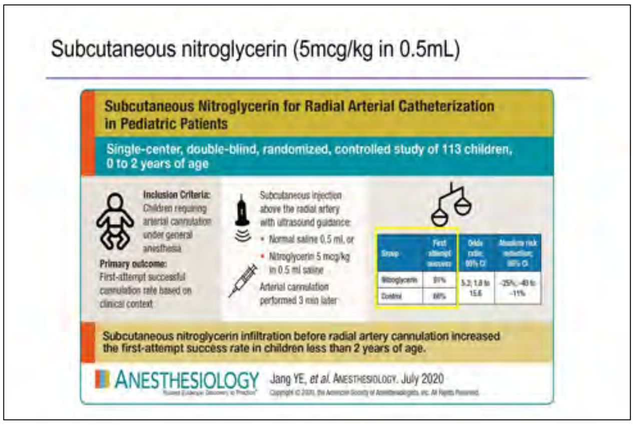


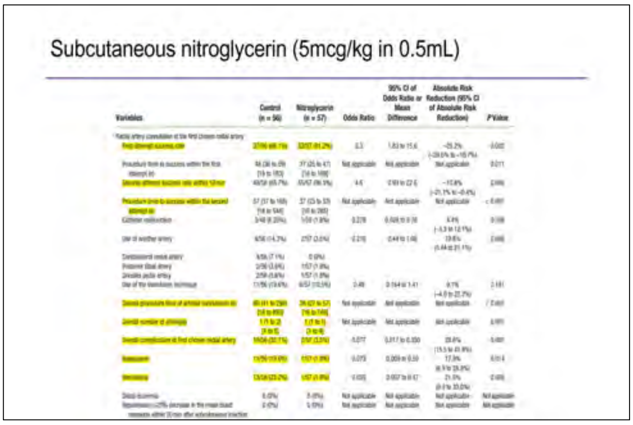


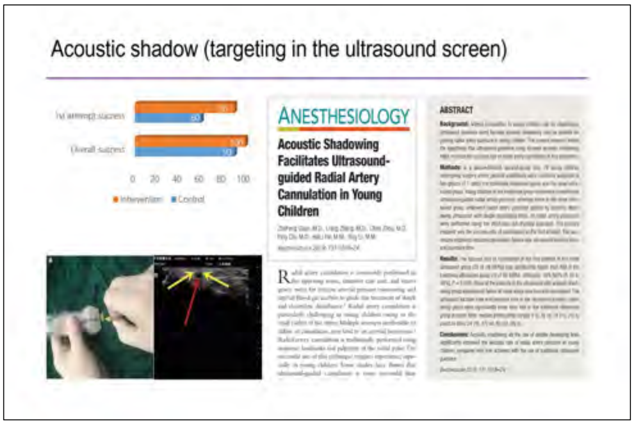
Weight	Radial/dorsalis pedis/ posterior tibial arteries	Brachial artery
<2 kg	24 ga	Not recommended
~~2–5 kg~~ < 10kg	~~22 ga~~ 24 ga	24 ga
~~5–30 kg~~ 10 - 30kg	22 ga	22 ga
>30 kg	20 ga	22 ga
Weight	**Femoral/axillary arteries**	
<10 kg	2.5 Fr, 5 cm	
10–50 kg	3 Fr, 8 cm	
>50 kg	4 Fr, 12 cm	





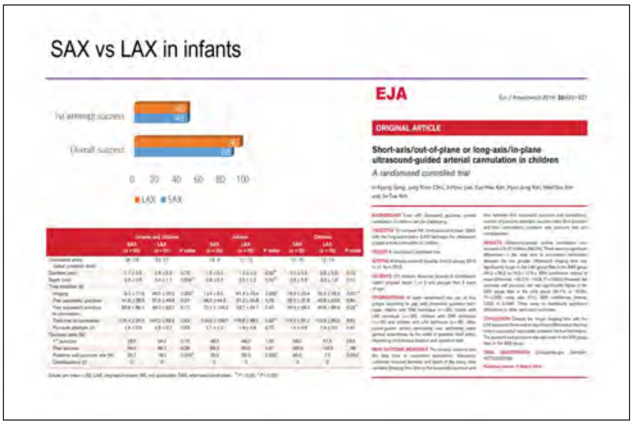


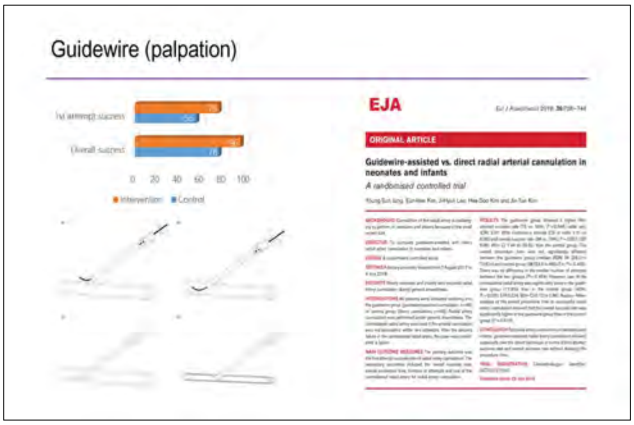



Acoustic shadow (targeting in the ultrasound screen)
1st attempt success
Overall success
0 20 40 60 80 100
Intervention Control
ANESTHESIOLOGY
Acoustic Shadowing Facilitates Ultrasound-guided Radial Artery Cannulation in Young Children
ABSTRACT

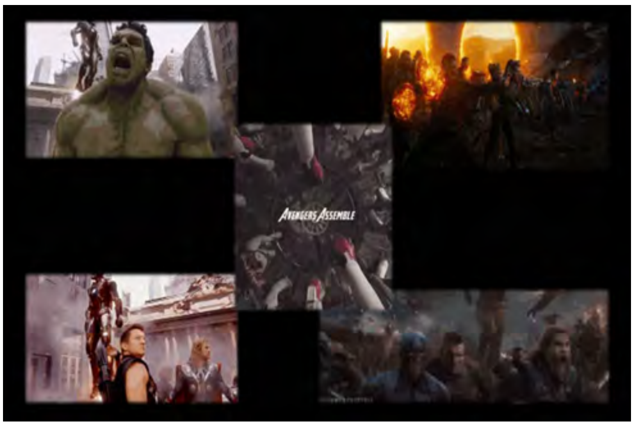

Smart glasses (hand-eye coordination)
1st attempt success
Overall success
0 20 40 60 80 100
Intervention Control
ANESTHESIOLOGY
Smart Glasses for Radial Arterial Catheterization in Pediatric Patients: A Randomized Clinical Trial
EDITOR'S PERSPECTIVE
ABSTRACT

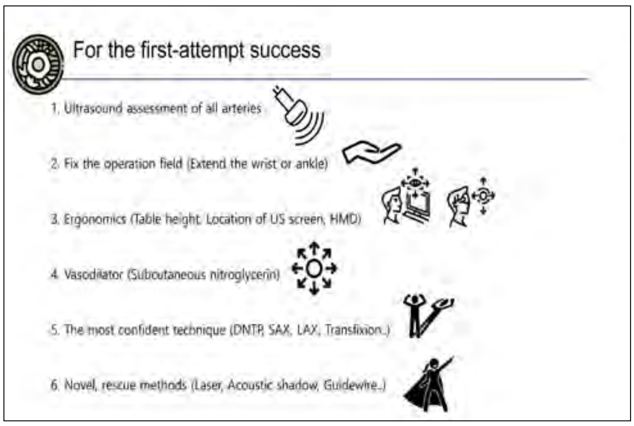

Laser-assist (targeting in the operation field)
1st attempt success
Overall success
0 20 40 60 80 100
Intervention Control
ANESTHESIOLOGY
Comparison of Single-operator Laser-assisted Ultrasound-guided Radial Arterial Cannulation in Young Children with Traditional Ultrasound Guidance: A Randomized Clinical Trial
EDITOR'S PERSPECTIVE
ABSTRACT


SAX vs LAX in infants
1st attempt success
Overall success
0 20 40 60 80 100
LAX SAX
EJA
ORIGINAL ARTICLE
Short-axis/out-of-plane or long-axis/in-plane ultrasound-guided arterial cannulation in children
A randomised controlled trial

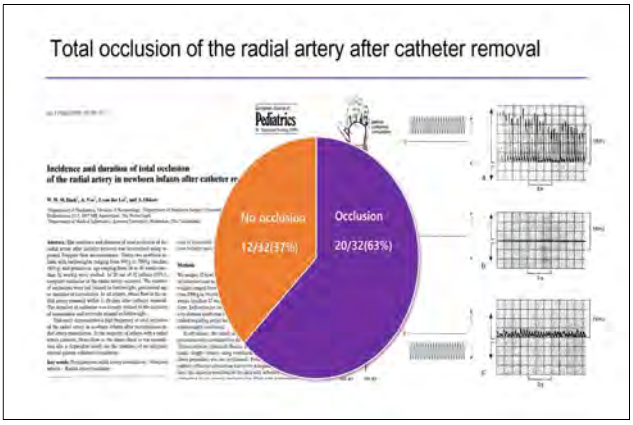

Guidewire (palpation)
1st attempt success
Overall success
0 20 40 60 80 100
Intervention Control
EJA
ORIGINAL ARTICLE
Guidewire-assisted vs. direct radial arterial cannulation in neonates and infants
A randomised controlled trial

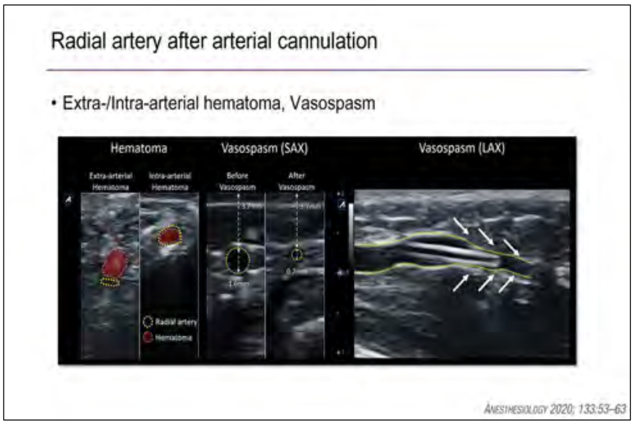

Assembling

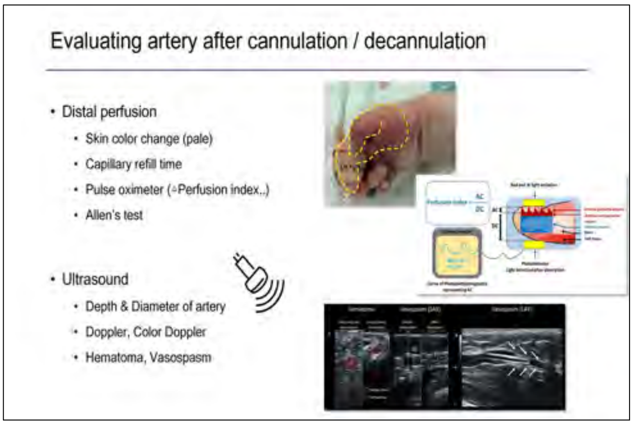

AVENGERS ASSEMBLE

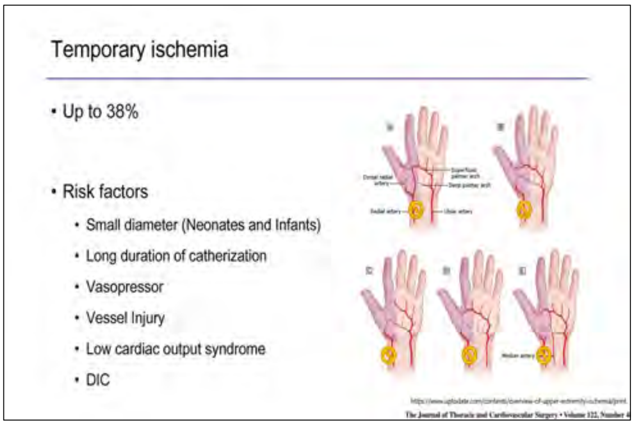

For the first-attempt success
1. Ultrasound assessment of all arteries
2. Fix the operation field (Extend the wrist or ankle)
3. Ergonomics (Table height, Location of US screen, HMD)
4. Vasodilator (Subcutaneous nitroglycerin)
5. The most confident technique (DNTP, SAX, LAX, Transfixion)
6. Novel, rescue methods (Laser, Acoustic shadow, Guidewire)

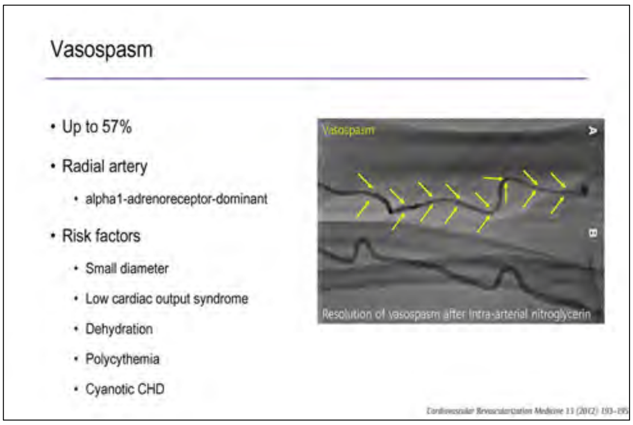

3. The artery
after cannulation


Total occlusion of the radial artery after catheter removal
Pediatrics
Incidence and duration of total occlusion of the radial artery in newborn infants after catheter re
No occlusion
12/32(37%)
Occlusion
20/32(63%)

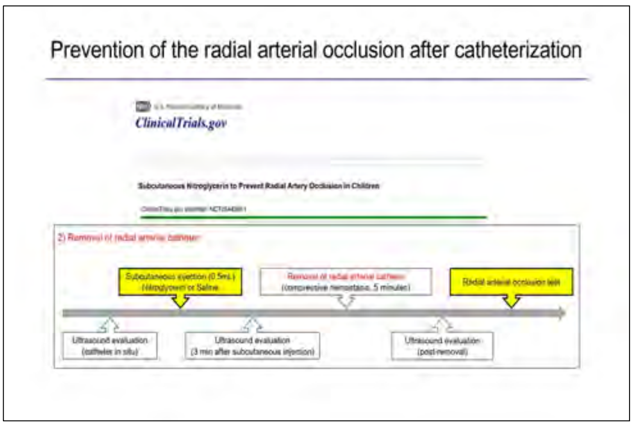

Radial artery after arterial cannulation
• Extra-/Intra-arterial hematoma, Vasospasm
Hematoma
Vasospasm (SAX)
Vasospasm (LAX)
Extra-arterial Hematoma
Intra-arterial Hematoma
Before Vasospasm
After Vasospasm
Radial artery
Hematoma
Anesthesiology 2020; 133:53–63


Evaluating artery after cannulation / decannulation
• Distal perfusion
• Skin color change (pale)
• Capillary refill time
• Pulse oximeter (÷Perfusion index..)
• Allen's test
• Ultrasound
• Depth & Diameter of artery
• Doppler, Color Doppler
• Hematoma, Vasospasm


Temporary ischemia
• Up to 38%
• Risk factors
• Small diameter (Neonates and Infants)
• Long duration of catherization
• Vasopressor
• Vessel Injury
• Low cardiac output syndrome
• DIC
The Journal of Thoracic and Cardiovascular Surgery • Volume 122, Number 4


Vasospasm
• Up to 57%
• Radial artery
• alpha1-adrenoreceptor-dominant
• Risk factors
• Small diameter
• Low cardiac output syndrome
• Dehydration
• Polycythemia
• Cyanotic CHD
Vasospasm
Resolution of vasospasm after intra-arterial nitroglycerin
Cardiovascular Revascularization Medicine 13 (2012) 193–195


Ischemia after brachial arterial cannulation in neonates
8hr later
Topical Nitroglycerin
NITRO-BID
Nitroglycerin Ointment USP, 2%
5days later
10days later
7 weeks later


Prevention of the radial arterial occlusion after catheterization
ClinicalTrials.gov
Subcutaneous Nitroglycerin to Prevent Radial Artery Occlusion in Children
2) Removal of radial arterial catheter
Subcutaneous injection (0.5mL)
(Nitroglycerin or Saline)
Removal of radial arterial catheter
(compressive hemostasis, 5 minutes)
Radial arterial occlusion test
Ultrasound evaluation
(catheter in situ)
Ultrasound evaluation
(3 min after subcutaneous injection)
Ultrasound evaluation
(post removal)

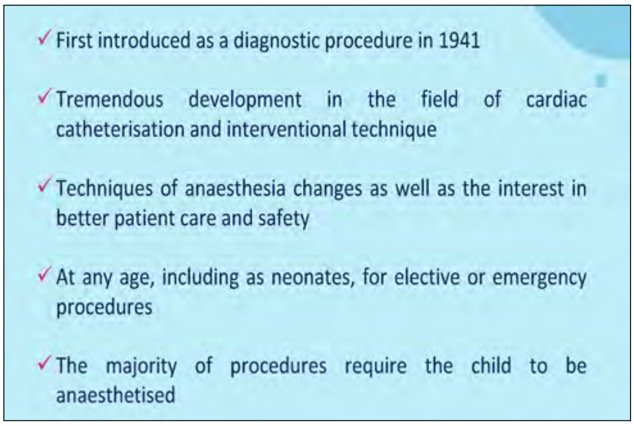
Summary

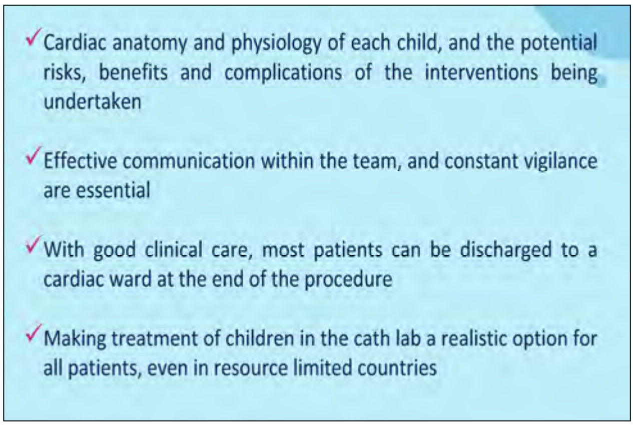
Question	Recommendation	
Artery	Radial (= PTA >DPA)	Large, Adequate depth, Collateral(+)
Depth of the artery	2-4 mm	Better ultrasound guidance & Needle manipulation
Diameter of the artery (Neonates, Infants)	Subcutaneous NTG (5mcg/mL, 0.5mL)	50mcg/mL 0.5mL for ~5kg 100mcg/mL 0.5mL for ~10kg
Operation field	Minimize movement	Firm surface Fix wrist or ankle with tapes to stretch the artery
Operator	Ensure the most comfortable posture	Height of the table (operation field) Location of the ultrasound screen
Ultrasound view	Operator's preference	SAX, LAX, Dynamic, Oblique.
Deep location or Curved pathway	Guidewire-assist	Long cannula (need to evaluate distal perfusion)
Hand-eye coordination Additional Guidance	Smart glasses Acoustic shadowing Laser-assist	Hand-eye coordination From large arteries to small arteries

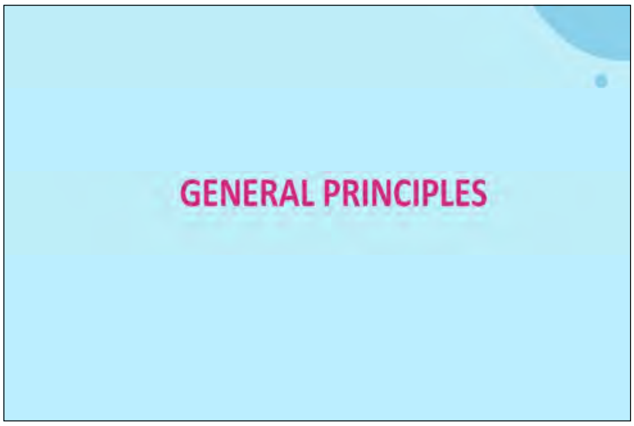
Anesthetic Management of Neonates Undergoing Diagnostic and Therapeutic Cardiac Catheterization

Duygu Kara

Aydin Adnan Menderes University, Department of Anesthesiology and Reanimation, Türkiye







Role of the anaesthesiologist?

During the conduct of several catheterisation procedures for

- Monitored anaesthetic care
- Sedation & analgesia
- General anaesthesia
- Resuscitation of patients if complications arise during the procedure

Difficulties in cath. lab?

- The environment of the cath. lab="unknown"
- Access to the patient due to fluoroscopy equipment all around the patient with dimmed light and movable tables
- Access to the patient and in particular to the patient's airway
- Interaction between the cardiologist and anaethesiologist is necessary

Preoperative Evaluation

- Complete diagnosis
- List of the procedures in the past
- Patient's level of activity
- Review with cardiologist anatomy of the case and review the ECHO films
- Ask the cardiologist about reason for the catheterization and what he is planning to do?

- **Rule out recent upper respiratory infections**
  They may cause reactive airways and develop peri-GA laryngospasm, bronchospasm, desaturate and increase PVR during the procedure
- Medication list
  The last time when any medication was taken (furosemid, captopril and digoxin are commonly used)
- Ask about allergies

Physical examination

- should focus on the airway, heart, and lung problems
  - signs of CHF such as pedal edema, jugular venous distention, enlarged liver, and rales
  - signs of respiratory distress such as increased respiratory rate, diaphoresis, chest retraction, nasal flaring, and use of accessory muscles of respiration

- Special attention to the presence of other congenital lesions, including
  - musculoskeletal abnormality
  - neurological defects
  - genitourinary irregularities
  - atlanto-occipital subluxation (in 20% in Down's syndrome)

- **Hemogram**, for all patients pre-operatively
- **Coagulation tests** (prothrombin time [PT], partial thromboplastin time [PTT], partial thromboplastin time with kaolin [PTTK]
- **Electrolytes, renal&liver functions**, particularly in patients with significantly impaired cardiac function or those with complex co-existing diseases
  - Serum electrolytes should be determined in patients receiving digoxin or diuretics

- Thrombocytopenia, hypofibrinogenemia, and low levels of vitamin K dependent clotting factors can be seen in patients with polycythemia and cyanosis
- Thrombocytopenia; in severe hypoxia and compensatory polycythemia
- The platelet count should be >100x10^9/L; transfusion may be needed
- For higher risk procedures (balloon dilatation of valves) blood should be cross-matched and immediately available

Fasting

- ✓ The most common problem in all parts of the world is that clear fluids are withheld for too long
- ✓ Prolonged starvation for fluids will make the child miserable, more likely to be hypoglycaemic, and if dehydrated, more difficult to cannulate
- ✓ Avoid dehydration for patients with severe hypoxia who are polycythaemic, as it increases the risk of thrombotic complications

Equipment

- ✓ Cardiac cath labs tend to be situated in remote areas of the hospital
- ✓ In adults, procedures are often performed under local anaesthesia or sedation and as such, immediately available anaesthesia resources or equipment may not always be optimal
- ✓ The anaesthetist must be familiar with, and check, the anaesthetic equipment pre-operatively

---

- ✓ **Standard monitoring**
  - ✓ ECG
  - ✓ Noninvasive blood pressure
  - ✓ Pulse oximetry
  - ✓ Temperature
- ✓ - **Arterial, atrial, and pulmonary pressures** can be obtained during the procedure by the cardiologist

---

- ✓ **End-tidal carbon dioxide (EtCO2)** for the patients decided to be mechanically ventilated
- ✓ **A working defibrillator** with paediatric paddles or attenuated pads must be available
  - ✓ The operator should be trained to use this device

- ✓ The cath lab is often **cold**; children can become hypothermic
  - ✓ This may promote arrhythmias and will delay recovery from anaesthesia
- ✓ **Active warming using an air blanket** is ideal
  - ✓ At minimum, the patient should be kept covered and the room temperature controlled

Maintenance fluids

- ✓ **Isotonic maintenance fluids** -Ringer's Lactate or Hartmann's- for all patients
- ✓ Concerns about **hypoglycaemia** (prolonged starvation), 50% glucose 10 – 50ml can be added to a 500ml bag of fluid to make a solution of 1-5% glucose/Ringer's (or Hartmann's)
  - ✓ Blood glucose levels should be measured in this situation
- ✓ There is no place for hypotonic maintenance fluids in modern paediatric anaesthesia practice

Post-operative care

- ✓ The child should be **fully recovered** before returning to the ward
  - ✓ Ideally after a period of time in a staffed recovery room, with oxygen, suction and monitoring available
- ✓ The **vascular puncture site must be checked** for bleeding prior to return to the ward, particularly where arterial access has been obtained

Anaesthetic technique

- ✓ An anaesthetic technique for a safe and rapid recovery of the patient and return to the ward post-operatively
- ✓ Balanced anaesthesia with **controlled ventilation±muscle relaxant** is the usual technique of choice
- ✓ Spontaneous ventilation without intubation may be an option
  - ✓ Often used in resource limited countries for short cases where ketamine can be used as the sole agent

- Long-acting muscle relaxants (pancuronium) and deep volatile anaesthesia (particularly halothane) are best avoided
- It is essential to obtain secure vascular access, despite pressure from others to proceed
  - Failure to secure good vascular access may be regretted later if a serious adverse event occurs
- Alternatively, access can be achieved following induction of anaesthesia with an inhalational agent or ketamine (5-10mg/kg IM or 2mg/kg IV)

- During catheterization, **direct cardiac and arterial pressure readings** can be measured as part of the diagnostic work up and repeated to assess for post intervention changes
- The fractional inspired oxygen concentration **[FiO2]** delivered can have significant effects on the pulmonary vascular resistance, and as such will affect pressure readings taken during catheterization
- Following a safe induction, aim to deliver the same oxygen requirement the patient would normally be exposed to (i.e. close to [FiO2] 0.21 if spontaneously ventilating in air), but do liaise with the cardiologist during the brief if in doubt

- **Premedication** highly recommended
  - Routes of premedication include oral, rectal, IM, IV
  - Oral Versed 0.5 mg/kg to 1 mg/kg is a good choice
- Patient may be very sensitive to premedication; **pulse oxymeter monitoring** is mandatory
- Consider adding **ketamine** to your premedication to improve level of sedation w/o increased respiratory depression

- Inhalation induction requires adequate pulmonary blood flow
- **Etomidate, ketamine, versed and fentanyl** are good choices for IV induction
- When administering narcotics for the induction and maintenance of the anesthesia remember that the majority of these cyanotic patients are going home in 6 hours after end of procedure
- Remember that ketamine maintains cardiac function and spontaneous respiration and also is a good analgesic

General anesthesia in cath lab

- **Uncooperative children**
- **High risk patients**
  - Hypoxaemic infants
  - Infants with CHF and obstructed valvular lesion
  - Infants with cyanotic heart disease

Due to increasing invasive nature of the procedures, complications can arise in the cath lab
Anaesthesiologist's presence may be desired as a stand-by in high risk patients

Sedation and analgesia to GA

During diagnostic procedure an ideal technique would be to maintain;

- normal respiration on room air steady haemodynamics, normal blood gas values
- immobility
- provide adequate analgesia and amnesia

While transition to GA, consider

- Patient's age and clinical condition
- Access by cardiologist: neck vs. groin
- Length of the procedure
- Patient's disease (hypoplastic heart or single ventricle, etc.)
- If procedure is diagnostic or interventional

While transition to GA, consider

- Patient's cardiopulmonary physiology
  - Has to be as close to the baseline (awake state) as possible in order to obtain real data from the procedure
- Note Qp/Qs ratio if available
  - You will not be successful in mask induction of GA for pts with decreased pulmonary blood flow
- Evaluate patient's cardiac function
  - Remember that all inhalation anesthetics are myocardial depressants

Procedural Concerns

- Vascular access by cardiologist
  - If neck approach is planned, you will have better control of the airway using LMA or ETT
- FiO2 concerns
  - During procedure cardiologist will measure O2 saturations in the different chambers of the heart to evaluate degree of the shunt and calculate Qp/Qs ratio
  - If patient is sedated, keep them on room air if tolerated, if not, inform cardiologist that you have to administer supplemental O2 and they will stop the measurements
  - Return the patient to room air as soon as tolerated, and inform cardiologist
  - If patient is intubated or has LMA in place keep ≤25%

Procedural Concerns

- Specifics of the procedure: diagnostic vs. invasive
  - If invasive, there is always possibility of vessel rupture and uncontrolled bleeding
    - Volume expanders available and blood typed, screened and cross-matched
- If a neck approach is used
  - There is possibility of hemo/pneumothorax, whic can be easily diagnosed via chest fluoroscopy

Procedural Concerns

- Ectopy; always possible with wires and catheters in the heart chambers
  - Development of the heart block is also a possibility
- Coil embolization of the PDA
  - More distal embolization of the pulmonary arteries is always a possibility
- Balloon dilatation
  - Rupture of the balloon is always a possibility
- Coronary angiogram
  - Thrombosis or dissection of coronary arteries is always a possibility

SPECIFIC SITUATIONS

Pulmonary hypertension

- ✓ **Pulmonary hypertension (PH): Resting mean pulmonary artery pressure (mPAP) >25 mmHg**
- ✓ Following induction of anaesthesia, FiO2 should ↓
  - ✓ as close to room air
  - ✓ the minimum FiO2 the patient can tolerate safely
- ✓ 100% O_2 is then given for 10 minutes and PAP is measured again to assess for evidence of reversibility of PH (15% reduction in mPAP vs. mean blood pressure (MAP) [without a significant change in MAP]
- ✓ FiO2 must ↑ during testing if there is profound hypoxia or any ischaemic changes

Tetralogy of Fallot (TOF)

- ✓ Mostly diagnosed with ECHO
- ✓ Cardiac catheterization may be carried out to;
  - ✓ Assess the course and severity of the right ventricular outflow tract (RVOT) obstruction
  - ✓ Map the coronary blood supply and assess for an aberrant coronary artery crossing the infundibulum of the right ventricle (which could be jeopardised during surgery if not recognised)
  - ✓ Identify major aorto-pulmonary collateral arteries (MAPCAs)

- ✓ The major risk during cardiac catheterization of a child with unrepaired TOF is a **hypercyanotic 'spell'**
  - ✓ Particularly if the angiography catheter stimulates the infundibular area of the RVOT
  - ✓ This results in increased right to left shunting and profound hypoxaemia
- ✓ The risk of spelling can be minimised by reducing sympathetic drive
  - ✓ Premedication
  - ✓ Delivering balanced anaesthesia with opioid analgesia
  - ✓ Avoiding 'light' anaesthesia
- ✓ Epinephrine should be avoided as this will worsen any RVOT obstruction

A cyanotic spell should be treated in the following way:

- ✓ Increase the **FiO2**
- ✓ Give an **IV fluid bolus** of 10ml/kg isotonic fluid, reassess and repeat if necessary
- ✓ **Phenylephrine** (1 mcg/kg boluses) or **norepinephrine** infusion (0.05-0.1mcg/kg/min)
- ✓ **Beta-blockers** (**esmolol** (0.5mg/kg IV over 1 min, repeat if required, or infusion 25-300mcg/kg/min) or **metoprolol** (0.1 mg/kg IV over 5 min, max 5mg)

Single Ventricle

- ✓ Should be kept 'well filled' to facilitate venous return and hence pulmonary blood flow
- ✓ Should avoid prolonged starvation and dehydration
- ✓ Should be intubated and positive pressure ventilation provided
- ✓ Small tidal volumes (≤7ml/kg) should be set to avoid increased (PVR) seen with large tidal volumes
- ✓ EtCO2 should be controlled to avoid unwanted PVR changes from hyper or hypoventilation, and importantly, to ensure adequate venous return from the cerebral circulation into the SVC

Transoesophageal echocardiography (TOE)

- ✓ TOE is used to guide interventions (secundum ASD device placement) or to improve diagnostic information when trans-thoracic echocardiography is found to have lower diagnostic capability
- ✓ Tracheal intubation and controlled ventilation is required
- ✓ A diagnostic TOE is generally a short procedure requiring only a brief period of intubation
- ✓ An intermediate acting muscle relaxant to facilitate intubation
- ✓ Some centres may have the benefit of having rocuronium and sugammadex available

INTERVENTIONAL PROCEDURES

- ✓ Interventional procedures must only be conducted in centres where surgical back up is immediately available to assist with complications
- ✓ Blood should be cross-matched and immediately available
- ✓ Most interventions aim to either close an open or unwanted defect, or enlarge or create a defect
- ✓ Interventional catheters have larger diameters than those used in diagnostic procedures and carry an increased risk of vascular injury

Common interventions performed in the cath lab include:

- PDA closure
- ASD closure
- Pulmonary valvotomy
- Aortic valvotomy
- Atrial septostomy
- Vascular stents (coarctation, pulmonary vessels)
- Occlusion of collateral vessels
- Pulmonary valve insertion

Patent ductus arteriosus (PDA) closure

- ✓ Leads to pulmonary overflow and congestive heart failure
- ✓ Repeated chest infections and failure to thrive
- ✓ Small isolated PDAs are amenable for device closure in the cath lab
- ✓ Most anaesthetic agents reduce SVR and shunting across the PDA, so avoid high FiO2
- ✓ Balanced anaesthetic technique with intubation and ventilation
- ✓ Possible to manage using ketamine in a spontaneously breathing patient

Atrial septal defect (ASD) closure

- ✓ ASD can be closed percutaneously under angiographic and TOE guidance
- ✓ Indications for ASD closure using a percutaneous device is based on size, anatomy and location of the defect
- ✓ Indications for elective closure;
  - ✓ Excess pulmonary overflow from a significant shunt pulmonary flow [Qp] / systemic flow [Qs] ratio > 1.5
  - ✓ Right ventricular overload

- ✓ **Prophylactic intravenous antibiotics** within 30 minutes of the start of the procedure
- ✓ **Anticoagulation with heparin** according to local protocol
  - ✓ If the ASD is deemed unsuitable for device closure following angiography, the heparin should be reversed with protamine, guided by the activated clotting time (ACT)
- ✓ **Particular care to check for bleeding** after the procedure if a large sheath has been used and the puncture site should be **compressed for at least 10 minutes**
- ✓ ASD device closure complications
  - ✓ Arrhythmias
  - ✓ Trauma to cardiac structures
  - ✓ Air embolism

- Embolization of the septal occluder →
  - The device will need to be retrieved urgently by the interventional cardiologist
  - If it is not achievable, cardiothoracic surgery

Pulmonary Valvotomy

- **Significant pulmonary valve (PV) stenosis**
  - Pressure gradient across the PV >50mmHg
  - It is an indication for pulmonary valvotomy
- The PV area may be very small or slit like and the right ventricular (RV) outflow is easily occluded when catheterized
- During this time, the patient will become profoundly desaturated as the pulmonary blood flow is obstructed

Pulmonary Valvotomy

- The catheter should be withdrawn until the SpO2 normalizes
- A balloon tipped catheter is inserted under fluoroscopic control and the balloon inflated momentarily to split the commissure between the valve leaflets
- A post procedure pressure gradient across the PV <40 mmHg is usually acceptable

Aortic valvotomy

- **Children with significant aortic stenosis (AS)**
  - Left ventricular hypertrophy
  - Reduced left ventricular function
- SVR must be maintained to prevent coronary ischaemia
- Aortic valvotomy via balloon dilatation is indicated if:
  - Aortic valve (AoV) pressure gradient >70 mmHg
  - AoV pressure gradient >50 mmHg with symptoms such as chest pain, or if there is evidence of ischaemia on ECG

- During placement of the balloon tipped catheter across the valve, blood flowing through the left ventricular outflow tract may displace the balloon device away from the AoV
- Rapid overdrive pacing can be used to reduce cardiac output during this procedure to reduce the cardiac output acutely and improve the success of the procedure
- Severe aortic incompetence (AI) from over dilatation of the AoV can result in coronary insufficiency

Coarctation of the aorta (CoA)

- **Severe coarctation** usually requires surgery in early infancy
- **Moderate CoA/residual stenosis** after initial surgical treatment can be treated in the cath lab
  - In suitable young patients, balloon angioplasty
  - In older children, a stent may be placed across the coarctation if the anatomy is amenable
- Complications; aortic rupture, aortic dissection, cerebrovascular events, femoral artery trauma, thrombosis and aneurysm formation
- Cross matched blood must be available

- Older children often have **upper limb hypertension**; place the **blood pressure cuff or an arterial line on the right arm** to obtain a true measure of the blood pressure
- Anaesthesia should aim to maintain haemodynamic stability, but **not reduce arterial blood pressure excessively**
  - In young children; inhalational anaesthesia with small doses of opioid (fentanyl [1-2 mcg/kg] or ketamine [0.5mg/kg])
  - In older children; total intravenous anaesthesia techniques

Balloon Atrial Septostomy (BAS)

- Main indication is to **improve mixing** between systemic and pulmonary circulations in neonates with **dextro-transposition of the great arteries (d-TGA) and insufficient oxygenation, prior to corrective surgery**
- Neonates with TGA
  - Usually present with hypoxia and acidaemia
  - Those with better mixing, such as patent ductus arteriosus (PDA) have a better chance of survival
  - BAS may also be used to improve mixing in other cyanotic CHD's (pulmonary atresia with intact ventricular septum, tricuspid atresia, and hypoplastic left heart syndrome)

Balloon Atrial Septostomy (BAS)

- ✓ A balloon-tipped catheter is passed across the foramen ovale from the right atrium to the left atrium and pulled back with the balloon inflated to create the septostomy
- ✓ The procedure is carried out under ECHO guidance with or without sedation
- ✓ Well-tolerated in skilled cardiology hands

Ventricular septal defect (VSD) closure

- ✓ VSD device closure is complex and requires general anesthesia with tracheal intubation and TOE guidance
- ✓ There is a high risk of cardiovascular instability and long operating time
- ✓ Should only be undertaken in experienced centres

Cardiac tamponade

- ✓ Cardiac tamponade impairs venous return and leads to a reduction in cardiac output (CO)
- ✓ Maintaining heart rate is crucial to avoid rapid decompensation
- ✓ Vasoactive drugs (atropine and epinephrine) should be prepared in advance
- ✓ Children with severe tamponade are very sick
- ✓ Ketamine is the anaesthetic drug of choice
- ✓ Maintenance of preload is crucial in tamponade

Cardiac tamponade

- ✓ Spontaneous breathing is better tolerated than positive pressure ventilation as this may impede venous return further, increase RV afterload, and further reduce CO
- ✓ After draining the tamponade (usually using a catheter) a sudden return in pulmonary blood flow may precipitate pulmonary edema
- ✓ Invasive monitoring is essential for these high-risk cases

Electrophysiology (EP) Studies

- ✓ Symptomatic cardiac arrhythmias can be treated in the cath lab
  - ✓ Radiofrequency ablation
  - ✓ Cryoablation of the abnormal conduction pathways
- ✓ Patients stop their anti-arrhythmic drugs prior to the study, but anaesthesia suppresses endogenous sympathetic drive, and provocation of the arrhythmia during the procedure can be more difficult
- ✓ Fine balance to ensure the patient is fully anaesthetised, not too deep under the anaesthetic but importantly not aware

- ✓ **General anaesthesia with tracheal intubation is necessary** for EP studies as these are long procedures with multiple large intravascular catheters
- ✓ **Propofol based total intravenous anesthesia** is popular
- ✓ **Sevoflurane+opioids** is alternative
- ✓ **Dexamethasone** should not be used as a routine antiemetic in these patients, as limits the size of the radiofrequency ablation 'burn'

- ✓ Uncommon, but **severe arrhythmias** (ventricular fibrillation, sustained ventricular tachycardia) must be managed with **defibrillation**
- ✓ **Supra-ventricular tachycardias** may respond to adenosine, but must be cardioverted if the patient is compromised

COMMON COMPLICATIONS SEEN IN THE CATH LAB

Anaesthesia related complications

- ✓ Patients may have limited pulmonary and cardiovascular functional reserve
- ✓ Respiratory depression and hypoxia occur quickly following induction of anaesthesia, especially in neonates and infants
  - ✓ Adequate monitoring of breathing is essential
- ✓ All anaesthetic agents are direct cardiovascular depressants
- ✓ Ketamine
  - ✓ Direct myocardial depressant activity
  - ✓ Stimulatory effect via catecholamine reuptake inhibition
  - ✓ Delirium, which can be ameliorated with midazolam in older patients

Anaesthesia related complications

- ✓ Opioids such as fentanyl
  - ✓ Excellent option as part of a multi-modal technique
  - ✓ Commonly associated with post-operative nausea and vomiting
  - ✓ Anti-emetics should be used routinely in older children

Environment related complications

Cold environment and hypothermia

- ✓ The cath lab is cold environment and especially neonates and infants can develop hypothermia easily
- ✓ Hypothermia will delay recovery from anaesthesia and may lead to arrhythmias
- ✓ Temperature recorded throughout the case
- ✓ Active warming should be used

Procedure-related complications

- ✓ **Compromised vascular perfusion**
  - ✓ Vascular access with large sheaths can compromise distal perfusion
  - ✓ Poor perfusion or even ischaemia of the lower limbs
- ✓ **Arrhythmias**
  - ✓ Occur frequently and are mostly due to intracardiac catheters
  - ✓ Usually resolve with catheter withdrawal
  - ✓ Other causes; electrolyte disturbances, hypercapnia, coronary air embolism
- ✓ Contrast is **nephrotoxic** and may precipitate an **allergic reaction**, and occasionally intractable coughing
  - ✓ Should limit the contrast load as far as possible

Other less common complications

- ✓ Embolization of the device
- ✓ Catheter fracture
- ✓ Valvular trauma
- ✓ Cardiac tamponade
- ✓ Vascular trauma
- ✓ Bleeding at femoral access sites

- Most complications are dealt with in the cath lab
- Occasionally more severe complications require emergency surgery

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- ✓ It is important to understand the individual cardiac anatomy and physiology of each child
- ✓ Aim to deliver the safest and most effective balanced anaesthetic in the cath lab
- ✓ Cooperate with the cardiologist to understand their requirements for each case
- ✓ Like other remote anaesthetic sites, the full range of safety checks, including blood availability, must be in place for any unwanted complication might occur

TAKE HOME MESSAGE

- ✓ Anaesthesia for children with complex cardiac disease in the remote environment of a cath lab can be challenging
- ✓ Recurrent chest infections are common in children with cardiac disease, so respiratory infections should be treated before proceeding with elective cases
- ✓ Fasting should be kept to a minimum and dehydration avoided
- ✓ It is important to maintain normothermia with active warming

Session 4.

Fluid and Transfusion

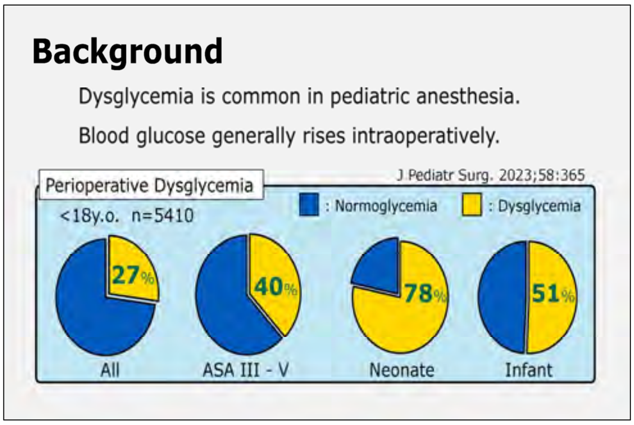
Chair(s): Yoshie Taniguchi (Japan)

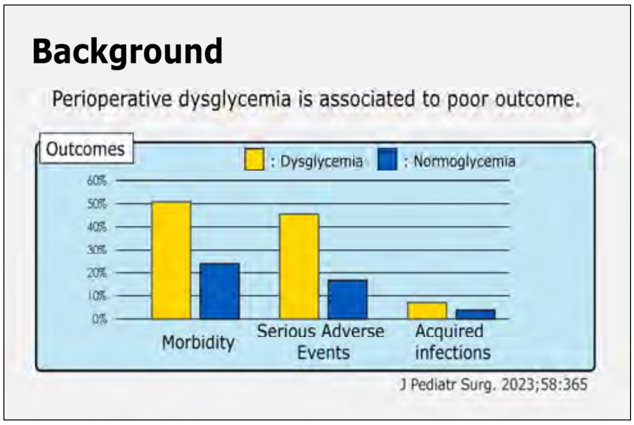
Sun Young Park (Korea)

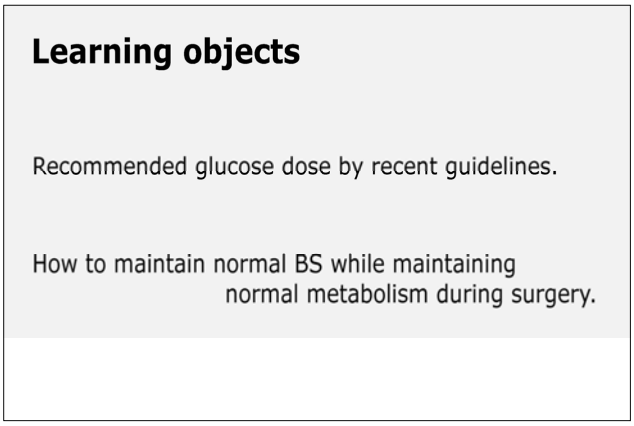
Perioperative Glucose Management: Would You Like Some Sugar?

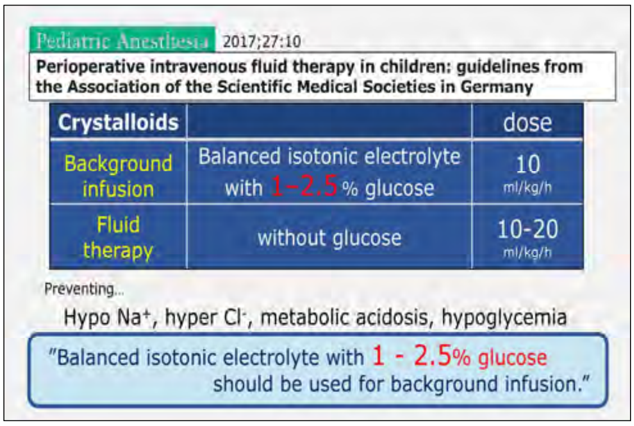
Mineto Kamata

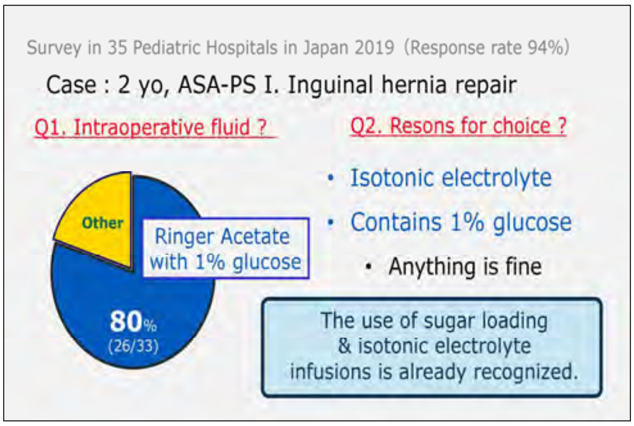
Saitama Medical University International Medical Center, Japan

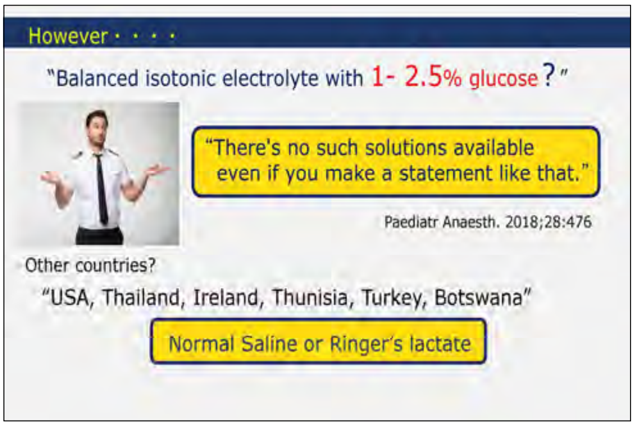












Evidence: in Minor surgery 2 RCTs

Patient: 40 infants for cleft lip or palate repair

Intervention: glucose in fluids ① 1% vs 2%, ② 0% vs 1%

Comparison: intraoperative BS level

① Glucose in fluid		1% vs 2%	
Age in months		10.3 ± 5.6	9.1 ± 4.3
BS (mg/dl)	induction	Not significant	
	60 min		
	120 min		

Anesth Essays Res. 2019;13:631

② Glucose in fluid		0% vs 1%	
Age in months		8.4 ± 3.7	8.3 ± 3.6
BS (mg/dl)	induction	Not significant	
	60 min		
	120 min		

J Anaesthesiol Clin Pharmacol. 2020;36:162

If it's just for BS, glucose is not essential.

Any benefit of actively adding sugar?

Randomized Controlled Trial
Intravenous dextrose *versus* ondansetron for prevention of postoperative vomiting in children: a randomized non-inferiority trial Can J Anaesth. 2020;67:1333

Intraoperative Glucose for antiemetic prophylaxis

Patient : 3-9yo, GA for ambulatory surgery (dental) (n=300)

Control : ondansetron 0.15mg/kg (max 4mg) + NS

Intervention : No ondansetron + NS with 5% glucose

Dextrose supplementation was not as effective as ondansetron in preventing PONV.

Neonate

Premature 23w 300g ~ term 41w 4kg

Premature
Gluconeogenesis
Glycogen storage → Hypoglycemia

BS drop temporarily after birth → stabilize around 80mg/dL after 72 hrs

Glucose administration rate (GIR) required to maintain BS.

4~8 mg/kg/min (240 - 480mg/kg/h)

Glucose 1% (10mg/ml) → 24~48 ml/kg/h

High-concentration glucose infusions are required. (e.g., 10% glucose)

Target for Neonate ?

Prolonged hypoglycemia affects neurodevelopment.

NEJM. 2015;373:1507

"BS>47mg/dL was not associated with an adverse neurologic outcome at 2y.o."

Hyperglycemia > 150 mg/dL persistence can result in

- Intracranial hemorrhage
- BPD
- Kidney Injury
- ROP
- NEC etc.

Perinat Med. 2007;35:245

In the late neonatal period and later in infancy, it would be about 80-140 mg/dL.

Neonatal ERAS guideline

Consensus Guidelines for Perioperative Care in Neonatal Intestinal Surgery: Enhanced Recovery After Surgery (ERAS®) Society Recommendations World J Surg. 2020;44:2482

ERAS Society

Perioperative fluid management

Isotonic solutions with glucose are recommended.

Avoiding
Hypovolemia
Hyponatremia
Fluid overload
Hyperglycemia

Recommended BS level
60 - 126 mg/dL

"Optimal perioperative blood glucose levels are unknown. It will be managed slightly higher to avoid hypoglycemia."

BS is normal, is it enough good?

Paediatr Anaesth. 2016;26:599

Patient: Neonates undergoing esophageal atresia repair (n=45)

Intervention: glucose in fluids 1% vs 2% vs 4% 10ml/kg

Comparison: Perioperative BS and insulin level

<Result①: BS level>

BS mg/dL	induction	Post ope	PO 24h	PO 48h
1%	68	158	139	99
2%	82	166	120	108
4%	74	175	85	100
P value	NS	NS	0.006	NS

<②: insulin level>

induction	Post ope
6.0	6.0
5.5	7.0
7.8	10.8
NS	0.035

Glucose administered intraoperatively affects metabolism.

Do you check BS intraoperatively ?

NECTARINE

Morbidity and mortality after anaesthesia in early life: results of the European prospective multicentre observational study, neonate and children audit of anaesthesia practice in Europe (NECTARINE)
n = 6,542 BJA. 2021;126:1157

Risk factors for intraoperative hypoglycemia in children: a retrospective observational cohort study n = 73,592 Can J Anaesth. 2020;67:225

Association of dysglycemia with post-operative outcomes in pediatric surgery n = 12,252 J Pediatr Surg. 2023;58:365

Only 10 - 50% of cases were checked BS intraoperatively.

Perioperative BS abnormalities are likely to be overlooked.

Summary

ASPA 2023

- Perioperative dysglycemia is common and associated with poor outcome.
- Glucose administration may not be essential for minor surgeries in healthy children but is essential in neonates.
- Perioperative dysglycemia may be overlooked, and proactive BS checks may improve outcomes.

No More Hypotonic Fluid!

Hyungmook Lee

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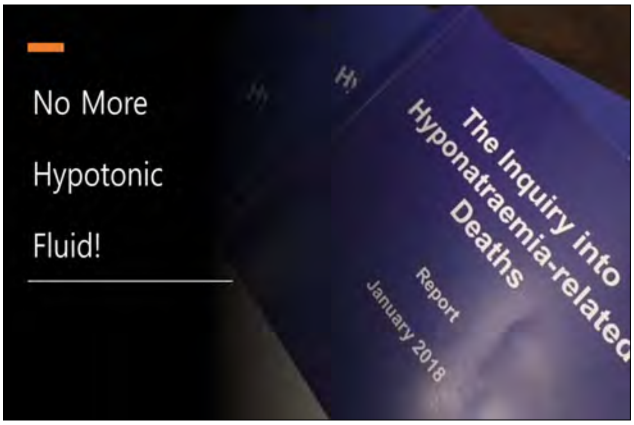

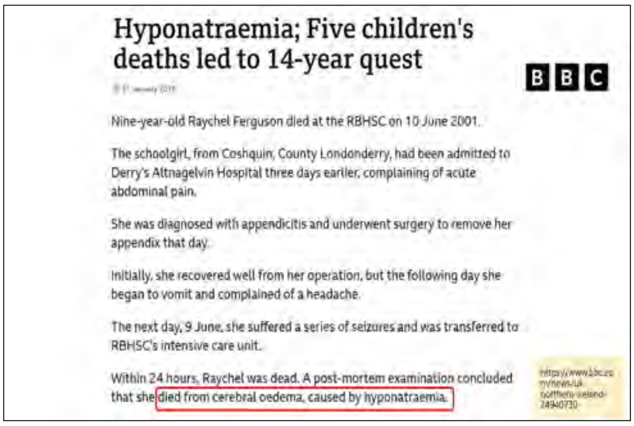

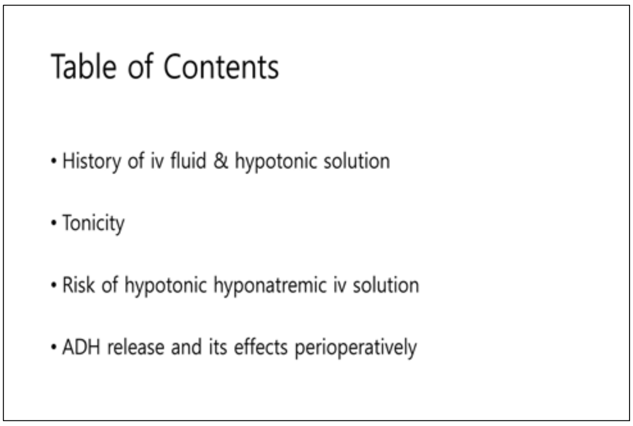

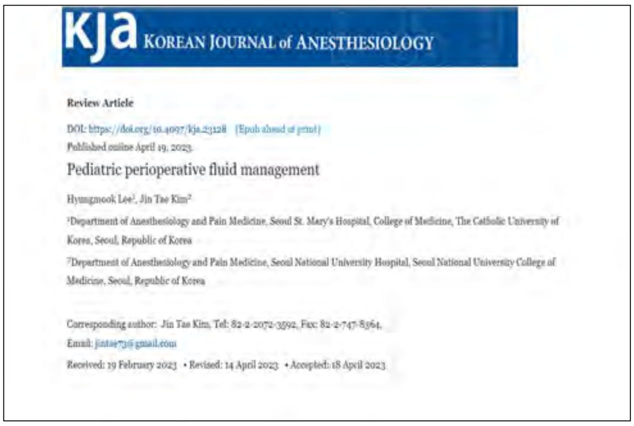
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Review Article

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Pediatric perioperative fluid management

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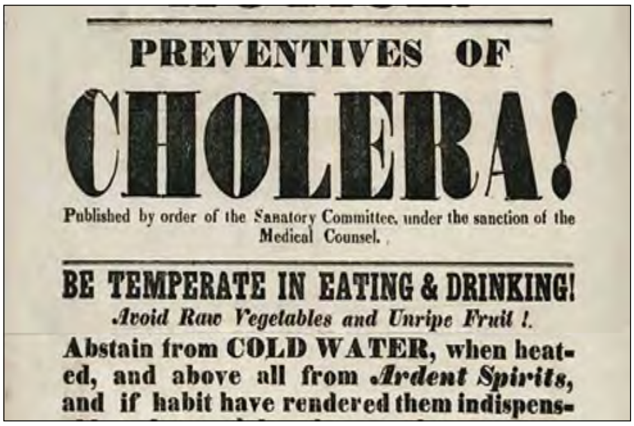


1832: 1st iv injection into human

SALINE VENOUS INJECTION
IN CASES OF
MALIGNANT CHOLERA,
PERFORMED WHILE IN THE
VAPOUR-BATH.
By THOMAS LATTA, M.D., Leith.
To the Editor of THE LANCET.

sodium 106mmol/L

chloride 78mmol/L

carbonate 14mmol/L

- 1882 : Ringer's lactate
- 1888 : 1st normal saline (We don't know why it is normal)
  - 150 mmol Na, 128 mmol Cl, 2.5 mmol PO_4^{2-}, and 27 mmol CO_3^{2-} in 1000 ml of water
- 1921 : 1st scientific support of 0.9% NaCl as an isotonic solution
- 1932 : Hartmann's solution

THE MAINTENANCE NEED FOR WATER IN PARENTERAL FLUID THERAPY

By Malcolm A. Holliday, M.D., and William E. Segar, M.D.

Department of Pediatrics, Indiana University Medical Center

~10kg : 100cal/kg/day -> 4.2 cal/kg/hr

10~20kg : 50cal/kg/day -> 2.1 cal/kg/hr

20kg ~ : 20cal/kg/day -> 0.8 cal/kg/hr

~10kg : 4.2 ml/kg/hr

10~20kg : 2.1 ml/kg/hr

20kg ~ 0.8ml/kg/hr

4-2-1 rule

Pediatrics 1957;19;823

Daily requirement

- Na 3mEq/100cal/day
- K 3mEq/100cal/day

Pediatric maintenance fluid -> hyponatremic solution

- If BW is 20kg, daily requirements are
  - Fluid : (4*10+2*10)*24 = 1440 ml/day
  - Na : 3*(1440/100) = 43.2 mEq/day (30 mEq/L)
    - 1:4DS (Na : 30mEq/L) 1440mL/day
    - 1:2DS (Na : 51mEq/L) 860mL/day + 5DW 580 ml/day

Misconception of renal maturation

- False belief in the past
  - Immature kidneys could not handle the high sodium loads
- Routine maintenance & replacement fluid
  - 5% dextrose quarter normal saline (D5 0.25 NS)
  - 5% dextrose water

The development of pediatric fluid resuscitation: an interview with Dr. Frederic A. Fritz Berry
Pediatric Anesthesia 24(2014) 211-222, doi:10.1111/pan.12309

TABLE 6.3 Maturation of Renal Function with Age

Measurement	Premature Newborn	Full-Term Newborn	1–2 Weeks	6 Months–1 Year	1–3 Years	Adult
GFR (mL/min/1.73 m²)*	14 ± 3	40.6 ± 14.8 (32%)	65.8 ± 24.8	77 ± 14 (62%)	96 ± 22	Male: 125 ± 15 Female: 110 ± 15
RBF (mL/min/1.73 m²)	40 ± 6	88 ± 4	220 ± 40	352 ± 73	540 ± 118	620 ± 92
Tm_{PAH} (mg/min/1.73 m²)	10 ± 2	16 ± 5	38 ± 8	51 ± 20	66 ± 19	79 ± 12
Maximal concentration ability (mOsm/kg)	480	700 (50%)	900	1200 (86%)	1400	1400
Serum creatinine (mg/dL)	1.3	1.1	0.4	0.2	0.4	0.8–1.5
Tm_P/GFR (mg/dL)	—	7.39 ± 0.37	—	5.58 ± 0.28	5.71 ± 0.28	3.55 ± 19
Fractional excretion of sodium (%)	2%–6%	<1	<1	<1	<1	<1
Tm_G (mg/min/1.73 m²)	—	—	71 ± 20	—	—	339 ± 51

*GFR, Glomerular filtration rate; RBF, renal blood flow; Tm_{PAH}, tubular maximum for paraaminohippuric acid; Tm_P, tubular maximum for phosphorus; Tm_G, tubular maximum for reabsorption of glucose.

Smith's Anesthesia for Infants and Children, Tenth Edition, 2022
Ch. 6 Regulation of fluids and electrolytes

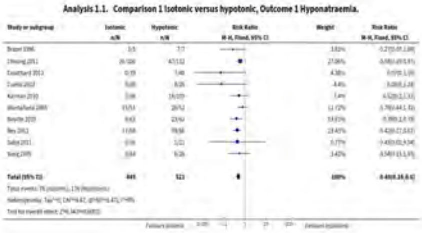
Isotonic versus hypotonic solutions for maintenance intravenous fluid administration in children (Review)

McNab S, Ware RS, Neville KA, Choong K, Coulthard MG, Duke T, Davidson A, Dorofaeff T

Cochrane Database of Systematic Reviews 2014, Issue 12. Art. No.: CD009457.

isotonic fluid had a substantially lower risk of hyponatraemia (17% versus 34%; RR 0.48; high quality evidence)

Analysis 1.1. Comparison 1 Isotonic versus hypotonic, Outcome 1 Hyponatraemia.



REVIEW

Fluid therapy for children: facts, fashions and questions

Malcolm A Holliday, Patricio E Ray, Aaron L Friedman

Arch Dis Child 2007;92:546–550. doi: 10.1136/adc.2006.106377

For children admitted for surgery, isotonic saline to counter any hypovolaemia may be given as a measured expansion, 20–40 ml/kg followed by a "keep open" rate.

In 1972 half average maintenance was recommended if there was a possibility that urine output might be limited by non-osmotic stimulated antidiuretic hormone activity (table 2).[a]

Holliday MA. Body fluid physiology during growth. In: Maxwell MH, Kleeman CR, eds. *Clinical disorders of fluid and electrolyte metabolism*. New York: McGraw-Hill, 1972, chapter 13.

Table 2 Calculation of maintenance fluid needs (in ml/100 kcal) as described by Holliday

	[illegible]	[illegible]	[illegible]
[illegible]	40–50	40–50	40–50 (0.5–1.0×UO)
[illegible]	60–75	15–20	-
Total loss	100–125	55–70	40–50
[illegible]	20–10	20–10	20–10
[illegible]	100	30	25 (0.5–1.0×UO)

UO, urine output.

140 mmol/L of sodium versus 77 mmol/L of sodium in maintenance intravenous fluid therapy for children in hospital (PIMS): a randomised controlled double-blind trial

Sarah McNab, Trevor Duke, Mike South, Franz E Babl, Katherine J Lee, Sarah J Arnup, Simon Young, Hannah Turner, Andrew Davidson — Lancet 2015; 385: 1190-97

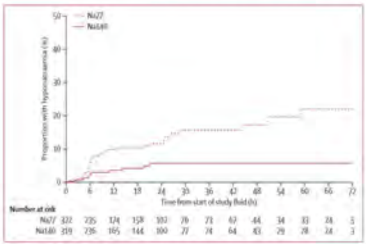


Figure 2: Time to hyponatraemia

Fewer patients given Na140 than those given Na77 developed hyponatraemia

(4% vs 11%, odds ratio 0·31)

	Na^+ (mEq/L)	Cl^- (mEq/L)	K^+ (mEq/L)	Ca^{2+} (mEq/L)	Mg^{2+} (mEq/L)	Glucose (g/L)	Lactate (mEq/L)	Acetate (mEq/L)	Gluconate (mEq/L)	Osmolarity (mOsm/L)	pH
Blood											
Plasma	135-145	94-111	4.5-5.0	2.2-2.6	0.8-1.0	0.07-0.1	1-2			275-295	7.4
Isotonic solution											
0.9% sodium chloride	154	154								308	5.6
Hartmann's solution	131	112	5.4	1.8			28			280	6
Plasma-Lyte A	140	98	5.0		3.0			27	23	294	7.4
Hypotonic solution											
5% dextrose in water						50				280	4
0.45% sodium chloride	77	77								154	5.6
0.3% sodium chloride with 3.3% dextrose (1:2 DS)	51	51				33				285	4.5
0.18% sodium chloride with 4% dextrose (1:4 DS)	30	30				40				284	4.2

Osmolarity

- measurement of the osmotic activity of electrolyte solutions
- the number of osmoles of solute per volume of solution (Osm/L)
- can be measured using an osmometer

Osmolarity

- a simple summation of the osmolarity of all solutes in a solution (theoretical osmolarity) is not equal to the measured value (real osmolarity)
- Theoretical osmolarity of 0.9% NaCl solution = 308 mOsm/L
- Real osmolarity of 0.9% NaCl solution = 286 mOsm/L

Tonicity

- the behavior of a solution when a specific cell is fully submerged
- **Hypotonic Solution**
  - water moves into the cell
  - the submerged **cell swells**

- Primarily determined by Na Concentration

Tonicity & Osmolarity

- Osmolarity
  - All solutes if they are osmotically active.
- Tonicity
  - Only nonpermeable solutes to human cell membranes

Tonicity & Osmolarity (2)

- **0.9% NaCl solution** is considered **isosmotic** and **isotonic**
  - Real osmolarity = 286 mOsmol/L (Human plasma : 288)
  - Both Na and Cl are nonpermeable to human cell membranes
  - Na and Cl are effective solutes for tonicity

Tonicity & Osmolarity (3)

- **5DW** is considered **isosmotic**, but **hypotonic**
  - Real osmolarity = 278 mOsmol/L (Human plasma : 288)
  - glucose can completely permeate human cell membranes
  - glucose metabolizes into energy, CO_2, and water once inside the cell
  - Glucose is not an effective solute for tonicity
  - 5DW is not different from pure water in terms of tonicity

	Na⁺ (mEq/L)	Cl⁻ (mEq/L)	K⁺ (mEq/L)	Ca^{2+} (mEq/L)	Mg^{2+} (mEq/L)	Glucose (g/L)	Lactate (mEq/L)	Acetate (mEq/L)	Gluconate (mEq/L)	Osmolarity (mOsm/L)	pH
Blood											
Plasma	135-145	94-111	4.5-5.0	2.2-2.6	0.8-1.0	0.07-0.1	1-2			275-295	7.4
Isotonic solution											
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0.18% soidum chloride with 4% dextrose (1:4 DS)	30	30				40				284	4.2

HYPONATREMIC

HYPOTONIC

	1:2DS		1:4DS	
NaCl	3g/L (1/3)	0.30%	1.8g/L (1/5)	0.18%
Na	51.3mEq/L		30.8mEq/L	
Dextrose	33.3g/L	3.30%	40g/L	4%
Osmolarity	288mOsm/L		284mOsm/L	

Hyponatraemia: Five children's deaths led to 14-year quest

BBC

Nine-year-old Raychel Ferguson died at the RBHSC on 10 June 2001.

The schoolgirl, from Coshquin, County Londonderry, had been admitted to Derry's Altnagelvin Hospital three days earlier, complaining of acute abdominal pain.

She was diagnosed with appendicitis and underwent surgery to remove her appendix that day.

Initially, she recovered well from her operation, but the following day she began to vomit and complained of a headache.

The next day, 9 June, she suffered a series of seizures and was transferred to RBHSC's intensive care unit.

Within 24 hours, Raychel was dead. A post-mortem examination concluded that she died from cerebral oedema, caused by hyponatraemia.

https://www.bbc.co.uk/news/uk-northern-ireland-24940730

Prepubescent children are more vulnerable to hyponatremia-induced brain edema

- increased brain-size-to-cranial-vault ratio
- decreased Na-K ATPase activity
- increased antidiuretic hormone levels in response to stress

Ayus JC, Achinger SG, Arieff A. Brain cell volume regulation in hyponatremia: role of sex, age, vasopressin, and hypoxia. Am J Physiol Renal Physiol 2008;295:F619-24

Consequences of iatrogenic hyponatremia

- Brain edema
- Loss of CSF & blood
- Increased irritability, headaches, seizures
- Even sudden death due to brain herniation

Post op. physiology – ADH & water retention

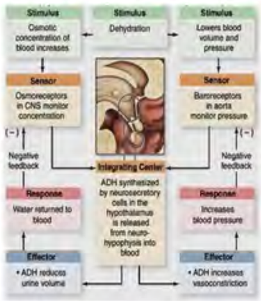

TABLE 9.5 Perioperative Causes of Increased ADH Release
Nonosmotic
Pain
Inflammation
Stress, catecholamines
Surgery; laparoscopic surgery
Vomiting
Hypoxia
Hypercapnia
Medications (e.g., opioids, amiodarone, vincristine)
Respiratory diseases (e.g., asthma, pneumonia, atelectasis)
Central nervous system disorders (e.g., head injury, tumors)
Osmotic
Fasting
Hypovolemia
Hypertonicity
Hypotension
Renal insufficiency
Hepatic insufficiency

Cote and Lerman's a Practice of Anesthesia for Infants and Children, 6th ed. (2019)

Prepubescent children are more vulnerable to hyponatremia-induced brain edema

- increased brain-size-to-cranial-vault ratio
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- increased antidiuretic hormone levels in response to stress

Ayus JC, Achinger SG, Arieff A. Brain cell volume regulation in hyponatremia: role of sex, age, vasopressin, and hypoxia. Am J Physiol Renal Physiol 2008;295:F619-24

REVIEW

Fluid therapy for children: facts, fashions and questions

Malcolm A Holliday, Patricio E Ray, Aaron L Friedman

Arch Dis Child 2007;**92**:546–550. doi: 10.1136/adc.2006.106377

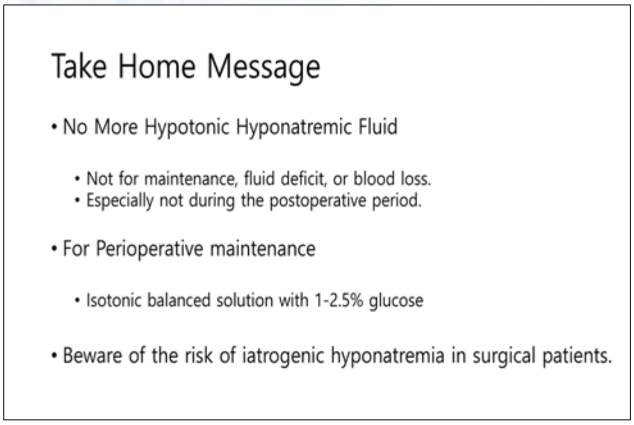
In 1972 half average maintenance was recommended if there was a possibility that urine output might be limited by non-osmotic stimulated antidiuretic hormone activity (table 2).[20]

Holliday MA. Body fluid physiology during growth. In: Maxwell MH, Kleeman CR, eds. *Clinical disorders of fluid and electrolyte metabolism*. 2nd edn. New York: McGraw-Hill, 1972, chapter 13.

Table 2 Calculation of maintenance fluid needs (in ml/100 kcal) as described by Holliday[20]

	Average normal renal responses	Maximal concentration of urine	Anuric, isothenuric, hyposthenuric
Insensible water loss	40-50	40-50	40-50 (0.5-1.0 UO)
Urinary water loss	60-75	15-20	-
Total loss	100-125	55-70	40-50
Water of oxidation, gain	20-10	20-10	20-10
Net need, average	100	50	25+(0.5-1.0 UO)

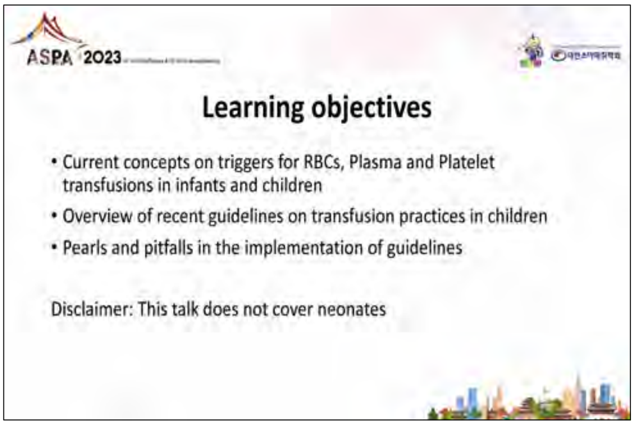
UO, urine output.

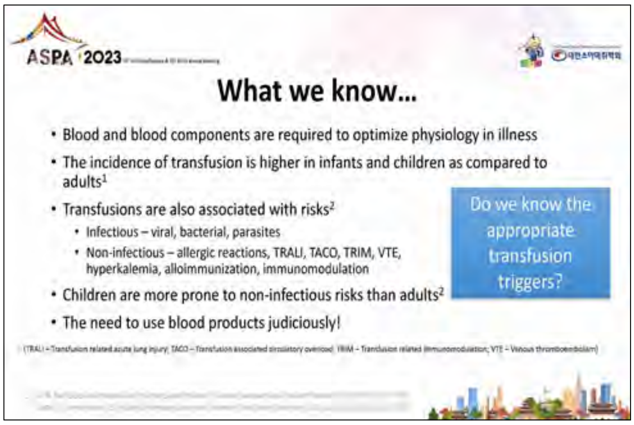

Take Home Message
• No More Hypotonic Hyponatremic Fluid
• Not for maintenance, fluid deficit, or blood loss.
• Especially not during the postoperative period.
• For Perioperative maintenance
• Isotonic balanced solution with 1-2.5% glucose
• Beware of the risk of iatrogenic hyponatremia in surgical patients.

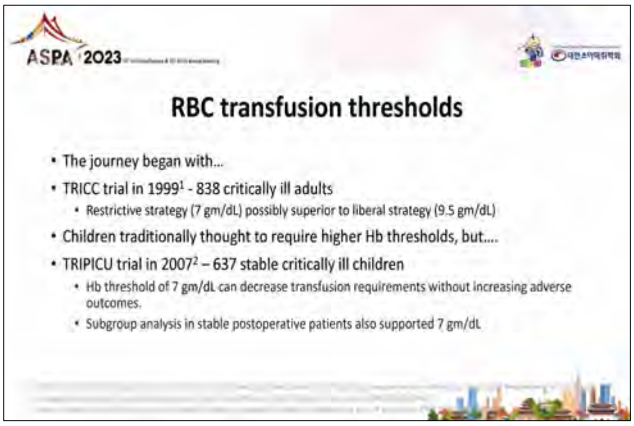
Transfusion Triggers: RBC, Plasma, Platelets

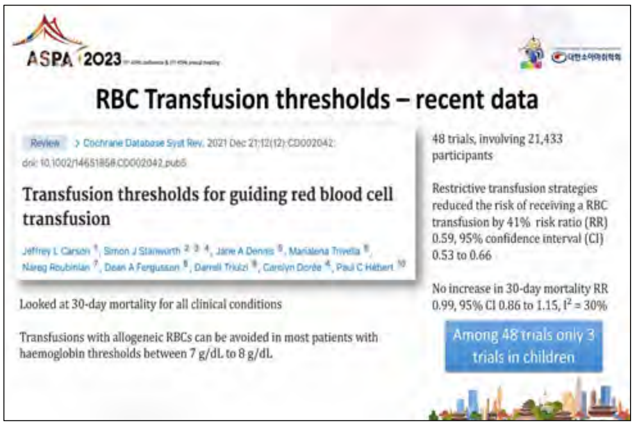
Vibhavari Naik

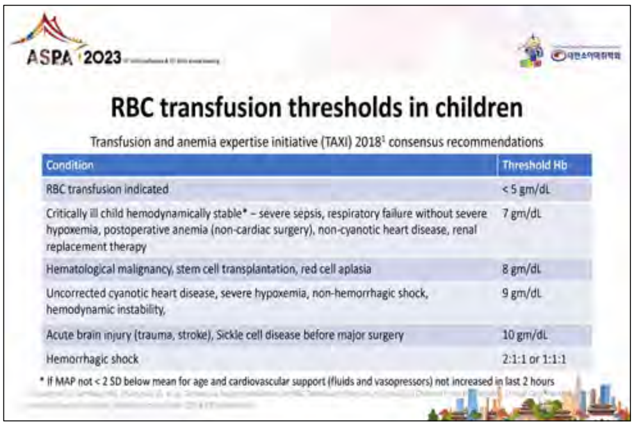
Basavatarakam Indo-American Cancer Hospital and Research Institute, India

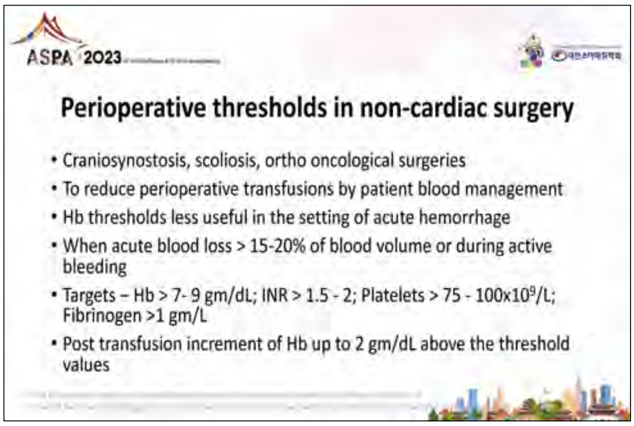




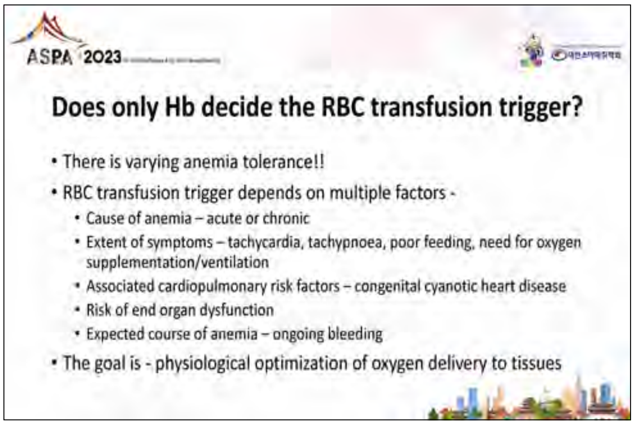


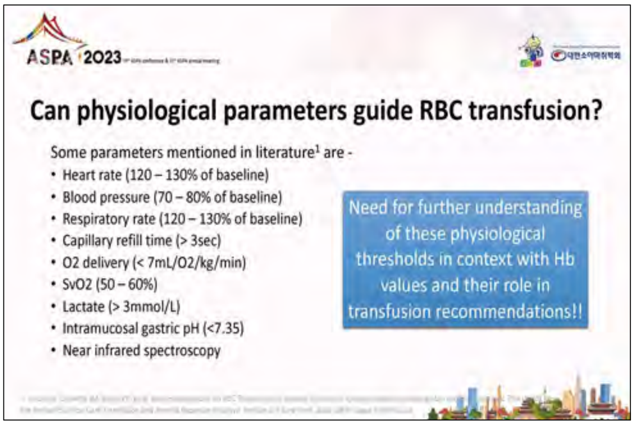


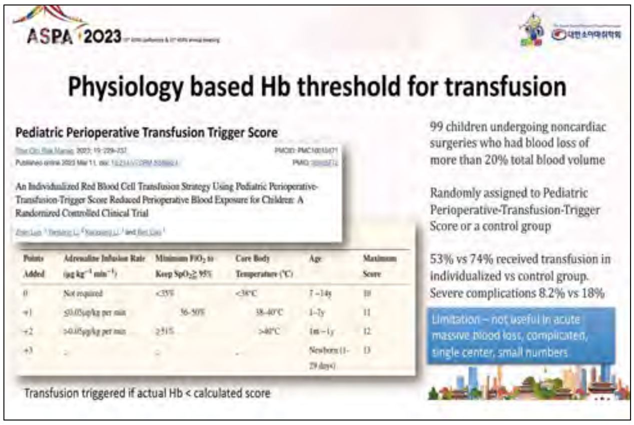


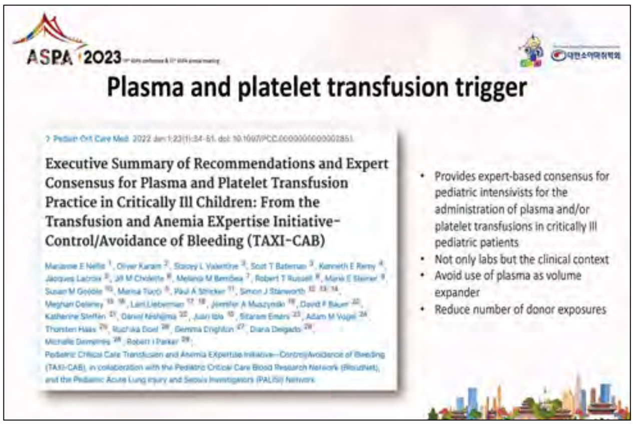


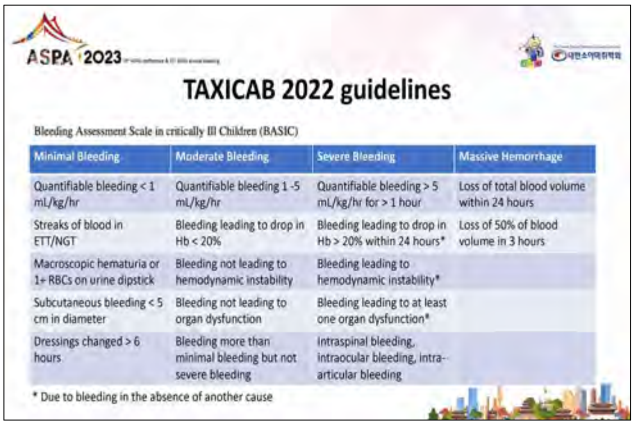

ASPA 2023
Fresh whole blood – still a role?
• Fresh whole blood (< 5 days old) – limited role1
• 32nd edition of AABB guidelines (2020) allow blood banks to issue whole blood - low titer group O/ ABO specific whole blood2
• Advantages
• Replace all components
• Reduce donor exposure1
• Reduced inflammatory markers3
• Role – severe traumatic hemorrhage, complex cardiac surgeries, perioperative massive transfusion
• Limitations – limited availability, storage of whole blood is difficult (Factor V and VIII are labile, platelets deform)

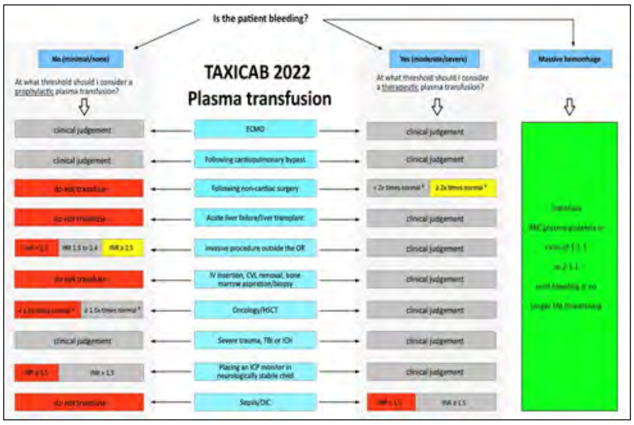

ASPA 2023
Does only Hb decide the RBC transfusion trigger?
• There is varying anemia tolerance!!
• RBC transfusion trigger depends on multiple factors -
• Cause of anemia – acute or chronic
• Extent of symptoms – tachycardia, tachypnoea, poor feeding, need for oxygen supplementation/ventilation
• Associated cardiopulmonary risk factors – congenital cyanotic heart disease
• Risk of end organ dysfunction
• Expected course of anemia – ongoing bleeding
• The goal is - physiological optimization of oxygen delivery to tissues

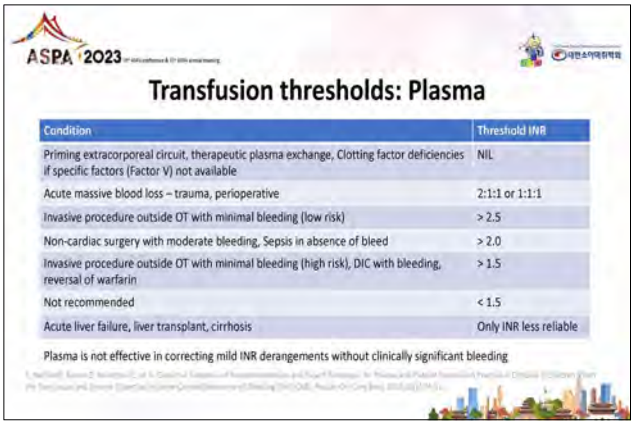

ASPA 2023
Can physiological parameters guide RBC transfusion?
Some parameters mentioned in literature1 are -
• Heart rate (120 – 130% of baseline)
• Blood pressure (70 – 80% of baseline)
• Respiratory rate (120 – 130% of baseline)
• Capillary refill time (> 3sec)
• O2 delivery (< 7mL/O2/kg/min)
• SvO2 (50 – 60%)
• Lactate (> 3mmol/L)
• Intramucosal gastric pH (<7.35)
• Near infrared spectroscopy
Need for further understanding of these physiological thresholds in context with Hb values and their role in transfusion recommendations!!

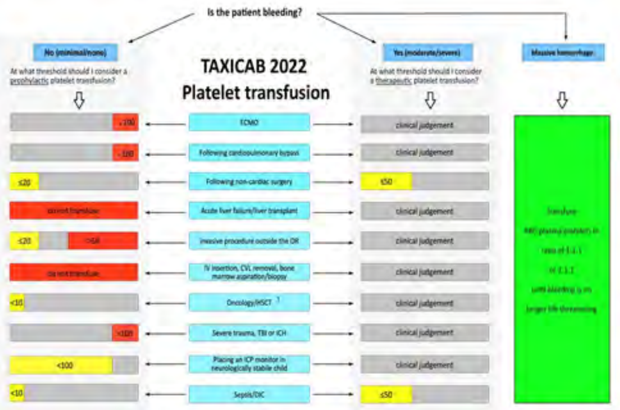

ASPA 2023
Physiology based Hb threshold for transfusion
Pediatric Perioperative Transfusion Trigger Score
An Individualized Red Blood Cell Transfusion Strategy Using Pediatric Perioperative-Transfusion-Trigger Score Reduced Perioperative Blood Exposure for Children: A Randomized Controlled Clinical Trial
Points Added | Adrenaline Infusion Rate (μg kg−1 min−1) | Minimum FiO2 to Keep SpO2 ≥ 95% | Core Body Temperature (°C) | Age | Maximum Score
0 | Not required | <35% | <38°C | 7 – 14y | 10
+1 | ≤0.05μg/kg per min | 36-50% | 38-40°C | 1–7y | 11
+2 | >0.05μg/kg per min | ≥51% | >40°C | 1m – 1y | 12
+3 | - | - | - | Newborn (1-29 days) | 13
Transfusion triggered if actual Hb < calculated score
99 children undergoing noncardiac surgeries who had blood loss of more than 20% total blood volume
Randomly assigned to Pediatric Perioperative-Transfusion-Trigger Score or a control group
53% vs 74% received transfusion in individualized vs control group. Severe complications 8.2% vs 18%
Limitation – not useful in acute massive blood loss, complicated, single center, small numbers


ASPA 2023
Plasma and platelet transfusion trigger
Executive Summary of Recommendations and Expert Consensus for Plasma and Platelet Transfusion Practice in Critically Ill Children: From the Transfusion and Anemia EXpertise Initiative-Control/Avoidance of Bleeding (TAXI-CAB)
• Provides expert-based consensus for pediatric intensivists for the administration of plasma and/or platelet transfusions in critically ill pediatric patients
• Not only labs but the clinical context
• Avoid use of plasma as volume expander
• Reduce number of donor exposures


ASPA 2023
TAXICAB 2022 guidelines
Bleeding Assessment Scale in critically Ill Children (BASIC)
Minimal Bleeding | Moderate Bleeding | Severe Bleeding | Massive Hemorrhage
Quantifiable bleeding < 1 mL/kg/hr | Quantifiable bleeding 1 -5 mL/kg/hr | Quantifiable bleeding > 5 mL/kg/hr for > 1 hour | Loss of total blood volume within 24 hours
Streaks of blood in ETT/NGT | Bleeding leading to drop in Hb < 20% | Bleeding leading to drop in Hb > 20% within 24 hours* | Loss of 50% of blood volume in 3 hours
Macroscopic hematuria or 1+ RBCs on urine dipstick | Bleeding not leading to hemodynamic instability | Bleeding leading to hemodynamic instability* |
Subcutaneous bleeding < 5 cm in diameter | Bleeding not leading to organ dysfunction | Bleeding leading to at least one organ dysfunction* |
Dressings changed > 6 hours | Bleeding more than minimal bleeding but not severe bleeding | Intraspinal bleeding, intraocular bleeding, intra-articular bleeding |
* Due to bleeding in the absence of another cause


Is the patient bleeding?
TAXICAB 2022
Plasma transfusion
At what threshold should I consider a prophylactic plasma transfusion?
At what threshold should I consider a therapeutic plasma transfusion?
clinical judgement
ECMO
Following cardiopulmonary bypass
Following non-cardiac surgery
Acute liver failure/liver transplant
invasive procedure outside the OR
IV insertion, CVL removal, bone marrow aspiration/biopsy
Oncology/HSCT
Severe trauma, TBI or ICH
Placing an ICP monitor in neurologically stable child
Sepsis/DIC


ASPA 2023
Transfusion thresholds: Plasma
Condition | Threshold INR
Priming extracorporeal circuit, therapeutic plasma exchange, Clotting factor deficiencies if specific factors (Factor V) not available | NIL
Acute massive blood loss – trauma, perioperative | 2:1:1 or 1:1:1
Invasive procedure outside OT with minimal bleeding (low risk) | > 2.5
Non-cardiac surgery with moderate bleeding, Sepsis in absence of bleed | > 2.0
Invasive procedure outside OT with minimal bleeding (high risk), DIC with bleeding, reversal of warfarin | > 1.5
Not recommended | < 1.5
Acute liver failure, liver transplant, cirrhosis | Only INR less reliable
Plasma is not effective in correcting mild INR derangements without clinically significant bleeding



Transfusion thresholds: Platelets

Condition	Threshold Platelet count
Peripheral line placement, bone marrow aspiration and biopsy, non-tunnelled central line removal, blood draw	Not required to check
Irrespective of signs of hemorrhage (except ITP, TTP/HUS, HIT), stem cell transplantation	< 10 x 10^9/L
Risk of bleeding, sepsis, anticoagulant therapy, non-tunnelled central line insertion	< 20 x 10^9/L
Lumbar puncture, tunnelled central line insertion	20 - 40 x 10^9/L
Non-cardiac surgery with moderate hemorrhage, DIC	< 50 x 10^9/L
Major hemorrhage, surgery in closed cavities - brain, spine, eye, on ECMO	< 100 x 10^9/L

Huge variability in platelet counts and the risk of bleeding because of inability to monitor platelet function routinely

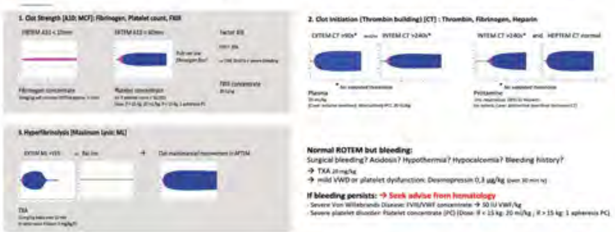
Are we chasing the wrong triggers?

- So far, we discussed transfusion triggers based on standard tests – Hb/Hct (packed cells), PT/INR (plasma), platelet count (platelets)
- Recent literature shows –
  - In comparison to conventional coagulation tests (Platelet count, PT, INR, aPTT, fibrinogen)
  - Viscoelastic testing (TEG, ROTEM, Sonoclot) is more reliable of clot formation and platelet function[1]
  - Application of TEG/ROTEM guided transfusion strategies reduce need for blood products and improve morbidity[2]

Conventional tests vs Viscoelastic tests

Conventional coagulation tests	Viscoelastic tests advantages	Viscoelastic tests limitations
Less expensive	Single device measures real time clot formation in whole blood	Varying nomenclature in different tests
Easy availability	More closely resembles in vivo hemostasis	Non-availability of uniform algorithm
	Assesses multiple pathways of clot formation and stability	Data mainly in trauma, cardiac and liver transplant surgeries
	Can detect hyperfibrinolysis	Limited data in children
	Rapid turnaround (<30 mins)	Unclear reference ranges in less than 1 year
	Reduces blood product transfusions and has better outcomes	Cost and availability!!

Pediatric Perioperative Coagulation Management



Pearls and pitfalls

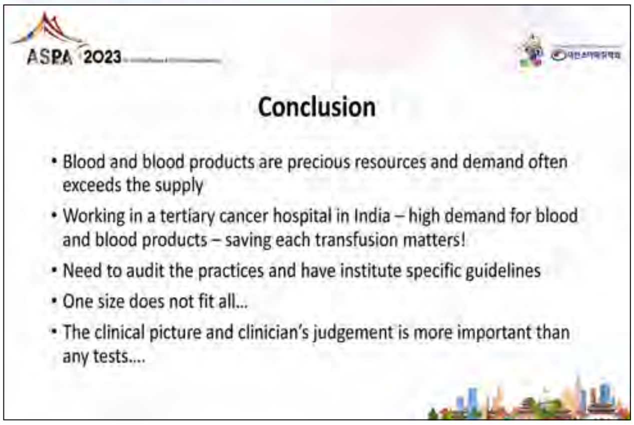
- Iatrogenic blood loss from frequent tests can contribute to anemia in small babies
- Restrictive RBC transfusion threshold of 7 gm/dL is acceptable in hemodynamically stable, non-bleeding critically ill child
- Higher transfusion trigger for those with symptomatic anemia and/or impaired cardiorespiratory function
- Special groups (preterm infants, children with cyanotic heart disease, severe hypoxemia, active blood loss or hemodynamic instability) need higher thresholds

Pearls and pitfalls

- Can thresholds be same for all ethnic groups? Does 'tolerance to anemia' matter?
- RBC transfusions should be focused on improving tissue oxygenation (heart rate, blood pressure, lactate levels) rather than fixed Hb thresholds
- Major blood loss – Is ratio of 2:1:1 or 1:1:1 transfusion better?
- Role of whole blood – reemerging??

Pearls and pitfalls

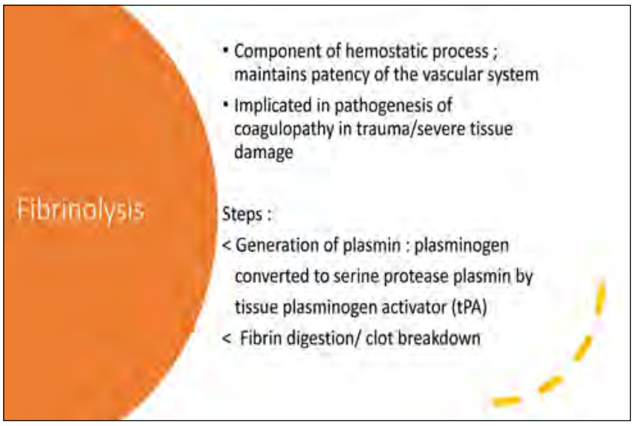
- Plasma should not be used for mild coagulopathy, volume replacement and hypoalbuminemia in children
- Platelet count is not a reliable test for platelet function and decision should be guided on clinical bleeding
- Are we pursuing the wrong markers (Hb, INR, aPTT, platelet count)?
- TEG/ROTEM guided decision making – is this the solution?
- Unclear role, limited utility and high costs of Prothrombin complex concentrate, fibrinogen concentrate have prohibited routine use

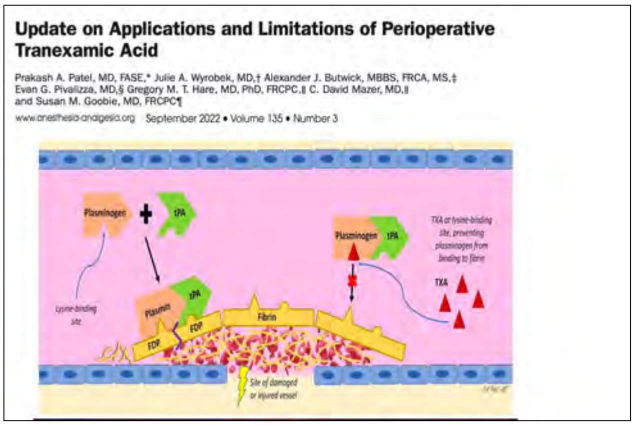

ASPA 2023
Conclusion
• Blood and blood products are precious resources and demand often exceeds the supply
• Working in a tertiary cancer hospital in India – high demand for blood and blood products – saving each transfusion matters!
• Need to audit the practices and have institute specific guidelines
• One size does not fit all...
• The clinical picture and clinician's judgement is more important than any tests....

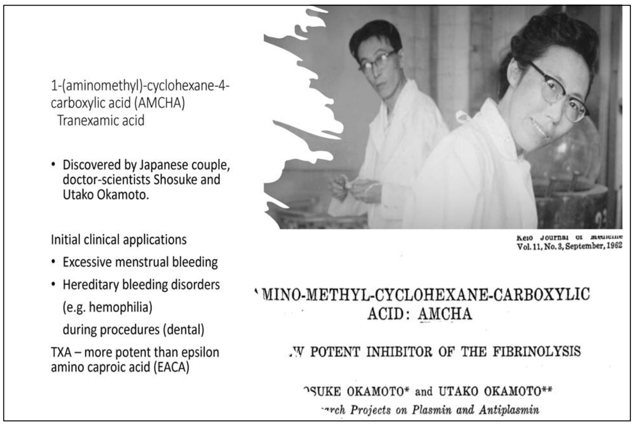
Tranexamic Acid: Antifibrinolysis and Beyond

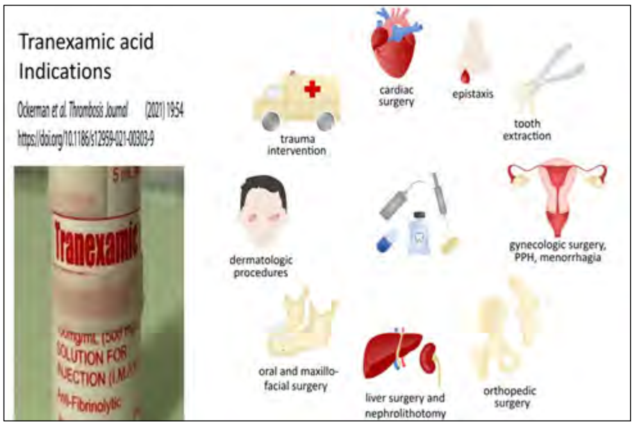
Angelina A. Gapay

Divine Word Hospital, Philippines









Tranexamic acid & perioperative bleeding in children

Susan M. Goobie and David Faraoni. Curr Opin Anesthesiol 2019,32:343-352

Indications
- Prophylaxis/treatment of trauma/surgery with 'major' bleeding/hge
- Prophylaxis/treatment with 'mild/moderate' bleeding
  < strong desire to avoid transfusion or blood is not an option
  < preexisting anemia or coagulopathy
  < preexisting hypofibrinogenemia
  < difficult to crossmatch because of antibodies

Tranexamic acid use in children: reduction in blood loss & allogeneic blood transfusion

Susan M. Goobie & David Faraoni. Curr Opin Anesthesiol 2019, 32:343-352

- Cardiac surgery
- Spinal fusion/scoliosis surgery
- Craniosynostosis
- Neurosurgery (tumor / seizure surgery)
- Major plastic / maxillary surgery
- Major abdominal surgery

Tranexamic acid: Contraindications

Susan M. Goobie and David Faraoni. Curr Opin Anesthesiol 2019,32:343-352

- Absolute
  < Hypersensitivity
  < Active thromboembolic disease
  < Fibrinolytic conditions with consumption coagulopathy
- Relative (risk/benefit ratio needs to be considered)
  < renal impairment/ dysfunction – dose adjustment required
  < acquired or inherited disorder of thrombosis
  < preexisting coagulopathy or oral anticoagulants

Adverse events with Tranexamic acid use

Susan M. Goobie and David Faraoni. Curr Opin Anesthesiol 2019,32:343-352

Rare: ≥1/10 000 to <1/1000
- Allergic skin reactions
- Hypotension (with fast IV injection)
- Nausea, vomiting , diarrhea
- Color vision disturbances

Very rare: <1/1000
- Thromboembolic events(TXA is a clot stabilizer, not clot promoter)
- Convulsions (with high doses)
- Hypersensitivity reactions/ anaphylaxis

Update on Perioperative Tranexamic Use

Patel, Prakash A. MD, FASE*; Wyrobek, Julie A. MD†; Butwick, Alexander J. MBBS, FRCA, MS‡; Pivalizza, Evan G. MD§; Hare, Gregory M. T. MD, PhD, FRCPC‖; Mazer, C. David MD‖; Goobie, Susan M. MD, FRCPC¶

Anesthesia & Analgesia 135(3):p 460-473, September 2022. | *DOI:* 10.1213/ANE.0000000000006039

TXA in cardiac surgery

< Routine TXA use well established/ strongly recommended

< Recent investigations have demonstrated TXA's safety / no increase in thrombotic complications

< Lower dose TXA regimens- lower seizure risk

< Ongoing TXA investigation for optimal dosing strategies

< Use in pediatric cardiac surgery patients should account for additional bleeding risk, age, CP bypass circuit prime

Update on Perioperative Tranexamic Use

Patel, Prakash A. MD, FASE*; Wyrobek, Julie A. MD†; Butwick, Alexander J. MBBS, FRCA, MS‡; Pivalizza, Evan G. MD§; Hare, Gregory M. T. MD, PhD, FRCPC‖; Mazer, C. David MD‖; Goobie, Susan M. MD, FRCPC¶

Anesthesia & Analgesia 135(3):p 460-473, September 2022. | *DOI:* 10.1213/ANE.0000000000006039

TXA in pediatric surgery

< recommended for prophylaxis or treatment in pediatric surgery with high/ moderate risk of bleeding

< dosing regimens based on p'kinetic modeling & simulation which also accounts for bleeding risk

< **Seizures are not a contraindication to TXA use**

< Given that pediatric trials are often small or single center, thrombotic risk in pediatric patients is often extrapolated from larger multicenter adult trials, which is LOW.

Patel, Prakash A. MD, FASE*; Wyrobek, Julie A. MD†; Butwick, Alexander J. MBBS, FRCA, MS‡; Pivalizza, Evan G. MD§; Hare, Gregory M. T. MD, PhD, FRCPC‖; Mazer, C. David MD‖; Goobie, Susan M. MD, FRCPC¶

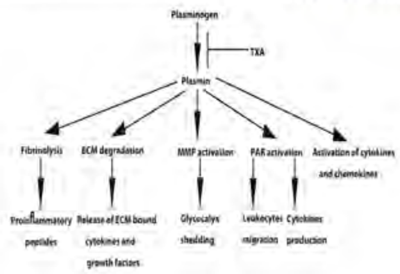
Anesthesia & Analgesia 135(3):p 460-473, September 2022. | *DOI:* 10.1213/ANE.0000000000006039

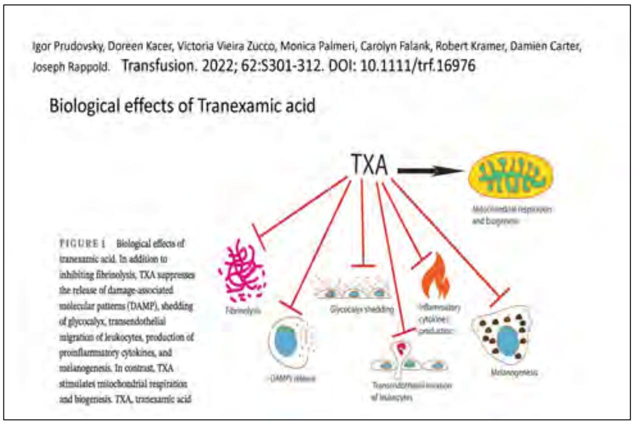
Table 1. Typical Dosing Regimens for Perioperative TXA Administration

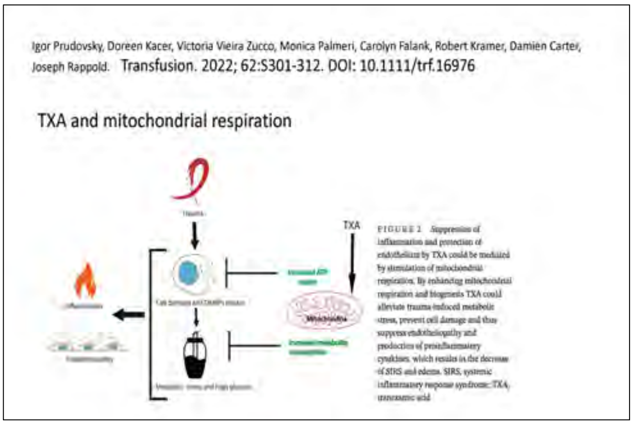
Setting	Typical TXA dosing regimen[a]	Notes
Adult cardiac surgery[10,11]	10–30 mg/kg IV loading dose; then 2–16 mg/kg/h infusion; ±1–2 mg/kg for pump prime	Target plasma concentrations 20–100 μg/mL (depending on desired degree of fibrinolysis inhibition)[2]
Obstetrics[2]	1 g IV over 10 min; can repeat 1 g IV if bleeding persists after 30 min	Recommended to give within first 3 h of birth
Acute trauma[8,12]	1 g IV over 10 min; then 1 g infused over 4–8 h	Recommended to give within first 3 h of injury (ideally within first hour)
Orthopedic surgery[13,14]	10–20 mg/kg IV in single or divided doses (or 1–3 g topical dose)	Target plasma concentration ≥10 μg/mL
Neurosurgery[15]	10 mg/kg IV loading dose; then 0.5–2 mg/kg/h infusion	
Pediatric surgery[16]	10–30 mg/kg IV loading dose; then 5–10 mg/kg/h infusion	Maximum loading dose 2 g; target plasma concentrations between 20 and 70 μg/mL[3]
Pediatric cardiac surgery[16–18]	30 mg/kg (age <12 mo) or 10 mg/kg (age ≥12 mo) IV loading dose; then 10 mg/kg/h infusion; ±addition to pump prime for concentration of 60 μg/mL	Maximum loading dose 2 g; intermediate target plasma concentration 60 μg/mL (lower target concentration of 20 μg/mL or higher target concentration of 150 μg/mL requires dosage scheme adjustment)[2]

Biological effects of plasmin

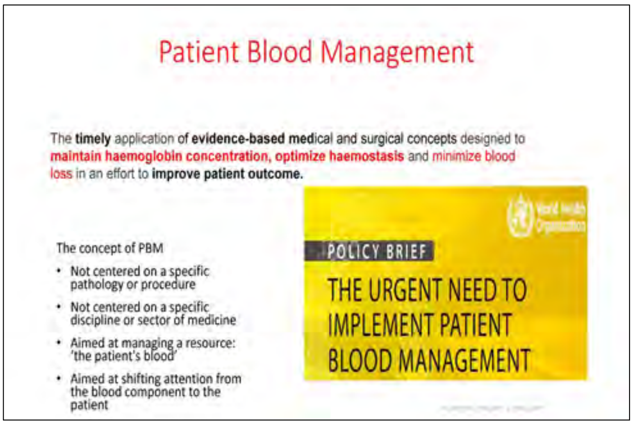
PRUDOVSKY et al. Transfusion 2022;62:S301-S312 TRANSFUSION

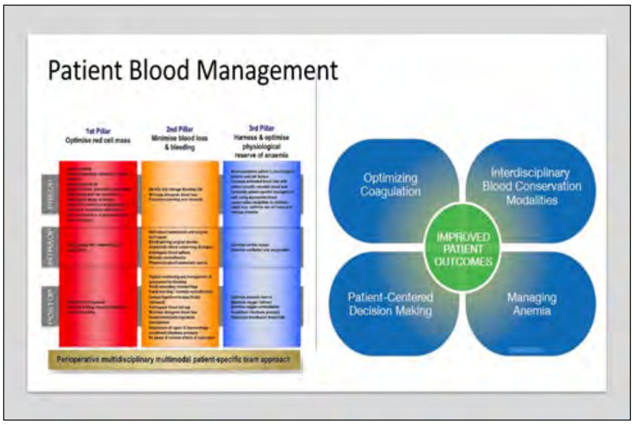


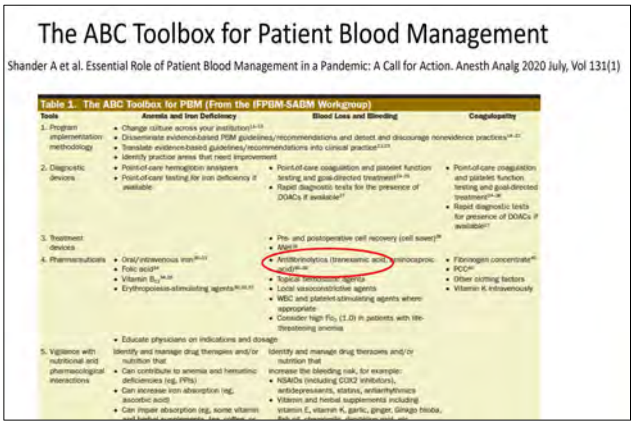

Igor Prudovsky, Doreen Kacer, Victoria Vieira Zucco, Monica Palmeri, Carolyn Falank, Robert Kramer, Damien Carter, Joseph Rappold. Transfusion. 2022; 62:S301-312. DOI: 10.1111/trf.16976
Biological effects of Tranexamic acid
TXA
FIGURE 1 Biological effects of tranexamic acid. In addition to inhibiting fibrinolysis, TXA suppresses the release of damage-associated molecular patterns (DAMP), shedding of glycocalyx, transendothelial migration of leukocytes, production of proinflammatory cytokines, and melanogenesis. In contrast, TXA stimulates mitochondrial respiration and biogenesis. TXA, tranexamic acid

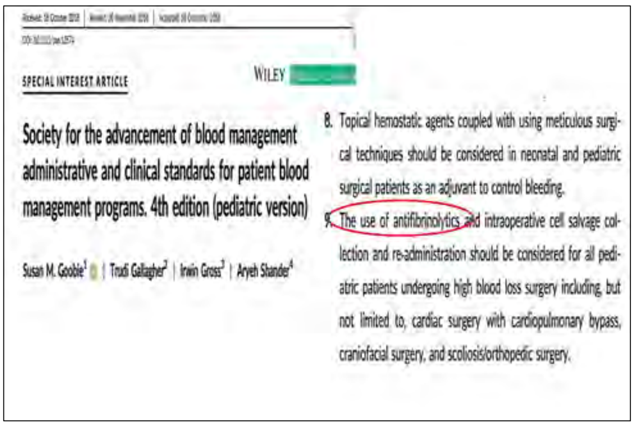

Igor Prudovsky, Doreen Kacer, Victoria Vieira Zucco, Monica Palmeri, Carolyn Falank, Robert Kramer, Damien Carter, Joseph Rappold. Transfusion. 2022; 62:S301-312. DOI: 10.1111/trf.16976
TXA and mitochondrial respiration
TXA
FIGURE 2 Suppression of inflammation and protection of endothelium by TXA could be mediated by stimulation of mitochondrial respiration. By enhancing mitochondrial respiration and biogenesis TXA could alleviate trauma-induced metabolic stress, prevent cell damage and thus suppress endotheliopathy and production of proinflammatory cytokines, which results in the decrease of SIRS and edema. SIRS, systemic inflammatory response syndrome; TXA, tranexamic acid

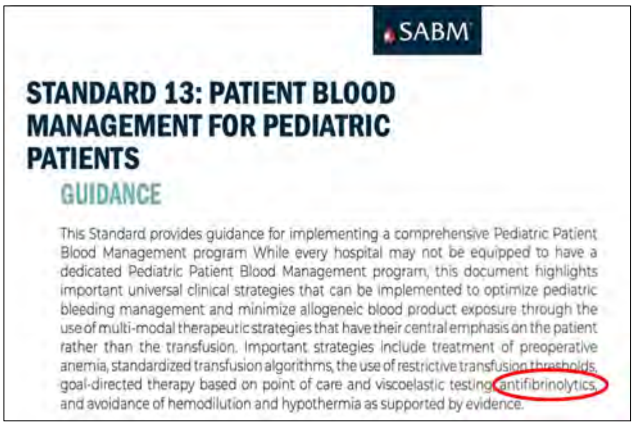

Patient Blood Management: the Role of Tranexamic Acid
Tranexamic


Patient Blood Management
The timely application of evidence-based medical and surgical concepts designed to maintain haemoglobin concentration, optimize haemostasis and minimize blood loss in an effort to improve patient outcome.
The concept of PBM
Not centered on a specific pathology or procedure
Not centered on a specific discipline or sector of medicine
Aimed at managing a resource: 'the patient's blood'
Aimed at shifting attention from the blood component to the patient
POLICY BRIEF
THE URGENT NEED TO IMPLEMENT PATIENT BLOOD MANAGEMENT


Patient Blood Management
1st Pillar
Optimise red cell mass
2nd Pillar
Minimise blood loss & bleeding
3rd Pillar
Harness & optimise physiological reserve of anaemia
Perioperative multidisciplinary multimodal patient-specific team approach
Optimizing Coagulation
Interdisciplinary Blood Conservation Modalities
IMPROVED PATIENT OUTCOMES
Patient-Centered Decision Making
Managing Anemia


The ABC Toolbox for Patient Blood Management
Shander A et al. Essential Role of Patient Blood Management in a Pandemic: A Call for Action. Anesth Analg 2020 July, Vol 131(1)
Table 1. The ABC Toolbox for PBM (From the IFPBM-SABM Workgroup)
Tools
Anemia and Iron Deficiency
Blood Loss and Bleeding
Coagulopathy
1. Program implementation methodology
2. Diagnostic devices
3. Treatment devices
4. Pharmaceuticals
5. Vigilance with nutritional and pharmacological interactions


SPECIAL INTEREST ARTICLE
WILEY
Society for the advancement of blood management administrative and clinical standards for patient blood management programs. 4th edition (pediatric version)
Susan M. Goobie | Trudi Gallagher | Irwin Gross | Aryeh Shander
8. Topical hemostatic agents coupled with using meticulous surgical techniques should be considered in neonatal and pediatric surgical patients as an adjuvant to control bleeding.
9. The use of antifibrinolytics and intraoperative cell salvage collection and re-administration should be considered for all pediatric patients undergoing high blood loss surgery including, but not limited to, cardiac surgery with cardiopulmonary bypass, craniofacial surgery, and scoliosis/orthopedic surgery.


SABM
STANDARD 13: PATIENT BLOOD MANAGEMENT FOR PEDIATRIC PATIENTS
GUIDANCE
This Standard provides guidance for implementing a comprehensive Pediatric Patient Blood Management program While every hospital may not be equipped to have a dedicated Pediatric Patient Blood Management program, this document highlights important universal clinical strategies that can be implemented to optimize pediatric bleeding management and minimize allogeneic blood product exposure through the use of multi-modal therapeutic strategies that have their central emphasis on the patient rather than the transfusion. Important strategies include treatment of preoperative anemia, standardized transfusion algorithms, the use of restrictive transfusion thresholds, goal-directed therapy based on point of care and viscoelastic testing, antifibrinolytics, and avoidance of hemodilution and hypothermia as supported by evidence.

Objectives

1. Revisit tranexamic acid's therapeutic use in the prevention and treatment of bleeding.
2. Evaluate tranexamic acid's activities beyond antifibrinolysis.
3. Know the role of tranexamic acid in Patient Blood Management.

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Abstract Presentation

ASPA 2023

Day 2_Room C

Abstract Presentation 1 (In-person)

Chair(s): Seokyoung Song (Korea)
In-Kyung Song (Korea)

AP1-1

Nasotracheal vs. Orotracheal Intubation and Post-Extubation Airway Complications Among Children Undergoing Congenital Heart Surgery

Deniz Sivrioğlu[1], Nükhet Akovalı[1], Murat Özkan[2], Pınar Zeyneloğlu[1]

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Background: In cardiac surgery, oral intubation is more common due to its ease and lower pain. However, it may be associated with oral aversion in children (1). Moreover, nasal intubation has several benefits; including less trauma, less postoperative sedation, and possibly lower post-extubation airway obstruction rate. There is additional concern that nasal intubation carries an increased risk of epistaxis and sinusitis (2,3). In children undergoing cardiac surgery, extubation failure has been associated with increased morbidity and mortality (4). Studies involving post-extubation airway complications of nasal vs oral intubation in children undergoing congenital heart surgery are not available. The study aims to compare post-extubation airway complications in children undergoing congenital heart surgery after nasal and oral intubation.

Methods: A retrospective observational study was conducted on pediatric cardiac surgery patients <2 years from April 2022 to March 2023. Patients with preoperative endotracheal tube, tracheostomy, known airway anomalies, or those who died before extubation attempt were excluded. Perioperative data were collected from medical records. Standard protocol was followed to perform nasal and oral intubation. Extubation failure was defined as reintubation within 72 hours of the first planned extubation. The primary outcome was the extubation failure rate and secondary outcomes were duration of postoperative intubation, post-extubation airway obstruction, skin trauma, postoperative arrhythmia, bleeding, pneumothorax, cardiac arrest, infection, oral aversion, duration of ICU stay, hospital length of stay, and mortality.

Results: Among 122 children who underwent congenital heart surgery, 107 patients were analyzed and of those, 54 were intubated nasally and 53 orally. The extubation failure rate was similar (22.2 vs 20.8%, respectively, $p = 1.00$). Duration of postoperative intubation was significantly longer among nasally intubated children (39.5 vs 38.7 hours, $p = 0.02$). Nasally intubated patients had a statistically significant lower rate of oral aversion (24.1 vs 47.2 %; $p = 0.02$), but other secondary outcomes were similar in both patient group.

Discussion: In our cohort, the postoperative extubation failure rates were similar after nasal and oral intubation. No significant difference was found in post-extubation airway complications between nasal and oral intubation. Nasal intubation may be a preferable option.

AP1-2

Anesthesia Management of Cleft Lip Repair, Complicated with Gordon Syndrome and Its Challenges

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[1]Department of Anesthesiology, North Goa District Hospital, Mapusa, Goa, India
[2]Department of Anesthesiology, Goa Medical College and Hospital, Bambolim, Goa, India

Background: Cleft lip with cleft palate is an anticipated difficult airway in children, management of which can be demanding if associated with a syndrome. Our patient had Gordon syndrome, also known as distal arthrogyrposis type 3 (DA3) is an autosomal dominant disorder, that mainly affects the movement in the joint of the upper and lower limb, caused by genetic changes in PIEZO 2 gene on chromosome 18p11.Other abnormalities, may also be present and include camptodactyly, club feet, congenital hip dislocation(CDH), cleft palate, bifid uvula, pterygium colli, scoliosis. The intravenous access as well as intubation can be exigent. The anesthetist needs to be well equipped for a difficult airway.

Case Report: We report a case of male infant, with deformity of lips, palate and face.He was posted for cheiloplasty(lip repair).He had complete bilateral cleft lip and palate, buphthalmos with megalocornea, prolapsed iris (left eye), ectropion, coloboma as well as, congenital hip dislocation, deformity at elbow and flexion at wrist joint. He had short neck, retroganthia as well distortion of cervical spine. We managed the airway as per DAS/APA guidelines for 'Anticipated Difficult Airway in pediatrics' using inhalational technique for intubation, balanced general anesthesia for with infra-orbital block. Intubation and surgery were uneventful

Discussion: Patients with Gordan syndrome may undergo at least 1 surgical procedure for the arthrogrypotic deformities. These underlying abnormalities are challenging to the anesthetists, and causes difficult intravenous access and anticipated difficult intubation.
Anticipated difficult airway is due to facial and neck involvement which may include micrognathia, cleft lip and palate, retro-glossoptosis, limited mouth opening, and limited neck extension, requiring skills, preparedness and advanced airway equipment.

Conclusions: Airway management of children with cleft lip in Gordan syndrome is an arduous task for an Anesthetist, it needs expertise, accessibility of modern airway equipment and knowledge of difficult airway guidelines.

AP1-3

~~Pediatric Airway Management in Undiagnosed Congenital Subglottic Stenosis Undergoing Congenital Cardiac Surgery~~

Virtual

AP1-4

Risk Factors for Delayed Extubation after Pediatric Perineal Anoplasty: A Retrospective Study

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Department of Anesthesiology, The Affiliated Hospital, School of Medicine,
UESTC Chengdu Women's & Children's Central Hospital

Anorectal malformation are common congenital problems occurring in 1 in 5,000 births and have a spectrum of anatomical presentations, requiring individualized surgical treatments for normal growth. Delayed extubation or reintubation may result in a longer intensive care unit (ICU) stay and hospital stay, increased mortality, prolonged duration of mechanical ventilation, increased tracheostomy rate, and higher hospital costs.It is necessary and beneficial to postoperative extubation for infants. The successful identifification of factors associated with prolonged time to extubation could assist clinicians in identifying patient at risk who may benefit from individualised approaches and allow schedulers to anticipate operating room turnover times more accurately.

we performed a retrospective study of Neonates and infants (≤ one years old) who underwent anorectal malformation surgery between June 2018 and June 2022. The principal goal of this study was to investigate the incidence of delayed extubation in pediatric anorectal malformation surgery. The secondary goals was to identify the factors associated with delayed extubation in these patients. The variables associated with delayed extubation ($P \le 0.2$) by univariate analysis were included in the multivariate logistic regression for identification of predictive risk factors. Adjusted odds ratio and 95% CI were reported.

We collected data describing 123 patients who had anorectal malformations from 2019 to 2022 .It shown that 74(60.2%) in the normal intubation group and 49(39.8%) in the longer extubation.

In the final model, anesthesia methods and age was independently associated with delayed extubation ($P< 0.05$). None of others factors were found significant in the multivariate logistic regression. There are no patient with post operative ICU, in-hospital mortality, readmitted within 30-dayor accepted an unplanned reoperation.

Theoretically, the perioperative management for neonates and infants is challenged from many aspects, not only regarding complicated and rapidly deteriorating conditions, but also with comprehensive anesthesia managements. Early extubation may be beneficial in reducing postoperative mortality and morbidity. Therefore, it is very important to achieve early extubation clinically of neonates and infants.Our study also showed that age ≤ 1 month old was a predictor for delayed extubation after congenital anorectal surgery.

AP1-5

Anaesthetic Management of a Case of Fraser Syndrome with Group III Cleft Lip-Palate with Laryngomalacia and Subglottic Stenosis

Sumit Kumar Singh

Department of Anaesthesiology, Pain Medicine and Critical Care, All India Institute Of Medical Sciences, New Delhi, India

Background: Fraser syndrome is a rare autosomal genetic disorder with an incidence of less than 0.043 per 1000 live births. It is characterised by cryptothalmos, syndactyly, genital malformations, renal anomalies, musculoskeletal anomalies and mental retardation. We report a case of Fraser syndrome with group III cleft lip- palate scheduled for cleft lip repair.

Case Description: A one year nine month old female child presented to the plastic surgery department of the hospital with group III cleft lip palate since birth. The child had normal birth, perinatal and developmental history. She was diagnosed to have Fraser syndrome at birth. On examination, she had cryptothalmos of both eye, depressed nasal bridge, low set ears, group III cleft lip-palate and syndactyle of all four limbs. On airway examination mouth opening was adequate, modified mallampati grade I, neck movements were adequate and teeth were absent. Lab investigations were within normal limit. Electrocardiogram and 2D echo showed normal study. An ultrasound while abdomen revealed single functioning kidney. FOL revealed type I and II laryngomalacia with grade I subglottic stenosis. In the operation threatre, difficult airway cart was kept ready and ENT backup team was kept standby for emergency surgical airway. ASA standard monitors were attached and a 24G IV cannula was secured on rt foot. Anaesthesia was induced with 50% oxygen and 50% sevoflurane followed by videolaryngoscope guided intubation of trachea. After failing to intubate with size 3 cuffed and uncuffed flexometallic tube, trachea was intubated with size 2.5 uncuffed pvc tube. Once the tube position was confirmed by capnography, IV fentanyl, propofol and atracurium was given. Under all aseptic precaution, b/l infraorbital nerve block was given with 1 ml of 0.25% bupivacaine on each side. The surgery was completed uneventfully and was shifted to PACU. The perioperative course was uneventful.

Discussion: Mohan et al stated that facial anomalies can make mask ventilation, laryngoscopy and laryngeal mask airway insertion difficult. They suggested that awake Fibreoptic bronchoscopy or direct laryngoscopy with aid of gum elastic bougie is a possible option. Use of videolaryngoscope can provide a better vision and assistance for airway management. Inhalational induction with preserved spontaneous ventilation followed by check laryngoscopy can give a good safety margin in case of laryngeal abnormalities, as we did in our case.

Figure 1: Our patient post intubation

Figure 2- Our patient at the preanesthetic checkup

AP1-6

Developing Interdicipline Communication to Enhanced Patient Safety in Pediatric Difficult Airway Management

Raihanita Zahra

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Departemen of Anesthesiology and Intensive Care University of Indonesia, Jakarta, Indonesia

Background: Difficult airway management in children resulting in increased morbidity and mortality, is considered the unique problems of children. Even paediatric anaesthesiologists and trained emergency paediatricians sometimes have difficulties managing airways in paediatric patients, resulting in catastrophic event. Cognitive biases and mental processing shortcuts, also known as heuristics, have been demonstrated as leading errors in clinical decisions. Lack of communication between team was found as pitfalls due to authority bias.

Case Description: We experienced the case of an 8 y.o. boy with mandible tumour having cardiac arrest after failure of airway management before planned tracheostomy, all the team who was involved had a discussion after and analysed the problems related. In the process we found that there is ineffective communication and inappropriate plan for airway management. One of the recommendations is to form a difficult pediatric airway team consisting of experts such as pediatric anesthesiologist, pediatric emergency, and pediatric ENT surgeons to manage similar cases. We need top management support to fulfill the equipment, now we are still developing training and education for the staff to enhance their skill in difficult paediatric airway management. We start by planning interdiciplinary communication and make preformulated airway plan for each case before the patient is sent to the operating theatre. As a result, there is decreased number of patients experiencing adverse event during the surgery.

Discussion: Communication is required between experienced anaesthesiologists, pediatrician, and, ENT surgeons, to devise a plan for airway management; using a standardized checklist during a time out could result in a favourable outcome based on patient safety when facing a child with a difficult airway. These actions may also improve the level of care provided for the next surgeries, since effective communication has been built and every team member has been given a specific task according to their area of expertise. The number of paediatric airway complications, morbidity, and mortality also can be decreased.

RSCM

Pediatric Airway Response Team Form

IDENTIFICATION

Time Activation :

Time Response :

Consultants Response :

POTENTIAL AIRWAY PROBLEMS

- ☐ Difficult to ventilate
- ☐ Difficult to intubate
- ☐ Difficult to Supraglottic Airway
- ☐ Difficult to Tracheostomy

AIRWAY TEAM

- ☐ Pediatricians
- ☐ Anesthesiologists
- ☐ ENTs
- ☐ Emergency Physicians
- ☐ Nurses
- ☐ Technicians

PREFORMULATED AIRWAY PLAN

....

....

....

....

CONSULTANT BACK UP

....

....

EQUIPMENTS

DRUGS

- ☐ Fentanyl
- ☐ Remifentanil
- ☐ Propofol
- ☐ Dexmedetomidine
- ☐ Ketamine
- ☐ Midazolam
- ☐ Rocuronium
- ☐ Atracurium

Emergency Drugs

- ☐ Sulfas Atropin
- ☐ Epinephrine

BASIC AIRWAY EQUIPMENTS

- ☐ OPA/NPA
- ☐ SGA
- ☐ Face Mask
- ☐ ETT
- ☐ T-Piece/BVM
- ☐ Connectors

ADVANCED AIRWAY EQUIPMENTS

- ☐ Video Laryngoscope
- ☐ FOB
- ☐ Gum Elastic Boogie
- ☐ Bonfills
- ☐ Front-of-neck Airways Equipments

ADDITIONAL EQUIPMENTS

- ☐ Oxygen Source
- ☐ Suction
- ☐ Airway Surgical Equipments

AP1-7

Guidewire Use for Nasopharyngeal Passage in Pediatric Nasotracheal Intubation: A Randomized Prospective Study

Asim Esen, NıGar Kangarli, Ayda Türköz

Department of Anesthesiology and Intensive Care, Bezmialem Vakif University, Turkey

Background: Nasotracheal intubation (NTI) is a frequently used airway management method in pedodontic dental treatments performed under general anesthesia. However, nasopharyngeal trauma and associated bleeding are common during conventional NTI. In this study, we aimed to examine the effect of angling the end of the endotracheal tube (ETT) by placing a guide wire inside the ETT on nasopharyngeal bleeding.

Methods: 90 patients aged 2-12 years were included in the study and were divided into two groups. In the control group (Group C), NTI was performed in the conventional way, that is, by advancing the ETT directly through the nose. In the study group (Group S), before intubation, a guide wire was inserted into the ETT and an angle of 100-120 degrees (hockey stick shape) was given 2.5-3 cm proximal from the distal end of the ETT. The ETT was inserted into the nose perpendicular to the face. After the angled part of the ETT passed through the nostrils, the ETT was directed to caudal with a movement in accordance with the angle given to the tip of the ETT. In the meantime, the ETT was moved as a whole and aimed to prevent the ETT tip from contacting the posterior wall of the nasopharynx. When the ETT tip reached the oropharynx, the guide wire was removed and the rest of the intubation was completed as in the conventional method.

Results: There was no difference between the groups in terms of demographic data, ASA scores, nostril used, duration of surgery and anesthesia. Bleeding control was performed at the 1st and 5th minutes of intubation by an anesthetist who did not know the group the patient was in. Bleeding; no bleeding, mild bleeding (blood on the tube surface), and severe bleeding (blood pooling around the tube in the oropharynx) were evaluated in three categories. In all three categories, the study group was better than the control group (1st minute: no bleeding S: 84.4%, C: 46.7%; mild bleeding S: 15.6%, C: 31.1%; severe bleeding S: 0.0%, C: 22.2%. 5th minute: No bleeding S: 82.2%, C: 28.9%, mild bleeding S: 15.6, C: 40.0, severe bleeding S: 2.2, C: 31.1. 1st min and 5th min $p < 0.001$)

Discussion: Although, this method is not expected to prevent trauma and bleeding in the nasal passage, according to the results of our study, performing NTI by passing through the nasopharyngeal passage with an ETT in which a guide wire was inserted, caused significantly less nasopharyngea bleeding compared to the conventional method.

AP1-8

Case Reports: Newborns with Tracheal Agenesis

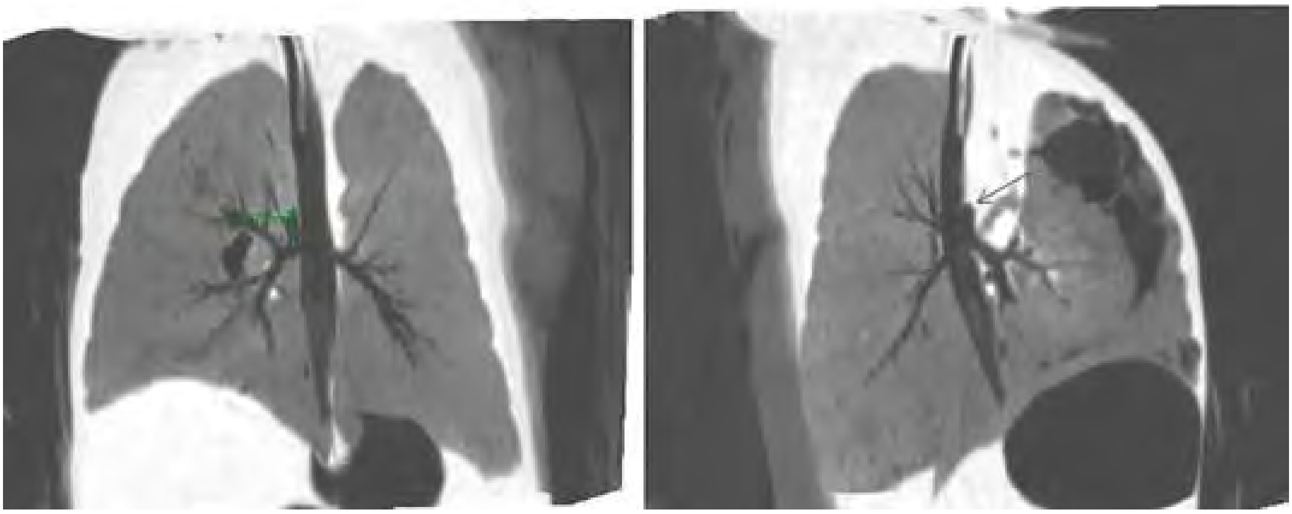
Hye Su Kim, Jun Hyug Choi, Young-Eun Joe, Jeong-Rim Lee

Department of Anesthesiology and Pain Medicine, Anesthesia and Pain Research Institute, Yonsei University College of Medicine, Seoul, Republic of Korea

Background: Tracheal agenesis (TA) is a rare congenital anomaly characterized by the absence or interruption of the trachea that presents challenges in airway management for newborns. Newborns with tracheal agenesis show a lack of crying, ventilation difficulties, and difficulty with endotracheal intubation. It is crucial to secure an airway for patients suspected of having TA.

Case Description: The patient was delivered by cesarean section at 39+1 weeks of gestation due to fetal bradycardia. The patient weighed 2830gm and Apgar score was 3-3-4. The patient did not cry immediately after birth, appeared cyanosed, and developed bradycardia with a heart rate below 100 beats per minute (bpm). Positive pressure ventilation was administered, but the oxygen saturation remained lower than 50% and the heart rate was 70-80. The pediatrician attempted to intubate three times, but failed. The otolaryngologist attempted a tracheostomy, but the trachea was not visible. Due to suspicion of tracheal agenesis, an endotracheal tube was inserted into the esophagus. After oxygen saturation and heart rate was recovered, the patient was transferred to the neonatal intensive care unit (NICU). A computed tomography scan confirmed the diagnosis of type 2 tracheal agenesis. On the second day of life, the patient underwent a loop colostomy to correct imperforate anus. Sevoflurane, dexmedetomidine, and sufental was used to achieve adequate anesthetic depth and hemodynamic stability. A caudal block was performed before the surgery to provide postoperative analgesia. During the surgery, no neuromuscular blockade was used to maintain self-respiration. The patient was transferred to the NICU without complications. A gastrostomy and esophageal banding were scheduled for the sixth day of life, but the patient expired on the fourth day of life due to aggravation of hypoxia and respiratory acidosis

Discussion: Unexpected TA can present challenges in airway management for newborns. Early suspicion and securing the airway immediately after birth are crucial for patients suspected of having TA. Maintaining an airway during anesthesia is crucial, as the esophagus used as a pseudo-trachea can easily collapse and minimal movement of the endotracheal tube can occlude the tracheo-esophageal fistula. Anesthesiologists should be familiar with the overall pathophysiology of tracheal agenesis to effectively manage emergencies.



Day 2_Room C

Abstract Presentation 2 (In-person)

Chair(s): Won-Jung Shin (Korea)
Young Eun Jang (Korea)

AP2-1

~~Comparison of Morphine and Fentanyl Induced Cardioprotection Against Ischemia-Reperfusion Injury In Acyanotic Children Undergoing Open Heart Surgery: A Preliminary Report~~

Withdrawn

AP2-2

Report of the First Successful Senning Procedure from Nepal

Santosh Sharma Parajuli[1], Rabindra B. Timala[2], Marisha Aryal[2]

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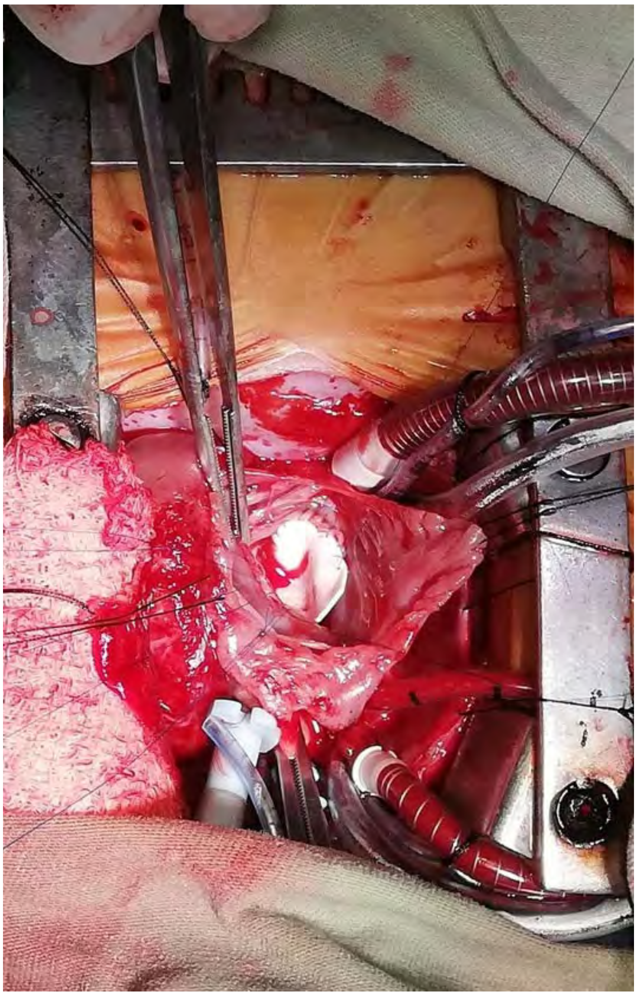
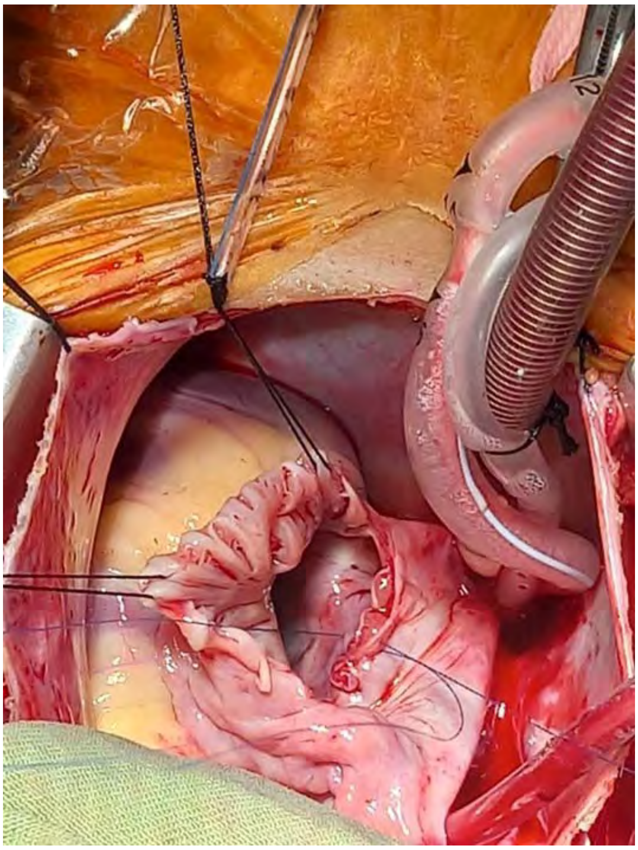
3 years old male presented with history of bluish discoloration. Echocardiography showed transposition of great arteries with intact ventricular septum. Catheterization revealed LV systolic pressure of 36 mmHg, while systemic systolic arterial pressure was 80 mmHg. Due to his deconditioned left ventricle, decision was taken to do atrial switch. On 12th July 2022, he underwent modified Senning procedure. In the operation theatre, standard monitoring system including ECG, invasive blood pressure, central venous pressure, pulse oxymeter and temperature monitoring was established. The prebypass heart rate was between 102-124/min, opening CVP was 11 mmHg. Systolic blood pressure ranged between 81-93mmHg and diastolic blood pressure was between 42-47 mmHg. Pulse oxymeter showed patient oxygen saturation between 65-73% with FIO2 of 60% and the arterial blood gas showed PaO2 of 48mmHg. Atrial septum was excised and PTFE patch was used as first layer to separate mitral valve from pulmonary veins. Lateral wall of right atrium was sutured to the medial aspect of atrial septum to drain systemic vena cava into the mitral valve. Pericardial patch along with medial wall of right atrium was used to channel pulmonary venous return into the tricuspid valve. Total cardiopulmonary bypass time was 155 minutes. Total cross clamp time was 111 minutes. Patient was weaned from the Cardiopulmonary bypass with sinus rhythm and heart rate ranged between 108-118/min, CVP was 13mmHg. Patient was under inotropic support of Dopamine at 5mcg/kg/min and Adrenaline at 0.05mcg/kg/min. His systolic blood pressure ranged between77- 81mmHg and diastolic blood pressure was between 38-42 mmHg. Pulse oxymeter showed patient oxygen saturation between 97-100% with FIO2 of 60% and the arterial blood gas showed PaO2 of 188mmHg. Patient was shifted to the intensive care unit with low dose of inotropic support and extubated the next day. He had atrial tachyarrhythmia on 3rd post-operative day, which subsided itself without any intervention. He was shifted out of ICU on 5th post op day. Echocardiography done at the time of discharge showed good biventricular function without any baffle leak. Patient was discharged on 8th post operative day and his hospital stay was uneventful. Patient had visited out-patient department for three-months follow-up. His echocardiography report showed unobstructed flow from pulmonary veins to RA baffle and unobstructed flow in SVC and IVC to Left Atrium.





AP2-3

Evaluation of an Enhanced Recovery Protocol in Pediatric Cardiac Surgical Patients in a Single Tertiary Care Unit

Esha Nilekani[1], Kamlesh Tailor[2], Shankar Kadam[2], Nilesh Bohra[2], Keyoor Bhavsar[2], Suresh G Rao[3]

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Background: The pillars of Enhanced Recovery after Surgery (ERAS) include multi-modal analgesia, early extubation, rapid mobilization and recovery leading to a shorter ventilation time and reduced hospital stay. By adapting the ERAS protocol there is an associated reduced postoperative morbidity with congenital heart surgeries.

Methodology: In a retrospective observational study over two years (2021-2023), data was collected via medical records & patient's files which included those of Risk Adjusted Congenital Heart Surgery (RACHS) I & II, undergoing elective on pump cardiac surgery who were extubated up to 24 hours postoperative as per our unit protocol. Excluded were those who had missing or incomplete data, emergency cases and on preoperative ventilator. Demographics and parameters such as type of surgery, cardiopulmonary bypass time (CPB time), aortic cross clamp time (AOX time), ventilation time and ICU stay were compared, analysed using SPSS version 25 for Windows and Data as Mean±SD or Frequency (%). Our cohort made two groups-FastTrack extubation (<6 hours) (FE) and Delayed extubation (6-24 hours) (DE).The FastTrack sub-divided ?On table extubation (OTE) and early extubation (EE) (0-6 hours) Cross tabulations were computed for categorical variables and compared using the chi-square test (P<0.05 -statistically significant).(table 1&2)

Results: Of the 1469 operated, 188 patients were included in this study. FastTrack group had 138 (33 ?OTE and 105 ?EE) and delayed extubation had 50 patients. Age, height and weight were significantly higher in the FE group as compared to DE group (p<0.04). In contrast, CPB time and ICU stay was significantly lower in the fast-track group as compared to delayed (p<0.05) both found statistically significant. Significantly higher percentage of patients in DE group had RACHS II as compared to early extubated (EE) (p<0.05). No significant difference was observed between gender and RACHS in both groups.

Discussion: Owing to our established ERAS protocol (table 3) of use of multimodal analgesia (caudal & reduced IV opioid) our patients remained comfortable, pain free with stable hemodynamics leading to a safe, early extubation, associated with a shorter ICU stay (statistically significant) in the EE group. Enhanced recovery after surgery has proven benefits with regards to reduced ventilation & ICU stay. An individualized unit-based protocol inclusive of a team approach could improve overall outcomes.

Table 1: Comparison of FastTrack (<6 hours) and delayed (6-24) hours extubation

	<6 hours (n=138)		6 to 24 hours (n=50)		P value
	Mean±SD	Median (IQR)	Mean±SD	Median (IQR)	
Age (month)	42.9±37.7	34 (0-69)	32.2±42	12 (4.5-44)	0.006
Body length (cm)	86.38.3±25.6	83 (68-110)	79.4±25.7	69 (60-92)	0.011
Weight (kg)	11.7±7.3	9.3 (6.6-14.8)	9.2±6.3	6.9 (4.9-11.4)	0.004
Cardiopulmonary bypass time (minutes)	95±34	93 (70-117)	118±45	115 (90-141)	0.001
Aortic cross clamp time (minutes)	43.9±24	42 (25-60)	51±30	56 (30-70)	0.077
ICU stay (hours)	48.2±32.7	42.5 (24.8-60)	64.2±34.4	54.3 (40.6-74.6)	0.001
	<6 hours (n=138)		6 to 24 hours (n=50)		P value
	Freq.	%	Freq.	%	
RACHS					
1	50	36.2	9	18	0.020
2	88	63.8	41	82	
Gender					
Males	86	62.3	25	50	0.129
Females	52	37.7	25	50	
Surgery					
ASD closure	35	24.1	4	9.3	NA
ASD closure PAPVC	2	1.4	1	2.3	
ASD VSD closure	1	0.7	0	0	
Atrial Septectomy BDGS	11	7.6	5	11.6	
ASVD repair	2	1.4	0	0	
BDGS	9	6.2	6	14	
BDGS + TV repair	1	0.7	0	0	
Fenestrated ASD closure	2	1.4	0	0	
HAPVC repair	2	1.4	0	0	
PDA ligation	1	0.7	1	2.3	
RVOTO relief	1	0.7	0	0	
SAM excision	2	1.4	0	0	
SV ASD repair	2	1.4	1	2.3	
VSD closure	52	35.9	1	48.8	
VSD closure PDA ligation	4	2.8	1	2.3	
VSD closure RVOT relief	5	3.4	0	0	
VSD RVOTO	6	4.2	0	0	
VSD closure SAM excision	4	2.8	0	0	
Wardens	6	4.1	1	2.3	

Table 2: Comparison between on table (0 hrs) and early extubation (<6 hours)

	On table (n=33)		1 to 6 hours (n=105)		P value
	Mean±SD	Median (IQR)	Mean±SD	Median (IQR)	
Age (month)	41.2±32.3	38 (9-65.5)	43.4±39.4	33 (10-72)	0.951
Body length (cm)	89.2±22.9	94 (22.9-105)	88.1±26.5	80 (68-112)	0.676
Weight (kg)	11.9±7.0	10.6 (7.3-14.0)	11.7±7.5	9.1 (6.5-15)	0.654
Cardiopulmonary bypass time (minutes)	88±26	85 (68-108)	97±36	94 (71-123)	0.224
Aortic cross clamp time (minutes)	40±16	39 (29-52)	45±25	43 (28.3-60)	0.327
ICU stay (hours)	36.8±22.2	36 (20.2-44.8)	51.8±34.6	45.5 (30-65.3)	0.00
	On table (n=33)		1 to 6 hours (n=105)		P value
	Freq.	%	Freq.	%	
RACHS					
1	15	45.5	35	33.3	0.206
2	18	54.5	70	66.7	
Gender					
Males	25	75.8	61	58.1	0.068
Females	8	24.2	44	41.9	

Table 3-Institutional Enhanced Recovery after surgery (ERAS) protocol: Criteria for extubation

- RACHS category 1 and 2
- Age > 6 months
- CPB duration of < 120 minutes
- Vasoactive-inotropic score (VIS) at extubation <5 and ABG lactate <2
- Effective multi-modal analgesia (caudal morphine 100mcg/kg and clonidine 2 mcg/kg with pre-emptive NSAID analgesia), local infiltration with 0.25% bupivacaine at surgical site at end of procedure along with minimal fentanyl consumption (1-2 mcg/kg)
- Postoperative ECHO- good ventricular function and no residual shunts/defects
- Adequate reversal of muscle relaxant with good airway reflexes prior to extubation

AP2-4

~~Multisystem Inflammatory Syndrome in Children. An Emerging Clinical Challenge for Pediatric Cardiac Surgery in the COVID 19 Era: Case Series~~

Withdrawn

AP2-5

Anesthetic Management of Patent Ductus Arteriosus Ligation by Video-Assisted Thoracoscopy in Premature Babies Low-Birth Weight<2kg: A Retrospective Observational Study

Qinghua Huang, Jirimutuya, Jing Yang, Yalan Zhan

Department of Anesthesiology, Chengdu Women's and Children's central Hospital, Chengdu, Sichuan, China

Background: Thoracoscopic surgery in neonates and infants for Patent Ductus Arteriosus (PDA) is widely used in recent years and thoracoscopy is currently considered the standard approach for several procedures. But so far, there have been no reports of video-assisted thoracoscope for PDA ligation in low-weight babies.

Objective: To retrospectively analyse the anesthetic management, complications and hemodynamic changes in neonates extremely low-birth weight<2kg undergoing video-assisted thoracoscopy for PDA ligation.

Methods: This a single-center, retrospective study. Clinical data from 21 neonates, <2kg, who underwent video-assisted thoracoscope for PDA ligation in our hospital from January 2017 to November 2021 were retrospectively analyzed. Main outcomes considered were hemodynamicin stability or vasoactive medication requirements, hypothermia, intubation time after the surgery, postoperative acute kidney injury and perioperative red blood cell transfusion.

Results: All patients received general anesthesia with endotracheal intubation and standard ASA monitoring. All patients survived the surgery. Our anesthetic management protocols are outline and analyzed.

Discussion: Perfect preoperative preparation is crucial for obtaining a desirable postoperative outcome in neonates undergoing a thoracoscopy repair of PDA. In our analysis, intraoperative ventilation strategies included pressure control ventilation with peak airway pressure maintained at 15-25 cmH2O, a respiratory rate of 35-55 breaths/minute, a fraction of inspired oxygen (FiO2) of 40-60%, and careful airway suctioning to clear secretions. Maintain hemodynamic stability and normovolemia during intraoperative are critical for successful weaning of ventilatory support and extubation.

AP2-6

Anesthetic Experience of Repair of Esophageal Atresia in a Child with BPFM, Esophageal Atresia, and Full-length Tracheal Stenosis

Takashi Fujiwara

Department of Anesthesiology, Kobe Children's Hospital, Kobe, Hyogo, Japan

Background: There are no reports of anesthesia with BPFM and full-length tracheal stenosis. In this report, we describe our experience in the anesthetic case with BPFM, esophageal atresia, and full-length tracheal stenosis undergoing repair of esophageal atresia.

Case Description: She was born at 34 weeks, 1488 g. She was diagnosed with VACTERAL association and Klippel-Feil syndrome due to esophageal atresia C, vertebral dysplasia, and other findings. Abdominal esophageal banding, gastrostomy, and colostomy were performed at day zero, and there was resistance under the glottis even with a cuffless ID 2.5 mm tracheal tube. On day 118, rigid bronchoscopy was scheduled, but after administration of muscle relaxants, the patient became 'cannot intubate-cannot ventilate'. Finally, a soft bronchoscopy under spontaneous breathing was performed, which confirmed stenosis of the left main bronchus. The patient was transferred to our hospital, and a rigid bronchoscopy under general anesthesia was performed at 5 months of age. The patient had a bifurcation into a right main bronchus and a tracheoesophageal fistula at the level of the second tracheal ring, and the right main bronchus was all complete tracheal rings. The left main bronchus was also bifurcated beyond the tracheoesophageal fistula and was diagnosed as BPFM. At 6 months of age, tracheoesophageal fistula surgery, abdominal esophageal de-banding, and esophageal anastomosis were performed. This time, Mask ventilation was easy, and a cuffless ID 3.5 mm tracheal tube was intubated nasally. The tube tip was placed at the level of the second tracheal ring and inserted only about 1 cm below the glottis. There were many leaks around the tracheal tube, and the artificial nose was inadequately humidified. The hardened secretions frequently resulted in poor ventilation. The possibility of accidental extubation required careful airway management. Fortunately, the patient survived the surgery without any problems such as accidental extubation.

Discussion: Management of the tracheal tube which was placed only 1 cm below the glottis was quite challenging, but the fact that the patient's neck mobility was quite limited due to Klippel-Feil syndrome worked in the positive direction. The trachea above the full complete tracheal ring was dilated, and although it was anticipated that there would be more tube leakage, a cuffed tracheal tube could not be used because of the restriction of cuff insertion below the glottis.

AP2-7

Anesthetic Management in a Child with Single Ventricle Heart Undergoing Drainage of Brain Abscesses

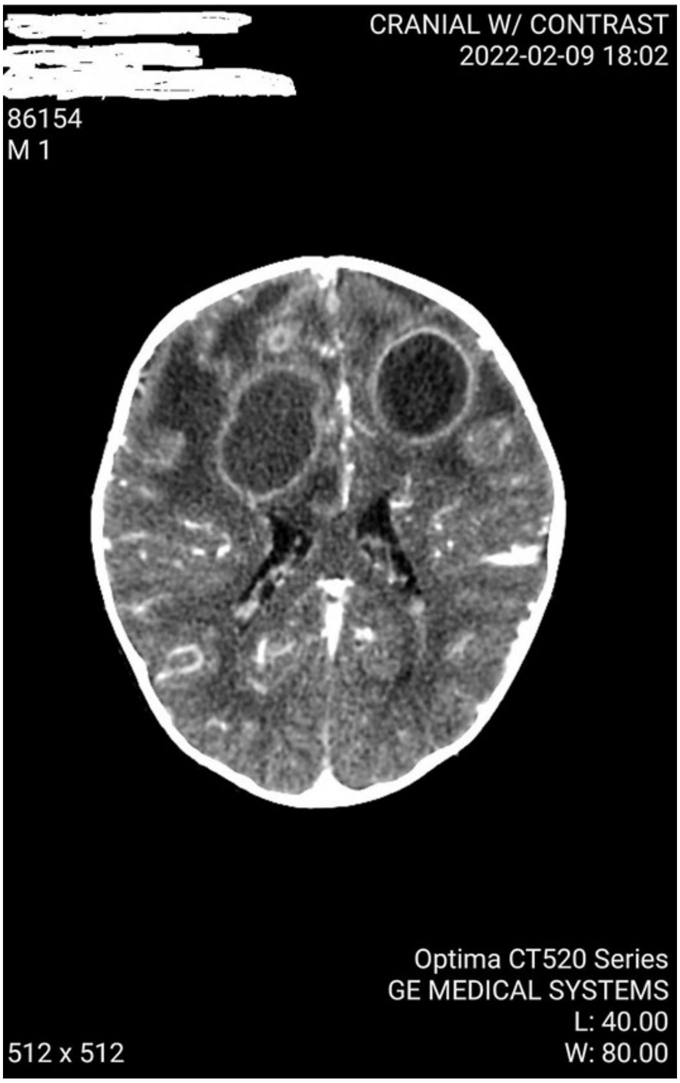
Pryl Kim Ngoslab[1,2], Raisa Tumbocon[1]

[1]Saint Louis University -Sacred Heart Medical Center, [2]Baguio General Hospital and Medical Center

Single ventricle congenital heart disease is uncommon, with incidence of 3.1-4.9 per 10,000 live births. Brain abscess is a rare but fatal complication of cyanotic heart disease. Its incidence among children with cyanotic CHDs are 5-18%. If untreated, mortality is 27.5-71%. Thus it is imperative that prompt treatment be done after diagnosis.

Case: This is a case of a 1 year 7 months old male known with congenital heart disease, single ventricle with atrial inversion and abdominal situs invertus. He presented with a 5 week history of left sided hemiparesis. CT scan done showed multiple cystic lesions in the bilateral frontal lobe (Figure 1). Bilateral tube drainage of abscess was done successfully.

Discussion: Brain abscess is a rare but fatal complication of CHD. Patients with CHD develop polycythemia which results in tissue hypoxia and ischemia creating a suitable environment for the growth of bacteria. The right-to-left shunting allows bacteria in the airway to enter the cerebral circulation. Prompt intervention prevents mortality brought about these abscesses. Anesthetic goals in patients with single ventricle include maintaining normovolemia and slight hypercapnia, avoiding excessive pulmonary blood flow, maintenance of O2 saturations at baseline, supporting cardiac contractility and preventing atelectasis and intrapulmonary shunting. Overall, there should be a balance between pulmonary and systemic hemodynamics in order to prevent end-organ damage. With the above considerations in mind, anesthetic agents used for this patient was carefully selected. Anesthetic done was total intravenous anesthesia with endotracheal tube for airway. On induction, Midazolam was given for anxiolysis. Fentanyl was used to attenuate the hemodynamic response to laryngoscopy and because it has minimal effect on cardiac contractility and systemic vascular resistance. Bupivacaine 0.125% was infused on the surgical site prior to surgery for added pain control. It is important to address anxiety and pain as this may invoke unpredictable rise in pulmonary and systemic resistance. Ketamine has an onset of action of 15-30 seconds making it an ideal agent for induction of anesthesia in children. It increases SVR while PVR is unaffected. Anesthesia was maintained on Midazolam, Fentanyl and Rocuronium. Intravenous fluid given intraoperatively was pNSS at maintenance rate. Brain abscess was successfully drained and patient was discharged after almost a month of treatment.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AP2-8

Anesthetic Management in a Child with Late Onset Congenital Diaphragmatic Hernia Undergoing Repair

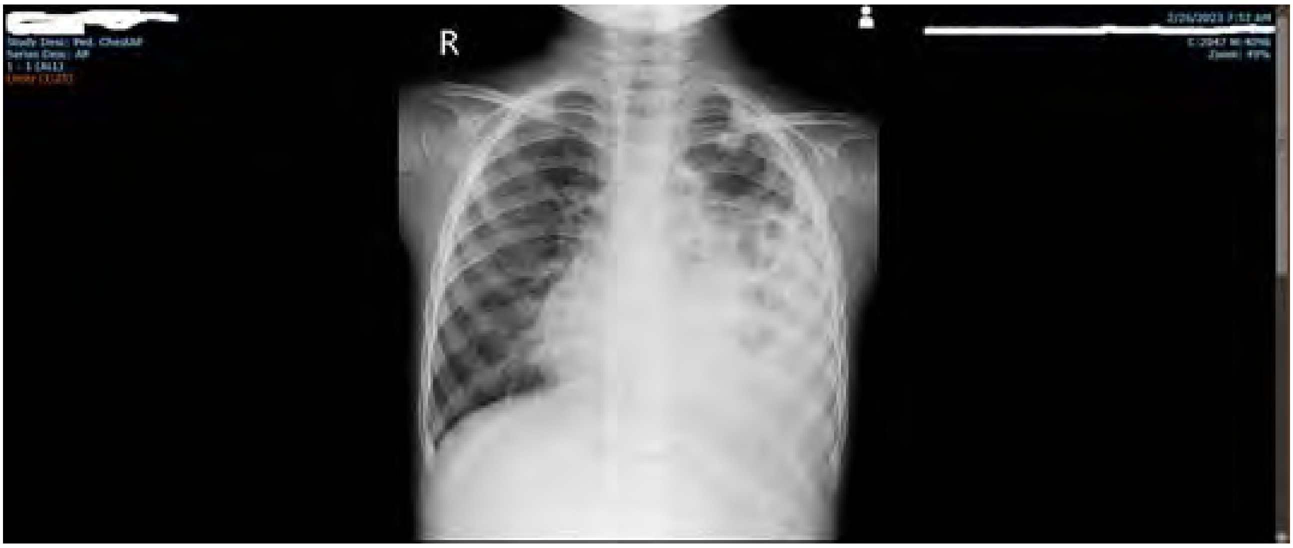
Anna Loraine Ostrea, Pryl Kim Ngoslab

Baguio General Hospital and Medical Center

Congenital Diaphragmatic hernia (CDH) presents as underdeveloped diaphragm resulting in herniation of abdominal organs in the thoracic cavity. In the Philippine epidemiology, 35.82 cases per 10,000 live births were noted under a disease classification. It generally occurs in 1 in 2500-3000 live births with late onset arising at 2.4-20% of CDH patients. We aim to present a rare case of late onset congenital diaphragmatic hernia and discuss our experience in the difference of presentation and management compared to the typical presentation.

The patient is a case of a 2-year-old male presenting as a recurrent vomiting initially managed for acute gastroenteritis with dehydration. CDH was diagnosed after a chest radiograph was done when patient developed respiratory symptoms.

Due to limited studies, patient management was guided by the considerations of CDH in typical cases and was tailored according to patient's individual indications. In a typical CDH management, optimization of pulmonary hypoplasia, pulmonary hypertension and accompanying associated congenital anomalies is the goal. Intra and post operative management generally includes employment of invasive monitoring with specific ventilatory strategies and prolonged intensive care. Prognosis is poor with severe cases and chronic problems are encountered for those who survive. In our case, anesthetic management focused on preoperative optimization for hydration with minimal respiratory support not needing advance airway for ventilation. Patient had no associated congenital problems after preoperative surveillance for other congenital anomalies. Intra operatively, standard monitors with end tidal carbon dioxide were employed. Avoiding abdominal distention on induction prevented quick desaturation during laryngoscopy. Careful inflation of the lung after CDH repair prevented injury on the unaffected lung. Post operative management composed of early weaning from ventilator which he tolerated within 24 hours of intensive care. Patient was also sedated overnight to give time for the body to adjust to the new lung volume. Multimodal pain management strategy, considering respiratory optimization, is done using intravenous Paracetamol and epidural analgesia. Patient was discharged on post operative day 5 with no problems encountered on follow up. The use of less extensive and invasive strategies with individualized approach was favorable for our patient.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Day 2_Room C

Abstract Presentation 3 (In-person)

Chair(s): Eugene Kim (Korea)
Young Sung Kim (Korea)

AP3-1

Perioperative Hypothermia in Pediatric Population in University Malaysia Medical Centre

Noor Iftitah Ab Rahman[1], Mohd Ali 'Imran Ab Rahman[2], Ina Ismiarti S[1], Chaw Sook Hui[1], Mok Chuang Shin[1]

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[2]Department of Social and Preventive Medicine, Faculty of Medicine, University Malaya, Kuala Lumpur

Background: Perioperative hypothermia in the pediatric population has been associated with adverse events and serious complications. Incidences vary between studies, ranging from as low as 20% to as high as 85%. Risk factors include low body weight, small and sick children, inadequate temperature monitoring, major intestinal surgery, operating theatre temperature less than 23°C, Interventional cardiac procedures, older age group, type and duration of surgery and low baseline temperature. This study aims to describe perioperative hypothermia pediatric population incidence in UMMC and evaluate its associated factors.

Method: This observational cohort study included prospectively recorded data from patients younger than 16 years old undergoing general anesthesia for surgical or diagnostic procedures at University Malaya Medical Centre. A structured data collection form included perioperative data on the patient's demographic, ASA status, and surgical, clinical and anesthetic characteristics. Intraoperative data collected were surgery type, duration of anesthesia and surgery, estimated blood loss, blood transfusion, total fluids, all warming methods, temperature monitoring type and measurements throughout perioperative periods. Perioperative hypothermia was defined as temperature (T) < 36°C.

Results: Of the 144 patients studied, hypothermia was recorded were 70 (53.8%) in 1st hour of the operation, 42 (40.4%) during 2nd hour, 24 (36.9%) in the 3rd hour, 10 (27.0%) in the 4th hour and 18 (12.5%) in the post-anaesthesia unit. Age, weight, ASA and surgical type were not associated with hypothermia. There were also no significant differences in techniques of preventive measures between normothermic and hypothermic groups.

Discussion/Conclusion: We hereby report a 12.7% incidence of hypothermia amongst our local pediatric surgical patients, a much lower incidence than other reports. We could not identify the significant variables between the patients in the hypothermic group. However, age, weight, ASA, and surgical type were insignificant predictors. Most of our patients received at least one type of preventive hypothermia measure. And there were no significant differences found between the patients' preventive measures. This may be due to the small sample size and the potential cofounders needed to be considered in this study, such as environmental factors and preoperative medications.

Data Analysis

Table 1. Patient Demographics and Clinical characteristic in Normothermic and Hypothermic patient groups

Variables		N Total (N = 144)	Normothermic, ≥ 36 °C (n = 124)	Hypothermic, < 36 °C (n = 18)	p-value
Age category	0 - < 1 y	32 (22.5%)	28 (19.7%)	4 (2.8%)	0.716
	1 - < 5 y	44 (31.0%)	39 (27.5%)	5 (3.5%)	
	5 - < 10 y	33 (23.2%)	30 (21.1%)	3 (2.1%)	
	10 - ≤ 16 y	33 (23.2%)	27 (19.0%)	5 (4.2%)	
Gender	Male	94 (66.2%)	82 (57.7%)	12 (8.5%)	0.964
	Female	48 (33.8%)	42 (29.6%)	6 (4.2%)	
Weight (kg)		n = 138	20.95 ± 18.32	24.86 ± 20.68	0.418
BMI (kg/m^2)		n = 138	17.43 ± 6.88	15.43 ± 6.88	0.212
ASA, n (%)	1	64 (45.1%)	55 (38.7%)	9 (6.3%)	0.538
	2	58 (40.8%)	50 (35.2%)	8 (5.6%)	
	3	20 (14.1%)	19 (13.4%)	1 (0.7%)	
Surgical level	Minor	47 (33.1%)	38 (26.8%)	9 (6.3%)	0.211
	Intermediate	63 (44.4%)	56 (39.4%)	7 (4.9%)	
	Major	32 (22.2%)	30 (21.1%)	2 (1.4%)	

Categorical variables were expressed as frequency and percentage; n (%)

Continuous variables were expressed as mean ± standard deviation for normally distributed and median (IQR) for non-parametric distributed.

Chi-square test or Fisher's exact test was used to check for significant differences for categorical variables.

Independent t-test or a Whitney rank test was used to check for any significant differences for continuous variables.

*Significant level p <0.05

Table 2. Temperature monitoring

Variables	N Total (N = 144)	Normothermic, ≥ 36 °C	Hypothermic, < 36 °C	t-stat	p-value
Receiving Bay	136	36.50 ± 0.50; n = 118	36.34 ± 0.63; n = 18	-0.998	0.320
After Induction	133	35.70 ± 0.75; n = 117	35.96 ± 0.66; n = 16	1.353	0.179
Intra-operative					
1st hour	129	35.79 ± 0.78; n = 117	35.83 ± 0.57; n = 12	0.156	0.877
2nd hour	103	35.96 ± 1.35; n = 95	36.0 ± 0.39; n = 8	0.084	0.934
3rd hour	65	36.23 ± 0.82; n = 58	36.0 ± 0.45; n = 7	-0.743	0.460
4th hour	37	36.43 ± 1.07; n = 32	35.92 ± 0.51; n = 5	-1.025	0.312
PACU	142	36.64 ± 0.63; n = 124	35.57 ± 0.38; n = 18	-7.100	<0.001*

#Independent t-test for two-sided level significant

*Significant level p <0.05

Table 3. Preventive measures

Variables		N Total (N = 144)	Normothermic, ≥ 36 °C (n = 127)	Hypothermic, < 36 °C (n = 17)	p-value
Pre-warmed fluid	Yes	126 (87.5%)	111 (78.2%)	15 (10.6%)	0.438
	No	16 (11.3%)	13 (9.2%)	3 (2.1%)	
Pre-warmed patient	Yes	82 (57.7%)	71 (50%)	11 (7.7%)	0.757
	No	60 (42.3%)	53 (37.3%)	7 (4.9%)	
Active warming	Yes	134 (93.1%)	118 (83.1%)	16 (11.3%)	0.281
	No	8 (6.9%)	6 (4.2%)	2 (1.4%)	
Passive warming	Yes	137 (96.5%)	119 (83.8%)	18 (12.7%)	0.386
	No	5 (3.5%)	5 (3.5%)	0 (0)	
PACU warming	Yes	116 (81.7%)	101 (71.1%)	15 (10.6%)	0.847
	No	26 (18.3%)	23 (16.2%)	3 (2.1%)	

Chi-square test for two-sided level significant

*Significant level p <0.05

AP3-2

Atelectasis and Re-Expansion Pulmonary Edema in Patient Undergoing Atrial Septal Defect (ASD) Closure with Minimally Invasive Cardiac Surgery

Stephanus Andy Prakasa Kaligis, Anas Alatas

Department of Anesthesiology and Intensive Therapy, Faculty of Medicine University of Indonesia, Jakarta, Indonesia

Background: Despite providing many benefits, minimally invasive cardiac surgery can cause potential complications that leads to morbidity and mortality. Here we present a case about atelectasis and re-expansion pulmonary edema complication during atrial septal defect closure with right thoracotomy approach.

Case Description: A 23 years old female came to the hospital for ASD closure. She experienced shortness of breath with moderate intensity activities. Echocardiography showed ASD with 25.4 mm diameter. Cardiac catheterization revealed pulmonary hypertension (PH) reactive to oxygen test. General anesthesia, intubation with 35 Fr left double lumen tube, and invasive monitoring was applied. Right thoracotomy and one lung ventilation (OLV) was done with low tidal volume and PEEP. ASD closure was done in 33 minutes cardiopulmonary bypass (CPB) time and 20 minutes aortic cross clamp time. After weaning from CPB, desaturation occur until 70%. Only left lung was ventilated after CPB. Tidal volume was only 100 ml despite lung recruitment maneuver. Because of hemodynamic instability we commenced two lung ventilation. Oxygen saturation rise to 95%. Operation was done with intermittent deflation of the right lung. There was pink frothy secret from the right lung. The secret was suctioned carefully. Chest X-ray showed atelectasis in the left lung.

Discussion: PH is not an absolute contraindication but tend to increase risk of hypoxemia and right ventricular failure during OLV. Permissive hypercapnia was common in OLV but may not be appropriate for PH. Management of severe hypoxemia during OLV beside lung recruitment maneuver, was inflating the other lung. Higher PEEP and intrathoracic pressure had negative effect on venous return and pulmonary vascular resistance that compromise hemodynamics. Re-expansion of the nondependent lung need coordination with the surgeon to ensure they work safely. Alveoli on nondependent lung were easier to recruit, but sudden expansion of the lung can create shear stress and re-expansion pulmonary edema. This phenomenon was rare, but potentially fatal. Proper titration of PEEP and inspiratory pressure reduced the risk. High oxygen fraction had to be avoided because re-expansion was linked to oxidative stress which is cytotoxic and stimulate inflammation. Management of re-expansion pulmonary edema remain conservative with protective lung ventilation using low tidal volume, appropriate level of PEEP and negative fluid balance.

Figure 1. Post operative chest x-ray

Figure 2. Pre operative chest x-ray

AP3-3

Activation of Rapid Response Team in Pediatric Ward : A Cross Sectional Study in Indonesia's Top Referral Hospital

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Background: Rapid Response Teams (RRT) goal is to identify and rapidly assess patient's at risk of clinical decompensation and thus to prevent cardiac arrest. In Cipto Mangunkusumo Hospital (CMH), RRT activation can be performed based on single criteria or PEWS. This study aim to describe the activation triggers and characteristic of pediatric patients treated by RRT in CMH.

Methods: A cross-sectional study. Consecutive pediatric (<18 years) RRT events from January 2020 to Desember 2022 in tertiary care hospital CMH were included.

Results: 493 RRT activations for pediatric patients from 4,094 total RRT activation during the study period. 75.5% (372 of 493) of RRT events occurred during daytime hours. The main trigger for RRT activation was oxygen desaturation (43.8%) (Table 1). Among 22 groups of diagnosis, the largest primary diagnosis was neoplasm (26%), followed by congenital malformations, deformations, and chromosomal abnormalities (19%), and diseases of nervous system (9%) (Fig.1). 91.1% (449 of 493) were actively treated and 8.9% receiving "do not attempt resuscitation" orders. The outcome of the patients was 79.1% alive and 20.9% died during RRT events. The mortality rate of RRT events from 2020 to 2022 was 28%, 17.8%, and 18.1% respectively. In-hospital mortality following RRT activation are highest due to neoplasm (30.1%). Of pediatric RRT events, 12.6% (62 of 493) were admitted to PICU, and 87.4% (431 of 493) stayed in the ward where the call was made.

Discussion: In our study, daytime hours were defined as 07:00 AM to 10.59 PM. In line with the study by Raymond et al (2015), 70.2% of pediatric medical emergency team events occurred during daytime hours and the most trigger for activation RRT was decreased oxygen saturation (32%). Study by Martinez et al (2018) in tertiary-care pediatric hospital in Australia, the number of patient who admitted to PICU after RRT events was 24%, that was higher compare to our study. The possible reason might be due to the capacity of PICU in Cipto Mangunkusumo Hospital was limited. In children cardiac arrest is generally caused by progressive respiratory failure, hypotension or both. With the existence of rapid response system (early detection and activation based on a single criteria or PEWS), we hope it can reduce the incidence of cardiac arrest and reduce intrahospital deaths. However, further studies are still needed regarding the effectiveness of the rapid response system in the pediatric population.

Fig.1 Patients Diagnosis (ICD X) Prior to RRT Activation in Pediatric Patients

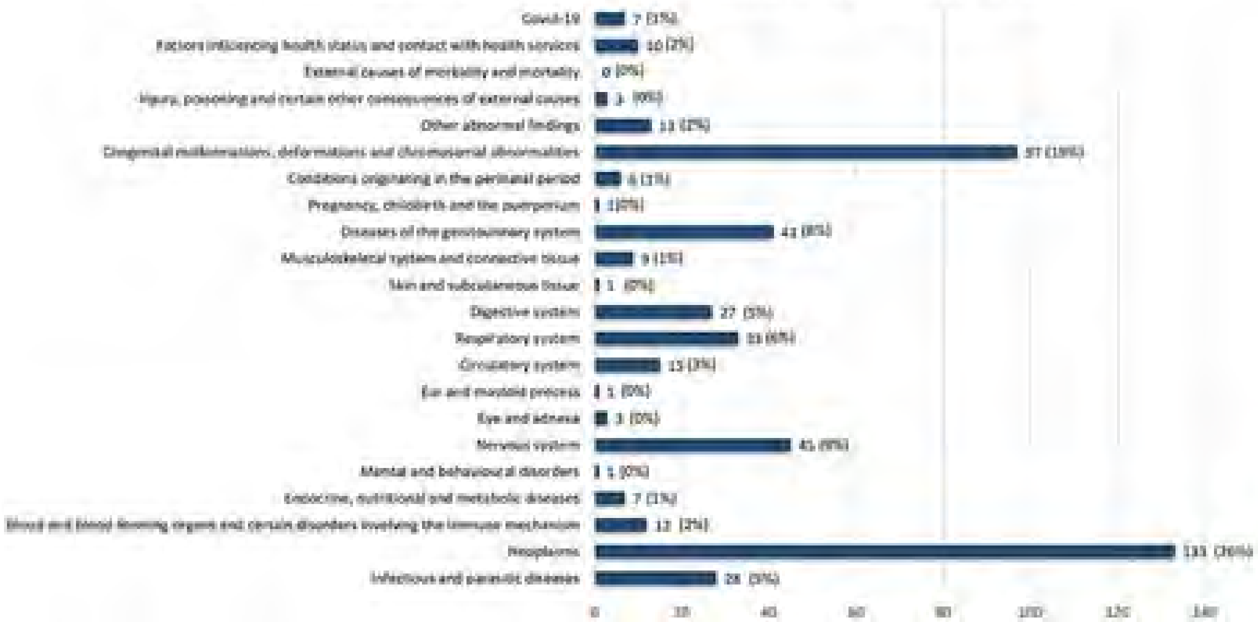

Table 1. Characteristic of RRT Activation

Age	
Mean (years)	6.6
Sex	
Male (n,%)	278 (56.4%)
Female (n,%)	215 (43.6%)
Response time	
< 5 minutes	432 (87.63%)
> 5 minutes	61 (12.37%)
RRT Activation Time	
Daytime (07.00-22.59)	372 (75.5%)
Nighttime (23.00-06.59)	121 (24.5%)
Mortality	
Alive (n,%)	390 (79.1%)
Dead (n,%)	103 (20.9%)
DNR	
Yes (n,%)	44 (8.9%)
No (n,%)	449 (91.1%)
RRT Activation Triggers	
Respiratory Arrest	65 (13.2%)
Cardiac Arrest	42 (8.5%)
Airway threat	51 (10.3%)
Desaturation	216 (43.8%)
Tachypnea	10 (2.0%)
Hypotension	5 (1.0%)
Bradycardia	3 (0.6%)
Tachycardia	3 (0.6%)
Acute loss of consciousness	44 (8.9%)
Seizure	28 (5.8%)
PEWSS score >6	17 (3.4%)
Worry about patient's situation	9 (1.8%)

AP3-4

Towards a Zero Postoperative Vomiting (POV) in Children after Tonsillectomy

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Background and Objective: Studies have quoted 13-42% postoperative vomiting (POV) in children after tonsillectomy. Postoperative vomiting can result in severe distress to child and family/care giver. POV can provoke pain in oropharynx, delay oral intake, lead to dehydration, delay recovery from surgery and can delay discharge from hospital. Besides an unpleasant perioperative experience for the child, there is a significant diversion of finite resources from the postoperative care team. Anaesthetic and surgical risk factors have been under the microscope for over two decades. This study was conducted to find the incidence of early (less than 6 hours) postoperative nausea and vomiting in children after tonsillectomy in a regional private hospital and how the results may influence our future approach to a possible zero POV.

Methods: Retrospective chart review, clinical audit.

Population: 370 (Three hundred and seventy) children, who had tonsillectomy performed by same surgeon and anaesthesia provided by same anaesthetist; surgical technique; mode of anaesthesia and prophylactic anti emetics were the same. Age: 3 to 16 years, Period: 4years (2019-2022), Sample: 300 (Three hundred). From the sample charts, number of children who reported/experienced nausea or POV within 6 hours after tonsillectomy were found and those charts analysed.

Results: Eleven children (incidence of 3.7%) reported/experienced nausea or vomiting within 6 hours of tonsillectomy and they received rescue antiemetics with desired effect.

Discussion: The incidence of early POV in children after tonsillectomy in this centre is 3.7%, which is significantly less than published literature. There were no identifiable added risk factors to the POV group. The conduct of perioperative anaesthesia and surgical technique for tonsillectomy in children continue to evolve and refine to enhance a safe recovery and a positive experience and outcome. While we strive to achieve a zero POV, perhaps it is time to examine more closely other factors like child and parents' preoperative education, their attitude, emotions, and psychological support; quantity and quality of pre and postoperative oral intake; underuse of multimodal analgesia and adjuvants; protocol driven or unwarranted prescription of post operative opioid analgesics; subjective or objective reporting and interpretation of nausea and vomiting; all of which may have a greater influence in achieving a zero POV than current evidence.

AP3-5

~~Anesthetic Management in a Patient with Nonketotic Hyperglycinemia~~

Withdrawn

AP3-6

~~Distraction Techniques for Post-operative Paediatric Patients in Post Anaesthesia Care Unit (PACU) a Randomized Control Trial~~

Virtual

AP3-7

Perioperative Respiratory Adverse Events Following General Anesthesia among Pediatric Patients after COVID-19

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Background: We examined the association between preoperative coronavirus disease 2019 (COVID-19) Omicron infection and the incidence of overall perioperative adverse events in pediatric patients who received general anesthesia.

Methods: This retrospective study included patients aged <18 years who received general anesthesia between February 1 and June 10, 2022, in a single tertiary pediatric hospital. They were divided into two groups: patients in a COVID-19 group were matched to patients in a non-COVID-19 group in the Omicron-predominance in Korea. Data on patient characteristics, anesthesia records, post-anesthesia records, COVID-19-related history, symptoms, and mortality were collected. The primary outcomes were the overall perioperative adverse events including perioperative respiratory adverse events (PRAEs), escalation of care, and mortality.

Results: In total, 992 patients were included in data analysis (n=496, COVID-19; n=496, non-COVID-19) after matching. The overall incidence of perioperative adverse events was significantly higher in the COVID-19 group than in the non-COVID-19 group (OR 1·92; 95% CI 1·89-1·94). The difference was notable in PRAEs (OR 2·00; 95% CI 1·96-2·02) but not in the escalation of care or mortality. Compared with the non-COVID-19 group, the risk of overall perioperative adverse events was higher in the COVID-19 group diagnosed 0?2 weeks (OR 6·5; 95% CI 2·1-20·4) or symptomatic at anesthesia day (OR 6·4; 95% CI 3·30-12·4).

Conclusion: Pediatric patients with preoperative COVID-19 Omicron infection had an increased risk of PRAEs but of similar severity to an upper respiratory infection. Patients within 2 weeks after COVID-19 or those with symptoms had a higher risk of PRAEs.

Table 1. Patient and surgical characteristics, and anesthetic management of COVID-19 patients and non-COVID-19 patients after propensity score matching (PSM).

	All (n=992)	Non-COVID-19 (n=496)	COVID-19 (n=496)	OR or mean difference	95% CI of OR or mean difference	STD before PSM	STD after PSM	P-value
Age (month)	6·5 ± 4·5	6·6 ± 4·7	6·3 ± 4·2			0·261	–0·058	0·371
Sex						0·101	0·017	0·844
Male (%)	662 (62·7%)	309 (62·3%)	313 (63·1%)					
Female (%)	370 (37·3%)	187 (37·7%)	183 (36·9%)					
Weight (kg)	28·2 ± 18·8	28·3 ± 19·4	28·0 ± 18·3			0·241	–0·018	0·788
Height (cm)	117·5 ± 30·5	117·5 ± 31·9	117·4 ± 29·1					0·962
ASA physical status								0·865
I	418 (42·1%)	211 (42·5%)	207 (41·7%)					
II	449 (45·3%)	224 (45·2%)	225 (45·4%)					
III	112 (11·3%)	56 (11·3%)	56 (11·3%)					
IV	13 (1·3%)	5 (1·0%)	8 (1·6%)					
Emergent surgery	29 (2·9%)	23 (4·6%)	6 (1·2%)	0·252	0·245 – 0·259			0·003
Grade of surgery				0·907	0·90– 0·92			0·557
Major	247 (24·90%)	128 (25·6%)	119 (22·2%)					
Minor	745 (75·10%)	368 (74·2%)	377 (76·0%)					
Anesthesia management								
Duration of anesthesia (min)	111·8 ± 101·5	102·7 ± 89·5	120·9 ± 111·6	18·3	5·7 – 30·9			0·005
Duration of surgery (min)	72·3 ± 85·4	66·6 ± 73·6	78·0 ± 95·5	11·4	0·78 – 22·0			0·036
Anesthesia induction								
Intravenous induction	992 (100·0%)	496 (100·0%)	496 (100·0%)	N/A	N/A			1·00
Inhalation induction	0 (0%)	0 (0%)	0 (0%)	N/A	N/A			
Maintenance of anesthesia								
Intravenous agents	85 (8·6%)	34 (6·9%)	51 (10·3%)	1·56	1·53 – 1·58			0·070
Inhalation agents	907 (91·4%)	462 (93·1%)	445 (89·7%)	0·64	0·63 – 0·65			0·070
Airway management device								0·134
Endotracheal tube	403 (40·6%)	201 (40·5%)	202 (40·7%)	1·01	1·00 – 1·02			
Supraglottic airway device	585 (59·0%)	291 (58·7%)	294 (59·3%)	1·03	1·02 – 1·03			
No device	4 (0·403%)	4 (0·81%)	0 (0%)	0	0			

Values are mean ± standard deviation, or median (interquartile range) [range] or number (proportion). ASA, American Society of Anesthesiologists; STD, standardized difference.

Table 2. Overall perioperative adverse events including perioperative respiratory adverse events (PRAEs), escalation of care, and mortality of COVID-19 patients and non-COVID-19 patients.

	All (n=992)	Non-COVID-19 (n=496)	COVID-19 (n=496)	OR or mean difference	95% CI of OR or mean difference	P-value
Overall perioperative adverse events	114 (11·5%)	41 (8·3%)	73 (14·7%)	1·92	1·89 – 1·94	0·002
Escalation of care, or mortality		2 (0·40%)	4 (0·81%)	2·01	1·90 – 2·12	0·68
Unexpected general ward admission	3 (0·302%)	2 (0·40%)	1 (0·202%)	0·50	0·46 – 0·54	1·00
Unexpected ICU admission	2 (0·202%)	1 (0·202%)	1 (0·202%)	1	0·92 – 1·09	1·00
Unexpected respiratory support	2 (0·202%)	1 (0·202%)	1 (0·202%)	1	0·92 – 1·09	1·00
All-cause mortality within 6 weeks	0 (0·0%)	0 (0·0%)	0 (0·0%)	N/A	N/A	N/A
PRAEs	111 (11·2%)	39 (7·9%)	72 (14·5%)	2·00	1·96 – 2·02	0·001
Laryngospasm	17 (1·9%)	11 (2·22%)	6 (1·21%)	0·54	0·52 – 0·56	
Bronchospasm	0 (0·0%)	0 (0·0%)	0 (0·0%)	N/A	N/A	N/A
Pneumonia	0 (0·0%)	0 (0·0%)	0 (0·0%)	N/A	N/A	N/A
Crackle or Wheezing	4 (0·403%)	0 (0·0%)	4 (0·81%)	N/A	N/A	0·133
Copious secretion requiring endotracheal suction	8 (0·81%)	1 (0·202%)	7 (1·41%)	7·1	6·6 – 7·6	0·076
High peak inspiratory pressure(≥25 cmH$_2$O)	34 (3·43%)	3 (0·60%)	31 (6·2%)	11·0	10·5 –11·4	<0·001
Airway obstruction (Chest retraction)	36 (3·63%)	17 (3·43%)	19 (3·83%)	1·12	1·10–1·15	0·87
Desaturation (SpO$_2$ <95%)	52 (5·2%)	27 (5·4%)	25 (5·0%)	0·92	0·91–0·94	1·00
During anesthesia induction	2 (0·202%)	1 (0·202%)	1 (0·202%)	1	0·92 – 1·09	1·00
During emergence from anesthesia (Including laryngospasm)	23 (2·5%)	12 (2·42%)	11 (2·22%)	0·91	0·89 – 0·94	1·00
Desaturation in PACU	27 (2·72%)	14 (2·82%)	13 (2·62%)	0·93	0·90 – 0·95	1·00
Oxygen after PACU (> 2 hours)	14 (1·6%)	10 (2·23%)	4 (0·88%)	0·39	0·38 – 0·41	0·174
Postoperative care						0·826
ICU	92 (9·3%)	48 (9·7%)	44 (8·9%)	0·91	0·90 – 0·92	
PACU	900 (90·7%)	448 (90·3%)	452 (91·1%)	1·10	1·08 –1·11	
PACU stay (min)	34·0 ± 22·5	24·9 ± 25·0	43·0 ± 15·0	18·12	15·43 – 20·81	<0·001
After PACU care						
Ward		211 (47·1%)	194 (42·9%)	0·84	0·84 – 0·85	
Day–surgery center		237 (47·8%)	258 (52·0%)	1·18	1·17 – 1·19	

Values are mean ± standard deviation, or median (interquartile range) [range] or number (proportion).

COVID-19, coronavirus disease 2019; ICU, intensive care unit; N/A, not applicable; OR, odds ratio; PACU, post–anesthesia care unit; SpO$_2$, oxygen saturation.

AP3-8

Platelet-lymphocyte Ratio and Neutrophil-lymphocyte Ratio for Predicting Respiratory Complications after Congenital Heart Surgery

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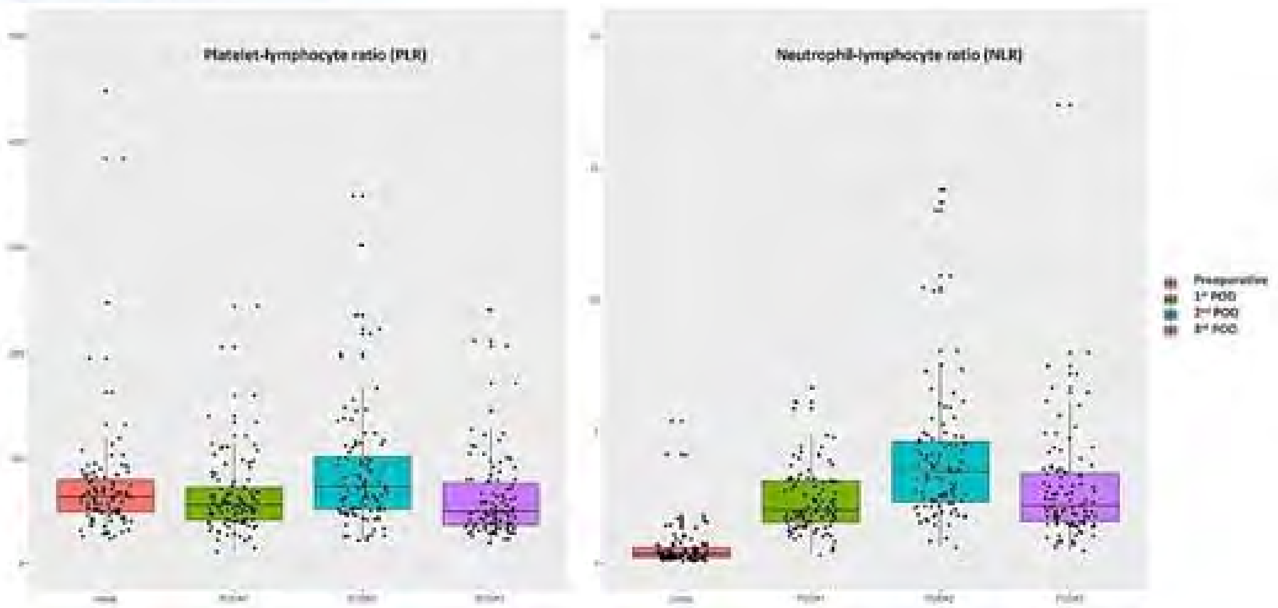
[2]Department of Anesthesia and Pain Medicine, Pusan National University Yangsan Hospital, Seoul, Korea

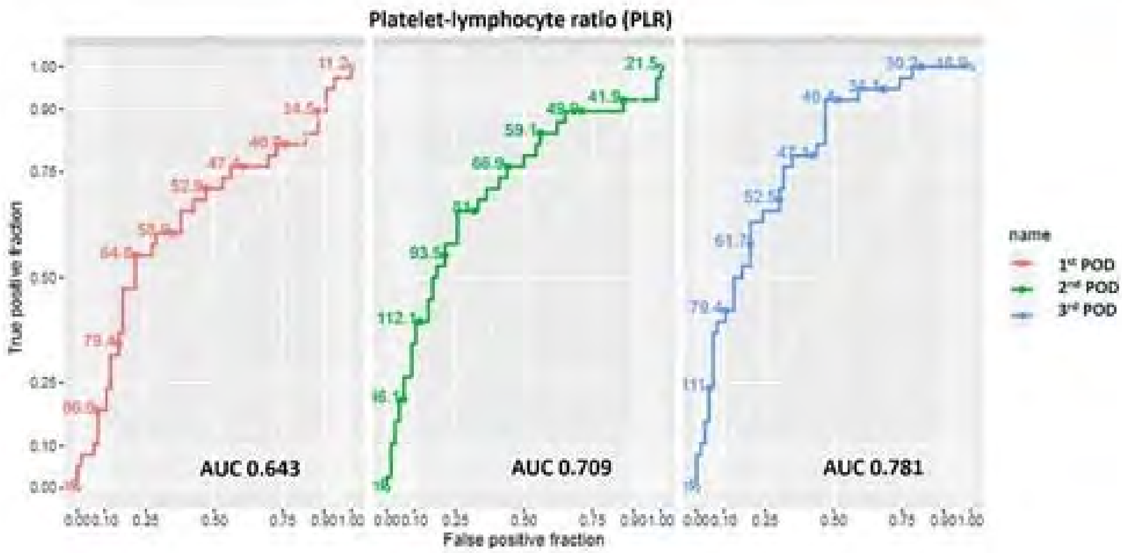
Background: Young infants undergoing congenital heart surgery are at risk of postoperative adverse outcomes, which are contributed by the inflammatory response. Platelet-lymphocyte ratio (PLR) and neutrophil-lymphocyte ratio (NLR) have scarcely been reported as immune-inflammatory indices associated with the prognosis in children with congenital heart disease. We examined prognostic ability of PLR and NLR on postoperative respiratory complications after congenital heart surgery in young infants.

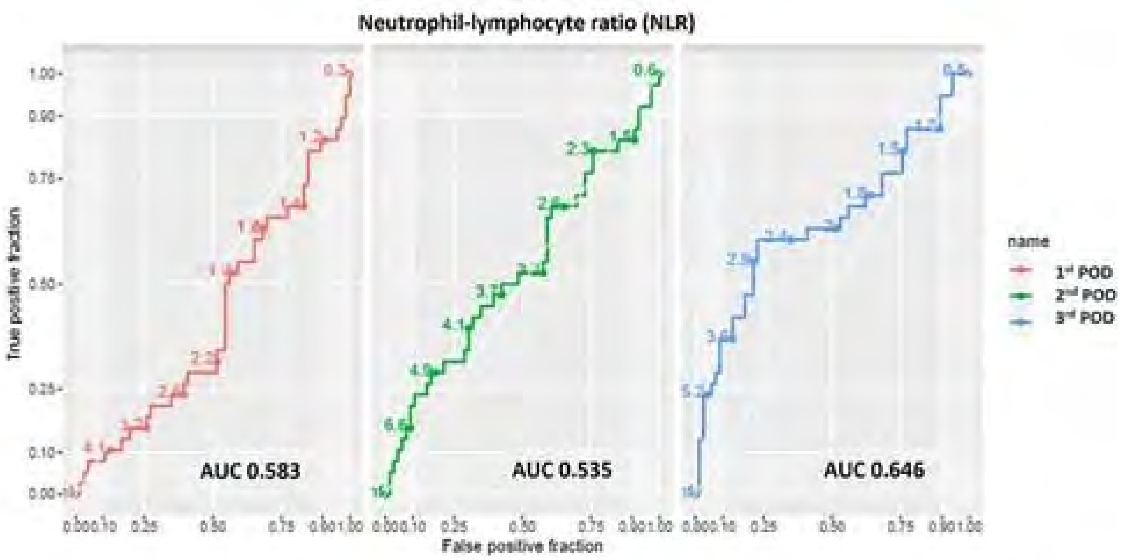
Methods: We retrospectively collected data on 104 patients younger than 1 year who underwent corrective or palliative cardiac surgery for congenital heart disease, and calculated cell count indices (PLR and NLR). Receiver operating characteristic curves analysis was used to evaluate predictive ability of postoperative PLR and NLR for respiratory complications, which were defined as pneumonia, acute respiratory failure, prolonged mechanical ventilation (>48 hours), or reintubation within 30 days after surgery.

Results: Thirty-eight patients (37%) developed respiratory complications. Patients developed respiratory complications were younger, more frequent cyanosis, and higher preoperative B-type natriuretic peptide compared with those who did not. Postoperative PLR did not show a significant change compared with preoperative value. After surgery, NLR increased and showed a peak value on the 2nd postoperative day (POD) (Fig.1). On the 3rd POD, PLR showed an area under the curve (AUC) of 0.781 (95% CI 0.689-0.856, P<0.001) with 92.1% sensitivity and 53.0% specificity to predict respiratory complications at a cut-off >41.34. NLR values on the 3rd POD had an AUC 0.646 (95% CI 0.546-0.738, P<0.001) with a cut-off >2.74 (Fig.2).

Conclusion: Elevated postoperative PLR and NLR can predict respiratory complications after congenital heart surgery in young infants. These biomarkers may be used as systemic inflammatory indices, which are simple and easily accessible methods.


Platelet-lymphocyte ratio (PLR)
Neutrophil-lymphocyte ratio (NLR)
Preoperative
1st POD
2nd POD
3rd POD


Platelet-lymphocyte ratio (PLR)
True positive fraction
False positive fraction
AUC 0.643
AUC 0.709
AUC 0.781
name
1st POD
2nd POD
3rd POD


Neutrophil-lymphocyte ratio (NLR)
True positive fraction
False positive fraction
AUC 0.583
AUC 0.535
AUC 0.646
name
1st POD
2nd POD
3rd POD

Day 2_Room C

Abstract Presentation 4 (In-person)

Chair(s): Sang Hun Kim (Korea)
Hyun Kang (Korea)

AP4-1

Transversus Abdominis Plane Block after Sub Arachnoid Block Reduces Postoperative Pain Intensity and Analgesic Consumption in Elective Lower Abdominal Surgeries in Pediatric Patients - Case Series

Gunjan SIngh

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Transversus abdominis plane (TAP) block reduces post operative pain of Lower Abdominal Surgery in pediatric patients. The primary outcome of this study was the evaluation of the efficacy of TAP block on pain intensity following lower abdominal surgeries after giving spinal anaesthesia

We conducted eight surgeries in the age group between 8 months to 10 years for lower abdominal surgeries. After discussing in detail and taking written inform parental consent, we planned for the procedure. EMLA cream was applied at the L4-L5 region one hour before the procedure and the dressing was done using transparent adhesive plaster.

After securing IV access, intravenous (IV) glycopyrrolate at 10 microgram per kg was administered. This was followed by IV Ketamine 1.5mg per kg bolus and infusion propofol at the rate of 75microgram per kg per minute using infusion pump.

All the patients were given intrathecal bupivacaine at the dose of 0.08ml per kg of 0.5% Bupivacaine (heavy) for 5 to 10 kg and 0.06ml per kg of 0.5% Bupivacaine(heavy) for more than 10 kg using 50mm spinal needle. Propofol infusion continued throughout the surgery. All the children were made in supine position and oxygen was administered by face mask at the rate of five liter per minute.

After the completion of surgery and dressing done, under strict asepsis, using ultrasound machine, 0.5ml per kg of solution containing 0.25% bupivacaine was administered with the help of block needle between internal oblique and transversus abdominis muscle.

After administering the drug for TAP block, infusion propofol was stopped and the child was made to recover from the sedation. After shifting to PACU, child was observed for 30 minutes for any signs of toxicity like decreased heart rate, tingling, irritability and seizure.

Child was then shifted to ward and observed every thirty minutes for the next 24 hours vital parameters and for analgesic requirements.

FLACC score was then observed for next 24 hours at 4 hour interval.

AP4-2

~~Postoperative Sedation and Analgesia in Pediatric Cardiac Surgery~~

Virtual

AP4-3

Erector Spinae Plane Block with Ropivacaine 0.2% in Children - A Case Series, Single Center Experience in Tertiary Pediatric Center in Malaysia

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Background & Purpose: Erector spinae plane block (ESPB) has been first described in 2016 by Forero et all as a modified interfascial plane block that used for patient with chronic neuropathic thoracic pain and was applied in the pediatric population for postoperative pain management as early as 2017. Most evidence on efficacy of ESPB as a postoperative analgesia mainly came from case report but very few trials were conducted. The purpose of this case series mainly to report few cases of variable age group with different type of surgeries that received ESPB in our center.

Case Description: Four ESPB related cases done postoperatively under general anesthesia with ultrasound guided were described. Standard dose of ropivacaine 0.2% 0.5mls/kg was used. 1st case was a 4.12kg 1.5 months old boy that underwent on table cholangiogram and Kasai procedure. Bilateral ESPB was performed at level of T6. He was supplemented with intravenous morphine intraoperative and postoperatively. His FLACC score was 2 immediately postoperative and 0 on post op D1 until D3. 2nd case was an 18.4kg 8 years old girl, who admitted for stoma closure. She received bilateral ESPB at level of T10 with adjunct clonidine 1.5mcg/kg. Her VAS was 0-1 immediately post operative until day 2 post operative. 3rd case was a 46.3kg 15 years old girl who underwent left thoracotomy. She received left ESPB at level of T5. She was supplemented with morphine and intercostal nerve block intraoperatively. PCA morphine postoperatively. Her VAS was 2-4 immediately postoperative but reduced to 0-2 on D2 postoperative. She also received an oral analgesia. The last case was a 32.1kg 13 years old girl. She underwent left thoracotomy and nodulectomy. Left ESPB was performed at level of T5. She received intravenous morphine and intercostal nerve block intraoperatively, and PCA morphine postoperatively. Her VAS was 0-2 postoperative and reduced to 0-1 on D2 postoperative. She also supplemented with oral analgesia. No complication was observed during the block procedure.

Discussion: Based on these case series, its shown that ESPB can be performed not only in patient that undergoing thoracic surgery but also intraabdominal surgery. All of the case series proved that performing ESPB as part of multimodal analgesia can achieved good pain control postoperative in view of all patient had shown a FLACC or given VAS of 0-1 during immediate postoperative or postoperatively D2.

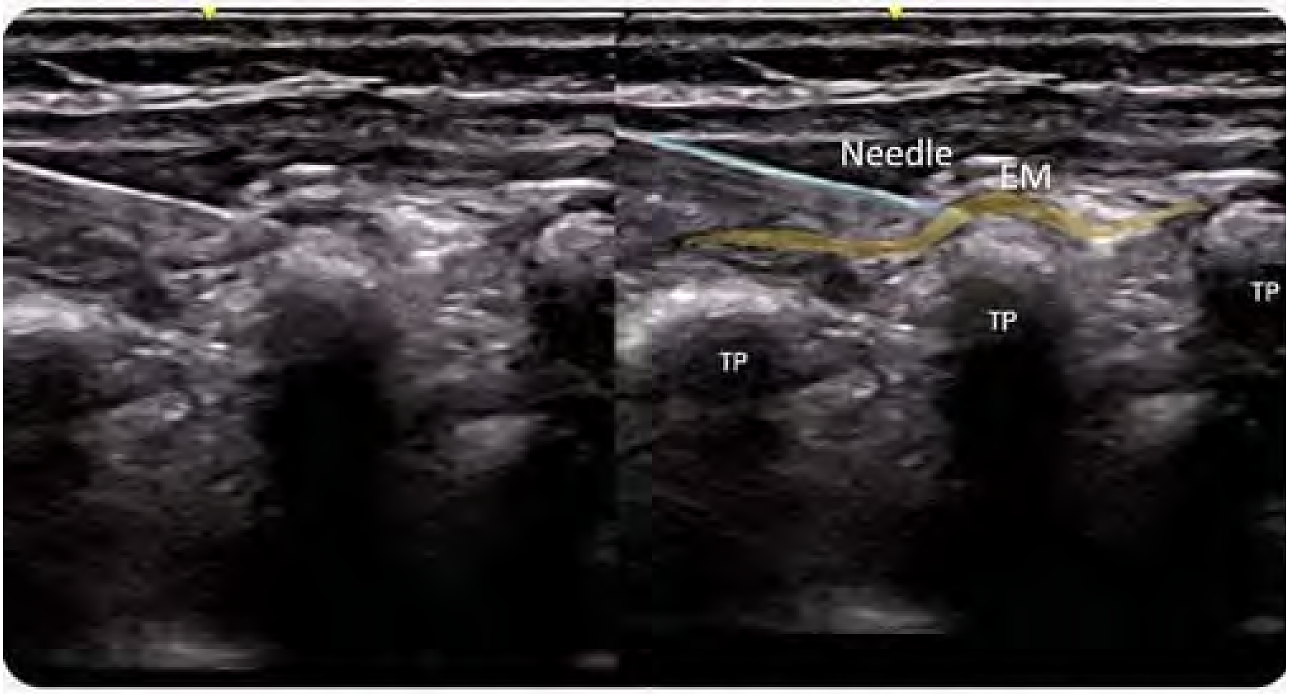

Figure 1: Ultrasound demonstrating needle to ESP at the level of T6 (cranial- caudal orientation)
TP: transverse process
EM: erector muscle

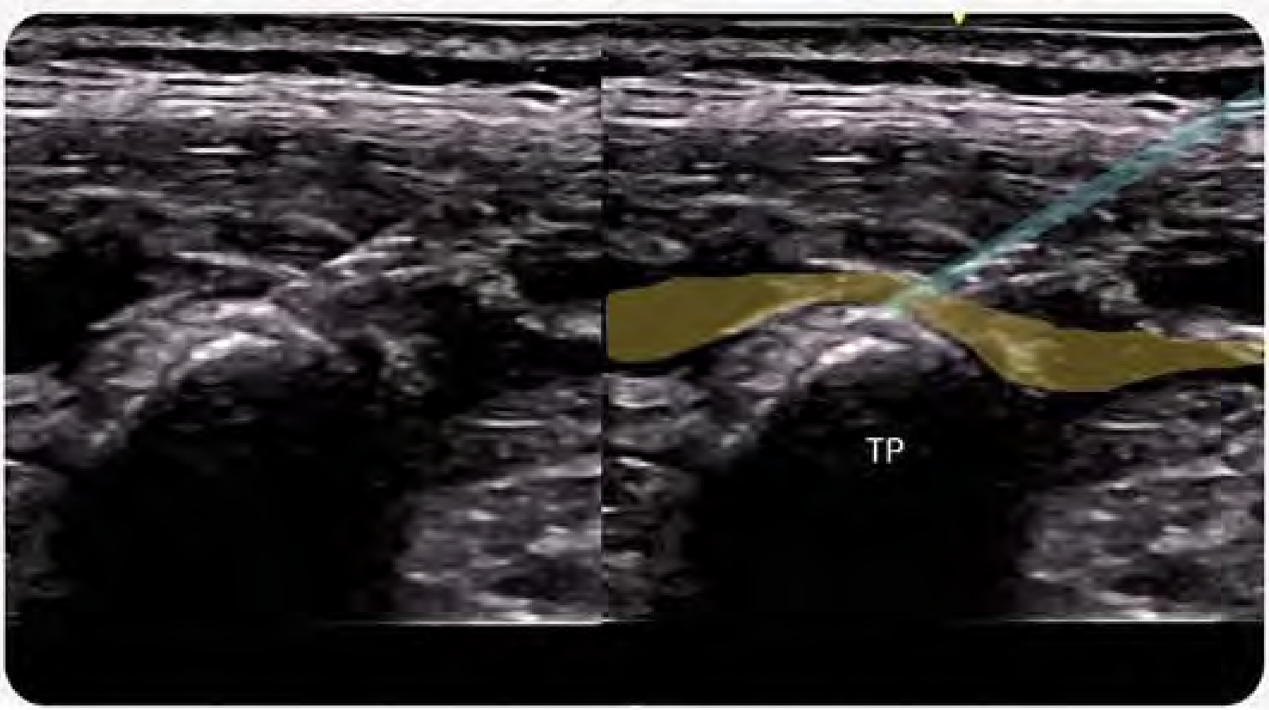

Figure 2: Ultrasound demonstrating needle to ESP at the level of T10 (cranial-caudal orientation)
TP: transverse process

AP4-4

ESP Block for Anesthesia in a Pediatric Patient Who Underwent Diagnostic Laparoscopy after Foreign Body Injury

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[2]Department of Pediatric Surgery, Sisli Hamidiye Etfal Education and Research Hospital,Istanbul, Turkiye

Introduction: ESP block is a relatively new block characterized by the injection of local anesthetic between the erector spinae muscle and the transverse process. It is technically easier and safer in terms of central complications. (1) It is used in acute and chronic pain management as well as in various surgical procedures. Today, with the widespread use of USG, ESP block is used in many surgical procedures in both adult and pediatric patients for anesthesia and analgesia. (2) We aimed to share our pediatric patient who underwent diagnostic laparoscopy for trauma that we applied ESP block for anesthesia.

Case: A 11 years old 35 kg male patient with pencil penetration at lumbar region that planned diagnostic laparoscopy to investigate penetrating posterior abdominal injury. ESP block was applied after sedation with 0,5 mg/kg ketamine and 0,1 mg/kg midazolam. After hydrodisection (1 ml %0,9 NaCl), local anesthetic solution which contains 10 ml 0.5% bupivacaine and 15 ml SF were injected between the transvers process and erector spinae muscle. Then, spread of the solution in this plane was observed.Nonpenetran trauma was confirmed laparoscopically. Then foreign body was removed and surgery was terminated. Patient was followed up with VAS score and recorded at 0.-30 min-1-2-4-6 hours postoperatively. His VAS scores were 0-3.

Discussion: There is little data about ESP block and using as an anestheasia technique ın pediatric patients is quite limited in the literature. We provided peroperative anesthesia and postoperative analgesia control effectively in our pediatric patient who underwent laparoscopic abdominal surgery.We believe that US guided ESP block can be safely performed for peroperatively ın some surgeries and decreased the postoperative pain related complications.

AP4-5

Epidural Analgesia in Major Paediatric Oncosurgeries: A Review of Safety Profile and Practices

Withdrawn

AP4-6

Analgesic Efficacy and Safety of Ultrasound-guided Erector Spinae Plane Block in Pediatric Patients Undergoing Surgery: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

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Introduction: Ultrasound-guided erector spinae plane block (ESPB) has gained popularity for perioperative analgesia in adults undergoing various surgeries. But, its efficacy and safety in pediatric patients remain unclear. This review aimed to investigate the analgesic effect and safety of ultrasound-guided ESPB in pediatric patients undergoing surgery under general anesthesia through a meta-analysis of randomized controlled trials (RCTs) reported so far.

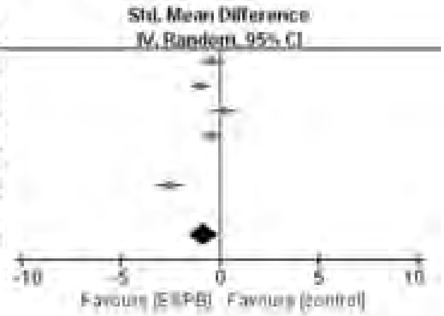
Methods: We searched the databases including PubMed, EMBASE, the Cochrane Library, Web of Science etc. for published eligible RCTs comparing ESPB with control (no block/sham block) in pediatric patients undergoing surgery from inception to March 2023. The analgesic efficacy outcomes were intraoperative opioid (i.v. morphine milligram equivalents) consumption, time to first rescue analgesic requirement, number of patients who required rescue analgesic, postoperative cumulative opioid requirement up to 24 h, the pain scores using the FLACC (Face, Legs, Activity, Cry, Consolability) scale for 24 h after surgery, and incidences of postanesthetic adverse events including bradycardia, hypotension, and postoperative vomiting (POV) were considered as safety outcomes.

Results: Data from 9 studies involving 501 pediatric patients were included. Compared to the control, ESPB significantly reduced the intraoperative opioid consumption and postoperative cumulative opioid requirement up to 24 h [standardized mean difference (SMD) = -0.79; 95% confidence interval (CI), -1.55 to -0.03, and SMD = -2.10; 95% CI, -2.97 to -1.23, respectively; Fig. 1 & 2] and significantly lowered the pain scores at 2, 6, 24 h after surgery. ESPB significantly prolonged the time to first rescue analgesic requirement and decreased the number of patients who required rescue analgesic. However, considerable heterogeneity in the outcomes was observed. As for safety outcomes, ESPB significantly decreased the incidence of POV compared to the control, while incidences of bradycardia and hypotension were comparable.

Conclusions: ESPB effectively and safely provided intraoperative and postoperative analgesia resulting in lower opioid requirement and pain scores in postoperative period up to 24 h with decreased POV in pediatric patients undergoing surgery under general anesthesia compared to the control. However, further studies are needed, considering the small number of studies included and the high heterogeneity of some efficacy outcomes.

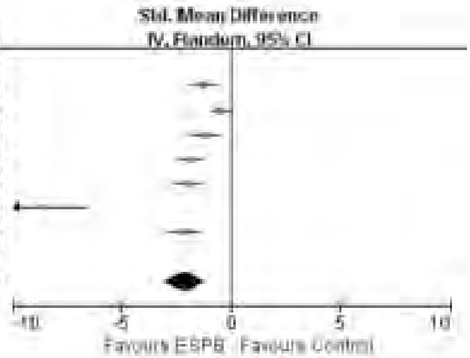
Study or Subgroup	ESPB Mean	ESPB SD	ESPB Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
Abdelrazik 2022	0.078	0.03	20	0.102	0.08	20	19.5%	-0.39 [-1.02, 0.24]
Abdullah 2022	0.43	0.19	50	0.67	0.3	48	21.1%	-0.95 [-1.37, -0.53]
Karacear 2022	1.946	1.123	20	1.76	0.324	20	19.5%	0.22 [-0.40, 0.84]
Kaushal 2020	1.045	0.323	40	1.146	0.206	40	20.9%	-0.37 [-0.81, 0.07]
Mostafa 2019	0	0	30	4	2.11	30		Not estimable
Yuan 2022	6.173	0.642	30	8.83	1.333	30	19.0%	-2.51 [-3.19, -1.82]
Total (95% CI)			**190**			**188**	**100.0%**	**-0.79 [-1.55, -0.03]**

Heterogeneity: Tau² = 0.67; Chi² = 38.47, df = 4 (P < 0.00001); I² = 90%
Test for overall effect: Z = 2.03 (P = 0.04)



Study or Subgroup	ESPB Mean	ESPB SD	ESPB Total	Control Mean	Control SD	Control Total	Weight	Std. Mean Difference IV, Random, 95% CI
Abdelrazik 2022	0	0	20	0.535	0.438	20		Not estimable
Abdullah 2022	0.065	0.023	20	0.105	0.036	20	14.9%	-1.30 [-1.99, -0.61]
Ali Gado 2022	0.4	0.2	50	0.5	0.2	49	15.9%	-0.50 [-0.90, -0.09]
Karacear 2022	0.013	0.03	20	0.04	0.001	20	14.9%	-1.25 [-1.93, -0.56]
Kaushal 2020	0.109	0.091	40	0.552	0.327	40	15.5%	-1.83 [-2.36, -1.31]
Mostafa 2019	0.02	0.026	30	0.089	0.041	30	15.2%	-1.98 [-2.61, -1.36]
Singh 2020	0.051	0.004	20	0.101	0.007	20	8.5%	-8.60 [-10.67, -6.52]
Yuan 2022	0.26	0.11	30	0.47	0.08	30	15.1%	-2.16 [-2.80, -1.51]
Total (95% CI)			**230**			**229**	**100.0%**	**-2.10 [-2.97, -1.23]**

Heterogeneity: Tau² = 1.19; Chi² = 76.90, df = 6 (P < 0.00001); I² = 92%
Test for overall effect: Z = 4.73 (P < 0.00001)



AP4-7

Prediction of Effect and Complications of PCA in Children Undergoing Urologic Surgery

Young-Eun Joe, Jeong-Rim Lee, Ho-Jae Nam, Hyo-Jin Byon

Department of Anesthesiology and Pain Medicine, Severance Hospital, Yonsei University College of Medicine, Seoul, Korea

Purpose: Postoperative pain is common in children, and the proper treatment of postoperative pain can be a challenge for physicians. This is a retrospective study investigating the effects and complications of patient-controlled analgesia (PCA) in children undergoing pediatric urology surgeries.

Method: Medical records of children who received intravenous PCA following urology surgery in a single tertiary hospital were analyzed. Data on the patient's gender, age, height, weight, medical history, surgical method, type of anesthesia, dosage of PCA, postoperative pain, additive analgesics and postoperative complications were collected. Machine learning-based predictive models were constructed to explore demographic, anesthetic and surgical attributes in order to predict post-operative pain and complications of PCA.

Results: The statistical analysis included data from 3,544 children. Random Forest model (AUC:0.79, ACC:0.83) and Glmnet Ridge model (AUC:0.84, ACC:0.86) were suitable for predicting moderate post-operative pain for 6-24 hours and 24-48 hours after surgery, respectively. The attributes used to predict moderate post-operative pain were previous post-operative pain score, anesthesia time, whether regional block was done, and age. XGBoost model (AUC:0.71, ACC:0.74) and Glmnet Ridge model (AUC:0.71, ACC:0.82) were chosen to predict complications of PCA for 6-24 hours and 24-48 hours after surgery, respectively. Attributes for predicting complications of PCA included age, motion sickness, total opioid dose, and anesthetic time.

Conclusion: In this retrospective study, machine learning-based models and attributes were proposed to predict moderate post-operative pain and complications of PCA in children undergoing urologic surgeries, which could contribute to improve postoperative pain management in children.

Day 2_Room D

Abstract Presentation 1 (Virtual)

Chair(s): Sooyoung Cho (Korea)
Hee Young Kim (Korea)

V1-1

“Know It to Deal with It"- Neonatal Airway Management with a Large Sincipital Encephalocele

Pranita Mandal, Anupama AS, Jayasree T, Molli Kiran, SRAN Bhushanam Padala, Sunaina T Karna

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Background: Encephalocele is a rare birth defect of the neural tube that affects the brain with incidence of about 10-20% of all the cranial dysraphism. We here present a neonate with a huge frontonasal encephalocele planned for surgical excision.

Case Description: A 29 days old male, weighing 3 kg, admitted with a large frontonasal swelling for excision. MRI brain revealed a midline round to oval shaped bony defect of 2.2 cm in the frontal region, with herniation of brain tissue and CSF filled spaces. A diagnosis of sincipital frontonasal encephalocele was made by the neurosurgeons. His birth history was uneventful. The mass was present since birth and increased gradually (Fig. a). This was an obvious expected difficult mask ventilation case. Our general anesthetic plan was to go ahead with graded sevoflurane induction using I-gel size 1 for assisted ventilation, while an assistant held the mass. Para-oxygenation was done with nasal prongs. Our general anesthetic plan was to go ahead with graded sevoflurane induction using inverted RBS mask, while an assistant held the mass in supine position (Fig. b). Inj. glycopyrolate 15 mcg and Inj. ketamine 3 mg were given to help insert size #1 I-gel. After appropriate depth of anesthesia using I-gel for delivery of gases, a check video-laryngoscopy with Miller blade size 0 revealed CL grade 2b. The trachea was then intubated with 3.0 uncuffed PVC endotracheal tube. Mechanical ventilation was instituted and maintained anesthesia with oxygen/ air, isoflurane and intermittent doses of atracurium. Intraoperative course was uneventful and patient trachea was extubated afterwards.

Discussion: Reporting of problems faced in anterior encephaloceles is very sparse. In our case, we planned to use a size #0 RBS mask in an inverted position for proper seal and adequate bag & mask ventilation. But it could not help for maintaining adequate depth, so we used I-gel instead. As this was an anticipated difficult airway, Inj. succinylcholine 6 mg, appropriate size oral airway, mask, SGDs, FOB 2.8 mm size was kept ready. Besides difficult airway, perioperative concerns like CSF leak, hemorrhage, raised ICP, seizures and brainstem compression should be kept in mind. We conclude that a difficult airway cart should always be ready with airway management plans.

Reference: 1) Dhirawani RB, Gupta R, Pathak S, Lalwani G. Frontoethmoidal encephalocele:Case report and review on management. Ann Maxillofac Surg 2014;4:195-7

V1-2

~~Nasotracheal Intubation Guided by the Esophageal Temperature Probe in Children~~

Withdrawn

V1-3

Risk Factors for Failed First Attempt of Intubation in Pediatric Patients: Preliminary Results of a Prospective Observational Study

Faiza Grati[1], Manel Kammoun[2], Imen Zouche[1], Khadija Ben Ayed[2], Rahma Derbel[1], Anouar Jarrya[2]

[1]Department of Anesthesiology, Habib Bourguiba Hospital, Sfax, Tunisia,
[2]Department of Anesthesiology, Hedi Chaker Hospital, Sfax, Tunisia

Background: Unpredicted difficult intubation in children remains frequent. The aim of this study was to investigate risk factors for failed first attempt of intubation in children

Methods: This is a prospective observational study including newborns, infants, and children under 5 years old undergoing general anesthesia with tracheal intubation. We collected data about demographic parameters, anesthesia protocol, facial dysmorphia, and circumstances of anesthesia. Patients were divided into two groups. Group1: included patients whose intubation failed in the first attempt. Group 2 included patients with easy intubation and who were intubated from the first laryngoscopy. After statistical comparison between the two groups, a univariable logistic regression was performed to investigate predictors for failed first intubation in children.

Results: in this study we included 65 patients. The incidence of failed first attempt of intubation was 7.7% and no failed intubation was noted. Demographic and anesthesia parameters were comparable between the two groups. The main risk factors for failed first intubation werepremature neonates with[OR=9.7; 2.7-35.1], emergency [OR= 5.2; 1.6-16.3], surgery after midnight [OR=14.6; 1.5-135], andsyndromicdysmorphia [OR= 66; 7.5-58].

Conclusions: It seems that syndromicdysmorphia remains the main risk factor for difficult intubation in children. However, particular cautions shold be given for premature newborns and emergent surgeries.

V1-4

Management of a Rapidly Growing Sublingual Congenital Ranula: A Case Report

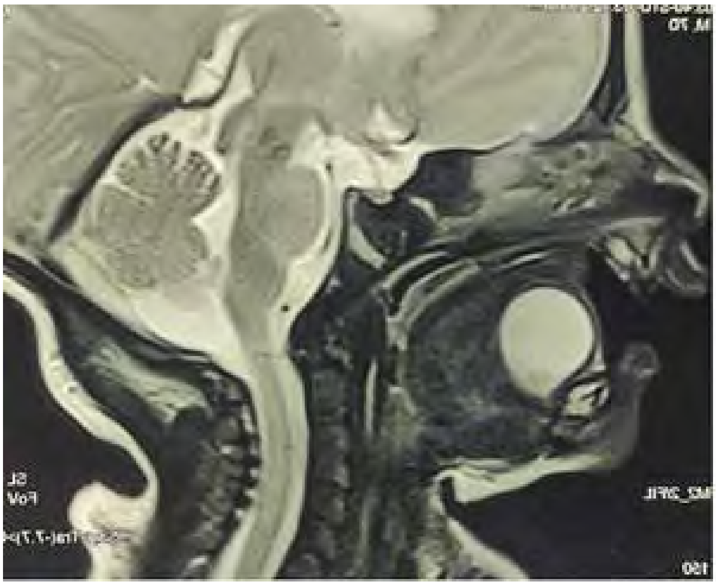
Anouar Jarraya[1], Faiza Grati[2], Manel Kammoun[1], Imen Zouche[2], Ahlem Bouzid[1], Hichem Cheikhrouhou[2]

[1]Department of Anesthesiology, Hedi Chaker Hospital, Sfax, Tunisia,
[2]Department of Anesthesiology, Habib Bourguiba Hospital, Sfax, Tunisia

Background: Congenital ranula is a rare sublingual mucous extravasation pseudocyst. It can remain asymptomatic for a long period of time. However, we report a case of a rapidly growing ranula that became obstructive within two weeks. We also describe the original airway and anesthetic management that allowed the total excision of the cyst.

Case Presentation: We report the case of a newborn born at 37 weeks gestation who had a small swelling under the tongue. Two weeks later, the patient was having feeding and breathing difficulties, as well as losing weight. We chose cyst puncture and drainage after two failed intubation attempts, which allowed for better conditions for a successful oral intubation. The cyst excision was done under deep general anesthesia using a transoral approach. The histologic examination showed a congenital ranula.

Conclusion: Congenital ranula can grow rapidly, causing the obstruction of the airway. It seems that the puncture and drainage of the cyst prior to the intubation may facilitate the airway management. Furthermore, radical surgical treatment remains the best solution to reduce the risk of recurrence.



V1-5

An Innovative Technique to Deflate and Reinflate the Tracheostomy Tube to Facilitate Ventilation During Tracheal Resection and Reconstruction Surgeries

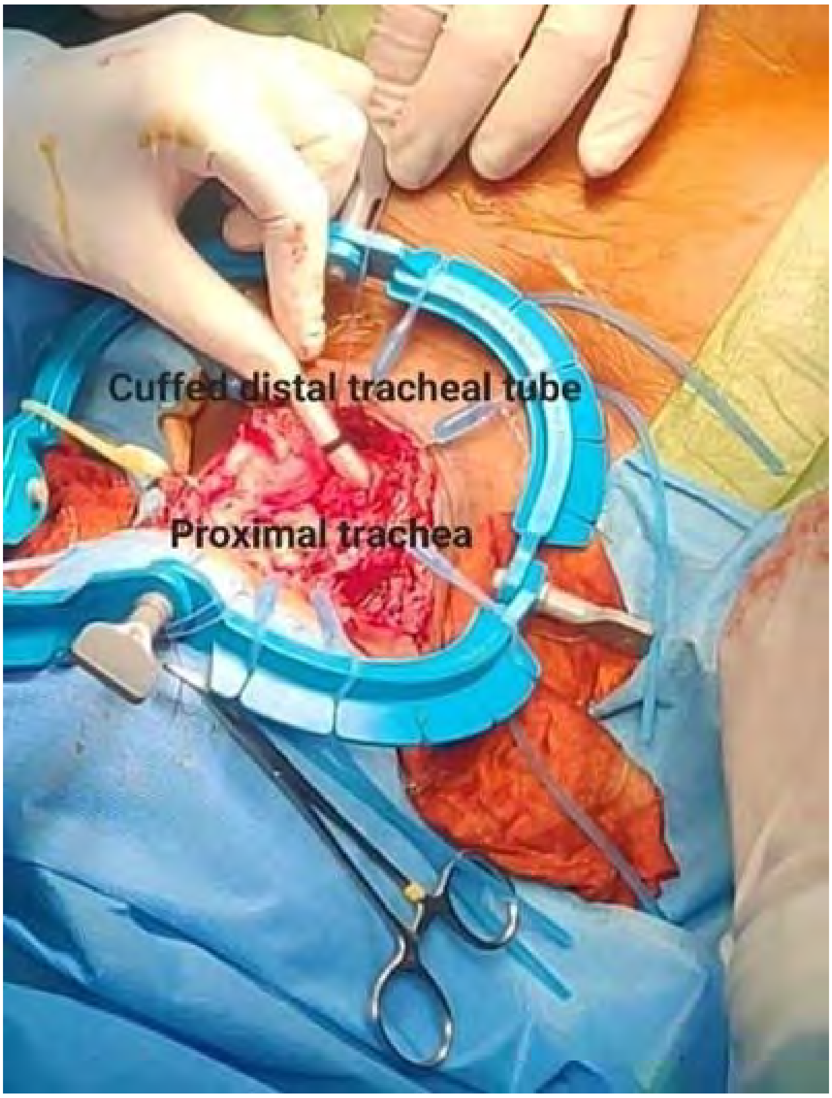
Nesara N[1], Suma Sriramanan[2], Gayatri sasikumar[2], Jayashree Simha[2], E V Raman[3], H S Murthy[4]

[1]Department of Anesthesiology, Manipal hospital, Bangalore, Karnataka, India, [2]Senior consultant, Department of anesthesiology, Manipal hospital, Bangalore, Karnataka, India, [3]Senior consultant, Department of ENT, Manipal hospital, Bangalore, Karnataka, India, [4]HOD, Department of anesthesiology, Manipal hospital, Bangalore, Karnataka, India

Background: Tracheal resection and reconstruction (TRR) is one of the most challenging surgeries for anesthetists because of compromised airway. Advances in surgical, anesthetic and airway management have improved the outcomes. Plan for ventilation during the "open airway phase" where the trachea is mobilized by the surgeon is crucial. The conventional approach of distal tracheal intubation for cross field ventilation followed by apnea-ventilation-apnea technique requires good coordination between surgeons and anesthetist.

Case Description: A young girl sustained accidental strangulation injury due to scarf entangled around her neck while pillion riding on a bike. This led to blunt airway trauma for which she was intubated and later tracheostomized owing to failed extubation. Multiple attempts at decannulation failed and she was found to have tracheal stenosis for which TRR was planned. After thorough pre-operative work up, assessment of the airway was done with flexible bronchoscope and surgery proceeded. After intravenous induction, tracheostomy tube was exchanged with 5 sized cuffed flexometallic tube. An uncuffed flexometallic tube of the same size was passed nasally and placed proximal to the stenotic segment. During open airway phase anesthesia was maintained with TIVA (dexmedetomidine and propofol infusion) allowing patient to breathe spontaneously. This gave longer periods of tubeless surgical field without significant drop in saturation.

Discussion: For TRR surgeries, the distal tracheal tube needs to be deflated and retracted for surgical exposure very often which can be cumbersome and time consuming. To facilitate smooth manipulation of the cuff we attached a regular pressure monitoring line with luer lock to the pilot balloon of the distal tracheal tube which in turn was connected to a cuff pressure gauge monitor. This allowed easy and quick deflation and reinflation away from the surgical field without disturbing the surgical team. Later the nasal tube was introduced into the reconstructed airway. Patient was shifted to intensive care unit for elective ventilation and extubated on 3rd post operative day. She was discharged with advice of bi-level positive airway pressure at night. Anesthesia for airway procedures is among the most technically challenging task for the entire team and new modifications such as these offer potential advantages. We wish to share our experience for the benefit of all.



Cuffed distal tracheal tube
Proximal trachea

Cuffed distal tracheal ETT
cuff pressure gauge monitor
pilot balloon of the ETT
pressure monitoring line

V1-6

Airway Management of a Congenital Teratoma with a Cleft Palate: An Original Case Report

Kammoun Manel[1], Faiza Grati[2], Khadija Ben Ayed[1], Imen Zouche[2], Salma Ketata[2], Anouar Jarraya[1]

[1]Department of Anesthesiology, Hedfi Chaker Hospital, Sfax, Tunisia,
[2]Department of Anesthesiology, Habib Bourguiba Hospital, Sfax, Tunisia

Background: Airway management in neonates is difficult because the risk of rapid hypoxia. It presents a challenge even for an experienced anesthesiologist. Oral tumors in neonates are very rare but they can seriously worsen the conditions of intubation. To surmount these difficulties, a special multidisciplinary approach and particular precautions are needed.

Case Presentation: We describe the airway management and precautions taken in the anesthesia for surgical removal of a rare case of congenital palate teratoma associated to a wide cleft palate in a 25 days old girl. Impossible intubation was predicted on the magnetic resonance imaging. The difficult airway management cart as well as an otorhinolaryngologist, skilled in performing emergency tracheostomy in a neonate was available. The patient was intubated by conventional laryngoscopy under sevoflurane inhalatoryanaesthesia. To prevent post operative edema and bleeding, the patient received dexamethasone and he was extubated 24 hours after the end of the intervention.

Conclusion: This case illustrates that predicting difficult airway in a newborn by clinical evaluation and radiological exams allowed us to take necessary precautions for successful neonatal airways management.

Figure 1: Clinical appearance of palate teratoma associated with a cleft palate: tumor covered with fine downy skin protruding from the shelves of the cleft.

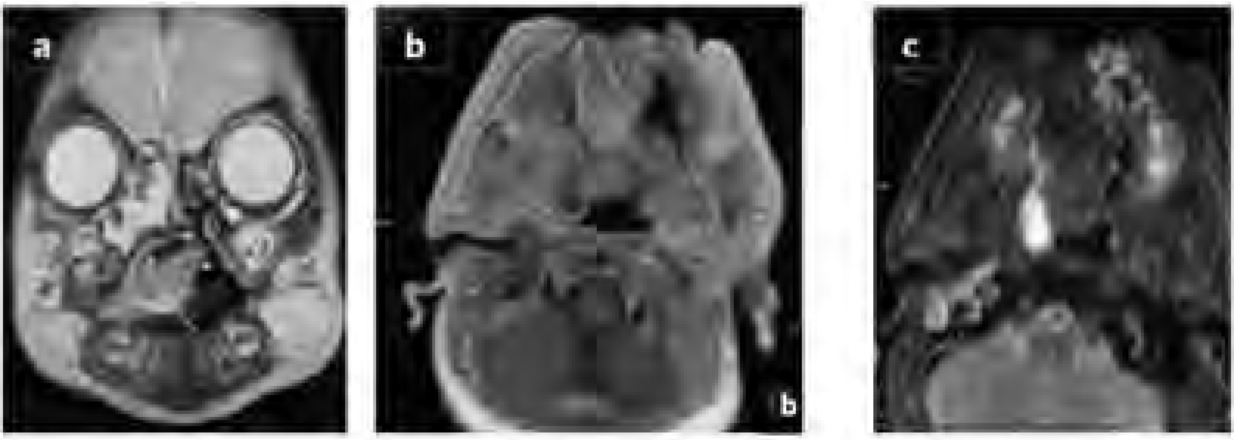


Figure 2 :

a) MRI T2-weighted coronal image shows a lesion attached to the nasal septum between the two palate shelves with endobuccal extension. The lesion is heterogeneous and contains areas of hyperintense signalling (arrow). We note also retention of fluid within ethmoid cells upstream from the tumour (curved arrow).

(b) An axial T1-weighted image shows a hyper-intense heterogeneous encapsulated lesion measuring 3 cm approximately.

(c) T2-weighted fat suppressed axial image shows loss of signal intensity on the tumoral lesion which suggests the presence of macroscopic fat (arrow).

V1-7

Airway Management of Congenital Pulmonary Airway Malformation Resection in an Infant in Resource Limited Setting: A Case Report

Shephali[1], Preethy J Mathews[2], Shiv Soni[3], Muneer Abbas Malik[4]

[1,2,3]Division of pediatric anesthesia and intensive care, Postgraduate Institute of Medical Education and Research, Chandigarh, India, [4]Department of pediatric surgery, Postgraduate Institute of Medical Education and Research, Chandigarh, India

Background: Congenital Pulmonary Airway Malformation (CPAM) is a rare developmental anomaly of lower respiratory tract. Incidence of 1/20,000?1/30,000 live births. It does not participate in gas exchange, communicates with bronchial tree and receives blood supply from pulmonary circulation. Positive pressure ventilation causes cystic dilatation of affected airways with risk of tension pneumothorax. CPAM may contain fluid, increasing risk of spillage and flooding of airway intraoperatively. We report management of an infant in resource limited setting with CPAM who had risk of pneumothorax and airway flooding.

Case Discussion: 1 month-old female infant weighing 2.5 kilograms, presented with fever and respiratory distress for 20 days. The baby was referred to our institution on day-46 of life for worsening respiratory distress. She was intubated in emergency. Chest x-ray (Figure 1) and computed tomography-scan (Figure 2) showed middle lobe CPAM with air-fluid level. Posted for lobectomy under general anesthesia. On pre-anaesthetic evaluation, right lung obliterated by large cyst and had hardly any tidal exchange. The consensus decision (by surgery and anaesthesia) was to place ultrasound-guided intercostal chest drain (ICD) to drain fluid and relieve compression of lung tissues preoperatively. Infant was taken up for surgery after 48 hours of stabilization on ICD. It was ideal to place right sided bronchial blocker (BB) or left sided endobronchial intubation, which was not feasible due to non-availability of 2.2 or 2.8 mm flexible bronchoscope. The following precautions were taken: Muscle relaxant avoided till pleural opening, ICD not clamped fearing risk of pneumothorax, and on thoracotomy bronchial communication to cyst was blocked with gauze till clamping of bronchus was achieved. Intermittent endotracheal tube suction was done to prevent its blockage with blood. To avoid operation theatre pollution from inhalation agent, propofol infusion was instituted.

Discussion: CPAM resection necessitate one-lung ventilation (OLV) which is achieved by Double lumen tube (DLT), BB and endobronchial intubation. DLT for infants are not available. Left endobronchial intubation needs FOB guidance, which is challenging in resource-poor setting and leads to ventilation-perfusion mismatch. In our case scenario, the risk of placing BB was more than benefit. This case will give an alternate idea for airway management in such cases in resource limited setting.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V1-8

Pediatric Airway Management in Undiagnosed Congenital Subglottic Stenosis Undergoing Congenital Cardiac Surgery

Dilek Altun[1], Demet Altun Bingöl[2], Zehra Serpil Ustalar Özgen[3]

[1]Department of Anesthesiology and Reanimation, Vocational School of Health Sciences, Acıbadem Mehmet Ali Aydınlar University, İstanbul, Turkey, [2]Department of Anesthesiology and Reanimation, Istanbul Faculty of Medicine, Istanbul University, İstanbul, Turkey, [3]Department of Anesthesiology and Reanimation, School of Medicine, Acıbadem Mehmet Ali Aydınlar University, İstanbul, Turkey

The pediatric unanticipated difficult airway in cases of subglottic stenosis is always a challenge. Children form a specific group of patients as there are significant differences in both anatomy and physiology. Here, we have presented a case managed according to pediatric difficult intubation protocols where tracheostomy was used as a secondary intubation plan successfully.

A 6-month-old female child weighing 8 kg underwent congenital cardiac surgery for the repairment of ASD-VSD closure. Preoperatively airway examination revealed no abnormalities. Mouth opening was adequate for her age. Preoperatively systemic examination and all relevant investigations were normal. The Copur index was 6 which revealed easy normal intubation. On the day of surgery, premedication was done with oral midazolam (0.5 mg/kg). Anesthesia induction was done with fentanyl 1.5 μg/kg and a midazolam 0.25 mg/kg iv. Adequacy of mask ventilation was established following which injection of atracurium 0.5 mg/kg was administered. Although mask ventilation was adequate, direct laryngoscopy revealed Cormack?Lehane Grade 4. Four attempts with 2 specialized pediatric anesthesiologists to intubate with cuffed endotracheal tube sizes 4.5, 4.0, and 3.5 were unsuccessful. Each attempt was done after preoxygenation with 100% oxygen; hence, on no occasion, oxygen saturation went below 80%. Supraglottic airway, i-gel®, size 2 can't be inserted as a rescue device. Since mask ventilation can be established successfully tracheostomy decision was taken. The cardiovascular surgeon has established a surgical tracheostomy successfully within 8 minutes.

If the operation was not urgent, the case can be postponed and both surgical and non-surgical treatment methods could be recommended.

After operation, she was taken to the intensive care unit (ICU). Fiberoptic bronchoscopy staged it as a Grade 3 subglottic stenosis. On the third day of ICU, she was discharged from the service without any problem.

Many patients with difficult airways can be identified before induction of anesthesia or sedation. These patients should be cared for only in a tertiary care facility with qualified caregivers. Current practice guidelines and recommendations should be reviewed and practiced so that individuals and institutions can be ready to act quickly when problematic airway scenarios arise. Needed equipment should be readily available in a portable difficult airway cart.

Day 2_Room D

Abstract Presentation 2 (Virtual)

Chair(s): Ji-Hyun Lee (Korea)
Ye Yun Phang (Malaysia)

V2-1

Anesthesia Management of Left Pulmonary Artery Sling: LPA Reimplantation Without Cardiopulmonary Bypass

Anshoril Arifin, Aries Perdana

Department of Anesthesiology and Intensive Care University of Indonesia - National Cipto Mangunkusumo Hospital, Jakarta, Indonesia

Background: Left Pulmonary Artery Sling (LPAS) is a rare vascular anomaly. The surgical technique is generally carried out with a median sternotomy approach using a Cardiopulmonary Bypass (CPB) to release the slinging pulmonary artery and repair the tracheal stenosis. In this case, we will discuss the anesthetic management of LPA reimplantation without using CPB to improve the understanding and provide an overview for practitioners in managing patients with this rare vascular anomaly.

Case Description: The patient was a 10-month-old baby complaining of shortness of breath since he was 4 months old. Based on the results of cardiac MSCT, the patient was diagnosed with LPAS. The patient was planned for LPAS repair surgery without using CPB. The patient underwent general anesthesia. The surgery was performed by releasing the left pulmonary artery (LPA) and reimplanting it into the main pulmonary artery (MPA). When the LPA was clamped to cut and release the sling, there was a decrease in blood pressure and an increase in end-tidal CO2 (EtCO2) to 70 mmHg. After the reimplantation process was completed, the LPA and right pulmonary artery (RPA) showed confluence, and the end-tidal returned to normal at 36 mmHg. Tracheoplasty procedure was not performed on the patient. After the operation, the patient was treated in the intensive care Unit (ICU) for 10 days.

Discussion: LPAS is one of the rare congenital heart defects caused by abnormalities of left pulmonary artery grew from the right pulmonary artery and ran posteriorly between the trachea and esophagus towards the left lung. Diagnosis of LPAS can be established by examining a multi-slice CT scan to look for defects in the LPA. Generally, surgery for correction of LPAS is performed using a median sternotomy approach with CPB. The surgical process consists of releasing the sling LPA and reimplanting the new LPA into the MPA. In this patient, corrective surgery was performed through median sternotomy without CPB. Intraoperatively, there was a decrease in blood pressure due to decreased preload and increased EtCO2 due to increased dead space which was successfully overcome by administering fluids, inotropes and increasing alveolar ventilation in ventilator settings. When the LPA was successfully released and reimplanted, hemodynamic and EtCO2 returned to normal. Postoperatively, the patient experienced Ventilator Acquired Pneumonia (VAP) and we administered antibiotics according to the culture results.

Figure 1. MSCT (Multi-slice Computerized Tomography) Cardiac shows that the LPA (Left Pulmonary Artery) is narrowing due to the LPA sling.

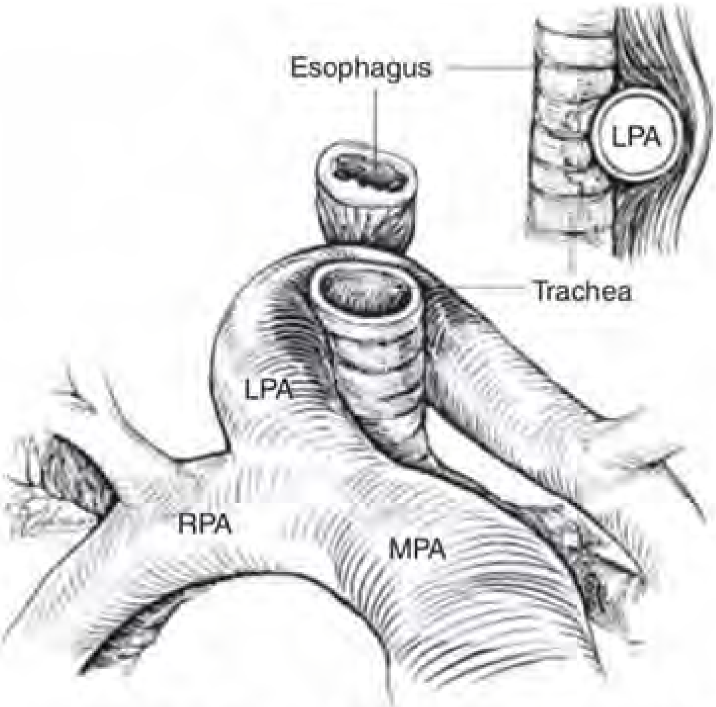


Figure 2. Left Pulmonary Artery Sling (LPAS). L, Left; R. Right; M, Main; PA, Pulmonary Artery. Fig 2 Shows a lateral view of anterior compression of the esophagus and posterior compression of the trachea.

V2-2

Fast Track Extubation in Severe Scoliosis with Cor Pulmonale: The Role of Non Invasive Ventilation

Alia Vidyadhara, Lakshmipraba. M, Gayatri Sasikumar

Department of Spine Anesthesia, Manipal Hospital, Old Airport Road, Bangalore, Karnataka, India

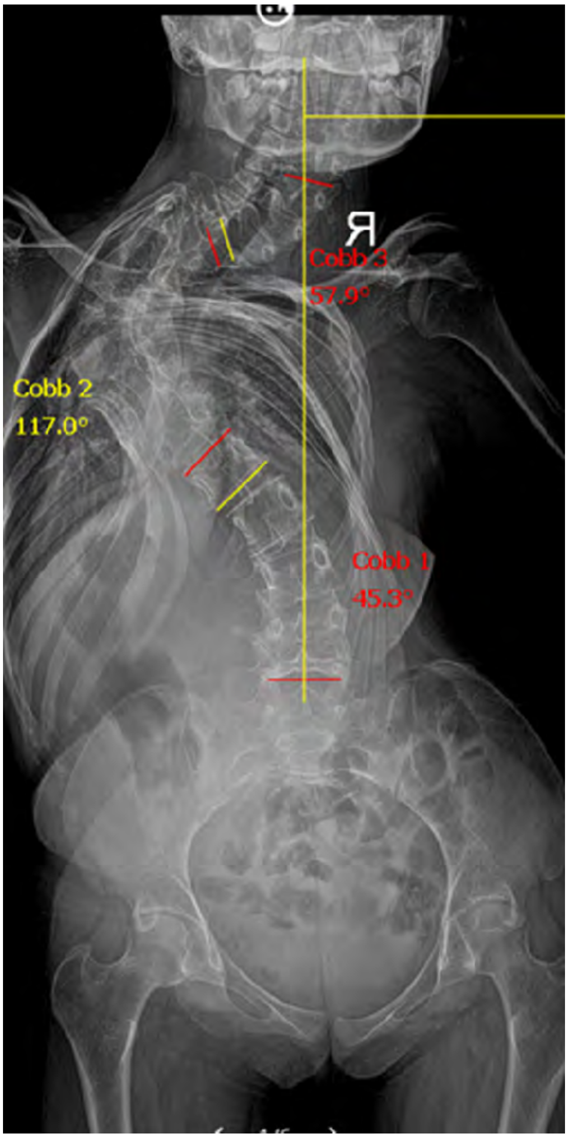
Background: Advanced congenital scoliosis causes cardiorespiratory dysfunction resulting in severely restricted lung disease and cor-pulmonale. Corrective surgery curbs decline in cardiorespiratory function. Intraoperative arrhythmia, myocardial ischemia due to right heart failure, neuromonitoring and blood loss makes anesthetic management challenging. The severely restricted lung function makes them candidates for prolonged postoperative mechanical ventilation.

Case Description: A 16-year-old female presented with severe congenital thoracolumbar scoliosis, Cobb's angle 117^{o}, dyspnea NYHA grade 3, breath holding time 10s and room air saturation (SPO2) 62%.

Investigations: PFT-FEV1-24%, FVC-26%, ECHO-right heart dysfunction; CT Angiography: severe pulmonary artery hypertension (PAH), Room air ABG-Type 1 respiratory failure. A staged scoliosis correction was planned. Sildenafil was initiated preoperatively. Standard ASA monitors and invasive monitoring were established. Intubation was done after adequate preoxygenation. TIVA technique with propofol 100mcg/kg/minute, fentanyl 1mcg/kg/hour and dexmedetomidine 0.7mcg/kg/hour was used to facilitate SSEP and MEP monitoring. Temperature, urine output, entropy, serial ABG were monitored. CVP trends served as surrogate for right heart function. Hemodynamic fluctuations and factors worsening PAH, RV dysfunction were avoided. 100ml blood loss was replaced with plasmalyte. At the end of surgery, once spontaneous respiration resumed, patient was shifted to PACU on pressure support mode. She was extubated after 3 hours and immediately switched to Non Invasive Ventilation (NIV). Postoperative analgesia included IV paracetamol 300 mg and IV tramadol 30 mg, avoiding opioid infusion.

Post Operative Course: Following the first 24 hours on NIV, patient was weaned to night-time only BiPAP over the next 72 hours and discharged home on the same. Hypercapnia (permissive) on ABG was accepted since patient had no tachypnea. On the 10th day follow up, room air SPO2 improved to 91% and ECHO showed mild PAH with good RV/LV function. By the third week PFT showed improved values.

Discussion: Transition to NIV immediately post extubation in patients with severe restrictive lung disease avoids complications of mechanical ventilation like ventilator associated pneumonia and prolonged hospital stay. Dexmedetomidine infusion is safely tolerated in cor pulmonale, decreases perioperative opioid consumption and facilitates early extubation.



Parameters	PRE-OP	INTRA-OP	1 HOUR POST NIV	POST-OP Day 1	POST-OP Day 2	POST-OP Day 10
ABG						
pH	7.45	7.52	7.29	7.32	7.33	7.43
PaO2	45.4	352	153	93.4	121	31.7
PaCO2	46.4	37.9	59.7	67.8	64.3	51.4
SPO2	62% RA	99%	98%	98%	99%	91% RA
PFT						
FEV1	24%					33%
FVC	26%					31%
MMEF	23%					24%

V2-3

A Single Institute Retrospective Audit of the Anaesthesia Management in Children Undergoing Epilepsy Surgery

Vedhika Shanker[1], Nandini Dave[2]

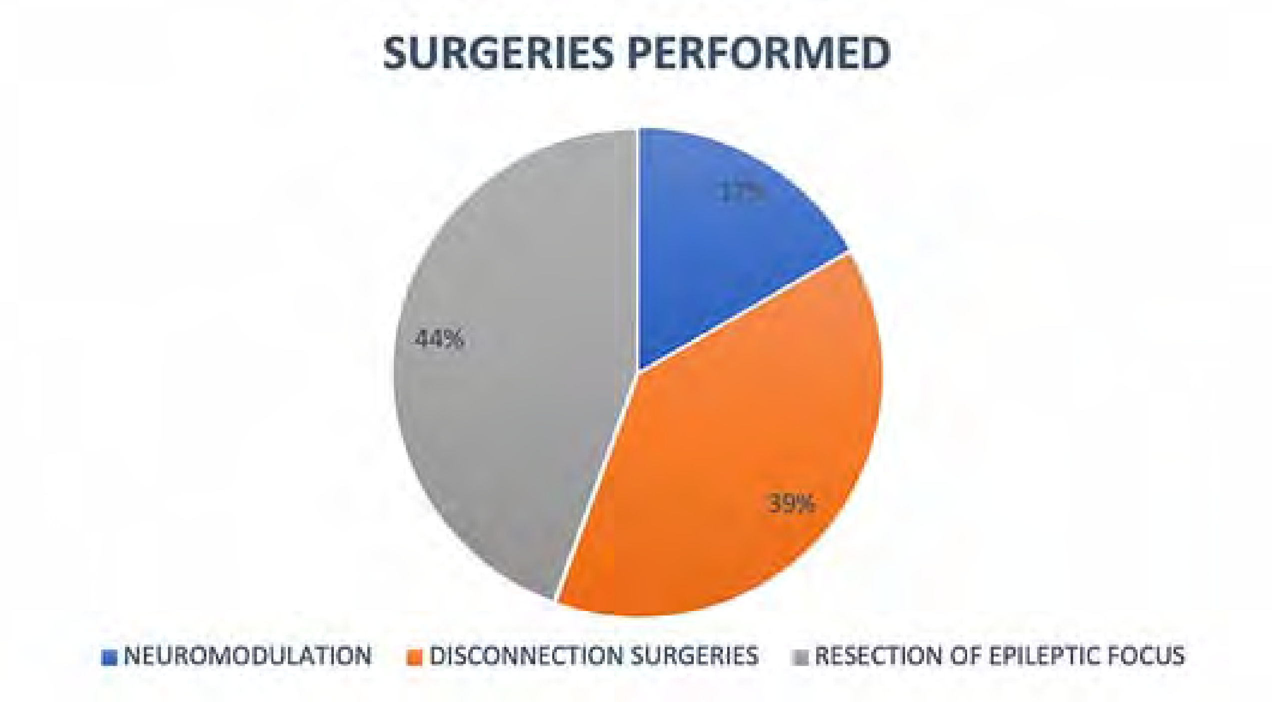
[1]Pediatric Anaesthesia Fellow, Department of anaesthesia, NH-SRCC Children's Hospital, Mumbai, India
[2]Senior Consultant and Head, Department of anaesthesia, NH-SRCC Children's Hospital, Mumbai, India

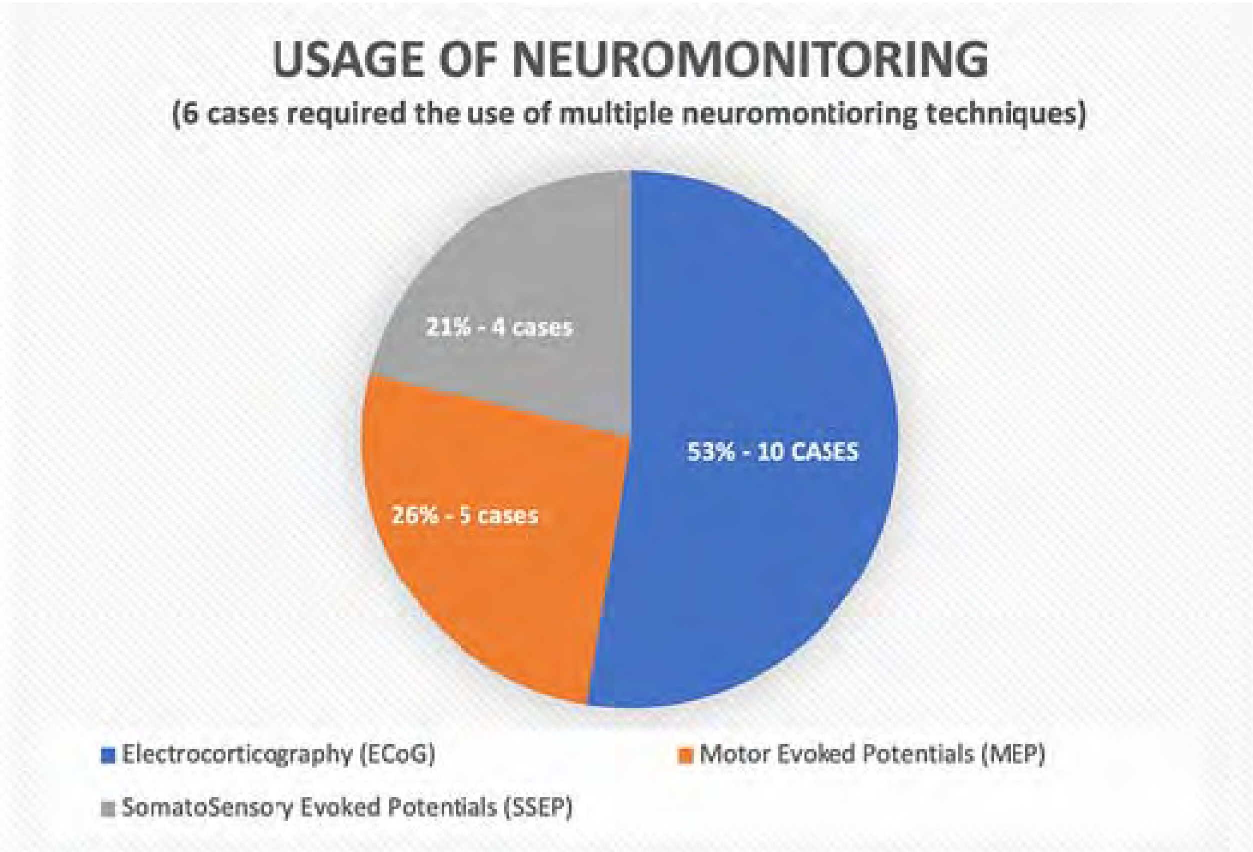
Background: Once patients meet the criteria for epilepsy surgery, a multidisciplinary team involving the neurologist, neurosurgeon, radiologist, anaesthesiologist and, often, a psychologist form the collaborative team dealing with their perioperative care. Anaesthesiology involvement begins from the investigative work up itself - MRI, SPECT or electrocorticography (ECoG) and deep electrode placement. Patients are always on long term anti-epileptic therapy and are screened for any side effects. The challenge in the intraoperative management lies in the dynamic alteration of our anaesthesia management, often multiple times within a single case, as the type of neuromonitoring being used changes from time to time. ECoG recordings are central to the surgical process and since our anaesthesia medications interfere with the readings we are required to modify our plan. The administration of a scalp block attenuates our anaesthetic requirement greatly and has been used in many of our cases. We may even be required to produce pharmacoactivation in order to better map the epileptogenic focus.

Methods: We audited our institutions' patients who underwent epilepsy surgery. The study design is a retrospective audit from February 2022 - 2023.

Results: A total of 18 patients had undergone epilepsy surgery in the study period. The surgeries performed were 3 neuromodulation, 8 disconnections and 9 epileptic focus resections. We performed a preoperative TEG? in all our patients, and none of the patients showed an abnormal Maximum amplitude value. Neuromonitoring was used in 10 cases, all of whom received a TIVA based anaesthetic with BIS monitoring. A scalp block was administered in 8 of the 18 patients. 1 patient underwent an awake craniotomy and our youngest patient was a 6 month old with tuberous sclerosis. All except the neuromodulation cases required invasive arterial and central venous lines and monitoring. Of the 18, 2 patients were electively ventilated post operatively, the rest were extubated on table, and all shifted to the PICU.

Conclusions: This paper outlines the role of the anaesthesiologist in children undergoing epilepsy surgery. The preoperative radiological workup, anaesthesia implications of AEDs, intraoperative anaesthesia techniques to facilitate neuromonitoring and identification of the epileptogenic focus, and common perioperative problems are discussed. A protocolized approach to management & team coordination are keys to a successful outcome.


SURGERIES PERFORMED
17%
39%
44%
NEUROMODULATION
DISCONNECTION SURGERIES
RESECTION OF EPILEPTIC FOCUS


USAGE OF NEUROMONITORING
(6 cases required the use of multiple neuromontioring techniques)
53% - 10 CASES
26% - 5 cases
21% - 4 cases
Electrocorticography (ECoG)
Motor Evoked Potentials (MEP)
SomatoSensory Evoked Potentials (SSEP)

V2-4

Anaesthesia Management in a Rare Skeletal Dysplasia - Desbuquois Syndrome: A Case Report

Vedhika Shanker[1], Nandini Dave[2]

[1]Pediatric Anaesthesia Fellow, Department of anaesthesia, NH-SRCC Children's Hospital, Mumbai, India
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Background: This report elucidates the management of a 21 month old patient - weighing 5kg with a height of 68cm - with Desbuquois syndrome undergoing bilateral knee deformity correction. Desbuquois syndrome has an incidence of less than 1/1,000,000 live births. The disorder was first described in 1966 and since then less than 50 cases have been reported, with wide heterogeneity in characteristics. Only 2 reports exist on the anaesthesia management in a pediatric patient. It has a reported mortality of > 33%, attributed mostly to respiratory causes, with peak incidence of death being in infancy. Our child had characteristic features - flat face, micrognathia, hypoplastic abdominal musculature, bell-shaped thorax, hyperflexible joints, knee dislocation, clinodactyly, a short neck and dwarfism.

Case Description: Our pre anaesthetic evaluation revealed potential difficulties with obtaining intravenous access, positioning, difficult airway and difficulty in placing a regional block in view of anatomical distortions. We also expected to face respiratory insufficiency post anaesthesia. Our plan was an inhalational induction followed by airway management via an LMA, with endotracheal intubation being plan-B, followed by caudal analgesia, and post-operative ICU standby in case of respiratory insufficiency. The airway proved challenging; a 1.0 i-gel LMA did not provide adequate seal, following which two intubation attempts were needed - first with a 4.0 uncuffed ETT and the second successful one with a 3.5 uncuffed ETT, railroaded over a 8Fr FROVA . We postulate a subglottic narrowing as, by age, the child should have accommodated a 4.5 sized ETT, which, despite adequate visualisation of the glottis, could not be passed. The caudal block was also difficult, requiring two attempts by a senior anaesthetist. Post-procedure the child was extubated following full recovery from neuromuscular blockade.

Discussion: A literature review allowed us to surmise the general problems associated with this patient population, and even though anaesthesia related reports were only 3 in total, the general reviews helped us anticipate potential problems. This and a keen clinical judgement form the cornerstones of anaesthesia management in patients with rare illnesses. Additionally, Desbuquois syndrome patients could have a component of subglottic stenosis complicating their airway, and this needs further study, as we still do not know the full phenotypic expression of this disease.

V2-5

Perioperative Management of a Preterm Infant for Subgaleo-Ventricular Shunt

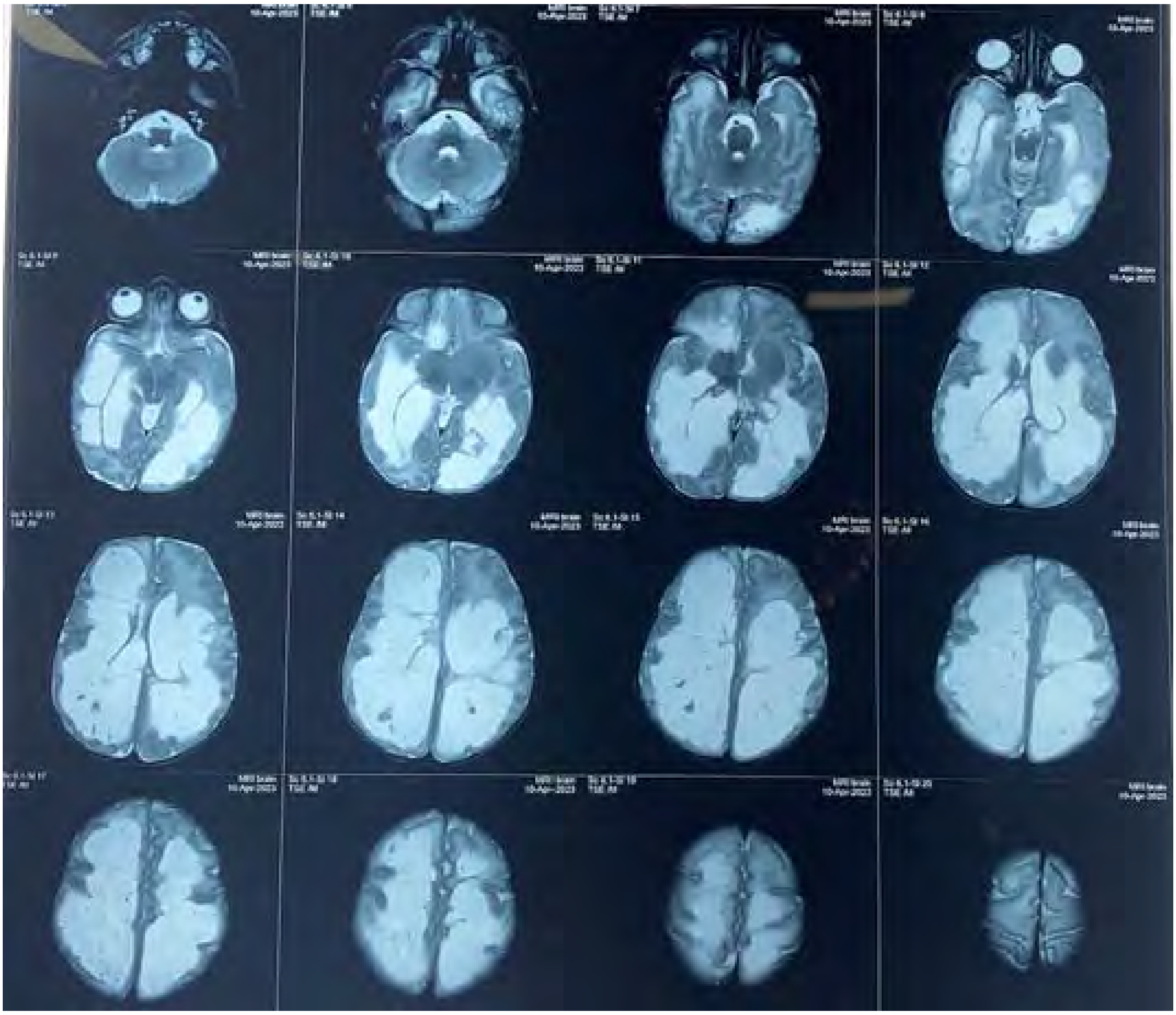
Archana Raichurkar, Suma S, HS Murthy

Department of Anaesthesiology, Manipal Hospital, Old airport road, Bangalore 5600[1]7

Background: Perioperative management of a hydrocephalitic preterm neonate is complex due to the raised intracranial pressure (ICP) and comorbidities related to prematurity. We report a 28 day old preterm baby (35 weeks post conceptional age) posted for subgaleo-ventricular shunt.

Case Description: A neonate with history of respiratory distress and necrotising enterocolitis with intermittent episodes of apnoea and desaturation on caffeine infusion presented to us for Subgaleo-ventricular shunt. Serial Neurosonography showed periventricular flare with increasing cystic areas bilaterally with aqueductal septum. The child weighed 1.83 kg was active but hypotonic with bulging anterior fontanelle. Packed red blood cell was transfused to increase the haemoglobin from 6 to 10g/dl. We intubated the baby in PICU considering the apnoea episodes. In OT standard monitoring was done.Anaesthesia was induced and maintained with oxygen, air and sevoflurane. Pressure control mode of ventilation was used to maintain ETCO2 between 30 to 35 mmHg. FiO2 was adjusted to keep saturation above 95%. Care was taken to keep baby warm. Surgery lasted for 40 minutes with negligible blood loss.Postoperatively the child was shifted to PICU and extubated after 2 hr. Ventriculoperitoneal shunt was planned for a later date.

Discussion: Subgaleo-ventricular shunt is a temporary measure to reduce the compression on brain tissue in preterm infants as they are not candidates for VP shunt due to reduced capacity of peritoneum to absorb CSF and increased susceptibility to infection due to the immature immune system. Hydrocephalous in these babies can be associated with congenital anomalies.Additionally, these babies can have problems of low birth weight, anemia, coagulopathy, jaundice, respiratory disease, and persistent fetal circulation. The anesthetic plan should take into consideration these factors. Airway management and positioning is challenging due to the macrocephaly and large occiput. Elevating the shoulder with a roll facilitates laryngoscopy. Measures should be taken to avoid increase in ICP. Anaesthetist should be alert to bradycardia, hypertension, and respiratory changes which may occur due to brainstem compression . Apnoea monitoring is important after extubation in addition to neurological monitoring and some babies may need respiratory support. Thus these babies can pose a multitude of challenges for the anaesthesiologist but one can tackle these issues with proper preparation.



V2-6

Ultrasound Assessment of Cricothyroid Membrane (CTM) in Children with Respect to Front of Neck Access - An Observational Study

Vibhavari Naik, Sandeep Viyyuri

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Background: "Cannot intubate, cannot ventilate" (CICV) is a rare, but life-threatening situation. Cricothyroidotomy is recommended for CICV scenario1. The size of device for cricothyroidotomy is dependent on multiple factors2. There is inadequate literature on age-wise anatomical considerations for cricothyroidotomy in children.

Methods: This is an observational study on 69 children (age > 6 months to 6 years) posted for any procedure under anesthesia. We would do an ultrasound evaluation of CTM after induction. The Primary outcome was to see the dimensions (height and width) of CTM, to see any Overlap of thyroid cartilage by hyoid bone, and presence of any vascular structures over CTM, the secondary outcomes are to see the usefulness of ultrasound, to describe the difficult nature of airway according to age.

Results: 69 children took part in this study, the average CTM height was 0.505 cm and width was 0.48 cm, we observed overlap of the hyoid bone in 4 cases (P value 0.017), all of them belonged to age group <12 months and we found vascular structures near CTM in 29 patients, and it took 139.53 seconds with an SD of 26.76 to do the scan. Demographics are included in Tables 1& 2.

Conclusion: There is an association between age concerning height and width of CTM. The width of CTM is smaller than height in children <5 years of age which needs to be considered when planning cricothyroidotomy in this age group. Significant overlap of hyoid bone is seen in age < 1yr and also the average time taken to do the scan(154.6 seconds) in children less than 1 year of age is more when compared to other age groups. This helps in assessing the difficulty in cricothyroidotomy.

V2-7

Anaesthetic Implications and Considerations in Children with Permanent Pacemaker for Non-Cardiac Surgery: A Report of 2 Cases

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Department of Anaesthesiology and Intensive Care, Hospital Sultanah Bahiyah, Alor Setar, Malaysia

Background: Complete heart block is a common complication after correction of congenital heart defects. Increasing number of paediatric patients with permanent pacemaker (PPM) are encountered by anaesthesiologists for non-cardiac surgery due to high survival rate. We report 2 toddlers with complete heart block on PPM anaesthetised for non-cardiac surgery.

Case Description: Table 1 summarized relevant history, anaesthesia and analgesia regime for both patients. General anaesthesia was tailored to surgical needs. Standard monitors were attached, 5 leads ECG with pacemaker detector was used to monitor pacing activities. After surgery, they were extubated and discharged to ward. No PICU admission required.

Discussion: A child with PPM needs a thorough preoperative evaluation and multidisciplinary plans. Primary focus is to assess patient's cardiovascular status based on history, examination and investigations (ECG, CXR - Figure 1 & ECHO). Followed by interrogation of the PPM (type, mode, parameters & battery lifespan). Patient's dependency on PPM has to be established and factors affecting myocardial pacing threshold (electrolytes & acid-base abnormalities) must be optimised. Anaesthesiologist must understand physiology and pharmacology effects of anaesthesia towards paediatric cardiovascular system. Anaesthetics (propofol, dexmedetomidine, remifentanil) that suppresses AV or SA node may abolish intrinsic heart rate and render the patient PPM dependent. Anxiety and surgical stress may affect pacing threshold and increase myocardial oxygen demands. Thus, consideration should be made to increase pacing rate to meet the metabolic demand prior to induction. In our cases, the pacing rate was adjusted from 80 to 100 bpm then reduced back to 80 bpm after the surgery. Intraoperatively, monopolar electrocautery is the commonest exogenous source of electromagnetic interference (EMI) hazard. The EMI may trigger abnormal sensing causing pulse generator inhibition and malfunction. Ultrasonic scalpel and bipolar cautery are recommended against monopolar to minimise EMI. Monopolar is to be used at lowest feasible energy with only 1s short burst and 10s interval pause. In summary, it is crucial to understand effects from anaesthesia and EMI from surgery to formulate perioperative plans and prevent device-related interactions. In modern PPM, magnet and mode reprogramming rarely necessary but the pacing rate should be tailored to anaesthesia technique and agents use.

	CASE 1	CASE 2
DEMOGRAPHIC	3 year old 23.9kg ASA III	3 year old 13kg ASA III
RELEVANT HISTORY	1. Atrioventricular septal defect (AVSD) in failure on oral frusemide and spironolactone; status post • pulmonary artery banding at 2 month old. • pulmonary artery de-banding and augmentation, atrioventricular canal & valves repair, and posterior annuloplasty at 17 month old • complicated with complete heart block, PPM inserted on POD 14. • anti-failures discontinued 3 months after surgery	1. Ventricular septal defect (VSD) with pulmonary stenosis and small right ventricle in failure on oral frusemide, spironolactone and captopril; status post • VSD and right ventricular outflow tract resection at 3 month old. • complicated with complete heart block and low cardiac output syndrome with multi organ failure, PPM inserted on POD 7. • required prolong ventilatory support, discharged 3 months later • anti-failures discontinued 6 months after surgery
PACEMAKER DETAILS	Evity 8 DR-T, BIOTRONIK • Dual chamber - Epicardial • Bipolar system • DDDR mode • Pacing rate of 80 bpm Patient is pacemaker dependent	Epyra 6 DR-T, BIOTRONIK • Dual chamber - Epicardial • Bipolar system • VVI mode • Pacing rate of 80 bpm Patient is NOT pacemaker dependent. Heart rate 90 – 100bpm
SURGICAL DIAGNOSIS & OPERATION	Left Undescended testis • Left orchidopexy • Generator to surgical site distance 12cm	Bilateral profound sensorineural hearing loss • Right cochlear implant surgery • Generator to surgical site distance 26cm
ANAESTHESIA & ANALGESIA	• GA spontaneous • Sevoflurane maintenance • Lt ilioinguinal block + scrotal infiltration • IV Fentanyl 1mcg/kg • IV Ketamine 0.1mg/kg • IV Dexamethasone 0.2mg/kg	• GA IPPV • TCI Propofol • TIVA Remifentanil • Field-block by surgeon • IV Ketamine 0.1mg/kg • IV Paracetamol 15mg/kg • IV Dexamethasone 0.2mg/kg • IV Morphine 0.05mg/kg (end)
PACEMAKER CONCERNS & MANAGEMENT	1. Pacemaker dependent • Increase pacing rate to 100 bpm prior to induction • reprogrammed to 80 bpm prior to extubation	1. TIVA abolish intrinsic heart rate • Increase pacing rate to 100 bpm prior to induction • reprogrammed to 80 bpm in PACU after extubation

Table 1. Summary of the cases.

Figure 1: CXR of case 1 and case 2, showing PPM with bipolar pacing wire system (two wires implanted at epicardium of designated chamber). Generator was embedded at epigastrium in case 1 and umbilical quadrant in case 2.

V2-8

Spinal Anaesthesia: The Choice in Preterm Neonates with Chronic Lung Disease

Jayashree Simha[1], Suma Sriramanan[1], Pavitra G C S[2], Gayatri Sasikumar[1], C N Radhakrishnan[3], Karthik Nagesh N[4]

[1]Senior consultant, Department of Anesthesiology, Manipal Hospitals, Bangalore, [2]Second year DNB resident, Department of Anesthesiology, Manipal Hospitals, Bangalore, [3]Consultant Pediatric Surgeon and Pediatric Urologist, [4]Chairman and HOD of Neonatology, Manipal Hospitals, Bangalore

Introduction: Chronic lung disease (CLD) is an important cause of morbidity and mortality in preterm infants. General anesthesia adds insult to the injury by increasing the risk of apneic spells and incidence of post operative mechanical ventilation in these infants. We present a case series of twenty preterm neonates with chronic lung disease who were given spinal anesthesia for inguinal hernia repair.

Case Description: Preterm babies with CLD are given spinal anesthesia for inguinal hernia repair in our institute. Routine preoperative evaluation including cardiac and neurological assessment, complete blood count and coagulation profile is done. Intravenous access is secured in the NICU. One hour prior to the procedure EMLA patch is placed on the lower back at the proposed site of lumbar puncture. In the operating room, care is taken to keep the babies warm, ASA standard monitors are connected, and dextrose-soaked pacifier is used to keep the infant quiet. Maintenance rate of appropriate IV fluid is given. If the baby is on oxygen or nasal CPAP, the same is continued intraoperatively. Sub arachnoid block is performed in the lateral position. EMLA patch is removed, and the area prepped with warm betadine solution. 26G hypodermic needle is used to give the block and 0.2mL/kg of 0.5% heavy bupivacaine is injected intrathecally using an insulin syringe. No sedatives are given and post-operatively they are shifted back to the NICU. The average gestational age of our group at surgery was 41.25 ± 10.7 SD and the weight of the babies was 2.7 ± 1.9 SD. The block was effective in all cases and there were no cardiorespiratory events in the period during and following the procedure.

Conclusion: Anesthetic management of preterm infants with chronic respiratory sequelae of prematurity is very challenging. Subarachnoid block is a safe and effective alternative to general anesthesia in these babies.

	Gestational age at surgery	Weight at surgery	Gestational age at birth	Weight at birth
Mean	41.25	2709.5	31.7	1625.25
SD	5.3496	951.76	3.09	656.68
2 SD	10.699	1903.52	6.19	1313.36

Day 3_Room C

Abstract Presentation 5 (In-person)

Chair(s): Hyo-Jin Byon (Korea)
Hye Mi Lee (Korea)

AP5-1

~~Predictors of Sedation Failure with Initial Dose of Intranasal Dexmedetomidine and Oral Midazolam for Pediatric Procedural Sedation~~

Withdrawn

AP5-2

Retrospective Study on an Inhalational Sevoflurane Technique for Ex-preterm Infants Undergoing Elective Inguinal Hernia Surgery

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Department of Paediatric Anaesthesia,Kanchi Kamakoti CHILDS Trust Hospital, Chennai,Tamil Nadu, India

Background: Awake regional anesthesia in high-risk infants can be challenging and sedation is associated with apnea. However, sevoflurane for procedural sedation with minimal airway intervention may have a lesser frequency of complications.

Methodology: Over a year, retrospectively data on ex-preterm infants who underwent routine hernia surgery were included in this study. All infants were optimized preoperatively with blood transfusion for anemia (<10 g/dL) and caffiene. They were sedated with inhalational sevoflurane, and then given regional anesthesia (caudal alone for unilateral repair & combined spinal/caudal anesthesia for bilateral repair), and the airway maintained with mask/LMA via spontaneous ventilation. In the event the child moved on incision, failed block was considered and intubation with paralysis was done. The efficacy of the technique was assessed via the number of attempts of regional anesthesia, incidence of bloody tap, failed block and the type of airway intervention (mask/LMA/ ET). Post operatively the infant was monitored specifically for apnea, bradycardia and hypotension. Data analysis was performed with counts/percentage for parametric data and ANOVA multivariate analysis for the continuous variables.

Results: In a sample size of forty infants, most infants were between 40-52 weeks post conceptual age (PCA).18 infants were anemic and transfused packed cells a day prior to surgery. The airways were maintained via pro-seal LMA in 26, mask in 14 infants, and no failed blocks were noted. 16 infants received caudal anesthesia in 1st attempt with no bloody tap (100% success), and in the combined regional of 24, a second attempt (88% success with 1st attempt) was needed in 3 out of 24, incidence of 4% of bloody tap. Two infants developed apnea [incidence 5%] both <45 weeks PCA with anemia and weight<2kgs not needing further intervention.

Discussion: Sevoflurane has been used in preterm infants as the sole sedation technique for injections retinopathy of pre-maturity as it preserves spontaneous ventilation. Combining sevoflurane with a regional anesthetic in these high-risk ex-preterm infants allows minimal airway intervention and a better success rate of regional administration with no failed blocks. Apnea of pre-maturity is seen up 60 weeks PCA with added risk in previous apnea, anemia, neurological disease,sepsis,metabolic derangement and anesthetic drugs. Optimizing the preoperative anemia and caffeine alongside close monitoring gave a lower incidence of apnea comparable to previous studies.

AP5-3

The Use of Dexmedetomidine for Pediatric Patients with Conjoined Twins undergoing Computed Tomography Thoracoabdominal

Priscilla Tulong, Rudy Vitraludyono

Department of Anesthesiology and Intensive Therapy, University of Brawijaya of Medicine, Malang, East Java

Introduction: Conjoined twins are a very rare developmental accident of uncertain etiology. Prevalence has been previously estimated to be 1 in 50,000 to 1 in 100,000 births.

Objective: To investigate a case report using Dexmedetomidine for sedation management in conjoined twins patients.

Case Study: A - 4 months old baby girl referred to Saiful Anwar Hospital, Malang to be scheduled for a separation surgery. Before the separation surgery, pediatric surgeon need a radiology imaging to know the fusion between the two babies. The Pediatric - surgeon need an imaging from CT thoraco-abdominal with contrast We do the pre-operative visit to the patient, we decide to do the sedation with Dexmedetomidine as the regiment of choice for the patient. The challenging part in anesthesia for this patient is the CT scan room is not prepared for two individuals being anesthetized in one time. So that, we prepared the CT scan room with double set equipment, labeled the infants and put color code for each infant 1 day before the procedure. We also gathered a special team and do the simulation one day before the procedure. We monitored the patient with ASA standard monitoring for pediatric. Before the induction, we inject the first baby with atropine 0,01 mg/kg (IV), to observe if there is a raising heart rate to the second infant, and turn out there is no increasing heart rate to the second infant. As the induction regiment, dexmedetomidine loading dose 2 mg/ kg over 10 minutes for each baby. After the loading dose, we start the maintenance dose with Dexmedetomidine 0,4 mcg/kg/h.

Conclusion: Ambulatory for conjoined twins is challenging. We prepared two anesthesia machines, doubled every drug and labeled each equipment with color code. We use blue and red sticker for every drug and other equipment so that if the patient fell in an emergency situation, each baby had their own drugs, equipment and anesthesia machine. Dexmedetomidine could be drug of choice for TIVA in ambulatory for conjoined twin patient. Atropine injection with dose 0,01 mg/kg before the induction could be useful to predict the fusion between the babies. There is no respiratory depression for the patient.

AP5-4

Stirp Sugar Midazolam! New Formulation of Midazolam (Midazolam Loaded Oral Film Via Electrospinning)(Preluminary Study)

Ş Geze Saatcı[1], K Özcan[2], V Serdaroğlu[3], Ö Çoban[4]

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[2]Department of Pharmaceutical Technology, Faculty of Pharmacy. Karadeniz Technical Univercity, Trabzon, Turkey
[3]Department of Pharmaceutical Technology, Faculty of Pharmacy Application & Research Center, Karadeniz Technical Univercity, Trabzon, Turkey, [4]Turkish Medicines and Medical Devices Agency, Ankara

Background: It is possible with effective premedication make comfortable for both the children and their family and doctors in the elimination of pre-operative anxiety and the opening of vascular access in children who will undergo surgery. In this context, it is aimed to develop the most suitable pharmaceutical form that can be used orally, high stability, taste tolerable, and non-cytotoxic, which can be easily accepted by the child, for routinely used drugs to calm children before surgery.

Methods: Water-soluble poly(vinyl alcohol) (PVA, MW: 30,000-70,000) was used as the polymer for green electrospinning (1). The film-forming property of PVA was evaluation by studying two different polymer concentrations. Briefly, PVA was dissolved in water at 90°C under magnetic stirring, and the solution was cooled to room temperature. Plasticizer, sweetener, color agent or aromatizer, saliva simulator, preservative and ethanol as an active pharmaceutical ingredient (API) solvent were added into the solution. Table was shown the formulation contents. Flow rate, voltage and the distance of the nozzle tip to the collector were changed as device parameters, and the optimum values were determined as 4 mL/h, 24 kV and 150mm, respectively.

Results: According to our results (Table), it was determined that PVA did not form fibers at low concentrations. Although the polymer concentration used varies with the molecular weight of the polymer, 15% w/v polymer concentration was sufficient to form fiber according to the PVA type used (2).

Discussion: As a result of the studies, it was seen that the best oral film was obtained with ODF3. In the ongoing studies, using the F3 formulation parameters, midazolam-loaded multilayer oral films which have in the middle layer containing the API will be prepared and their characterization will be made.

Funding: This work was supported by the Karadeniz Technical University Scientific Research Projects Coordination Unit (TAY-2021-9763 and TSA-2022-10503).

Refs: 1. Zhong T. et al., Carbohydr Polym, 2021; 2. Celebioglu A. et al., Carbohydr Polym, 2014

AP5-5

Sedation in a Child with Difficult Airway for Magnetic Resonance Imaging (MRI)

Nirawanti Mohamad Said, Ye Yun Phang

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Background: Magnetic resonance imaging (MRI) scans in children can be challenging to anaesthesiologists especially for patients with difficult airways. Current trend of procedural sedation using combination of dexmedetomidine and propofol shows promising results as they are associated with fewer respiratory events.

Case Description: A 9-year-old-girl, weighing 20kg with delayed developmental milestones and venolymphatic malformation of the neck, was scheduled for an MRI scan of the neck. She had 3 sclerotherapy injection for the neck mass and defaulted follow up for 4 years ago. The neck swelling has been increasing in size over the past 2 years. A nasoendoscopy showed crowded oropharynx with cystic lesion around epiglottis region. An attempt to sedate the child using chloral hydrate was unsuccessful thus she was posted for MRI under general anaesthesia. Pre-anaesthetic evaluation showed limited mouth opening with huge and diffuse neck swelling. Due to the anticipation of a difficult airway and possibility of 'cannot intubate, cannot ventilate' (CICV), the child was planned under sedation using a combination of dexmedetomidine and propofol with fibreoptic intubation (FOI) as backup. Once intravenous cannula secured, a loading dose of 1mcg/kg dexmedetomidine was administered over 10 minutes followed by an infusion of 1mcg/kg/h. Subsequently, propofol infusion was administered as an adjunct sedation at the rate of 2mg/kg/h, aiming to achieve Ramsay sedation scale (RSS) of 5. Simultaneously, continuous vital sign monitoring, pulse oximetry and end-tidal CO2 were attached. After being transferred to the MRI room, the child received oxygen supplementation of 5 L/min through a facemask. During contrast administration, the child's airway became obstructed with the presence of stridor and oral secretions. Suctioning was done and airway patency was maintained with nasopharyngeal airway. Dexmedetomidine infusion was titrated up to 1.5mcg/kg/h to maintain RSS above 4. The were no episodes of desaturation and haemodynamic were stable. MRI was successfully done after 50 minutes to confirm the extent of swelling and airway narrowing. The child was monitored in recovery room until fully awake.

Discussion: The use of dexmedetomidine and propofol has helped to overcome these difficulties as the risk of airway obstruction is minimised, the induction and recovery was smoothened. This technique can be an option in managing difficult airway patients in remote setting.


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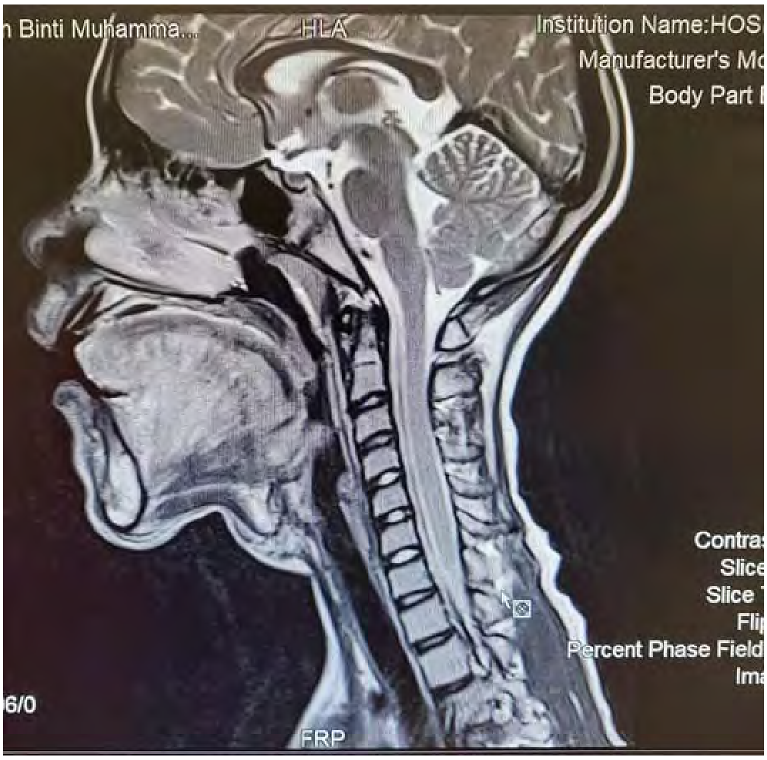
HOSPITAL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AP5-6

A Balancing Act of Survival: A Case Report on the Anesthetic Management of an Ex Utero Intrapartum Procedure

Virtual

AP5-7

Effect of High-flow Nasal and Buccal Oxygenation on Safe Apnea Time in Children with Open Mouth

Chan-Ho Hong, Sang-Hwan Ji, Jung-Bin Park, Pyoyoon Kang, Young-Eun Jang, Jin-Tae Kim

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Introduction: High-flow nasal oxygenation (HFNO) is being applied for various purposes, and its utility as method of oxygenation during preoxygenation and apnea for intubation has been studied. HFNO is reported to prolong duration of apnea while maintaining adequate oxygen saturation with the mouth closed. We aimed to examine whether the same effect can be expected when patients' mouth are open and planned a prospective study.

Methods: We compared the effectiveness of HFNO and buccal oxygenation (BO) in children with their mouth open, simulating airway management conditions. Thirty-eight patients, aged 0-10 yr were randomly allocated to either the HFNO group (n=17) or the BO group (n=21). After induction of anesthesia including neuromuscular blockade, manual ventilation was initiated until the expiratory oxygen concentration reached 90%. Subsequently, ventilation was paused, and the patient's head was tilted and mouth was opened. During apnea, the HFNO group received oxygenation at a flow rate of 2 L/min/kg while the BO group received oxygen to the buccal space via an oral Ring-Adair-Elwyn tube at a flow rate of 0.5 L/min/kg. Ventilation was resumed when pulse oximetry decreased to 92% or the apnea time exceeded twice the apnea time without any oxygenation previously reported, which was defined as 'success' in prolongation of safe apnea time.

Results: The success rate of safe apnea time prolongation was 100% in the HFNO group compared to 76.2% in the BO group ($p = 0.041$). In 5 patients who were unable to prolong safe apnea time, the average duration of apnea was 1.17 times longer than the apnea time without any oxygenation previously reported. Oxygen reserve index, end-tidal or transcutaneous carbon dioxide partial pressure, and pulse oximetry did not differ between groups during or after the apnea period.

Discussion: Although both of them prolonged apnea time, HFNO was superior to BO. The difference can be explained by flow rate and mechanism of oxygenation. As there was no difference in carbon dioxide level, we should be aware of hypercapnia during apneic oxygenation. In conclusion, we can consider HFNO as means of apneic oxygenation when attempting airway management in children. BO may also be useful for lengthening safe apnea time when HFNO is not available.

*This research was supported by a grant of Patient-Centered Clinical Research Coordinating Center (PACEN) funded by the Ministry of Health & Welfare, Republic of Korea (grant number : HC20C0060).

Table 1. Oxygenation and ventilatory parameters of patients received high-flow nasal oxygenation or buccal oxygenation. Values are mean ± SD or median (IQR [range]).

	HFNO group (n = 17)	BO group (n = 21)	p-value
ORi™ after apnoea	0.2 (0.05 – 0.3 [0 – 0.8])	0.17 (0.08 – 0.25 [0 – 0.88])	0.337
Lowest ORi™	0.18 (0 – 0.3 [0 – 0.75])	0.12 (0.06 – 0.22 [0 – 0.45])	0.908
Lowest S_pO_2 (%)	100 (100 – 100 [97 – 100])	100 (100 – 100 [79 – 100])	0.622
Highest E_tCO_2 (mmHg)	53.7 ± 6.3	51.0 ± 7.6	0.250
T_cCO_2 after apnoea (mmHg)	56.7 ± 19.6	57.6 ± 9.0	0.870

Statistical comparisons were done Student *t*-test for normally distributed data and Mann-Whitney U test for nonparametric analysis.

HFNO group; High-flow nasal oxygenation at a rate of 2 $L.min^{-1}.kg^{-1}$ during apnoea, BO group; Buccal oxygenation at a rate of 0.5 $L.min^{-1}.kg^{-1}$ during apnoea, ORi™; Oxygen reserve index, E_tO_2; End-tidal oxygen concentration, E_tCO_2; End-tidal carbon dioxide partial pressure, T_cCO_2; Transcutaneous carbon dioxide partial pressure

AP5-8

Near-infrared Spectroscopy Monitoring Failure in a Patient with Chronic Hypoxemia Undergoing Total Correction of Tetralogy of Fallot

Hwa-Young Jang[1], Won-Jung Shin[2], In-Kyung Song[2]

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Background: Near-infrared spectroscopy is a reliable and non-invasive technique for monitoring regional blood flow and measuring regional oxygen saturation (rSO_2). While previous studies have shown that secondary erythrocytosis does not affect cerebral rSO_2, profound polycythemia, in this case, appeared to impede the measurement of cerebral oxygenation by near-infrared spectroscopy.

Case Description: A 12-year-old boy from Cambodia was admitted with dyspnea, cyanosis, and activity limitations for total correction of tetralogy of Fallot. Four years earlier, the patient had undergone a right Blalock-Taussig shunt operation but had not received appropriate postoperative care and could not take antiplatelet medication due to financial constraints. Despite receiving 6 L/min of nasal prong oxygenation, the patient had severe hypoxia with pulse oximetry (SpO_2) of 72%. The preoperative blood test revealed secondary erythrocytosis, with a hematocrit of 71.3%. The patient underwent general anesthesia for open heart surgery according to the institution's protocol, and standard monitoring, including O3® pediatric regional oximetry (Masimo, Irvine, CA, USA), was applied. Regional oximetry was measured at four sites: the left and right forehead (S1 and S2), splanchnic (S3), and renal (S4) (Fig. 1). After the induction of anesthesia, the patient showed SpO_2 of 61?74% and partial pressure of oxygen (PaO_2) of 49 mmHg despite mechanical ventilation with a fraction of inspired oxygen (FiO_2) of 0.8. However, cerebral rSO_2 values (S1 and S2) were unobtainable until the initiation of cardiopulmonary bypass (CPB) (Fig. 2). While the initial intraoperative hematocrit was unmeasurable (>65%), after the initiation of CPB, hemodilution was achieved, resulting in hematocrit of 49%. The operation went smoothly, and the patient was successfully weaned from the cardiopulmonary bypass with the aid of inhaled nitric oxide. Post-CPB SpO_2, PaO_2, and hematocrit were relatively 100%, 104 mmHg, and 44% with a FiO_2 of 0.6.

Discussion: In this case, polycythemia may have contributed to the failure to monitor cerebral rSO_2. This hypothesis is supported by the fact that cerebral rSO_2 monitoring became feasible after acute hemodilution. Medical professionals managing chronically hypoxemic children with significant secondary erythrocytosis should recognize the risk of cerebral rSO_2 monitoring malfunction.

Figure 1. Regional oxygen saturation monitoring sites. S1, left forehead; S2, right forehead; S3, splanchnic; S4, right renal.

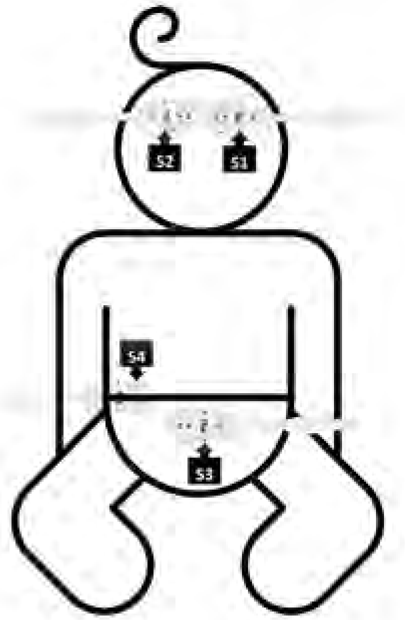
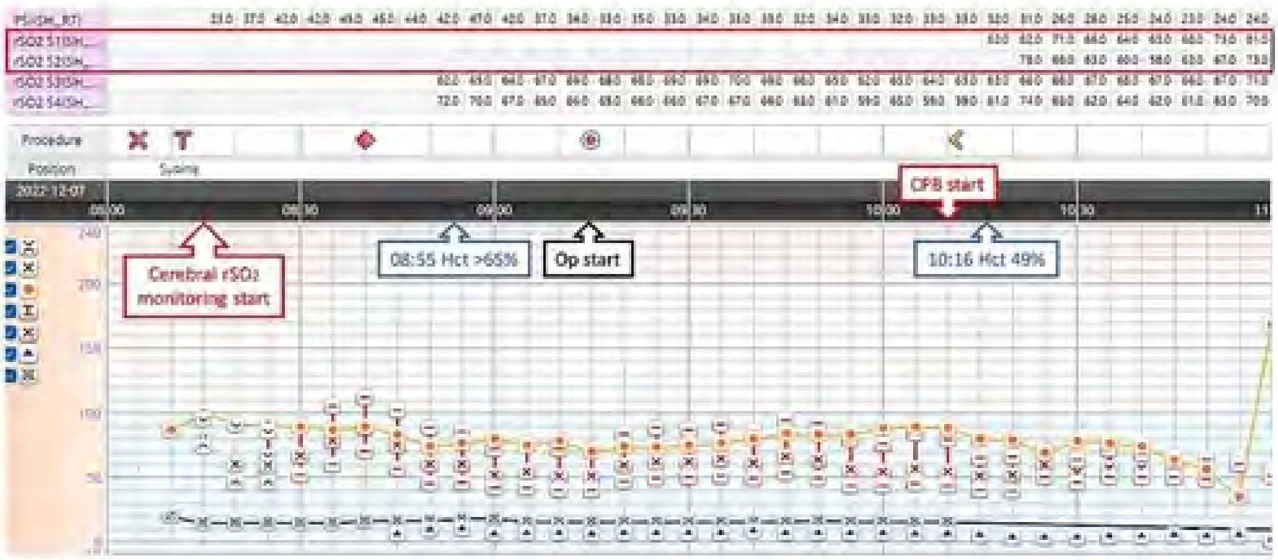


Figure 2. Anesthesia records of the patient from the induction of general anesthesia to the initiation of cardiopulmonary bypass. rSO_2, regional oxygen saturation; Hct, hematocrit; Op, operation; CPB, cardiopulmonary bypass.



Day 3_Room C

Abstract Presentation 6 (In-person)

Chair(s): Eun-Hee Kim (Korea)
Yong-Hee Park (Korea)

AP6-1

~~Implementation of "Goal Directed Bleeding Management" at Shahid Gangalal National Heart Center~~

Virtual

AP6-2

The Outcomes of PICC Insertion in Pediatric Patient at Siriraj Hospital

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Background: Peripherally-inserted central catheter (PICC) is widely used for intermediate- and long-term venous access. Venipuncture and catheterization in pediatric patients were challenging. Children's vein may become damaged by frequent and painful needle insertions. In Thailand, PICC was not yet prevailing even in adult patients and limited of the published works in pediatric patients. This study aims to demonstrate the outcome of PICC insertion in pediatric patients by the Anesthesia Line Service Team (ALiST) of a tertiary-care, university hospital in Thailand.

Methods: This is a retrospective, descriptive study which enrolled patients from January 2018 to December 2021. The inclusion criteria were pediatric patients (age < 15 years), body weight more than 5 kg with no history of previous complicated central venous accesses. The primary outcome is the success rate of insertion. The characteristic of patients, catheter, reason of removal and complications were also reported.

Results: A total of 1,850 PICCs were inserted during the study period in which 149 PICCs were inserted in pediatric patients. There were 63 boys and girls evenly. The median age of patients was 5.47 years (ranging from 3 months to 15 years). The median height was 106.06 cm (42-170 cm), while median weight was 20.10 (2.97-73.73 kg) The successful insertion rate was 99.21%. All of them were inserted by using ultrasound-guided technique, with or without fluoroscopy. No complications during insertion were noted. The mean indwelled catheter days were 66.48 days (4-402). A 4 French single lumen catheter was the most common PICC used (38.1%), followed by 3 French, single lumen (32.5%) and 5 French, double lumen (29.4%). Reason for removal of PICC lines were completion of therapy (50.86%), catheter malfunction (25.86%), infection (6.9%), and accidental removal (2.59%).

Conclusion: This is the first report for PICC lines insertion in pediatric patient in university hospital of Thailand. Our study showed the successes rate of 99.41%. PICC in pediatric patients are safe and low complications.

AP6-3

Routine to Risk-Based: A Pediatric Hemophilia B Case Report and the Adoption of Targeted Preoperative Blood Testing Practices with Questionnaires

Aya Sueda, Tetsuro Kagawa

Department of Anesthesiology, Hyogo Prefectural Kobe Children's Hospital, Hyogo, Japan

Background: In line with the principles of the Choosing Wisely campaign, which aims to reduce unnecessary medical tests and procedures, there has been an increasing emphasis on adopting risk-based preoperative blood testing practices in pediatric surgeries. Identifying patients with potential bleeding risks is crucial. This case presentation discusses a pediatric patient with hemophilia B who experienced postoperative complications, prompting our institution to shift from routine preoperative blood tests to a targeted approach using questionnaires.

Case Presentation: A 5-month-old male infant with small patent ductus arteriosus underwent inguinal hernia repair surgery. Preoperative blood tests were normal, and coagulation tests were not performed. Surgery was performed under general anesthesia with caudal epidural anesthesia. Postoperatively, a hematoma developed, and the patient was diagnosed with moderate hemophilia B. Further testing revealed a family history of the condition. This case highlights the importance of targeted preoperative assessments and a thorough family history review.

Discussion: Hemophilia B is a rare inherited bleeding disorder. Despite the consensus that routine preoperative blood tests for pediatric patients undergoing minor surgeries are neither cost-effective nor necessary, this practice remains prevalent in Japan. Implementing targeted questionnaires to assess patients' personal and family history of bleeding disorders can help identify those at higher risk and guide appropriate preoperative testing and management. Our experience has prompted a shift away from routine preoperative blood tests to a more targeted approach using questionnaires, focusing on individual patient risk factors.

Conclusion: The pediatric hemophilia B case report emphasizes the importance of adopting a risk-based approach to preoperative blood testing using targeted questionnaires to optimize patient assessment and ensure patient safety.

AP6-4

Use of Continuous Positive Airway Pressure during Sevoflurane Inhalational Induction Does Not Result in Faster Induction but Increases Sevoflurane Consumption

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Introduction: Inhalational induction of anaesthesia is more acceptable to children. Sevoflurane is inhalation anaesthetic agent of choice because of low pungency, a non-irritant odour, and a low blood: gas partition coefficient. Continuous positive airway pressure (CPAP) refers to the delivery of a continuous level of positive airway pressure. It is functionally similar to PEEP (positive end expiratory pressure) and is most commonly used in the management of sleep-related breathing disorders, cardiogenic pulmonary oedema and obesity hypoventilation syndrome.

Methods: A prospective, randomized controlled trial conducted at a single centre in New Delhi, India. Children aged 1-5 years, ASA physical status classification I-II, posted for ophthalmic examination under general anaesthesia. 129 subjects were included and randomized into three groups; group Z (Zero CPAP), group A (5 cm H2O) and group B (10 cm H2O) using a computer-generated random number table. Subjects were anaesthetized according to a predecided protocol. Important time points: Starting time (T0), loss of eyelash reflex (T1), first prick to IV access (T2), placement of SGD (T3), 15 seconds after SGD placement (T4). 80 (62%) out of 129 patients recruited were males.

Results: No significant differences were observed in the anthropometric variables. No significant difference was observed in the time to induction and time to supraglottic device insertion between the study groups was noted. There was a significant difference in sevoflurane consumption between the study groups ($p<0.05$). No difference in number of IV attempts, propofol requirement was observed in the two groups.

Conclusion: Use of CPAP during sevoflurane induction does not lead to faster induction but increases agent consumption.

AP6-5

Effect of Single-dose Intravenous Lignocaine versus Fentanyl on Neuromuscular Recovery Time after General Anesthesia in Elective Pediatric Surgery: A Randomized Controlled Pilot Study

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Background: Intra-venous (IV) lignocaine is often used to prevent the airway response to extubation, but may prolong the duration of action of neuromuscular blocking drugs (1). The primary objective of this study was to compare neuromuscular recovery time with IV lignocaine versus fentanyl, in pediatric patients undergoing elective surgery under general anesthesia (GA). Secondary objectives included comparison of clinical parameters and respiratory events.

Methods: A randomised double blinded pilot study was conducted in children aged 2-8 years undergoing GA with neuromuscular blockade, who received either 1.5mg/kg of lignocaine (LG) or 0.5 mcg/kg of fentanyl (FG) IV, just prior to giving reversal at a train of four (TOF) count of 2-3. Time to achieve TOF ratio of 0.9 and extubation was noted as well as hemodynamic and respiratory parameters. Incidence of coughing, bucking, laryngospasm etc. were also noted. Post hoc power analysis was done with a sample size of 21 in each group. P value <0.05 was considered significant.

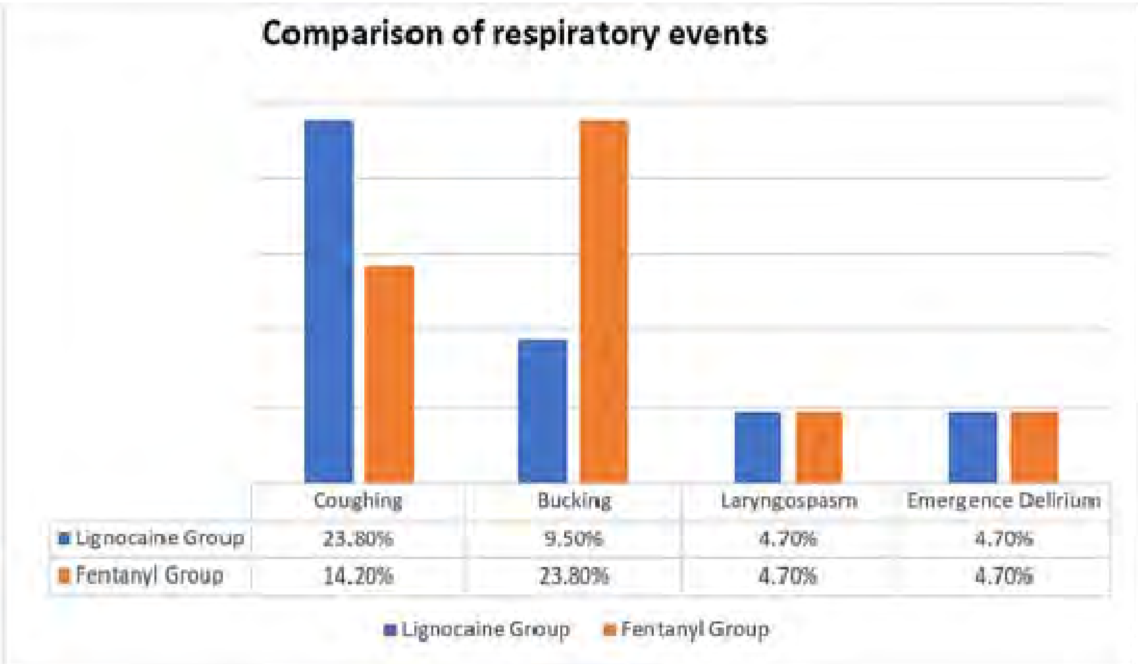
Results: Demographic, operative data and clinical parameters were similar in both groups (Figure 1). Time from reversal to TOF ratio of 0.9 was similar in both LG (6.79 ± 3.03 mins) and FG (6.79 ± 3.31 mins), p=0.99. Time to extubation was also similar in both groups (8.14 ± 3.31 vs 9.19 ± 2.89 mins). The incidence of bucking was more in FG (23.8%) vs LG (9.5%), p=0.41 (Figure 2).

Discussion: Klucka et al found the incidence of residual blockade neuromuscular blockade in pediatric population to be 48.2% in the operation room and 26.9% in post anesthesia care unit (2). Studies on lignocaine and neuromuscular recovery is lacking in pediatric surgeries. Single-dose IV lignocaine administered before reversal did not prolong neuromuscular recovery time compared to fentanyl, with a similar (low) incidence of respiratory events in pediatric patients. Thus, both fentanyl and lignocaine can be safely used in pediatric patients to prevent perioperative adverse respiratory events, guided by intra-operative neuromuscular monitoring.

References: 1. Bryssine B, Maurin C, Soubiroud JL, Ksarelof M, Roche O. Abstract PR425: Interaction of Intravenous Lidocaine with Neuromuscular Blocking. Anesthesia & Analgesia. 2016 Sep 1;123(3S):538.; 2. Klucka J, Kosinova M, Krikava I, Stoudek R, Toukalkova M, Stourac P. Residual neuromuscular block in pediatric anaesthesia. Br J Anesth. 2019 Jan;122(1):e1-e2

Table 1: Comparison of haemodynamic and respiratory parameters

S.no.	Characteristics		LG (n= 21)	FG (n= 21)	P Value
1	**Heart Rate**	Baseline	106 ± 21.02	102.05 ± 19.41	0.530
2		At reversal	108.85 ± 20.54	117.28 ± 20.48	0.191
3		At extubation	119.57 ± 20.73	126.71 ± 28.49	0.359
4		5 mins post extubation	108.80 ± 23.03	119.33 ± 26.17	0.174
5	**SBP (mm Hg)**	Baseline	94.52 ± 12.84	98.81 ± 15.56	0.338
6		At reversal	99.85 ± 10.05	105.71 ± 14.06	0.129
7		At extubation	107.24 ± 10.52	112.71 ± 13.72	0.155
8		5 mins post extubation	101.43 ± 14.72	104.76 ± 12.79	0.438
9	**DBP (mmHg)**	Baseline	56.19 ± 11.10	55.95 ± 13.49	0.951
10		At reversal	50.09 ± 9.52	62.42 ± 11.11	0.303
11		At extubation	67.47 ± 11.90	67.19 ± 12.33	0.9395
12		5 mins post extubation	60.76 ± 12.39	63.05 ± 10.45	0.522
13	**Respiratory Rate**	Baseline	20.71 ± 3.29	19.67 ± 4.69	0.408
14		At extubation	28.71 ± 7.19	26.76 ± 6.95	0.377
15		5 mins post extubation	23.24 ± 7.61	24 ± 6.01	0.721
16	**SPO_2**	Baseline	99.28 ± 0.46	99.52 ± 0.51	0.183
17		At reversal	99.23 ± 0.62	99.23 ± 0.62	0.989
18		At extubation	99.52 ± 0.51	99.47 ± 0.60	0.908
19		5 mins post extubation	99.42 ± 0.51	99.57 ± 0.59	0.364



AP6-6

The Perioperative Coagulation Profile in Pediatric Patients Undergoing Liver Transplant Surgery

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Background: Bleeding and coagulopathy remain challenging in pediatric liver transplant perioperative management. Thromboelastography (TEG) is a point-of-care test that may be utilized to guide therapy. However, the benchmark intra- and postoperative data, especially regarding coagulation complications in pediatric liver transplant patients, still need to be made available.

Aim: To summarize the perioperative trend of coagulation profile in children undergoing liver transplant surgery.

Methods: We conducted a descriptive study based on medical records, including all pediatric patients who received liver transplants from October-April 2023 in Cipto Mangunkusumo Hospital, Indonesia. We collected conventional coagulation profile data (platelet count, prothrombin time (PT), and activated partial thromboplastin time (APTT)) before and after the transplant. TEG profiles were collected before induction of anesthesia, at the anhepatic, and reperfusion phases. We calculated the difference in values by using SPSS ver. 28.

Results: The analysis included ten patients [1.82 (0.90) years, 10.21 (1.41) kgs] with cirrhosis due to progressive familial intrahepatic cholestasis (n=1) and biliary atresia (n=9). During the postoperative period, all patients had lower platelet count (p=.002), longer PT (p=.002), and longer APTT (p=.034) compared to preoperative values. Compared to pre-induction, the children had longer clot formation time (K) (p=.012), smaller α angle (p=.020), lower maximum amplitude (MA) (p=.023), lower generated value (G) (p=.035), and lower estimated percent lysis (EPL) (p=.048) at anhepatic phase. In contrast, they had longer K (p=.032), smaller α angle (p=.047), lower MA p=.031), and lower G (p=.022) in the reperfusion phase. All TEG parameters between the anhepatic and reperfusion phases were similar.

Discussion: The lower platelet, longer INR, and longer APTT ratio trend showed impaired hemostasis ability during the postoperative period. Furthermore, the TEG trend suggested that the impairment had started at the anhepatic phase of liver transplant surgery and persisted to the reperfusion phase. Periodic TEG monitoring during the anhepatic and reperfusion phase may be beneficial to anticipate and immediately correct coagulation problems, especially in patients with prolonged anhepatic phases. Future studies may explore further use of periodic TEG and its effect on intra- and postoperative coagulation-related complication rates and other clinical outcomes.

Table 1. Perioperative conventional coagulation profile in children undergoing liver transplant

Coagulation profile	Pre-operative	Post-operative
Platelet count (/ul)	161,625 (97,228.65)	51,375 (36,947.60)
INR (PT ratio)	1.07 (0.14)	1.81 (0.43)
APTT ratio (patient: control)	1.25 (0.21)	2.27 (1.18)

Values expressed as mean (standard deviation, SD). APTT=activated partial thromboplastin time; INR=international normalized ratio; PT=prothrombin time.

Table 2. Perioperative coagulation profile based on TEG in children undergoing liver transplant

TEG profile	Pre-induction	Anhepatic	Reperfusion
R time (min)	6.82 (1.65)	9.82 (5.37)	9.15 (5.14)
K time (min)	1.98 (0.88)	3.08 (1.22)	4.45 (3.33)*
α angle (°)	62.28 (12.77)	53.51 (10.27)	43.96 (21.63)
MA (mm)	63.06 (12.29)	54.44 (5.91)	46.11 (14.41)
G (dynes/cm2)	9.86 (5.35)	6.41 (1.98)	3.95 (2.22)*
EPL	0.1 (1.64)*	0.00 (0.13)*	0.00 (0.20)*
A (mm)	62.80 (18.15)*	53.59 (9.29)	44.35 (12.07)*
CI	-1.64 (4.74)	-4.37 (4.96)	-5.71 (5.79)
LY30	0.1 (0.33)*	0.0 (0.30)*	0.0 (0.20)*

Values expressed as mean (standard deviation, SD). *Values expressed as median (interquartile range, IQR). EPL=estimated percent lysis; G=generated value; K time=clot formation time; LY30=clot lysis at 30 min; MA=maximum amplitude; SD=standard deviation; TEG=thromboelastography; R time=reaction time.

AP6-7

Experiences of Our Pediatric Anesthesia after Devastating Earthquakes in Turkey

Sengul Ozmert[1], Melike Demir[1,2], Suleyman Arif Bostancı[3]

[1]Bilkent City Hospital, Department of Anesthesiology and Reanimation, Ankara Türkiye
[2]Kars Kagizman State Hospital, Kars, Türkiye, [3]Bilkent City Hospital, Department of Pediatric Surgery, Ankara Türkiye

Background: 7.8 and 7.5-magnitude earthquakes, caused over 50,000 deaths and more than 122,000 wounded people, occurred in Kahramanmaras on February 6, 2023. The healthcare system was affected by these earthquakes. Victims were transported to tertiary care hospitals. In this study, we aim to documents anesthetic management of children victims who needed urgent surgical care.

Methods: 41 under 18 years old pediatric patients were admitted via air ambulance to undergo surgical operations after the first intervention in where earthquake-affected area. In this study, these patients' medical records were analyzed retrospectively. Demographic data, surgical procedures, anesthesia methods, intensive care needs, hours under ruins, complications, mortality, and morbidity of pediatric patients were reviewed. Descriptive statistics of all numerical variables, including medians, interquartile range (IQR), together with the proportions of all categorical variables were calculated.

Results: Of the 41 cases 27 (65.9%) were male and 14 (34.1%) were female, 1 (2.4%), 4 (9.8%), 5 (12.2%), 19 (46.3%) and 12 (29.3%) were infant, toddler, preschool, school age and adolescent, respectively. Median time spent under the ruins was 30 hours. Cranial 5 (12.2%), spinal 2 (4.9%), limb 39 (95.1%), thoracic 1 (2.4%), abdominal 5 (12.2%), burn 1 (2.4%) trauma were present among patients and 17 (41.5%) of whom developed Crush syndrome. The American Society of Anesthesiologists (ASA) Score was assessed as 4 in 14 (34.1%), 3 in 17 (41.5%), 2 in 10 (24.4%) patients. Fasciotomy 23 (56.1%), wound debridement 31 (75.6%), cranial surgery 1 (2.4%), limb amputation 5 (12.2%), fracture fixation 3 (7.3%), spinal fixation 2 (4.9%) and reconstructive surgery 3 (7.3%) times were carried out in the operating room under sedation 8 (19.5%), general anesthesiology 7 (17.1%) or both 26 (63.4%). Subsequently, of the patients 7 (17.1%), 17 (41.5 %), 1 (2.4%), 2 (4.9%) were followed due to sepsis, acute kidney injury (AKI), osteomyelitis, and peripheral neuropathy, respectively.31(%75,6) patients were admitted to the intensive care unit (ICU) and 4 (9.8%) patients needed invasive mechanical ventilation after surgery, whose length of stay in ICU was 8 and all patients' median hospitalization days were 79. The percentage of exitus was 4.9%, remaining 39 (95.1%) were discharged (Table 2).

Conclusion: Ideal anesthesic management of these patients group may vary depend on available personnel, supplies and equipments.

Age (year), [median, (IQR)]	10 (5.5-13.5)
Infants	1 (2.4%)
Toddler	4 (9.8%)
Preschool	5 (12.2%)
School	19 (46.3%)
Adolescent	12 (29.3%)
Gender	
Male	27 (65.9%)
Female	14 (34.1%)

Hours under ruins [median, (IQR)]	30 (11.5-40)
First intervention at previous hospital	
Fasciotomy	25 (61%)
Limb amputation	5 (12.2%)
Diagnosis	
Cranial trauma	5 (12.2%)
Spinal trauma	2 (4.9%)
Limb trauma	39 (95.1%)
Thoracic Trauma	1 (2.4%)
Abdominal Trauma	5 (12.2%)
Burn	1 (2.4%)
Soft tissue injury	2 (4.9%)
Crush syndrome	17 (41.5%)
GCS on admission	
15	33 (80.5%)
14	4 (9.8%)
13	3 (7.3%)
8	1 (2.4%)
ASA score	
4	14 (34.1%)
3	17 (41.5%)
2	10 (24.4%)
Anesthesiology	
General	7 (17.1%)
Sedation	8 (19.5%)
Both	26 (63.4%)
Hospitalization days [median, (IQR)]	79 (42-82)
Surgical procedure	
Fasciotomy	23 (56.1%)
Wound debridement	31 (75.6%)
Total number	107
Cranial surgery	1 (2.4%)
Limb amputation	5 (12.2%)
Fracture fixation	3 (7.3%)
Reconstructive surgery	3 (7.3%)
Spinal fixation	2 (4.9%)
Complication	
Sepsis	7 (17.1%)
AKI	17 (41.5 %)
Osteomyelitis	1 (2.4%)
Peripheral neuropathy	2 (4.9%)
Days in ICU [median, (IQR)]	8 (1.5-24.5)
Invasive ventilation requirement	4 (9.8%)
Exitus	2 (4.9%)

ASPA 2023

Day 3_Room D

Abstract Presentation 3 (Virtual)

Chair(s): Jin Hee Ahn (Korea)
Sung-Ae Cho (Korea)

V3-1

Bispectral Index Relation with Delirium in Post Cardiac Surgery Patients

AFAD Abro

Department of Cardiovascular and Thoracic Surgery, Lithuanian University of Health Sciences, Kaunas, Lithuania

Introduction: postoperative delirium is a common complication in post-cardiac surgery patients. It is a leading cause of death and a big burden on economic resources. There are three types of delirium hypoactive, hyperactive, and mixed. In this study, we have mentioned a case study of a patient who presented cardiac symptoms in Kaunas Clinics, LSMU. After cardiac surgery, the patient was diagnosed as delirious based on CAM-ICU features.

PICO Question: in post-cardiac surgery patients, can the monitoring of anesthesia depth during surgery reduce the risk of delirium? Research Questions: what are the main risk factors of postoperative delirium? How to monitor the anesthesia depth? What is the relation between intraoperative depth level and postoperative delirium?

Methodology of the Research: the main sources of the literature review were Google scholar and web of science, which led to PubMed, NCBI, ScienceDirect, and the American Journal of Anesthesiology. An inclusion and exclusion criterion was applied according to keywords; Bispectral-index relation with delirium in post-cardiac surgery patients (184), dexmedetomidine use for delirium with post-cardiac surgery (33), dementia vs. delirium after cardiac surgery (80), in this prospective research study the 67 number of publications are included from 2013-2023 which were directly related to the theme of this study. To fulfill the study aimed to understand the Bispectral index relation with delirium in post-cardiac surgery patients. For this purpose, a patient observed who had undergone total surgery under general anesthesia with the help of volatile and non-volatile drugs as well as the depth of anesthesia was monitored through BIS.

Result & Discussion: in this study, it is revealed through the case study, meta-analysis, and literature review that the perioperative Bispectral index monitoring decreases the chances of delirium postoperatively and dexmedetomidine diminishes the delirious symptoms without causing respiratory depression.

Conclusion: delirium assessment needs the preoperative proper assessment and evaluation of a patient and finding out which comorbidity may cause delirium postoperatively. CAM-ICU tool is the best tool to assess delirium. Correction of the cardiac biomarkers and physical ASA classification has a greater role in elderly populations who are prone to develop delirium after cardiac surgery. During cardiac surgery, BIS monitoring can reduce the chance of delirium by reducing volatile

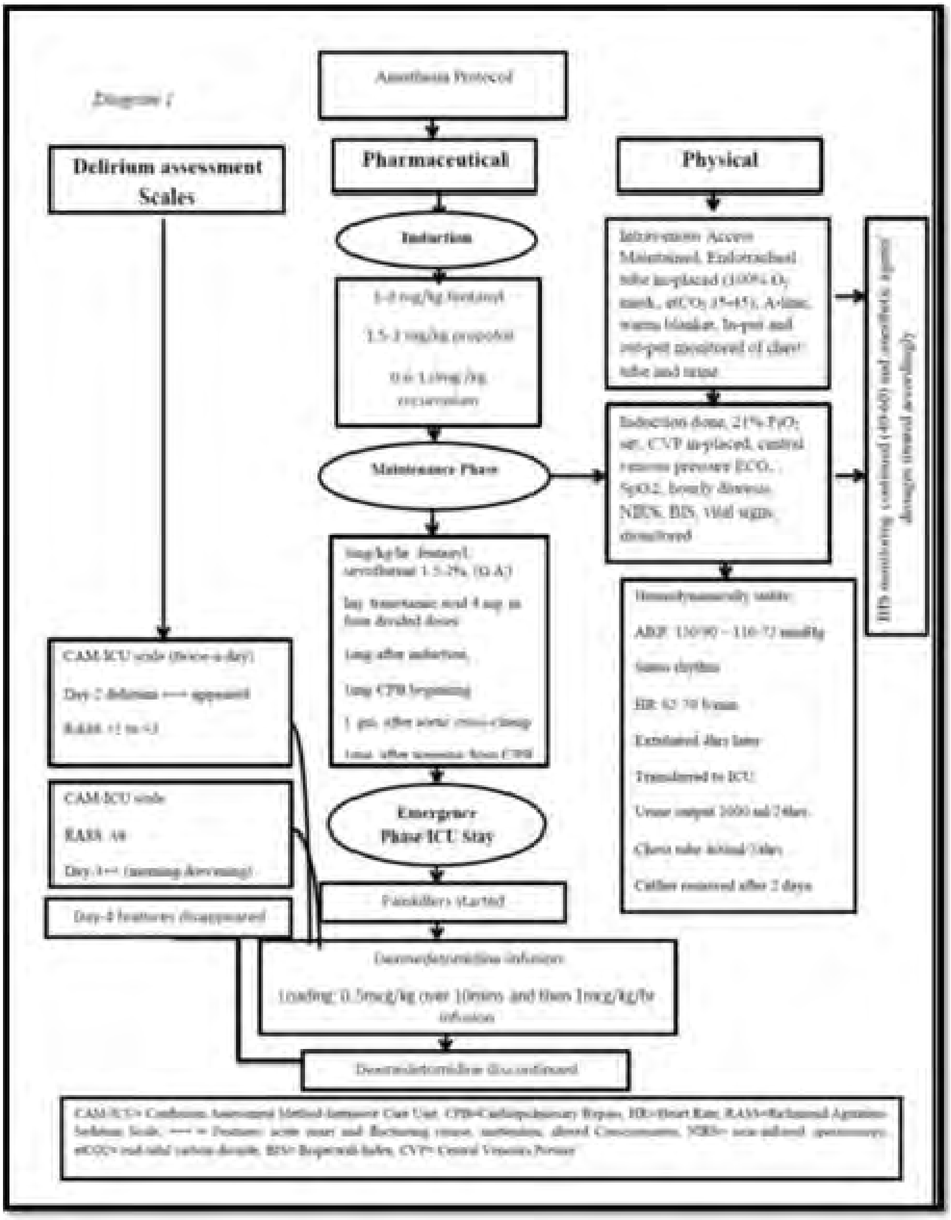

Table 3: Post-surgery delirium features appeared in the patient (Source: Author of study)

Postop day	*acute onset and fluctuating course*	*inattention*	*altered C consciousness*	*disorganised thinking*	*Delirium*
1 evening	No	No	No	No	No
2 morning	No	No	No	No	No
2 evening	Yes	Yes	Yes	No	Yes
3 morning	Yes	No	Yes	No	Yes
3 evening	Yes	No	Yes	No	Yes
4 morning	No	No	No	No	No
4 evening	No	No	No	No	No

Denotions: (red symbol) *= No,* (green symbol) *=Yes*

V3-2

The Impact of Oral Fluid Intake 1 Hour Prior to Surgery on Anxiety Levels and Gastric Volume in Pediatric Patients

Burcu Bozoglu Akgun[1], Zehra Hatipoglu[2], Mediha Turktan[2], Ersel Gulec[2], Dilek Ozcengiz[2]

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Background: Children and parents preparing for surgery often feel fear of the unknown, and hunger during the preoperative period adds to this anxiety. While preoperative fasting times have changed to allow clear liquid foods up to 1 hour before surgery, there is concern that this may increase the risk of aspiration. This study aims to investigate the effect of clear liquids given 1 hour before surgery on a child's anxiety and stomach volume during the preoperative period.

Materials and Methods: This study involved 90 pediatric patients aged 5-12 with ASA Scores of 1-2. They were divided into three groups: Group A (n=30) - standard fasting, Group S (n=30) - given 5 mL/kg (max 250 ml) of water orally 1 hour before, and Group K (n=30) - given 5 mL/kg (max 250 ml) of clear liquid rich in carbohydrates orally 1 hour before. Patients were evaluated with the modified Yale Preoperative Anxiety Scale (m-YPAS) before and 1 hour after receiving fluids. After intubation, the gastric antrum cross-sectional area (GACA) was measured, and gastric residual volume (GRV) values were calculated. Hemodynamic data, blood glucose levels, and parent satisfaction were recorded.

Results: One hour after the intervention, the measurements of m-YPAS were significantly lower in Group K than in Group S and Group A ($p<0.001$). The GACA and GRV values were significantly lower in the groups that received carbohydrate drinks and water compared to the fasting group ($p<0.001$). Parental satisfaction was highest in the group that received carbohydrate drinks.

Conclusion: Giving oral water and carbohydrate solution to children 1 hour before surgery reduces preoperative anxiety without increasing stomach volume. In fact, the intake of a carbohydrate solution is even more effective in reducing anxiety.

V3-3

Improvement of Broviac Catheter-related Outcomes after the Implementation of a Quality Management System: A Before-and-after Prospective Observational Study

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Introduction: The tunneled Hickman-Broviac® catheter is widely used for neonates and young infants having difficult central venous access and requiring prolonged intravenous therapy, however, it needs surgical experience and nursing skills to prevent adverse outcomes. In our institution, high rates of catheter-related complications were previously observed. Because of the high rates of Broviac catheter complications, we started an urgent quality process to reduce this morbidity.The aim of this study is to assess the efficiency of the main actions we have taken in enhancing our practice and improving Broviac outcomes.

Methods: We included all neonates and young infants requiring surgical central venous access using a Broviac tunneled catheter. We compared the catheters' outcomes before and after the implementation of a quality program based on a nurse teaching program, patient selection, and catheter management multidisciplinary protocol. The significance threshold was set at $p < 0.05$.

Results: We included 94 patients: 51 in the protocol group and 43 in the control group. The complication rate was reduced from 60.3% to 25.5% with p=0.001. The lifetime of the catheter was improved from 11.3 ± 4.3 days to 19.1 ± 9 days with p=0.007. The catheter infection was reduced from 65.3% to 46.1% with p≤0.001.

Conclusion: This quality improvement project shows the utility of a quality assurance program based on careful indications and patient selection, a nursing teaching program, and a multidisciplinary catheter management protocol, in reducing Broviac catheter-related morbidity.

V3-4

Predictors of Perioperative Respiratory Adverse Events Among Children with a Cold Undergoing Pediatric Ambulatory Ilio-inguinal Surgery: Prospective Observational Research

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Background: Anesthesia for children with a cold has an increased risk of perioperative respiratory adverse events (PRAEs) that may be predicted according to the COLDS score.The aim of this study was to evaluate the validity of COLDS score in children undergoing ilioinguinal ambulatory surgery with mild colds and to investigate new predictors of PRAEs.

Methods: This was a prospective observational study including children aged from 1 to 5 years with mild symptoms of a cold proposed for ambulatory ilioinguinal surgery. The anesthesia protocol was standardized. Patients were divided into 2groups according to the incidence of PRAEs. Multivariate logistic regression was performed to assess predictors for PRAEs.

Results: In this study, 216 children were included. The incidence of PRAEs was 21%. Predictors of PRAEs were respiratory comorbidities [aOR=6.3; 95%CI: 1.19-33.2; p=0.003], patients postponed before 15 days [aOR= 4.3; 95%CI: 0.83-22.4; p=0.029], passive smoking [aOR=5.31; 95%CI: 2.07-13.6; p=0.001], and COLDS score >10 [aOR=3.7; 95%CI: 0.2-53.4; p=0.036]

Conclusion: COLDS score was effective in predicting the risks of PRAEs even in ambulatory surgery. It seems that children with severe respiratory upper tract infections should be postponed for more than 15 days. Passive smoking and previous comorbidities were the main predictors of PRAEs in our population.

V3-5

Intra Operative Fat Embolism in a Child With Osteogenesis Imperfecta -Double Whammy!

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Background: Osteogenesis imperfecta is an uncommon hereditary connective tissue disorder distinguished by fragile bones, hearing loss, defective dentition, and blue sclera. Difficult intravascular access, potentially difficult airway, pulmonary compromise, risk of intraoperative bleeding and hyperthermia are some of the many challenges for the anaesthetist. Fat embolism syndrome is rare in paediatric age group. It's a fatal complication of femur nailing surgery and is always diagnosed as an outlier; it may require cardiopulmonary support. This report describes an intraoperative fat embolism syndrome that occurred during intramedullary femur nailing in a young patient with osteogenesis imperfecta.

Case Description: A 11-year-old male with osteogenesis imperfecta and severe scoliosis, short stature, multiple limb deformities and obstructive sleep apnea; was scheduled for bilateral femoral osteotomies. Intraoperatively there occurred severe cardio-respiratory collapse during advancement of femur nail. The event included, a sudden drop in ETCO2, hypotension, increased airway pressure with inability to ventilate, desaturation and bradycardia. Worsening of cardio-respiratory parameters led to pulseless electrical activity which needed cardiopulmonary resuscitation and adrenaline. A diagnosis of fat embolism syndrome was confirmed with transesophageal echocardiography and by eliminating other differentials. A successful ROSC was achieved followed by completion of surgery and postoperative stabilization.

Discussion: Most popular existing diagnostic criterias for FES are designed for spontaneously breathing, awake patients. Under general anaesthesia, diagnosing a fat embolism is challenging since the symptoms are obscured. In our case, management was also a challenge due to the high fragility of bones in osteogenesis imperfecta.


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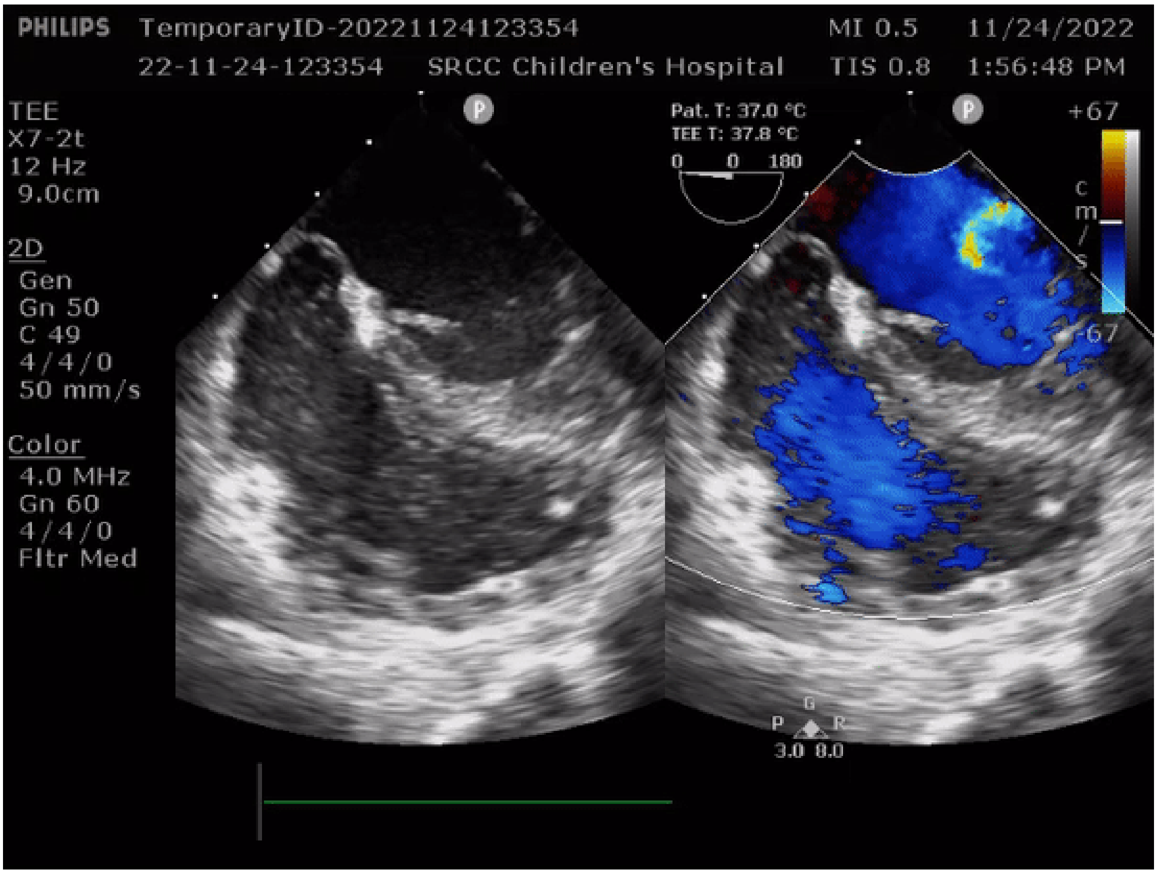
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V3-6

Risk Factors for Hickman-Broviac Catheter Complications: The Experience of a Tunisian Hospital

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Introduction: Hickman-Broviac catheters have improved the care of young children needing frequent and prolonged venous access at the cost of substantial morbidity, particularly in the developing countries. The aim of our study is to describe the experience of a Tunsian hospital and to look for the main risk factors for complications.

Methods: In this prospective observational study, we included all neonates and infants aged less than 12 months who were proposed for catheter Broviac insertion in the pediatric surgery department. Patients were divided into 2 groups according to the incidence of complications. Then, we compared the two groups.Univariate logistic regression analyses were used to determine the risk factors for complications.

Results: forty-three children were included in the study. The incidence of complicated catheters was 60.4%.The following factors were significantly associated with an increased risk of complications: age 6 months [OR 3.5, 95% CI: 0.6-19.3], weight 6 kg [OR 1.54, 95% CI: 0.46-5.2], emergency circumstances [OR 1.62, 95% CI: 0.8-5.4], and antibiotherapy as an indication for Broviac catheter insertion [OR 1.8, 95% CI: 0.5-6.2].

Conclusion: Complications seem to be more frequent in patients younger than 6 months and those with a low weight of less than 6Kg and to reduce the morbidity related to the catheters, the indications should be carefully chosen.

V3-7

Complications and Risk Factors of Percutaneous Subclavian Vein Catheters in Pediatric Patients: Enhancing the Outcomes of a University Hospital in a Developing Country

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Purpose: Assessing central venous catheter-related complications with regular feedback and investigating risk factors is mandatory to enhance outcomes. The aim of this study is to assess our experience in the management of pediatric subclavian vein catheters (SVCs) and to investigate the main risk factors for complications.

Materials and Methods: In this prospective observational research, we included 3 months to 14 years children proposed for infraclavicularsubclavian vein catheterization consecutively using the anatomic landmark technique. Patients were divided into 2 groups: Group1 included complicated catheters and Group 2 included non-complicated catheters. The management protocol was standardized for all patients. After comparing the two groups, univariate and multivariate logistic regression were used to investigate the risk factors for complications.

Results: In this study, we included 134 pediatric patients. The rate of complications was 32.8%. The main complications were: Central Line-associatedBloodstream Infection (63.6%); bleeding and/or hematoma (22.7%); mechanical complications (13.6%); and vein thrombosis (13.6%).After adjustment for confounding factors, predictors of catheter-related complications were: difficult insertion procedure [aOR=9.4; 95%CI: 2.32-38.4], thrombocytopenia [aOR=4.43; 95%CI: 1.16-16.86], and comorbidities [aOR=2.93; 95%CI: 0.58-14.7]

Conclusion: High rates of complications were associated with difficult catheter placement and patients with comorbidities and severe thrombocytopenia.To reduce catheter-related morbidity, we suggest ultrasound guided-approach, a multidisciplinary teaching program to improve nursing skills, and the use of less invasive devices for cancer patients.

V3-8

Implementation of "Goal Directed Bleeding Management" at Shahid Gangalal National Heart Center

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Patient Blood Management (PBM) is a proactive, patient-centered, and multidisciplinary approach to manage anemia, optimize hemostasis, minimize iatrogenic blood loss, and harness tolerance to anemia.

World Health Organization has endorsed PBM in 2010, many hospitals still seek guidance with the implementation of PBM in clinical routine.

Coagulation management of patients undergoing cardiac surgery is complex. A balance between anticoagulation for cardiopulmonary bypass (CPB) and hemostasis after CPB. Patients have impaired platelet function at baseline due to administration of anti-platelet agents.

After surgery, coagulation abnormalities, platelet dysfunction and fibrinolysis can occur, creating a situation whereby hemostatic integrity must be restored. The complex process of anticoagulation with heparin, antagonism with protamine, and postoperative hemostasis therapy can be guided by point-of-care (POC) tests that assess hemostatic function in a timely and accurate manner.

Looking at the progress worldwide, multi-disciplinary team at Shahid Gangalal National Heart Center (SGNHC) took initiative to enhance knowledge about principles and practices of PBM. The concept of early, individualized and goal-directed bleeding management (GDBM) is practiced in cardiac operations at SGNHC using rotational thromboelastometry(ROTEM), a newer modality started in the country from 2022.

GDBM will change empirical blood and blood product transfusion that would decrease the cost, complications and casualties related to both transfusion and bleeding.

Despite the demonstrated benefits of PBM, many barriers and challenges limit translation of PBM guidelines into clinical practice, staffs don't know about the latest guidelines and consequences of the blood transfusion. There is standard dogma that "one size fits all ". Lack of knowledge of the physicians, lack of interdisciplinary commitment, lack of resources (hospital administrators need to invest initially before saving money)and other general concerns are rest to be named.

ROTEM is not designed to answer "Will the patient bleed" But "Why does the patient bleed". We should not treat pathologic laboratory results 'numbers' in the absence of bleeding. If both, POC viscoelastic (ROTEM) and platelet function testing (ROTEM) are normal, surgical bleeding has to be considered and treated adequately.

Day 3_Room D

Abstract Presentation 4 (Virtual)

Chair(s): Eun-Young Joo (Korea)
Woo Suk Chung (Korea)

V4-1

The Utility of Enhanced Recovery After Surgery (ERAS) Protocols in Adolescent Scoliosis Surgery: A Systematic Review and Meta Analysis

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Background: Posterior spinal fusion (PSF) for adolescent idiopathic scoliosis (AIS) is the most invasive orthopaedic surgical procedure in the pediatric age group with profound perioperative stress. The efficacy and feasibility of ERAS protocols to enhance recovery and improve outcomes of PSF surgery in AIS patients are yet to be established.

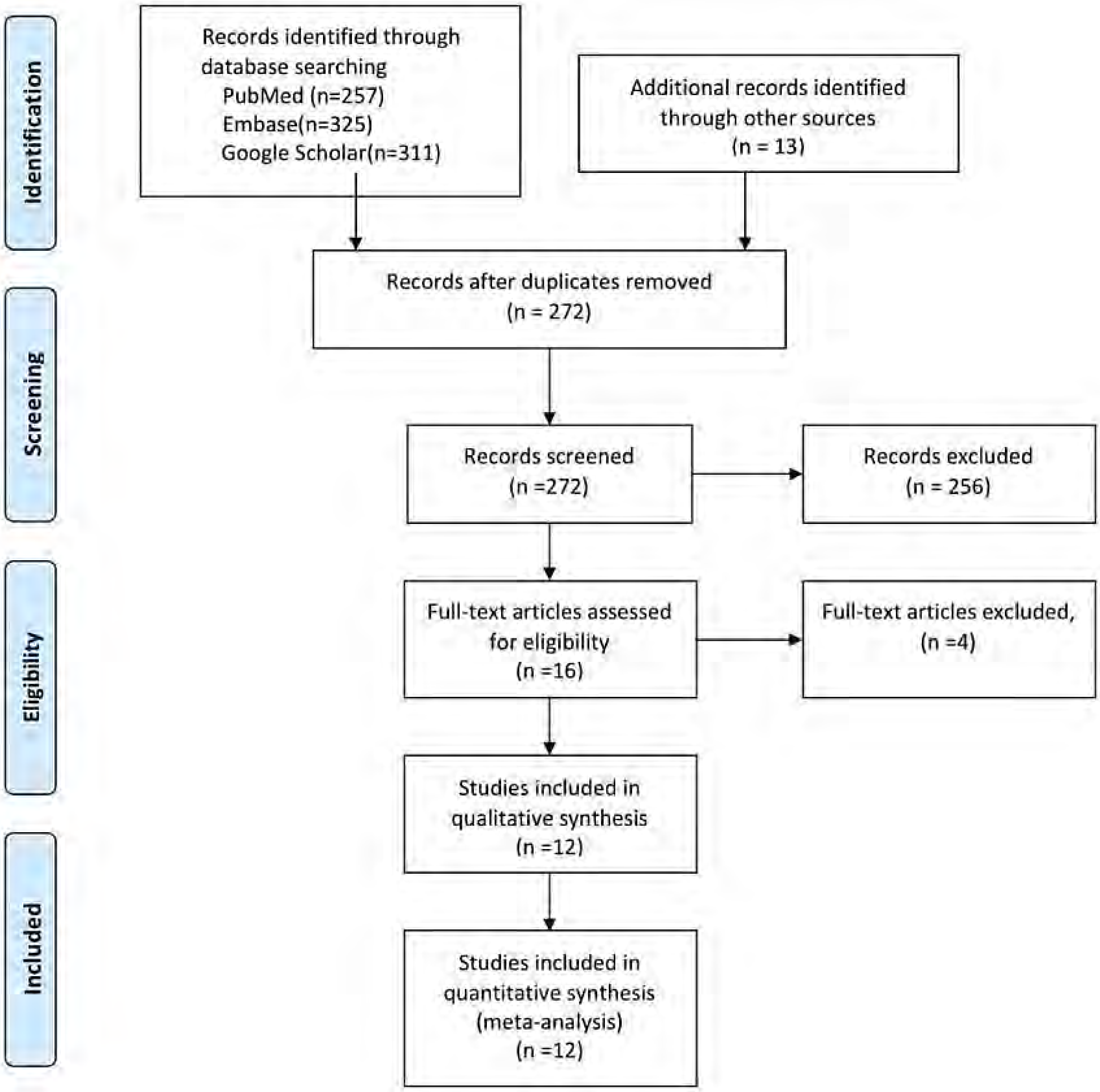
Methods: Controlled cohort studies and randomized control trials comparing enhanced recovery pathways with conventional pathways in AIS undergoing PSF at adolescent age were included. The inverse variance and Mantel-Haenszel statistical analysis methods were used for continuous and dichotomous data, respectively. All results were quantitatively analyzed using the random effect model.

Results: 12 studies, including 13886 patients undergoing PSF at adolescent age for AIS were included. Patients in the ERAS group had a significant reduction in LOHS by an average of 1.61 days (95% CI -1.25 to -1.97, I2 = 96%), blood loss by 281.93 ml (95% CI -74.88 to -488.98, I2=96%), duration of surgery by 52.81 minutes (95% CI -25.97 to -79.65, I2 88%), pain scores-NRS by 1.20 (95% CI -0.75 to -1.65, I2=58%), PCA duration by 1.38 days (95% CI -0.70 to -2.06, I2=96%) without any significant difference in complications (OR 0.53, 95%CI 1.01-0.28, I2=54%), readmission rates (OR 1.57, 95%CI 0.77-3.22, I2 =7%), PONV (OR 0.42, 95% CI 0.09-1.95, I2 =91%), cost with a mean difference of 2721.55 $ (95% CI -4987.34 to 10430.45, I2=93%) and opioid consumption -3.14 mg(95% CI -10.81 to 4.53, I2 =79%) compared to the traditional protocol group.

Conclusion: Implementation of ERAS protocols in AIS patients undergoing PSF results in enhanced recovery without a considerable increase in complications, readmission rates, opioid consumption, cost, and PONV compared to traditional protocols. Thus, the formulation of standardized ERAS protocols for scoliosis surgery is necessary.

AUTHOR/ YEAR	STUDY DESIGN	COUNTRY	SAMPLE SIZE (n)	PROTOCOL NAME	PRIMARY OUTCOME
Fletcher *et al*[34] 2014	Retrospective cohort	USA	279	AD	Clinical & economic implications of accelerated discharge
Gornitzky *et al*[35] 2016	Retrospective cohort	USA	138	RRP	RRP improves pain control, reduces opioid-related complications and expedites early mobilization
Rao *et al*[36] 2016	Retrospective cohort	USA	190	-	Educating preoperatively and standardizing care decrease the time to discharge
Sanders *et al*[31] 2016	Retrospective cohort	USA	284	AP	Average hospital stay
Fletcher *et al*[37] 2017	Retrospective cohort	USA	150	AD	Impact of the novel postop pathway on length of stay and complications
Kim *et al*[38] 2017	Prospective cohort	USA	72	NP	New protocol improves patient experience, lowers the length of hospital stay and cost
Yang *et al*[39] 2020	Retrospective cohort	China	79	ERAS	Impact and feasibility of optimised ERAS pathway
DeVries *et al*[40] 2020	Retrospective cohort	USA	244	RRP	Feasibility to implement RRP for surgical treatment of AIS
Fletcher *et al*[41] 2021	Retrospective cohort	USA	276	ERAS	To compare immediate postoperative outcomes following an ERAS pathway
Ding *et al*[42] 2022	Retrospective cohort	China	90	ERAS	Feasibility and efficacy of ERAS protocol in AIS
Tondevold *et al*[43] 2022	Retrospective cohort	Denmark	154	ERAS	LOHS, Transition to solid foods, PONV
Shaw *et al*[44] 2022	Retrospective cohort	USA	12010	ERAS	LOHS and total treatment charge

Table 1: LOHS= length of hospital stay , LOE= level of evidence, ERAS= Enhanced recovery after surgery, AD= Accelerated discharge, RRP= Rapid recovery pathway, NP= New protocol, AIS= Adolescent idiopathic scoliosis.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Records excluded
(n = 256)
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(n =16)
Full-text articles excluded,
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(n =12)
Studies included in quantitative synthesis (meta-analysis)
(n =12)

V4-2

Comparison of Ultrasound Guided Thoracic Paravertebral Block Versus Serratus Anterior Plane Block in Children Undergoing Thoracic Surgery: A Prospective Observational Study

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Background: Thoracic paravertebral block (TPVB) and serratus anterior plane block (SAPB) are two truncal blocks that are alternative to thoracic epidural block in thoracic surgery. In the current study, it is aimed to compare the effects of ultrasound (US) guided TPVB and US guided SAPB on postoperative pain and opioid consumption in pediatric thoracic surgery population.

Methods: After obtaining ethics committee approval, 46 children whose legal guardians provided consent (1-14 years old) and were scheduled for lung resection were included in the study. TPVB (Group T) and SAPB (Group S) were performed prior to incision with 0.5 ml/kg or 0.4 ml/kg bupivacaine, respectively. The primary outcome was total intravenous (IV) morphine consumption in postoperative 48 hours. Secondarily, FLACC scores (Face, Legs, Activity, Cry, Consolability) were evaluated at postoperative 0th, 15th, 30th, 45th minutes and at 1st, 2nd, 6th, 24th, and 48th hours. If the FLACC score was >4, 0.03 mg/kg morphine IV was administered as rescue analgesia. Other types of analgesics were not provided since a strong opioid was chosen along with truncal block. Time to first morphine administration (minutes), time to first mobilization (minutes), lentgh of hospital stay (hours), postoperative vomiting (POV) incidence (%), and chronic pain incidence (%) were also recorded. Chronic pain was evaluated three months after the surgery.

Results: Total 40 patients were included. Demographic data, ASA physical status scores and duration of surgery were similar in both groups (p>0,05). Morphine consumption during postoperative 48 hours was higher in Group S (0.24±0.07 mg/kg) than in Group T (0.17±0,08 mg/kg) (p=0,01). Time to first morphine administration was shorter in Group S comparing to Group T (205,5±68,7 min vs 356,7±83 min, respectively, p<0,001). Both groups did not differ with regards to intraoperative fentanyl consumption, time to first mobilization, length of hospital stay, POV incidence, and chronic pain incidence (p>0.05). (Table 1). During the postoperative two hours, FLACC scores were statistically close between two groups (p>0.05). However, in Group S, postoperative 6th, 12th, and 24th hours FLACC scores were significantly higher. (p=0.01 p=0.02 p<0.001) (Table 2).

Conclusion: This study demonstrated that both US-guided SAPB and US- guided TPVB provided effective post-

operative analgesia in early postoperative hours in pediatric patients undergoing thoracic surgery. However, after postoperative 6th hour, TPVB was superior to SAPB in terms of FLACC scores, postoperative morphine consumption and time to first analgesic requirement.

Table 1: Brief summary of demographic and perioperative period data including pain-related details.

	Group S (n=20)	Group T (n=20)	p
Female (n) (%)	10 (50%)	4 (20%)	0.04
Age (Years)	7,38±4.56	8±4,75	0.67
Weight (kg)	29,85±17,14	33,20±18,57	0.56
ASA I/II/III	3 (15%) /16 (80%) / 1 (5%)	5 (25%) / 14 (70%) / 1 (5%)	0.73
Duration of surgery (min)	106±18,25	115±22,83	0.18
Patient number requiring intraoperative additional fentanyl (n) (%)	13 (65%)	9 (45%)	0.34
Patient number requiring rescue analgesia (n) (%)	20 (100%)	18 (90%)	0.49
Time first morphine administration in the postoperative period (min)	205,5±68,71	356,67±82.96	<0,001
Total morphine consumption in the postoperative 48 hours (mg/kg)	0,24±0,07	0,17±0,08	0.01
Time to first mobilization in the postoperative period (Hours)	23,75±21,49	27,50±24,05	0.61
Length of hospital stay (Hours)	121,2±41,55	109,2±38,5	0.35
Postoperative vomiting incidence (n) (%)	4 (%20)	1 (%5)	0.34
Chronic pain incidence in postoperative 3rd month (n) (%)	1 (%5)	1 (%5)	1

Table 2: Postoperative FLACC scores. FLACC: Face, Legs, Activity, Cry, Consolability.

Postoperative FLACC scores	Group S (n=20)	Group T (n=20)	*p*
0th minute	2 (2-2)	2 (1-2)	0.77
15th minute	2 (2-2)	2 (1-2)	0.35
30th minute	2 (1-3)	2 (1-3)	0.89
45th minute	1 (1-3)	2 (1-3)	0.64
1st hour	2 (2-2)	2 (2-3)	0.81
2nd hour	2 (2-3)	2 (2-3)	0.84
6th hour	3 (3-4)	2 (2-3)	**0.01**
24th hour	3 (2-4)	2 (1-3)	**0.02**
48th hour	2 (2-3)	1 (0-1)	**<0,001**

V4-3

Procedural Sedation and Anaesthetic Technique in Paediatric Patients with Anterior Mediastinal Mass in a Quaternary Centre - Our 3 Years of Experience

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Background: Anaesthetic management of children with anterior mediastinal mass (AMM) is challenging. Due to its proximity to airway and major cardiovascular structures, patients may present with cardiorespiratory compromise. Anaesthesia or sedation is often required for urgent diagnostic or therapeutic procedures. While classical teaching suggests avoidance of general anaesthesia (GA), data on anaesthetic or sedation techniques and their outcomes is lacking.

Methods: We performed a retrospective review of anaesthetic records of all patients with AMM presenting to our hospital for procedure under sedation or anaesthesia from June 2019 to May 2022.

Results: 22 patients underwent a total of 34 procedures at Hong Kong Children's Hospital between June 2019 and May 2022. Twenty-eight procedures (82%) were image guided biopsies, bone marrow aspiration, insertion of vascular access, drainage of pleural or ascitic fluid. The remaining were tumour excision and emergency appendectomy. In 22 patients, only 13 patients had preoperative vascular or airway obstructive symptoms. However, 18 patients had major airway or vascular compression on imaging. Symptoms and degree of airway or vascular compression did not correlate. 25 procedures were done under monitored anaesthetic care (MAC) and all were successful. Sedation was provided by paediatric anaesthesiologist using agents included dexmedetomidine, ketamine, propofol and fentanyl. Eighteen episodes required low or high flow nasal oxygen but none required assisted ventilation or advanced airway. Six procedures were done under GA. Among these, two were done with spontaneous ventilation and laryngeal mask airways. Four were done with muscle relaxants. Two patients had non-compressing tumours and received paralysis upon induction. The other two with significant airway and vascular compression were paralysed only when sternum was opened and tumour controlled by surgeons. However, they still developed significant haemodynamic instability requiring inotropes and one of them even required extracorporeal membrane oxygenation (ECMO). Three adolescents had local anaesthesia for peripheral body parts biopsies.

Conclusion: Paediatric AMM cases present with great anaesthetic challenges. A multidisciplinary approach to streamline the diagnostic and therapeutic workflows, good case selection and experienced anaesthetists and cardiothoracic surgeons allow urgent diagnostic or therapeutic procedures to be safely performed.

V4-4

Distraction Techniques for Post-operative Paediatric Patients in Post Anaesthesia Care Unit (PACU); A Randomized Control Trial

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Introduction: Paediatric pain is complex involving physiological, behavioural, and development factors. Non-pharmacological therapies can be used to treat the affective, cognitive, and behavioural dimensions of pain (1). But its use in postoperative anaesthesia care unit (PACU) is still limited. This study aimed to compare the distraction method with the conventional pharmacological method in paediatric pain scores and parent's satisfaction after surgery.

Methodology: This parallel randomized control trail was conducted at PACU of a tertiary care hospital by including all elective paediatric patients of age 3 to 7 years. Patients were divided into two equal groups i.e. 22/group by computer generated random numbers. The control group (C) received conventional analgesia while experimental group (CD) received distraction technique as well as routine. After obtaining the informed consent, data was collected in PACU at four time points on a predesigned form. Faces pain scale was used to score pain in both groups. The groups were compared using independent t-test/Mann Whitney U test and Fisher's exact test.

Results: Forty- four paediatric children of 4.6 (1.45) years participated in the study. 54.5% received only caudal analgesia. Intraoperative systemic analgesics include paracetamol in 18 (40.9%) patients, nalbuphine in 2 (4.5%), and both paracetamol & nalbuphine in 11 (25%) patients. In group CD, children chose to play games (9%), to listen poems (13.6%), and to watch cartoons (27.3%). The heart rate at 20 minutes (p-value 0.021) and pain score at 20 minutes (p-value 0.049), 60 minutes (p-value 0.05) and parent satisfaction (p-value 0.003) were statistically significantly.

Conclusion: Distraction technique was found to be superior to conventional paediatric pain management in PACU.

Key Words: distraction techniques, paediatric pain, pain management, PACU

V4-5

Perioperative Anaesthetic Management of Button Battery Ingestion: A Case Report

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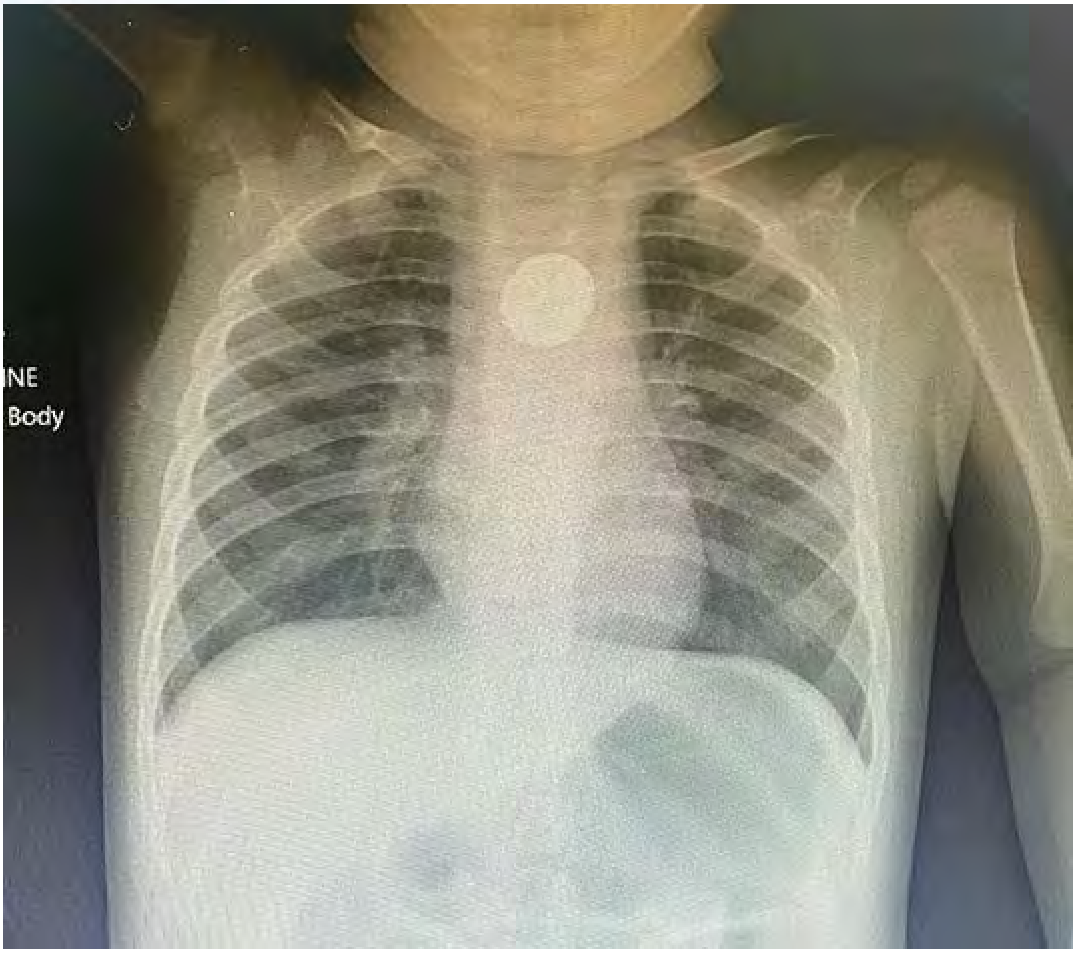
The ingestion of button batteries by paediatric patients is not uncommon. It has been reported >3500 ingestions annually and 12.6% of children<6 years old develop serious or fatal injuries including damage to esophagus, adjacent airway, vascular and mediastinal structures. Due to the rapid development of these corrosive injuries, treatment protocols and guidelines have been published. These protocols emphasises on emergent removal of button battery to limit the ongoing damage caused by it. However, this is not always possible due to delays in initial or atypical patient presentation and/or need for transfer to a paediatric facility for removal of the button battery. This case report describes the perioperative anaesthetic management of a 14 month old infant who presented to ED with worsening respiratory symptoms for 5 days with incidental finding of button battery ingestion by CXR, complicated with acquired tracheoesophageal fistula and the challenges that came with it. Recommendations from current guidelines of button battery ingestion including risk stratification of patients and its intraoperative anaesthetic management are discussed. Anaesthetists should be aware of potential complications and risk stratify the patients to provide appropriate perioperative management and care coordination for the patient. Care by multidisciplinary team and prompt interventions are key to a successful outcome.



High Risk	Intermediate Risk	Low Risk
• Children <5 years old • Battery >20-mm diameter • Underlying esophageal pathology or stricture • Esophageal impaction – at the level of the aortic arch – with the negative pole (narrow side) facing posteriorly – prolonged impaction • Signs of gastrointestinal bleeding	• Esophageal impaction not meeting high-risk criteria • Symptomatic gastric button batteries	• Children >5 years old • Battery <20-mm diameter • No history of esophageal pathology or stricture • Asymptomatic gastric button batteries

V4-6

Computed Tomographic (CT) Scan Measurements of Anatomical Landmark for Suprazygomatic Maxillary Nerve Block in Children

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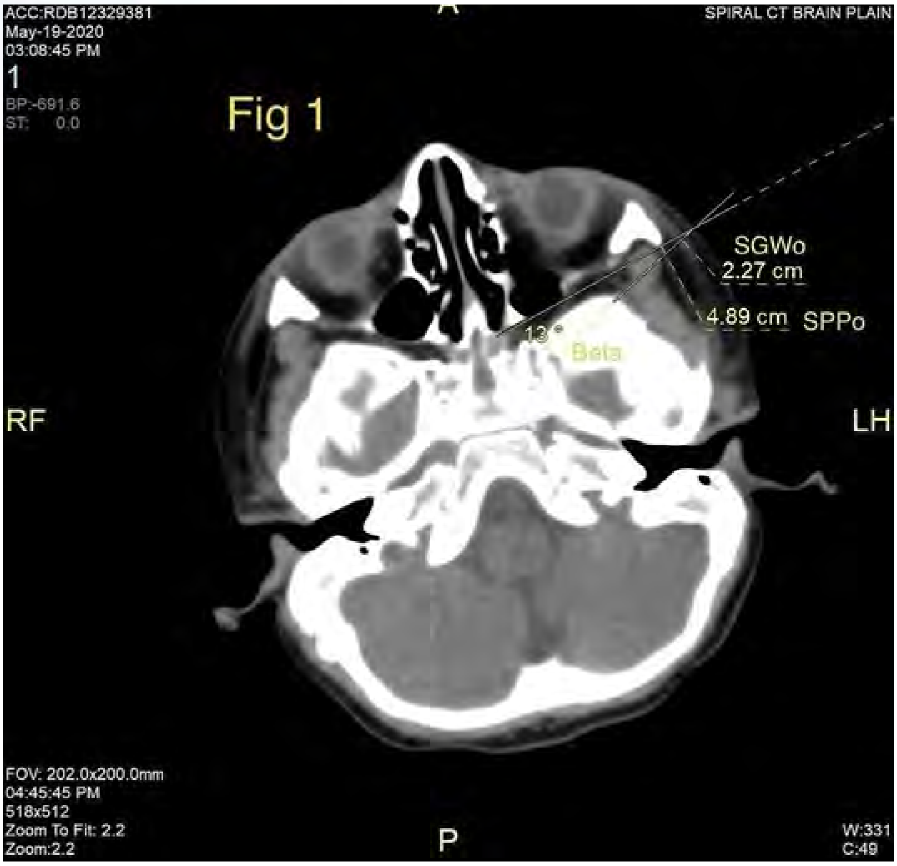
Background: Maxillary nerve block is used as a part of multimodal analgesia for cleft palate surgery. Suprazygomatic approach for maxillary nerve block is preferred, as it avoids injury to the eye and base of the skull. Effective analgesia depends on exact positioning of the needle. Measurements of anatomic landmark have been described in infants of Caucasian origin but not in children of Asian origin. Hence, we studied CT guided anatomical landmark for suprazygomatic maxillary nerve block in our pediatric population.

Method: In this retrospective observational study, data of children of Asian (Indian) origin aged 1-5 years who underwent CT brain in our hospital were analyzed. Exclusions were those with facial malformations. The distance from skin to greater wing of sphenoid process and distance from skin to medial end of pterygopalatine fossa in both axial and coronal oblique view, the angles (œ, β) between them were measured. The distance from skin to deep end of temporalis muscle (ST) was measured.

Results: 30 consecutive CT scans meeting the selection criteria were analyzed there were 19 (63.33%) males; mean±SD age of the children was 30.63±11.94 months (range 12-50 months). Mean±SD distance from skin to greater wing of sphenoid in axial (SGWa) and coronal oblique (SGWo) view were 29.93±0.21mm, and 22.42±1.83mm, respectively. Mean±SD distance from skin to medial end of pterygopalatine fossa (SPP) in axial (SPPa) and coronal oblique(SPPo) view were 46.24±2.47mm, and 43.98±0.49mm, respectively.The anterior angle between SGWa and SPPa (œ) was 9.13±2.909°. The inferior angle between SGWo and SPPo (β) was 7.266±0.707°. Figs 1and 2 shows SGWa, SPPa, œ in axial view and SGWo, SPPo, β in coronal oblique view respectively. Mean±SD depth from skin to deep end of temporalis muscle (ST) was 23.21±6.27mm. There was no significant correlation with age and gender.

Discussion: CT measurements guide us to reach the maxillary nerve in pterygopalatine fossa, for precise deposition of local anesthetic and the measurements may vary with ethnicity. Our study provides distances and angles for anatomical landmark based suprazygomatic maxillary nerve block. However, these need to be validated clinically.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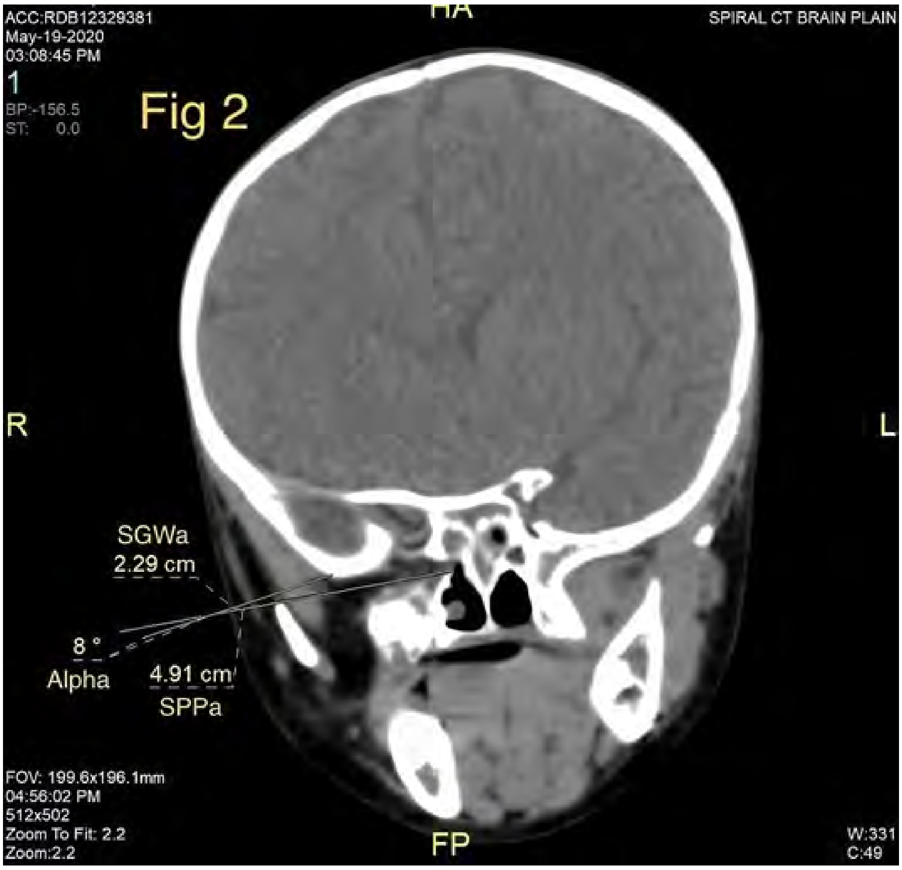
SPIRAL CT BRAIN PLAIN
Fig 1
SGWo
2.27 cm
4.89 cm SPPo
13 °
Beta
RF
LH
FOV: 202.0x200.0mm
P
W:331
C:49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SPIRAL CT BRAIN PLAIN
Fig 2
R
L
SGWa
2.29 cm
8 °
Alpha
4.91 cm
SPPa
FOV: 199.6x196.1mm
FP
W:331
C:49

V4-7

A Balancing Act of Survival: A Case Report on the Anesthetic Management of an Ex Utero Intrapartum Procedure

Alexandra Christine K. Lao, Anne Michelle M. Salomon

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The Ex Utero Intrapartum Treatment (EXIT) procedure is a rare technique conducted in conjunction with an elective Cesarean Section. The goal is to safely deliver a fetus with a severe congenital airway abnormality. This case report describes the anesthetic management of an EXIT procedure conducted in a 29 year old primigravid in threatened labor of a 30 week old fetus with a cervical teratoma. An EXIT procedure is distinct in its anesthetic management as it must involve careful planning from both the maternal and fetal perspectives. Maintaining adequate uteroplacental circulation through uterine relaxation is a vital cornerstone of management for both mother and fetus. Maternal considerations also include adequate analgesia, prevention of uterine atony and bleeding. Fetal considerations include adequate anesthesia and analgesia, continuous fetal monitoring, preparation for resuscitation measures and fetal airway management.

V4-8

Postoperative Sedation and Analgesia in Pediatric Cardiac Surgery

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[1]Department of Pediatric Anesthesiology and Intensive Care, Tashkent Pediatric Medical Institute, Tashkent, Uzbekistan,
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Relevance: The desire to provide an optimal method of sedation and analgesia has led to the improvement of multimodal methods of anesthesia. One of the safest methods of anesthesia for children is the use of non-narcotic drugs.

The Goal of Study: The aim of our study was a comparative assessment of the efficacy and safety of the use of dexmedetomidine in combination with paracetamol in children after cardiac surgery.

Materials and Methods of Research: The study included 65 children aged 2 to 4 years with congenital heart defects. The patients were divided into 2 groups. group 1, main (n = 35), where patients started intravenous infusion 30 minutes after surgery dexmedetomidine with a loading dose of 1.0 mcg/kg/h for 10 minutes followed by an infusion at a rate of 0.8 mcg/kg/h during the day against the background of planned postoperative analgesia with acetaminophen (Infulgan, 15 mg/kg, intravenously, bolus) 2 hours after the operation and subsequent every 8 hours during the day. Group 2, control group (n = 30), for analgesia, morphine 0.3 mg/kg was used, intramuscularly, the initial dose was 2 hours after the operation. Both groups were homogeneous in terms of surgical pathology, age, body weight, and duration of surgery. studied all patients in the following stages: 1-stage 2 hours after surgery, 2-stage 8 hours after surgery, 3-stage 16 hours, 4-stage after 24 hours. During the first day after the operation, the patient's condition was monitored, blood pressure, heart rate, blood gases, mechanical ventilation parameters or spontaneous respiratory rate, pulse oximetry were recorded; assessment of the level of sedation according to the RASS- scale (Richmond arousal-sedation scale), assessment of the intensity of pain according to the FLACC behavioral scale .

Results: In the course of the study, in all children, hemodynamics remained stable, within the age norm. By the 4th stage of the study, patients of group 2 showed an increase in hemodynamic and respiratory parameters, which required repeated administration of morphine in order to treat postoperative pain. In this group, a high incidence of complications was noted: vomiting (16.6%), pruritus (13.3%), intestinal paresis (10%), urinary retention (6.7%).

Conclusions: Thus, dexmedetomidine in combination with acetaminophen provides adequate sedation, early extubation, prevents psychomotor agitation, prolongs analgesia and promotes early natural feeding feeding in patients with cardiac surgery profile.

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31st Annual Meeting of the Korean Society of Pediatric Anesthesiologists

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* Based on time-adjusted $SPID_{48}$, calculated from VAS pain intensity scores recorded up until the time of consumption of the first dose of rescue.[1] ** Based on the total oral Morphine Milligram Equivalent (MME) dose of all rescue medication over the full 48 hour study period.[1]
*** According to VAS pain intensity, Pain Intensity Differences and Pain Relief scores. Dosed as one vial every 6 hours over 48 hour period.[1]

References : 1. Daniels, S.E, Playne, R., Stanescu, I., Zhang, J., Gottlieb, I.J, Atkinson, H.C. (2019). Efficacy and safety of an intravenous acetaminophen/ibuprofen fixed-dose combination after bunionectomy: A randomized, double-blind, factorial, placebo-controlled trial. Clinical Therapeutics https://doi. org/10.1016/j.clinthera.2019.07.008 . Research sponsored by AFT Pharmaceuticals.

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