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

The Korean Society Pediatric Anesthesia

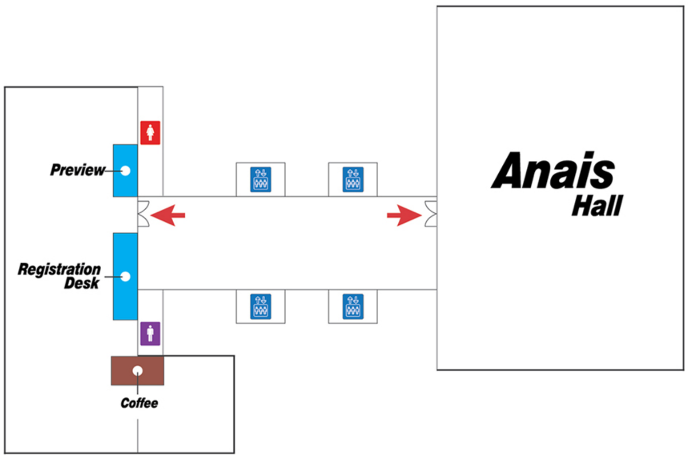
대한소아마취학회

INFORMATION

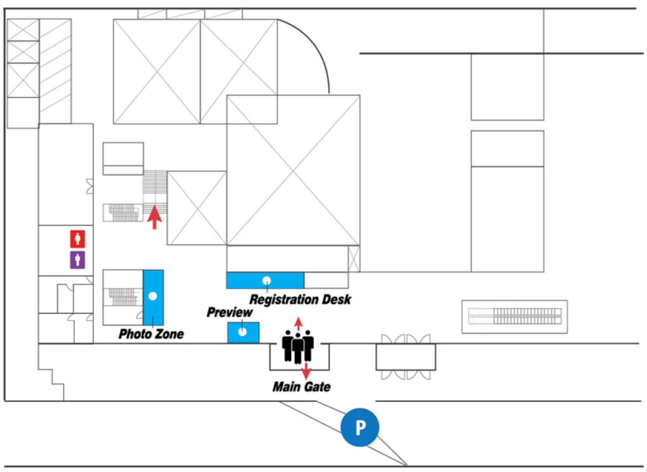
WIFI ID: KOFST-2
PW: 12345678

Floor Plan

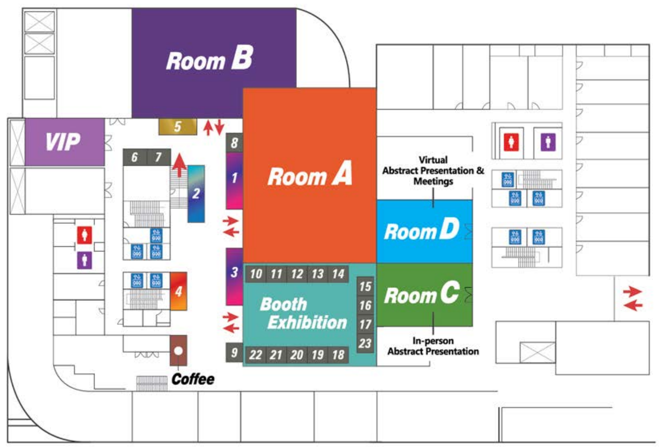
12 F



1 F



B1 F



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

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

President	Jin-Tae Kim	Seoul National University
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
Director of Medical Information	Sooyoung Cho	Ewha Womans University
Director of Treasurer	Seokyoung Song	Daegu Catholic University
Director of Cooperation	In-Kyung Song	University of Ulsan College of Medicine
Director of Research and Development	Won-Jung Shin	University of Ulsan College of Medicine
Director of Public Relation	Woo Suk Chung	Chungnam National University
Executive Secretary	Ji-Hyun Lee	Seoul National University
Steering Members	Hyun-Jung Kim	Jeju National University
	Helen Ki Shinn	Inha University
	Sang Hun Kim	Chosun University
	Jeonghan Lee	Inje University
	Younghee Shin	Samsung Medical Center
Auditor	Hyun Kang	Chung-ang University
Advisor	Il-Ok Lee	Korea University
	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 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.

References

1. Lee-Archer P, von Ungern-Sternberg BS. Pediatric anesthetic implications of COVID-19-A review of current literature. Paediatr Anaesth 2020; 30: 136-141.
2. Regli A, Becke K, von Ungern-Sternberg BS. An update on the perioperative management of children with up-

per respiratory tract infections. Curr Opin Anaesthesiol 2017; 30: 362-367.
3. Michael A. Gropper: Miller's Anesthesia. 9th ed. pp 2437-8. Fig. 77.10.
4. Paul G. Barash: Clinical Anesthesia. 8th ed. p 2108.
5. von Ungern-Sternberg BS, Boda K, Chambers NA, Rebmann C, Johnson C, Sly PD, et al. Risk assessment for respiratory complications in paediatric anaesthesia: a prospective cohort study. Lancet 2010; 376: 773.783.
6. Kim HS, Kim YS, Lim BG, Lee JH, Song J, Kim H. Risk Assessment of Perioperative Respiratory Adverse Events and Validation of the COLDS Score in Children with Upper Respiratory Tract Infection. Medicina (Kaunas). 2022; 58: 1340.
7. Tait AR, Malviya S, Voepel-Lewis T, Munro HM, Seiwert M, Pandit UA. Risk factors for perioperative adverse respiratory events in children with upper respiratory tract infections. Anesthesiology 2001; 95: 299-306.
8. Parnis SJ, Barker DS, van der Walt JH. Clinical predictors of anaesthetic complications in children with respiratory tract infections. Paediatr Anaesth 2001; 11: 29-40.
9. Skolnick ET, Vomvolakis MA, Buck KA, Mannino SF, Sun LS. Exposure to environmental tobacco smoke and the risk of adverse respiratory events in children receiving general anesthesia. Anesthesiology 1998; 88: 1144-1153.
10. Kim SY, Kim JM, Lee JH, Kang YR, Jeong SH, Koo BN. Perioperative respiratory adverse events in children with active upper respiratory tract infection who received general anesthesia through an orotracheal tube and inhalation agents. Korean J Anesthesiol 2013; 65: 136-141.
11. Becke K. Anesthesia in children with a cold. Curr Opin Anaesthesiol 2012; 25: 333-339.
12. Afshari A, Disma N, von Ungern-Sternberg BS, Matava C. COVID-19 implications for pediatric anesthesia: Lessons learnt and how to prepare for the next pandemic. Paediatr Anaesth 2022; 32: 385-390.
13. Ji W, Zhang K, Li M, Wang S, Sun L, Huang Y, Bai J, Zhang M, Zheng J. Do COVID-19 pandemic-related behavior changes affect perioperative respiratory adverse events in children undergoing cardiac interventional catheterization? BMC Anesthesiol. 2022; 22: 406.
14. Binns E, Koenraads M, Hristeva L, et al. Influenza and respiratory syncytial virus during the COVID-19 pandemic: time for a new paradigm? Pediatr Pulmonol 2022; 57: 38-42.
15. Van Brusselen D, De Troeyer K, Ter Haar E, et al. Bronchiolitis in COVID-19 times: a nearly absent disease? Eur J Pediatr 2021; 180: 1969-1973.

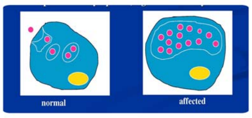
Anaesthesia for Patient with Mucopolysaccharidosis

Vivian Yuen

Department of Anaesthesiologyand Perioperative Medicine, Hong Kong Children's Hospital, Hong Kong

Lysosomal Storage Disorders

- > **50** different genetic disorders
- Deficiency or malfunctioning of certain lysosomal enzymes
- **Progressive** nature affecting different organ systems with a **wide spectrum of clinical symptoms, signs and sev**erity
- 1 in 7700 live births



Type of Lysosomal Disorders

Sphingolipidoses	
	Failure to degrade glycosphingolipids
	Fabry, Gaucher, ASM deficiency, Metachromatic Leukodystrophy
Mucopolysaccharidoses	
	Failure to degrade glycosaminoglycans
	Hurler, Hunter, Sanfilippo, Morquio, Maroteaux-Lamy, Sly
Oligosaccharidoses	
	Failure to degrade oligosaccharides
	Fucosidosis, Mannosidosis, Sialidosis, Galactosialidosis
Others	
	Pompe, Mucolipidosis, Neuronal Ceroid Lipofuscinosis

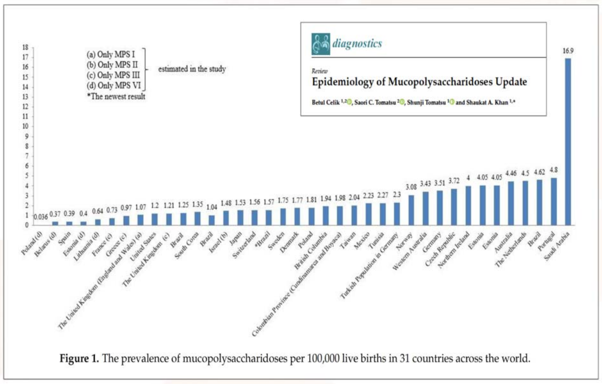
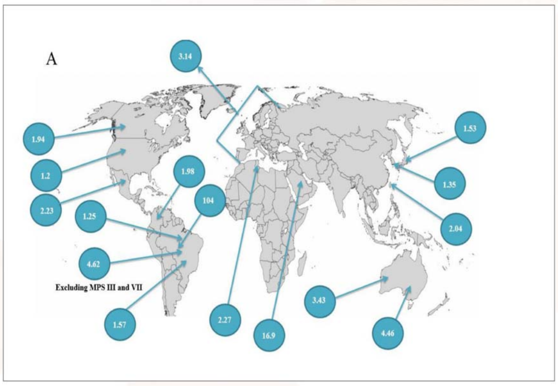
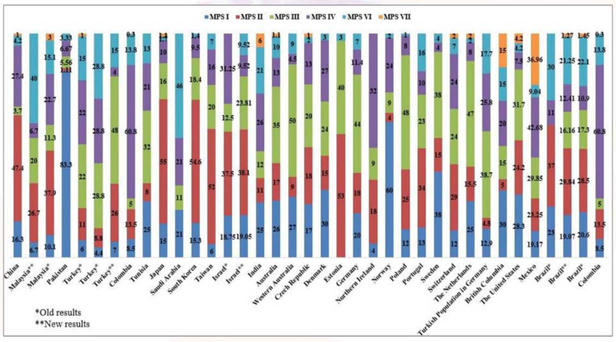


Figure 1. The prevalence of mucopolysaccharidoses per 100,000 live births in 31 countries across the world.



Incidence of MPS (%)



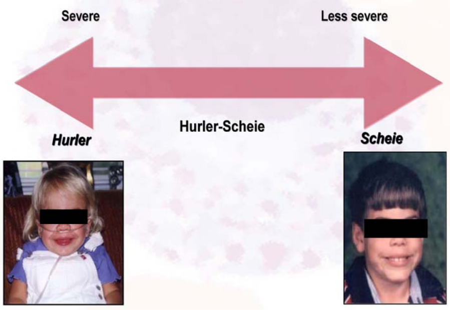
Heterogenous Presentation

Types of MPS

Disorder	Deficient Enzyme	GAG Accumulation	Inheritance	Severity	Treatment Options
MPS I H (Hurler)	a-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 (Sanfillipo A)	Heparan-N-sulfatase	HS	AR	Variable	Supportive
MPS III (Sanfillipo B)	a-N-Acetylglucosaminidase				
MPS III (Sanfillipo C)	a-Glucosaminidase acetyltransferase				
MPS III (Sanfillipo 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

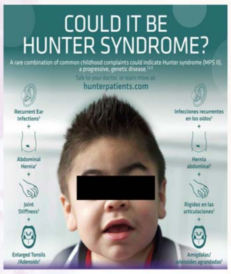
HS- Heparan sulfate, DS – Dermatan sulfate, KS – Keratan sulfate, C6S – Chondroitin-6-sulfate, C4S – Chondroitin 4,6-sulfate

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 intelligence**

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 evere UAO
- **Surgery for hernias repair, shunt operation** for obstructuve 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)	a-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 (Sanfillipo A)	Heparan-N-sulfatase	HS	AR	Variable	Supportive
MPS III (Sanfillipo B)	a-N-Acetylglucosaminidase				
MPS III (Sanfillipo C)	a-Glucosaminidase acetyltransferase				
MPS III (Sanfillipo 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	
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

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

AIRWAY

That Airway Makes Me Nervous

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

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

Journal of Personalized Medicine — MDPI

Article

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

Hsuan-Chih Lao, Ying-Chun Lin, Muh-Lii Liang, Ying-Wei Yang, Ya-Hsien Huang, Ying-Lun Chan, Yung-Wei Hsu, Shuan-Pei Lin, Chih-Kuang Chuang, Jen-Kun Cheng and Hsiang-Yu Lin

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.

46.6% 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

- 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

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

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

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

- 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

- 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

Case 3 - MPS I

- F/4, MPS I diagnosed 3-4 months of age
- Received ERT since 1 year of age
- MUD DCBT 1.5 year of age – mild skin GVHD
- Previous GA revealed grade IIb larynx with videoscope

Multi-team Examination Under Anaesthesia

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

Case -3 MPS I

- F/4, MPS I diagnosed 3-4 months of age
- Received ERT since 1 year of age
- MUD DCBT 1.5 year of age – mild skin GVHD
- Previous GA revealed grade IIb larynx with videoscope

ANAESTHESIA PROCEDURE
- Mild sedated with IV dexm for NCV and TTE
- Proceed to GA with SDA and TCI propofol
- Caudal analgesia
- Procedure duration: 192 mins
- Anaesthesia duration : 226 mins

Other organ involvement

Cardiac
- cardiomyopathy
- valvular heart disease
- cardiac arrhythmia

Pulmonary
- restrictive or obstructive pulmonary disease
- pulmonary hypertension

Skeletal abnormalities
- Kyphoscoliosis, pectus excavatum, abnormal rib cage
- Contribute to restrictive pulmonary disease in MPS IV patients

Effect of ERT and HSCT on Cardiac Manifestations

- HSCT is associated with preservation of cardiac function and regression of cardiac manifestations
- Long-term ERT may improve systolic ventricular function and resolution of LVD.
- Both therapies did not show clear amelioration of valvular thickening, stenosis or regurgitation

Summary

- Rare and progressive disease with very heterogenous clinical presentation and multi-system involvement
- Repeated diagnostic and surgical interventions
- ERT and BMT alter the natural course of the disease

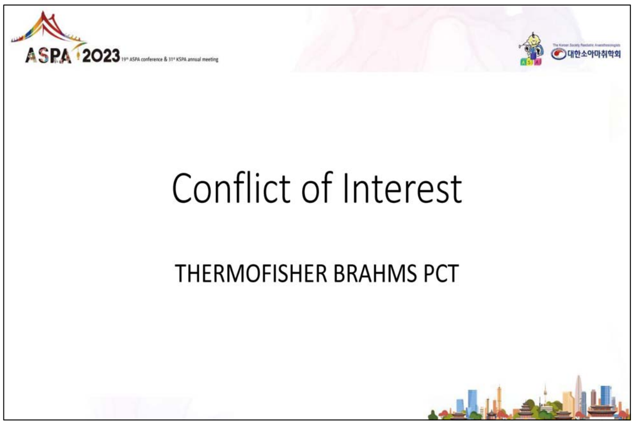
Recommendation

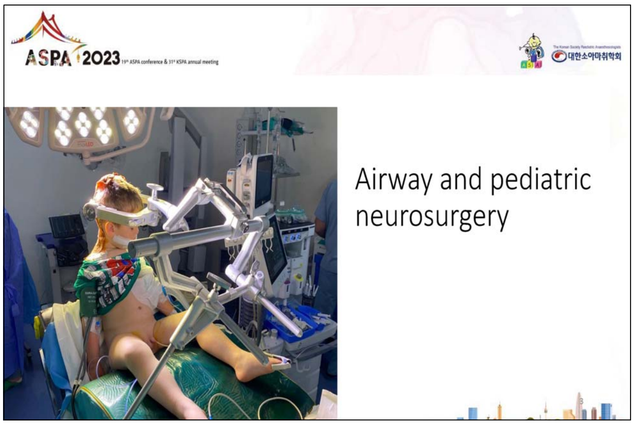
- Consolidation of clinical management in a tertiary or quaternary center
- Perioperative management led by pediatrician with special interest in IEM
- Multi-disciplinary approach to diagnostic and surgical intervention

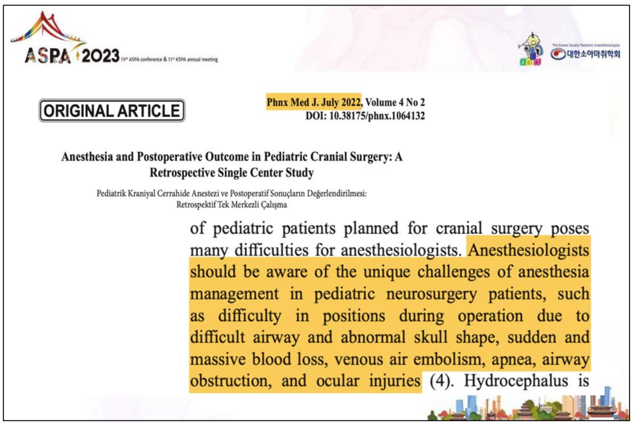
Airway and Ventilation Management in Pediatric Neurosurgical Cases

Rudin Domi

Faculty of Medicine, University of Medicine, Albania





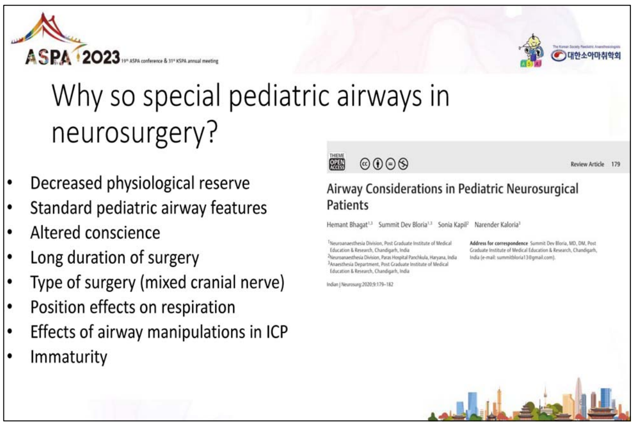

ORIGINAL ARTICLE

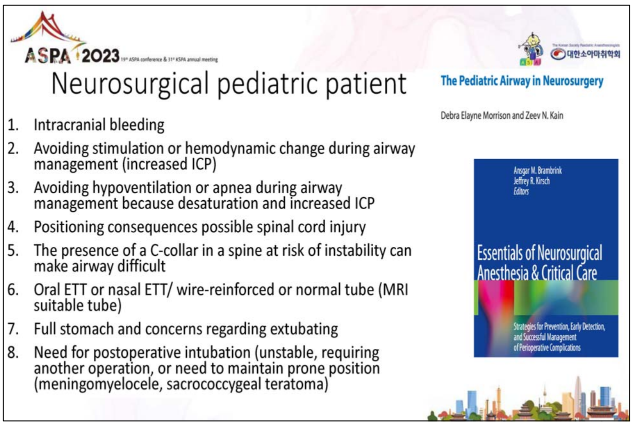
Phnx Med J. July 2022, Volume 4 No 2
DOI: 10.38175/phnx.1064132

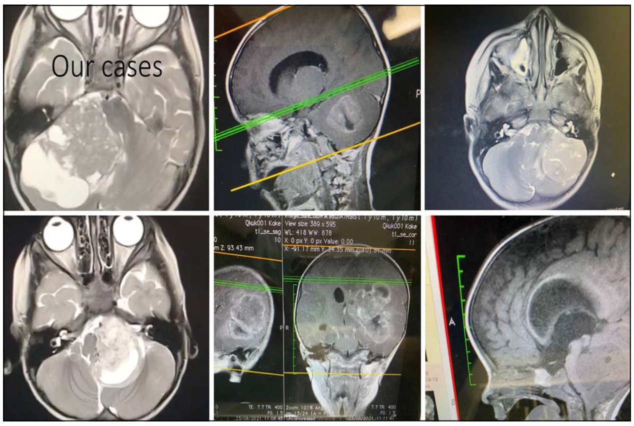
Anesthesia and Postoperative Outcome in Pediatric Cranial Surgery: A Retrospective Single Center Study

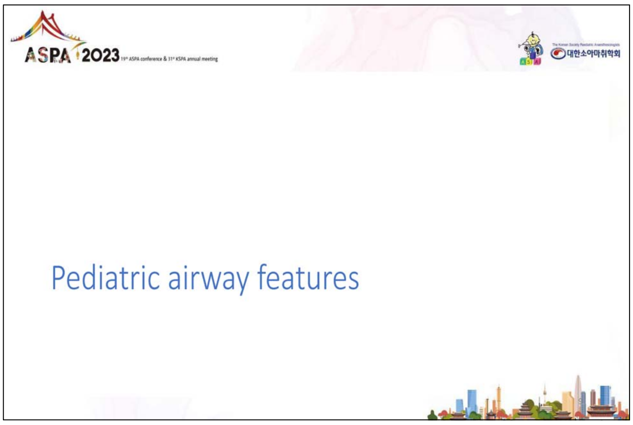
Pediatrik Kraniyal Cerrahide Anestezi ve Postoperatif Sonuçların Değerlendirilmesi: Retrospektif Tek Merkezli Çalışma

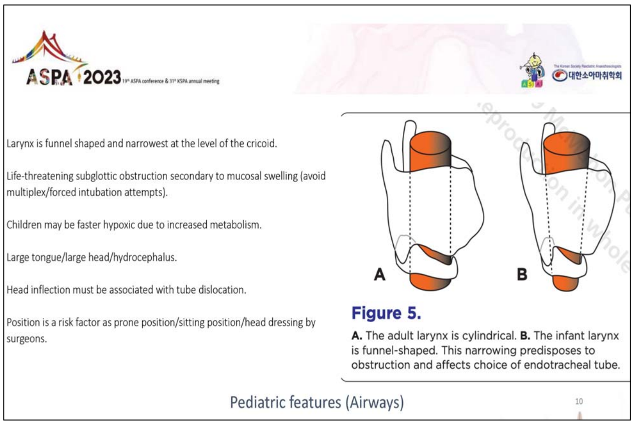
of pediatric patients planned for cranial surgery poses many difficulties for anesthesiologists. Anesthesiologists should be aware of the unique challenges of anesthesia management in pediatric neurosurgery patients, such as difficulty in positions during operation due to difficult airway and abnormal skull shape, sudden and massive blood loss, venous air embolism, apnea, airway obstruction, and ocular injuries (4). Hydrocephalus is

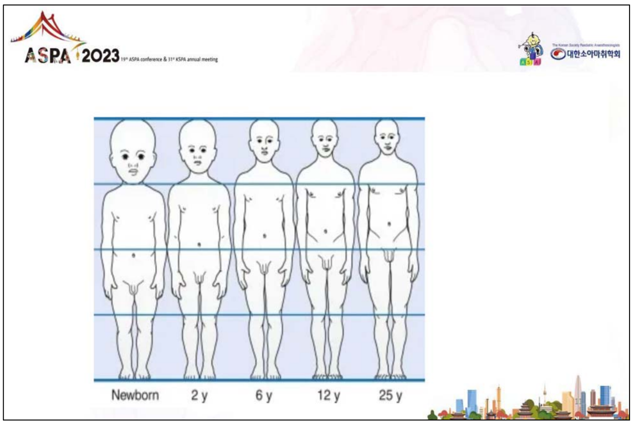


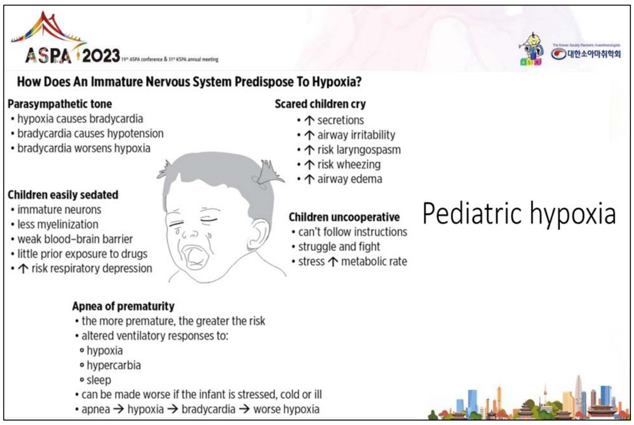


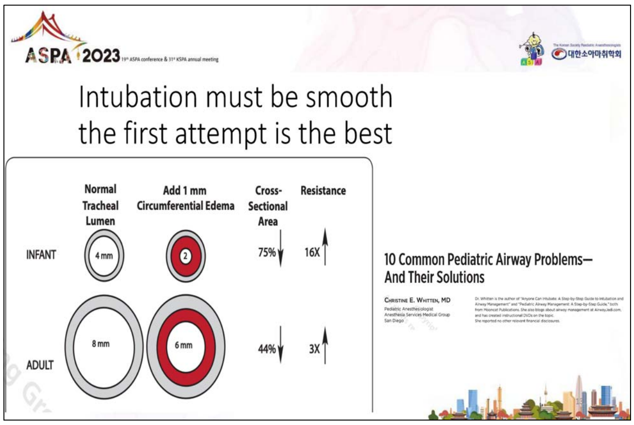

Our cases

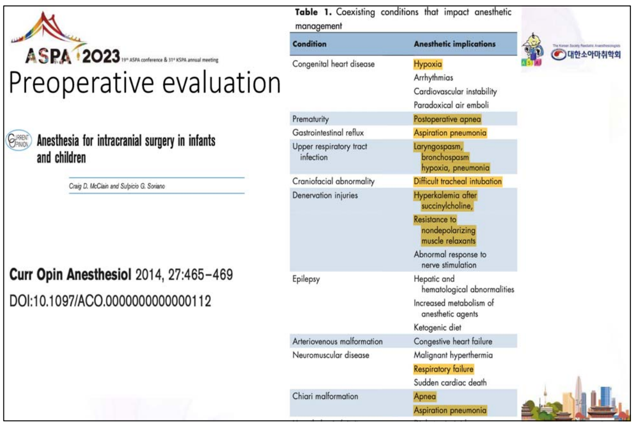

ASPA 2023
Pediatric airway features

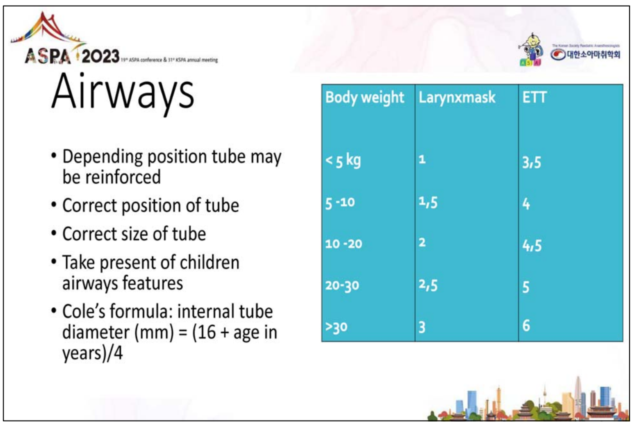

ASPA 2023
Larynx is funnel shaped and narrowest at the level of the cricoid.
Life-threatening subglottic obstruction secondary to mucosal swelling (avoid multiplex/forced intubation attempts).
Children may be faster hypoxic due to increased metabolism.
Large tongue/large head/hydrocephalus.
Head inflection 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)
10


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
Christine E. Whitten, MD


ASPA 2023
Preoperative evaluation
Anesthesia for intracranial surgery in infants and children
Craig D. McClain and Sulpicio G. Soriano
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

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

Indian J Anaesth. 2012 Sep-Oct; 56(5): 502–510.
doi: 10.4103/0019-5049.103979: 10.4103/0019-5049.103979

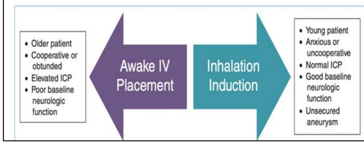
Anaesthesia for neurosurgical procedures in paediatric patients

Girija Prasad Rath and Hari H Dash[1]

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
- Remifentanil use can reduce till zero the muscle relaxants use
- Inhalators less than 1% MAC are not associated with increased ICP

17

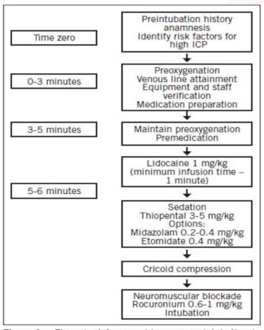


Figure 1 – Flow chart for a rapid sequence intubation in patients with high intracranial pressure (ICP).

REVIEW ARTICLE

Perioperative patient management in pediatric neurosurgery

Eduardo Mekitarian Filho[1], Werther Brunow de Carvalho[2], Sérgio Cavalheiro[3]

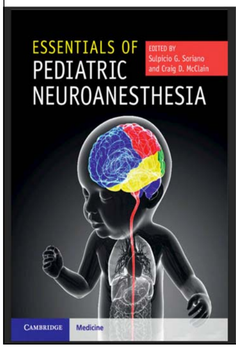


Table 7.1 Physiologic Effects of Patient Positioning

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

Position

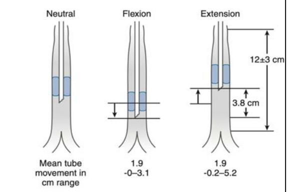
Sitting position

- 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

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



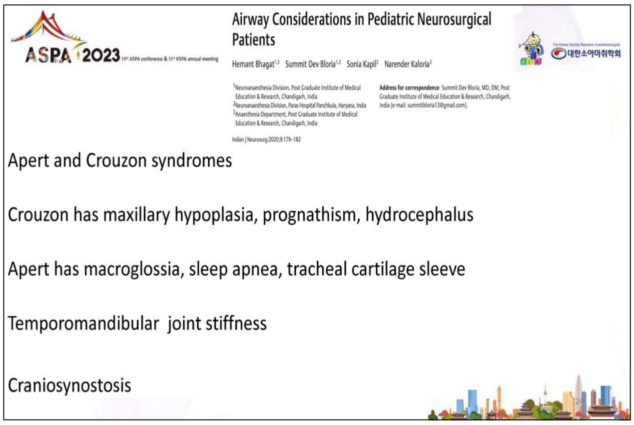
Pediatric Neuroanesthesia and Critical Care 20

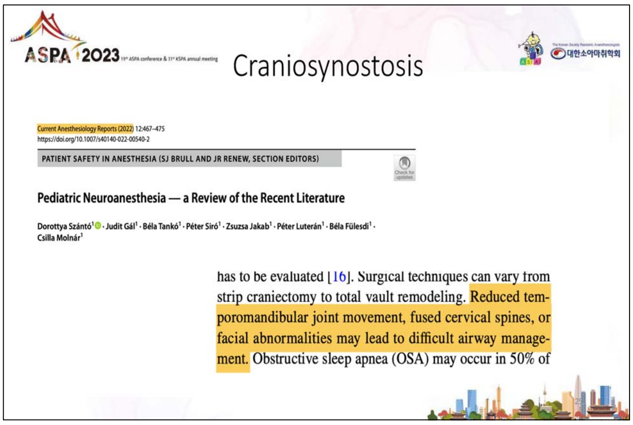
S.G. Soriano III • M.L. McManus

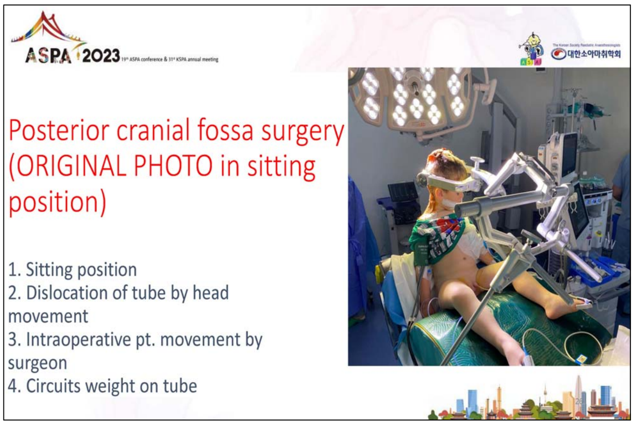
Specific situations

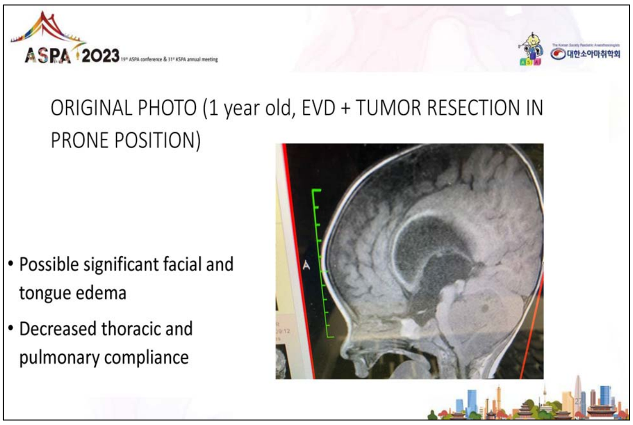
Hydrocephalus

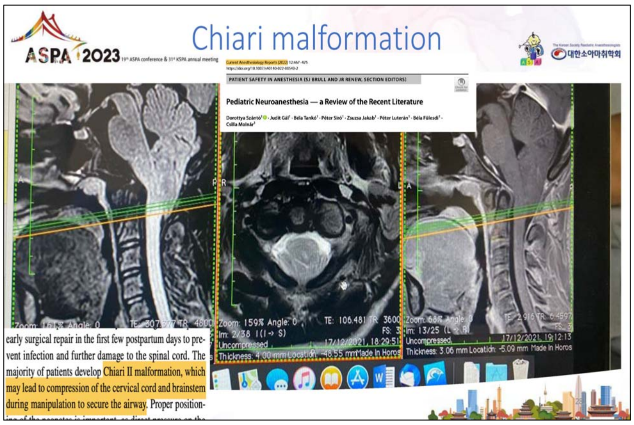
- Large head
- Altered level of conscience
- Long duration if VPD
- Not accessible airway and tube
- Rotation of head and tube dislocation

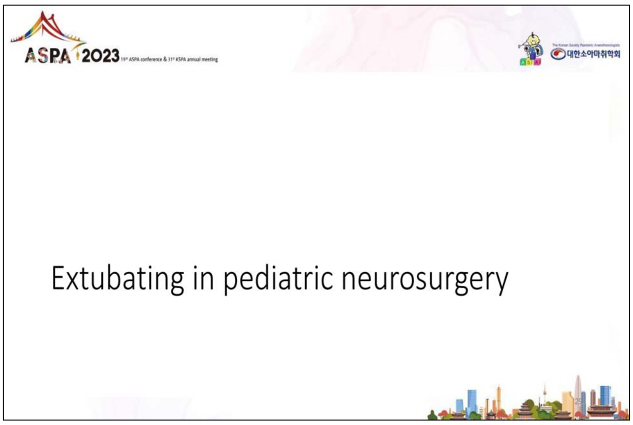

ASPA 2023
Airway Considerations in Pediatric Neurosurgical Patients
Hemant Bhagat Summit Dev Bloria Sonia Kapil Narender Kaloria
Apert and Crouzon syndromes
Crouzon has maxillary hypoplasia, prognathism, hydrocephalus
Apert has macroglossia, sleep apnea, tracheal cartilage sleeve
Temporomandibular joint stiffness
Craniosynostosis

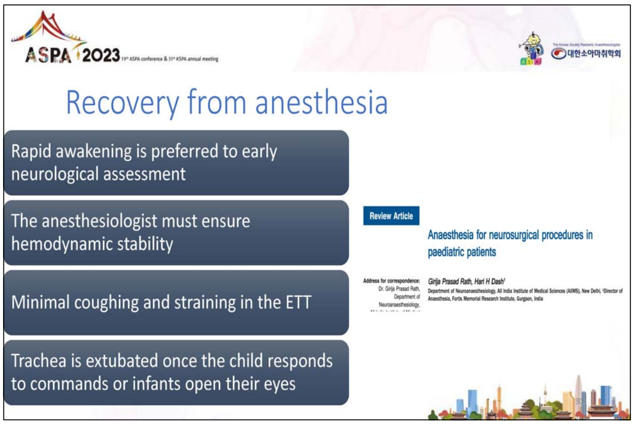

ASPA 2023
Craniosynostosis
Current Anesthesiology Reports (2022) 12:467–475
https://doi.org/10.1007/s40140-022-00540-2
PATIENT SAFETY IN ANESTHESIA (SJ BRULL AND JR RENEW, SECTION EDITORS)
Pediatric Neuroanesthesia — a Review of the Recent Literature
Dorottya Szántó · Judit Gál · Béla Tankó · Péter Siró · Zsuzsa Jakab · Péter Luterán · Béla Fülesdi · Csilla Molnár
has to be evaluated [16]. Surgical techniques can vary from
strip craniectomy to total vault remodeling. Reduced tem-
poromandibular joint movement, fused cervical spines, or
facial abnormalities may lead to difficult airway manage-
ment. Obstructive sleep apnea (OSA) may occur in 50% of

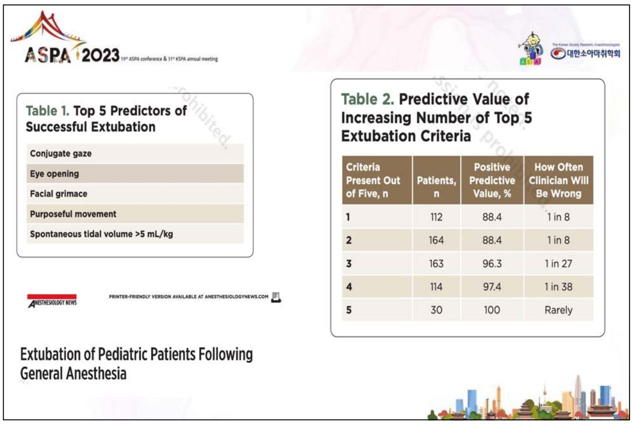

ASPA 2023
Posterior cranial fossa surgery (ORIGINAL PHOTO in sitting position)
1. Sitting position
2. Dislocation of tube by head movement
3. Intraoperative pt. movement by surgeon
4. Circuits weight on tube


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
PATIENT SAFETY IN ANESTHESIA (SJ BRULL AND JR RENEW, SECTION EDITORS)
Pediatric Neuroanesthesia — a Review of the Recent Literature
early surgical repair in the first few postpartum days to pre-
vent 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
Girija Prasad Rath, Hari H Dash


ASPA 2023
Table 1. Top 5 Predictors of Successful Extubation
Conjugate gaze
Eye opening
Facial grimace
Purposeful movement
Spontaneous tidal volume >5 mL/kg
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
Extubation of Pediatric Patients Following General Anesthesia

Prolonged recovery from anesthesia

- Apnea
- Vocal cord paralysis
- Airway edema and postoperative obstruction
- Large lingual or supraglottic swelling
- Significant blood losses
- PONV is frequent
- New deficits: dysarthria, hypotonia, dysphagia, cerebellar mutism

Table 3. Summary of Near-Term Complications Associated With Extubation in Pediatric Patients

Complications	Cause	Diagnostic/Clinical Signs	Interventions
Apnea	• Oversedation with opioid • Hypocarbia ($EtCO_2$ <40) • Oversedation caused by synergism of multiple anesthetic agents including preoperative benzodiazepine and/or inhalational agent	• No spontaneous ventilatory effort • Able to mask-ventilate patients • $EtCO_2$ can be high or low • Small or pinpoint pupils • ↑ End-tidal potent inhalational agent concentration	• Bag mask ventilation to maintain SpO_2 >94% • Allow $PaCO_2$ to rise • Consider flumazenil or naloxone in recalcitrant situations
Bronchospasm	• Preexisting upper respiratory infection • Asthma • Bronchiole constriction • Routine exposure to secondhand smoke	• Persistent coughing • No breath holding • Wheezing on auscultation • ↓ SpO_2 although this is usually a late sign • ↑ CO_2	• Albuterol • Epinephrine 0.05 mcg/kg IV if extreme
Coughing/ breath-holding	• Preexisting upper respiratory infection • Premature extubation while patient is in stage 2 • Bronchiole constriction • Routine exposure to secondhand smoke	• Persistent coughing • Breath holding typically <10 seconds • ↓ SpO_2 • ↑ $EtCO_2$ caused by ↓ alveolar ventilation	• ↑ FiO_2 via mask • Apply CPAP with 10-20 cm H_2O • Overly aggressive CPAP can worsen • Attempt to wait for resolution • This will usually resolve with time as patient emerges further
Laryngospasm	• Premature extubation while patient is in stage 2 • Glottic closure from stimulation by endotracheal tube removal or secretions	• Usually preceded by cough • Rigid abdominal wall • Unable to mask-ventilate even with oral airway and elevated ventilatory pressures • Breath holding for >10 seconds • ↓ SpO_2	• Briefly attempt mask ventilation or apply CPAP with 100% FiO_2 • Propofol 1 mg/kg IV (repeat or escalate dose if initially unsuccessful) • Succinylcholine 1 mg/kg, 4 mg/kg IM if IV is infiltrated or pulled out • Reintubate if significant laryngospasm requiring more propofol or succinylcholine recurs
Upper airway obstruction	• Lack of oropharyngeal tone • Collapse of base of tongue and soft palate onto posterior pharyngeal wall • Oversedation with opioid or benzodiazepine • Residual inhalational agent • Underlying sleep-disordered breathing	• Patient appears to attempt to breathe but no breath sounds are present • Sternal notch sinks in with attempts at inspiration • ↓ SpO_2 • Loud upper airway noises with inspiration	• Jaw thrust • 10-20 cm H_2O of CPAP • Oral airway • Lateral position • Consider flumazenil or naloxone • Bag-mask ventilate patient with 100% FiO_2

CO_2, carbon dioxide; CPAP, continuous positive airway pressure; $EtCO_2$, end-tidal carbon dioxide; FiO_2, fraction of inspired oxygen; IM, intramuscular; $PaCO_2$, partial pressure of carbon dioxide; SpO_2, oxygen saturation

ANESTHESIOLOGY NEWS

Extubation of Pediatric Patients Following General Anesthesia

Extubating after neurosurgical procedures

- After Chiari malformation and brainstem: intermittent postoperative apnea, vocal cord paralysis, and respiratory pattern.
- After prone position: facial and tongue edema
- After intracranial tumor resection take in consideration the conscience level

1148 pts 2004-2011

Respiratory complications as laryngospasm, atelectasis, and aspiration (0.89%)

Anesthesia-related mortality is 10-fold higher in pediatric patients than in adults, and higher in neonates and infants than in older children

Mortality rate is 0.42–6.8 per 10,000 anesthetics mostly due to airway or cardiocirculatory events

According to pediatric anesthesia literature, anesthesia complications are 2.8-9.6%

Most of causes are totally preventable

JNS PEDIATRICS — CLINICAL ARTICLE — J Neurosurg Pediatr 18:363–371, 2016

Intraoperative complications in pediatric neurosurgery: review of 1807 cases

Erik J. van Lindert, MD, PhD,[1] Sebastian Arts, BSc,[2] Laura M. Blok, MD,[2] Mark P. Hendriks, MD,[2] Luc Tielens, MD,[2] Martine van Bilsen, MD,[1] and Hans Delye, MD, PhD[1]

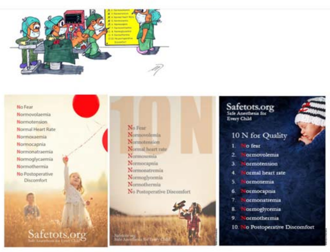
TABLE 2. Different types of complications

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

Neurosurgical procedures/airway implications

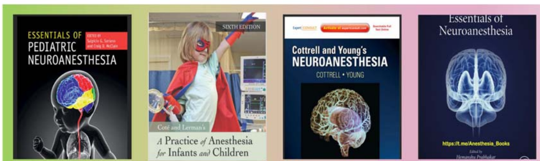
Condition	Potential complications
Myelomeningocele, myelodysplasia, Chiari malformations, sacrococcygeal teratoma	Positioning
	Hydrocephalus
	Difficult intubation
	Latex avoidance
	Risk of postoperative apnea, need for prolonged prone positioning
Craniosynostosis	Difficult intubation
	Long operation/risk 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

SAFETOTS.ORG — FOR PROFESSIONALS — FOR PARENTS — RESOURCES — ABOUT — TRANSLATIONS



Taking home messages

- Anesthesia care for pediatric neurosurgery includes pediatric age, (airway), neurosurgery (altered mental status, position)
- Children with decreased conscience level (pathophysiologic features) present challenge for airway management
- Difficult airway management (anatomic features) are faced as well (hydrocephalus)
- Positioning the pediatric pts during neurosurgical procedures may be challenged by tube dislocation and respiratory effects
- Extubating must take in consideration pediatric features and neurosurgical issues



REFERENCES


ASPA 2023
대한소아마취학회
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 Until every child is well
HARVARD MEDICAL SCHOOL TEACHING 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

Boston Children's Hospital Until every child is well
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

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

Boston Children's Hospital Until every child is well
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

HIGH RISK POPULATION

Boston Children's Hospital Until every child is well
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

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

Boston Children's Hospital Until every child is well
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

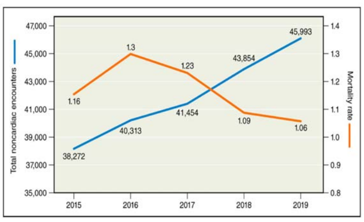
> Sci Rep. 2021 Jan 15;11(1):1543. doi: 10.1038/s41598-021-81161-3.

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

CHILDREN'S HOSPITAL ASSOCIATION

Viviane G Nasr[1], Steven J Staffa[2], David Faraoni[3], James A DiNardo[2]

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



Boston Children's Hospital Until every child is well
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

Post-Operative Outcomes in Children With and Without Congenital Heart Disease Undergoing Noncardiac Surgery

David Faraoni, MD, PhD, David Zurakowski, PhD, Daniel Vo, MD, Susan M. Goobie, MD, Koichi Yuki, MD, Morgan L. Brown, MD, PhD, James A. DiNardo, MD

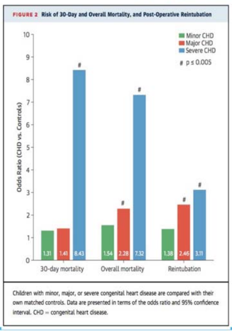
JACC

TABLE 1 ACS NSQIP Classification of CHD Based on Residual Lesion Burden and Functional Status

Classification	Definition and Criteria
Minor CHD	• Cardiac condition with or without medication and maintenance (e.g., atrial septal defect, small-to-moderate ventricular septal defect with no symptoms) • Repair of congenital heart defect with normal cardiovascular function and no medication
Major CHD	• Repair of congenital heart defect with residual hemodynamic abnormality with or without medications (e.g., tetralogy of Fallot with wide open pulmonary insufficiency, hypoplastic left heart syndrome including stage 1 repair)
Severe CHD	• Uncorrected cyanotic heart disease • Patients with any documented pulmonary hypertension • Patients with ventricular dysfunction requiring medications • Listed for heart transplant

ACS NSQIP = American College of Surgeons National Surgical Quality Improvement Program; CHD = congenital heart disease.

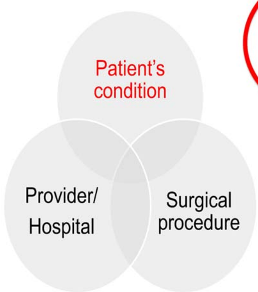
FIGURE 2 Risk of 30-Day and Overall Mortality, and Post-Operative Reintubation



Children with minor, major, or severe congenital heart disease are compared with their own matched controls. Data are presented in terms of the odds ratio and 95% confidence interval. CHD = congenital heart disease.

Faraoni D et al. J Am Coll Cardiol 2016; 67: 793-801

Boston Children's Hospital
Until every child is well
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL



CHD
Comorbidities
Race

Boston Children's Hospital
Until every child is well
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

Development of a Pediatric Risk Assessment Score to Predict Perioperative Mortality in Children Undergoing Noncardiac Surgery

Viviane G. Nasr, MD,* James A. DiNardo, MD, FAAP,* and David Faraoni, MD, PhD, FCCP†

Anesth Analg. 2017 May;124(5):1514-1519

- Derivation cohort: 2012 and 2013 American College of Surgeons National Surgical Quality Improvement Program Pediatric databases
- Validation cohort: 2014 database

Table 3. PRAm Score to Predict Postoperative Mortality

Variables	Definition	Value
Urgent	Urgent surgical procedure	+1
Comorbidity	The presence of at least 1 comorbidity among the following: respiratory disease, congenital heart disease, preoperative acute or chronic kidney disease, neurologic disease, hematologic disease	+2
Critically ill	The presence of at least 1 of the following characteristics of critical illness: preoperative mechanical ventilation, inotropic support, preoperative cardiopulmonary resuscitation	+3
Age <12 mo	Age at the time of the surgical procedure <12 mo	+3
Neoplasm	Surgical procedure in a patient with a neoplasm with or without preoperative chemotherapy	+4

Abbreviation: PRAm, Pediatric Risk Assessment.

Boston Children's Hospital
Until every child is well
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

Development and Validation of a Risk Stratification Score for Children With Congenital Heart Disease Undergoing Noncardiac Surgery

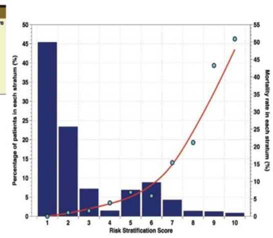
David Faraoni, MD, PhD, FCCP, Daniel Vo, MD, FAAP, Viviane G. Nasr, MD, and James A. DiNardo, MD, FAAP

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.

- Scores ≤ 3 are associated with low risk of mortality (OR: 1.54, 95% CI: 0.78–3.04)
- Scores ranging from 4 to 6 associated with medium risk (OR: 4.19, 95% CI: 2.56–6.87)
- Scores ≥ 7 associated with high risk (OR: 22.15, 95% CI: 15.06–32.59)



Boston Children's Hospital
Until every child is well
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

Development and Validation of a Risk Stratification Score for Children With Congenital Heart Disease Undergoing Noncardiac Surgery

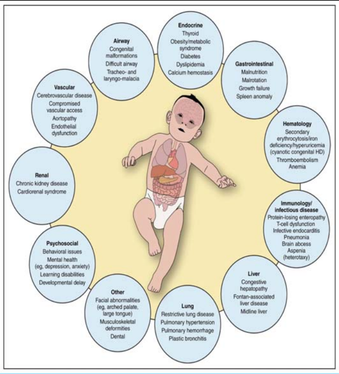
David Faraoni, MD, PhD, FCCP, Daniel Vo, MD, FAAP, Viviane G. Nasr, MD, and James A. DiNardo, MD, FAAP

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.

Boston Children's Hospital
Until every child is well
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL



Circ Cardiovasc Qual Outcomes. 2023;16:e000113. DOI: 10.1161/HCQ.0000000000000113

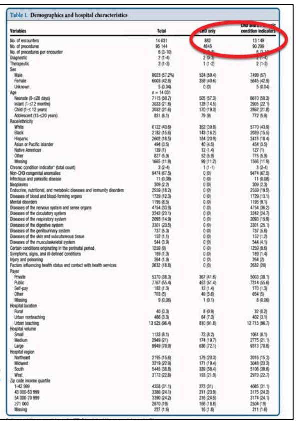
Boston Children's Hospital
Until every child is well
HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

The Role of Chronic Conditions in Outcomes following Noncardiac Surgery in Children with Congenital Heart Disease

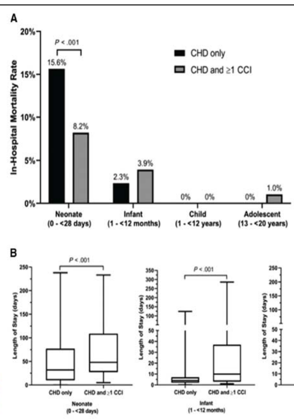
Eleonore Valencia, MD[1], Steven J. Staffa, MS[2], David Faraoni, MD, PhD[3], Jay G. Berry, MD, MPH[4], James A. DiNardo, MD[2], and Viviane G. Nasr, MD, MPH[2]

- Children with CHD who undergo noncardiac surgery have at least 1 chronic condition.

J Pediatr. 2022 Jan 21:S0022-3476(22)00017-8.



Boston Children's Hospital
Until every child is well

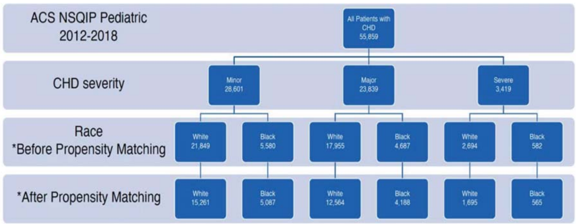


- Increased risk of in-hospital mortality and prolonged length of stay:
  - Age
  - Chronic conditions type and number
  - Low socioeconomic status
  - Black race

The Association Between Race and Adverse Postoperative Outcomes in Children With Congenital Heart Disease Undergoing Noncardiac Surgery

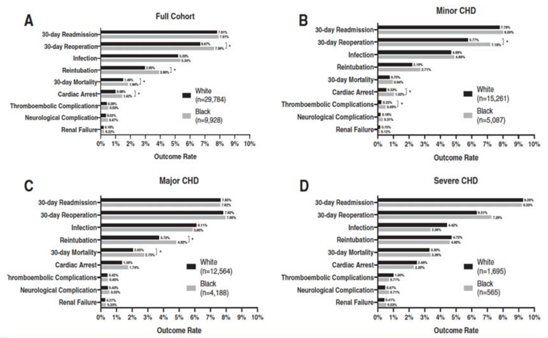
Viviane G. Nasr, MD,* Steven J. Staffa, MS,† James A. DiNardo, MD, FAAP,* and David Faraoni, MD, PhD, FAHA‡

Anesth Analg 2022;134:357-68

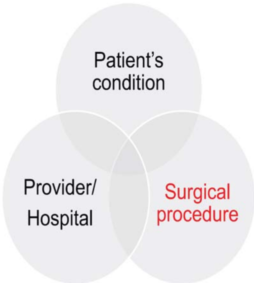


Boston Children's Hospital — Until every child is well

Outcomes following Propensity Score Matching



Boston Children's Hospital — Anesth Analg 2022;134:357-68



Boston Children's Hospital — Until every child is well

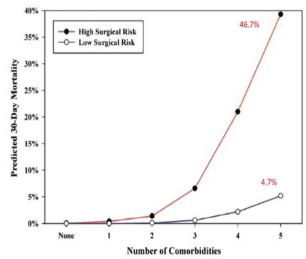
Intrinsic Surgical Risk

ANESTHESIOLOGY

Pediatric Risk Stratification Is Improved by Integrating Both Patient Comorbidities and Intrinsic Surgical Risk

Viviane G. Nasr, M.D., Steven J. Staffa, M.S., David Zurakowski, M.S., Ph.D., James A. DiNardo, M.D., F.A.A.P., David Faraoni, M.D., Ph.D., F.A.H.A.

ANESTHESIOLOGY 2019; 130:00–00



- 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

AUC (c-index) 0.95 (95% CI, 0.94 to 0.96; p<0.001)

Boston Children's Hospital — Nasr VG et al. Anesthesiology 2019; 130: 971-80

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.

Risk Quartiles	Examples
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 — Until every child is well

> Anesth Analg. 2020 May 29. doi: 10.1213/ANE.0000000000004906. Online ahead of print.

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

David Faraoni [1], Xue Zou [2], James A DiNardo [3], Viviane G Nasr [3]

- 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 — Until every child is well

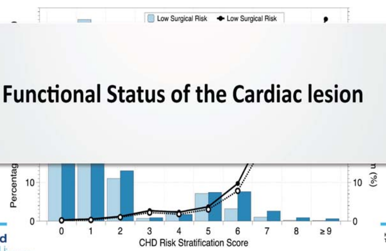
> Anesth Analg. 2020 May 29. doi: 10.1213/ANE.0000000000004906. Online ahead of print.

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

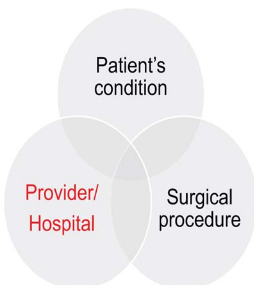
ANESTHESIA & ANALGESIA

David Faraoni [1], Xue Zou [2], James A DiNardo [3], Viviane G Nasr [3]

Functional Status of the Cardiac lesion



Boston Children's Hospital



Boston Children's Hospital — Until every child is well

State Inpatient Data

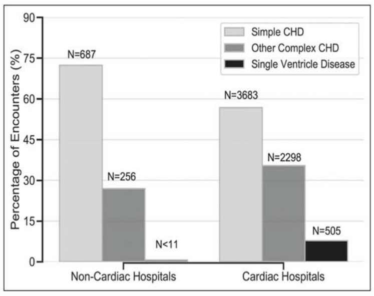
H·CUP

- 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
Until every child is well
Harvard Medical School Teaching Hospital

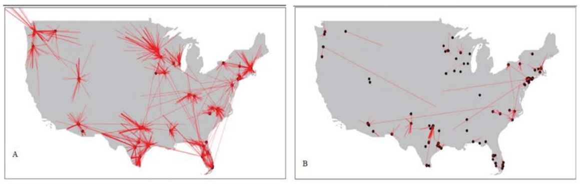
Where do they go for noncardiac procedures?

- 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



JAHA. In press

Boston Children's Hospital
Until every child is well
Harvard Medical School Teaching 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
Until every child is well
Harvard Medical School Teaching Hospital

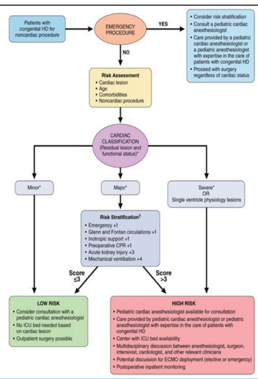
Circulation: Cardiovascular Quality and Outcomes

AHA SCIENTIFIC STATEMENT

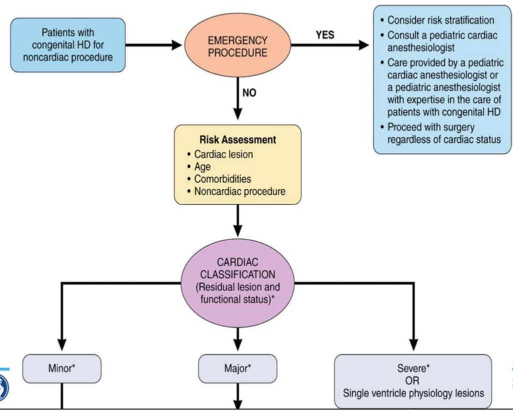
Perioperative Considerations for Pediatric Patients With Congenital Heart Disease Presenting for Noncardiac Procedures: A Scientific Statement From the American Heart Association

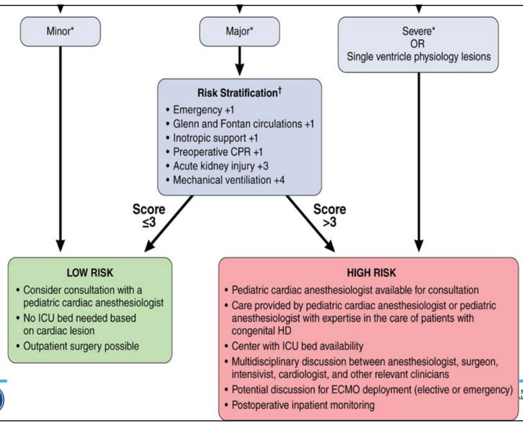
Viviane G. Nasr, MD, MPH, Chair; Larry W. Markham, MD, Vice Chair; Mark Clay, MD; James A. DiNardo, MD; David Faraoni, MD, PhD, FAHA; Danielle Gottlieb-Sen, MD, MPH, MS; Wanda C. Miller-Hance, MD; Nancy A. Pike, PhD, CPNP-AC/PC, FAHA; Chloe Rotman, MLIS; on behalf of the American Heart Association Council on Lifelong Congenital Heart Disease and Heart Health in the Young and Council on Cardiovascular Radiology and Intervention

Boston Children's Hospital
Until every child is well
Circ Cardiovasc Qual Outcomes. 2023;16:e000113. DOI: 10.1161/HCQ.0000000000000113
Harvard Medical School Teaching Hospital



Boston Children's Hospital
Until every child is well
Harvard Medical School Teaching Hospital





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
Until every child is well
Harvard Medical School Teaching 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
Until every child is well

HARVARD MEDICAL SCHOOL TEACHING HOSPITAL

ASPA 2023

Session 2.

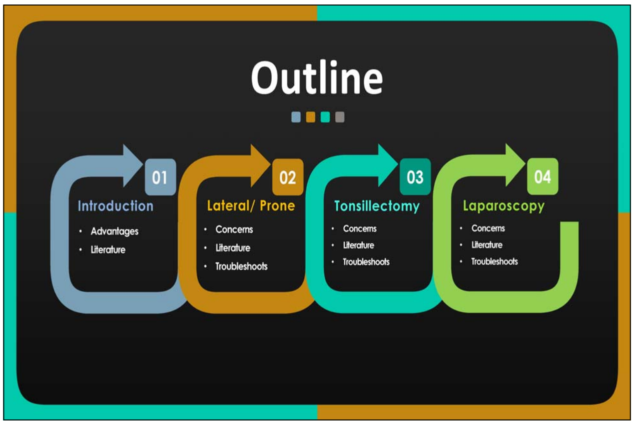
Choices Are Yours: Debating and Challenging Issues in Airway Management

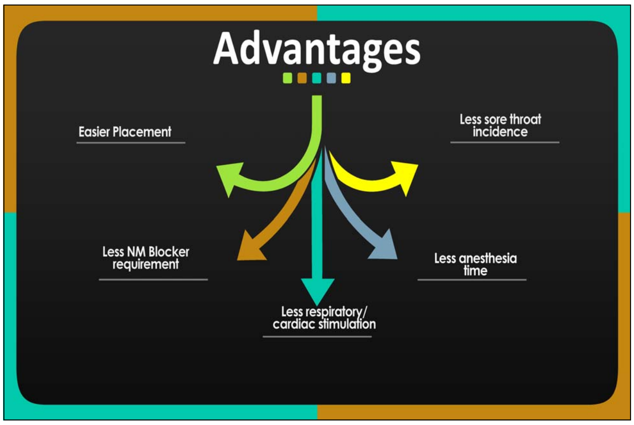
Chair(s): Evangeline Lim (Singapore)
Hyo-Seok Na (Korea)

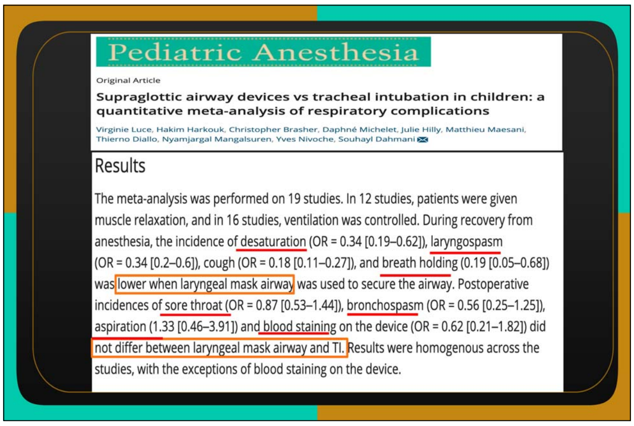
Supraglottic devices in variety of situations: Non supine position, Tonsillectomy, Laparoscopy

Abhyuday Kumar

All India Institute of Medical Sciences Patna, India







Pediatric Anesthesia

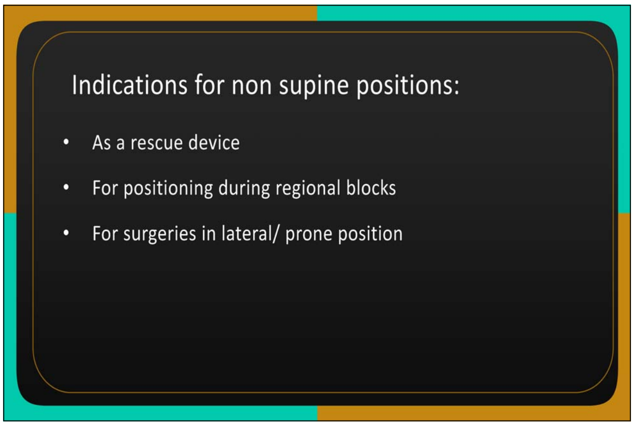
Original Article

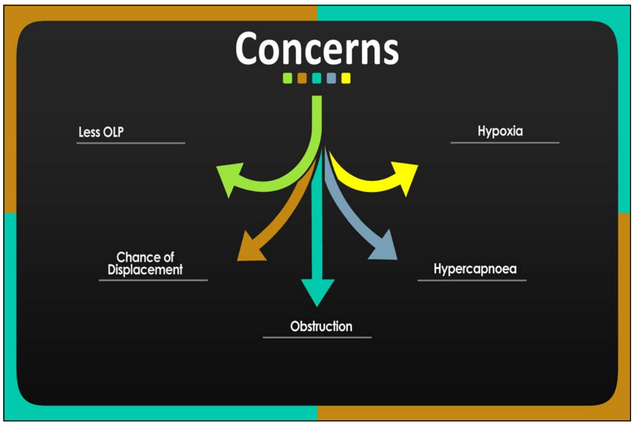
Supraglottic airway devices vs tracheal intubation in children: a quantitative meta-analysis of respiratory complications

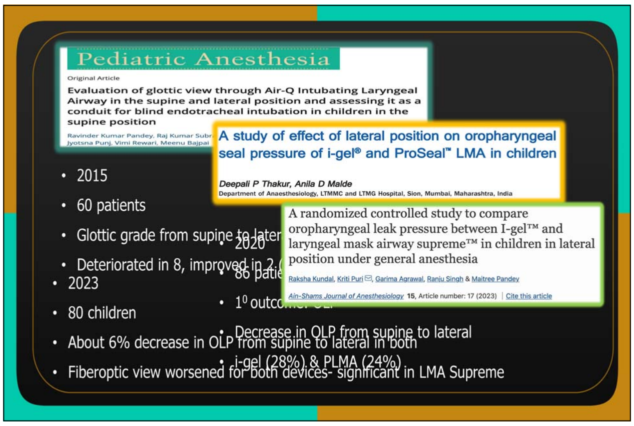
Virginie Luce, Hakim Harkouk, Christopher Brasher, Daphné Michelet, Julie Hilly, Matthieu Maesani, Thierno Diallo, Nyamjargal Mangalsuren, Yves Nivoche, Souhayl Dahmani

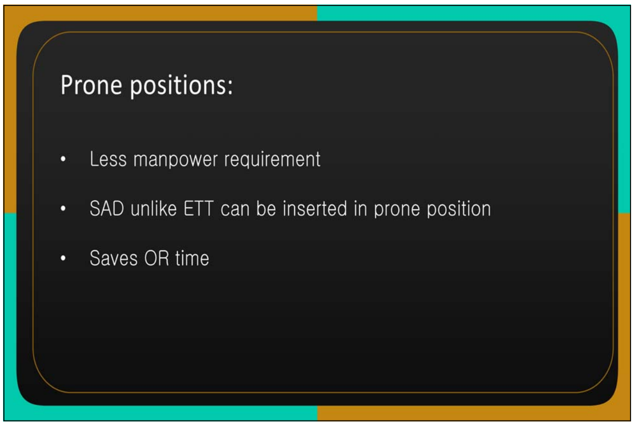
Results

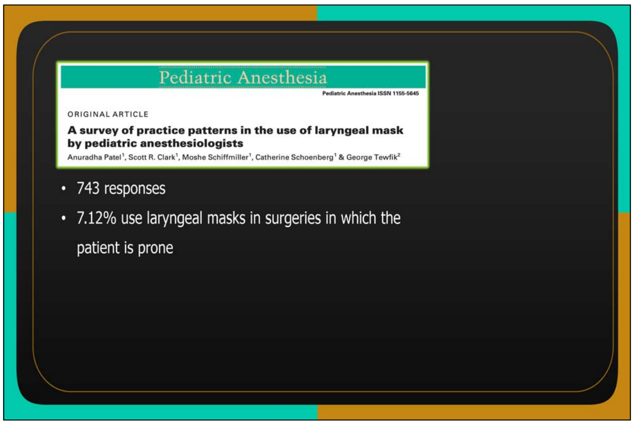
The meta-analysis was performed on 19 studies. In 12 studies, patients were given muscle relaxation, and in 16 studies, ventilation was controlled. During recovery from anesthesia, the incidence of desaturation (OR = 0.34 [0.19–0.62]), laryngospasm (OR = 0.34 [0.2–0.6]), cough (OR = 0.18 [0.11–0.27]), and breath holding (0.19 [0.05–0.68]) was lower when laryngeal mask airway was used to secure the airway. Postoperative incidences of sore throat (OR = 0.87 [0.53–1.44]), bronchospasm (OR = 0.56 [0.25–1.25]), aspiration (1.33 [0.46–3.91]) and blood staining on the device (OR = 0.62 [0.21–1.82]) did not differ between laryngeal mask airway and TI. Results were homogenous across the studies, with the exceptions of blood staining on the device.

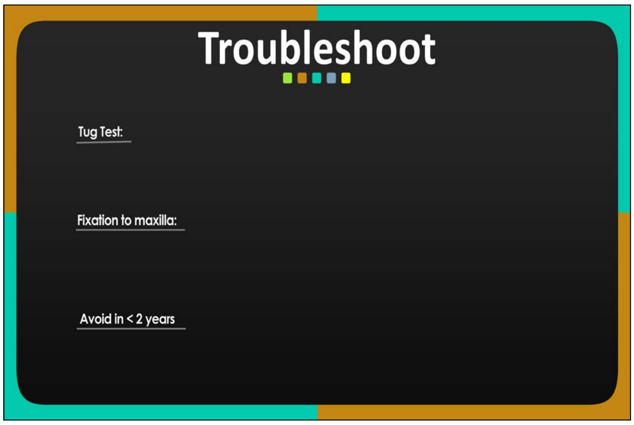


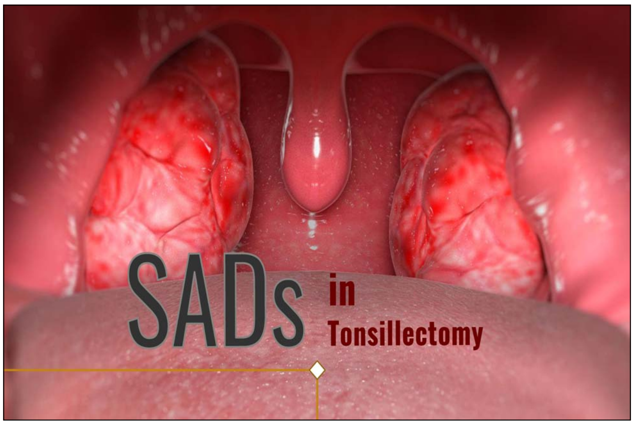


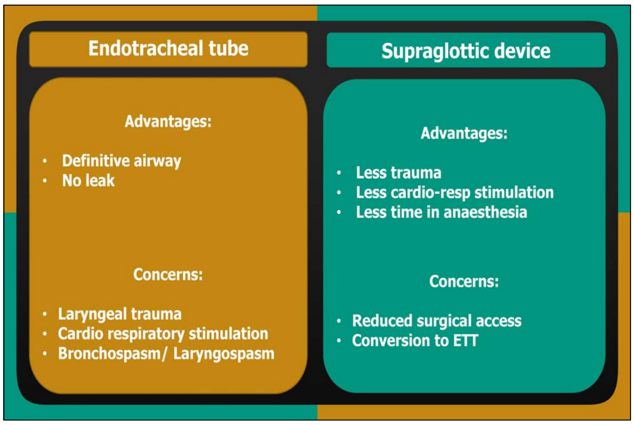

Pediatric Anesthesia
Original Article
Evaluation of glottic view through Air-Q Intubating Laryngeal Airway in the supine and lateral position and assessing it as a conduit for blind endotracheal intubation in children in the supine position
A study of effect of lateral position on oropharyngeal seal pressure of i-gel® and ProSeal™ LMA in children
Deepali P Thakur, Anila D Malde
Department of Anaesthesiology, LTMMC and LTMG Hospital, Sion, Mumbai, Maharashtra, India
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
Raksha Kundal, Kriti Puri, Garima Agrawal, Ranju Singh & Maitree Pandey
Ain-Shams Journal of Anesthesiology 15, Article number: 17 (2023)
• 2015
• 60 patients
• Glottic grade from supine to lateral
• Deteriorated in 8, improved in 2
• 2020
• 86 patients
• 1⁰ 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

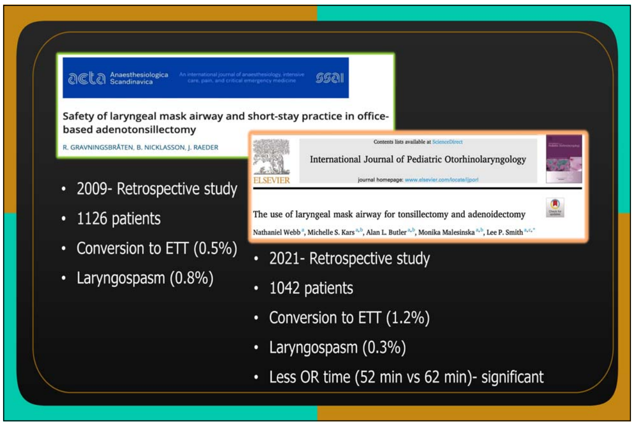

Prone positions:
• Less manpower requirement
• SAD unlike ETT can be inserted in prone position
• Saves OR time

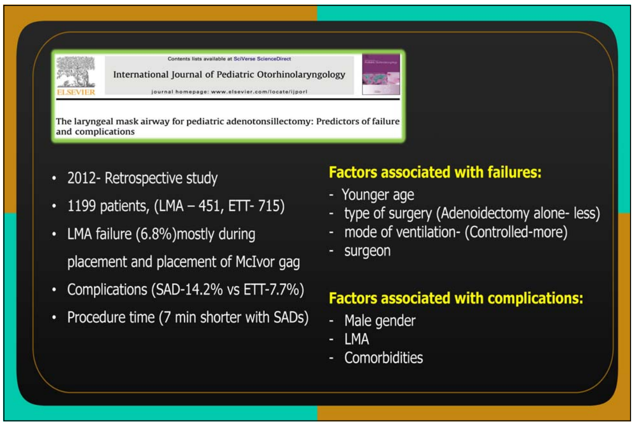

Pediatric Anesthesia
ORIGINAL ARTICLE
A survey of practice patterns in the use of laryngeal mask by pediatric anesthesiologists
Anuradha Patel, Scott R. Clark, Moshe Schiffmiller, Catherine Schoenberg & George Tewfik
• 743 responses
• 7.12% use laryngeal masks in surgeries in which the patient is prone


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


acta Anaesthesiologica Scandinavica
Safety of laryngeal mask airway and short-stay practice in office-based adenotonsillectomy
R. GRAVNINGSBRÅTEN, B. NICKLASSON, J. RAEDER
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

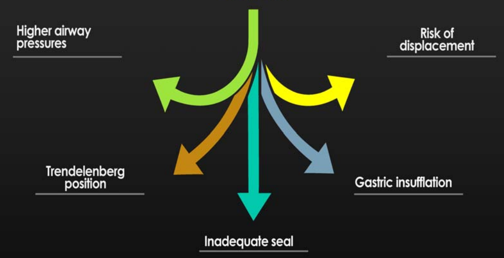
Maintain depth of anesthesia during gag placement

Caution during positioning

Surgeons experience matters

Avoid in young children

Concerns



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

Copyright © 2010 EDIZIONI MINERVA MEDICA
language: English

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

Ozdamar D. [1], Güvenç B. H. [2], Toker K. [1], Solak M. [1], Ekingen G. [1]

- 2010- RCT
- 40 patients (Classic LMA vs ETT)
- 1^0 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

APARNA SINHA MD, BIMLA SHARMA MD, JAYASHREE SOOD MD FFARCS

- 2007- RCT
- 60 patients (Proseal LMA vs ETT)
- 1^0 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

Contents lists available at ScienceDirect

Journal of Pediatric Surgery

journal homepage: www.elsevier.com/locate/jpedsurg

Prospective Clinical Trial

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

Serkan Tulgar [a], Ibrahim Boga [b], Basri Cakiroglu [c], David Terence Thomas [d,*]

- 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[1]

- 2019- RCT
- 80 patients of 2-8 years (I gel vs ETT)
- 1^0 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)

Pediatric Anesthesia

RESEARCH REPORT

Comparison of the oropharyngeal leak pressure between three second generation supraglottic airway devices during laparoscopic surgery in pediatric patients

Abhyuday Kumar, Chandni Sinha, Neeraj Kumar, Ajeet Kumar, Bindey Kumar, Amarjeet Kumar, Rajnish Kumar

- 2022- RCT
- 90 patients of 6 month to 10 years (I gel vs Ambu Auragain vs Proseal LMA)
- 1^0 outcome: OLP
- 2^0 outcome: peak pressures before and after pneumoperitoneum, fiberoptic view, insertion attempts, insertion time, manipulations, perioperative and postoperative anesthesia-related problems.

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.

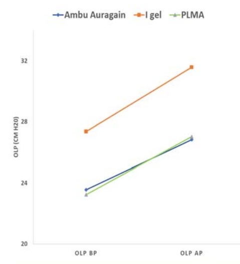


FIGURE 2 Line graph showing changes in the OLP after pneumoperitoneum in SADs. OLP BP, OLP before pneumoperitoneum; OLP AP, OLP after pneumoperitoneum

- Significant increase in OLP after pneumoperitoneum in all groups
- Good fiberoptic view in all groups
- No difference in complications

All three SADs can be used in pediatric laparoscopic surgeries. I gel may be better suited in conditions where higher ventilatory pressures may be necessary, for example, in extremes of weight, trendelenburg position, etc.

Troubleshoot

OLP measurement before and after pneumoperitoneum

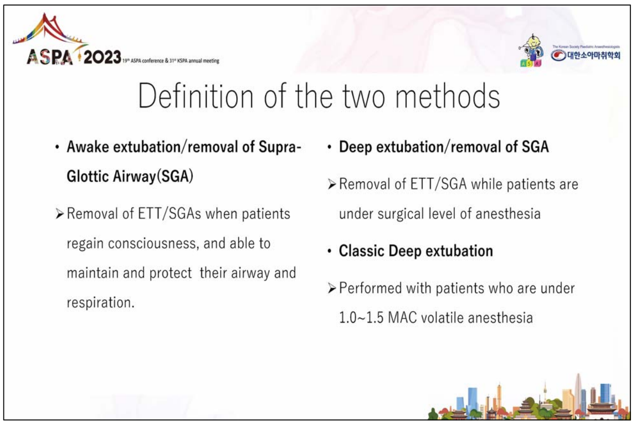
Device with higher OLPs in obese patients and in trendelenberg position

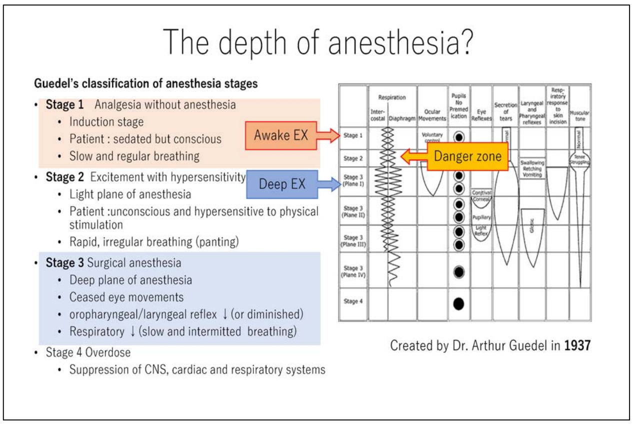
Avoid in infants (inadequate studies)

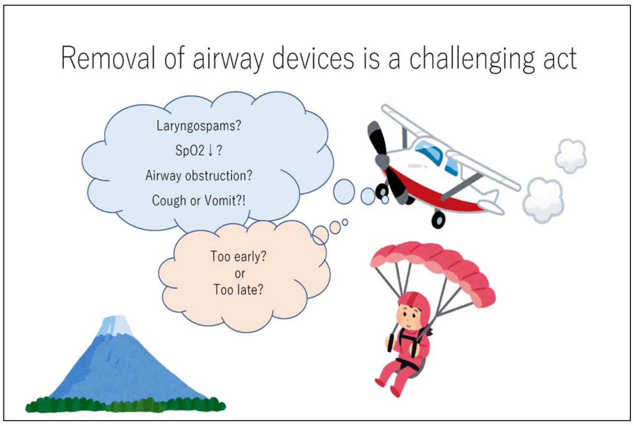
LMA removal and Endotracheal extubation: Deep or Awake?

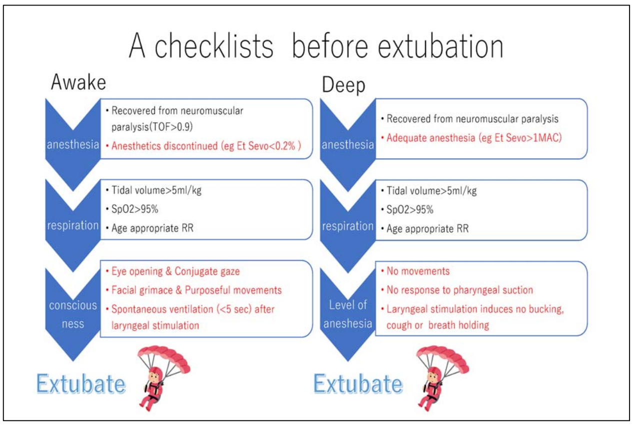
Ayuko Igarashi

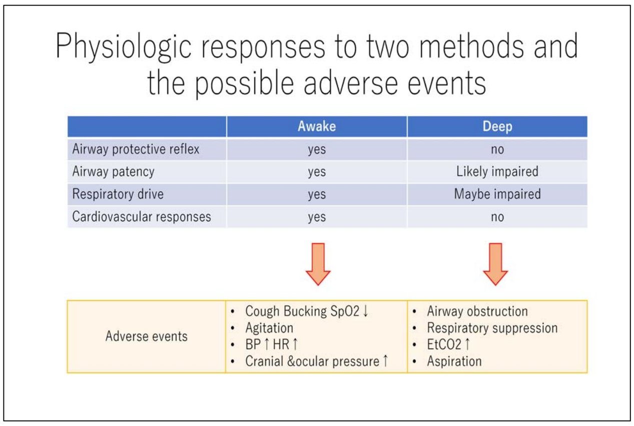
Department of Anesthesia, Miyagi Children's Hospital, Japan



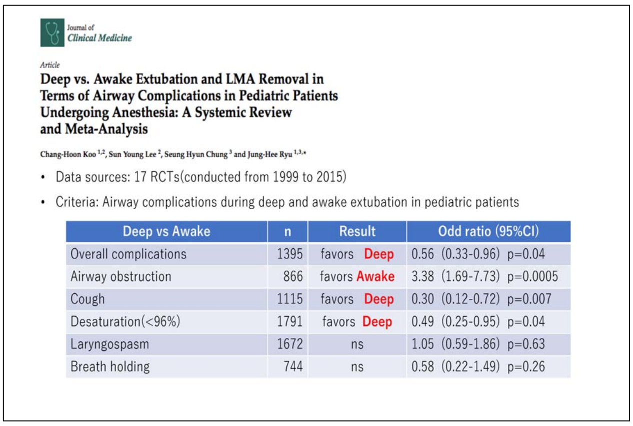








	Awake	Deep
Airway protective reflex	yes	no
Airway patency	yes	Likely impaired
Respiratory drive	yes	Maybe impaired
Cardiovascular responses	yes	no
Adverse events	• Cough Bucking SpO2↓ • Agitation • BP↑HR↑ • Cranial &ocular pressure↑	• Airway obstruction • Respiratory suppression • EtCO2↑ • Aspiration



Deep vs Awake	n	Result	Odd ratio (95%CI)
Overall complications	1395	favors Deep	0.56 (0.33-0.96) p=0.04
Airway obstruction	866	favors Awake	3.38 (1.69-7.73) p=0.0005
Cough	1115	favors Deep	0.30 (0.12-0.72) p=0.007
Desaturation(<96%)	1791	favors Deep	0.49 (0.25-0.95) p=0.04
Laryngospasm	1672	ns	1.05 (0.59-1.86) p=0.63
Breath holding	744	ns	0.58 (0.22-1.49) p=0.26

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

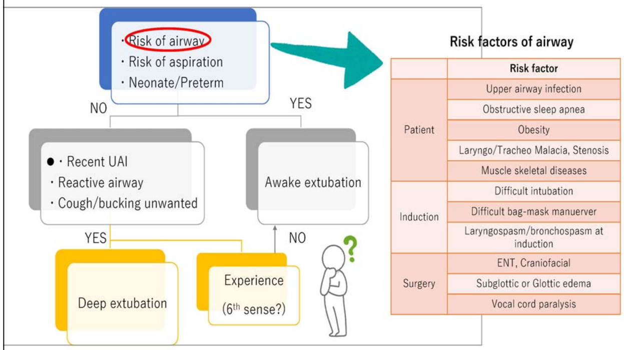
Lisa Vitale, Briana Rodriguez, Anne Baetzel, Robert Christensen and Bishr Haydar

- 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

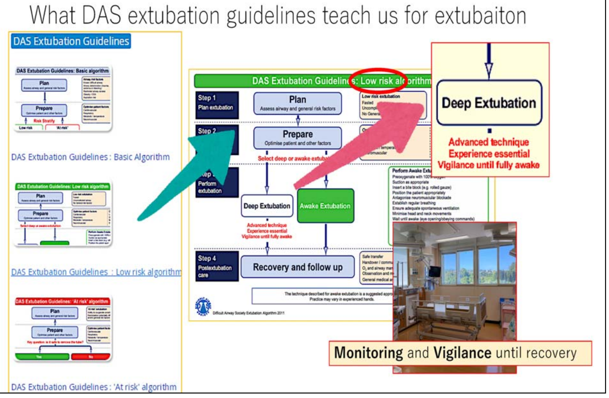
Respiratory event	n (%)
Laryngospasm	35 (54.7)
Airway obstruction	7 (10.9)
Emesis	5 (7.8)
Apnea	4 (6.3)
Bronchospasm	4 (6.3)
Others	13 (20.3)
Multiple events	7 (10.9)

Outcomes	n
Cardiac arrest	19
Re-intubation	5
PICU admission	24

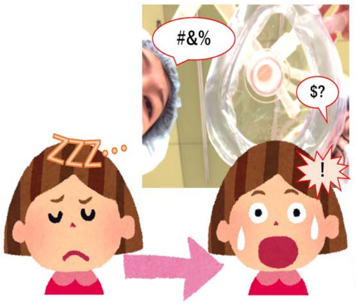
Evaluation of patient risk factors



What DAS extubation guidelines teach us for extubaiton



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

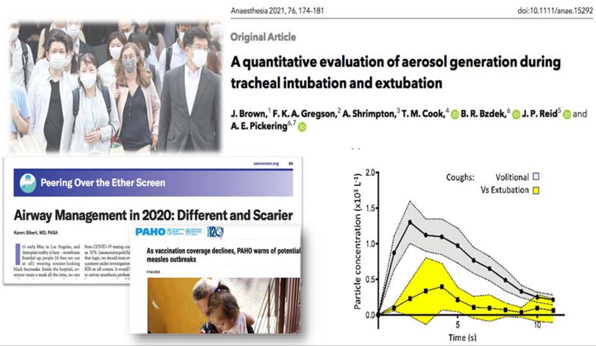
- AAGA is higher in children than in adults (0.2~1.2%, 0.1~0.2%)

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?



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 ↓	Sevo1,1.5,0.8MAC	Di M et al. 2017
Lidocaine	2mg/kg	•		Erb TO et al. 2013
Remimazolam	0.5-2mg/kg/min			Future authors

Anesthesiology 2005; 103:1142–8 © 2005 American Society of Anesthesiologists, Inc. Lippincott Williams & Wilkins, Inc.

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

Christine Oberer, M.D.,* Britta S. von Ungern-Sternberg, M.D.,† Franz J. Frei, M.D.,‡ Thomas O. Erb, M.D., M.H.S.‡

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

Yu-Bo Fang', Cheng-Yu Wang', Yu-Qing Gao, Yu-Hang Cai, Jia Chen, Xu-Lin Zhang, Le-Qi Dong, Wang-Ning Shang-Guan and Hua-Cheng Liu*

Positioning matters for extubation

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

A randomised controlled trial

Thomas-Kattappurathu, George; Kasisomayajula, Ananth; Short, Judith

Author Information

European Journal of Anaesthesiology 32(9):p 624-630, September 2015. | *DOI:* 10.1097/EJA.0000000000000286

- 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 $SpO_2<90\%$ 1	Airway obstruction 3 Secretions 13 Biting 8 $SpO_2<90\%$ 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 PaO_2 and decrease $PaCO_2$.

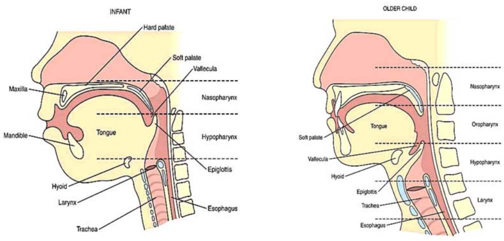
Mechanisms of HFNC action	
PEEP	+
Mechanical splinting of nasopharynx	+
CO2 washout	+
Nasopharyngeal dead space	↓
Work of breathing	↓
Consistent O2 supply	+

ASPA 2023 19th ASPA conference & 31st KSPA annual meeting

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.

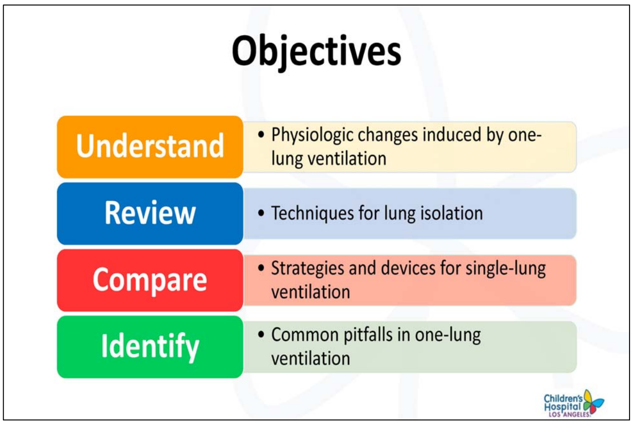
Children's airway is narrow and collapsible

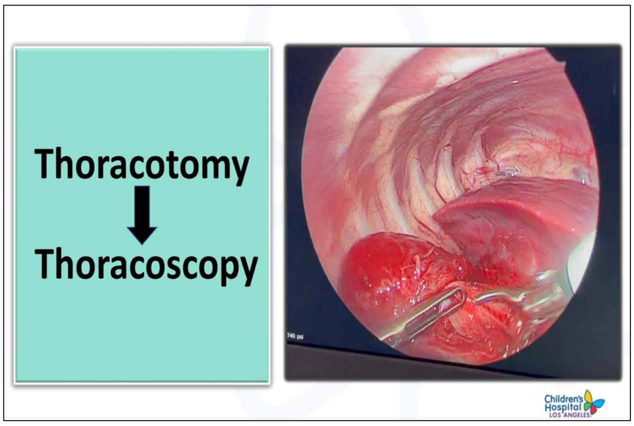


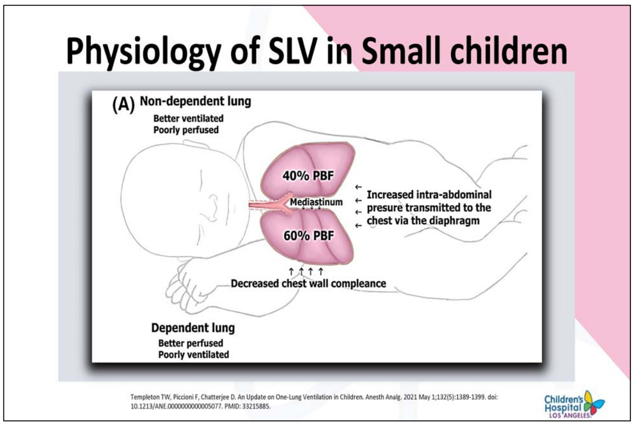
Beyond the Mainstem: Lung Isolation Techniques in Small Children

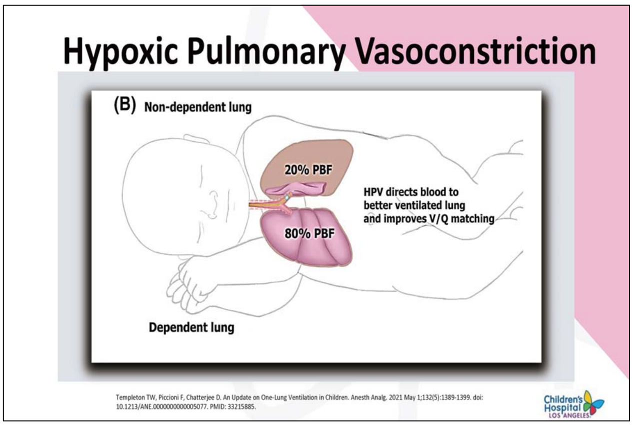
Rebecca Donovan Margolis

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







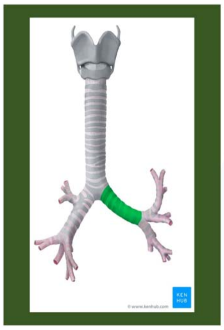


Anatomic Considerations

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)

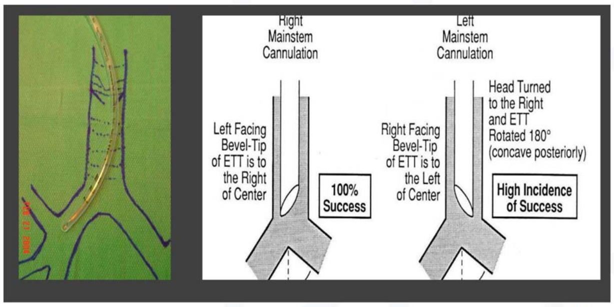
Templeton TW, Piccioni F, Chatterjee D. An Update on One-Lung Ventilation in Children. Anesth Analg. 2021 May 1;132(5):1389-1399. doi: 10.1213/ANE.0000000000005077. PMID: 33215885.

Anatomic Considerations

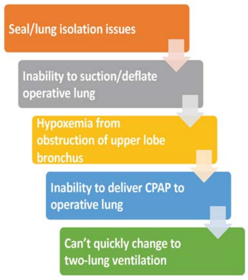


- Distance from carina to take-off of LUL bronchus is ≈ 3X greater than on the right
- The take-off of the RUL remains within 1cm of the carina in children up to 8 y.o.

Techniques: Mainstem Intubation



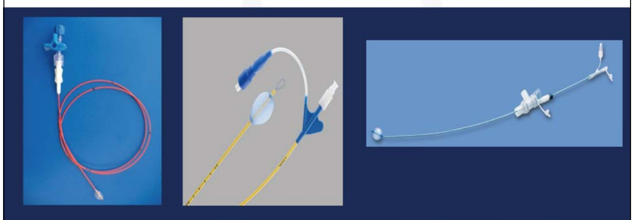
Mainstem Intubation: Disadvantages



The unspoken truth

Thapa DB, Greene NH, Udani AG. Complete Obstruction of Endotracheal Tube in an Infant with a Retropharyngeal and Anterior Mediastinal Abscess. Case Rep Pediatr. 2017;2017:1848945. doi: 10.1155/2017/1848945. Epub 2017 Feb 14. PMID: 28299222; PMCID: PMC5337372.
Piccioni F, Templeton TW, Morris B, Valenza F. Pediatric thoracic anesthesia: airway management for lung isolation and postoperative analgesia. Pediatr Med 2019;2:23.

Bronchial Blockers

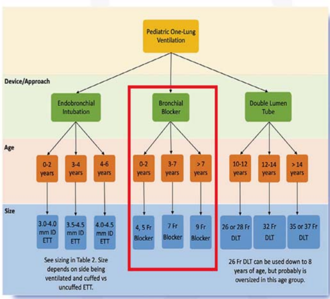


Fogarty
- Low volume, High pressure cuff
- No central channel
- Round not elliptical balloon

Arndt
- High volume, Low pressure cuff
- Most literature in young children
- Removable internal wire with central channel

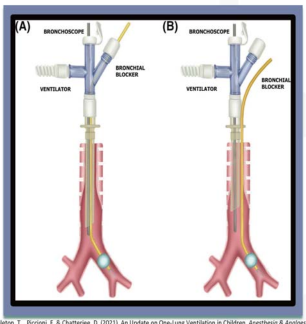
5Fr Uniblocker
- Has a bend at the tip
- More rigid
- High volume, Low pressure cuff
- No central lumen or suctioning or CPAP

SLV Age & Size Guide



Lazar A, Chatterjee D, Templeton TW. Error traps in pediatric one-lung ventilation. Paediatr Anaesth. 2022 Feb;32(2):346-353. doi: 10.1111/pan.14333. Epub 2021 Nov 21. PMID: 34767676

Intraluminal & Extraluminal Bronchial Blocker

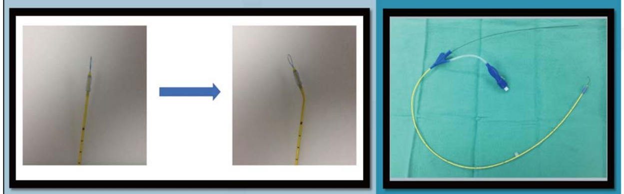


Extraluminal placement is only option for children < 2 y.o.

Need at least 4.5 ETT for blocker & fiberoptic scope

Templeton, T. , Piccioni, F. & Chatterjee, D. (2021). An Update on One-Lung Ventilation in Children. *Anesthesia & Analgesia, 132* (5), 1389-1399. doi: 10.1213/ANE.0000000000005077

Techniques: Bend the BB

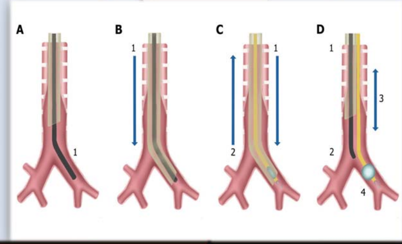


30-45° bend 1.5 cm proximal to cuff

Remove blue loop, replace with j tip wire

Templeton TW, Downard MG, Simpson CR, Zeller KA, Templeton LB, Bryan YF. Bending the rules: a novel approach to placement and retrospective experience with the 5 French Arndt endobronchial blocker in children <2 years. Paediatr Anaesth. 2016 May;26(5):512-20. doi: 10.1111/pan.12882. Epub 2016 Mar 9. PMID: 26956889.

Getting the blocker in place



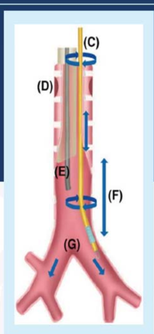
Turn the head to the right to facilitate left-sided placement

Consider a mainstem approach using mainstem intubation

Lazar A, Chatterjee D, Templeton TW. Error traps in pediatric one-lung ventilation. Paediatr Anaesth. 2022 Feb;32(2):346-353. doi: 10.1111/pan.14333. Epub 2021 Nov 21. PMID: 34767676

Tips for Bronchial Blockers

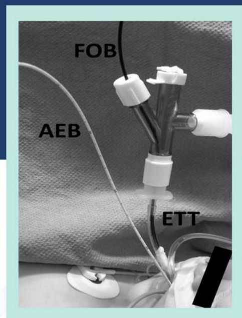
- Place **ETT anterior to BB** so blocker occupies larger posterior glottic opening
- Target **leak of 18-24** cm H_20
- Place **ETT high in trachea** to allow better visualization of carina



Templeton, T. , Piccioni, F. & Chatterjee, D. (2021). An Update on One-Lung Ventilation in Children. *Anesthesia & Analgesia, 132* (5), 1389-1399. doi: 10.1213/ANE.0000000000005077

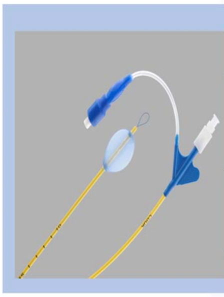
Tips for Bronchial Blockers

- Leave **blocker slightly deep** before positioning
- Inflate the cuff under direct vision



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_20
- Expect hypercarbia

Hypoxemia During OLV

1. Increase FiO_2 to 1.0 and inform surgeon
2. Apply recruitment breaths (20-30 cm H_2O) to the dependent lung
3. Suction endotracheal tube for blood/secretions
4. Check position of lung isolation device with fiberoptic bronchoscopy
5. Apply additional PEEP (2-5 cm H_2O) as tolerated, to the dependent lung
6. Apply CPAP (5-10 cm H_2O) if possible, to the non-dependent lung
7. Transition to two-lung ventilation

Lazar A, Chatterjee D, Templeton TW. Error traps in pediatric one-lung ventilation. Paediatr Anaesth. 2022 Feb;32(2):346-353. doi: 10.1111/pan.14333. Epub 2021 Nov 21. PMID: 34767676.

Thank you! 감사합니다

ASPA 2023

The Korean Society Pediatric Anesthesia
대한소아마취학회

Children's Hospital LOS ANGELES

References

1. 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.
2. Bawazir OA. Thoracoscopy in pediatrics: Surgical perspectives. Ann Thorac Med. 2019 Oct-Dec;14(4):239-247. doi: 10.4103/atm.ATM_114_19. PMID: 31620207; PMCID: PMC6784445.
3. Lee JH, Bae JI, Jang YE, Kim EH, Kim HS, Kim JT. Lung protective ventilation during pulmonary resection in children: a prospective, single-centre, randomised controlled trial. Br J Anaesth. 2019 May;122(5):692-701. doi: 10.1016/j.bja.2019.02.013. Epub 2019 Mar 8. PMID: 30916035.
4. Templeton TW, Downard MG, Simpson CR, Zeller KA, Templeton LB, Bryan YF. Bending the rules: a novel approach to placement and retrospective experience with the 5 French Arndt endobronchial blocker in children <2 years. Paediatr Anaesth. 2016 May;26(5):512-20. doi: 10.1111/pan.12882. Epub 2016 Mar 9. PMID: 26956889.
5. Thapa DB, Greene NH, Udani AG. Complete Obstruction of Endotracheal Tube in an Infant with a Retropharyngeal and Anterior Mediastinal Abscess. Case Rep Pediatr. 2017;2017:1848945. doi: 10.1155/2017/1848945. Epub 2017 Feb 14. PMID: 28299222; PMCID: PMC5337372.
6. Piccioni F, Templeton TW, Morris B,Valenza F. Pediatric thoracic anesthesia: airway management for lung isolation and postoperative analgesia. Pediatr Med 2019;2:23.
7. Kubota H, Kubota Y, Toyoda Y, Ishida H, Asada A, Matsuura H. Selective blind endobronchial intubation in children and adults. Anesthesiology. 1987 Oct;67(4):587-9. doi: 10.1097/00000542-198710000-00028. PMID: 3662089.
8. Lazar A, Chatterjee D, Templeton TW. Error traps in pediatric one-lung ventilation. Paediatr Anaesth. 2022 Feb;32(2):346-353. doi: 10.1111/pan.14333. Epub 2021 Nov 21. PMID: 34767676.
9. Shazia Mohammad, MD, Staci Cameron MD, Dalia Teima MD, Evelyn Griffin MD, Eric Nesrsta MD, Maria Matuszczak MD . An Innovative Way to Place Bronchial Blockers in Pediatric Patients. Society for Pediatric Anesthesia Annual Meeting. March 2018; Houston, TX.
10. Stephenson, Lianne L. et al. Routine Extraluminal Use of the 5F Arndt Endobronchial Blocker for One-Lung Ventilation in Children up to 24 Months of Age. Journal of Cardiothoracic and Vascular Anesthesia, Aug 2011, Volume 25, Issue 4, 683 – 686.
11. Campos, J.H., Peacher, D. Application of Continuous Positive Airway Pressure During Video-Assisted Thoracoscopic Surgery. *Curr Anesthesiol Rep* 11, 446–456 (2021). https://doi.org/10.1007/s40140-021-00479-w
12. Templeton TW, Miller SA, Lee LK, Kheterpal S, Mathis MR, Goenaga-Díaz EJ, Templeton LB, Saha AK; Multicenter Perioperative Outcomes Group Investigators. Hypoxemia in Young Children Undergoing One-lung Ventilation: A Retrospective Cohort Study. Anesthesiology. 2021 Nov 1;135(5):842-853. doi: 10.1097/ALN.0000000000003971. PMID: 34543405; PMCID: PMC8607983.

Children's Hospital LOS ANGELES

Reference Chart for OLV Device Sizing

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

Age	Mainstem Bronchus Diameter (mm)[a]		Standard UC ETT Size for Endobronchial Intubation (OD mm)[b]		Standard C ETT Size for Endobronchial Intubation (OD mm)[b]		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
	R	L	R	L	R	L											
0–3 mo	4.4[a]	3.6[a]	3.0 (4.2)	2.5 (3.6)	3.0 (4.3)	–	E	–	–	E	E	E	–	–	–	–	–
3–6 mo	4.7[a]	3.9[a]	3.0 (4.2)	2.5 (3.6)	3.0 (4.3)	–	E	–	–	E	E	E	–	–	–	–	–
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)	E	–	–	E	E	E	–	–	–	–	-
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)	E	–	–	E	E	E	–	–	–	–	–
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)	E/I	E	–	E/I	E/I	E/I	–	–	–	–	-
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)	E/I	E	–	E/I	E/I	E/I	–	–	–	–	
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)	E/I	E/I	–	–	–	E/I	–	E	+	–	–
8–10 y	9.9[c]	8.8[c]	–	–	6.0 (8.2)	5.0 (6.9)	–	E/I	E/I	–	–	–	E/I	E/I	+	+	+

Summary of bronchial diameters and recommended lung isolation device or ETT size for lung isolation. ETT outer diameters can vary significantly by manufacturer, so care must be taken to evaluate the outer diameter of a given ETT when planning to use it for endobronchial intubation and OLV.

Abbreviations: BB, bronchial blocker; C, cuffed; CT, computerized tomography; DLT, double-lumen tube; E, extraluminal; ETT, endotracheal tube; Fuji, Fuji Uniblocker; I, intraluminal; L, left; OD, outer diameter; OLV, one-lung ventilation; R, right; UC, uncuffed.

[a]Median bronchial diameter measured by high resolution CT (Downard MG, Johnson AL, Heald CJ, Anthony EY, Singh J, Templeton TW, unpublished data, April 2019).

[b]Measurement of outer diameter is for Shiley endotracheal tubes.

[c]Median bronchial diameter measured by high resolution CT.[32]

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.

Children's Hospital LOS ANGELES

Session 3.

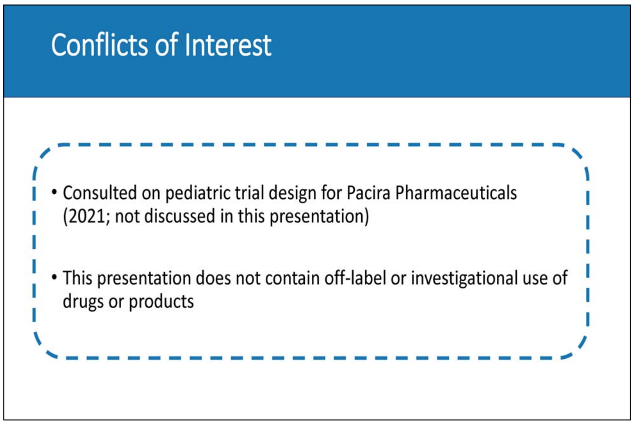
Beyond Drugs and Blocks: Latest Knowledge of Pediatric Pain Management

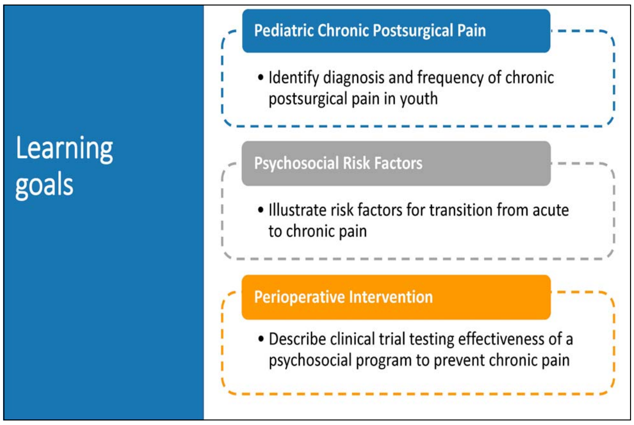
Chair(s): Sang Hun Kim (Korea)
Seokyoung Song (Korea)

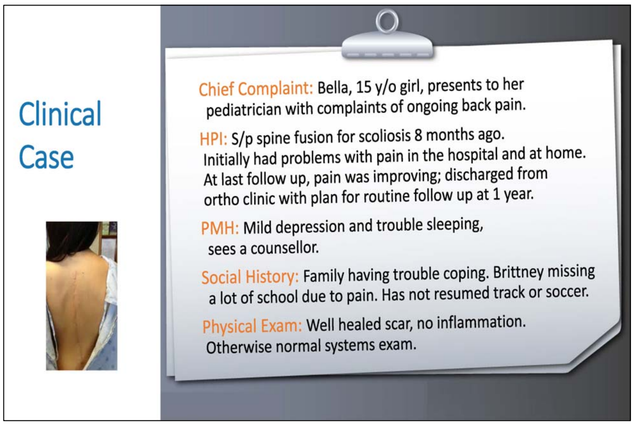
Acute to Chronic Postsurgical Pain: Influence of Psychosocial Factors

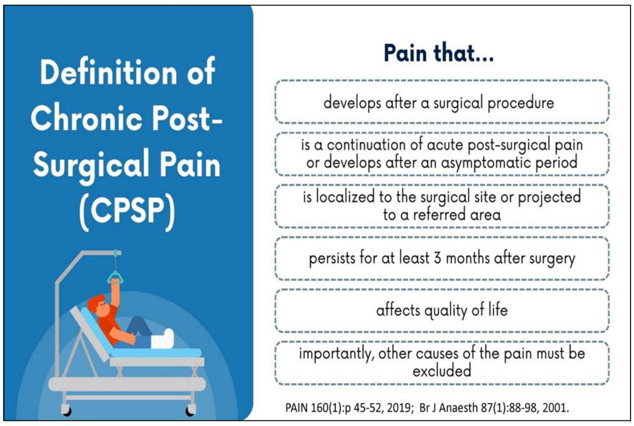
Jennifer A. Rabbitts

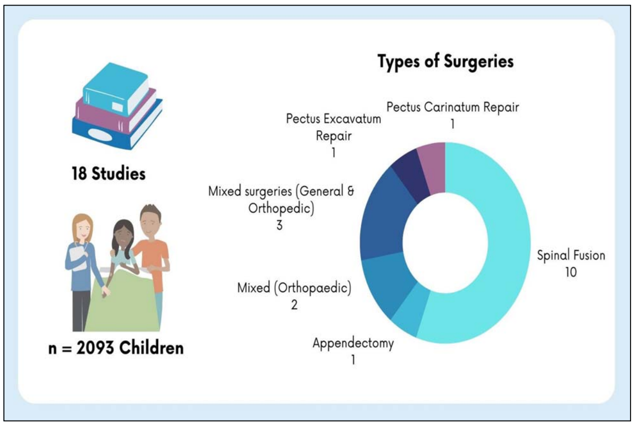
Department of Anesthesiology & Pain Medicine, University of Washington, Seattle Children's Hospital, USA

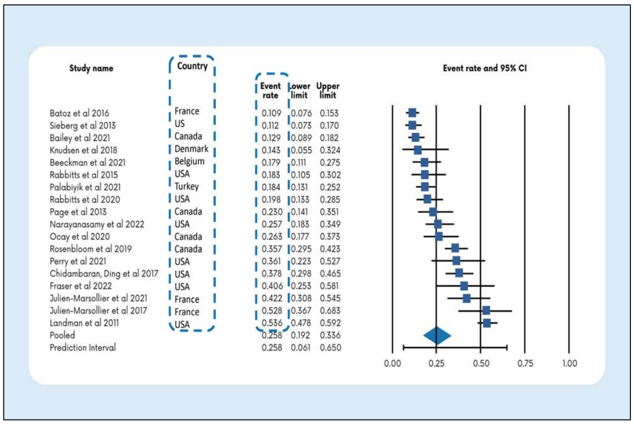


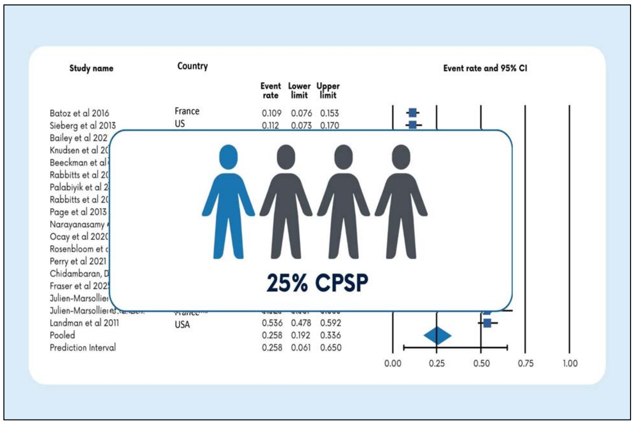


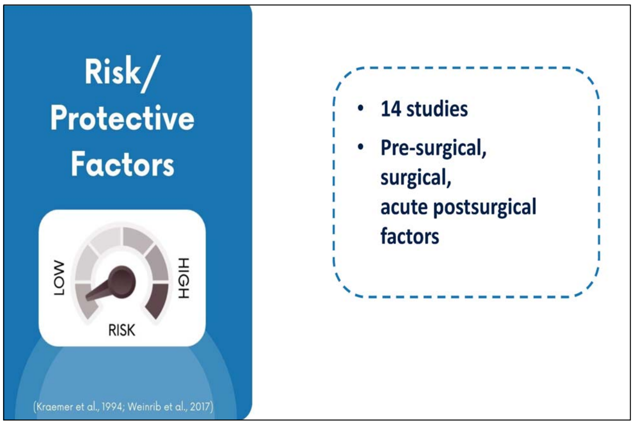


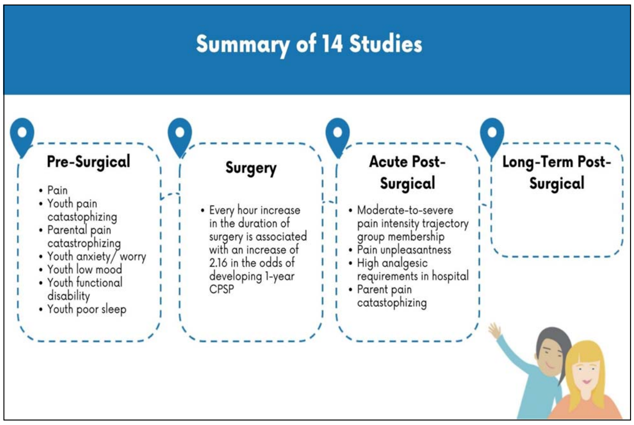


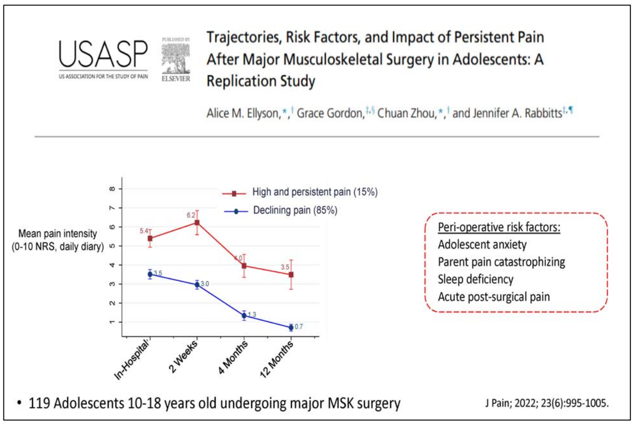


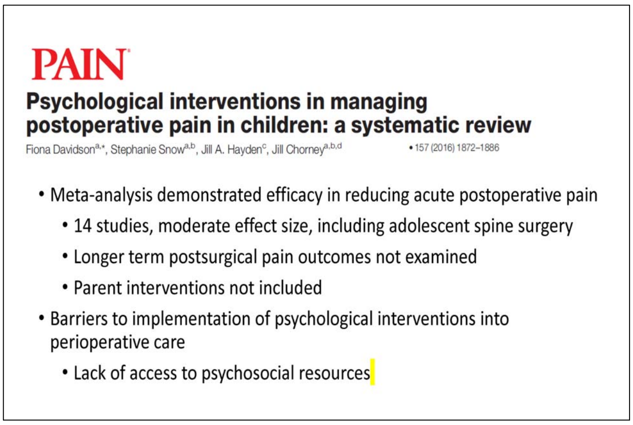

Study name
Country
Event rate
Lower limit
Upper limit
Event rate and 95% CI
Batoz et al 2016 France 0.109 0.076 0.153
Sieberg et al 2013 US 0.112 0.073 0.170
Bailey et al 2021 Canada 0.129 0.089 0.182
Knudsen et al 2018 Denmark 0.143 0.055 0.324
Beeckman et al 2021 Belgium 0.179 0.111 0.275
Rabbitts et al 2015 USA 0.183 0.105 0.302
Palabiyik 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
Fraser 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

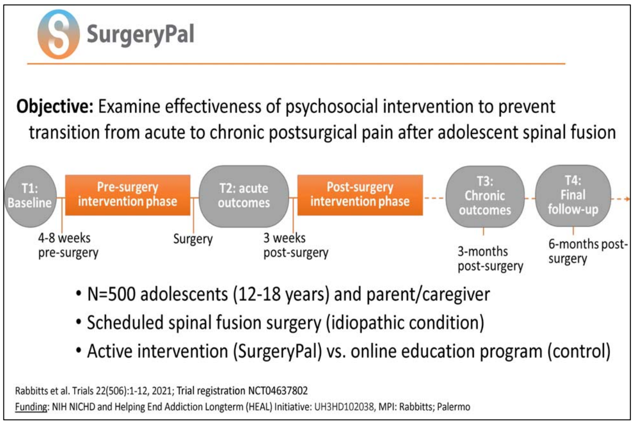

Study name
Country
Event rate and 95% CI
25% CPSP
Pooled 0.258 0.192 0.336
Prediction Interval 0.258 0.061 0.650
0.00
0.25
0.50
0.75
1.00

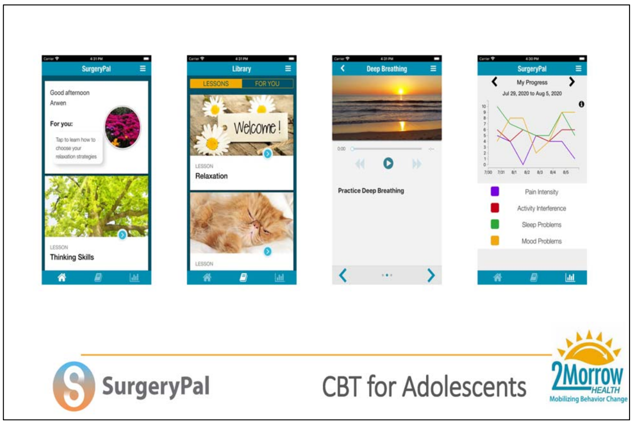

Risk/
Protective
Factors
LOW
HIGH
RISK
(Kraemer et al., 1994; Weinrib et al., 2017)
• 14 studies
• Pre-surgical, surgical, acute postsurgical factors


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

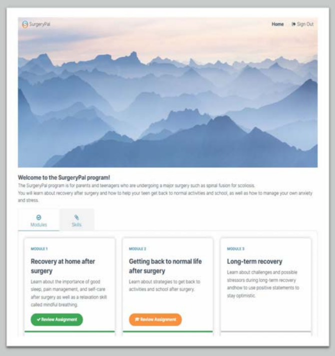

USASP
ELSEVIER
Trajectories, Risk Factors, and Impact of Persistent Pain After Major Musculoskeletal Surgery in Adolescents: A Replication Study
Alice M. Ellyson, Grace Gordon, Chuan Zhou, and Jennifer A. Rabbitts
High and persistent pain (15%)
Declining pain (85%)
Mean pain intensity (0-10 NRS, daily diary)
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
Fiona Davidson, Stephanie Snow, Jill A. Hayden, Jill Chorney
157 (2016) 1872–1886
• 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
Library
Deep Breathing
Welcome!
Relaxation
Thinking Skills
Practice Deep Breathing
My Progress
Pain Intensity
Activity Interference
Sleep Problems
Mood Problems
SurgeryPal
CBT for Adolescents
2Morrow HEALTH
Mobilizing Behavior Change

Parent CBT Website



Online Preoperative Intervention Targeting Anxiety, Sleep, and Pain Self-Management

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.

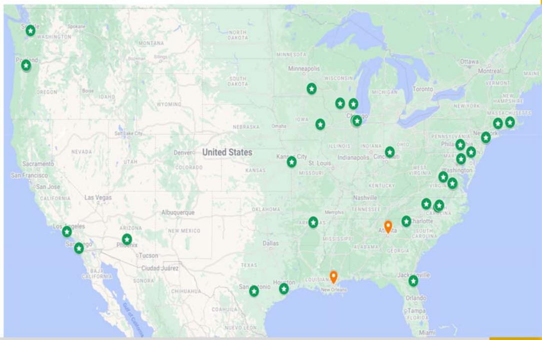
Murray et al. (2022), Canadian Journal of Pain 6(1):12-23

Online Postoperative Intervention Targeting Anxiety, Sleep, and Pain Self-Management

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.

Murray et al. (2022), Canadian Journal of Pain 6(1):12-23

Referring Sites



SPal map

Preliminary feedback

- 250 youth consented (66% enrollment rate)
- 96% retention rate (1 voluntary dropout; 9 surgery cancellations).
- Promising feedback from completed participants.

"Deep breathing like calms me down and usually makes my pain feel a whole lot better" (teen)

"How would we have gone through recovery if we hadn't had this study? And why isn't this a part of our everyday medical practice?" (parent)

"Picturing being on a sunny island helps me relieve stress… those [skills] were like the main things that made me recover" (teen)

"That flexibility because we just wouldn't have been able to participate if it had to be during business hours" (parent)

Pain Outcomes

- Recovery trajectory of acute pain over 14 days
- Daily pain intensity & interference at 3 & 6 months

Secondary Outcomes

- Quality of life; psychosocial distress; sleep quality; Prevalence of chronic pain

CLINICAL CASE

Chief Complaint: Bella, 15 y/o girl, presents to her pediatrician with complaints of ongoing back pain.

HPI: S/p spine fusion for scoliosis 8 months ago. Initially had problems with pain in the hospital and at home. At last follow up, pain was improving; discharged from ortho clinic with plan for routine follow up at 1 year.

PMH: Mild depression and trouble sleeping, sees a counsellor.

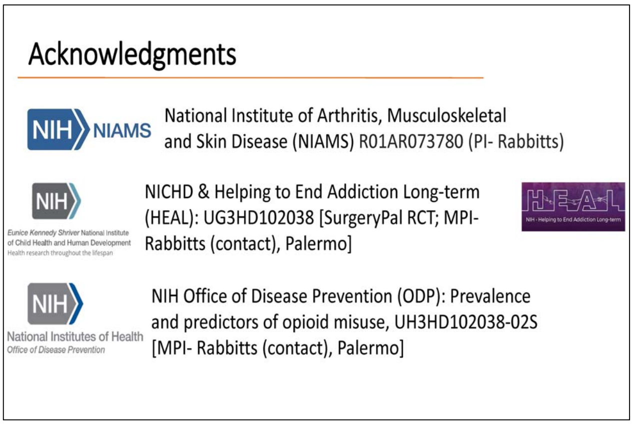
Social History: Family having trouble coping. Brittney missing a lot of school due to pain. Has not resumed track or soccer.

Physical Exam: Well healed scar, no inflammation. Otherwise normal systems exam.

Implications

- Chronic postsurgical pain is common in adolescents following major surgery
- Psychosocial risk factors are key in driving pain persistence following surgery
- Perioperative psychosocial interventions have potential to interrupt negative trajectory of pain and disability


Pediatric Pain and Sleep Innovations Lab
Seattle Children's

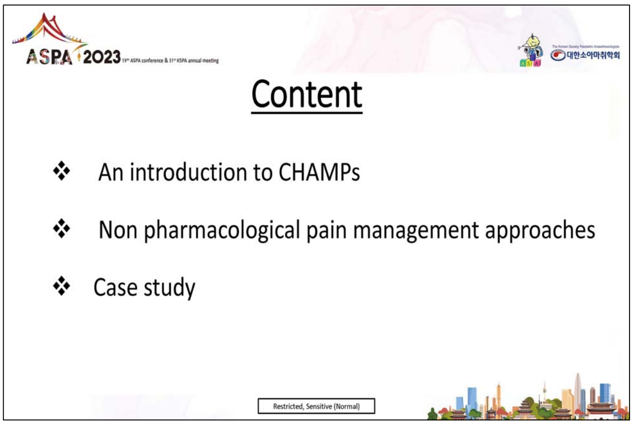

Acknowledgments
NIH NIAMS
National Institute of Arthritis, Musculoskeletal and Skin Disease (NIAMS) R01AR073780 (PI- Rabbitts)
NIH
Eunice Kennedy Shriver National Institute of Child Health and Human Development
NICHD & Helping to End Addiction Long-term (HEAL): UG3HD102038 [SurgeryPal RCT; MPI- Rabbitts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

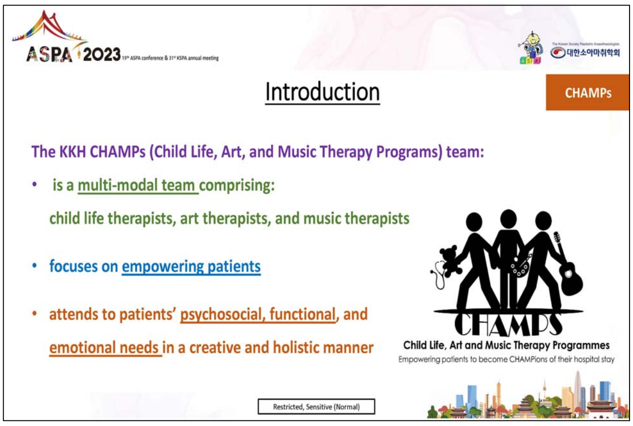

Special Interest Group on
Pain in Childhood
INTERNATIONAL ASSOCIATION FOR THE STUDY OF PAIN
ISPP 2023 will be held in Halifax, Nova Scotia, Canada from 1st to 4th October 2023.
ISPP

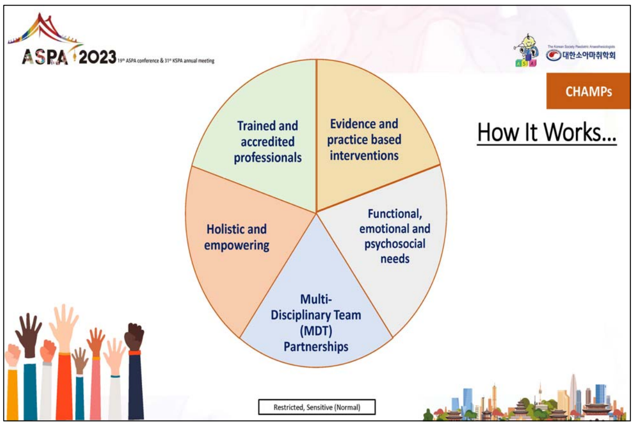
A Non-Pharmacological Approach to Post-Operative Pain Management in Children with Multiple Traumatic Injuries -A Presentation for ASPA 2023 by KKH CHAMPs

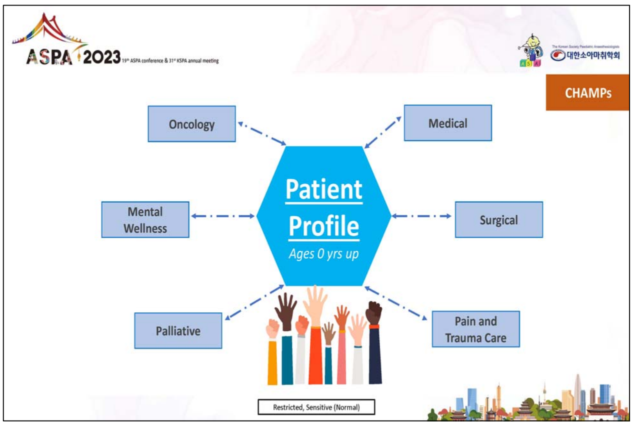
Tanuja Nair

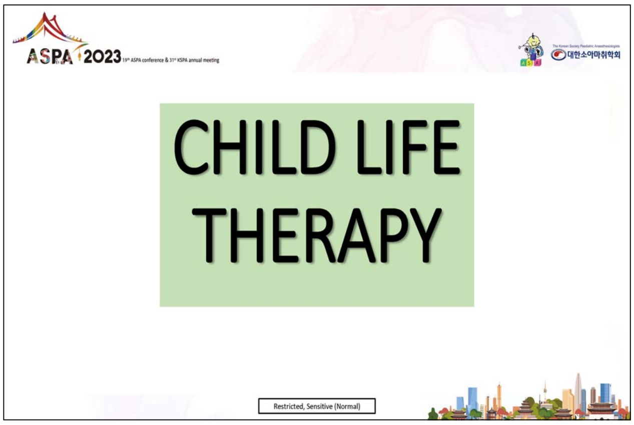
KK Women's and Children's Hospital (KKH), Singapore

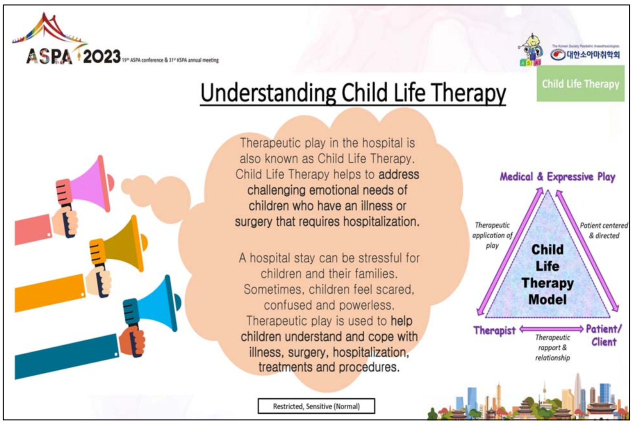


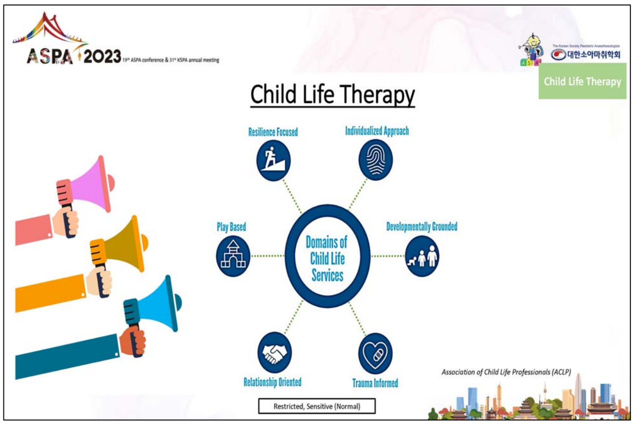


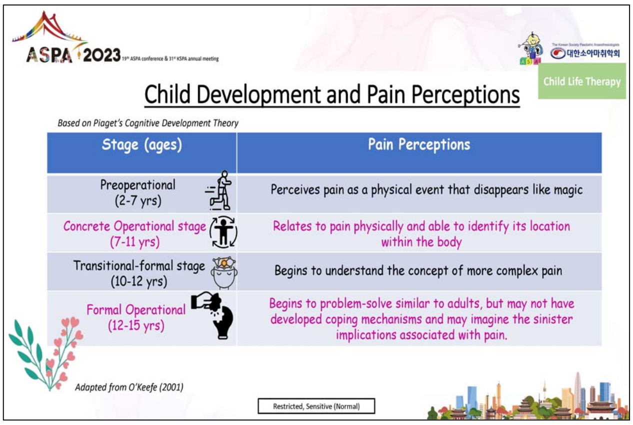


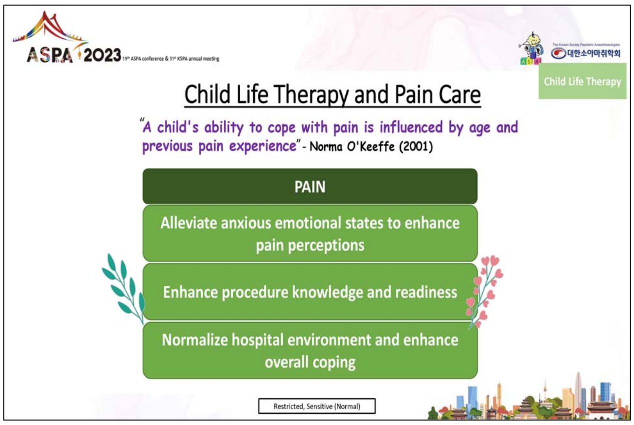


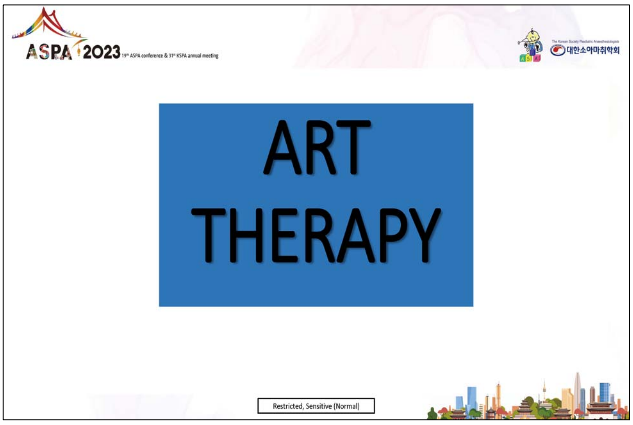

ASPA 2023
CHILD LIFE THERAPY
Restricted, Sensitive (Normal)

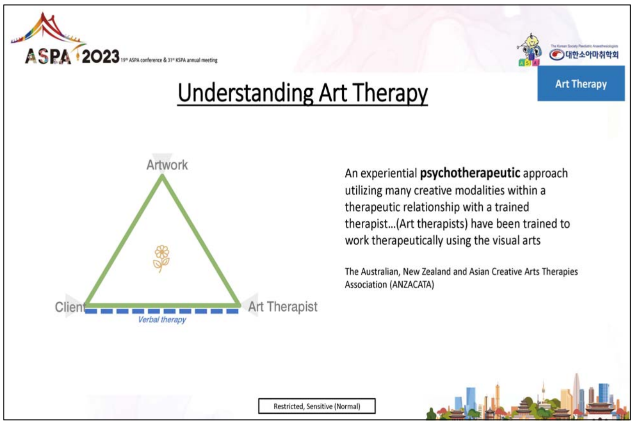

ASPA 2023
Understanding Child Life Therapy
Child Life Therapy
Therapeutic play in the hospital is also known as Child Life Therapy. Child Life Therapy helps to address challenging emotional needs of children who have an illness or surgery that requires hospitalization.
A hospital stay can be stressful 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 Development and Pain Perceptions
Child Life Therapy
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)

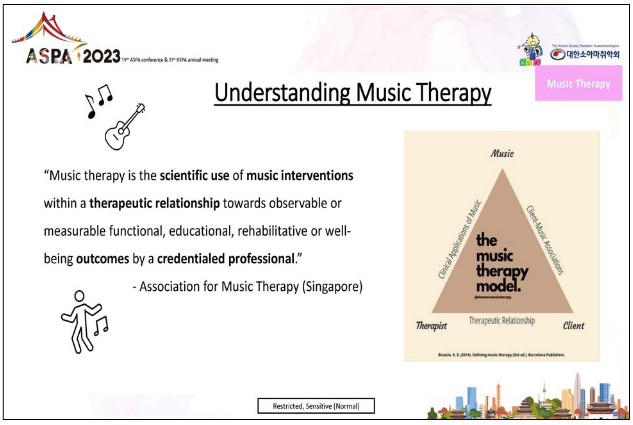

ASPA 2023
Child Life Therapy and Pain Care
Child Life Therapy
"A child's ability to cope with pain is influenced by age and previous pain experience" - Norma O'Keeffe (2001)
PAIN
Alleviate anxious emotional states to enhance pain perceptions
Enhance procedure knowledge and readiness
Normalize hospital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

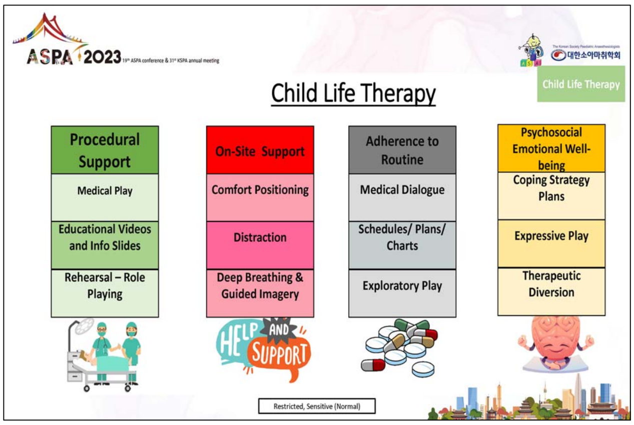

ASPA 2023
ART THERAPY
Restricted, Sensitive (Normal)

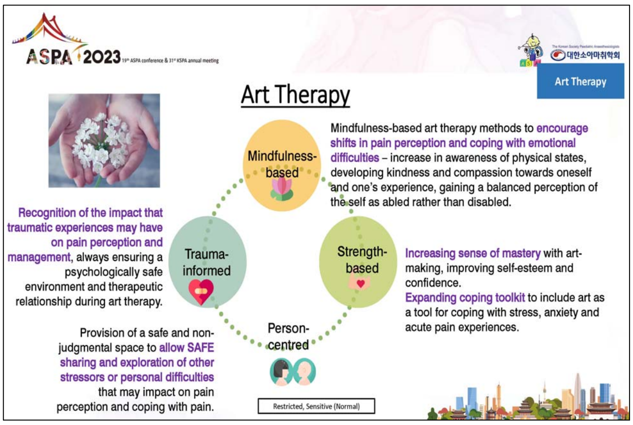

ASPA 2023
Understanding Art Therapy
Art Therapy
Artwork
Client
Art Therapist
Verbal therapy
An experiential psychotherapeutic approach utilizing many creative modalities within a therapeutic relationship with a trained therapist...(Art therapists) have been trained to work therapeutically using the visual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

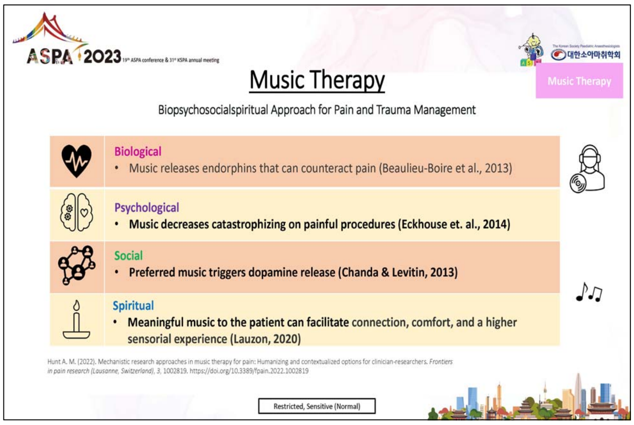

ASPA 2023
Art Therapy in Pain & Trauma Care
Art Therapy
Through art making...
PAIN
Modify response to emotional and physical problems
Manage symptoms of stress and anxiety
Reduces pain perception by moving the mental focus and improve mood (Shella, 2018)
Restricted, Sensitive (Normal)

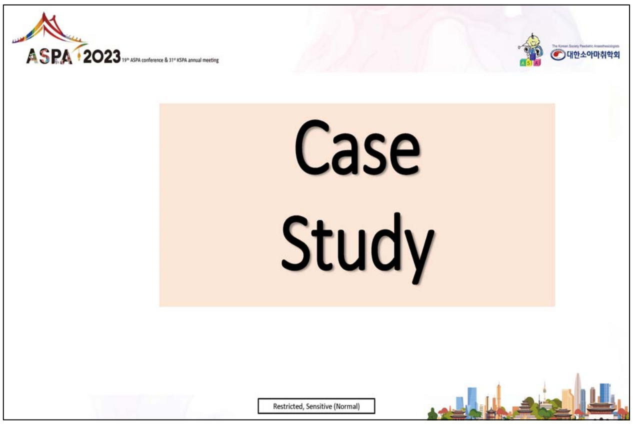
Tanuja Nair: A Non-Pharmacological Approach to Post-Operative Pain Management in Children with Multiple Traumatic Injuries

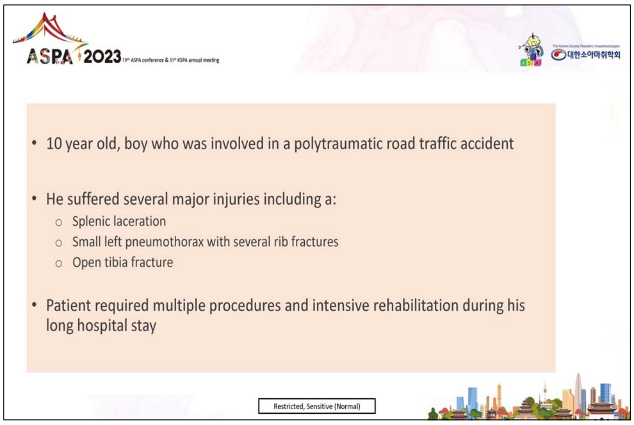


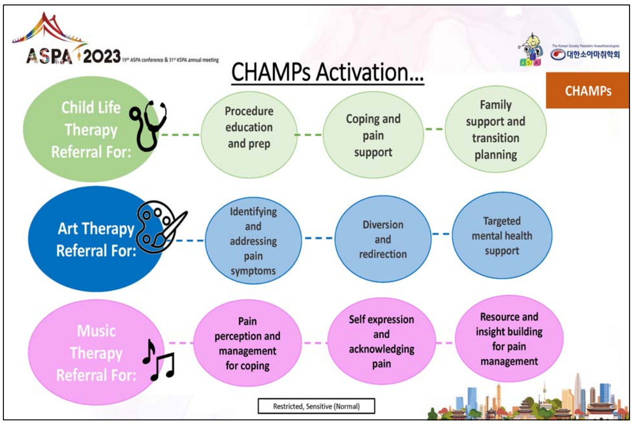


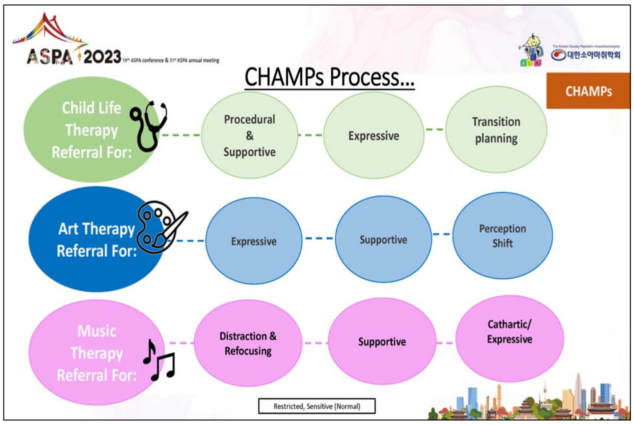


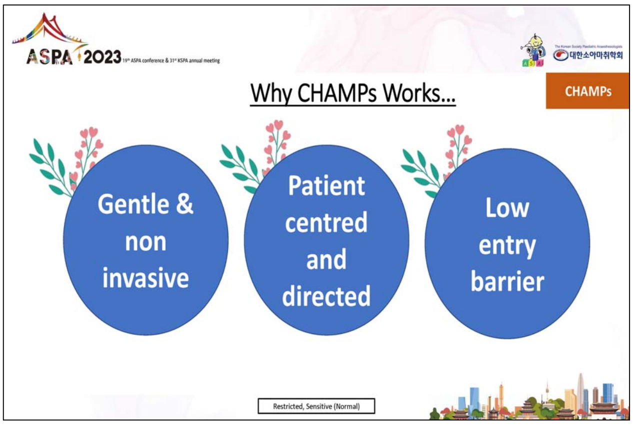


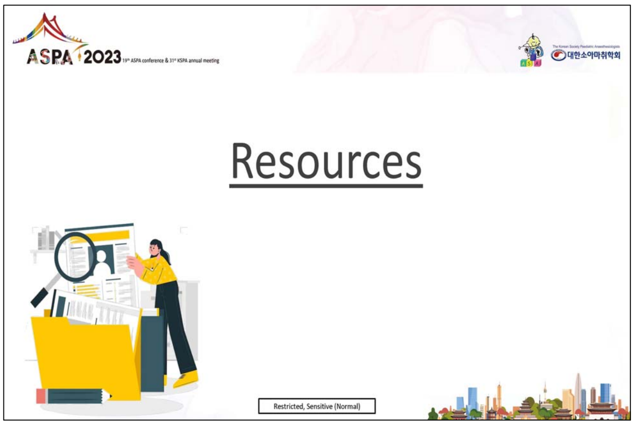


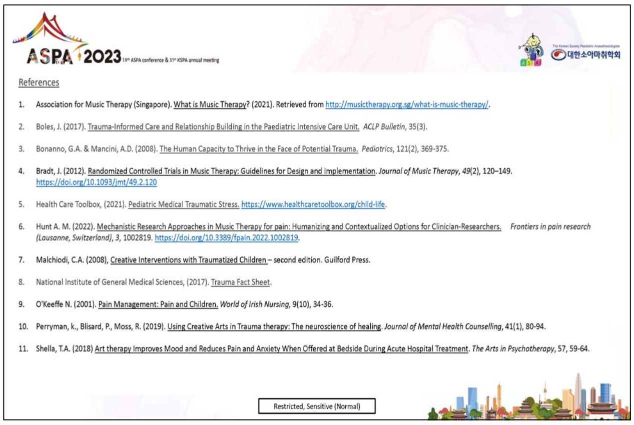











References

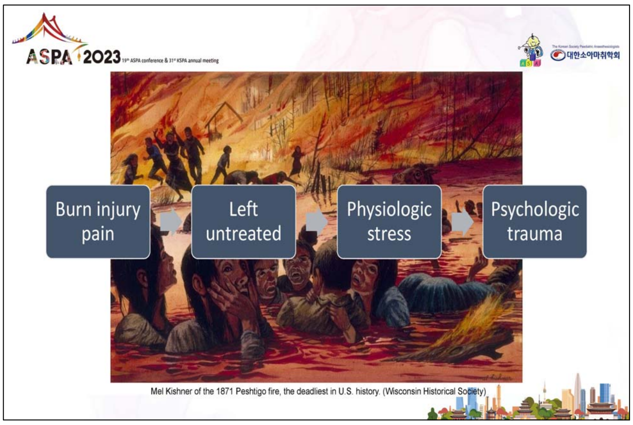
1. Association for Music Therapy (Singapore). What is Music Therapy? (2021). Retrieved from http://musictherapy.org.sg/what-is-music-therapy/.
2. Boles, J. (2017). Trauma-Informed Care and Relationship Building in the Paediatric Intensive Care Unit. *ACLP Bulletin*, 35(3).
3. Bonanno, G.A. & Mancini, A.D. (2008). The Human Capacity to Thrive in the Face of Potential Trauma. *Pediatrics*, 121(2), 369-375.
4. Bradt, J. (2012). Randomized Controlled Trials in Music Therapy: Guidelines for Design and Implementation. *Journal of Music Therapy*, *49*(2), 120–149. https://doi.org/10.1093/jmt/49.2.120
5. Health Care Toolbox, (2021). Pediatric Medical Traumatic Stress. https://www.healthcaretoolbox.org/child-life.
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.
7. Malchiodi, C.A. (2008), Creative Interventions with Traumatized Children – second edition. Guilford Press.
8. National Institute of General Medical Sciences, (2017). Trauma Fact Sheet.
9. O'Keeffe N. (2001). Pain Management: Pain and Children. *World of Irish Nursing*, 9(10), 34-36.
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.

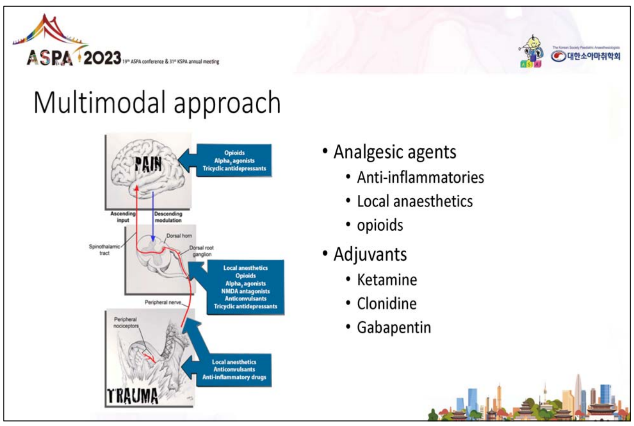
Restricted, Sensitive (Normal)

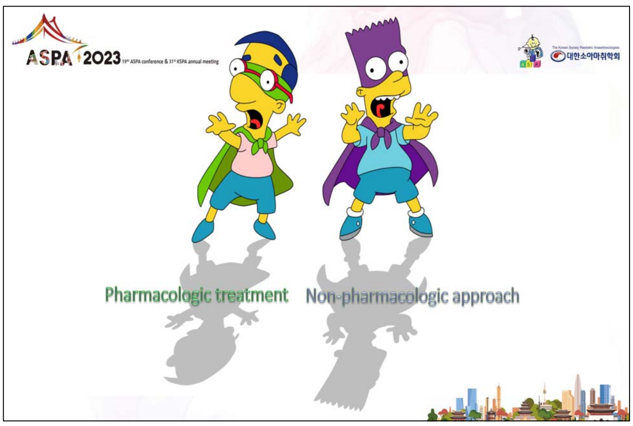
Role of Analgesic Adjuvants in Severe Burn Injury in Children: Timing and Precision

Teddy Fabila

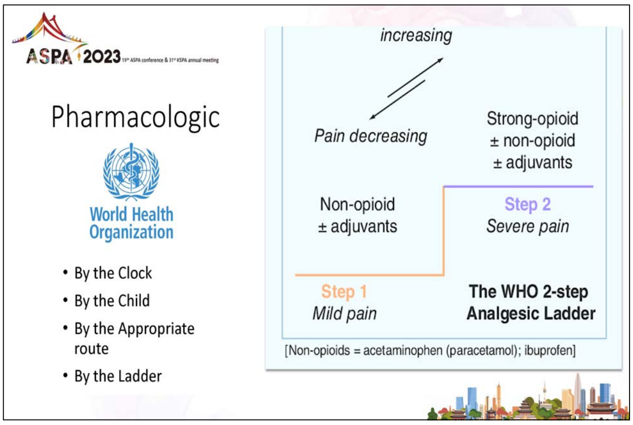
KK Women's and Children's Hospital, Singapore/Philippine

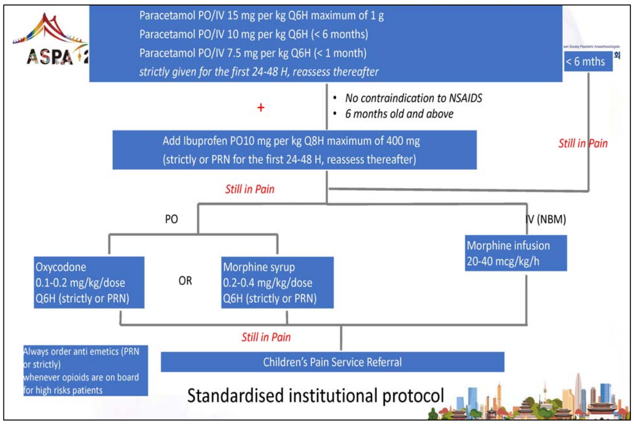




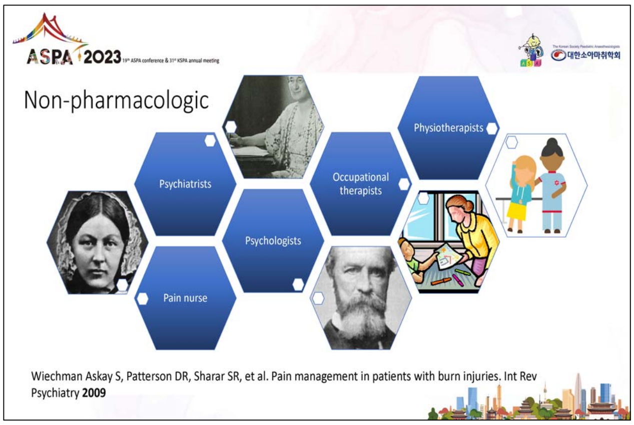


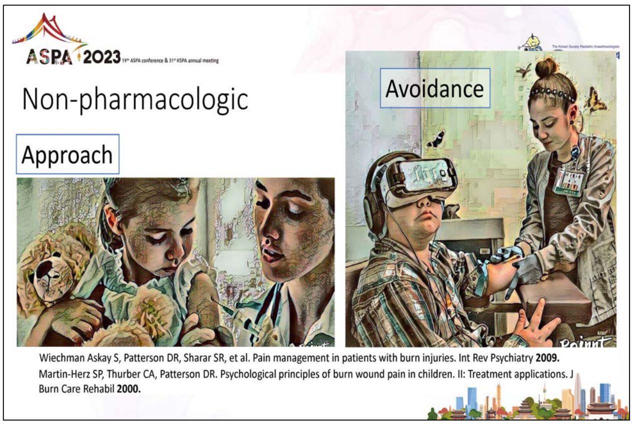

ASPA 2023
Multimodal
Multispecialty
Opioid sparing technique
Pharmacologic
Non-Pharmacologic
Carlos "Botong" Francisco, Bayanihan, 1962
UNILAB's administration building in Manila

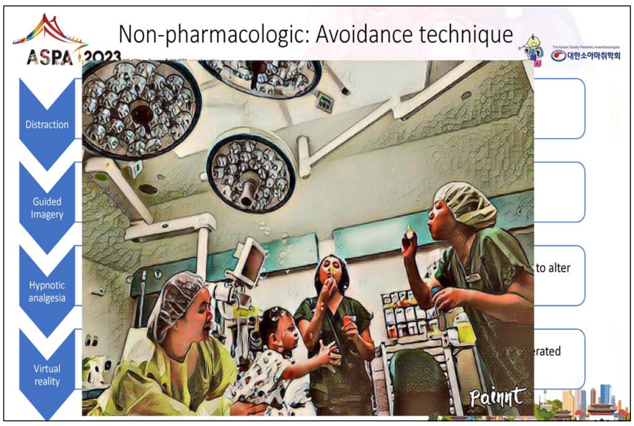

ASPA 2023
Pharmacologic
World Health Organization
By the Clock
By the Child
By the Appropriate route
By the Ladder
increasing
Pain decreasing
Strong-opioid
± non-opioid
± adjuvants
Non-opioid
± adjuvants
Step 2
Severe pain
Step 1
Mild pain
The WHO 2-step Analgesic Ladder
[Non-opioids = acetaminophen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

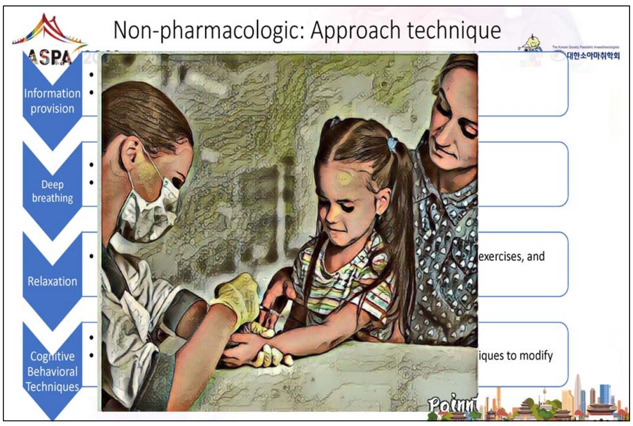

Paracetamol PO/IV 15 mg per kg Q6H maximum of 1 g
Paracetamol PO/IV 10 mg per kg Q6H (< 6 months)
Paracetamol PO/IV 7.5 mg per kg Q6H (< 1 month)
strictly given for the first 24-48 H, reassess thereafter
< 6 mths
+
No contraindication to NSAIDS
6 months old and above
Add Ibuprofen PO10 mg per kg Q8H maximum of 400 mg
(strictly or PRN for the first 24-48 H, reassess thereafter)
Still in Pain
Still in Pain
PO
IV (NBM)
Morphine infusion
20-40 mcg/kg/h
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)
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

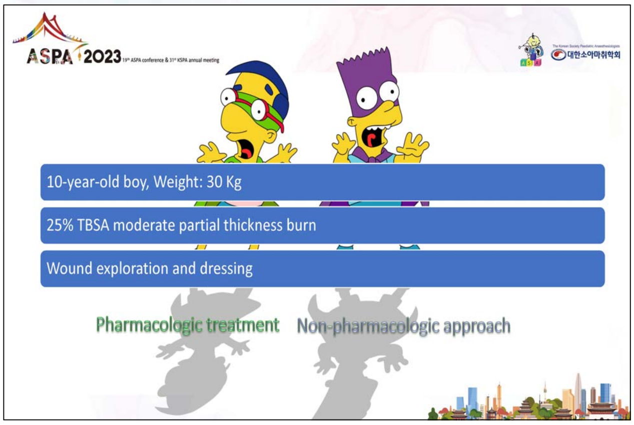

ASPA 2023
Non-pharmacologic
Physiotherapists
Psychiatrists
Occupational therapists
Psychologists
Pain nurse
Wiechman Askay S, Patterson DR, Sharar SR, et al. Pain management in patients with burn injuries. Int Rev Psychiatry **2009**

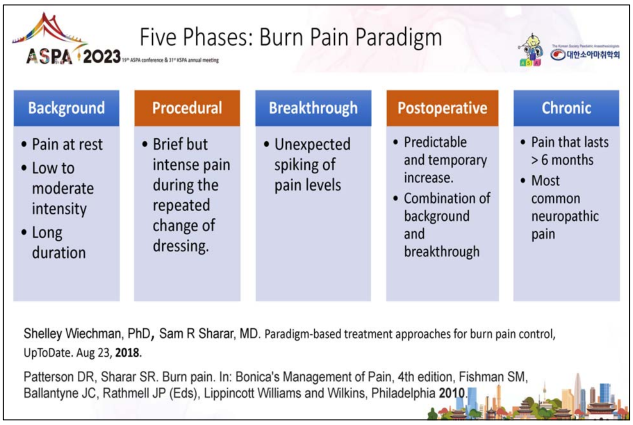

ASPA 2023
Non-pharmacologic
Avoidance
Approach
Wiechman Askay S, Patterson DR, Sharar SR, et al. Pain management in patients with burn injuries. Int Rev Psychiatry **2009**.
Martin-Herz SP, Thurber CA, Patterson DR. Psychological principles of burn wound pain in children. II: Treatment applications.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

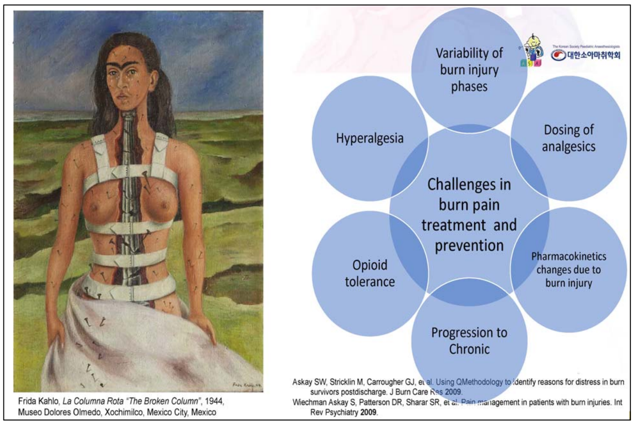

Non-pharmacologic: Avoidance technique
Distraction
Guided Imagery
Hypnotic analgesia
Virtual reality
to alter
rated

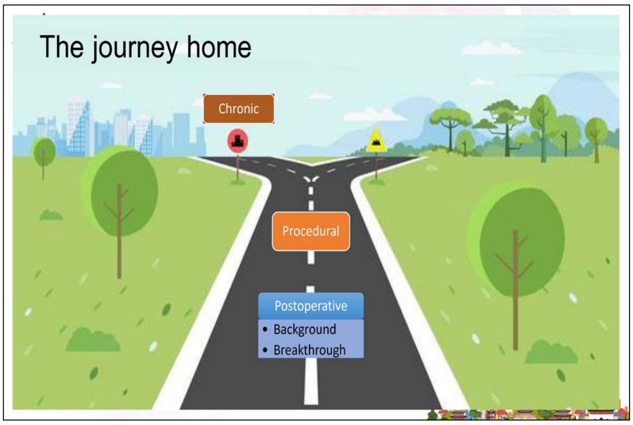

Non-pharmacologic: Approach technique
Information provision
Deep breathing
Relaxation
Cognitive Behavioral Techniques
exercises, and
iques to modify

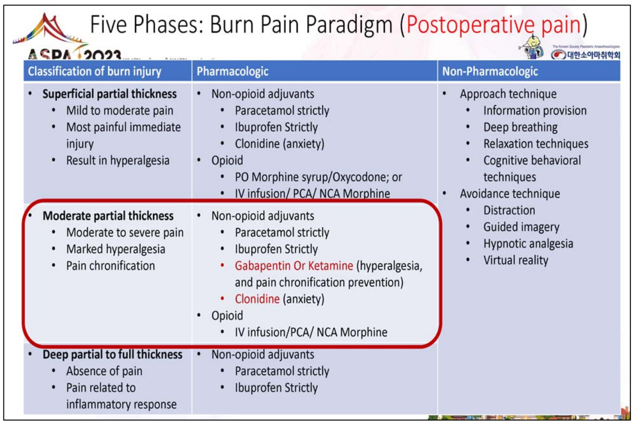
Teddy Fabila: Role of Analgesic Adjuvants in Severe Burn Injury in Children: Timing and Precision

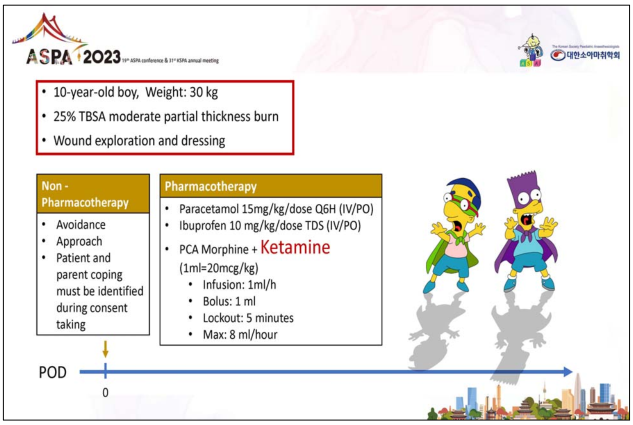


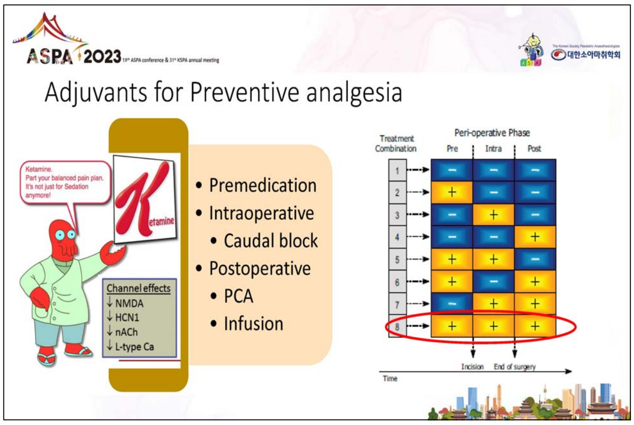


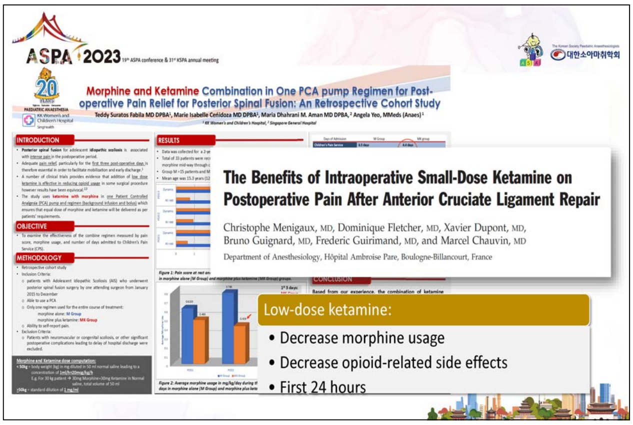


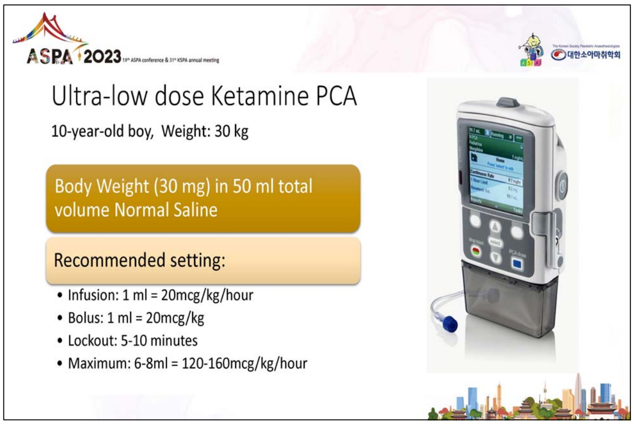


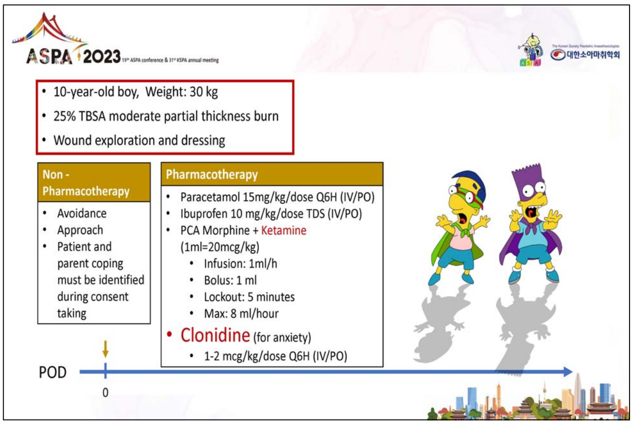


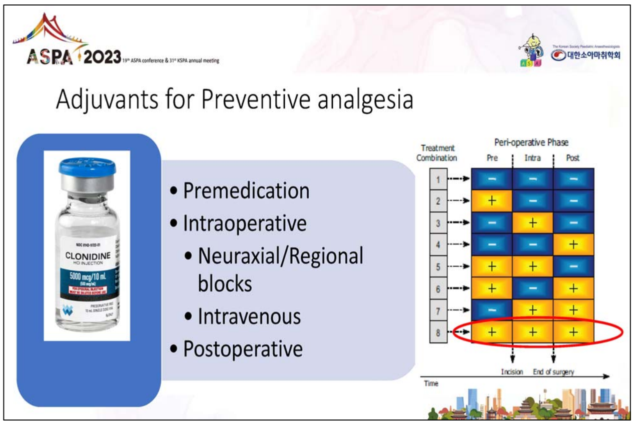


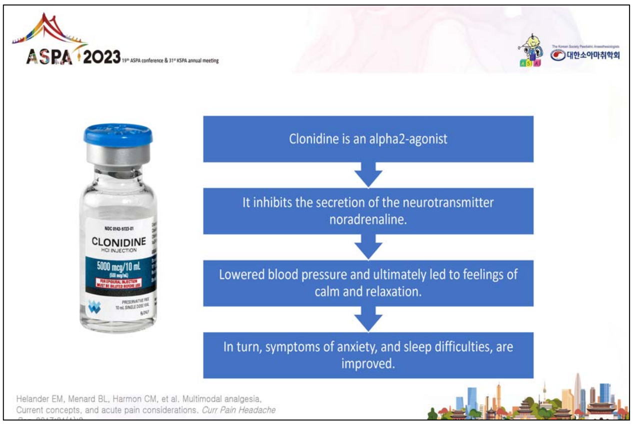


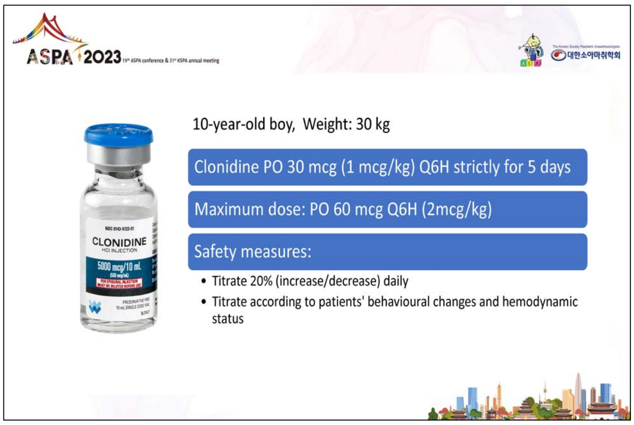


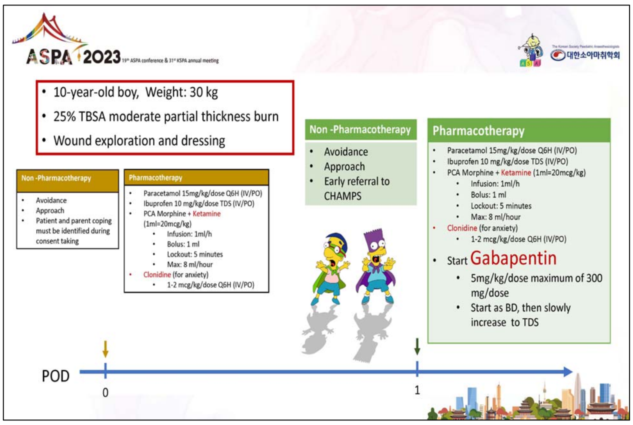

Ultra-low dose Ketamine PCA
10-year-old boy, Weight: 30 kg
Body Weight (30 mg) in 50 ml total volume Normal Saline
Recommended setting:
• Infusion: 1 ml = 20mcg/kg/hour
• Bolus: 1 ml = 20mcg/kg
• Lockout: 5-10 minutes
• Maximum: 6-8ml = 120-160mcg/kg/hour

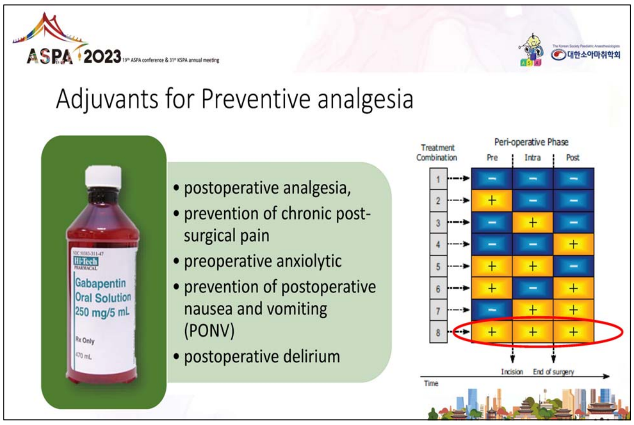

• 10-year-old boy, Weight: 30 kg
• 25% TBSA moderate partial thickness burn
• Wound exploration and dressing
Non - Pharmacotherapy
• Avoidance
• Approach
• Patient and parent coping must be identified during consent taking
Pharmacotherapy
• Paracetamol 15mg/kg/dose Q6H (IV/PO)
• Ibuprofen 10 mg/kg/dose 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

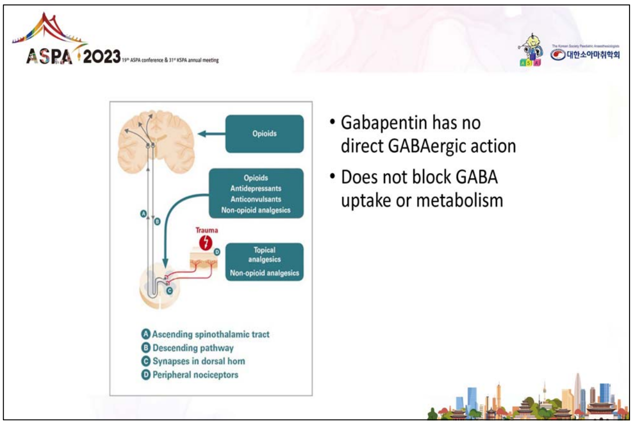

Adjuvants for Preventive analgesia
• Premedication
• Intraoperative
• Neuraxial/Regional blocks
• Intravenous
• Postoperative
Treatment Combination
Peri-operative Phase
Pre
Intra
Post
Incision
End of surgery
Time

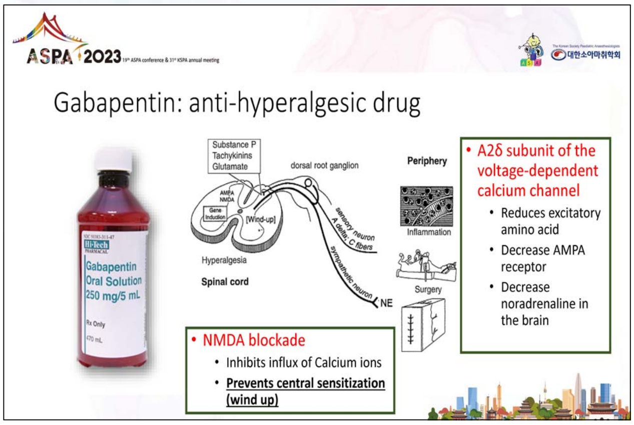

Clonidine is an alpha2-agonist
It inhibits the secretion of the neurotransmitter noradrenaline.
Lowered blood pressure and ultimately led to feelings of calm and relaxation.
In turn, symptoms of anxiety, and sleep difficulties, are improved.
Helander EM, Menard BL, Harmon CM, et al. Multimodal analgesia, Current concepts, and acute pain considerations. Curr Pain Headache

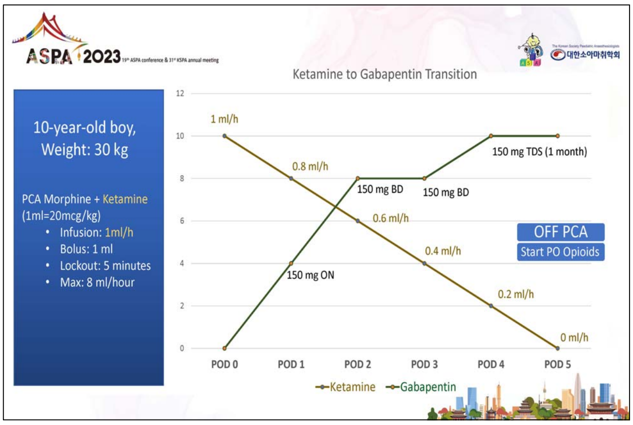

10-year-old boy, Weight: 30 kg
Clonidine PO 30 mcg (1 mcg/kg) Q6H strictly for 5 days
Maximum dose: PO 60 mcg Q6H (2mcg/kg)
Safety measures:
• Titrate 20% (increase/decrease) daily
• Titrate according to patients' behavioural changes and hemodynamic status

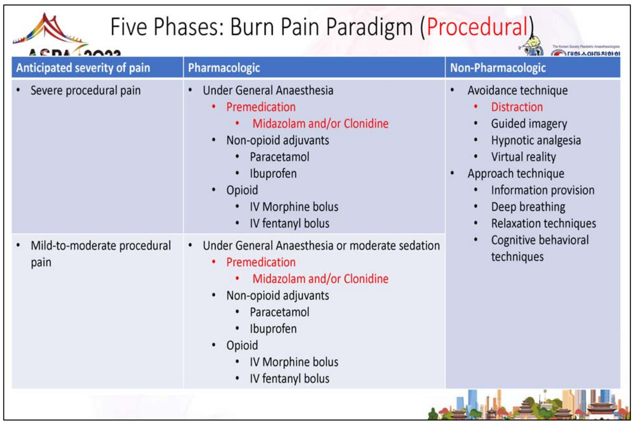

• 10-year-old boy, Weight: 30 kg
• 25% TBSA moderate partial thickness burn
• Wound exploration and dressing
Non -Pharmacotherapy
• Avoidance
• Approach
• Patient and parent coping must be identified during consent taking
Pharmacotherapy
• Paracetamol 15mg/kg/dose Q6H (IV/PO)
• Ibuprofen 10 mg/kg/dose 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)
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

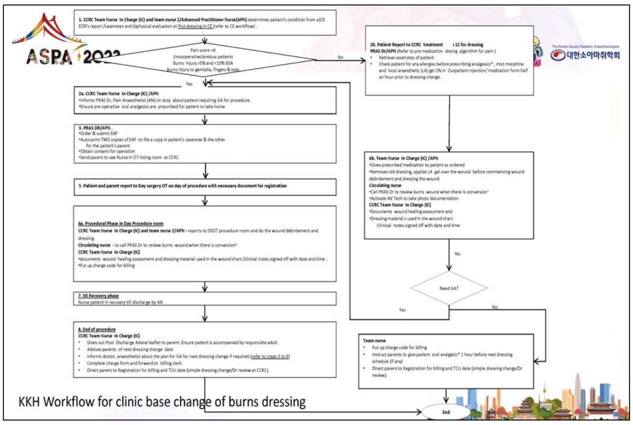

Adjuvants for Preventive analgesia
• postoperative analgesia,
• prevention of chronic post-surgical pain
• preoperative anxiolytic
• prevention of postoperative nausea and vomiting (PONV)
• postoperative delirium
Treatment Combination
Peri-operative Phase
Pre
Intra
Post
Incision
End of surgery
Time

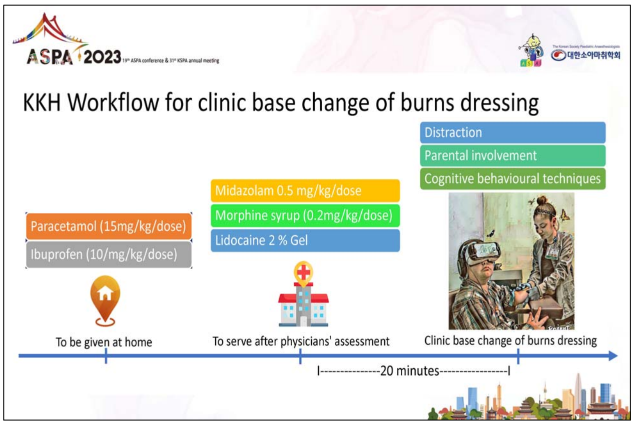

Opioids
Opioids
Antidepressants
Anticonvulsants
Non-opioid analgesics
Trauma
Topical analgesics
Non-opioid analgesics
A Ascending spinothalamic tract
B Descending pathway
C Synapses in dorsal horn
D Peripheral nociceptors
• Gabapentin has no direct GABAergic action
• Does not block GABA uptake or metabolism

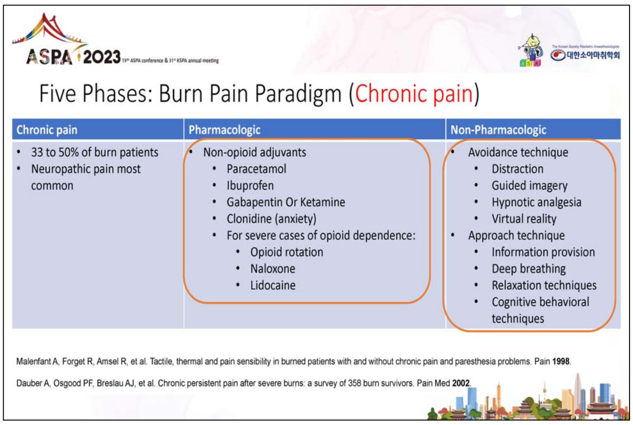

ASPA 2023
Gabapentin: anti-hyperalgesic drug
Gabapentin Oral Solution 250 mg/5 mL
Substance P
Tachykinins
Glutamate
dorsal root ganglion
Periphery
Inflammation
Hyperalgesia
Spinal cord
Surgery
NE
A2δ subunit of the voltage-dependent calcium channel
Reduces excitatory amino acid
Decrease AMPA receptor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

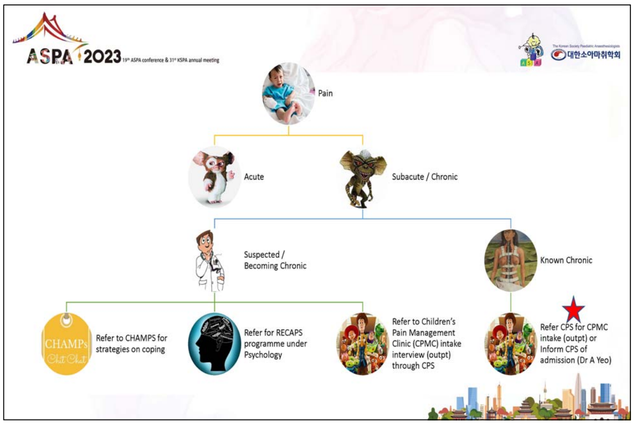

ASPA 2023
Ketamine to Gabapentin Transition
10-year-old boy, Weight: 30 kg
PCA Morphine + Ketamine (1ml=20mcg/kg)
Infusion: 1ml/h
Bolus: 1 ml
Lockout: 5 minutes
Max: 8 ml/hour
1 ml/h
0.8 ml/h
0.6 ml/h
0.4 ml/h
0.2 ml/h
0 ml/h
150 mg ON
150 mg BD
150 mg BD
150 mg TDS (1 month)
OFF PCA
Start PO Opioids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

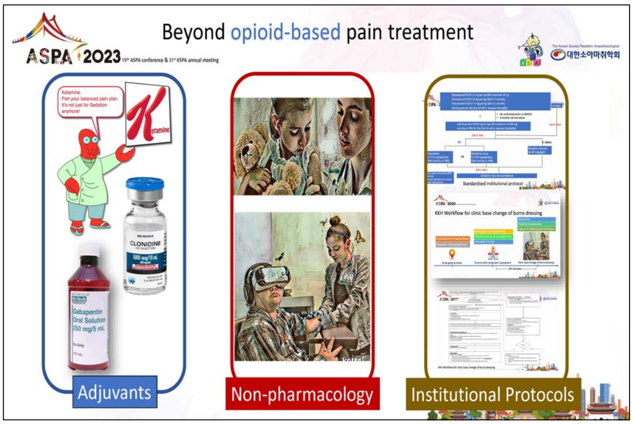

Five Phases: Burn Pain Paradigm (Procedural)
Anticipated severity of pain
Pharmacologic
Non-Pharmacologic
Severe procedural pain
Under General Anaesthesia
Premedication
Midazolam and/or Clonidine
Non-opioid adjuvants
Paracetamol
Ibuprofen
Opioid
IV Morphine bolus
IV fentanyl bolus
Mild-to-moderate procedural 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

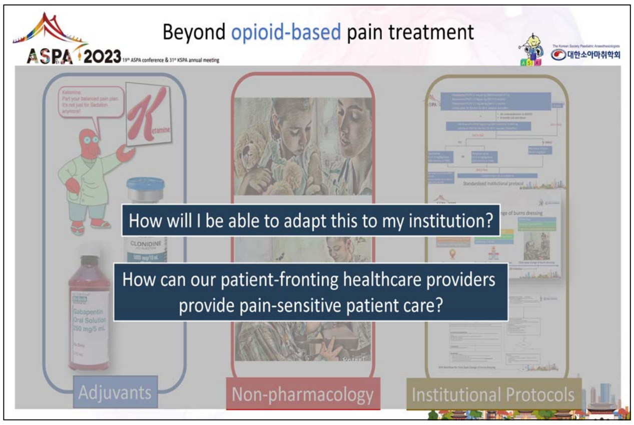

ASPA 2023
KKH Workflow for clinic base change of burns dressing

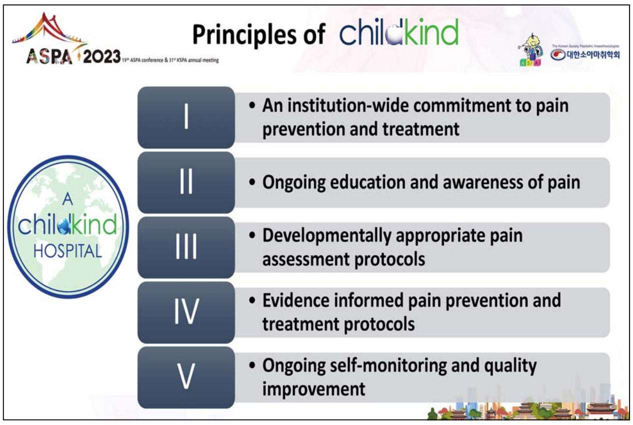

ASPA 2023
KKH Workflow for clinic base change of burns dressing
Distraction
Parental involvement
Cognitive behavioural techniques
Midazolam 0.5 mg/kg/dose
Morphine syrup (0.2mg/kg/dose)
Lidocaine 2 % Gel
Paracetamol (15mg/kg/dose)
Ibuprofen (10/mg/kg/dose)
To be given at home
To serve after physicians'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

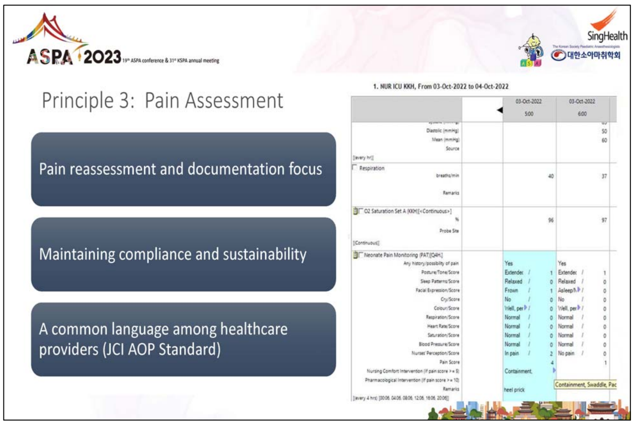

ASPA 2023
Beyond opioid-based pain treatment
Adjuvants
Non-pharmacology
Institutional Protocols

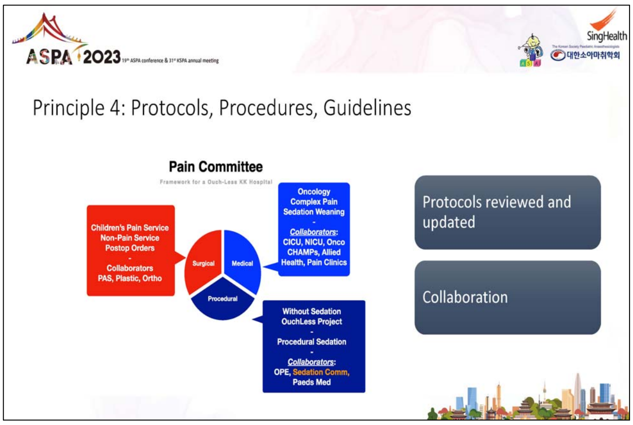

Beyond opioid-based pain treatment
How will I be able to adapt this to my institution?
How can our patient-fronting healthcare providers provide pain-sensitive patient care?
Adjuvants
Non-pharmacology
Institutional Protocols

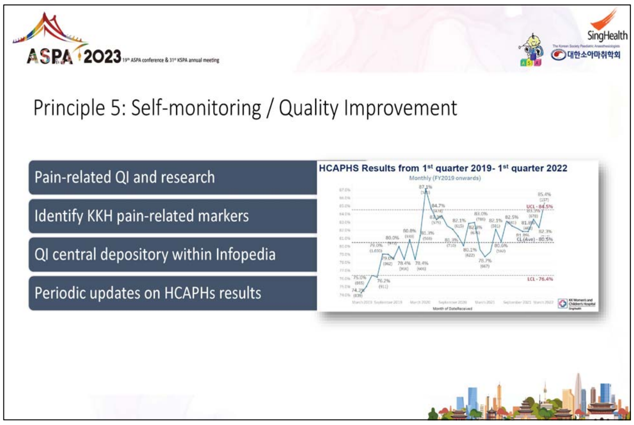

Principles of childkind
A childkind HOSPITAL
I
• An institution-wide commitment to pain prevention and treatment
II
• Ongoing education and awareness of pain
III
• Developmentally appropriate pain assessment protocols
IV
• Evidence informed pain prevention and treatment protocols
V
• Ongoing self-monitoring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

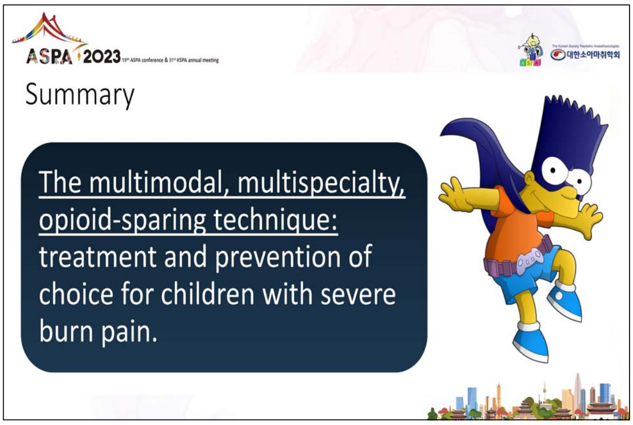

Principle 1: Institutional Commitment to Pain Prevention, Assessment and Management
Awareness and acknowledgement
• Handwritten appreciation postcard
• ChildKind Champion Award 23
Leadership support
Pain Awareness Week
Leadership
Managers
Staff

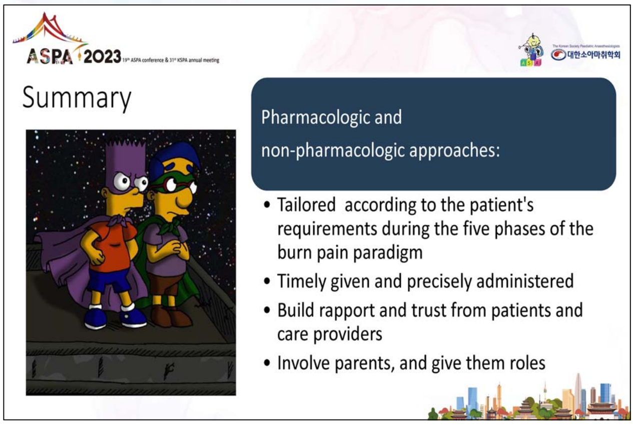

Principle 2: Ongoing Education and Awareness of Pain
KKH pain handbook
Annual multidisciplinary Pain conference
Online education for new staff (pain culture awareness)

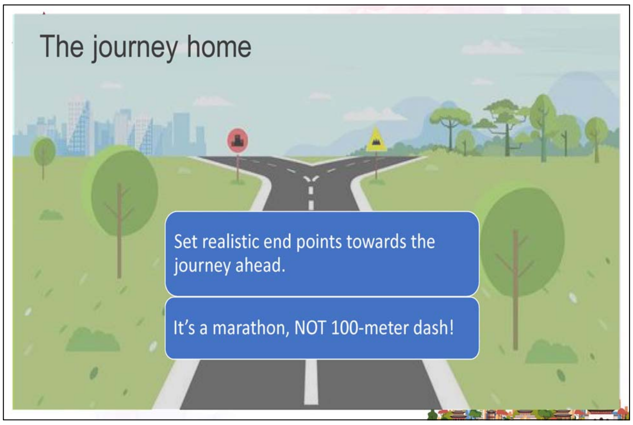

Principle 3: Pain Assessment
Pain reassessment and documentation focus
Maintaining compliance and sustainability
A common language among healthcare providers (JCI AOP Standard)

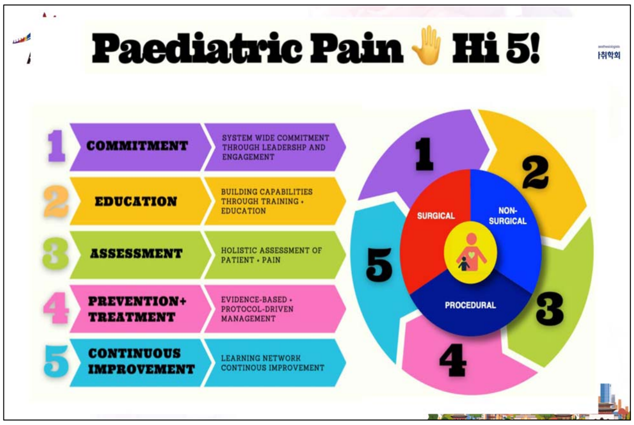

Principle 4: Protocols, Procedures, Guidelines
Pain Committee
Children's Pain Service
Non-Pain Service
Postop Orders
Collaborators
PAS, Plastic, Ortho
Surgical
Medical
Procedural
Oncology
Complex Pain
Sedation Weaning
Collaborators:
CICU, NICU, Onco
CHAMPs, Allied
Health, Pain Clinics
Without Sedation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


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


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

19th Conference of Asian Society of Paediatric Anesthesiologists &
31st Annual Meeting of the Korean Society of Pediatric Anesthesiologists

Published on 12 June 2023

Publisher Jin-Tae Kim, President of Korean Society of Pediatric Anesthesiologists

Printed by Gaon Convention

E-mail : gaonpco@gaonpco.com