A Review of Current Literature of Interest to the Office-Based Anesthesiologist

Christensen RE, Haydar V, Voepel-Lewis TD. Pediatric cardiopulmonary arrest in the postanesthesia care unit, rare but preventable: analysis of data from Wake Up Safe, The Pediatric Anesthesia Quality Improvement Initiative. *Anesth Analg*. 2017;124:1231–1236.

Nearly 20% of anesthesia-related pediatric cardiac arrests (CAs) occur during emergence or recovery. The aim of this report was to describe the nature of pediatric postanesthesia care unit CA (PACU CA), subsequent patient outcomes, and factors associated with harm after pediatric PACU CA. Cases of PACU CA were drawn from the Wake Up Safe Pediatric Anesthesia Quality Improvement Initiative, a multicenter registry of adverse events in pediatric anesthesia. Demographics, underlying conditions, cause of CA, and outcomes were extracted. Descriptive statistics were used to characterize data and to assess risk of harm in those suffering CA. A total of 26 CA events were included: 67% in children <5 years, and 30% in infants (<1 year); 18 (69%) were deemed likely or almost certainly preventable. All preventable CAs originated as respiratory events and most (67%) had purported root causes that included poor provider judgment or inexperience, inadequate supervision, and competing priorities. CAs of cardiac origin were associated with increased level of harm (temporary or greater), whereas those of respiratory origin were associated more often with no harm. In conclusion, PACU CA events are rare and generally survivable, with better outcomes for respiratory-based events. Most were deemed preventable, suggesting a need for further vigilance in the early postoperative period. Maintenance of monitoring during patient transport to PACU and continuing care by anesthesia care providers until emergence from anesthesia may further reduce the preventable arrest rate. The root cause analyses conducted by individual institutions reporting these data to Wake Up Safe provided only limited insight, so multicenter collaborative approaches may allow for greater insight into effective arrest prevention strategies.

Comment: Although postoperative CA in children was noted in the Pediatric Perioperative Cardiac Arrest Registry (POCA), it is relatively uncommon, compared to presurgical and intraoperative events (*Anesth Analg*. 2010;110:1376–1382). The current study found that although only 4.7% of perioperative pediatric CA occurred in the PACU, 69% of those arrests were

determined to be preventable. As in the POCA registry, both preexisting cardiac pathophysiology and respiratory events were identified as the major underlying causes of CA; however, all CAs in the current study that were deemed preventable were respiratory in nature. Provider error (decision making or judgment) was equally as important or more important than patient issues (disease processes) in the PACU CAs. Although factors such as residual muscle relaxation and history of obstructive sleep apnea were not well described in the Wake Up Safe data, the need for improved vigilance is clearly demonstrated in this paper. (Summary MA Saxen*)

Joshi GP, Desai MS, Gayer S, Vila H, for the Society for Ambulatory Anesthesia (SAMBA). Succinylcholine for emergency airway rescue in class B ambulatory facilities: the Society for Ambulatory Anesthesia position statement. *Anesth Analg*. 2017;124:1447–1449.

Procedures in class B ambulatory facilities are performed exclusively with oral or intravenous sedative-hypnotics and/or analgesics. These facilities typically do not stock dantrolene because no known triggers of malignant hyperthermia (ie, inhaled anesthetics and succinylcholine) are available. This article argues that, in the absence of succinylcholine, the morbidity and mortality from laryngospasm can be significant, indeed, higher than the unlikely scenario of succinylcholine-triggered malignant hyperthermia. The Society for Ambulatory Anesthesia (SAMBA) position statement for the use of succinylcholine for emergency airway management is presented.

Comment: The American College of Surgeons' "Guidelines for Optimal Ambulatory Surgical Care and Office-Based Surgery" classifies facilities according to the type of anesthesia provided. These guidelines define class B facilities as those that perform minor or major surgical procedures in conjunction with oral, parenteral, or intravenous sedation or under analgesic or dissociative drugs. Drawing on published reports, the authors state the overall incidence of laryngospasm ranges from 0.1 to 5% but note that these figures are likely underreported. In contrast, the incidence of malignant hyperthermia is reported to range from 0.00018 to 0.00031%. The authors refer to reports that estimate succinylcholine is used in the management of approximately 1 in every 4 laryngospasms. By calling for a reassessment of the Malignant Hyperthermia Associ-

ation of the United States policy, this SAMBA position statement is consistent with the recommendation for properly trained dentists to stock succinylcholine for the emergency management of laryngospasm only regardless of whether dantrolene is also available. (Summary MA Saxen*)

Hassanein AG, Mabood MA. Can submandibular tracheal intubation be an alternative to tracheotomy during surgery for major maxillofacial fractures. *J Oral Maxillofac Surg.* 2016;75(3):508.e1–508.e7.

During surgery for major maxillofacial fractures, orotracheal intubation can interfere with some surgical procedures and nasal intubation can be contraindicated or impossible. Tracheotomy is often presented as a solution, although it carries a relatively high incidence of complications. This prospective study examined submandibular intubation in 26 patients, ranging between 14 and 57 years of age, who underwent surgery for major maxillofacial procedures in which both nasal and oral intubation were not indicated. Intubation technique, perioperative and postoperative course, complications, and outcomes were examined. All patients had mandibular fractures, with 19 midface fractures (73.1%), 11 nasal bone fractures (42.3%), 10 zygomatic bone fractures (38.5%), 9 naso-orbito-ethmoidal fractures (34.6%), and 9 frontobasilar fractures (34.6%). The procedure time for submandibular intubation ranged from 5 to 12 minutes (mean, 7 minutes 4.6 seconds). Delayed extubation was performed in 15 cases (57.7%) in which the tube was left in place for a period ranging from 8 to 50 hours (mean, 30 hours 24 minutes). The technique has proved to be straightforward and satisfactory. A postoperative superficial infection occurred in 2 patients, whereas hypertrophic scars occurred in another 2 patients. This study demonstrates submandibular endotracheal intubation is a straightforward, safe, and quick alternative to tracheotomy in selected cases.

Comment: This paper reports an approach to securing the airway during anesthesia for panfacial fractures. The technique used in this case involved initial oral intubation with an armored oral endotracheal (OET) followed by an extraoral 1.5-cm submandibular incision anterior to the gonial angle. A forceps was then introduced from the incision into the floor of the mouth, where the previously placed OET and pilot line were grasped and delivered through the incision to be reattached to the anesthesia circuit connector. After the surgical procedure, the OET and pilot line were reinserted into the oral cavity and reattached to the

anesthesia circuit connector. Extubation was then performed in the “ordinary way.”

This technique is interesting but likely of little practical value to this reviewer, based on treatment of over 2500 major facial fractures. A need to avoid an OET is not documented in the case described. Such a need might have included the necessity of placing maxillomandibular (arch bar) fixation (MMF), which would require no interference from an OET. Occasionally, nasoendotracheal (NET) is also contraindicated, particularly if the anesthesiologist is not familiar with such trauma, and tracheostomy may be relatively contraindicated, such as in younger pediatric populations. Briefly, other alternatives that avoid NET and tracheostomy during placement of MMF can include passing an OET through edentulous spaces or placing the arch bars in the operating room and placing the MMF postoperatively after extubation. (Summary DL Orr II†)

Mason KP. Paediatric emergence delirium: a comprehensive review and interpretation of the literature. *Br J Anaesth.* 2017;118:335–343.

Several unanswered questions relating to emergence delirium in children remain since it was first described over 50 years ago. Despite our subsequent identification of several predisposing factors, we are unable to accurately predict which patients are at greatest risk for this phenomenon. The author concludes that emergence delirium should be considered as a “vital sign” that should be followed and documented in every child in the postanesthetic recovery period. Standardized screening tools and research criteria should also be adopted for managing and studying pediatric emergence delirium.

Comment: Dr Mason presents a thorough and systemic review of the literature on emergence agitation and delirium in children. The relationship of this phenomenon to volatile anesthetics, type of surgery, age, parent and patient anxiety, and health care interaction are explored. No information is presented, however, on the relationship between the use of intraoral local anesthetic blocks and emergence delirium in children undergoing general anesthesia for dental treatment, although a relationship has long been suspected in the pediatric dental community (*Pediatr Dent.* 2013;35:422–425). Interestingly, this review identifies tonsil surgery, thyroid surgery, ophthalmic surgery, and otorhinolaryngologic procedures as being associated with a significant degree of postoperative emergence delirium. Local anesthetic is used, in various degrees, in all of these surgeries, suggesting a possible

relationship between head and neck surgery and/or local anesthesia usage and emergence agitation/delirium. (Summary MA Saxen*)

Grunwell JR, Kamat PP, Miksa M, et al, for the National Emergency Airway Registry for Children (NEAR4KIDS) and the Pediatric Acute Lung Injury and Sepsis (PALISI). Network trend and outcomes of video laryngoscope use across PICUs [published online ahead of print May 10, 2017]. *Pediatr Crit Care Med*. doi:10.1097/PCC.0000000000001175.

Video (indirect) laryngoscopy is used as a primary tracheal intubation device for difficult airways in emergency departments and in adult intensive care units (ICUs). The use and outcomes of video laryngoscopy compared with direct laryngoscopy have not been quantified in pediatric ICUs (PICUs) or cardiac ICUs. This retrospective review examines observational data from a multicenter tracheal intubation database (National Emergency Airway Registry for Children) from July 2010 to June 2015 including 36 PICUs/cardiac ICUs across the United States, Canada, Japan, New Zealand, and Singapore. Any patient admitted to a PICU or a pediatric cardiac ICU and undergoing tracheal intubation was included. The use of direct laryngoscopy versus video laryngoscopy for tracheal intubation was examined. There were 8875 tracheal intubations reported in the National Emergency Airway Registry for Children database, including 7947 tracheal intubations (89.5%) performed using direct laryngoscopy and 928 (10.5%) performed using video laryngoscopy. Wide variability in video laryngoscopy use exists across PICUs (median, 2.6%; range, 0–55%). Video laryngoscopy was more often used in older children ($p < .001$), in children with history of a difficult airway ($p = .01$), in children intubated for ventilatory failure ($p < .001$), and to facilitate the completion of an elective procedure ($p = .048$). After adjusting for patient-level covariates and site-level variance, the use of video laryngoscopy significantly increased over a 5-year period compared with fiscal year 2011 (odds ratio, 6.7; 95% CI, 1.7–26.8 for fiscal year 2014 and odds ratio, 11.2; 95% CI, 3.2–38.9 for fiscal year 2015). The use of video laryngoscopy was independently associated with a lower occurrence of tracheal intubation adverse events (adjusted odds ratio, 0.57; 95% CI, 0.42–0.77; $p < .001$) but not with a lower occurrence of severe tracheal intubation adverse events (adjusted odds ratio, 0.86; 95% CI, 0.56–1.32; $p = .49$) or fewer multiple attempts at endotracheal intubation (adjusted odds ratio, 0.93; 95% CI, 0.71–1.22; $p = .59$). This examination of patient-centered adverse outcomes associated with video

laryngoscopy compared with direct laryngoscopy for tracheal intubation is the largest reported international cohort of children to date.

The National Emergency Airway Registry for Children (NEAR4KIDS) is a multi-center, prospective registry for advanced airway management in Pediatric ICUs (<http://www.near.edu/near4kids/welcome.cfm>). The project collects data from over twenty participating centers in the North America, and has generated seven peer-reviewed publications on intubation practice, training and safety since 2010. Video laryngoscopy is an important emerging trend in clinical anesthesiology (Gooden CK, Video laryngoscopy and the pediatric airway. *Anesthesiology News*. <http://www.anesthesiologynews.com/Review-Articles/Article/08-16/Video-Laryngoscopy-and-The-Pediatric-Airway/37298/ses=ogst>. Accessed 07/25/2017). This article is highly relevant to those contemplating the addition of a video laryngoscope system to their dental anesthesia practice. (Summary MA Saxen)

Ghai B, Jain K, Saxena AK, Bhatia N, Sodhi KS. Comparison of oral midazolam with intranasal dexmedetomidine premedication for children undergoing CT imaging: a randomized, double-blind, and controlled study. *Pediatr Anesth*. 2017;27:37–44.

Children undergoing computerized tomography (CT) frequently require sedation to allay their anxiety to and prevent motion artifacts and stress of intravenous (IV) cannulation. The aim of this trial was to compare the effectiveness of oral midazolam and intranasal dexmedetomidine as sole premedicants in children for carrying out both IV cannulation and CT scanning, without the need for additional IV sedatives. Fifty-nine children, aged 1–6 years, scheduled to undergo CT imaging under sedation were randomized to receive either 0.5 mg/kg oral midazolam (group M) or 2.5 mcg/kg intranasal dexmedetomidine (group D). After 20–30 minutes, IV cannulation was performed and response to its placement was graded using the Groningen Distress Rating Scale (GDRS). After cannulation, children were transferred on the CT table and assessed using the Ramsay sedation score (RSS). CT imaging was performed without any further sedative if the RSS was ≥ 4 . If there was movement or decrease in sedation depth ($\text{RSS} \leq 3$), ketamine 1 mg/kg IV was given as an initial dose, followed by subsequent doses of 0.5 mg/kg IV if required. A significantly higher proportion of children in group D (67%) achieved $\text{RSS} \geq 4$ as compared to group M (24%) ($p = .002$). The risk ratio (95% CI) was 2.76 (1.38–5.52). Significantly lower GDRS scores were noted in group D (1 [1–2]) as compared to group M (2

[1–2]) at the time of venipuncture ($p = .04$). In the doses and time intervals used in this study, intranasal dexmedetomidine (2.5 mcg/kg) was found to be superior to oral midazolam (0.5 mg/kg) for producing satisfactory sedation for CT imaging.

Comment: Both oral and intranasal midazolam are commonly used in pediatric dentistry for achieving moderate sedation. Both techniques are limited by the physiochemical properties of midazolam, which cause a very bitter taste upon oral administration and significant burning upon nasal administration. Additional drawbacks include limited working time for dentistry and possible association with postoperative emergence agitation. Previously published reports suggest intranasal dexmedetomidine is better tolerated than oral or intranasal midazolam and may produce better intraoperative conditions with fewer postoperative complications as compared to midazolam. This double-blind, well-controlled study demonstrates better patient acceptance of intranasal dexmedetomidine as compared to oral midazolam; however, several limitations prevent its extrapolation to dental sedation. The most painful stimulus after the onset of sedation was IV cannulation, in a site previously treated with EMLA cream. The desired clinical objective was to have the child stationary enough to undergo CT imaging, which differs markedly from the stimulation caused by most intraoral dental procedures. Despite these limitations, this small study demonstrates the desirable sedative properties of dexmedetomidine and provides a foundation for future studies examining its use as a single sedative agent for procedural sedation, or as an anesthetic premedication or adjunct. (Summary MA Saxen*)

Mark A. Saxen, DDS, PhD,*
Indiana Office-Based Anesthesia,
Indianapolis, Indiana

D. L. Orr II, DDS, PhD, JD, MD,†
University of Nevada, Las Vegas, School of Dental
Medicine,
Las Vegas, Nevada