Challenges in Pediatric Ambulatory Anesthesia: Kids are Different

Corey E. Collins, DO\textsuperscript{a,b}, Lucinda L. Everett, MD\textsuperscript{b,c,*}

The care of the child having ambulatory surgery presents a specific set of challenges to the anesthesia provider. This review focuses on areas of clinical distinction that support the additional attention children often require, and on clinical controversies that require providers to have up to date information to guide practice and address parental concerns.

Specifically, this article addresses various categories of risk as applied to children presenting for ambulatory surgery (cardiovascular and respiratory risk, as well as the potential for neurocognitive dysfunction in the very young). The authors consider the role of perioperative anxiety and agitation, the influence these phenomena have on the experience of pediatric patients and their families, and potential strategies to minimize these outcomes. Considering the preponderance of head and neck surgery for pediatric ambulatory surgery, the authors focus on issues that complicate ear, nose, and throat (ENT) cases, including surgical risk, issues related to sleep-disordered breathing, and postoperative nausea and vomiting (PONV). This article discusses guidelines for pediatric anesthesia care and possible future implications for credentialing providers.

RISK IN PEDIATRIC AMBULATORY ANESTHESIA

Many pediatric anesthetics are done on an outpatient basis; although these are minor cases, they may present significant challenges to the clinician. In 2006, the most...
common cases in children less than 15 years of age were myringotomy with tube insertion (667,000), tonsillectomy with or without adenoidectomy (530,000), and adenoidectomy alone (132,000).1

Information about risk comes from several types of data. Large descriptive series give an overall picture of pediatric anesthesia outcomes, but may be limited in the type and amount of detail, and often come from a single institution; most of these are not specific to outpatients. Incident-reporting studies such as the American Society of Anesthesiologists (ASA) Closed Claims study give more detail on individual serious adverse events, but do not have denominator data to describe the population. Clinical registries gather data prospectively about a given population or problem; the Pediatric Perioperative Cardiac Arrest (POCA) registry has provided valuable information about anesthetic-related cardiac arrest, and in the future more and larger registry efforts should yield more precise outcomes data.

Risk factors associated with serious adverse events in pediatric anesthesia include young age (most frequently <12 months), coexisting disease as reflected by higher ASA status (particularly congenital heart disease), and emergency surgery.2 A recent large study from France reflects the modern era of anesthetic drugs and monitoring and shows a low overall rate of major morbidity related to anesthesia.3 In outpatient outcome studies, Fleisher and colleagues4 analyzed data of 783,558 surgical admissions in New York State, but no pediatric-specific risks were identified. A retrospective survey of outpatient-procedure–related death in Massachusetts between 1995 and 1999 did not report any pediatric deaths.5 Smaller series of pediatric ambulatory cases primarily detail unanticipated admission rates (0.9%–2%, usually for extensive surgery or protracted vomiting) and the rates of minor complications such as vomiting, cough/croup, and somnolence.6–8

The ASA Closed Claims Project reviews claims against anesthesiologists after the cases have reached some conclusion in the legal system. Analysis of patterns of injury from these cases has identified several situations in which anesthesiologists can recognize and decrease risk, such as cardiac arrest in adults having spinal anesthesia. Comparison of pediatric with adult claims in the early era of the Closed Claims Project showed that claims in pediatric patients were more likely to have been precipitated by a respiratory event, and more often deemed preventable by reviewers.9 Analysis of the more recent pediatric cases in the Closed Claims database found a relative reduction in claims for death/brain damage and for respiratory events, particularly inadequate ventilation and oxygenation. This improvement may be related to the adoption of pulse oximetry and capnography as standards in the early 1990s.10 Again, younger age and higher ASA status correlated with risk; half of the claims involved patients less than 3 years of age, and one-fifth were ASA 3 to 5.

Cardiac Risk

After the observations in the early Closed Claims series relating cardiac arrest to respiratory events, the POCA Registry was established to study anesthetic-related cardiac arrest in children. The initial results showed a cardiac arrest rate of 1.4 per million anesthetics, with the highest incidence in children less than 1 year of age and ASA 3 to 5. Cardiac arrests described in healthy children were primarily related to respiratory difficulty (laryngospasm or anatomic airway obstruction) and to relative anesthetic overdose (primarily with halothane), the latter accounting for nearly half of cardiac arrests in patients who were ASA 1 to 2.11 The POCA group published a follow-up analysis in 2008 that showed a significant decline in cardiac arrest related to volatile anesthetic overdose, but a constant proportion of respiratory causes, with laryngospasm still prominent.12 The other causes of pediatric cardiac arrest identified in
healthy patients (hypovolemia from blood loss and hyperkalemia from transfusion of stored blood) are unlikely to be seen in the ambulatory population. There was only 1 cardiac arrest in the 2000 POCA report related to hyperkalemia from succinylcholine in a patient with unrecognized myopathy; case reports of this clinical scenario from the early 1990s resulted in a US Food and Drug Administration (FDA) warning against the routine use of succinylcholine in pediatric patients.\textsuperscript{13}

**Respiratory Risk**

As noted earlier, perioperative respiratory adverse events (PRAE) in children may precipitate serious adverse outcomes. Respiratory events are common in studies of pediatric anesthesia complications; in evaluating these studies, it is important to consider the definitions used, which are frequently not consistent (eg, selection of an oxygen saturation of 95% as the threshold to describe a complication will result in a higher incidence than a threshold of 90% saturation). It is also important to consider the patient population, case type, and anesthetic technique; for example, a series of children with indwelling central venous catheters having propofol anesthetics for diagnostic and therapeutic procedures described a significantly lower incidence of laryngospasm than was seen in many other series.\textsuperscript{14}

In a large series of pediatric patients, Murat and colleagues\textsuperscript{3} found that respiratory events represented 53% of all intraoperative events, and were more frequent in ENT surgery, with ASA physical classification status 3 to 5, and with tracheal intubation. Mamie and colleagues\textsuperscript{15} described an overall 1.57 relative risk increase for PRAE in any child having ENT surgical procedures. Other risks for PRAE included provider experience, younger age, and upper respiratory infection. Although data suggest low overall risks for brief procedures such as myringotomy and ventilation tube (M&T) placement,\textsuperscript{12,16} the clinician must consider the risk of upper respiratory infection, potentially difficult mask ventilation, and comorbidities. In 1990, Markowitz-Spence and colleagues\textsuperscript{17} reported their experience with 510 children having M&T with 12% minor PRAE and 1.4% serious PRAE. In 2002, Hoffman and colleagues\textsuperscript{18} reported a similar series of 3198 children with a 9% adverse-event rate and 1.9% major PRAE. All patients received inhalation induction with halothane, and therefore it is unclear whether the data are applicable to today’s practice. Their data included 19/1005 cases of laryngospasm, airway obstruction, or significant desaturation.\textsuperscript{18} These investigators and others report that significant comorbidities and concurrent illness, including acute or recent respiratory infection, predicted increase PRAE.\textsuperscript{19–21} Both of these series represent data from a pediatric specialty center, and applicability to a general anesthesia practice should be made with caution; available data make it impossible to quantify whether risks are different in other settings. Because most M&T patients are less than 6 years of age, with peak incidence during infancy, an effort should be made to optimize the timing of the procedure and perioperative care to minimize risk.

**Neurocognitive Outcomes**

Although there is generally a focus on immediate risk in the perioperative period, a growing concern among parents relates to the possibility of adverse neurocognitive outcomes in very young children after anesthesia. In the last several years, the lay press has picked up on some animal and preliminary clinical studies that raise these questions. The initial animal studies involved chronic exposure of pregnant rats to subanesthetic concentrations of halothane, and showed behavioral abnormalities in the rat pups produced. Subsequent studies designed more specifically to study the effects on the brain have found neural degeneration, usually apoptosis (programmed
cell death) in a diffuse pattern. Multiple studies have shown this effect, although some have not. Almost all classes of anesthetic and sedative medications have been shown to have adverse effects in laboratory animals (volatile anesthetics, nitrous oxide, benzodiazepines, propofol, barbiturates, ketamine). Opioids generally show minimal effects, and there is some suggestion of mitigation of adverse effects of isoflurane by dexmedetomidine. Some animal data suggest that the adverse effects on neuronal development occur to a more significant extent in the absence of a painful stimulus, and so would be more relevant to sedation/anesthesia for intensive care unit (ICU) care or prolonged procedures. There remains much to learn about the mechanism of the tissue changes seen in animals, as well as how the experimental factors apply to humans (developmental age, duration of exposure and dosages, animal species, and anesthetic management).

Epidemiologic information from human studies has only recently become available. A study from the Mayo Clinic used an existing birth cohort for learning disability, and found that children who had received 2 or more anesthetics before the age of 4 years were at increased risk to develop learning disability. This was a retrospective study and impossible to discern whether this was a causal association or whether anesthesia was a marker for other factors which might cause learning disability; the anesthetics involved also occurred in children born between 1976 and 1982, before the availability of current drugs or monitoring modalities. A retrospective pilot study found more behavioral disturbances in children who had anesthesia/urologic surgery before 24 months of age. Most recently, a twin study showed no differences in learning ability in twin pairs in which 1 was exposed to anesthesia before the age of 3 and 1 was not; these investigators concluded that anesthesia at an early age is a marker of vulnerability for learning disability rather than a causative factor. Several large prospective studies are being designed or are in process to attempt to find a more definitive answer to this question, but conclusive data are likely to be several years away. However, it seems that, if risk for postanesthetic neurocognitive dysfunction exists in human infants, it is greatest in the very premature infant, for prolonged anesthesia/sedation and possibly at very high doses, and in the absence of painful stimuli. All of this should be reassuring to parents of children coming for brief ambulatory procedures.

Preoperative Anxiety and Postoperative Agitation

Predicting and managing anxiety in the child and parents is an important part of creating a safe and pleasant anesthetic experience for the pediatric outpatient. Studies confirm some of our clinical impressions: risk factors for high anxiety at induction include younger age, behavioral problems with previous health care attendances, longer duration of procedure, having more than 5 previous hospital admissions, and anxious parents. Kain and colleagues have published on several aspects of this issue, showing that midazolam premedication or parental presence decreases anxiety and improves acceptance of a mask induction, with midazolam somewhat more effective than parental presence, but that parental presence does not add to the benefit of premedication. Detailed analysis shows that children who benefit most from parental presence are somewhat older, have lower levels of anxiety at baseline, and have calmer parents who value preparation and coping skills for medical situations. A calm parent did benefit anxious children, whereas overly anxious parents did not confer any benefit. A comprehensive patient preparation program decreased anxiety and improved the quality of induction to a similar degree compared with midazolam, but patients in the preparation program also had decreased incidence of emergence delirium, lower requirements for opioids in the recovery area,
and a shorter time to discharge compared with premedication or parent-present induction alone.\textsuperscript{31}

Emergence agitation or delirium is a troublesome and poorly understood entity. It occurs most often in children aged 2 to 5 years, and an association has been found between preoperative anxiety in the child and parent, emergence delirium, and maladaptive behaviors (sleep disturbances, and so forth) after discharge.\textsuperscript{32} Agitation is more common after volatile anesthetics than after propofol. Although the clinical opinion of many recovery nurses is that delirium is more common after the shorter-acting volatile anesthetics than after halothane or isoflurane, the literature does not strongly support this\textsuperscript{33,34}, the occurrence in the early postoperative period with these shorter acting medications may lead to this impression. The rate of emergence does not seem to be responsible for the agitation itself, as comparison between sevoflurane and propofol showed that children emerged at the same rate but there was significantly higher agitation with sevoflurane.\textsuperscript{35} Midazolam premedication does not seem to decrease the incidence of emergence agitation, whereas several studies have suggested that ketamine has a favorable effect, perhaps related to duration of sedation. Small doses of propofol or dexmedetomidine near the end of anesthesia have been effective in reducing agitation.\textsuperscript{36,37}

In true emergence delirium, children are agitated, unaware of their surroundings, and inconsolable.\textsuperscript{38} Several clinical scales have been developed to attempt to quantify the severity of emergence delirium. The clinician faced with such a child needs to determine whether pain is, or could be, a component, in which case analgesics should be titrated if there is no contraindication. For nonpainful procedures, or if pain is believed to have been treated adequately, sedative drugs may be administered. In a monitored setting with appropriate staffing, a small dose of propofol may be used. Some agitation is self-limited; the anesthesia team should assess the need for treatment, weighing the potential for patient injury against risks such as respiratory depression, nausea/vomiting, and delayed discharge.

**CHALLENGES IN AMBULATORY ENT ANESTHESIA**

As noted earlier, rates of mortality or significant morbidity are low in pediatric ambulatory anesthesia. ENT surgery is routinely cited as the highest-risk surgical area for pediatric outpatients,\textsuperscript{3,11,12,39} and anesthetic-related decisions can affect length of stay (LOS), total costs, patient satisfaction, and secondary morbidity.\textsuperscript{40,41} Favorable results are reported in many series of outpatient ENT surgery with careful preoperative screening and intraoperative management; Gravningsbråten and colleagues\textsuperscript{42} reported an office-based practice of ENT surgery in 1126 children with 90 minutes or less of observation time with 1 reintubation for atelectasis (0.1\% immediate complication rate).

Tonsillectomy with or without adenoidectomy confers some specific risks resulting from a shared airway, a surgical site in the pediatric airway, and sequelae from the necessary depth of anesthesia. Bleeding, pain control, oral intake, and oxygenation are the primary early complications following elective pediatric tonsillectomy.\textsuperscript{43–45} Most sources support the safety of tonsillectomy as an outpatient procedure in older children who are ASA 1 to 2 at general hospitals,\textsuperscript{19,41,44–46} but some literature reports an increase in complications among children less than 3 years of age.\textsuperscript{47,48} Other reports recommend application of clinical indicators to recommend safe discharge, even in younger children.\textsuperscript{19,48,49} Same-day discharge may be more costly than admission because of increased recovery-room LOS in children less than 3 years of age.\textsuperscript{50} Children with obstructive sleep apnea (OSA) may require overnight monitoring, as is discussed in more detail later.
Despite the overall low morbidity associated with ambulatory tonsillectomy in children, there are important rare and ominous risks. In a 2008 review of closed claims in New York State, awards against anesthesiologists were higher than against surgeons ($5 million vs $839,650) and often involved airway complications. The presenting indications for many children undergoing tonsillectomy may include comorbidities that increase risk, such as OSA, obesity, central sleep apnea, or syndromes associated with facial dysmorphisms (eg, trisomy 21 syndrome, CHARGE syndrome). Post-tonsillectomy hemorrhage (PTH) can result in death. Windfuhr and colleagues reported survey data on lethal and near-lethal hemorrhage and concluded that delay in return to the operating room, repeated hemorrhage episodes, and aspiration of blood contributed to mortality. They also concluded that admission status did not affect morbidity. These investigators urge aggressive airway management to prevent the secondary sequelae of aspiration and inability to intubate when faced with significant PTH; immediate volume resuscitation, and transfusion, if indicated, are also important components of care.

Direct vascular injuries can occur, most often during adenoidectomy. Significant vascular branches of the external carotid artery (tonsillectomy) or the facial and maxillary arteries (adenoidectomy) may be injured during surgery and may require proximal carotid control for repair. Other rare complications include atlantoaxial subluxation, mandible condyle fracture, infection, and eustachian tube injury. Myringotomy and tube placement can also be complicated by significant vascular events (intrapetrous internal carotid artery puncture leading to pseudoaneurysm formation or arterial hemorrhage requiring endovascular intervention; profuse venous hemorrhage from injury to an anomalous jugular bulb).

Surgical technique may affect the quality of recovery, with techniques such as radiofrequency ablation of tonsillar tissue having less pain than standard cold tonsillectomy; dissection with electrocautery seems to be associated with the highest degree of postoperative pain. Injection of local anesthesia after tonsillectomy seems to confer a modest reduction in pain, but systematic review suggests that equivalent results can be obtained by topical application using swabs. Rare serious events are reported related to local anesthetic injection (cervical osteomyelitis, Horner syndrome, and airway obstruction due to vocal cord paralysis).

Anesthetic management can also affect the perioperative course. Intubation without muscle relaxant has become more common in pediatric anesthesia because of a lack of appropriately short nondepolarizing muscle relaxants; although adequate depth must be ensured to avoid laryngospasm, this obviates any possible emetogenic effects of reversal agents and the risk of residual muscle weakness. A propofol-based technique offers advantages in minimizing PONV and may be associated with less bleeding during tonsillectomy.

Supraglottic airways are used enthusiastically in tonsillectomy by some providers but are not widely embraced; providers in the United Kingdom report the use of an endotracheal tube in 79% of cases, despite the continued trend to avoid paralytics and the availability of reinforced supraglottic devices. Conversely, a recent Norse report documented 1126 cases of office-based tonsillectomy and adenoidectomy with a supraglottic airway; 0.6% required conversion to endotracheal tube. A letter in response from Xue and colleagues presented a thorough argument for a reinforced supraglottic airway with specific attention to the implications of kinking and dislodgment from the intraoral surgical gag, the mechanical impediment tonsillar hyperplasia can create, and the risk of PRAE without adequate anesthetic depth. Clearly, safe airway management can include a spectrum of techniques, and further study is needed to confirm whether any specific technique is superior.
The implications of sleep-disordered breathing, OSA, or central sleep apnea are significant and can introduce predictable risk in the care of the pediatric patient. As Lerman61 states in a 2009 review, there are important pathophysiological, anatomic, and pharmacological considerations and important distinctions between the child with this disease and the adult.49 In children, this disease affects both genders equally, is associated with all body types, and is primarily a surgically treated entity; in adults, incidence in men exceeds women, obesity is often present, and nonsurgical interventions are first-line therapy (continuous positive airway pressure [CPAP], weight loss). Children and adults can suffer cardiovascular sequelae such as cor pulmonale and pulmonary hypertension. Cognitive impairment, learning disorders, and behavioral problems can complicate both populations.60 Although children with OSA are recognized as being at increased risk perioperatively, the provider must consider whether extensive preoperative testing (echocardiogram, electrocardiogram, complete blood count, nocturnal somnography) will contribute to decision making about management or plans for admission.61,62

A review of adenotonsillectomy for OSA in young children found a significantly higher incidence of respiratory complications before the age of 3 years, and recommended routine admission for those patients.63 In a survey of anesthesiologists in the United Kingdom, only 36% of respondents considered children for same day discharge after tonsillectomy with adenoidectomy, especially with a history of OSA.59 Sanders and colleagues64 documented increased complications after tonsillectomy with adenoidectomy in children with OSA versus those without, but found no effect on LOS.

Several articles have documented enhanced sensitivity to opioids in children with OSA. Brown and colleagues65 calculated that sleep somnography can predict the risk of sensitivity to parenteral morphine: if the pulse oximetry nadir was less than 85%, a subject requires roughly 50% of the postoperative dose of morphine for analgesia. Hullett and colleagues66 described equivalent analgesia with less respiratory depression using tramadol compared with morphine in nonobese children with OSA after tonsillectomy with adenoidectomy.

Obesity

Obesity is an important confounder for ambulatory risk. An estimated 16% of the children in the USA meet the definition of obesity. Tait and colleagues67 reported that obese children are significantly more likely to present for surgery with complicating comorbidities such as asthma, reflux disease, type II diabetes mellitus, and OSA. Obesity increased the risk of complication during anesthesia including higher incidence of difficult mask ventilation, airway obstruction, and PRAE. Four-hundred and two of 1147 subjects underwent ENT surgery. The obese children had significantly less PONV (4.8% vs 16.8%).67 Ye and colleagues68 reported an 11.2% PRAE rate following tonsillectomy for OSA; obesity (as well as young age and higher apnea-hypopnea indexes) was identified as a significant risk factor. Nafiu and colleagues62 correlated obesity with increased risks for PRAE after tonsillectomy, including intraoperative desaturation, difficult laryngoscopy, and airway obstruction in the operating room and the recovery room. A correlation between body mass index (BMI) and LOS was documented.

Outcomes after surgery may be variable. In an article comparing tonsillectomy with tonsillotomy, de la Chaux and colleagues69 reported complete surgical cure of OSA (apnea-hypopnea index [AHI] 14.9 preoperative to 1.1 postoperative) with significantly less pain and lower PTH rates after CO₂ laser tonsillotomy. Shine and colleagues70 found a less dramatic effect with tonsilloadenoidectomy in morbidly obese children.
with OSA; although all subjects benefited from surgery (AHI 20.7 preoperatively to 7.3 postoperatively), only 8 of 18 children no longer needed CPAP management after surgery. They were unable to assign variables for responders to nonresponders to surgery. A 2009 meta-analysis further documented the incomplete benefit of surgery in obese children with OSA. In 2004, Shatz investigated the effectiveness of adenoidectomy in 24 infants with OSA symptoms and reported curative results with no morbidity.

**PONV and Pain Management in Tonsillectomy**

PONV can be troublesome to patients and families, and is known to delay discharge. General risk factors for PONV in children include age more than 3 years, duration of surgery more than 30 minutes, strabismus surgery, and history of postoperative vomiting in the child or PONV in the parents. PONV after tonsillectomy occurs at rates as high as 50% to 89%, which is believed to be related to swallowed blood, pharyngeal stimulation, and the need for opioid analgesics. Blacoe and colleagues reported their experience with unplanned admissions after ambulatory surgery and found PONV to be the most common reason for admission. General surgery cases were significantly more likely to result in PONV than ENT cases (24% vs 15%). Edler and colleagues studied LOS data after tonsillectomy with adenoidectomy in 2008 and found PONV to be the most significant factor in delayed discharge readiness. Each PONV/retching episode increased LOS by 30 minutes (as did a single SpO2<95%). Prophylaxis is generally recommended using 1 or more agents including dexamethasone, 5-hydroxytryptamine-3 (5-HT3) antagonists, droperidol, or promethazine. Dexamethasone, frequently used by the otolaryngologist to decrease swelling and improve oral intake, is also effective in reducing PONV. The usual dose is 0.5 mg/kg, although a prospective dose-response study showed no difference within the range of 0.0625 to 1.0 mg/kg in the outcomes of pain, vomiting, time to oral intake, or voice change. Dexamethasone at 0.5 mg/kg has recently been linked to increased PTH.

Nonsteroidal antiinflammatory drugs (NSAIDS) are used infrequently in tonsillectomy in the United States because of concern for bleeding, but a Cochrane Review concluded that their use significantly decreased PONV without significant effect on PTH. A recent survey of pediatric anesthetists in the United Kingdom revealed that 77% use NSAIDs in the perioperative care of children having tonsillectomy. Acetaminophen is effective when effective loading doses are used, although rectal administration has a slow and variable onset; intravenous propacetamol (not available in the United States at the time of writing) may offer further advantage. Other non-opioid analgesics such as ketamine, tramadol, and dexmedetomidine have shown efficacy and opioid-sparing effects in small studies. Although codeine is frequently prescribed for post-tonsillectomy analgesia, newer understanding of the pharmacogenetic basis of variability of codeine activity and reports of respiratory depression after discharge suggest that a uniformly safe and effective analgesic regimen has yet to be identified.

Although no data currently document the variability in practice among American anesthesia providers, it seems prudent to recommend a tonsillectomy technique that uses dexamethasone and 5-HT3 antagonists, minimizes opioid doses possibly (including a revisitation of the American acceptance of NSAID use), and uses propofol as a main component of the anesthetic. Cost analysis also supports the use of propofol and multimodal PONV prophylaxis. Several groups have described low incidence of complication in outpatient tonsillectomy with appropriate patient selection and clinical protocols designed to manage postoperative pain and decrease PONV. Unlike adult patients, there is a requirement to consider the ability of the
parent or guardian to understand the discharge risks and instructions, proximity, and potential causes for delay should return to hospital become indicated, and the overall clinical assessment of the surgical team before discharge. Each institution should consider these issues in formulating specific discharge criteria.

CREDENTIALING IN PEDIATRIC ANESTHESIA

Credentialing continues to be an area of controversy in pediatric anesthesia; which patient requires a pediatric anesthesiologist? What is the definition of a pediatric anesthesiologist? There is general consensus that high-risk procedures should not be undertaken on an infrequent basis, but specifics are less clear on what numbers are required for ongoing competency and what situations require specialized care. There is some evidence that adverse events are less common in the hands of experienced pediatric anesthesiologists. The 1989 conclusion of the National Confidential Enquiry into Perioperative Deaths recommended that surgeons and anesthetists in the United Kingdom not undertake occasional pediatric practice; in the United Kingdom, specialists care for children younger than 5 years of age, and in Scandinavia, the age is 2 years.

Training programs are accredited by the Accreditation Council for Graduate Medical Education (ACGME); pediatric anesthesia was the first operating room (OR) subspecialty of anesthesiology to have accreditation for fellowship training, beginning in 1997. Anesthesiologists receive board certification through the American Board of Anesthesiology (ABA); at present, subspecialty board certification does not exist for any OR subspecialty of anesthesiology, although it does exist for Pain Management and Critical Care. The Society for Pediatric Anesthesia has proposed “subspecialty certification in advanced pediatric anesthesiology” as part of a tiered system to provide excellent care to high-risk pediatric patients, but, at the time of writing, this proposal remains with the Board of Directors of the ABA.

Until formal requirements, if any, are developed for pediatric anesthesia care, institutions and anesthesiologists should consider their individual practice settings and competencies, and guidelines from several professional organizations. The American Academy of Pediatrics (AAP) Section on Anesthesiology has published Guidelines for the Pediatric Perioperative Anesthesia Environment, which suggest that each facility define the spectrum of pediatric patients and cases for which it will provide care, and the number of cases of each required for the facility to maintain its competence. These guidelines also suggest that the institution define which pediatric patients are considered to be at increased risk, and that their anesthesia care should be provided by anesthesiologists who are fellowship trained in pediatric anesthesia or have equivalent experience. Similar recommendations have been made by the ASA and the Society for Pediatric Anesthesia. Some states have also instituted or considered requirements to have anesthesiologists caring for children (of some defined age) meet certain minimal case numbers. The AAP guidelines also include recommendations for appropriately sized airway and monitoring equipment, child-friendly spaces including separate preoperative area for children/families, and age-specific competencies and resuscitation skills for OR and recovery staff.

SUMMARY

Careful patient screening and selection help to minimize the risk of adverse outcomes in pediatric ambulatory surgery, and the overall rates of serious morbidity in the United States remain low. Errors in medication doses and effects, airway management, malfunctioning equipment or alarms, distraction, inexperience, or other human-related
issues contribute to many preventable events. The unique physiologic, anatomic, and pharmacologic state of children of various ages challenges the anesthesia provider to remain vigilant during surgery; knowledge of potential complications in common pediatric ENT procedures may help avoid risk. Each institution should continuously review admission criteria, staffing decisions, postoperative management resources, and quality-improvement methods to moderate risk and respond to crises.

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