Chapter 35: Pediatric Ambulatory Anesthesia: What is New and Safe?

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INTRODUCTION

FOCUS POINTS

1. Children with asthma are common in ambulatory surgery. Evaluation should be made for active disease. Rescheduling after a respiratory illness should be in 4 to 6 weeks.
2. Prematurity is less common in ambulatory practices, but still can be a significant risk. Histories for young children should be investigated and cases delayed to 45 weeks post-conceptual age (PCA) for full-term babies and ranges from 51 to 60 weeks for premature infants. Later is safer.
3. Congenital cardiac disease patients may be appropriate for outpatient surgery, but single-ventricle physiology should be absolutely avoided.
4. Embryology may be considered in evaluating children with syndromes. Those associated with abnormal airway physiology may be especially difficult in the outpatient setting.
5. Malignant hyperthermia (MH) is a genetic issue that may be unknown in pediatric patients prior to their exposure to an anesthetic. Neuromuscular syndromes may cause other anesthetic problems, but few are truly related to MH.
6. Risk factors for adverse events in pediatric anesthesia are mostly related to younger age, but also coexisting diseases and less so to types of procedure, length of procedure, and lateness in the day of procedure.
7. As with adults, children should be screened for sleep apnea especially in cases that involve the airway or long-term narcotic pain treatment. The STBUR score is analogous to STOP-BANG in adults.
8. Emergence delirium is more common in pediatric patients. Absolute cause is uncertain, but a multi-prong approach may be used by identifying risk factors and planning medications used.
9. Postoperative nausea and vomiting risk factors are different from adults and may be assessed case by case for age, procedure, family history, and surgery duration.

Ambulatory surgery exploded in the 1990s. The most recent survey by the Centers for Disease Control and Prevention (CDC) in 2009 indicated that there were 53,329,000 ambulatory surgeries in the United States. Of these, 3,266,000 were carried out on patients under the age of 15 years and were evenly split between freestanding and hospital-based facilities. The pediatric cases were largely adenotonsillectomies, ear tube placements, fracture reductions/fixations, circumcisions, and diagnostic procedures such as endoscopies.[1] Community providers performed most of these cases without specialty training in pediatric anesthesia.

Ambulatory surgery centers (ASCs) are defined by the Centers for Medicare and Medicaid Services (CMS) as any distinct entity that operates exclusively for the purpose of providing surgical services to patients not requiring hospitalization and in which the expected duration of services would not exceed 24 hours following an admission.[2] This limits some procedures, but much of what a pediatric anesthesia practice covers meets these rules. A robust ASC can accommodate subspecialty cases from otolaryngology, orthopedics, general surgery, urology, ophthalmology, plastic surgery, dermatology, dentistry, gastroenterology, and even neurology, radiology, and physiatry.

The success of an ASC depends on being prepared for the cases with not only correct staffing and instrumentation, but also patient selection. Ambulatory surgery depends on cases that are predictable with defined risks that can be accounted for. Predictability results not only from routine surgical and anesthesia care but also from patients with well-controlled medical issues. The common ailments seen in pediatric care that are capable of serious disruption to a surgical schedule are asthma, respiratory infections, congenital heart disease, congenital syndromes, sickle cell anemia, prematurity, and family history of MH.

Asthma is the leading chronic disease in children. Patients with reactive airway can certainly tolerate anesthesia, but screening for active disease is important. Asthma is marked by an inflammatory reaction of the airway leading to bronchoconstriction in response to triggers. Common triggers are respiratory infection, exercise, or allergies.

The history should elicit a baseline for treatments and control. Medication history can give an idea of how severe the disease is. Just using albuterol as needed suggests a milder disease than being on maintenance steroids and leukotriene inhibitors with frequent beta-agonist use. Be aware that the medication history may better reflect the care by the caregivers than the disease severity. It is not uncommon to get a history of asthma triggered by respiratory infection in someone that shows up with an obvious respiratory illness. When asked about last inhaler use, the parents tell you it has been months! Eliciting a good history on medication compliance is very important.

A conservative approach to caring for these children begins with the surgical procedure and airway management planned. If the child is having airway surgery and/or planned intubation, giving a nebulizer treatment preoperatively can be beneficial. Patients that have been identified as having active disease on a preoperative phone call or have been recently cancelled for illness would likely benefit from a short course of steroid therapy preoperatively leading up to the day of surgery. Otherwise, if the patient has an asthma plan with “sick day” care, he or she can follow that leading up to the day of surgery. Be mindful that if a child arrives ill or with active wheezing, a dose of IV steroids won’t have effects until hours afterward and may be of little use in managing the patient in the recovery area after a short procedure.[3]

It has been author’s experience that if patients with asthma show up with wheezing, they can proceed with surgery if it can be cleared with a nebulizer treatment. If they show up with a fever, unabated wheezing, and/or oxygen saturations below 95% on admission, they tend to be the patients that have desaturations in recovery and require aggressive respiratory therapy to get them stable enough to leave. These patients make up the majority of patient transfers at the author’s center.

A practice controversy is what to tell the canceled patient about how soon he or she can return for surgery. A poll of anesthesiologists revealed that they wait 2 to 4 weeks with most at 4 weeks. Studies have supported the fact that the bronchiole tree remains irritated for 4 to 6 weeks after a respiratory illness and 6 weeks is a better choice. Of course, this all presumes that this is a single illness and that the patient will not get ill again immediately following. For example, otolaryngology patients have pathology inherent to their disease that puts them at risk for continued nasal congestion and respiratory illness.

The following is a guideline from Tait and Malviya for the approach to a child with a respiratory illness. First assessment is to see if surgery is emergent or if the upper respiratory symptoms are from a noninfectious etiology. If either is yes, proceed to the next step. Severe symptoms should be delayed. The need for general anesthesia requires a risk/benefit assessment. Things to consider are asthma history, invasive airway management including tracheal intubation, time pressure, opportunity pressure, or experience of team caring for the child. If the risk assessment is suggestive of a poor outcome, the case should be canceled. A case with favorable risk assessment may proceed, but the guardians (and patient when appropriate) should be informed of the risks.[4]

Figure 35-1

(Decision flow chart for assessement of a child presenting for surgery with an upper respiratory infection. (Adapted with permission, from Tait AR, Malviya S. Anesthesia for the Child with an Upper Respiratory Tract Infection: Still a Dilemma? *Anesth Analg.* 2005;100 (1): 59-65. https://journals.lww.com/anesthesia-analgesia.)

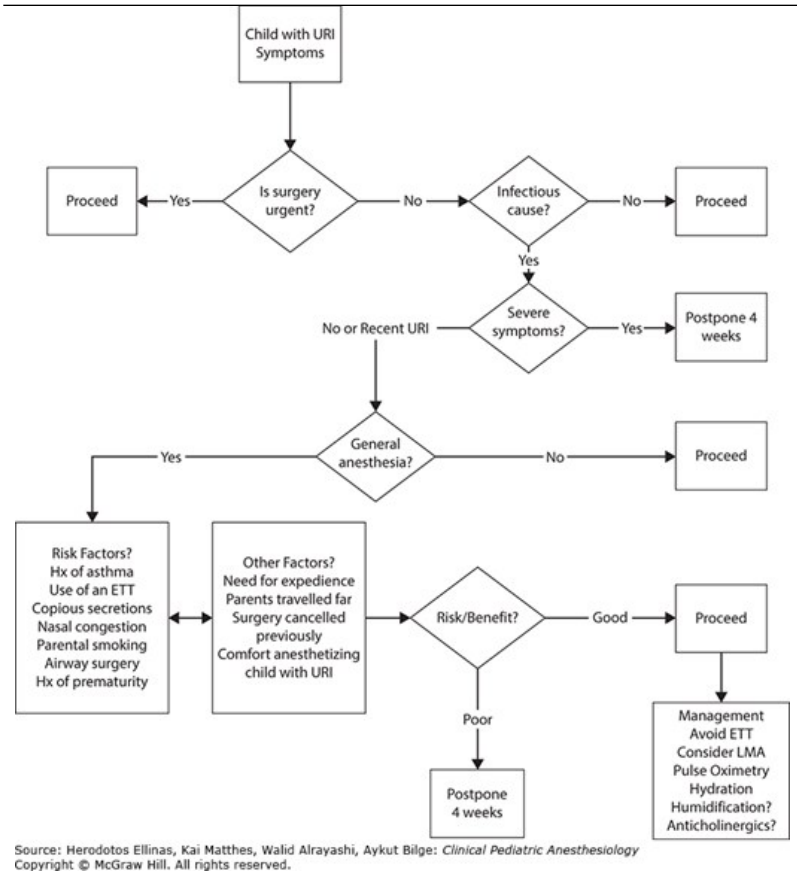


Table 35-1

Summary of Premature Infant and Apnea Studies

	Liu et al[5]	Welborn et al[6]	Kurth et al[7]	Gregory and Steward[18]
Year	1983	1986	1987	1983
No. of infants (preterm)	214 (41)	86 (38)	47 (49) (2 infants twice)	Editorial in same issue as Liu et al[5]
Def. of apnea	20 seconds	15 seconds	15 seconds (less if bradycardia)	
Oldest with apnea	Under 41 weeks PCA, under 4 months old	PCA <45 weeks	55 weeks PCA (in group 55–60 weeks PCA)	
Take home message	Anesthesia may unmask ventilatory defect in preterm infants 41–46 weeks PCA	Only preterm infants less than PCA 45 weeks had post-op apneic episodes. Full-term infants had none.	Premies <45 weeks PCA need monitoring 36 hours post-op, those 45–60 weeks PCA need 12–24 hours	Monitor premies <45 weeks PCA for 18 hours. Delay surgery if possible. Be prepared with ventilator.

It was the year 1983 in which pediatric providers were made aware of the risks of anesthetizing infants with a history of prematurity. There were deaths

among premature infants that experienced apnea postoperatively. A flurry of papers helped define what children were at risk, but there were small cohorts and used inconsistent definitions of apnea. Post-conceptual age (PCA) is an important concept and is defined by the weeks of gestation plus weeks in age. In summary, apnea was defined as 15 to 20 seconds long and the oldest infants with apnea had a PCA of 41 weeks in the study by Liu et al.[5] The group headed by Welborn found apnea in infants under 45 weeks PCA and Kurth's group found apnea in an infant 55 weeks PCA.[6,7] In 1995, Dr. Cote combined 8 studies to create a cohort of 255 premature infants. He determined that risk factors for apnea were related to gestational age, post-conceptual age, and anemia (hematocrit <30%). He also found that most apnea occurred within 2 hours of an anesthetic; however, it may be as long as 10 to 12 hours afterward.[8]

Fortunately, there is little that would be considered surgically appropriate on a premature infant to be done on an ambulatory basis. However, cases of ankyloglossia, extra-digits, and eye exams are possible. One should keep in mind that using 60 weeks PCA as a minimum would exceed all recommendations in the literature for premature infants. Furthermore, using 45 weeks PCA for full-term infants would be prudent. For anyone doing cases on a population this young, it would be wise to have pediatric specialists available and evaluate the entire facility for appropriateness.

A pediatric cardiac patient with heart failure, poor general health (failure to thrive), cyanotic heart disease, or pulmonary hypertension has been shown to be at higher risk for postoperative mortality. Assessing a former cardiac patient can be challenging in regard to fitness for ambulatory surgery. A strong rule of thumb is to not attempt to anesthetize a child with single-ventricle physiology as an ambulatory patient. The complex physiology of these patients does not tolerate positive-pressure ventilation well and once these patients begin to decompensate, it requires elements typically found in a high-level pediatric ICU or advanced pediatric cardiology team to resuscitate them. Diagnoses that are associated with this type of physiology include hypoplastic left heart syndrome, tricuspid atresia, or pulmonary valve atresia. They also may have a history of a Norwood, Fontan, or Hemi-Fontan (Glenn) procedure.

The rules for giving prophylactic antibiotics to prevent subacute bacterial endocarditis (SBE) have been simplified as of 2009. They are required only in patients with unrepaired cyanotic lesions, completely repaired congenital heart defects (CHDs) with prosthetic material or device during the first 6 months after the procedure, repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (which inhibit endothelialization), or previous endocarditis.[9]

Congenital syndromes can be very troubling especially if the provider is not familiar with the condition. Fortunately, there are many sources either online or in print detailing congenital and genetic syndromes far too numerous to list here and their anesthetic implications. Part of teasing out the implications of a syndrome, it helps to figure out if it has a genetic etiology or is due to an error in development. For example, a patient with gastroschisis may be similar to one with an omphalocele. However, the omphalocele occurs due to a problem with developmental steps that the gut does not return to the abdominal cavity after rotating in the umbilical stalk. A gastroschisis occurs when the abdominal wall becomes damaged or weakened such as during an ischemic event. The omphalocele has implications for other genetic errors that are usually not seen in gastroschisis patients. Examples of developmental issues that are typically in isolation are amniotic band syndrome, fetal alcohol syndrome, and intrauterine strokes.

The genetic syndromes are either inherited or from a spontaneous mutation. Many are quite familiar and represent classic cases in pediatric anesthesia such as cystic fibrosis, tetralogy of Fallot, Down syndrome, CHARGE syndrome, and glycogen storage diseases. However, some patients with these syndromes may still be appropriate for ambulatory surgery. The key is to recognize the potential issues and assess if the facility is capable of handling them from a staffing and resource point of view. For instance, a Down syndrome patient with adenotonsillar hypertrophy coming for procedure is a common occurrence. Recognize that obstruction may be multilevel and obstruction from a relatively large tongue may occur in recovery. You want a capable recovery nursing staff that can recognize and manage that issue. These patients may have difficult IV access, atlanto-axial subluxation, cardiac disease, developmental delay, and perhaps sleep apnea. A competent surgeon and an anesthesiologist are required, but the facility, too, must be able to accommodate this patient and his/her special needs. As with all of ambulatory surgery, anticipating problems and being proactive will be the best practice to avoid poor patient outcomes.

Malignant hyperthermia is a topic that deserves some special attention. Children are no more at risk than adults except that they usually do not have a history of a prior anesthetic or may not be old enough to demonstrate some of the more subtle manifestations. The disease is autosomal dominant and has been mapped to the RYR1 and CACNA1S genes that code for skeletal muscle proteins involved in calcium transport. Although some mutations have been mapped thanks to tissue donations from people diagnosed with MH, there are many more possible. There are blood tests for some of the common genes, but not having a common gene does not mean a person does not have *any* gene making them susceptible.

An article by Gurnaney et al. detailed muscular dystrophies and their link to MH. The authors concluded that three types of muscular dystrophy were definitely at risk for MH. The other types still were associated with hyperkalemic arrests and postoperative respiratory failure, but the risk of MH was considered baseline with the general population. The three types identified are rare and are King–Denborough syndrome, central core myopathy, and multi-minicore disease with RYR1 mutation. Keep in mind that treatment of MH in the form of dantrolene has been available for many years, and yet, there are still deaths from this disease.[10]

The Malignant Hyperthermia Association of the United States has created teaching aids to assist in a MH crisis and staff a 24-hour hotline. It also has definite recommendations for equipment an ASC should have available and how susceptible patients should be managed. Part of that is having complete treatment of dantrolene available (36 vials) or the newer formulations and keeping monitoring of a susceptible patient for 12 hours following the anesthetic. With these thoughts in mind, it is easier to establish a policy for allowing MH-susceptible patients in an appropriately staffed and equipped facility. A single crisis in a freestanding ASC will quickly use all of the facility's resources of staff and supplies and will have a large disruption in care given to other patients.

The risk of an adverse event is very real and needs to be actively prevented. As noted above, the best way to prevent one is to be able to predict it. In the adult world, some of these risks have been well studied. It has been just starting in the pediatric realm. One such article by Subramanyam et al, in 2016, used almost 9000 charts to develop risk criteria and then validated it in over 10,000 more charts. This group was looking at airway adverse events that they defined. The risks identified were as follows: age <3 years, ASA class II or III (no IV in study), pre-existing pulmonary disease, morbid obesity, and having a surgical procedure (as opposed to radiologic procedure). A grading scale was also developed along with giving an overall risk of respiratory event as 2.8% for all comers (see Table 35-2).[11]

Table 35-2

Multivariable Model Predicting Occurrence of Postoperative Adverse Event from the Derivation Cohort and the Risk Scores

Patient Characteristic	β	OR (95% CI)	*P*-value	Risk Score
Age (years)				
>3 (reference)	0.00	1.00		0
<3	0.55	1.73 (1.36–2.21)	<0.0001	1
ASA physical status				
I	0.00	1.00		0
II	0.50	1.65 (1.24–2.21)	0.0006	1
III	0.79	2.20 (1.48–3.28)	<0.0001	2
Pre-existing pulmonary disease	1.01	2.75 (2.06–3.66)	<0.0001	2
Morbid obesity	0.95	2.57 (1.36–4.87)	0.004	2
Type of procedure				
Radiology	1.00	1.00		0
Surgery	1.37	3.95 (2.56–6.08)	<0.0001	3

CI, confidence interval; OR, odds ratio.

Reproduced with permission, from Subramanyam R, et al. Perioperative respiratory adverse events in pediatric anesthesia. *Anesth Analg.* 2016; 122(5): 1578-85. https://journals.lww.com/anesthesia-analgesia.

Another study from 2016 by Whippey et al looked at risks for transferring pediatric patients from an ASC. The reasons were loosely grouped into anesthesia-related, surgical, social, and medical. The univariate analysis included age <2 years, prescription medication use, gastroesophageal reflux disease (GERD), obstructive sleep apnea, and other comorbidities. A multivariate analysis included age <2 years, ASA class III or IV, surgery >1 hour, procedure complete after 1500 hours, obstructive sleep apnea (OSA), orthopedic surgery, dental surgery, ENT surgery, or an intra-operative event occurring.[12]

Univariate Analysis	Multivariate Analysis
• Age <2 years • Prescription medication use • GERD • OSA • Other comorbidities	• Age <2 years • ASA class III or IV • Surgery >1 hour • Procedure complete after 1500 hours • OSA • Orthopedics, dental, ENT surgery • Intra-operative event

Source: Data from Whippey A, Kostandoff G, Ma HK, et al. Predictors of unanticipated admission following ambulatory surgery in pediatric population. *Paediatr Anaesth* 2016;26(8):831-7.

Obstructive sleep apnea has been large concern in the adult ambulatory world. The STOP-BANG grading system for OSA has become a regular part of pre-admission screening for adult ambulatory surgery reflecting the work of Francis Chung's group in Toronto. Part of the irony with pediatric patients is that tonsil surgery has sleep-disordered breathing as a primary diagnosis, accounts for one of the most frequent outpatient surgeries in children. In fact, data support that the more severe a child's OSA is, the more likely the child is to be transferred. The leading diagnosis that precipitates transfer is hypoxia. To address this concern, Tait and Malviya, developed a pediatric OSA scoring system known as STBUR.

The STBUR score asks about snoring, trouble breathing, and feeling unrefreshed after sleeping. The following five questions are as follows:

1. Does the child snore more than half the time?
2. Can snoring be heard through a closed door?
3. Does the patient have pauses in his breathing at night?
4. Does the patient have gasps in her breathing at night?
5. Is the child difficult to wake up in the morning or fall asleep during school?

The score is out of 5. Patients scoring 3 out of 5 have a three times greater chance of respiratory complications. A score of 5 out of 5 indicates a 10 times greater risk. The definition of respiratory complications can be as mild as desaturations postoperatively so a score of 5/5 may not mean the patient will need to be transferred, but it can focus a provider's attention on the most at-risk patients.[13]

Other conditions seen following surgery are emergence delirium, postoperative nausea and vomiting, and readiness for recovery. Each episode of postoperative nausea and vomiting (PONV) can delay a discharge by 30 minutes. Likewise, emergence delirium can tie up nursing resources over what is planned and delay a patient leaving by an hour or more. Lastly, having solid criteria for going home can keep the path to leaving better defined and more regular.

Every pediatric anesthesia provider or recovery room nurse has likely experienced emergence delirium. It is defined as a motor agitation state without awareness of surroundings. Classically, children suffering this will not engage their favorite toy or television show. They also may alternate quickly between parents trying to comfort them. The pathology is poorly understood, but there are strong associations (see Table 35-3). One of the minor issues is being able to explain this to the parents and what it means for going home and future anesthetics. This situation can be quite upsetting to a family.[14]

Table 35-3

Associations with Emergence Delirium

Preschool-aged patients
Sevoflurane or desflurane anesthetics
Patient preoperative anxiety
ENT surgery
May be unrelated to pain

Somewhat related is the issue of developing post-traumatic stress disorder following an anesthetic. Taking a screaming child back to the operating room can have negative sequela. There can be bedwetting, temper tantrums, sleep disturbances, attention-seeking behaviors, or a new fear of loneliness. The risks are very similar to emergence delirium and may appear in a child that has suffered delirium postoperatively. Any of these may appear even months after the attributing anesthetic.

The next logical question is typically how to prevent emergence delirium. There is a frequent reaction to blame preoperative midazolam. However, there are about as many articles that implicate as exonerate midazolam as a cause. Without a clear answer that way, anesthesia providers must weigh the benefit of the preoperative sedation and amnesia versus the possible risk of delirium. Table 35-4 gives recommendations for prevention, but not treatment of delirium. This means you need to screen your patients for their risks or history of having it after previous anesthetics. Clinically, effective treatment is with a combination of propofol and dexmedetomidine. This can be achieved with boluses of dexmedetomidine under 0.5 mcg/kg to avoid hemodynamic depression. Usually, a combination of 0.25 mcg/kg of dexmedetomidine IV and 0.5 mg/kg propofol IV gives good results such as unconsciousness with patent airway lasting 20 to 40 minutes. After that the patient wakes much more clearly. Other drugs in the literature used singly in treatment are fentanyl, sufentanil, propofol, dexmedetomidine, ketamine, midazolam, and clonidine.[14]

Table 35-4

Pharmacologic Prevention of Emergence Delirium in Children

Agent	Route and Timing of Administration	Efficacy	Doses
Midazolam	OR, IV, IR	No	OR: 0.5 mg/kg
	Preoperative		IV: 0.1 mg/kg
			IR: 0.5 mg/kg
Midazolam	IV, end of surgery	Yes	IV: 0.1 mg/kg
Hydroxyzine combined to midazolam	OR, preoperative	Yes	1 mg/kg
Propofol	Continuous intraoperative	Yes	Induction 2–3 mg/kg
			Maintenance: 3–12 mg/kg/h
Propofol	End of surgery	Yes	1 mg/kg

Ketamine	IV, preoperative	Yes	0.25 mg/kg
	IV, end of surgery	Yes	0.25 mg/kg
	OR, preoperative	Yes	6 mg/kg
α2 Adrenoceptors: Clonidine	OR or IR, preoperative	Yes	2, 3 or 4 μg/kg
α2 Adrenoceptors: Clonidine	IV after induction	Yes	2, 3 or 4 μg/kg
α2 Adrenoceptors: Clonidine	CAU	Yes	3 μg/kg
α2 Adrenoceptors: Dexmedetomidine	IV, preoperative	Yes	0.2 μg/kg
α2 Adrenoceptors: Dexmedetomidine	IV, intraoperative	Yes	0.3 μg/kg
α2 Adrenoceptors: Dexmedetomidine	IV, intraoperative	Yes	1 μg/kg
α2 Adrenoceptors: Dexmedetomidine	IV, intraoperative	Yes	0.5 μg/kg
α2 Adrenoceptors: Dexmedetomidine	Caudal	Yes	1 μg/kg
Fentanyl	IV, intraoperative	Yes	2.5 μg/kg
			1 μg/kg
Transcutaneous fentanyl	Preoperative	Yes	10–15 μg/kg
			100 μg/kg
Intranasal fentanyl	Intraoperative after induction	Yes	2 μg/kg
Nalbuphine	IV, end of surgery	Yes	0.1 mg/kg
Intraoperative nonopioids analgesia: Ketorolac	IV, during surgery	Yes	1 mg/kg
Caudal analgesia	After induction	Yes	1 mL/kg Bupivacaine (0.25%)
Gabapentin	Preoperative	Yes	15 mg/kg
Magnesium infusion	Intraoperative	Yes	30 mg/kg bolus and continuous infusion of 10 mg/kg/h
Dexamethasone	Preoperative	Yes	0.2 mg/kg

IR, intrarectal; IV, intravenous; OR, oral; PACU, postoperative care unit; PONV, postoperative nausea and vomiting.

Source: Reproduced with permission, from Dahmani S, Delivet H, Hilly J. Emergence delirium in children: an update. *Curr Opin Anesthesiol.* 2014; 27(3): 309-315. https://journals.lww.com/co-anesthesiology.

Pediatric PONV has a different set of risk factors than adult patients. It tends to be fairly rare in the very young and more associated with a specific

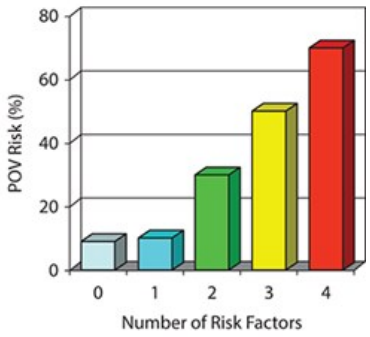
procedure. TJ et al. published a risk factor protocol in 2007 that still holds true. (see Figure 35-2).[15]

The treatments follow a similar trend from the adult world. Patients with two or more risk factors should receive two drugs from different classes for prophylaxis. Treating everyone without regard to risk of PONV may only increase the incidence of side effects seen from the drugs without significantly altering the rate if PONV. As in adults, choices for antiemetics are based on appropriate receptor choice and not simply reusing the same type. In very young patients, the anticholinergic anti-emetics may not be appropriate. Propofol is still a good anesthetic choice to decrease the incidence of PONV. However, the risk of narcotics triggering PONV does not seem to be as important in pediatrics as it is in adult patients. Figure 35-2 reinforces this.

Figure 35-2

Simplified risk score for POV in children. Simplified risk score from Eberhart et al. *Anesth Analg.* 2004;99:1630-1637 to predict the risk for POV in children. When 0, 1, 2, 3, or 4 of the depicted independent predictors are present, the corresponding risk for PONV is approximately 10%, 10%, 30%, 55%, or 70%. (Reproduced with permission, from Gan TJ, Meyer TA, Apfel CC, et al. Society for Ambulatory Anesthesia guidelines for the management of postoperative nausea and vomiting. *Anesth Analg.* 2007; 105(6): 1615-28. https://journals.lww.com/anesthesia-analgesia.)

Risk Factors	Points
Surgery ≥ 30 min.	1
Age ≥ 3 years	1
Strabismus surgery	1
History of POV or PONV in relatives	1
Sum =	0...4



Discharge times for patients can be highly variable. A couple of large studies shed some light on keeping them predictable and safe. A group in France led by Moncel looked at over 1600 ASA class I and II patients from 6 months old to 16 years old. They scored their patients at 1 and 2 hours postoperatively and found that over 97% met criteria at 1 hour and 99.8% met them at 2 hours. They used a scoring system that looked at hemodynamics, balance/ambulation, pain scores, PONV rating, respiratory status, and surgical bleeding. They also asked if family had questions for anesthesia provider. The two scores most often associated with delay were respiratory status and questions for the anesthesia provider. Compared to historical control, they were able to consistently reduce discharge times by 69 minutes with less than 1% unexpected admission rate.[16]

Armstrong et al published a Canadian study that combined a scoring using post-anesthetic discharge scoring system (PADSS) and Aldrete scores. The group found that physiologic-based criteria improved discharge times over simple, time-based criteria. Approximately 75% we discharged 15 to 45 minutes sooner. About 20% showed no difference. The score used is listed in Table 35-5.[17]

Table 35-5

Physiological Criteria-Based Discharge Scoring System Was a Combination of the Scoring Systems Reported by Aldrete[a] and Chung[b]

Discharge Criteria		Score
Conscious level and activity	Awake and orientated, appropriate movements	2
	Rousable with minimal stimulation, weak movements	1
	Responsive only to tactile stimulation, no movement	0
Respiratory stability	Able to cough, deep breathe or cry	2
	Hoarseness with crying or coughing	1
	Stridor, dyspnea, or wheeze	0
Oxygen saturation	Maintains >95% on room air	2
	90–95% on room air	1
	Requires O_2 to maintain >90%	0
Hemodynamic stability	HR and systolic BP within 15% of baseline value	2
	HR and/or systolic BP within 15–30% of baseline	1
	HR and/or systolic BP outside 30% of baseline, mottled	0
Post-op pain	None, or mild discomfort	2
	Moderate to severe, controlled with intravenous analgesia	1
	Persistent severe pain	0
Post-op nausea or vomiting	None, or mild nausea with no vomiting	2
	Transient vomiting or retching	1
	Persistent moderate to severe nausea and vomiting	0
Surgical site	No blood or fluid loss	2
	Minimal loss, no intervention required	1
	Ongoing losses, dressing changes required	0

[a]Aldrete JA. The post-anesthesia recovery score revisited. *J Clin Anesth.* 1995;7:89-91.

[b]Chung F. Discharge criteria–a new trend. *Can J Anaesth.* 1995;42:1056-1058.

BP, blood pressure; HR, heart rate.

Source: Reproduced with permission, from Armstrong J, et al. A prospective observational study comparing a physiological scoring system with time-based discharge criteria in pediatric ambulatory surgical patients. *Can J Anesth.* 2015; 62:1082–1088. www.springer.com/journal/12630.

Pediatric anesthesia certainly has a place in the ambulatory world. There are a great many cases that can be performed in a free-standing center with few risks of complications. As always, the secret to a successful pediatric ambulatory surgery center is based on wise patient selection, well-trained staff, and the ability to predict and treat complications. It can be a rewarding practice but can be very labor-intensive and challenging even if patients are ASA class I or II.

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