



CME Article

Pre-Anesthetic Evaluation: The Role of the Pediatrician

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Editor's Note: This is the fourth of four articles published in 2005 for which a total of up to 4 Category 1 CME credit hours can be earned. Instructions for how credit hours can be earned appear inside the front cover of the journal. Exam questions appear after the article.

Target Audience

This CME activity is intended for physicians, medical students and nurse practitioners. Pediatric emergency department physicians, emergency physicians, pediatricians, and family practitioners will find this information especially useful.

Learning Objectives

After completion of this article, the reader will be able to:

1. Identify the risks associated with anesthesia.
2. Understand the importance of a patient's medical and family history.
3. Identify conditions that require laboratory evaluation.

A smooth surgical course depends on careful screening and appropriate evaluation by pediatricians. Pre-operative evaluation by pediatricians is traditionally poorly focused, unstructured. The "OK for surgery" clearance is obviously not enough.

A communication gap also exists between pediatrician and anesthesiologist. Differentiating stable self-limiting conditions requiring no intervention by pediatricians from those needing active investigation and treatment and/or stabilization prior to surgery could be of special importance to anesthesiologists: e.g. asymptomatic heart murmur, upper respiratory tract infection, irritable airways disease (potential airway complications), and a well compensated hemoglobinopathy, etc.

The role of the pediatrician is not a substitute for an appropriate evaluation by the anesthesiologist, but an extremely important and very useful complement to it.

Risks of Anesthesia

While difficult to quantify, the risk in children appears to be between 1 in 20,000 and one in 100,000 exposures, approximately three times greater than in adults. The overall risk for pediatric cardiac arrest caused solely by anesthesia is reported to be 1 to 1.7 per 10,000 anesthetics. Other major complications (any fatal or life-threatening event or any major incident occurring within 24 hours of anesthesia) occur in 43 per 10,000 in children under age 1, compared to 5 per 10,000 in older children.

Abstract

The risk of complications associated with anesthesia is approximately three times greater in children than in adults. The overall risk for pediatric cardiac arrest caused solely by anesthesia is reported to be 1 to 1.7 per 10,000 exposures. Other major anesthesia-related complications (any fatal or life-threatening event or any major incident occurring within 24 hours of anesthesia) occur in 43 per 10,000 in children under age 1, compared to 5 per 10,000 in older children.

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Anesthesiologist's Classification of Physical Status

The ASA PS Classification (American Society of Anesthesiologists Physical Status) aims to provide a common frame of reference to describe overall functional ability of children to tolerate perioperative stress and is summarized in Table 1.

Medical History and Examination

This should initially focus on bodily systems of particular importance to perioperative management, and should include assessment of the functional status.

Include parents, grandparents, siblings and list other relatives. Inquiries regarding a family history of difficulties in anesthesia (prolonged emergence from anesthesia, unplanned admission to intensive care unit, unexpected ventilator dependence, death during anesthesia may suggest the presence of atypical cholinesterase, susceptibility to malignant hyperthermia.) Bleeding problems are particularly important (hemophilia, Von Will brand disease, etc.)

The history and problems review should inquire about bleeding diathesis, prematurity, neonatal respiratory distress syndrome (DRS), apneas, respiratory or cardiac problems, neuromuscular conditions and allergies – particularly to Latex.

The medications being taken by the child should not be overlooked, such as aspirin, steroids, insulin, etc., including dosage and duration of therapy.

System Review & Physical Examination

Obesity carries a risk of cardiovascular problems, restrictive pulmonary function, delayed gastric emptying and aspiration (The child might need premedication with H2 blockers and metoclopramide.) Severe skeletal abnormalities predispose to difficult intraoperative positioning, airway management and restrictive lung problems.

Cardiovascular

Presence of an asymptomatic murmur:

The pediatrician should always establish an accurate diagnosis. Aortic stenosis predisposes to an intraoperative drop in blood pressure, which is poorly tolerated as the cardiac output cannot increase. The presence of a “pink” tetralogy of Fallot or a large atrial septal defect (ASD) with increased pulmonary flow, carry a risk of intraoperative cardiac decompensation.

Subacute bacterial endocarditis (SBE) prophylaxis as required (American Heart Association guidelines). This is not required for tracheal intubation, bronchoscopy, endoscopy, tympanostomy tube insertion, eye surgery, dental procedures unlikely to induce gingival bleeding. Nor is it required for isolated ASD, repaired ventricular septal defect (VSD) or patent ductus arteriosus (PDA) for more than 6 months, mitral valve prolapse without regurgitation and cardiac pacemakers.

Respiratory

Facial assessment:

The pediatrician should assess neck and jaw mobility, micrognathia, glossoptosis, all of which may require ENT evaluation. Vertebral fusion and spine trauma also make airway management difficult, and the anesthesiologist will need to plan for a difficult intubation. Planning for difficult intubation will be required for these cases, either with fiberoptic intubation or an alternative mode of anesthesia (regional, etc.) needs to be considered.

Chest wall pathology:

Marked scoliosis (> 100 degrees), morbid obesity, dwarfism or neuromuscular problems will increase the risk of pulmonary post-operative complications.

Upper and Lower Airways:

Asthma may be exacerbated by tracheal intubation and some anesthetic medications (thiopental). Intensification of the maintenance

therapy will be needed prior to surgery, with inhaled bronchodilators to be administered during the 24 hours preceding the operation.

If the child is already on long-term theophylline therapy, a regular dose needs to be administered give on the day of surgery and serum levels carefully monitored. A short course of steroids needs to be considered in children with frequent and/or severe asthma episodes.

Upper Airways:

With a recent upper respiratory tract infection, there is an 11-fold increased risk of airway reactivity, laryngospasm, bronchospasm, mucous plugging, atelectasis and post-operative hypoxemia, and the risk is increased if the child is asthmatic.

Because there are no definite predicting factors for these complications, the pediatrician needs to always consider the urgency and invasiveness of the surgery and the child's condition. In view of continued airway reactivity and secretions, it is best to postpone the surgery (whenever feasible) for at least 4-8 weeks if tracheal intubation will be required.

Apnea:

Children with obstructive sleep apneas, and/or a history of significant snoring, may require preoperative sleep studies and careful post-operative observation. Premature infants (and even term infants) might develop apneas in the first 24 hours after anesthesia or intravenous sedation. Post-operative apnea monitoring is required for 24 hours after surgery in premature infants less than 44-60 weeks of post-conceptual age.

Mediastinal masses:

These carry the risk of large airway and great vessel compression by the mass during anesthesia as muscle tone and lung volume are suddenly lost. With airway collapse, it may become impossible to ventilate with resultant refractory cardiac arrest.

Neuromuscular Problems

Seizures:

Previously well-controlled seizures may occur following perioperative stress. Appropriate anticonvulsant serum levels should be achieved prior to surgery, and the patient should receive his or her regular dose of anticonvulsant on the day of surgery.

Hydrocephalus and increased intracranial pressure (ICP):

Neurosurgical consultation is required prior to and following surgery. SBE prophylaxis will be required if the child has a ventriculoatrial but not a ventriculoperitoneal shunt.

Neuropathies and myopathies:

Myasthenia gravis patients are susceptible to muscle weakness from neuromuscular blocking agents or their antagonists. There is a risk of malignant hyperthermia in other myopathies including Duchenne muscular dystrophy. Children with Duchenne muscular dystrophy are at increased risk of succinylcholine related hyperkalemic cardiac arrest. Children with myotonic dystrophy sometimes develop an increased sensitivity to narcotics and sedatives.

Neural tube defects:

Anaphylactic reactions to latex, with intraoperative cardiovascular collapse or bronchospasm within 30- 120 minutes after induction, may occur if latex gloves or urinary tract catheters are utilized and come in contact with peritoneal vascular or other surfaces.

Cerebral palsy:

In the presence of swallowing difficulties or gastroesophageal reflux, there is a risk of perioperative aspiration. There may be a need to patients pre-medicate with H2 antagonists and/or metoclopramide.

Hematology

Sickle cell anemia :

This hemoglobinopathy carries a risk of intraoperative sickling due to hypothermia,

hypoxia, acidosis, shifts in regional blood flow, dehydration. These sickling crises may lead to strokes, pulmonary infarction, or cardiac dysfunction. Pre-operative transfusions are customarily given to maintain the concentration of hemoglobin S (HbS) below 30%. Advice needs to be given to ensure peri-operative normothermia (warming blanket), normoxemia (oxygen), normal hydration, and the need to prevent and correct any acidosis. Tight restraining (constriction) of the limbs during surgery should also be avoided.

Coagulopathies:

Bleeding diatheses such as hemophilia, Von Willebrand disease, idiopathic thrombocytopenic purpura, etc., should be identified.

Endocrine

Diabetes mellitus:

Advice prior to surgery should be given to avoid hyper and hypoglycemia during and after surgery. Surgeries should be scheduled first in the morning to avoid prolonged fasting. If a short procedure is contemplated and normal oral intake is expected early in the post-operative period, half the usual morning dose of insulin is given and an intravenous glucose infusion is started before surgery.

The blood sugar needs to be monitored and titrated with supplements of insulin as needed. There is no need to strive for a "tight" control, as a glycemia of 100-200 mg/dL is satisfactory during that time. If prolonged post-op fasting is expected, intravenous glucose and continuous insulin infusion will need to be instituted. An endocrinology consultation is valuable prior to and after surgery.

Steroid therapy:

There is a risk of blunted adrenocortical response to stress if the patient has been on high-dose steroids for prolonged periods, and/or in case of more invasive surgery. In these conditions, hydrocortisone 2 mg/kg/24 hours (60 mg/m²) in three divided doses should be given.

Ex-Premature Infants

The risk of apneas, aspiration and laryngospasm increase if anemia exists, or there is a history of neonatal RDS. It is preferable to delay any elective surgery until the ex-premature is more than 52- 60 weeks post conceptual age or until the full term neonate is older than 44 weeks post conceptual age. If surgery is required before that age, cardiorespiratory monitoring must be available for 24 hours postoperatively. If brief episodes of apnea occur, oxygen for desaturations and monitoring for at least 24 hours, and at least 12 hours after the last apnea, is required.

Other Conditions

Down's syndrome:

There is an inherent danger of atlantoaxial dislocation. Radiological instability exists in 10-15% of cases, 10-15% of whom will have neurological complications. There is a risk of gait disturbances after procedures involving extreme positioning of the head and neck (tonsillectomy, etc.). The pediatrician needs to alert the staff in the operating and recovery rooms regarding handling and positioning of the child's head and neck.

Dwarfism and mucopolysaccharidosis:

Thoracic dystrophy and cervical spine abnormalities with odontoid hypoplasia leading to dislocation of atlas may be present. The same precautions need to be taken for a child with Down's syndrome.

Special Problems

Malignant hyperthermia:

Susceptible patients with this autosomal dominant condition may develop high fever, hyperkalemia, acidosis, myoglobinuria and generalized muscle rigidity after receiving potent inhalation agents or depolarizing muscle relaxants (succinylcholine). A good family history is the most important diagnostic tool,

although the condition might skip a generation as it has a variable penetrance.

Atypical cholinesterase:

The frequency of this condition is approximately 1:2500, and leads to the extremely long action of succinyl choline with delayed muscle recovery and difficulty in endotracheal extubation. Succinylcholine is contraindicated in these patients and a blood test for the atypical enzyme is diagnostic.

Laboratory Evaluation

No laboratory tests (other than perhaps a hemoglobin (Hb) level) nor routine chest x-ray are usually needed for children in ASA class 1 or 2.

A hemogram is required when there is the possibility of anemia, e.g. during the first year of life, in the growing preterm infant, in children with a chronic illness or sickle cell disease (SCD). It is also needed to establish a baseline if large blood losses are anticipated at surgery. No specific Hb level is required for anesthesia or surgery. The acceptable Hb level should be based on the child's estimated ability to tolerate the anemia in face of perioperative stress or blood losses. Blood transfusions always carry some risks. Autologous transfusions or intraoperative hemodilution are rapidly emerging as alternative solutions.

If not previously done, a quantitative Hb electrophoresis is required in children with SCD.

A pregnancy test is required in adolescent girls in view of the perioperative risk to a fetus.

There is no value in routine pre-operative urinalysis.

There is no need for routine coagulation screen. Studies have shown a very poor predictive value of operative bleed by any coagulation test alone or in combination. A bleeding history in the child or the family is the single most important predictor of bleeding problem. The pediatrician needs always to inquire about a history of aspirin or non steroidal anti-inflammatory medications intake. Coagulation studies need to be considered if

the history or medical condition are suggestive of a possible coagulation defect, as baseline studies for surgery where anticoagulation will be required (open heart surgery, etc.) and in the case of any surgery where even minimal bleeding could be catastrophic (intracranial or intraocular surgery).

Psychological Preparation

There is natural patient and parental anxiety in anticipation of surgery. The causes include separation, loss of control, fear of pain or of complications, disruption of normal daily routine, unfamiliar hospital surroundings, preoperative fasting, blood drawing, etc.

The pediatrician has a key role to explain to the patient and parents what is to be expected during the perioperative period. Whenever possible, it is advisable to arrange, long before hospital admission, a tour of the facilities that the child/parents will be exposed to, and the meet the medical and nursing staff.

Preoperative Fasting

Traditionally, the potential risk of aspiration pneumonitis if the stomach is not empty is overemphasized. (There is also the risk of hypoglycemia in fasting young children.)

Currently, children are permitted shorter fasts: clear liquids (glucose-electrolyte solutions, apple juice, etc.) are allowed up to 2-4 hours prior to elective surgery. For morning surgeries, no solids are allowed after midnight.

Discharge Criteria After Day Surgery

These are highlighted in Table 2.

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Pre-Anesthetic Evaluation

Table 1 - American Society of Anesthesiologists Physical Status Classification (ASA PS)

ASA PS 1: No underlying physical or metabolic disturbances

ASA PS 2: Mild to moderate disturbances that do not interfere with daily routines, excluding extremes of age (< 1 year). e.g. anemia, mild renal failure, asymptomatic heart disease, well-controlled asthma

ASA PS 3: Severe disturbances that interfere with ordinary daily activities. e.g. chronic lung disease, severe physical abnormalities (Pierre Robin, etc.)

ASA PS 4: Severe disturbances that are a constant threat to life. e.g. extreme prematurity, intractable heart failure, advanced renal, pulmonary or endocrine dysfunction, critical airways obstruction (epiglottitis), etc.

ASA PS 5: Moribund patient who is likely to die within 24 hours, whether or not surgery is undertaken. Surgery is attempted as a last hope effort to prevent death and is usually part of the ongoing resuscitation. e.g. major trauma requiring continuing CPR, severe head injury with rapidly deteriorating CNS status, etc.

E (Suffix): ASA status appended with an E when surgery is undertaken as an emergency, recognizing additional risk factors associated with absence of preoperative stabilization, fasting or evaluation, e.g. healthy child with testicular torsion = 1E

Table 2 - Discharge Criteria After Day Surgery

- Normal and stable vital signs, off oxygen
- Ability to swallow oral fluids (although children under are better admitted to a ward (surgical unit))
- Ability to ambulate according to developmental age
- Absence of nausea, vomiting, dizziness, respiratory distress
- Follow-up available

Suggested Reading

1. Holtzman R. Morbidity and mortality in pediatric anesthesia. *Pediatr Clin North Am* 1994;41:239.
2. Schriener MS, Treibwasser A, Koen TP. Ingestion of liquids compared to preoperative fasting in pediatric patients. *Anesthesiology* 1990;72:593.
3. Steward DJ. Preterm infants are more prone to complications following minor surgery than are infants. *Anesthesiology* 1982;56:304.
4. Cohen MM, Cameron CB. Should you cancel the operation when a child has an upper respiratory tract infection? *Anesth Analg* 1991;72:282.
5. Tait AR, Knight PR. The effects of general anesthesia on upper respiratory tract infections in children. *Anesthesiology* 1987;67:930.
6. O'Connor ME, Drassner K. Pre-operative laboratory testing of children undergoing elective surgery. *Anesth Analg* 1990;70:176.
7. Moon R. Fasting before surgery. *JAMA* 1995;273:1171.

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December 2005

EXAM POSTMARK DEADLINE: MARCH 31, 2006**Pre-Anesthetic Evaluation: The Role of the General Pediatrician**Narchi H, *Int Pediatr* 2005;20(4) 202-211.**QUESTIONS**

- 1. The risk of anesthesia in children is approximately:**
 - a. four times lower than in adults
 - b. equal to the risk in adults
 - c. three times greater than in adults
 - d. higher in children under age 1
 - e. lower in children under 9 months of age

- 2. An asymptomatic murmur is more worrisome if caused by:**
 - a. a peripheral pulmonary stenosis
 - b. a valvular pulmonary stenosis
 - c. any ventricular septal defect (VSD)
 - d. an aortic stenosis
 - e. a large atrial septal defect (ASD)

- 3. A concurrent upper respiratory tract infection (URTI):**
 - a. is unlikely to be associated with a considerable risk of perioperative respiratory complications.
 - b. may increase the risk of bronchospasm in an asthmatic child.
 - c. should not defer planned elective surgery
 - d. should defer elective surgery for a few days if tracheal intubation will be required
 - e. should postpone elective surgery for several weeks if tracheal intubation will be required

- 4. In a child on anticonvulsants:**
 - a. the risk of breakthrough seizures is negligible if the child was previously well controlled.
 - b. the regular dose of anticonvulsant should be omitted on the day of surgery and resumed 24 hours later.
 - c. anticonvulsants should be stopped 24 hours prior to surgery in view of their interaction with anesthetic medications.
 - d. elective surgery should be postponed in the absence of a well documented normal EEG within the prior 4 weeks.

- 5. Latex allergy**
 - a. is common in children with neural tube defects
 - b. may be associated with a history of previously unexplained intraoperative cardiovascular collapse
 - c. is unlikely to be associated with a history of previously unexplained intraoperative cardiovascular bronchospasm
 - d. is common in children undergoing intermittent bladder catheterization
 - e. may be associated with a history of perioral angioedema from balloons

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