



POLICY STATEMENT

The Pediatrician's Role in the Evaluation and Preparation of Pediatric Patients Undergoing Anesthesia

abstract

FREE

Pediatricians play a key role in helping prepare patients and families for anesthesia and surgery. The questions to be answered by the pediatrician fall into 2 categories. The first involves preparation: is the patient in optimal medical condition for surgery, and are the patient and family emotionally and cognitively ready for surgery? The second category concerns logistics: what communication and organizational needs are necessary to enable safe passage through the perioperative process? This revised statement updates the recommendations for the pediatrician's role in the preoperative preparation of patients. *Pediatrics* 2014;134:634–641

INTRODUCTION

Primary care providers, including pediatricians, are frequently called on to evaluate and psychologically prepare patients and families before a child undergoes a procedure requiring anesthesia or sedation. This policy statement identifies that primary care provider's preoperative goals of care are as follows: to clearly define the child's medical issue; to delineate the physiologic effects and limitations imposed by each condition; and to optimize the management of any comorbid conditions. Furthermore, the policy recommends that pediatricians facilitate essential communication about the historical, physical, and laboratory findings in children with unusual or complex medical histories with the anesthesiologist and/or surgeon to ensure safe perioperative care.

The objectives of the present statement were twofold:

1. to describe to pediatricians the issues of concern to anesthesiologists and surgeons to improve the effectiveness of medical consultations in preparing pediatric patients and families for the perioperative period; and
2. to present information that will encourage and facilitate communication among surgeons, anesthesiologists, medical subspecialists, pediatricians, and other primary care providers.

ROLE OF THE PEDIATRICIAN IN THE PREOPERATIVE PREPARATION

General Approach

The primary steps in preoperative preparation are to determine whether the child is in the best possible state of health, given the child's underlying

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KEY WORDS

anesthesia, pediatric anesthesia, pediatric surgery, perioperative, preoperative

ABBREVIATIONS

DNR—do not resuscitate
MH—malignant hyperthermia
NPO—nil per os
OR—operating room
PONV—postoperative nausea and vomiting
PPIA—parental presence during induction of anesthesia

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The recommendations in this statement do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

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medical condition, and to manage any concurrent acute interceding illness. The key concept is that the patient's medical condition should be "optimized" when he or she presents to the operating room (OR). The American Society of Anesthesiologists has an established risk-stratification system (Table 1).¹ Class 1 and class 2 are considered low risk. The goal of preoperative preparation is to bring patients from a higher risk stratum to a lower one when possible or, at least, to ensure that the patient is in the best condition within his or her physical status category.

The second step in preparing patients is to educate the family about the process of going to the OR and to help them advocate for a process that works best for them and their child. Preparation for surgery has many facets.² There is no "standard" procedure for preparing children for surgery, and available resources vary greatly from one institution to another. Options for family and child preparation may include Internet-based information, tours of the perioperative environment, coping/relaxation instruction, and interventions by child life specialists.³ General information can be found in video or book format, although content and accuracy vary.⁴ Some hospitals allow parental presence during induction of anesthesia (PPIA). However, PPIA is

not a universal practice and is always at the discretion of the anesthesiologist involved in a particular case. Although beneficial to some families and practiced in a number of centers, PPIA is not effective in relieving anxiety in the children, especially if the parent(s) is anxious.⁵⁻⁷ PPIA can be stressful to parents, and the pediatrician should thus make sure families know that PPIA may be an option but is never mandatory.

In many cases, children and their families benefit from preoperative sedation. Younger children (2-5 years of age) and patients who have been to the OR before are at higher risk of being stressed and uncooperative during the induction of anesthesia.⁸ In addition, some patients will suffer from postoperative behavioral changes, including sleep difficulties, which may present to the pediatrician in the weeks after surgery. Recent studies have concluded that the likelihood of these maladaptive behaviors is higher if the child is anxious preoperatively.⁹ Pediatricians need to be aware of the policies surrounding PPIA and preoperative sedation at the operative facilities to which they refer their patients. Parents should be encouraged to ask the anesthesia team about available options for preinduction sedation and PPIA. This information can empower them to better advocate for their child.

Most anesthesia departments will obtain informed consent for the anesthesia, separate from that for the procedure. For most minors, the parents will give informed consent (technically, informed permission). Adolescents can participate, to varying extents, in the process by giving assent to care. Pediatricians should encourage adolescent patients to ask questions to make sure they understand what is planned. In cases in which the patient can make no meaningful objection (emergency or other nonelective procedure), then the option to assent or decline care should not be presented.¹⁰

Currently, there is concern about the potential negative effects of general anesthesia in neurologic development, especially in children aged <2 years who undergo multiple procedures.¹¹⁻¹³ Pediatricians need to stay informed of this evolving area of inquiry. Although no firm guidelines exist, some experts have proposed delaying purely elective procedures as long as possible.¹⁴ The long-term effects of anesthesia on the developing human brain are still unknown, but there is broad agreement that limiting exposure to general anesthesia in infants is a wise policy.

The Preanesthesia Consultation

Patients with complex medical and surgical conditions can benefit from a thorough preoperative assessment by an anesthesia care provider. Ideally, these preoperative evaluations take place in advance of the day of surgery, to avoid last-minute cancellations that occur because of missing data critical to optimizing the patient's condition for surgery. Many anesthesia departments have consultation clinics to provide a common touch point for the pediatrician, anesthesiologist, surgeon, consultants, and family. If no such clinic is available, then the pediatrician and family should pose their questions about the perioperative preparation of the child directly to an anesthesiologist in the department (or group) that will be caring for the patient. Because the specific anesthesiologist assigned to the case may not be known more than a day ahead of the surgery, contact with an anesthesia provider will often be made through the anesthesiology department. Examples of criteria for preoperative anesthesia consultation are shown in Table 2.^{15,16}

Information of Importance to the Anesthesiologist and Surgeon

History of the Present Illness

This part of the history is usually clear, but medical factors leading to the need

TABLE 1 ASA Physical Status Classification System

ASA physical status 1: A normal healthy patient
ASA physical status 2: A patient with mild systemic disease
ASA physical status 3: A patient with severe systemic disease
ASA physical status 4: A patient with severe systemic disease that is a constant threat to life
ASA physical status 5: A moribund patient who is not expected to survive without the operation
ASA physical status 6: A declared brain-dead patient whose organs are being removed for donor purposes

ASA, American Society of Anesthesiologists.
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TABLE 2 Examples of Patients Who Should Be Seen for a Preanesthesia Consultation^{15,16}

Children who are having the following operations:

- Complex spine surgeries
- Airway reconstruction
- Major chest surgery (include cardiac)
- Major abdominal surgery
- Major neurosurgery

Children with the following medical conditions:

- Complex heart disease, history of heart failure, or pacemaker dependence
- Serious respiratory disease, such as severe asthma and cystic fibrosis and patients requiring ventilator support or oxygen therapy
- Complex airway patients, including those with craniofacial syndromes and those with a history of being difficult to intubate
- Patients with severe obstructive sleep apnea
- Muscular dystrophy, mucopolysaccharidoses, or any progressive neuromuscular disorders
- Cervical spine instability and patients in a neck brace
- Hunter syndrome and Hurler syndrome
- Morbid obesity
- Living related organ donors
- Transplant recipients
- Patients presenting with complex ethical issues; for example, religious objections to blood transfusion or end-of-life decisions (eg, DNR orders)
- Complex pain or psychosocial issues that affect perioperative care

for surgery are important, including the intended effect of the operation on health and future care.

Medical History

The details of the patient's medical history are not always apparent to the perioperative care team; therefore, the pediatrician's detailed knowledge of the patient's medical history is an especially important area in which he or she can improve overall care for a patient. For example, pediatrician input has been shown to frequently modify the perioperative plan in children undergoing dental procedures.¹⁷ Planning for anesthesia benefits from communication about neurologic development and function, airway anomalies (eg, difficult intubations, history of airway surgery), cardiac and pulmonary function (including sleep apnea as well as

lung disease), coagulation history, endocrine and renal diseases, and history of exposure to chronic opioids, anesthetics, and sedatives. Motion sickness is a risk factor in adults for postoperative nausea and vomiting (PONV) and is very likely a predictor in children as well. This history should be noted, as should a history of PONV with previous surgeries.¹⁸ General psychosocial history can guide perioperative management. Conditions such as severe anxiety or posttraumatic stress disorder or conditions that impair the child's ability to process information (eg, attention-deficit disorder) or interact with strangers under stressful conditions (eg, oppositional defiant disorder, autism spectrum disorders) should be conveyed to the anesthesia care team. Before elective procedures, consultation with a psychologist to aid in preparing the family and child with these severe cognitive and emotional disorders may be helpful as well.

Medications

The most common problem regarding perioperative medication administration is the misunderstanding that nil per os (NPO, or withholding oral foods/fluids) intervals do not necessarily include medications. Most regularly prescribed medications can be taken with a sip of water on the day of surgery and not violate NPO standards. Conversely, many nonprescription medications and herbal supplements may pose potential risk of bleeding or drug interaction.^{19,20} Over-the-counter medications and supplements should be stopped before surgery, unless there is specific reason to continue them (eg, aspirin in certain patients with cardiac conditions). The exact timing will depend on the medication or supplement involved.

Family History

Four items of family history are particularly important: malignant hyperthermia (MH), prolonged paralysis after

receiving succinylcholine (pseudocholinesterase deficiency), bleeding diathesis, and PONV. In the cases of MH and pseudocholinesterase deficiency, appreciation of either of these entities will dictate the avoidance of specific anesthetic agents, the use of which can result in potentially catastrophic effects in predisposed patients. A family history of spontaneous or postsurgical bleeding may indicate the need for hematologic investigation before certain procedures. As mentioned previously, a family history of PONV is less specific than a history of MH, because influences are multifactorial, but this information may help the anesthesiologist address the family's questions regarding anesthetic technique and prophylactic medications.

Physical Examination

The pediatrician's examination sets a baseline against which the perioperative physical status can be compared. Highlighting neurologic findings, cardiac murmurs, rashes, wheezing, congenital anomalies, and vital signs is helpful to perioperative care providers.

Pertinent Laboratory Evaluation

There is no role for routine laboratory testing of healthy children undergoing procedure with minimal risk of blood loss or for neurologic, cardiac, or pulmonary compromise. Some centers require hemoglobin testing for infants and for patients having surgery in which blood loss is expected. In healthy children, laboratory and radiologic testing should be limited to situations in which the history or physical examination raises a specific possibility of risk. For patients with specific illnesses, testing serves the purpose of establishing a baseline and determination if the patient's underlying condition is appropriately controlled before inducing the perturbations of anesthesia and surgery.

Many institutions have policies that require preoperative pregnancy testing

for all postmenarcheal females on the morning of surgery. It is helpful to warn patients and families that this testing may take place and is not a personal judgment but rather a matter of routine.

SPECIAL ISSUES FOR PRIMARY HEALTH CARE PROVIDERS: ANESTHESIA AND COEXISTING HEALTH PROBLEMS

Cardiac Disease

A child with a new murmur that does not have the characteristics of an “innocent murmur” should be evaluated by a cardiologist to determine the presence of an intracardiac shunt and/or obstruction to flow.

Children with known congenital heart disease, such as a history of “repaired” tetralogy of Fallot or pulmonary hypertension, should be evaluated by a cardiologist before anesthesia; the time interval necessary depends on the severity of the child’s disease and/or the need for possible cardiac intervention before anesthesia to optimize the child’s physiologic condition. The management of anticoagulation for patients with prosthetic valves requires coordination with a cardiologist (and often a hematologist) well in advance of surgery. Note should be made of pacemakers (and any perioperative adjustments may be made by a cardiologist), pulmonary hypertension (degree and duration), and any unusual electrocardiographic findings (eg, prolonged QTc interval).^{21,22} Patients with any of these issues should have been evaluated by a pediatric cardiologist before anesthesia and surgery to ensure optimal condition and management during the perioperative period.

Airway Anomalies

Few things are more dangerous than difficulty in maintaining a patent airway or being unable to intubate a patient. Therefore, it is imperative that the pediatrician inform the anesthesia team

of all patients with airway disorders. “Red flag” conditions include: previous difficulties with intubation or mask ventilation, Pierre Robin syndrome, Treacher Collins syndrome, Goldenhar syndrome, Down syndrome, Klippel-Feil syndrome, mucopolysaccharidoses, previous airway or cervical spine surgery, prolonged neonatal intubation, and stridor at rest.

Respiratory Disease

Asthma, cystic fibrosis, and other chronic lower respiratory disease all merit mention in the preoperative evaluation. The following are important to the anesthesiologist: use of steroids in the recent past, a history of chest or airway surgery, a history of bronchopulmonary dysplasia, upper airway malformation, and history of sleep apnea. In an otherwise healthy child, the presence of an acute upper respiratory tract infection without systemic or lower respiratory tract symptoms is not usually grounds for cancellation of surgery. Conversely, upper respiratory tract infections that are accompanied by fever, wheezing, or productive cough are likely to lead to cancellation of elective procedures.^{23,24} Patients scheduled for nonemergent procedures who are recovering from respiratory illness in the previous 2 weeks are taken on a case-by-case basis; detailed information provided by the pediatrician concerning the chest and upper airway examination can be very helpful in determining the timing of surgery.

Central Nervous System

Patients with seizure disorders should take their anticonvulsants as scheduled. Notation of the type of seizure, medications, and a brief description of a typical seizure may aid perioperative care providers in recognizing a seizure and speed treatment. Any patient with a baseline neurologic deficit should have that deficit described so that changes could be recognized in the perioperative

period. Increased intracranial pressure (of any extent) has particular implications for perioperative care and should be noted in the history. For children at risk for cervical spine instability (eg, Down syndrome,²⁵ mucopolysaccharidoses,²⁶ severe Ehlers-Danlos syndrome), results of cervical spine radiographs or history of symptomatic instability should be clearly identified for the surgeon and anesthesiologist. Radiographic screening does not predict risk of cervical instability²⁷ in Down syndrome. Thus, all these patients are treated with caution, and parents can be assured that their child will have cervical spine precautions regardless of radiograph results.

Hematologic Disorders

Histories of patients with hemoglobinopathies, such as sickle cell disease, should include medications, any previous serious complications (eg, acute chest syndrome, splenic crisis, aplastic crisis, cholecystitis), and opioid treatment. For children with hemophilia, von Willebrand disease and other factor deficiencies and platelet disorders, a history of complications and treatment algorithms are critical. A plan for perioperative management should be coordinated with the child’s hematologist and clearly delineated. For children with factor V Leiden deficiency or other genetic thrombophilias that increase the risk of deep vein thrombosis, the history should include any thromboembolic events and medications used for treatment. Central nervous system thromboembolic events should be carefully described, along with any residual neurologic deficits. Laboratory studies and preoperative preparations should be tailored to each disorder.

The Former Preterm Infant

When compared with infants born at term, former preterm infants (born at <37 weeks’ gestation) are estimated to be at higher risk of postoperative

apnea and bradycardia after general anesthesia until a postconceptual age of approximately 60 weeks.²⁸ Parents of former preterm infants should be counseled to expect an overnight stay after surgery (pediatricians should check the policy of their local facilities because the exact postconceptual age requiring overnight observation varies slightly from one institution to another). Physical signs in children with sequelae of preterm birth (eg, bronchopulmonary dysplasia, neurologic deficits) should be noted to establish a baseline for comparison and to aid intraoperative planning.

Muscular Diseases

Muscular dystrophies merit special attention because their multisystem effects have profound implications for anesthesia.²⁹ Special approaches to anesthesia, such as the avoidance of exposure to inhaled agents, are often necessary. Young children with hypotonia who do not carry a formal diagnosis should be identified so appropriate precautions can be taken. In many of these cases, mitochondrial inborn errors of metabolism are being considered in the differential diagnosis. In these cases, anesthetic approach and fluid management are different from that for muscular dystrophy; therefore, any relevant data indicating a specific metabolic deficiency are helpful.

Hypertension

Although mild to moderate hypertension does not seem to negatively affect outcome in the perioperative period, 2 issues need to be attended to preoperatively: (1) secondary causes of hypertension need to be identified and corrected before surgical intervention when possible; and (2) antihypertensive medications should be continued through the time of surgery. The exceptions to this rule are the angiotensin-converting enzyme inhibitors, which are generally held

on the day of the procedure.³⁰ The decision to administer these medications should be made with input from the anesthesiologist.

Diabetes Mellitus

For patients with diabetes mellitus, the key perioperative issue is: "how well controlled is the diabetes mellitus?" A patient with poorly controlled diabetes mellitus may need to have elective procedures postponed until blood sugar concentration is controlled.³¹ It is critical to coordinate care with the patient's endocrinologist and anesthesiologist to ensure optimal insulin management during the NPO interval before surgery. Families should be told to expect to arrive especially early on the day of surgery, to allow monitoring of glucose, to adjust insulin administration, and to begin administration of dextrose-containing intravenous fluids.

Morbid Obesity

Morbidly obese patients have potential issues with positioning, airway maintenance, placement of intravenous catheters, and comorbidities, such as obstructive sleep apnea and diabetes mellitus, which raise the risk profile of these patients.³² Baseline height, weight, and BMI should be recorded. If a history of significant sleep disturbance is elicited, consideration should be given to obtaining a sleep study to quantify the degree of obstructive sleep apnea. In general, patients who are morbidly obese would benefit from a consultation with an anesthesiologist and can be counseled that they may have a peripheral intravenous catheter placed before induction of anesthesia.

Patients With Transplanted Organs

Posttransplant patients have invariably undergone many procedures, and this history may result in extreme anxiety surrounding medical interventions. They require special attention to their stress

levels (and possible sedation) preoperatively. Immunomodulatory medications should be continued through the perioperative period, and coordination with the transplant team regarding medication management is helpful.

Inborn Errors of Metabolism

Patients with metabolic disease pose 3 general issues for optimal perioperative management. The first is the effect of the preoperative fast, which may have to be modified (or supplemented with an intravenous glucose infusion). The second issue pertains to the downstream effects of the particular disease, such as seizures, airway involvement, or developmental delay. Finally, the potential adverse effects of intravenous fluids, glucose, and certain medications must be considered. It is helpful for the pediatrician to facilitate early contact between the family, metabolic specialist, and anesthesiologist for careful preoperative planning involving all of these potential problem areas.

Renal Insufficiency/Failure

Three major classes of problems are important perioperatively in patients with renal impairment: electrolyte imbalances, fluid status, and associated medical conditions. Potassium concentrations need to be closely monitored. Hyperkalemia should be noted, and if the potassium concentration is significantly elevated from baseline, it should be treated preoperatively. A history of recent weight gain may signal fluid retention and should be relayed to the anesthesia team. Decreases in exercise tolerance can signal cardiac dysfunction. Underlying causes of renal dysfunction (eg, lupus, metabolic or toxic causes) should be noted for anesthesia providers.

Oncologic Diseases

There are 2 important considerations for patients who have or have had

oncologic diseases. First, patients with a mediastinal mass (most often with a new lymphoma diagnosis) are at risk for lethal airway or great vessel compression on induction of anesthesia.³³ Important signs include the inability to lie supine, dyspnea on exertion, plethora of head and neck, and biphasic stridor. Second, treatments for oncologic diseases can have profound effects on the overall perioperative management. Exposure to chemotherapies, such as bleomycin or doxorubicin, can result in long-term effects, such as pulmonary fibrosis and cardiomyopathy.^{34,35} Radiation treatments can cause fibrosis in multiple tissues, which can result in limited mouth opening and neck movement and can worsen pulmonary fibrosis.³⁶ Hematologic and metabolic perturbations are common during oncologic therapy and should be carefully monitored before surgery. Data regarding any of these factors are important to include with the preoperative evaluation.

Developmental Delay/Autism

The perioperative environment can be confusing and scary for any child, perhaps more so for those with cognitive delays. In addition, evaluation of postoperative pain can be difficult, and parents should be questioned about specific pain behaviors in their child. Difficulties in sensory processing and the social interaction often make the perioperative period difficult for children with autism spectrum disorders. Education of the family and child on the process of anesthesia and surgery is generally helpful. Parents should be queried for advice on how a particular child can be best approached by the

perioperative care team.³⁷ Information on “triggers” for aggressive behavior or comfort items should be communicated in a preoperative note.

Do-Not-Resuscitate Orders for Patients in the OR

The American Academy of Pediatrics, the American Society of Anesthesiologists, and the American College of Surgeons have statements on issues related to do-not-resuscitate (DNR) status during operative interventions.^{38,39} DNR orders will be reviewed with patients and families in light of the expected effects of surgery (eg, blood loss) and anesthesia (eg, intubation, cardiac effects of certain drugs). The family and surgical and anesthesia teams will decide on the best option for managing DNR status, which may include modification, suspension, or continuation for the perioperative period.⁴⁰ Patients need to know that such a discussion will occur before entering the OR.

Religious Considerations

For procedures such as spinal fusions or cranial vault reconstructions, blood transfusions are common. Jehovah's Witness families should meet with the anesthesiologist to review the options for handling hematologic issues. The legal and ethical issues are complex.⁴¹ In the event of life-threatening blood loss, many states allow blood transfusion in minors. The family and anesthesia team should discuss the implications of the law in the state in which surgery will be performed. The family can be reassured that all possible measures to avoid transfusion will be taken. Other religious practice

considerations include requirements for wearing specific clothing, charms, or covering the head. Removal of these items may or may not be required for anesthesia or surgery, and the pediatrician should counsel the family to discuss options with the anesthesia team.

CONCLUSIONS

Pediatricians are in a unique position to help prepare children and their families for surgery and help the perioperative team optimize care. Communication about conditions related to increased risk in the OR and aiding the family to advocate for their child in a stressful situation are valuable contributions to the preoperative preparation of the pediatric patient.

LEAD AUTHORS

Kenneth R. Goldschneider, MD
Joseph P. Cravero, MD

SECTION ON ANESTHESIOLOGY AND PAIN MEDICINE, 2013–2014

Corrie Anderson, MD
Carolyn Bannister, MD, Immediate Past Chairperson
Courtney Hardy, MD
Anita Honkanen, MD
Mohamed Rehman, MD
Joseph Tobias, MD, Chairperson

LIAISONS

Jeffrey Galinkin, MD – *AAP Committee on Drugs*
Mark Singleton, MD – *American Society of Anesthesiologists*

STAFF

Jennifer Riefe

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Lynne G. Maxwell, MD
Lynda J. Means, MD
Constance S. Houck, MD, FAAP
Jeffrey L. Koh, MD, FAAP

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