



Critical Elements for the Pediatric Perioperative Anesthesia Environment

Section on Anesthesiology and Pain Medicine

abstract

The American Academy of Pediatrics proposes guidance for the pediatric perioperative anesthesia environment. Essential components are identified to optimize the perioperative environment for the anesthetic care of infants and children. Such an environment promotes the safety and well-being of infants and children by reducing the risk of adverse events.

Studies published over the last 50 years have established that infants younger than 1 year and children with complex comorbidities have a higher risk of perioperative morbidity and mortality.¹⁻¹³ Proposals to decrease this risk have included implementing performance-based practitioner clinical privileging,^{14,15} instituting requirements that fellowship-trained anesthesiologists provide anesthesia for children under a specific age,^{6,16,17} and directing that all infants and critically ill children needing anesthesia be cared for in hospitals with special neonatal or pediatric care units.^{18,19} Although all these proposals define important concerns, they do not address the facility-based components needed to optimize the pediatric perioperative anesthesia environment, the absence of which can hinder the care provided by the anesthesiologist, usually the principal but often not the sole member of the perioperative anesthesia care team. The pediatric perioperative anesthesia environment is defined as areas of a patient care facility in which the patient preparation for, performance of, and recovery from surgical procedures occur or where anesthesia is administered for nonoperative procedures.

Important facility-based component issues for the perioperative anesthesia environment include the training and experience of the health care team, the resources (both human and structural) committed to both the medical and psychosocial care of infants and children in the perioperative period, and pediatric-specific techniques for airway management, fluid administration, temperature regulation, vascular catheter insertion, cardiorespiratory monitoring, and pain management. Patient care facilities and their medical staff members who want to provide pediatric anesthesia care must be able to address all these issues in a competent manner.

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www.pediatrics.org/cgi/doi/10.1542/peds.2015-3595

DOI: 10.1542/peds.2015-3595

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

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FINANCIAL DISCLOSURE: *The authors have indicated they have no financial relationships relevant to this article to disclose.*

POTENTIAL CONFLICT OF INTEREST: *The authors have indicated they have no potential conflicts of interest to disclose.*

The American Academy of Pediatrics (AAP) recommends the following guidance for the pediatric perioperative anesthesia environment for patients needing elective general and regional anesthesia. Anesthesia care needed under emergency circumstances may preclude strict adherence to this guidance. Other publications from the AAP address the issues involved in the administration of sedation for diagnostic and therapeutic procedures.²⁰ This AAP policy statement is intended to supplement rather than replace the standards and guidelines of the American Society of Anesthesiologists²¹ and the Society for Pediatric Anesthesia (<http://www.pedsanesthesia.org/about/society-for-pediatric-anesthesia-policy-statement-on-provision-of-pediatric-anesthesia-care/>) for the perioperative care of patients receiving anesthesia. The AAP has published policies concerning medical staff appointment and delineation of privileges in hospitals and facilities and equipment in the care of pediatric patients in community hospitals.^{22,23} These recommendations extend the concepts noted in those publications to the pediatric perioperative anesthesia environment.

PATIENT CARE FACILITY AND MEDICAL STAFF POLICIES

Designation of Operative Procedures, Categorization of Pediatric Patients Undergoing Anesthesia, and the Annual Minimum Case Volume to Maintain Clinical Competence

Facilities caring for children should have written policies designating and categorizing the types of pediatric operative, diagnostic, and therapeutic procedures requiring anesthesia on an elective and emergency basis and indicating the minimum number of cases needed in each category for the facility to maintain clinical competence in their performance.

Such policies should be based on the capability of the patient care facility and its medical staff to care for pediatric patients needing anesthesia, specifically identifying patients at elevated risk of adverse outcomes. Risk categories should include but are not limited to patient age, procedures for which postoperative intensive care is anticipated, and patients with special anesthesia risks because of coexisting medical conditions. Observational data on adverse outcomes have shown that infants between 1 month and 1 year of age have an approximately 4 times higher risk of anesthesia-related cardiac arrest than do children 1 to 18 years of age, and infants younger than 1 month have an approximately 6 times higher risk of cardiac arrest than do infants between 1 month and 1 year of age.^{5,9,10} The following age categories are recommended for credentialing and outcome measurement: 0 to 1 month, 1 to 6 months, 6 months to 2 years, and older than 2 years. Because of the anatomic, physiologic, and psychological differences between children and adults, additional differentiation in pediatric age groups for patients older than 2 years also is recommended.

Anesthesia care for pediatric patients should be provided or supervised by anesthesiologists with clinical privileges as noted in the following section. The annual minimum case volume needed to maintain clinical competence in each patient care category should be determined by the facility's anesthesiology department with approval by the facility's medical staff and governing board.

Clinical Privileges of Anesthesiologists

Regular Clinical Privileges

Anesthesiologists providing clinical care to pediatric patients should be graduates of an anesthesiology residency training program accredited by the Accreditation

Council for Graduate Medical Education or its equivalent and possess current Pediatric Advanced Life Support or Advanced Pediatric Life Support certification.

Special Clinical Privileges

In addition to the requirement for regular clinical privileges, anesthesiologists providing or directly supervising the anesthesia care of patients in the categories designated by the facility's anesthesiology department as having elevated anesthesia risk should be graduates of an Accreditation Council for Graduate Medical Education pediatric anesthesiology fellowship training program or its equivalent or have documented historical and continuous competence in the care of such patients. The American Board of Anesthesiology has established subspecialty certification in pediatric anesthesiology as of 2013. To qualify for the board examination, 30% of an anesthesiologist's clinical practice must be devoted to pediatric cases, including neonates and children younger than 2 years and procedures considered high risk.²⁴

Pain Management

There should be a patient care facility policy for effective pediatric pain treatment in the perioperative anesthesia environment. If case volume and complexity warrant, consideration should be given to establishing a pediatric pain management service, whose members may be drawn from multiple specialties and disciplines. Pain management strategies must be tailored to the types of surgical procedures, individual variations in pain perception, and the options available for analgesic intervention. The use of regional blockade, when indicated and when expertise is available, is encouraged. The American Society of Anesthesiologists has published practice guidelines for acute pain management in the perioperative setting.²⁵ Each facility

must establish its own set of standard protocols to optimize patient care, to facilitate ongoing education and training, and to encourage that surgeons and other hospital personnel are knowledgeable and skilled with regard to effective and safe use of treatment options available.²⁶ Parents of infants and children undergoing operative procedures on an outpatient basis should receive detailed instructions on postoperative care and pain management at home.²⁷

PATIENT CARE UNITS

Preoperative Evaluation and Preparation Units

A separate preoperative unit or an area within a general preoperative unit should be available and designated to accommodate pediatric patients and their families using patient- and family-centered care. It should have age- and size-appropriate equipment needed for the preoperative evaluation and preparation of the infant or child.

Operating Room

Anesthesiologists

An anesthesiologist with pediatric anesthesia experience should be responsible for the organization of the pediatric anesthesia services.¹⁹ These responsibilities should include liaison with other services and departments that are involved in perioperative care to establish systems and protocols to formalize handoffs and communication and increase patient safety.²⁸ All current medications should be reviewed by the anesthesiologist and discussed with the primary service. If medications are contraindicated during surgery for any reason, appropriate substitutions or an alternative treatment plan should be agreed upon.

Other Health Care Providers Involved in the Perioperative Care of the Infant or Child

Nursing and technical personnel involved in the care of infants and

children should be trained and experienced in routine and emergency pediatric perioperative care. Important considerations in the training of such personnel include the ability to formulate drugs and infusions in appropriate doses, concentrations, and volumes for pediatric patients and expertise in the methods of respiratory therapy administration for infants and children.

The facility's operating room administration should be responsible for organizing pediatric perioperative ancillary and support services. These team members should work in concert with the anesthesiology service to organize both day-to-day and emergency procedures for infants and children in the perioperative environment. Child life specialists can be particularly helpful in preparing children for the emotional and behavioral responses to the perioperative experience, and their involvement in the preoperative process should be encouraged. Modeling and targeting supportive behaviors of parents, anesthesiologists, and nurses during the preoperative period and induction of anesthesia have been shown to improve postoperative outcomes.^{29,30}

Clinical Laboratory and Radiologic Services: Availability and Capabilities

Clinical laboratory and radiologic services should be available at all times when patients are being cared for at the facility. The clinical laboratory must have the capability to provide hematologic and chemical analyses on small samples. Point-of-care testing with portable devices may be acceptable for low-risk procedures, especially in ambulatory or satellite pediatric facilities.

Pediatric Anesthesia Equipment and Drugs

There should be a full selection of equipment available for application to the pediatric patient. This equipment

should be appropriately maintained and easily accessible in both the procedure area and the postanesthesia care unit. A resuscitation cart with equipment appropriate for pediatric patients of all ages, including pediatric defibrillator paddles, is needed. The anesthesiologist should be educated in recognition of cardiac dysrhythmias, have equipment for accurate recording of abnormal cardiac rhythms, and know how to use defibrillators that can deliver pediatric doses of energy accurately. Resuscitation cardiac drugs should be available in appropriate pediatric concentrations. A written pediatric dose schedule for these drugs should be immediately available.³¹⁻³³ Pediatric-specific cognitive aids for the treatment of emergencies and critical conditions, which may help guide management during infrequent and unfamiliar crises, should be immediately available in the operating room and postanesthesia care unit³⁴ (http://www.pedsanesthesia.org/newnews/Critical_Event_Checklists.pdf; 201405121023).

In addition, 20% lipid emulsion should be readily accessible for the emergency treatment of local anesthetic systemic toxicity in any location where regional blocks are performed.³⁵

Other necessary items include

- Airway equipment for all ages of pediatric patients, including ventilation masks, supraglottic airway devices, tracheal tubes, oral and nasopharyngeal airways, and laryngoscopes with pediatric blades;
- A separate, fully stocked "difficult airway cart" containing specialized equipment for management of the difficult pediatric airway by a variety of techniques for airway control, ventilation, and intubation, including supraglottic airway devices, fiber-optic and rigid bronchoscopy equipment, video-laryngoscopes, optical stylets, and

other specialized pediatric airway devices³⁶;

- Positive-pressure ventilation systems appropriate for infants and children;
- Devices for the maintenance of normothermia (eg, warming lamps, circulating warm air devices, room thermal regulation capability, airway humidifiers, and fluid-warming devices);
- Intravenous fluid administration equipment, including pediatric volumetric fluid administration devices, intravascular catheters in all pediatric sizes, and devices for intraosseous fluid administration^{32,37};
- Noninvasive monitoring equipment for the measurement of electrocardiography, blood pressure, pulse oximetry, capnography including anesthetic gas concentrations, temperature, and inhaled oxygen concentration; and
- Equipment for the measurement of arterial and central venous pressures in infants and small children.

Postanesthesia Care Unit

Nursing Staff

Postanesthesia recovery nurses with pediatric education and experience who are knowledgeable in intraoperative pediatric anesthesia management are needed. Training and experience in pediatric airway management and basic resuscitation techniques, as well as the ability to recognize a child in distress and provide immediate assistance while calling for support staff or resuscitation team, are necessary. Pediatric Advanced Life Support course training and certification are important.

Anesthesiologist or Physician Staff

An anesthesiologist or other physician trained and experienced in pediatric perioperative care, including the management of postoperative complications and the

provision of pediatric cardiopulmonary resuscitation, should be immediately available to evaluate and treat any child in distress. Algorithms for the treatment of pediatric emergencies are continuously being updated on the basis of new data, so current certification in Pediatric Advanced Life Support or Advanced Pediatric Life Support is important.

Pediatric Anesthesia Equipment and Drugs

The pediatric anesthesia equipment and drugs previously specified in the section "Operating Room" should be available for patients in the postanesthesia care unit. Every child admitted to the postanesthesia care unit should have his or her vital signs regularly monitored according to unit policy. Suction equipment, oxygen, and positive-pressure ventilation devices with appropriately sized masks should be available at each bedside.

A respiratory oxygen delivery system and portable physiologic monitor should be available for use in the transport of infants and children from the operating room to the postanesthesia care or postoperative ICU when medically indicated. The use of a portable pulse oximeter during transport of patients from the operating room or procedure suite, especially if not immediately proximate to the postanesthesia care unit, is encouraged.^{38,39}

POSTOPERATIVE INPATIENT CARE

Former preterm infants (postconceptional age <37 weeks) are at elevated risk of postoperative apnea after anesthesia.^{40,41} Anemia and coexisting medical problems increase this risk. Although absolute parameters are limited by uncertainties in the data, admission and monitoring should be planned for at least 12 hours after anesthesia and surgery for preterm infants younger than 50 to 60 weeks'

postconceptional age and full-term infants younger than 4 weeks. Because of the immaturity of the respiratory control centers in the central nervous system and the prolonged effects of general anesthesia, healthy full-term infants >4 weeks old and <6 months old should be monitored for ≥ 2 hours after surgery and, if possible, scheduled early in the day. Patients of any age with a history of obstructive sleep apnea should also be considered for postoperative admission or prolonged postoperative monitoring.⁴²

Patient care facilities in which operative procedures are performed that involve postoperative intensive care should have intensive care facilities (neonatal or pediatric) appropriate for the age of the patient. The ICU should be designed, equipped, and staffed to meet state and federal standards for the care of critically ill neonates, infants, and children. The only exception is an operative procedure needed in an emergency.

Patient care facilities (including outpatient surgical centers) that perform operative procedures in children should have a transfer agreement in place with an appropriate facility to facilitate prompt transfer should unexpected complications occur.

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Section on Anesthesiology and Pain Medicine
Pediatrics 2015;136;1200; originally published online November 30, 2015;
DOI: 10.1542/peds.2015-3595

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Section on Anesthesiology and Pain Medicine

Pediatrics 2015;136;1200; originally published online November 30, 2015;

DOI: 10.1542/peds.2015-3595

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</content/136/6/1200.full.html>

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