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Review Article

Pediatric perioperative management: An integrated review of preoperative evaluation, fasting protocols, postoperative nausea and vomiting, and postoperative pain in light of current guidelines

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ABSTRACT

The aim of this review is to present an integrated overview of pediatric perioperative anesthesia care by focusing on its fundamental components—preoperative evaluation, fasting management, prevention of postoperative nausea and vomiting (PONV), and postoperative pain control—based on current guidelines and evidence. The aim is to emphasize the need for individualized, risk-based approaches in pediatric patients.

This study is designed as a narrative review based on current international guidelines and relevant literature on pediatric perioperative anesthesia. Key domains including preoperative assessment, fasting protocols, PONV prophylaxis, and postoperative pain management were evaluated within a comprehensive and integrated clinical framework. Emphasis was placed on risk stratification strategies, avoidance of unnecessary routine investigations, and the implementation of multimodal and age-appropriate approaches.

Current evidence indicates that pediatric perioperative care differs significantly from adult practice due to limited physiological reserves, developmental variability, and age-related pharmacokinetic and pharmacodynamic differences. Risk-adapted strategies improve patient safety and outcomes. Specifically, shortened and evidence-based fasting protocols reduce metabolic stress; opioid-sparing multimodal analgesia minimizes adverse effects; risk-based antiemetic prophylaxis decreases the incidence of PONV; and age-appropriate pain assessment tools enhance postoperative pain management. Avoiding unnecessary routine tests further contributes to efficient and patient-centered care.

Pediatric perioperative anesthesia care should be based on an integrated, individualized, and risk-oriented approach. The effective combination of optimized preoperative evaluation, evidence-based fasting strategies, tailored PONV prevention, and multimodal pain management improves safety and clinical outcomes. Current evidence strongly supports a shift from routine, standardized practices toward patient-specific, guideline-driven perioperative management in children.

Keywords: Pediatric anesthesia, postoperative nausea and vomiting, postoperative pain

Introduction

Pediatric perioperative care is fundamentally aimed not only at ensuring the safe completion of the surgical procedure, but also at maintaining perioperative physiological homeostasis, minimizing complications, and enabling the child to transition into the recovery phase with the least possible stress (1). In this context, although preoperative evaluation, fasting management, PONV prophylaxis, and postoperative pain treatment may appear as separate domains, in clinical practice they are directly interrelated and mutually influential processes. For example, inadequate preoperative evaluation may lead to overlooked respiratory or cardiac risks; unnecessarily prolonged fasting may result in metabolic instability and irritability; poorly planned analgesia may increase opioid requirements; and this, in turn, may lead to a higher risk of PONV and respiratory depression. Therefore, contemporary pediatric anesthesia practice supports not a fragmented but a comprehensive and integrated perioperative care model.

Preoperative evaluation: Identification of risk and individualized planning

Pediatric preoperative evaluation is not merely a simple checklist performed before surgery; rather, it is a structured clinical process aimed at identifying the patient's physiological resilience, comorbidity burden, airway characteristics, current medications, family history, and specific conditions predisposing to perioperative complications. Although a large proportion of children undergoing surgery are otherwise healthy, it has been emphasized that serious perioperative events are not limited to high-risk patients, and that respiratory complications may also occur in children considered healthy. Therefore, systematic evaluation is required even in apparently healthy children (2-3).

The medical history should comprehensively include birth history, prematurity, neonatal complications, growth and developmental characteristics, genetic syndromes, craniofacial anomalies, cardiac and pulmonary diseases, neuromuscular disorders, endocrine conditions, and current medications. The perioperative management of medications used in pediatric patients requires careful consideration. Discontinuation of antiepileptic drugs increases the risk of seizures, whereas continuation of asthma control medications is recommended. In patients receiving chronic steroid therapy, the need for stress-dose steroids should be evaluated due to the risk of adrenal suppression. A history of prematurity, bronchopulmonary dysplasia, and postmenstrual age are particularly important predictors of postoperative apnea and bradycardia risk. Family history should include malignant hyperthermia, pseudocholinesterase deficiency, bleeding diathesis, congenital myopathies, and severe drug reactions, as these may directly influence anesthetic planning. Behavioral and social history is also relevant in children and adolescents; substance use, psychosocial stress, and concealed health issues in adolescents may impact perioperative safety (2,4).

The physical examination should primarily focus on airway, cardiovascular, respiratory, neurological status, and hydration. Mallampati classification, mouth opening, neck mobility, dentition, and craniofacial anomalies are important predictors of difficult airway. Conditions such as trisomy 21, mucopolysaccharidoses, syndromes associated with cervical anomalies, and head and neck masses may complicate airway management. The ASA physical status (PS) classification provides a useful general framework for risk assessment in pediatric patients; however, it is not sufficient on its own (Table I) (5). Younger age, urgency of surgery, coexisting airway disease, and type of surgery may be equally or more decisive in clinical practice.

Current recommendations do not support routine laboratory testing in healthy children undergoing low-risk procedures. Instead, a targeted approach based on findings from history and physical examination is recommended. For instance, electrocardiography and, if necessary, echocardiography may be considered in cases of unexplained murmur, exercise intolerance, growth retardation, severe scoliosis, bronchopulmonary dysplasia, or neuromuscular disease (6). Similarly, routine chest radiography is not recommended in children with normal oxygen saturation and no clinical findings; however, it may be indicated in severe asthma, bronchopulmonary dysplasia, suspected mediastinal mass, or active pulmonary disease. This selective strategy reduces unnecessary interventions while focusing on clinically meaningful findings (2).

In children with upper respiratory tract infection, perioperative respiratory complications may increase by 2–7

Table I: ASA PS Classification (5)

ASA PS Classification	Definition	Pediatric Examples, Including but not Limited to:
ASA I	A normal healthy patient	Healthy (no acute or chronic disease), normal BMI percentile for age
ASA II	A patient with mild systemic disease	Asymptomatic non cyanotic congenital cardiac disease, well controlled dysrhythmias, asthma without exacerbation, well controlled epilepsy, non-insulin dependent DM, abnormal BMI percentile for age, mild/ moderate OSa, oncologic state in remission, autism with mild limitations, malignant hyperthermia risk (family history or patient with history)
ASA III	A patient with severe systemic disease	Uncorrected stable congenital cardiac abnormality, asthma with exacerbation, poorly controlled epilepsy, insulin dependent diabetes mellitus, morbid obesity, malnutrition, severe OSa, oncologic state, renal failure, muscular dystrophy, cystic fibrosis, history of organ transplantation, brain/ spinal cord malformation, symptomatic hydrocephalus, premature infant PCa
ASA IV	A patient with severe systemic disease that is a constant threat to life	Symptomatic congenital cardiac abnormality, congestive heart failure, active sequelae of prematurity, acute hypoxic-ischemic encephalopathy, shock, sepsis, disseminated intravascular coagulation, automatic implantable cardioverter-defibrillator, ventilator dependence, endocrinopathy, severe trauma, severe respiratory distress, advanced oncologic state.
ASA V	A moribund patient who is not expected to survive without the operation	Massive trauma, intracranial hemorrhage with mass effect, patient requiring ECMO, respiratory failure or arrest, malignant hypertension with hypertensive crisis, decompensated congestive heart failure, hepatic encephalopathy, ischemic bowel or multiple organ/ system dysfunction.
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes	

fold. Elective surgery should be postponed for at least two weeks in the presence of severe symptoms such as fever, purulent secretions, wheezing, lethargy, or oxygen requirement. In patients with mild symptoms, decision-making should be individualized based on age, comorbidities, need for airway surgery, planned intubation, institutional experience, and parental compliance. Intravenous induction with propofol, avoidance of desflurane, use of less invasive airway devices, and management by experienced pediatric anesthesia teams are recommended (7,8). The COLDS score may be helpful but is not sufficient alone (9).

In asthmatic children, recent exacerbations, emergency visits, hospitalizations, prior intubations, use of short-acting beta agonists, and steroid therapy should be assessed. Maintenance therapy should be continued, preoperative bronchodilator administration may be considered, and elective procedures should be postponed in the presence of active wheezing. In obese children and those with obstructive sleep apnea, risks of difficult ventilation, difficult intubation, excessive sedation, postoperative respiratory complications, and PONV are increased. Use of CPAP devices, review of polysomnography findings, and cautious opioid administration are recommended (2).

Premature infants represent a special risk group. Patients with postmenstrual age between 50–60 weeks require monitoring for postoperative apnea. Hematocrit levels below 30% may increase this risk. Bronchopulmonary dysplasia, hypothermia, pain, and acidosis-related pulmonary vasoconstriction are also relevant. Optimization of respiratory and nutritional status prior to elective surgery is essential; in selected cases, spinal anesthesia or perioperative caffeine administration may be considered (10). In children with neuromuscular disorders, both respiratory and cardiac insufficiency, as well as risks of rhabdomyolysis and malignant hyperthermia-like reactions, are increased; avoidance of triggering agents and careful postoperative monitoring are required (11).

Pediatric preoperative fasting: A metabolic and comfort-oriented approach beyond aspiration

The traditional aim of preoperative fasting is to reduce the risk of pulmonary aspiration during anesthesia. However, current literature indicates that aspiration of clear fluids in children is rare and, in most cases, not associated with serious sequelae; in contrast, prolonged fasting may lead to more frequent and clinically significant complications such as hypoglycemia, dehydration, irritability, ketosis, and hypotension. Therefore, the modern approach is based on the principle of “the shortest safe fasting duration” rather than “absolute prolonged fasting” (12,13).

According to current pediatric fasting guidelines, a duration of 6 hours for solid foods, 4 hours for formula and non-breast milk, 3 hours for breast milk, and 1 hour for clear fluids is recommended. This approach is consistent with the ESAIC 2022 recommendations (2,14). However, it should be noted that the ASA 2023 guideline adopts a more conservative stance and maintains a 2-hour fasting period for clear fluids. Therefore, while the 1-hour approach for clear fluids is an increasingly supported trend, there is no absolute consensus among all guidelines (15). This point should be emphasized transparently (Table II).

Table II: Preoperative fasting

6-4-3-1 Regimen & Basic Rules	Current Guidelines (ESAIC & ASA)	Contraindications for 1-Hour Fasting
• Solids: 6 hours • Formula milk: 4 hours • Other milks except breast milk: 4 hours • Breast milk: 3 hours • Clear liquids: 1 hour (TARD 2025)	• **ESAIC 2022:** 1 hour for clear liquids (max. 3 mL/kg). • **ASA 2023:** No difference between 1 hour and 2 hours, but 2 hours is recommended. • Solid food 8 hours, light solid food 6 hours. • A fasting period of 6 hours for infant formula and 4 hours for breast milk is recommended.	• Obesity • Gastroesophageal reflux • Renal failure • Some enteropathies • Esophageal strictures • Achalasia • Gastroparesis and/or Diabetes Mellitus • Surgical contraindications

Clear fluids exhibit rapid gastric emptying. According to the data summarized in the guideline, the gastric half-emptying time of clear fluids is very short, and no increase in pulmonary aspiration risk has been demonstrated with a 1-hour fasting period for clear fluids (16). Multicenter data indicate that a 1-hour clear fluid fasting protocol does not increase adverse respiratory events. Furthermore, shorter fasting durations are advantageous in reducing thirst, hunger, anxiety, and metabolic stress (17). However, in conditions such as obesity, gastroesophageal reflux, gastroparesis, achalasia, esophageal stricture, renal failure, and certain enteropathies, the 1-hour clear fluid approach is considered relatively contraindicated.

The guideline emphasizes that prolonged fasting leads to more pronounced metabolic disturbances, particularly in young children and those under 36 months of age. These include hypoglycemia, dehydration, electrolyte imbalance, increased ketone body production, irritability, and hemodynamic instability. These risks become even more significant when fasting durations exceed twelve hours. Therefore, it is important to schedule surgical lists early, prevent unnecessary delays, and encourage the intake of clear fluids safely up to the latest permissible time (13).

Carbohydrate-containing clear fluids appear to be beneficial in reducing physiological stress and maintaining insulin sensitivity. However, the available evidence is not uniformly strong enough across all contexts to conclude that they are superior to plain clear fluids in every situation. Perioperative glucose management requires special attention in children with diabetes; blood glucose levels should be maintained within the range of 90–180 mg/dL, measurements should be performed at least hourly, and more frequently in cases of rapid fluctuations. It has also been noted that gastric emptying may be delayed in diabetic patients even when standard fasting durations are followed. In such cases, or when fasting history is uncertain, gastric ultrasonography may assist in clinical decision-making (18-20).

Postoperative nausea and vomiting: risk-adapted yet increasingly liberal multimodal prophylaxis

Postoperative nausea and vomiting (PONV) is a significant perioperative problem, particularly in ambulatory surgery, as it delays discharge, impairs oral intake, complicates pain management, and reduces family satisfaction. The current 5th consensus guideline emphasizes the importance of an algorithm-based and multimodal approach in both adults and children (21). However, the evidence base in children is more limited compared to adults, and therefore the strength of some recommendations does not reach the level observed in adult populations. It is important to preserve this distinction.

In children, the concept of postoperative vomiting (POV) is often emphasized rather than PONV, as the verbal expression of nausea may be difficult in younger patients. Validated scoring systems such as VPOP (Vomiting in the Postoperative Period) and POVOC (Postoperative Vomiting in Children) are used in this population. High-risk surgical procedures include strabismus surgery, tonsillectomy/adenoidectomy, and tympanoplasty. The use of volatile anesthetic agents, opioids, anticholinesterases, and female sex after puberty may confer additional risk. However, the guideline emphasizes that a mechanistic strategy of increasing pharmacological agents solely based on the cumulative number of risk factors does not always yield consistent benefit; particularly in high-risk groups, risk-reduction strategies are at least as important as pharmacological interventions (21).

Propofol-based total intravenous anesthesia (TIVA) reduces the incidence of PONV/POV in both adults and children. Adequate hydration, opioid-sparing analgesia, the use of local and regional techniques, and in certain cases dexmedetomidine may reduce the risk of PONV (22,23). Avoidance of nitrous oxide may be considered, particularly in high-risk pediatric patients. The guideline also notes that evidence is limited regarding the routine addition of more than three pharmacological prophylactic agents in children; therefore, in high-risk patients, non-pharmacological and anesthetic risk-reduction strategies should be maximized (24).

Ondansetron and dexamethasone are the most extensively studied agents in children. The combination of dexamethasone and ondansetron is more effective than monotherapy (25). However, evidence supporting the benefit of adding a third agent in high-risk groups is limited; although some retrospective data suggest the addition of scopolamine or diphenhydramine, these findings should be interpreted with caution. If PONV develops despite prophylaxis, rescue therapy with an agent of a different mechanism of action is recommended rather than repeating a dose from the same drug class. The overarching message of the guideline is that applying a better algorithm is more important than simply administering more medications (Table III).

Table III: Prophylaxis in PONV

Drug	Dose
Ondansetron	0.1 mg/kg up to 4 mg
Dolasetron	0.35 mg/kg up to 12.5 mg
Granisetron	0.04 mg/kg up to 0.6 mg
Palonosetron	0.5-1.5 mcg/kg
Tropisetron	0.1 mg/kg up to 2 mg
Droperidol	10-15 mcg/kg up to 1.25 mg
Dimenhydrinate	0.5 mg/kg up to 25 mg
Dexamethasone	0.15 mg/kg up to 4 mg
Aprepitant	3 mg/kg up to 125 mg

PONV is not solely a matter of antiemetic selection. Prolonged fasting, increased opioid use, and inadequate hydration may exacerbate PONV. Conversely, early oral fluid intake has been shown in some studies to reduce both opioid requirements and vomiting. This finding highlights why fasting, pain, and PONV management should not be considered as separate entities, but rather as components of a unified recovery strategy within the perioperative process (21).

Pediatric postoperative pain: Assessment and multimodal management

The management of postoperative pain in pediatric patients is an integral component of successful surgical care. The guideline emphasizes that pain control not only provides comfort but also reduces the stress response, supports functional recovery, facilitates early mobilization, and may decrease the risk of chronic pain development. Furthermore, it is also critical in preventing negative pain memory in the child, maintaining the child–healthcare provider relationship, and ensuring family satisfaction (26,27).

Nociceptive receptors and thalamocortical pain pathways become functionally active during the later stages of fetal development. Therefore, the notion that neonates and infants do not “perceive” pain is not scientifically valid. Moreover, due to the immaturity of inhibitory neurotransmitter systems, pain modulation may be insufficient, and the pain response may be more pronounced (28). This biological reality indicates that pediatric pain treatment should not be delayed and that the “we can address it later if necessary” approach should be abandoned.

A single pain assessment scale is not suitable for all pediatric age groups. In children capable of communication, self-report is considered the gold standard. Visual Analog Scale (VAS), Numeric Rating Scale (NRS), and Wong-Baker FACES are commonly used in this group. In neonates and younger children, behavioral and physiological scales are required; FLACC, revised FLACC, PIPP, the COMFORT Scale, and CRIES are among the most prominent examples. One of the key points emphasized in the guideline is that pain should be assessed both at rest and during movement, and unexpected increases in pain scores should also be interpreted as potential indicators of surgical complications (26,27,29) (Table IV-V).

The guideline presents the use of multimodal analgesia in both children and adults as a strong recommendation supported by high-quality evidence. This approach may include appropriate combinations of paracetamol, NSAIDs, opioids when necessary, ketamine, gabapentinoids, intravenous lidocaine, regional blocks, and neuraxial techniques. The aim is not to administer more medications, but to achieve more effective analgesia with reduced opioid requirements by targeting different mechanisms (29,30).

Paracetamol is the primary agent for mild to moderate pain and is available in oral, rectal, and intravenous forms. In neonates and young infants, dosing should be carefully adjusted due to differences in volume of distribution and elimination. The total daily dose should not be exceeded due to the risk of toxicity. NSAIDs reduce opioid requirements; however, they should be used with caution due to

Table IV: Pain intensity rating scales in children (29)

Scales based on self-report	
FACES Scale (Wong Baker)	Aged 3 to 18 years (the scale consists of 6 drawings of facial expressions; each face is scored 0-5 or 0-10)
Faces Pain Scale	Revised- for those aged 4 to 12 years (the scale consists of 6 drawings of face expressions; an examiner gives 0,2,4,6,8 or 10 points to faces indicated by the child (counting from left to right)
VAS Scale (Visual Analogue Scale)	Aged 3 to 18 years (the VAS scale is a 10 cm line with 0 meaning total absence of pain, and 10 meaning the worst pain imaginable
NRS Scale (Numeric Rating Scale)	Aged 3 to 18 years (scale from 0 to 10, where 0 means I'm not feeling any pain, and 10 means the worst pain imaginable)
Pieces of Hurt Tool Scale	Aged 3 to 18 years
Scales based on child's behaviour or behaviour and physiological parameters	
Children and adolescents without cognitive impairment	
FLACC Scale (Face, Legs, Activity, Cry, and Consolability)	Aged 1 to 18 years
PPPM Scale	Parent's Postoperative Pain Measure
COMFORT scale	Behavioural and physiological parameters
Children and adolescents with cognitive impairment	
NCCPC-PV Scale (Non-Communicating Children's Pain Checklist-Postoperative Version)	Aged 3 to 18 years
PPP Scale(Paediatric Pain Profile)	Aged 1 to 18 years
FLACC Scale-Revised (Face, Legs, Activity, Cry, and Consolability)	Aged 4 to 18 years
INRS (Individualized Numeric Rating Scale)	Aged 3 to 18 years

Table V: Pain intensity rating scales in children (29)

Scale	Parameter	Outcome	Application
Premature infant pain profile (PIPP)	Age from conception, behaviour, pulse, haemoglobin oxygen saturation, raising eyebrows, tightening of eyelids, nasolabial sulcus	Number of points to score: 0-21 Each parameter scored 0-3 points Minimal pain ≤6, moderate-to severe pain >12	Procedural and postoperative pain
FLACC (Face, legs, activity, cry, and Consolability)	Facial expression, leg position activity, cry, possibility of consoling	Number of points to score: 0-10 Each parameter scored 0-2 points Moderate pain>4, severe pain >7	Procedural and postoperative pain
COMFORT scale (behavioural and physiological parameters)	Wakefulness, mood, reaction to ventilator breathing, ambulation, muscle tone, fasial expressions, MAP, HR	Number of points to score: 8-40 Each parameter scored 1-5 points Sufficient sedation 17-26, insufficient sedation/analgesia >27	Pain and sedation in neonatal intensive care unit
CRIES (Crying, requirement, for O2, increased heart rate, expression, sleeplessness)	Cry, demand for additional oxygen supply for saturation >95%, vital signs, facial expressions, sleep patterns	Number of points to score: 0-10 Each parameter scored 0-2 points Moderate pain>4, severe pain >7	Postoperative pain in neonatal intensive care unit

gastrointestinal, renal, and bleeding-related adverse effects, as well as potential effects on anastomotic healing in certain surgical procedures. Opioids remain necessary for moderate to severe pain; however, close monitoring is essential due to risks such as sedation, respiratory depression, and PONV. Patient-controlled analgesia (PCA) is an effective strategy in appropriately selected patients, although routine basal infusion is not recommended in opioid-naïve individuals. Ketamine and gabapentinoids may provide opioid-sparing effects, but sedation and neuropsychiatric side effects should be considered. Intravenous lidocaine may be considered in selected patients, particularly in abdominal surgery; however, safe administration requires an experienced team (26,29,31,32).

Techniques such as peripheral nerve blocks, epidural analgesia, and local infiltration can reduce opioid requirements and positively influence both analgesia and PONV control, particularly in major surgical procedures. Continuous peripheral blocks and epidural techniques are beneficial when appropriate organizational and monitoring conditions are ensured (33). Non-pharmacological approaches should not be underestimated; transcutaneous electrical nerve stimulation (TENS), cognitive therapy, relaxation techniques, music therapy, and play-based distraction methods may contribute to pain modulation, particularly in anxiety-related pain perception. These methods should be considered not as replacements for pharmacological treatment, but as complementary components (34).

Discussion

Four key messages emerge for pediatric perioperative care. First, the more thoroughly the preoperative evaluation is performed, the greater the likelihood of anticipating and preventing perioperative complications; in particular, conditions such as upper respiratory tract infection, asthma, obstructive sleep apnea, prematurity, and neuromuscular disorders cannot be managed using a standard "healthy child" approach. Second, the traditional concept of "the longer the fasting, the safer it is" is no longer sustainable; shorter, physiology-based fasting is both safer and more comfortable for the child, although there are still nuances among guidelines regarding the 1-hour clear fluid approach, and these nuances should be acknowledged transparently. Third, in the management of PONV, the focus should not be solely on administering more antiemetics, but rather on accurately identifying risk and implementing fundamental risk-reduction strategies such as total intravenous anesthesia (TIVA), adequate hydration, and opioid-sparing approaches. Fourth, postoperative pain management in children is not a secondary concern but a central component of perioperative care; delayed recognition of pain adversely affects not only the child's comfort but also other outcomes such as respiration, mobilization, nutrition, and PONV. When these four domains are considered together, the true objective should not merely be "to successfully complete the surgery," but rather "to guide the child safely and in a physiologically balanced manner into the recovery process."

Conclusion

Pediatric perioperative care should be based on the systematic identification of preoperative risks, optimization of fasting durations according to physiological evidence, implementation of risk-adapted multimodal prophylaxis for PONV, and the monitoring and treatment of postoperative pain using age-appropriate scales and multimodal strategies. These four domains should not be viewed as independent components, but rather as interrelated elements of the same clinical trajectory. Successful perioperative management in pediatric patients depends not on performing more tests, prolonging fasting, or administering more medications, but on selecting the appropriate intervention at the right time and with the appropriate intensity for the right patient. The common message of current evidence is clear: quality in pediatric anesthesia lies in achieving a balance between standardization and individualization.

Contribution of the authors

VE: draft manuscript preparation. All authors **VE, EH** reviewed the results and approved the final version of the manuscript.

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