AMBULATORY SURGERY

Surgical Specialty:	Ambulatory Surgery
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Background:

- General Considerations
    - Elective surgical procedures for patients who are fit enough to be discharged home on the same day.
    - The success of ambulatory surgery relies on patient and procedure selection.
- Patient Considerations
    - Any known chronic conditions should be well-controlled prior to surgery.
        - Pre-anesthesia screening should focus on eliciting a history of conditions that would disrupt the scheduled procedure and/or necessitate hospitalization post-operatively
            - Respiratory disease, i.e. asthma, obstructive sleep apnea
            - Cardiac conditions
            - Prematurity
            - Congenital syndromes
            - Malignant Hyperthermia
        - Many Ambulatory Surgery Centers have institutional Body Mass Index limits as well as other exclusion criteria.

Anesthetic Planning:

- Pre-Anesthetic Evaluation
    - A detailed history and physical should be completed to assess for risk factors or contraindications to anesthesia.
    - Depending on institutional policies, the patient's past medical history is often reviewed by a pre-operative nurse or nurse practitioner. If concerns arise, the patient's case may be referred to the medical director for assessment and recommendations. The anesthesiologist or other qualified personnel (anesthesiology resident/CAA/CRNA) complete the day of surgery history and physical exam.
    - The history and physical should consider the following:

Asthma

- Asthma is the most common chronic disease in children.[1]
- Patients should be screened for active disease and medication compliance.
- Asking a patient about their medication regimen, recent steroid use, or emergency room visits can help determine the severity of disease.
- If the patient had a peak flow meter, this can be used to assess acute disease.
- If there are significant concerns, consider pediatrician or pulmonology follow-up for clearance prior to elective surgery.
- If a patient is wheezing at presentation, consider canceling an elective anesthetic and referring the patient for treatment and follow-up.
- IV steroids will not take effect until hours after the procedure and are of little use on the day of surgery.[1]

Obstructive Sleep Apnea (OSA)

- Patients should be screened for OSA to predict the potential risk of respiratory complications. Consider scheduling patients with a high risk of respiratory compromise post-operatively in a facility with resources for overnight observation and admission.
- Risk factors for OSA include morbid obesity, neuromuscular disorders, cerebral palsy, moderate to severe asthma, craniofacial abnormalities, and/or trisomy 21 (or other chromosomal abnormalities).
- Use the STBUR (Snoring, Trouble Breathing, Un-Refreshed) Questionnaire to screen for OSA in children:[2]

  <u>Does your child</u>

  1. Snore more than half of the time?
  2. Snore loudly?
  3. Have any trouble breathing or struggle to breathe?
  4. Stop breathing during the night?
  5. Feel unrefreshed in the morning after a night of sleep?

  - If 3 of 5 symptoms are present, the patient is 3 times as likely to have respiratory complications. If all 5 symptoms are present, the patient is 10 times as likely to have respiratory complications.[3]

- Of note, severe airway obstruction is one of the most common indications for tonsillectomy in children.
  - These patients have altered control of respiration due to chronic nocturnal hypercarbia and hypoxia.
  - Airway obstruction tends to resolve over the course of several days rather than immediately after tonsillectomy.[3]

Cardiac Conditions

- Children with cyanotic heart disease, heart failure, failure to thrive, and/or pulmonary hypertension have a significantly higher risk for postoperative morbidity and mortality.[1]
- Echocardiography can be useful to assess cardiac function and the presence of pulmonary hypertension.
- Patients with single-ventricle physiology (hypoplastic left heart syndrome, tricuspid atresia, pulmonary valve atresia), patients with unrepaired cyanotic heart disease, patients with symptomatic dysrhythmias, and all patients with

new active cardiac concerns needing workup and/or treatment should not undergo anesthesia in ambulatory centers. ● Bacterial endocarditis prophylaxis is indicated for procedures with a high risk of bacteremia (invasive dental and oral procedures or surgery on infected tissue) for patients with the following conditions:[4] ○ Unrepaired cyanotic lesions ○ Completely repaired defects involving prosthetic material during the first six months after the procedure ○ Repaired lesions with residual defects ○ Previous endocarditis
Prematurity
● Children born prematurely (before 37 weeks gestational age) have an increased risk of apnea after receiving an anesthetic. ● Later is safer – post-conceptual age (weeks of gestation plus weeks in age) of a minimum of 60 weeks exceeds all recommendations in the literature.[1]
Congenital Syndromes
● Many congenital and genetic syndromes have multiple associated conditions with anesthetic implications. ● Common syndromes include cystic fibrosis, Down syndrome (and other chromosomal abnormalities), CHARGE syndrome, neuromuscular/mitochondrial disorders, and glycogen storage diseases. ● Syndromes associated with airway abnormalities may not be appropriate for an ambulatory surgery setting.
Malignant Hyperthermia (MH)
● Although children are not at any higher risk of malignant hyperthermia, the lack of previous anesthesia experience for many patients makes it of high concern in pediatric surgery. ● Asking about a family history of reactions to anesthesia can help predict risk.
Upper Respiratory Illness (URI)
● Increased risk of perioperative adverse respiratory events, including laryngospasm, bronchospasm, hypoxia/hypoventilation, and re-intubation. ● The airway remains hyperreactive for 4-6 weeks and most providers will delay elective anesthetic by 2-4 weeks.

- Additional labs/tests indicated during work-up
  - Routine preoperative laboratory tests are not typically indicated in children.
  - Laboratory tests should be performed based on the specific procedure planned and the patient's conditions.
- Discussions to have with surgeon/family
  - Management of preoperative anxiety
    - Utilization of Child Life services if available
    - Parental presence during induction
    - Distraction techniques
    - Premedication

- Specific or Unique Room Set-up Requirements
    - Airway
        - Laryngeal mask airways (LMAs) are frequently used for shorter surgical procedures.
        - Endotracheal tubes (ETT) sized according to age when airway protection is needed.
    - Drugs/Infusions
        - Premedication
            - Midazolam 0.5 mg/kg orally is commonly used for preoperative anxiety.
            - Other options include intranasal dexmedetomidine and IM ketamine in uncooperative and/or combative patients.
        - Post-operative nausea and vomiting (PONV) prophylaxis
            - Patients with 2 or more risk factors should receive prophylaxis with two drugs from different classes.[1]
                - Simplified risk score for children:[5]
                    1. Surgery ≥ 30 minutes
                    2. Age ≥ 3
                    3. Strabismus surgery
                    4. Family history of PONV
            - Common medications/doses include dexamethasone 0.15 mg/kg IV (max 4 mg) and ondansetron 0.1 mg/kg IV (max 4 mg).
        - Emergence delirium prophylaxis
            - Avoiding potent inhalational anesthetics when possible is the most effective preventative measure.
            - For high-risk cases, reasonable preventative interventions can be found in this chart from UpToDate: UpToDate Link[6]
        - Prophylactic antibiotics
            - Appropriate antibiotics must be selected according to the surgical case.
            - Guidelines for subacute bacterial endocarditis prophylaxis (if necessary) from the American Heart Association can be found here: AHA link[7]
        - Dantrolene and intravenous lipid emulsion should be readily accessible to treat malignant hyperthermia and local anesthetic toxicity, respectively.
        - Succinylcholine use is often restricted to the treatment of laryngospasm in children due to the risk of precipitating rhabdomyolysis and hyperkalemia in previously undiagnosed muscular dystrophy or MH.
    - Monitors
        - Standard ASA monitors with additional monitors specific to the case.
        - Bradycardia is typically the first sign of hypoxia in pediatric patients and often manifests earlier than desaturation on pulse oximetry.
    - Hospital bed availability and other indicated resources should be assessed if complications are encountered and hospital admission is needed.

Intraoperative Considerations:

- General
    - Regional anesthesia has many benefits in the pediatric population, including smoother emergence from anesthesia, quicker transition to PACU, and reduced discharge times by reducing the need for opioid analgesia and the likelihood of PONV.[8]
- Induction
    - If IV induction is needed/preferred, consider the use of PO/nasal midazolam, PO/nasal dexmedetomidine, nitrous oxide by mask, or EMLA cream for IV placement. IM ketamine may be useful for uncooperative patients.
    - Nerve blocks and catheters for regional analgesia are usually placed after induction of general anesthesia.
- Positioning
    - Many common ambulatory surgery procedures require neck extension for patient positioning (e.g., tonsillectomy, adenoidectomy).
        - Patients presenting for these procedures may have conditions that confer an increased risk of cervical spine instability (trisomy 21, glycogen storage diseases, achondroplasia).
    - Neck extension can cause displacement of the ETT, and mouth gags can compress the ETT; both of which can disrupt the airway.
- Maintenance
    - Inhalational with sevoflurane is the most common.
    - Consider using total intravenous anesthesia (TIVA) if applicable to decrease the likelihood of PONV and emergence delirium.
    - Consider multimodal analgesia with regional block, acetaminophen, and nonsteroidal anti-inflammatory agents (NSAIDs), in addition to opioids.
- Hemodynamic/Physiologic goals
    - Adequate hydration with IV fluids decreases PONV and pain.
- Emergence/Disposition
    - Emergence delirium (ED) is common in pediatric surgery.
        - ED manifests in the early recovery period and is defined as motor agitation and hypersensitivity with disturbed awareness of the environment.[9]
            - Risk factors include ages 2-6, use of potent inhalation anesthetics (sevoflurane, isoflurane, desflurane), ENT surgeries, and pre-procedure anxiety.
            - Assessed using the Pediatric Anesthesia Emergence Delirium (PAED) scale.
        - Rule out other causes (e.g., hypoxemia, hypoglycemia, urinary retention, and pain)
        - Multiple medications can be used for management, but treatment is largely supportive.
            - Propofol with dexmedetomidine is typically used for high-risk cases intraoperatively and can be given as an IV bolus in PACU for acute management.
        - ED can be upsetting for families and may delay discharge.
            - Addressing the risk during pre-procedure discussions can help manage expectations.

Postoperative Considerations:

- Utilization of a multimodal pain regimen (local anesthetics, acetaminophen, and NSAIDs) can reduce the use of opioids.
- Ketorolac is frequently used for short-term perioperative pain management in pediatric patients.
- Morphine should be dosed by ideal body weight.
- Patients with OSA have an increased sensitivity to opioid-induced respiratory depression.

Case-Specific Complications/Pitfalls

- Pediatric patients with asthma are common in the ambulatory surgery setting and pre-op evaluation should include assessment for active disease.
- OSA should be screened for using the STBUR score.
- Prematurity can pose significant anesthesia risks and procedures should be delayed until approximately 60 weeks post-conceptual age if possible.
- Cardiac conditions involving single ventricle physiology or unrepaired cyanotic heart disease should never be performed in an ambulatory setting.
- Malignant hyperthermia may be undiagnosed in pediatric patients and pre-anesthetic evaluation should include family history of MH.
- Active respiratory illness is an indicator for rescheduling, typically 2-4 weeks after resolution of symptoms.
- Emergence delirium is more common in the pediatric population.
    - Management should include screening, setting expectations with parents, and pharmacological treatment for high-risk cases.
- Complications may require an ambulatory surgery patient to be transferred to a nearby hospital for care, with the two most common reasons for transfer being inadequate pain control and PONV.[8]

References

1. Butz S. Pediatric Ambulatory Anesthesia: What is New and Safe?. In: Ellinas H, Matthes K, Alrayashi W, Bilge A. eds. Clinical Pediatric Anesthesiology. McGraw Hill; 2021.
2. Tait AR, Voepel-Lewis T, Christensen R, O'Brien LM. The STBUR questionnaire for predicting perioperative respiratory adverse events in children at risk for sleep-disordered breathing. *Paediatr Anaesth.* 2013;23(6):510-516. PubMed link
3. Bauer EE, Lee R, Campbell YN. Preoperative Screening for Sleep-Disordered Breathing in Children: A Systematic Literature Review. *AORN J.* 2016;104(6):541-553. PubMed link
4. Cannesson M, Earing MG, Collange V, Kersten JR. Anesthesia for noncardiac surgery in adults with congenital heart disease. *Anesthesiology*. 2009;111(2):432-440. PubMed link
5. Eberhart LHJ, Geldner G, Kranke P, et al. The development and validation of a risk score to predict the probability of postoperative vomiting in pediatric patients. *Anesth Analg.* 2004;99(6):1630-1637. PubMed link
6. Lerman J. Emergence delirium and agitation in children. In: Post T, ed. UpToDate. Waltham, Mass.: UpToDate; 2023. www.uptodate.com. Accessed August 10, 2023.
7. Baltimore RS, Gewitz M, Baddour LM, et al. Infective Endocarditis in Childhood: 2015 Update: A Scientific Statement From the American Heart Association. *Circulation*. 2015;132(15):1487-1515. PubMed link
8. Pediatric Anesthesia. In: Butterworth IV JF, Mackey DC, Wasnick JD. eds. Morgan & Mikhail's Clinical Anesthesiology, 7e. McGraw Hill; 2022. Accessed August 16, 2023.
9. Malarbi S, Stargatt R, Howard K, Davidson A. Characterizing the behavior of children emerging with delirium from general anesthesia. *Paediatr Anaesth*. 2011;21(9):942-950. PubMed link

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