Best Practice Guidelines for Pediatric Patients Undergoing Anesthesia

Presented By: Priscilla Aguirre, DNP, CRNA

Disclosure Information

• There are no financial or institutional conflicts of interest to disclose

Objectives

1. Participants will be able to describe the types of anesthetics used in the pediatric population.

2. Participants will be able to summarize how anesthesia providers formulate their anesthetic plan based on best practice guidelines for the pediatric population.

3. Participants will be able to identify and integrate best practice guidelines to decrease anxiety in the pediatric population.
History of Pediatric Anesthesia

- Crawford Long:
  - Administered the first documented ether anesthetic to an 8-year-old having a toe amputation in 1842.
- First multidisciplinary adult and pediatric ICU in the US developed in 1959.
- Mortality in medically advanced countries is now 1:200,000 anesthetics.
- In underdeveloped countries mortality is as high as 2.5:100,000 anesthetics.
- Medications and inhaled anesthetics have become much safer:
  - Progressed from open-drop ether and chloroform to circle systems.
  - Monitors that have had the greatest impact on pediatric anesthesia safety:
    - Continuous expired carbon dioxide.
    - Pulse oximeter.

(Pai & Cote, 2012)

Pediatric Developmental Considerations

- Not small adults!
- Significant differences in:
  - Cardiovascular system.
  - Respiratory system.
  - Renal system.
  - Hepatic system.

(Figure 1. Developmental Considerations)

Airway Considerations

<table>
<thead>
<tr>
<th></th>
<th>Pediatric</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laryngeal location</td>
<td>C2-C6</td>
<td>C3-C6</td>
</tr>
<tr>
<td>Narrowest location of</td>
<td>Cricoid</td>
<td>Glands</td>
</tr>
<tr>
<td>airway</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape of epiglottis</td>
<td>Round</td>
<td>Triangular</td>
</tr>
<tr>
<td>Right main bronchus</td>
<td>Less vertical</td>
<td>More vertical</td>
</tr>
<tr>
<td>Arytenoids</td>
<td>Large in proportion to the lumen of the larynx</td>
<td>Appropriate in proportion to lumen of the larynx</td>
</tr>
<tr>
<td>Breathing Pattern</td>
<td>Nose breath up to age 5</td>
<td>Nose and mouth</td>
</tr>
<tr>
<td>Tongue</td>
<td>Large relative to oral cavity</td>
<td>Small relative to oral cavity</td>
</tr>
</tbody>
</table>

(Table 1. Pediatric vs Adult Airway)
Common Pediatric Surgeries

- Dental procedures
- Ear, nose, and throat procedures
- Strabismus surgery
- Hernia surgery
- Orthopedic procedures
- Appendectomy

Preoperative Assessment

- Asthma
- Obstructive sleep apnea
- Upper respiratory tract infection
- Anxiety

Question for the audience: How long should you postpone surgery for a pediatric patient scheduled for elective survey presenting with a moderate upper respiratory tract infection?
Upper Respiratory Tract Infections

- The most common cause of surgery cancellations in the pediatric population:
  - Upper respiratory tract infections.
- Adverse events include:
  - Laryngospasm.
  - Bronchoospasm.
  - Airway obstruction.
- Residual pulmonary effects last approximately 2 to 6 weeks.

**BEST PRACTICE GUIDELINE:**
Postpone elective surgery for at least 2-4 weeks.

(Lema et al., 2018)

Preoperative Anxiety

- Up to 60% of the pediatric population experiences preoperative anxiety.
- A multimodal approach is necessary.
- If non-pharmacological methods have failed, anxiolytics may be utilized.
- The choice of sedation agent depends on the presence of chronic conditions (e.g., allergies, patent anatomical or physiological anomalies).

**BEST PRACTICE GUIDELINE:**
Attempt non-pharmacological techniques first!

(Ayenew et al., 2020; Heikal & Stuart, 2020; Nolan, 2019; Waldschmidt & Gordon, 2019)

Preoperative Pharmacology

- **Midazolam**: The recommended dose is 0.25-0.5 mg/kg with a maximum dose of 20 mg.
  - Mechanism of action: GABA A receptor agonist.
- **Ketamine**: The recommended oral and IM dose for ketamine are 5-8 mg/kg and 4-5 mg/kg, respectively.
  - Mechanism of action: primarily NMDA receptor antagonist.
- **Dexmedetomidine**: The recommended doses are 1-4 mcg/kg with a maximum of 200 mcg and should be administered to patients greater than one year of age.
  - Mechanism of action: selective α2-adenoreceptor agonist.

(Heikal & Stuart, 2020)
Volatile Agents

**Sevoflurane** - 2.5%

- Rapid uptake and elimination.
- Non-pungent.
- Cardiovascular effects broadly comparable to those of isoflurane.
- Possible neuro- and cardiac protection.
- Trigger for malignant hyperthermia.
- Emergence delirium.
- Airway irritant.
- Rapid increases in inspired concentration can lead to reflex tachycardia and hypertension.
- Trigger for malignant hyperthermia.
- Emergence delirium.
- Expansion of closed air spaces.
- Requires high concentrations.
- Amount of oxygen delivered is reduced.
- PONV.

**Desflurane** - 9.6%

- Rapid uptake and elimination.
- Possible neuro- and cardiac protection.
- Analgesic.
- Rapid uptake and elimination.
- Little cardiac or respiratory depression.
- Non-pungent.
- Reduces MAC of the more potent agents.

**Nitrous Oxide** - 104%

- Analgesic.
- Rapid uptake and elimination.
- Possible neuro- and respiratory depression.
- Non-pungent.
- Reduces MAC of the more potent agents.

**Advantages:**
- Reduced postoperative nausea and vomiting.
- Reduced operating room pollution.
- Reduced emergence delirium.
- Reduced airway reactivity, laryngospasm, and bronchospasm.
- Advocated for neuromuscular disease, core myopathies, and muscular dystrophy.
- Associated with overall reduced costs.
- Reliable delivery in airway procedures.

**Disadvantages:**
- Need for intravenous access.
- Pain on injection.
- Risk of bacterial contamination.
- No ability to monitor blood concentration.
- Need specialized equipment.
- Potential for disconnection, risk of awareness.
- Depth of anesthesia monitors in young children unreliable.

Total Intravenous Anesthesia

**Advantages:**
- Reduced postoperative nausea and vomiting.
- Reduced operating room pollution.
- Reduced emergence delirium.
- Reduced airway reactivity, laryngospasm, and bronchospasm.
- Advocated for neuromuscular disease, core myopathies, and muscular dystrophy.
- Associated with overall reduced costs.
- Reliable delivery in airway procedures.
- Used for anesthesia surgery.
- Can be used for other procedures.
- Can be used to maintain intraoperative concentration.
- Minimizes respiratory depression.
- No respiratory depression.
- Depth of anesthesia monitors in young children unreliable.

**Disadvantages:**
- Need for intravenous access.
- Pain on injection.
- Risk of bacterial contamination.
- No ability to monitor blood concentration.
Postoperative Nausea and Vomiting

- Variety of evidence-based risk scoring systems for PONV:
  - Apfel score.
  - Koivuranta score.
  - Vomiting in the postoperative period (VPOP) scoring system.
- Increased incidence of PONV:
  - Volatile agents.
  - Nitrous oxide.
  - Decreased pain management.
- Decreased incidence of PONV:
  - TIVA.
  - Hydration.

Emergence Delirium

- Risk factors include:
  - Preschool children.
  - Use of sevoflurane/desflurane.
  - Ear, nose, and throat surgery.
  - Preoperative anxiety.
- Symptoms usually abate in 15-30 minutes.
  - ED can continue for up to 2 days.
- Evidence-based screening tools:
  - Cravero scale.
  - Watcha scale.
  - Pediatric Anesthesia Emergence Delirium (PAED) scale.

References

# References

Questions?