Pediatric Airway-You Swallowed What?

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Objectives

* Understand basic pediatric airway anatomy and how it differs from adults
* Identify common syndromes associated with a pediatric difficult airway
* Describe techniques to manage a difficult airway
* Identify risk factors for airway complications during a general anesthetic in the pediatric patient
* Identify common airway emergencies that may present management challenges

Pediatric airway anatomy

* Tongue-large in proportion to oral cavity
* Position of larynx-higher in neck (C3-4) peds vs (C4-5) in adults

Pediatric airway anatomy

* Epiglottis-large, floppy, and angled away from axis of trachea


Pediatric airway anatomy

* Subglottis-narrowest portion of larynx is cricoid cartilage

- Vocal Cords-lower attachment anteriorly
- Axis of VC is perpendicular to the trachea


- Cuffed vs Uncuffed ETT
  - Cuffed ETT-(age/4) +3
  - Uncuffed ETT-(age/4) +4
  - Distance-(age/2) +12
  - Leak at 20-30 cm H2O
  - May want to consider uncuffed in infants with anticipated prolonged intubation

Microcuff ETT

Pediatric airway

Complications of intubation
- Post-intubation croup
- ETT to large
- Surgery > 1 hour
- Repeated attempts
- Traumatic intubation
- Age 1-4

- Position other than supine
- Change in position during procedure
- Coughing on ETT
- Previous history of croup

Pediatric syndromes

* **Pierre Robin**
  - Mandibular hypoplasia
  - Direct visualization may be difficult, if not impossible


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Pediatric syndromes

* **Achondroplasia**
  - Difficult intubation
  - Midfacial hypoplasia
  - Small nasal passages and mouth
  - Megacephaly

Pediatric syndromes

- Marfan syndrome
  - Difficult intubation
  - Narrow palate or high arched palate
  - Scoliosis or kyphosis
  - Cardiac and pulmonary disease
  - Dissecting aortic aneurysm


Pediatric Syndromes

- Rheumatoid Arthritis
  - Limited TMJ mobility
  - Hypoplastic mandible
  - Cricoarytenoid arthritis with narrow larynx
  - Cervical spine subluxation, rigid cervical spine

**Pediatric syndromes**

- **Scleroderma**
  - Extensive scarring of mouth, face and body
  - Difficult intubation
  - Decreased pulmonary compliance
  - Chronic steroid use


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**Pediatric syndromes-Treacher-Collins**

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Pediatric syndromes

* Trisomy 21 (Down’s syndrome)
  * Small mouth
  * Small mandible
  * Large, protruding tongue
  * Cervical spine subluxation
  * Consider ½-1 size smaller ETT


Pediatric syndromes

* Turner syndrome
  * Narrow maxilla
  * Small mandible
  * Short neck
  * Difficult intubation
  * Associated cardiac disease
  * Hypertension

Management of the Pediatric Difficult Airway

* Awake vs Asleep
* Asleep
  * Spontaneously breathing
  * Helpful in locating glottis
  * Avoid neuromuscular blockade
* Sedation-if tolerated
  * Midazolam (0.05 mg/kg IV) and fentanyl (0.5-1 mcg/kg IV)
  * Ketamine (0.25-0.5 mg/kg IV) every 2 minutes
  * Psychomimetic emergence reactions less in children


Anesthetizing the airway

* Nebulized lidocaine
* Topical spray or jellies
* Translaryngeal lidocaine
* “spray as you go” with lidocaine
* Superior laryngeal nerve block
* **Use caution not to deliver toxic lidocaine doses**
  * 5 mg/kg or 7 mg/kg with epinephrine

Unexpected Difficult Airway

* Biggest difference from adult
  * metabolic rate
  * FRC
* Time from zero 02sat from inspired concentration of 90% to neurological injury
* Adults-10 minutes
* Children-4 minutes!!!!


Who is at risk for respiratory adverse events?

* Laryngospasm
  * 14% in <6 year olds to 3.6% in >6 year olds (1)
  * Higher ASA score
  * Type of airway device used (1-4)
  * Upper respiratory infection (URI) (5)

Upper Respiratory Infections

* Bordet et al. in Pediatric Anesthesia (2002) (1)
  * <6 years
  * Recent RI
  * Use of LMA
* Flick et al. in Pediatric Anesthesia (2008) (2)
  * 130 children with laryngospasm under GA
  * Significant association between laryngospasm and current URI or airway anomaly
  * LMA + URI=strong association


When to Cancel?

* Croup, bronchitis, bronchiolitis, or pneumonia
  * Within 4-6 weeks
* Current or new URI
  * Dependent on procedure
* Fever
* Wheezing
* “Wet” cough
* Patient history-asthma

When to Cancel?

* How long to postpone?
  * Ideally 7 weeks… not practical
  * Postpone 2 weeks

* Bottom line-proceed with caution if asymptomatic


Laryngospasm

* Chin lift
* Jaw thrust
* Positive pressure
* Propofol
* Succinylcholine (0.5 mg/kg IV) or (3-4 mg/kg IM) (1)
* Rocuronium (4-5 mg/kg IM) (2)
* Treatment depends on severity of laryngospasm

Airway Emergencies

* Epiglottitis, foreign body, bleeding tonsil
* **AIRWAY TAKES PRIORITY OVER “FULL STOMACH”**
  * Keep spontaneously breathing
  * Laryngoscopy under deep volatile agent
  * ***KEEP CHILD CALM***
* Clear communication with ENT surgeon and OR staff PRIOR to induction

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Airway Emergencies

* IV after induction
* Parents into OR ????
* Induce in sitting position
* IV- 10-30 mL/kg of LR rapidly
* Early administration of atropine (10 mcg/kg IV) or glycopyrrolate (10 mcg/kg IV)

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Upper Airway Obstruction-inspiratory stridor, retractions, tachypnea

- **Epiglottitis**
  - Keep child calm
  - Inhalation induction in sitting position
  - IV, rapid rehydration, atropine (10 mcg/kg)
  - Deep intubation
  - ETT ½ size smaller
  - Unable to intubate → trach
  - Post-op-PICU, 24-48 hrs.


Foreign Body Aspiration

- 5th leading cause of death in <1 year olds
- May present with wheezing, cough, and unilateral breath sounds
- Emergency treatment if symptomatic... OR
- If stable, radiographic exam
- **DO NOT INDUCE WITHOUT ENT SURGEON!**

What is the foreign body?

LEGO!
Tonsil Bleed

* Occurs within 6 hours, or 5 to 10 days post-op
* Considered full stomach
* Potential loss of airway
* Hemodynamic compromise
* ***Replace fluid, if possible, and draw Hgb/Hct


Tonsil Bleed

* IV access prior to induction
* Pretreat with atropine (10 mcg/kg IV) or glycopyrrolate (10 mcg/kg IV)
* Induce with ketamine (1.2 mg/kg IV) or etomidate (0.3 mg/kg IV), and succinylcholine (1.5-2 mg/kg IV)
* RSI
* Difficulty visualizing VC-press on stomach
* Limit opioids
* OG tube prior to extubation

Asthma in Emergency cases

* **Goals:** oxygenation, reduce airway obstruction, prevent complications
* RSI if full stomach-avoid “light” intubation
* Premed prior to induction
  * Opioids, IV lidocaine
  * Glycopyrrolate or atropine
* Increase expiratory time to prevent air trapping
* Accept somewhat elevated PaCO2
* Limit peak inspiratory pressure to 40-45 cm H2O


Bronchospasm

* **Treatment**
  * Bronchodilator-nebulized or metered-dose inhaler
    * Albuterol
  * Beta-adrenergic agents
    * Epinephrine 1:1000 (0.01 mg/kg) SQ every 15 min x3 (max 0.3 mL)
    * Terbutaline-0.01 mL/kg (max 0.25 mL) SQ every 30 min x2 or 0.1 mcg/kg/min, titrate to effect

**Corticosteroids**

* Hydrocortisone 7 mg/kg IV immediately and 7 mg/kg/24hr, divided in 6 doses
* Methylprednisolone 2 mg/kg IV immediately and 2 mg/kg/24hr, divided in 6 doses
* Dexamethasone 0.3 mg/kg IV immediately and 0.3 mg/kg/24hr, divided in 6 doses


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**Conclusions**

* Pediatric airway anatomy is different from that of an adult airway
* Be alert to children with syndromes and the potential for a difficult airway
* Keep the child spontaneously breathing when a difficult airway is suspected
* Proceed with caution with recent URI
* Keep child calm during emergency airway situations
* Avoid “light” anesthesia with asthmatics