Life Threatening Airflow Limitation in Pediatrics

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Head and Neck

- Large head
- Short neck
- Soft superior larynx
- Weak shoulder girdle
  - Airway obstruction 2° positioning
- Matures up to 1 yr
  - Short neck up to 2-3 yrs.
Head and Neck

- Large tongue
  - Easy airway occlusion
  - Finger position
    - Caution during chin lift maneuver
  - Matures up to 2 yrs
Head and Neck

- Large U-shaped epiglottis
- Grunting, and self PEEP
- Epiglottic folds collapse into airway
- Matures 2 yrs
Head and Neck

- Active lymph tissue
- Edema
- Infection
  - Tonsils, adenoids
- Atrophies 6 - 12 yrs.
Head and Neck

- Nasal bridge
  - Prone to obstruction
    - Edema, trauma, foreign body
  - Fitting mask size
    - Use one size smaller than patient class
- Matures 6 mo to < 1 yr
Obligate Nose Breathing

✓ MYTH

✓ 1/3 Nose and mouth
✓ Minimal change in VE
✓ 2/3 Mouth breathe
✓ 1-3 Days
✓ Remainder in 3 – 6 mo
✓ Matures 3 – 6 mo
Upper Airway

- Cricoid cartilage
- Narrowest point
- Funnel shaped trachea
- **SUBGLOTTIC STENOSIS** post extubation
- Matures to 8 – 12 yrs
Signs of Airway Emergencies

✓ General
  ✓ Unconsciousness
  ✓ Cyanosis
  ✓ Work of breathing
  ✓ Cough
Signs of Airway Emergencies

✓ Specific
✓ Stridor
✓ Dysphagia
✓ Posture
Physiologic Considerations

- Rapid cardiopulmonary decompensation
- Pediatric higher risk of upper airway obstruction
- Prone to bradycardia
  - Hypoxia
- Higher oxygen consumption
- Lower FRC
  - Less pulmonary reserve
Pediatric Airway Emergencies

- Etiologies
  - Infectious
  - Allergic/Immunologic
  - Traumatic
## Airway Emergency Etiologies

<table>
<thead>
<tr>
<th>Infectious</th>
<th>Allergic/Immunologic</th>
<th>Traumatic</th>
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<tbody>
<tr>
<td>Epiglottitis</td>
<td>Anaphylaxis / Angioedema</td>
<td>Soft Tissue Trauma</td>
</tr>
<tr>
<td>Bacterial Tracheitis</td>
<td>Refractory Asthma</td>
<td>Inhalation/Thermal Injury</td>
</tr>
<tr>
<td>Pharyngeal Abscess</td>
<td>Laryngeal Spasm</td>
<td>Foreign Body</td>
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<tr>
<td>Adenotonsillitis</td>
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</tbody>
</table>

### Congenital / Acquired

- Laryngeal Web
- Malacia
- Tracheal, Laryngeal
- Hemangioma
- Subglottic Stenosis
Pediatric Airway Emergencies
Radiographs in Stridor

- Steeple’s sign
- Thumb sign
- Radio-opaque foreign bodies
- Mediastinal masses
- Congenital anomalies
Radiographs in Stridor

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Bacterial Tracheitis

- Pathology
  - H. influenzae B prior to 1992
    - In unimmunized children (immigrants)
  - Staph Aureus
    - Most common, usually superinfection.
  - Other:
    - Gr A Strep
    - Pneumococcus
    - Mycoplasma
  - Psuedomembrane formation
    - Bacteria, mucus, inflammatory products
    - Airway obstruction
Bacterial Tracheitis

Treatment

- Bronchoscopy and suction
- Intubation and suction
- IV Antibiotics
Epiglottitis

✓ Pathology
  ✓ H. influenzae B prior to 1992
    ✓ In unimmunized children (immigrants)
  ✓ Staph Aureus
    ✓ More common
  ✓ Gr A Strep
  ✓ Enlarged epiglottis
    ✓ Airway obstruction
    ✓ May not hear stridor
## Infectious causes of epiglottitis (supraglottitis)

<table>
<thead>
<tr>
<th>Bacterial causes</th>
</tr>
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<tbody>
<tr>
<td>Haemophilus influenzae type b (Hib)*</td>
</tr>
<tr>
<td>H. influenzae types A and F, and nontypeable strains</td>
</tr>
<tr>
<td>Haemophilus parainfluenzae</td>
</tr>
<tr>
<td>Streptococcus pneumoniae</td>
</tr>
<tr>
<td>Staphylococcus aureus (metherillin susceptible and methicillin resistant)</td>
</tr>
<tr>
<td>Beta-hemolytic streptococci: Groups A, B, C, F, G</td>
</tr>
<tr>
<td>Pasteurella multocida</td>
</tr>
<tr>
<td>Moraxella catarrhalis</td>
</tr>
<tr>
<td>Klebsiella pneumoniae</td>
</tr>
<tr>
<td>Neisseria spp</td>
</tr>
<tr>
<td>Escherichia coli</td>
</tr>
<tr>
<td>Enterobacter cloacae</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa*</td>
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</table>

| Viral causes^

| Herpes simplex virus type 1 |
| Varicella zoster virus      |
| Parainfluenza virus type 3  |
| Influenza B viruses        |
| Epstein-Barr virus         |

<table>
<thead>
<tr>
<th>Fungal causes</th>
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<tr>
<td>Candida*</td>
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Epiglottitis

### Signs and symptoms that may indicate epiglottitis

- Respiratory distress: stridor, tachypnea, anxiety, refusal to lie down, “sniffing” or “tripod” posture
- Sore throat, dysphagia, drooling, anterior neck pain (at the level of the hyoid)
- Muffled “hot potato” voice
- Marked retractions and labored breathing indicate impending respiratory failure

### Consider epiglottitis in

- Febrile, toxic-appearing children with rapid onset and progression of dysphagia, drooling, and respiratory distress, especially if unimmunized

### Evaluation

- Secure airway before diagnostic evaluation if respiratory distress is severe
- Communicate early with otolaryngologist, anesthesiologist, and intensivist
- Keep the patient in a setting where the airway can be rapidly managed if necessary (e.g., the emergency department, operating room, or intensive care unit)
## Epiglottitis

**Examination:**
- Defer examination of the pharynx in children when suspicion for epiglottitis is high (abrupt onset, high fever, tripod position, drooling, moderate to severe respiratory distress)
- Examine the patient in the upright position
- Attempt to visualize the epiglottis (with aid of tongue depressor, direct or indirect laryngoscopy) only when suspicion for epiglottitis is low (hoarseness, cough, mild distress, and fully immunized)
- Maintain the child in a position of comfort with parent present
- Avoid invasive procedures

**Findings:**
- Stridor, drooling, suprasternal and subcostal retractions
- Swollen, erythematous epiglottis, inflammation of the supraglottic structures
- Look for signs of extra-epiglottic infection (eg, pneumonia)

**Imaging:**
- Soft-tissue radiograph of the lateral neck (portable if possible) when the clinical diagnosis is in doubt
- Defer imaging in patients with severe respiratory distress or in whom it will delay definitive visualization of the epiglottis

**Findings:**
- Enlarged epiglottis ("thumb" sign), loss of vallecular air space, thickened aryepiglottic folds, distended hypopharynx, loss of cervical lordosis
Epiglottitis: Tripod posture

This child's "tripod" positioning (trunk leaning forward, neck hyperextended, chin thrust forward) is indicative of epiglottitis. Note the child's toxic appearance.

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### Epiglottitis

#### Management

**Airway**

In patients with moderate to severe respiratory distress, secure the airway in the operating room or similarly equipped setting (endotracheal tube or surgically if necessary) with an anesthesiologist and otolaryngologist present.

**If abrupt obstruction:**

- Attempt bag-valve mask ventilation first.
- During laryngoscopy, pressure on the chest by an assistant may produce bubbling and help indicate the location of the glottis.
- Perform needle cricothyrotomy or surgical cricothyrotomy if unable to ventilate or intubate.

**Laboratory studies:**

- Epiglottal cultures after establishment of artificial airway.
- Blood cultures after the airway is secured.

**Antimicrobial therapy**

**Administer empiric antimicrobial therapy:**

- Cefotaxime OR ceftriaxone
  - PLUS
  - If community- or hospital-acquired *Staphylococcus aureus* is suspected, add clindamycin OR vancomycin based upon local antimicrobial susceptibility patterns.

**Monitor**

- Monitor patient in the intensive care unit.
Adult features of epiglottitis

- Sore throat or odynophagia (90 to 100 percent)
- Fever $\geq 37.5^\circ C$ (26 to 90 percent)
- Muffled voice (50 to 80 percent)
- Drooling (15 to 65 percent)
- Stridor or respiratory compromise (approximately 33 percent)
- Hoarseness (20 to 40 percent)

- Artificial airway support required in only 6-10%
- Progression of symptoms slower
  - Normal 2 days after onset
  - 10% up to 9 days after onset
Pediatric Airway Issues

- Airway management has its challenges…
  - Anatomic
  - Physiologic
  - Relatively less experience
  - One size does not fit all
Artificial Airway

✓ Oral
✓ Tip of mouth to corner of mandible
Artificial Airway

✓ Nasal
✓ Nostril to tragus
Appropriate Size is Key

✓ Correct size

✓ Incorrect size

✓ (Atlas of Airway Management, 2007)
Difficult Intubation Tools

- LMA
Difficult Intubation Tools
Difficult Intubation Tools

✓ Video Assisted
Difficult Intubation Tools

- Aintree Catheter
  - Use with LMA and Scope
  - Can pass gas through lumen
Difficult Intubation Tools

✔ Cricothyrotomy
Summary

- Stridor is the hallmark of an upper airway obstruction, thus emergency
- Potential for difficult airway is high in pediatrics
- Identify resources, anticipate problems
- Familiarize yourself with alternative techniques