STRIDOR IN CHILDREN

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Normal Pediatric Airway Anatomy

- Larynx composed of hyoid bone and a series of cartilages
- Single: thyroid, cricoid, epiglottis
- Paired: arytenoids, corniculates, and cuneiform
Anatomy- cont.

- Sensory Innervation:
  - Recurrent Laryngeal Nerve-supraglottic larynx
  - Internal Branch of Superior Laryngeal Nerve- infraglottic larynx
- Motor Innervation:
  - External branch of Superior Laryngeal Nerve-cricothyroid muscle
  - Recurrent Laryngeal Nerve-all other laryngeal muscles

- Blood Supply
  - Laryngeal branches of the superior and inferior thyroid A.
Differences between Pediatric and Adult Airway

- More rostral larynx
- Relatively larger tongue
- Angled vocal cords
- Differently shaped epiglottis
- Funneled shaped larynx-narrowest part of pediatric airway is cricoid cartilage
Infant’s larynx is higher in neck (C2-3) compared to adult’s (C4-5)
- Large tongue
- Angled VF
• Funnel shape – narrowest part is the SG
What is Stridor?
Stridor

- Harsh sound caused by turbulent airflow, Implies partial airway obstruction

- Inspiratory
  - Associated with supraglottic, glottic lesions

- Expiratory
  - Associated with intrathoracic, tracheal or bronchial lesions- mimic BA.

- Biphasic
  - SGS. VF-paralysis, RRP, infections
• Until proven otherwise, patients with marked variation in pattern of stridor have a foreign body obstruction

• Age of patient will narrow the differential diagnosis
Common Causes of Stridor

- Children < 6 months of age
  - Laryngotracheomalacia: chronic, resolves by age 2
  - Vocal cord paresis or paralysis
  - Arnold-Chiari malformation

- Children > 6 months of age: acute
  - Viral Croup
  - Retropharyngeal abscess
  - Epiglottitis
  - Foreign Body aspiration
Laryngomalacia

- It is the most common cause of strider in infancy
- 60 % of all neonatal laryngeal problems
- 2° to weak larynx
- Each inspiration collapses epiglottis, aryepiglottic folds and arytenoids
- Worse with crying and agitation
- May be exacerbated by URI
- Improves with neck ext. and prone position
• Rarely a/w respiratory distress, apnea or feeding problem
• Tracheotomy or epiglottoplasty rarely needed
• Definitive dx-fiberoptic laryngoscopy
• Self limited disorder-90% of cases resolved by age 2.
Vocal Cord Paralysis or Paresis

- 2nd most common etiol. of neonatal stridor
- Most with h/o birth trauma, shoulder dystocia, macrosomia, forceps delivery, abnormal cry or other intrathoracic anomaly
- Dx-fiberoptic laryngoscopy during speech or crying
• Intubation during respiratory failure difficult if b/l vocal cords paralyzed
• Try placing bevel of ETT parallel to glottic opening then rotating ¼ turn while applying gentle pressure- Never force it
• Needle cricothyroidotomy and tracheotomy may be needed
Arnold Chiari Malformation

- Brain and cerebellum during development partially herniate thru foremen magnum
- Compression of cerebellar tonsils, pons, medulla, and upper cervical spinal cord leads to various neurologic abnormalities
- Consider it in patient with stridor and:
  - Child with trisomy 21
  - Myelomeningocele
  - Hydrocephalus
  - Sacral dimple or sacral epidermal abnormality
• If intubation required, inline stabilization is imperative to prevent further compression of CNS structures

• Obtain urgent neurosurgical consultation, decompression likely required for tx
Stridor in Children > 6 months old

- Usually present with short duration of symptoms (hours to days)

**Common causes**

- Epiglottitis
- Croup
- Bacterial Tracheitis
- Foreign Body Aspiration
- Peritonsillar abscess
- Retropharyngeal abscess
<table>
<thead>
<tr>
<th>Etiology</th>
<th>Viral Group</th>
<th>Bacterial Tracheitis</th>
<th>Epiglottitis</th>
<th>Peritonsillar Abscess</th>
<th>Retropharyngeal Abscess</th>
<th>Foreign-Body Aspiration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parainfluenza viruses</td>
<td><em>Staphylococcus aureus</em> (most)</td>
<td><em>Streptococcus pneumoniae</em> Haemophilus influenzae</td>
<td><em>Streptococcus pyogenes</em></td>
<td><em>Streptococcus pyogenes</em> 1.3.7</td>
<td>Variable</td>
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<tr>
<td></td>
<td>Occasionally RSV Influenza</td>
<td></td>
<td></td>
<td>Haemophilus influenzae</td>
<td><em>Staphylococcus aureus</em></td>
<td>Peanuts</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Sunflower seeds</td>
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<tr>
<td>Age</td>
<td>6 mo–3 y</td>
<td>3 mo–13 y</td>
<td>All ages</td>
<td>10–18 y (most)</td>
<td>6 mo–4 y</td>
<td>6 mo–5 y</td>
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<tr>
<td></td>
<td>Peak 1–2 y</td>
<td>Majority &lt;3 y</td>
<td>Classically 1–7 Median now 7</td>
<td>6 mo–5 y (rare)</td>
<td>Peak &lt;1 y</td>
<td>Most common</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Rare &gt;4 y</td>
<td></td>
<td>80% &lt;3 y</td>
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<tr>
<td>Onset</td>
<td>1–5 days</td>
<td>2–7 day viral upper respiratory infection Suddenly worse over 8–12 h</td>
<td>Rapid, hours Antecedent pharyngitis</td>
<td>Insidious over 2–3 days after an upper respiratory infection or local trauma</td>
<td>Immediate or delayed possible</td>
<td>Any</td>
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<td></td>
<td></td>
<td>60–90% &lt;3 y</td>
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<td></td>
<td></td>
<td></td>
<td>About 1/2 deaths &lt;1 y</td>
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<td>Position effect</td>
<td>None</td>
<td>None</td>
<td>Worse supine Prefer erect</td>
<td>Worse supine Almost opisthotonic May improve in sniffing position</td>
<td>Usually none Location-dependent</td>
<td>Location-dependent</td>
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<tr>
<td>Stridor</td>
<td>Inspiratory and expiratory</td>
<td>Inspiratory and expiratory</td>
<td>Inspiratory</td>
<td>Uncommon</td>
<td>Inspiratory when severe Location-dependent</td>
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<tr>
<td>Cough</td>
<td>Seal-like bark</td>
<td>Usually Possible thick sputum</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Often transient or positional</td>
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<tr>
<td>Voice change</td>
<td>Hoarse Not muffled</td>
<td>Usually normal Possibly raspy</td>
<td>Muffled “Hot potato” Muffled “Hot potato”</td>
<td>Muffled “Hot potato” Often muffled “Hot potato”</td>
<td>Location-dependent Primarily if at or above glottis</td>
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<tr>
<td>Drool</td>
<td>No</td>
<td>Rare</td>
<td>Yes</td>
<td>Often</td>
<td>Yes</td>
<td>Rare—often if esophageal</td>
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<tr>
<td>Dysphagia</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Rare—typically if esophageal</td>
</tr>
<tr>
<td>Radiologic appearance</td>
<td>Subglottic narrowing “steeple” Distended hypopharynx</td>
<td>Subglottic narrowing Ragged tracheal air shadow Tracheal foreign bodies</td>
<td>Enlarged epiglottis Vallecular space loss Supraglottic ballooning</td>
<td>May see enlarged tonsillar soft tissue</td>
<td>Thickened bulging pretracheal soft tissue</td>
<td>Often normal Possible radiopaque density Ball-valve effect Segmented atelectasis Air contrast effect may be seen</td>
</tr>
</tbody>
</table>
EPIGLOTTITIS

• Causative Organisms
  - H. influenza < 25% secondary to vaccinations
  - Strep pyogenes and pneumoniae
  - Staph aureus
• Immunocompromised patients
  - Herpes simplex, candida, varicella
• Prior to H. Flu vaccination median age was 3 years—currently age 7
• Classic symptoms- abrupt onset of high fever, sore throat, stridor, dysphagia, and drooling, +/- stridor. Usually no cough
• Some cases may develop over days
• OE.- toxic-appearing, apprehensive, often sits in tripod or “sniffing” position, voice may be muffled, marked tenderness with palpation of hyoid
• Dx- lateral XR unnecessary for classic sx
• If uncertain dx – lateral XR of soft tissues w/ neck extended during inspiration
• False (+) if XR with head flexed or in expiration
• If False (-) direct visualization needed to r/o dx
• XRays- epiglottis is swollen “thumbprint” at the base of the hypopharynx
• Commonly vallecular space obscured
• Supraglottic ballooning
• Airway Management- Try not to disturb the patient!!
• Urgently consult ENT and Anesthesia
• Oxygen as needed
• Nebulized racemic epinephrine- decreases airway edema
• ACLS-for difficult airway mgt or respiratory failure
• Use ETT one size smaller than usual
• Correct tube size will have small air leak on end inspiration
• Rx Management
• 2nd or 3rd cephalosporin +/- vancomycin
• Oral ATBX for 7-10 days after extubation
• Steroids remain controversial
Viral Croup (laryngotracheobronchitis)

- Most common cause of stridor after neonatal period
- Most affected are children 6 mo.- 3 y.o
- Peak incidence b/t 1-2 yrs of age
- Narrowest part of airway is at cricoid cartilage and in children 1 mm of airway edema may ↓ cross-sectional area 50-60%
- Most cases occur late fall or early winter
Normal Edema 1 mm

Infant 4 mm  ↑16x  ↓75%

Adult 8 mm  ↑3x  ↓44%

Resistance \( R \propto \frac{1}{\text{radius}^4} \)  

Cross-sectional area
VIRAL CROUP

- Etiology-mostly viral
- Parainfluenza virus type I,II,III
- Incubation 2-6 days, virus shed for about 2 weeks
- Others
  - Influenza A or B, RSV, rhinovirus, and measles
  - Adenovirus- also a/w hemorrhagic cystitis, and conjunctivitis
  - Mycoplasma pneumoniae may present with croup like syndrome
• Signs & Symptoms
• 1-5 day prodrome of cough, coryza, +/- low grade fever and URI type symptoms
• Followed by 3-4 days of barking cough, worse in late evening and night
• +/- biphasic stridor: inspiratory component greater than expiratory. Unaffected by position, worsened by agitation or crying
• Duration 3-7 days regardless of tx, usually 3rd and 4th days are worst, followed by improvement
• Diagnosis- made clinically

• X-rays: If other causes being considered or in atypical or prolonged cases

• Obtain lateral neck films and PA CXR

• PA CXR in croup “steeple sign”
**Treatment**
- Pulse ox, and humidified O2
- Antipyretics if fever present
- Antibiotics not indicated
- IV fluid hydration only if necessary
- Nebulized Albuterol
- Stridor only with agitation - doesn’t need epinephrine
- Stridor at rest or child in respiratory distress - tx with epinephrine and steroids
- Intubation if respiratory failure or pending (use ETT 0.5 to 1.0 mm smaller than typically used)
• Racemic Epinephrine
• Positive affects seen w/in 10 min
• Maximal affect seen in ~ 1 hr
• Therapeutic affects gone w/in 2 hrs
• Acts by vasoconstriction of mucosal vessels
• L-epinephrine 1:1,000 concentration may also be used
• Recommended to watch patient for 3 hrs before considering discharge
• Dexamethasone
• Steroids-used with moderate to severe episodes of croup
• Mild episodes controversial to tx with steroids
• Effects may be seen in ½ to 2 hrs with persistent effects over next 1 to 2 weeks
• 0.3-0.6 mg/kg IM or PO x 1, equal efficacy
BACTERIAL TRACHEITIS

• Often caused by bacterial superinfection of antecedent viral upper respiratory infection
• Most common in children <3 yrs
• Signs & Symptoms
• 2-7 days of croup-like syndrome
• Then worsening symptoms & toxic appearance
• Severe inspiratory & expiratory stridor
• Cough w/ occasional thick sputum
• Raspy / hoarse voice, no dysphagia
• May complain of gnawing/burning substernal chest discomfort
• **Diagnosis**
  - Most w/ ↑ WBC and left shift
  - XR- subglottic narrowing of trachea +/- irregular densities w/in trachea, borders appear ragged/indistinct
• **Management** - Similar to epiglottitis- 85 % require intubation
• **Abx** - Vancomycin and 3rd generation cephalosporin
FOREIGN-BODY (FB) ASPIRATION

- Peak incidence age 1 to 3 years
- 90% of cases under age 4
- Most commonly foods or toys
- Foods- peanuts, raisins, grapes, and hot dogs
- Vegetable matter can cause intense pneumonitis and subsequent pneumonia
- Toys/objects- typically small, smooth, and round
• Signs & Symptoms
• Majority with abrupt onset of stridor or respiratory distress or failure
• Classically, but not always, laryngotracheal FB cause stridor and bronchial FB cause wheeze
• Some may be asymptomatic and normal P.E.
• FB should be suspected in unilateral wheeze
• Other Signs & Symptoms
• History of choking episode
• Chronic cough
• History of persistent or recurrent pneumonia
• Persistent croup or asthma after adequate tx
• Pharyngeal pain
- Diagnosis
- Maintain high index of suspicion
- Up to 1/3 of FB aspirations may have normal XR as most FB are not radiopaque
- CT may be helpful
- If clinical suspicion is high may need laryngoscopy and rigid bronchoscopy
• Complete obstruction-may see segmental atelectasis on XR
• Partial obstruction-ball valve effect, may cause obstructive emphysema
• B/l decubitus PA XR obstructed side remains inflated and diaphragm inferiorly displaced when involved side is down
• Esophageal FB vs Tracheal FB
• Narrow flat FB in esophagus usually orients in coronal plane, vs sagittal plane if in the trachea
• **Treatment**
  
  • ACLS-obstructed airway management, or follow predetermined ED protocols if available
  
  • Obtain appropriate consults, ENT, Anesthesia or Pulmonary
  
  • Removal by trained personal
THANK YOU