QUESTION: WHAT WAS THAT SOUND?

BY THE END OF THE HOUR YOU WILL HAVE A(N)
- Understanding of the unique anatomic features of the pediatric airway.
- Appreciation of the initial management of a child with impending airway obstruction.
- Differential diagnosis for pediatric upper airway obstruction.
- Organized approach to the child with an upper airway infection.

USING A CASE BASED APPROACH:
- Review the anatomy of the pediatric airway
- Definition
- Causes
- Critical Interventions
- Management

Let’s Get Started!

QUESTION:
List as many points as you can on how the pediatric airway differs from the adult.
Pediatric Vs. Adult Airway

- Large head
- Short neck
- Small nares
- Loose teeth
- Small mandible
- Long uvula
- Long epiglottis
- Friable mucosa
- High larynx C3-4 (adult C4-5)
- Small cricoid

Pediatric Vs. Adult Airway

- Slanted chords
- Pliable trachea
- Immature alveolae
- Pliable chest wall
- Gastric dilation

The Respiratory Tract

- Main function: speech production & airway protection
- Supraglottic: above the vocal chords
- Glottic: at the vocal chords
- Subglottic: below the vocal chords

Larynx & Respiratory Cycle

- Chords close at end of the expiratory phase and rest.
- Chords open at beginning of the inspiratory phase
CASE 1

Previously healthy 3 year old with a one day history of fever, decreased PO intake, and increasingly restless behavior over the past 2 to 3 hours.

WHAT IS YOUR DIFFERENTIAL DIAGNOSIS?

WHAT WOULD YOU DO RIGHT AWAY/NOT DO RIGHT AWAY?

WOULD YOU...

CASE 2

3 day history of worsening sore throat, bilateral ear ache, and fever x 16 hours. She is not moving her neck.
She is lethargic and appears quite dry (as discerned from her poor skin turgor and lack of tears)
WHAT IS YOUR DIFFERENTIAL DIAGNOSIS?

Supraglottic Airway Diseases

Supraglottic Pathology

DDx Supraglottic Diseases

QUESTION: Epiglottitis

WHAT WOULD YOU DO RIGHT AWAY/NOT DO RIGHT AWAY?

Supraglottic part of the airway:

Problems here = expiratory stridor + respiratory distress

Questions:

Why has the incidence declined substantially over the past 15 years?
What is the age range typically involved?
What are 3 other organisms which can cause this?
What is the classic radiological finding?
Which antibiotic(s) would you use?
Epiglottitis

- Incidence has declined due to the widespread use of the Haemophilus influenzae B (HIB) vaccine.
- Epiglottitis usually affects children between 3 and 7 years old.
- Three other causal organisms:
  - Beta-hemolytic streptococcus
  - Staphylococcus aureus
  - Streptococcus pneumoniae
- Classic radiological finding is the "thumb print".

Epiglottitis

- Definition: An inflammation of the structures above the insertion site of the glottis.
- Pathophysiology:
  - Respiratory transmission
  - Bacteria penetrate the mucosal barrier, invade the bloodstream, and trigger an inflammatory cascade which leads to edema of the epiglottis and surrounding structures.
  - Bacteremia can also lead to infection of the meninges, lungs, skin, joints, and ears.

History

- Characteristic abrupt onset of severe symptoms - often less than 24 hours
- Fever usually is the first symptom, followed rapidly by stridor and labored breathing
- Fever > 40°C
- Dysphagia, muffled voice, and sore throat are common.
- Cough and ear pain occur less frequently.

Physical Findings

- The child appears toxic.
- Shock may occur early in the course of the disease.
- Marked restlessness, irritability, and extreme anxiety are common.
- Child will sit in the tripod position, their mouth may be open wide and tongue protruding.
- Stridor can occur with marked accessory muscle use.
- Tender anterior cervical lymphadenopathy

Management

- ABC’s
- Racemic epinephrine administration plays little role in the management of infectious or thermal epiglottitis and is not indicated.
- Appropriate antibiotics include:
  - Ceftriaxone
  - Cefotaxime
  - Cefuroxime or a combination of
  - Ampicillin and Chloramphenicol
- As in all invasive HIB infections, it is recommended that contacts receive either oral amoxicillin or oral rifampin.
- Corticosteroids have no proven efficacy for treating epiglottitis.

QUESTION:

Retropharyngeal Abscess

- What is the "retropharyngeal space"?
- What is the age range?
- What organisms are typically responsible?
- What are typical clinical features?
- How do you make the diagnosis?
- What is the management?
Retropharyngeal Space

- The potential space is bordered by the posterior pharyngeal wall and the prevertebral fascia.
- Extends from the base of the skull to level T2.
- Contains the lymph nodes that drain the nose, pharynx, sinuses, and ears.

Retropharyngeal Abscess

Age Range
- The age range is wide, with most cases occurring between 6 months to 6 years, and the mean being 3 to 4 years.

Organisms
- Staphylococcus aureus
- Group A streptococcus
- Anaerobes (Bacteroides)

Clinical Features
- Fever
- Sore throat
- Meningismus
- Torticollis
- Trismus
- Neck swelling
- Unilateral or bilateral cervical lymphadenopathy
- Drooling
- Stridor
- Muffled voice - "hot potato" voice
- Prefer to lie supine with head extended

Diagnosis

Making the Diagnosis
- A careful examination might reveal a bulging posterior pharyngeal wall.
- Lab tests are often inconclusive.
- Lateral soft tissue of the neck taken during inspiration, with the neck extended.
- A retropharyngeal space that is more than twice the diameter of the vertebral body.
- Sometimes an air-fluid level is seen, especially in perforation and anaerobic infections.
- CT Scan - modality of choice.

Appropriate antibiotics include:
- Clindamycin is the first line of treatment.
- Clindamycin can be used alone or in combination with cefazolin or a beta-lactamase-resistant penicillin, such as ticarcillin/clavulanate, piperacillin/tazobactam, or ampicillin/sulbactam.
- Consult ENT.

And now for something completely different!
Diseases of the Larynx

- Congenital
- Laryngomalacia
- Laryngeal Web
- Vocal Cord Paralysis

- Acquired
- Laryngeal Papillomas
- Foreign Body

Laryngomalacia

- Is the most common cause of chronic stridor in infants and young children.
- Results from flaccidity of laryngeal structures and tissues causing them to collapse into the airway.
- Note the collapsed larynx and pulled in arytenoid mucosa during inspiration.
- Symptoms usually worsen with supine position and increased respiratory effort.
- Resolution usually occurs by 2 years of age.

CASE 3

- A four year old boy is brought in after a 3 day history of a worsening barky cough, stridor, and a low grade fever.
- On the drive over, the symptoms seem to settle somewhat. However, from the "Asthma Corner" you hear:

WHAT IS YOUR DIFFERENTIAL DIAGNOSIS?

WHAT WOULD YOU DO RIGHT AWAY/NOT DO RIGHT AWAY?

Subglottic Tracheal Diseases
QUESTION: Croup

- In what age group does croup most often occur?
- What are the pathogens which cause croup?
- What exactly is croup?
- What is the "Westley Croup Score"?
- How is croup managed?
- What are the indications for admission?

Pathogens

- Parainfluenza virus type I causes most cases of croup, up to 60% depending on the study.
- Parainfluenza types II, III, and IV; influenza A and B; adenovirus; respiratory syncytial virus; herpes simplex virus; measles; rhinovirus; coxsackieviruses A and B; euovirus all can cause mild sporadic croup.
- Influenza A has been implicated in children with severe symptoms.

Definition

- Croup is caused by inflammation and edema of the mucosal and submucosal tissues of the subglottic space.
- The mucosa, bordered by the cricoid ring, swells into the airway lumen.

Clinical

History

- Croup begins with a prodrome of a few days of mild upper respiratory infection with coryza, nasal congestion, sore throat, and cough.
- A low grade fever, seldom higher than 39°C.
- A hoarse voice and harsh, bark-like cough follow.
- Respiratory stridor usually develops at night.

Physical Exam

- Typical constellation:
  - Barky cough
  - Hoarse voice
  - High-pitched inspiratory stridor
- Respiratory and heart rate are also important determinants of severity.
Management

Mild & Moderate
- Mist
  - Loose thick secretion
  - Improves symptoms within 10 to 20 minutes
- Racemic Epinephrine
  - Acts on the alpha receptors of the subglottic mucosa causing vasoconstriction thereby reversing edema.
  - Onset of action is 10 minutes
  - Patient can be discharged safely after 2 to 4 hours of treatment.
- Glucocorticoids
  - Dexamethasone 0.15 to 0.60mg/kg PO/IM as one single dose, lasts about 48 hours.
  - Nebulized Budesonide also effective but expensive.

Severe Croup
- Severe croup that is unresponsive to therapy may require intubation.
- Intubate the patient with an endotracheal tube that is 0.5-1 mm smaller than predicted.
- A helium-oxygen (helium 60-80%) mixture may prevent intubation.

Reasons a Child with Croup Might be Hospitalized
- Marked distress on presentation
- Unusual symptoms (hypoxia, high fever)
- Dehydration
- Poor response to racemic epinephrine
- Persistence of stridor
- Persistence of tachycardia, tachypnea
- Uncertain follow-up ability
- Young age
- Distance from hospital is far
- Complex past medical history
- Anxious parents

CASE 4
- A four year old girl is brought in after a 3 day history of a worsening barky cough, stridor, and a high fever.
- When you go to the crash room you see a little girl who is pale, cyanotic, and in severe distress.

WHAT IS YOUR DIFFERENTIAL DIAGNOSIS?

WHAT WOULD YOU DO RIGHT AWAY/NOT DO RIGHT AWAY?
Diseases of the Trachea

- **Congenital**
  - Tracheomalacia
  - Tracheal Stenosis
  - Vascular Ring

- **Acquired**
  - Bacterial Tracheitis

Tracheomalacia

**Definition:**
A process characterized by flaccidity of the supporting tracheal cartilage, widening of the posterior membranous wall, and reduced AP airway diameter.

**Tracheomalacia**

**Type I**
Congenital or intrinsic tracheal abnormalities that can be associated with a tracheoesophageal fistula

**Type II**
Extrinsic defects or anomalies, such as a vascular ring causing undue pressure on the trachea

**Type III**
Acquired tracheomalacia that occurs with prolonged intubation or chronic tracheal infections

**History**

- Infants present after a few weeks of life with expiratory stridor
- Expiratory stridor may worsen with supine position, crying, and respiratory infections.
- Feeding difficulties
- Hoarseness, aphonia, and breathing
- Obtain history of an acquired etiology:
  - prolonged intubation
  - tracheostomy
  - chest trauma
  - recurrent tracheobronchitis
  - cartilage disorder (relapsing polychondritis)
  - lung resection

**Physical**

- Accessory muscle use
- Thoracic deformity may be present in cases of chronic tracheomalacia, especially in younger patients
- Normal inspiration but abnormal expiratory noises on auscultation
- Growth failure

**Diagnosis**

- Plain x-ray films are usually non-diagnostic
- Dynamic studies such as fluoroscopy or ultra fast CT tend to be more useful
**Treatment**
- Supportive therapy is provided to most infants.
- Conservative management, consisting of humidified air, chest physical therapy, slow and careful feedings, and control of infection and secretions with antibiotics.
- The use of continuous positive airway pressure (CPAP) in patients with respiratory distress.

**Pathophysiology**
- Bacterial tracheitis is a diffuse inflammatory process of the larynx, trachea, and bronchi with adherent or semi-adherent mucopurulent membranes within the trachea.
- The lining of the trachea forms a loosely adherent membrane that cloughs into the lumina.

**Peak Age**
- Range is 3 weeks to 16 years with the peak age occurring around 4 years.

**Bacterial Tracheitis**

**Historical Features:**
- Symptoms intermediate between epiglottitis and croup.
- Typically a viral prodrome of fever, barking cough, and stridor with progression to higher fever, cough, inspiratory stridor, and a variable degree of respiratory distress.
- Patients may decompensate acutely with worsening respiratory distress due to airway obstruction from a purulent membrane that has loosened.

**Physical Findings:**
- Inspiratory and expiratory stridor
- Barky cough
- Hoarseness
- Variable degrees of respiratory distress
- Accessory muscle use
- Tachypnea
- Nasal flaring
- Cyanosis
- Sore throat, odynophagia
- No drooling*
- No specific position of comfort (The patient may lie supine)*
- Worsening or abruptly occurring stridor or respiratory distress
- Does not respond to typical treatment for croup (steroids & epi)

**Laboratory Tests:**
- WBC: Normal or slightly increased
- Blood cultures: Frequently negative
- X-rays:
  - Portable & only if patient is stable
  - Lateral and AP views of the neck and thorax
  - Subglottic narrowing
  - Ragged tracheal edge
  - Hazy density within the tracheal lumen
  - Coexisting pneumonia of CXR

**Management**

**Bronchoscopy:**
- Both diagnostic and therapeutic
- Should occur emergently
- Allows for visualization of the upper airway to exclude other diagnoses
- Allows for suctioning of debris and secretions
- Facilitates the establishment of an artificial airway.
Management

Airway:
- Avoid agitating the child.
- If respiratory status suddenly deteriorates, BVM ventilation is usually effective.
- Intubation is required over 70% of the time.
- If intubation is required, use an endotracheal tube 0.5-1 size smaller than expected in order to minimize trauma in the inflamed subglottic area.

Medication:
- IV access for fluid resuscitation and initiation of antibiotics
- Antibiotics: penicillinase-resistant penicillin and a third-generation cephalosporin (e.g. cefotaxime), or chloramphenicol and clindamycin for patients who are allergic to penicillin. Can use vancomycin in severe cases.

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