Common Pediatric Pulmonary Issues

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Objectives

• Learn common causes of upper and lower airway disease in the pediatric population

• Learn basic management skills for common pediatric pulmonary problems
Upper Airway Disease

- Extrathoracic structures
  - Pharynx, larynx, trachea

- Stridor
  - Externally audible sound produced by turbulent flow through narrowed airway
  - Signifies partial airway obstruction
  - May be acute or chronic
Remember Physics? Poiseuille’s Law

- Normal Infant: 4 mm
- Edema 1 mm
- Resistance: $R \propto \frac{1}{\text{radius}^4}$
  - $\uparrow 16x$
- Cross-sectional area: $\downarrow 75$

- Normal Adult: 8 mm
- Resistance: $\uparrow 3x$
- Cross-sectional area: $\downarrow 44$

Poiseuille’s Law expresses the relationship between fluid flow rate (Q), pressure difference ($\Delta P$), length ($L$), and the fourth power of the radius ($r^4$) of a tube.
Acute Stridor

• Febrile
  • Laryngotracheitis (croup)
  • Retropharyngeal abscess
  • Epiglottitis
  • Bacterial tracheitis

• Afebrile
  • Foreign body
  • Caustic or thermal airway injury
  • Angioedema
Croup - Epidemiology

- Usually 6 to 36 months old
- Males > Females (3:2)
- Fall / Winter predilection
- Common causes:
  - Parainfluenza
  - RSV
  - Adenovirus
  - Influenza
Croup - Pathophysiology

• Begins with URI symptoms and fever

• Infection spreads from nasopharynx to larynx and trachea

• Subglottic mucosal swelling and secretions lead to narrowed airway

• Development of barky, “seal-like” cough with inspiratory stridor

• Symptoms worse at night
Croup - Management

- Keep child as calm as possible, usually sitting in parent’s lap

- Humidified saline via nebulizer

- Steroids (Dexamethasone 0.6 mg/kg)
  - Oral and IM route both acceptable

- Racemic Epinephrine
  - <10kg: 0.25 mg via nebulizer
  - >10kg: 0.5 mg via nebulizer
Croup – Management

• Must observe for 4 hours after use of racemic epinephrine

• Admit if patient has recurrent stridor or any signs of respiratory distress

• Consider AP/Lateral neck films
  • Steeple sign
Croup – Steeple Sign
Retropharyngeal Abscess

- **Etiology**
  - Prior pharyngitis, otitis
  - Penetrating wound to posterior pharynx

- **Pathophysiology**
  - Cellulitis and suppurative adenitis of lymph node in prevertebral fascia
Retropharyngeal Abscess

• Presentation:
  • Fever
  • Difficulty swallowing
  • Drooling
  • Sore throat
  • Changes in voice
  • Stiff neck
Retropharyngeal Abscess
Retropharyngeal Abscess

• Diagnosis

  • Lateral soft tissue neck X-ray
    • Retropharyngeal soft tissue at level of C-3 is greater than 5mm
    • Retropharyngeal soft tissue is more than 40% of the body of C-4 at that level

  • Soft tissue neck CT
    • Better delineate extent of lesion
Retropharyngeal Abscess
Retropharyngeal Abscess

• Management:
  
  • Assess and secure patent airway
  
  • Antibiotic coverage
    • Nafcillin and Clindamycin
  
  • Analgesia
  
  • ENT consult for operative incision and drainage of abscess
Epiglottitis

• Life threatening emergency!!!

• Clinical presentation:
  • Sudden onset high fever
  • Moderate to severe respiratory distress
  • Stridor
  • Drooling
  • Toxic appearing child
    • Sits leaning forward in a sniffing position with an open mouth
Epiglottitis

• Not seen as frequently today
  • *Haemophilus influenza* type B vaccine
• Other bacterial causes include staphylococcus and streptococcus
• Diagnosis:
  • Lateral soft tissue neck
    • Epiglottis is rounded and blurred (thumbprint sign)
Epiglottitis

Figure 14.40 Epiglottitis
Epiglottitis
Epiglottitis

• Management:
  • Keep child as calm as possible, preferably in parent’s lap
  • Surgical consult to establish definitive airway in operating room
  • Start broad spectrum antibiotic coverage
    • Second or third generation cephalosporins
Bacterial Tracheitis

• Bacterial complication of a viral URI
  • *Staphylococcus aureus*
  • *Haemophilus influenzae*
  • Streptococci and pneumococci

• Pathophysiology:
  • Swelling of tracheal mucosa below vocal cords
  • Thick, purulent secretions may lead to mucous plugging
Bacterial Tracheitis

- Presentation similar to croup
  - More toxic appearing child
  - Does not respond well to typical croup treatment
  - Outside the typical age group for croup

- Soft tissue neck film
  - Edema with an irregular border of the subglottic tracheal mucosa
  - “Subglottic membrane”
Bacterial Tracheitis

Figure 14.45 Membranous Tracheitis
Bacterial Tracheitis

• Management
  • Assess and maintain patent airway
  • Frequent suctioning if intubated
  • ENT consultation
  • Broad spectrum antibiotic coverage
Foreign Body Aspiration

• Consider this when:
  • Child has recurrent wheezing or stridor unresponsive to typical therapy
  • Afebrile
  • Recurrent pneumonia in same location

• Symptoms may be:
  • Acute – large item in large airway
  • Chronic – small item in small airway; asymptomatic period common
Foreign Body Aspiration

- Common items found:
  - Coins
  - Nuts or seeds
  - Popcorn, small candy
  - Beads, buttons, safety pins
  - Balloons, latex gloves
  - Toys with small or loose parts
Foreign Body Aspiration

• Diagnosis:
  • Soft tissue films of neck
  • PA and lateral chest films
  • Bilateral decubitus films
  • Inspiratory and expiratory chest films
    • Look for air trapping, mediastinal deviation, atelectasis
    • Foreign body itself may be radio-opaque or radio-lucent
Foreign Body Aspiration
Foreign Body Aspiration
Foreign Body Aspiration
Other Upper Airway Problems

- Peritonsillar Abscess
  - Asymmetry of tonsilar pillars
  - Deviation of uvula

- Subglottic Stenosis
  - Common in premature infants that underwent prolonged intubation

- Tracheo/Laryngomalacia
  - Absence of abnormal breath sounds when infant prone
Other Upper Airway Problems

• Neoplasms:
  • Papilloma
  • Vocal cord nodules
• Bronchogenic cysts
• Cystic hygroma (Lymphangioma)
• Vascular rings
• Tracheo-esophageal fistulas
• Laryngeal webs
Papillomas
Tracheo-Esophageal Fistulas
Lower Airway Illnesses

- Intrathoracic Structures
  - Mainstem bronchi, bronchial tree, bronchioles

- Wheezing and Rales
  - Obstruction of intrathoracic airway
  - Heard during expiration and inspiration
  - Air trapping and atelectasis
  - Diminished air movement
Lower Airway Illnesses

- Asthma
- Bronchiolitis
- Bronchopulmonary dysplasia
- Pneumonia
Asthma

• Reversible airway obstruction:
  
  • Bronchospasm of lower airway
  
  • Swelling of airways and increased mucous production (inflammation)
Asthma - Triggers

• Atopic conditions
  • allergic rhinitis, eczema, chronic sinusitis

• Allergen exposures
  • Cigarette smoke
  • Pets
  • Carpeting, ceiling fans (dust mites)
  • Cockroaches

• Viral illnesses
Asthma - Presentation

- Cough
- Wheeze
- Shortness of breath
- Chest tightness
- Vomiting

History:
- Frequency, duration of symptoms
- Previous admissions, PICU stays
- Previous steroid use, varicella exposure
Asthma – Physical Exam

• Assess work of breathing
  • Retractions
  • Nasal flaring
  • Increased respiratory rate

• Assess for hypoxia

• Lung exam
  • Wheezing
  • Prolonged expiratory phase
  • Rhonchi or rales
  • Air movement
  • Absence of wheezing is worrisome
Asthma

- When to order X-ray?
  - Hypoxia
  - Asymmetric lung sounds
  - First time wheezing

- Chest X-ray findings:
  - Hyperinflation
  - Peribronchial cuffing
  - Atelectasis
Asthma – Chest x-ray
Asthma - Management

- **Bronchospasm**
  - Beta-2 agonists
    - Albuterol – administer via nebulizer with oxygen
      - <10kg: 2.5 mg
      - >10kg: 5.0 mg

- **Anticholinergics**
  - Atrovent (peanut allergy a contraindication for atrovent administered by metered dose inhaler, not for nebulized solution)
    - <10kg: 250 mcg
    - >10kg: 500mcg
Asthma - Management

• Inflammation
  • Corticosteroids
    • Prednisone
      • Loading dose 2mg/kg
      • Max dose 60mg
      • Orapred liquid comes in 15mg/5ml solution – tastes great!

• Solumedrol
  • Loading dose 2mg/kg
  • Max dose 125mg
  • Use when patient vomiting, unable to hold down oral medications
  • Same efficacy as oral steroids
Asthma – Management

• Non-responsive to traditional care:
  • Magnesium Sulfate
    • 25 mg/kg/dose
  • Continuous albuterol
    • 10mg/hour
  • Terbutaline
    • 0.01 mg/kg/dose SQ every 20 minutes x2
    • 0.1-0.4 mcg/kg/minute drip
  • Epinephrine
    • 0.01 mg/kg/dose SQ every 20 minutes x4
  • Consider ketamine as sedative if patient needs intubation
Bronchiolitis

- Similar to asthma but symptoms are caused by viral etiology:
  - RSV
  - Parainfluenza
  - Adenovirus
  - Rhinovirus
  - Mycoplasma
Bronchiolitis

- RSV induces damage to the bronchial epithelium resulting in lower airway inflammation
- Bronchospasm (with history of atopy)
- Most common in winter, early spring
- Age typically < 3 years old
- Symptoms worse in premature infants
Bronchiolitis - Symptoms

- Cough
- Tachypnea
- Accessory muscle use
- High pitched wheezing
- Fine inspiratory crackles; rhonchi
- Copious, thick nasal secretions
- Low grade fever
Bronchiolitis

• Associated findings:
  • Otitis media
  • Pneumonia
  • Apnea (premature infants)
  • Dehydration

• Chest X-ray:
  • Hyperinflation / air trapping
  • Increased perihilar markings
  • Areas of atelectasis
Bronchiolitis - Management

- Mainly supportive
  - Nasal saline spray, frequent suctioning
  - Adequate PO intake (Pedialyte, juice)

- Pharmacologic
  - Albuterol – may diminish wheezing
  - Racemic Epinephrine – may diminish tachypnea
  - Steroids – controversial – consider if history of atopy
Bronchiolitis

• Infants infected with RSV more likely to wheeze with future viral infections due to airway remodeling

• Appropriate Discharge Criteria:
  • No hypoxia
  • Taking PO fluids well
  • No tachypnea or increased work of breathing
  • Wheezing may still be present – consider use of Albuterol MDI with spacer and face mask
  • Reliable parents, follow up
Bronchopulmonary Dysplasia (BPD)

• Chronic lung disease of premature infants that required prolonged respiratory support in NICU:
  • Lung immaturity
  • Oxygen therapy
  • Positive pressure ventilation
  • Infection and inflammation
  • Poor nutrition
BPD

• Symptoms and Findings:
  • Tachypnea, retractions at rest or during mild URI
  • Lungs hyperinflated (increased AP diameter)
  • Crackles, wheezes, decreased breath sounds
  • Chronic CO2 retention
  • CXR – hyperinflation, cystic areas, atelectasis, coarse appearing
BPD – Chest X-Ray
BPD - Management

• Supportive care
  • Humidified oxygen
  • Frequent suctioning
  • Adequate hydration
  • Assisted ventilation
  • Trial of beta-agonist

• Screen for RSV infection
  • Most infants will receive Synagis
Pneumonia

• Etiology differs in age groups

• Chest X-ray may be useful to help differentiate between different etiologies

• Symptoms and findings:
  • Cough, tachypnea, hypoxia
  • Asymmetric breath sounds, rales, decreased air movement
  • Fever
  • Elevated WBC with left shift
Pneumonia - Neonatal

- Bacterial causes:
  - *E. Coli*
  - Group B Strep
  - *Staph aureus*
  - *Listeria monocytogenes*

- Treatment:
  - Ampicillin and Gentamycin
Pneumonia

- *Chlamydia trachomatis*
  - Consider this in 3 week old to 4 month old patients
  - Afebrile pneumonitis with congestion, wheezing, fine diffuse crackles
  - Paroxysmal cough
  - Prior concomitant inclusion conjunctivitis
  - Treat with erythromycin
Pneumonia

- *Bordetella pertussis*
  - Severe paroxysmal coughing episodes followed by cyanosis and apnea
  - Sometimes associated with inspiratory “whoop” in older children
  - Ask about immunization history
  - CXR: hyperinflation, perihilar infiltrates, atelectasis, or normal
  - CBC: elevated WBC with lymphocytic predominance
  - Send Bordetella FA and culture (call lab for kit)
  - Treat with Erythromycin
Pneumonia

- Infant / child <4 years
  - Lobar – *S. pneumoniae*
    - Amoxicillin – no hypoxia; well-hydrated
    - Rocephin IV
  - Atypical
    - Respiratory viruses
    - Influenza
Lobar Pneumonia - Bacterial
Pneumonia

- Older children
  - Lobar
    - *S. pneumonia*
  - Atypical
    - *Mycoplasma pneumoniae*
    - *Chlamydia pneumoniae*
    - Influenza
- Treat with Amoxicillin and/or Zithromax (outpatient)
- Treat with Rocephin and Zithromax (inpatient)