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

Poiseuille’s Law

\[ R \propto \frac{1}{\text{radius}^4} \]

Resistance:

- Infant: Normal 4 mm, Edema 1 mm (\( \uparrow 16x \))
- Adult: Normal 8 mm (\( \uparrow 3x \))

Cross-sectional area:

- Infant: Normal 4 mm, Edema 1 mm (\( \downarrow 75\% \))
- Adult: Normal 8 mm (\( \downarrow 44\% \))
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

Figure 14.43 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

A: 87%
B: 8%
C: 4%
D: <1%
E: <1%
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
Enterovirus D-68

• New strain of Enterovirus developed this year
  • Most enteroviral infections cause GI symptoms such as vomiting and diarrhea
  • Typically a summer illness
  • This strain was seen later in the season than most enteroviral infections
  • Symptoms include sudden onset asthma-like symptoms in patients with no prior history of asthma
    • Acute onset of wheezing, increased work of breathing
    • Little or no fever
    • Lack of typical GI symptoms
    • Treat like typical asthma patient
    • Symptoms improve rapidly over 48-72 hours
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)
Questions? Comments?

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