PEDIATRIC ASTHMA & BRONCHIOLITIS

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Objectives

- Discuss and understand the current treatment recommendations for pediatric asthma in the ED as well as the discharge treatment when appropriate.
- Discuss and understand the benefit of dexamethasone over other steroid preparations for asthma treatment.
- Discuss and understand the current AAP diagnosis and management guidelines for bronchiolitis as they pertain to the Emergency Department.
- Discuss and understand the benefit of bronchodilator and dexamethasone treatment in a certain subset of bronchiolitis patients.
Differential Diagnosis of Wheezing

- Asthma
- Bronchiolitis
- URI with wheezing
- Pneumothorax
- GERD with aspiration pneumonia
- Foreign body aspiration
- Pneumonia
- CHF

- Congenital pulmonary anomaly
- Cystic Fibrosis
- a1-Antitrypsin deficiency
- Tracheoesophageal fistula
- Allergic reaction/anaphylaxis
- Vocal cord dysfunction
- Toxic Exposure
Asthma Update

- Epidemiology
  - 13% of all children in the US with 6.7 million experiencing active disease
  - 3.5 million have >1 exacerbation per year
  - 600,000 ED visits; highest % in children <4
  - Disproportionately affects minority children, those in urban areas, and those of lower socioeconomic status
Asthma Update

- Pathophysiology
  - Airway obstruction
  - Bronchial hyper-responsiveness
  - Airway inflammation
  - Increased mucous production
Asthma Update

- Determine the severity of the episode
  - National Asthma Education and Prevention Program (NAEPP) recommends using spirometry or peak expiratory flow rate (PEFR)
  - This may be impossible in young or severely ill children
- Subjective clinical scores have been validated for use in such cases
  - PASS- Pediatric asthma severity score
  - Modified pulmonary index
  - Pulmonary score
<table>
<thead>
<tr>
<th>Table 1</th>
<th>Acute asthma severity assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mild</td>
</tr>
<tr>
<td><strong>Key examination elements (pediatric asthma severity score)</strong></td>
<td></td>
</tr>
<tr>
<td>Wheezing</td>
<td>None or mild (0)</td>
</tr>
<tr>
<td></td>
<td>None or end of expiration only</td>
</tr>
<tr>
<td>Work of breathing</td>
<td>None or mild (0)</td>
</tr>
<tr>
<td></td>
<td>Normal or minimal retractions</td>
</tr>
<tr>
<td>Prolonged expiration</td>
<td>None or mild (0)</td>
</tr>
<tr>
<td></td>
<td>Normal or minimally prolonged</td>
</tr>
<tr>
<td><strong>Other examination elements</strong></td>
<td></td>
</tr>
<tr>
<td>Breath Sounds/aeration</td>
<td>Normal</td>
</tr>
<tr>
<td>Symptoms</td>
<td></td>
</tr>
<tr>
<td>Breathlessness</td>
<td>With activity or agitation</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Talks in</td>
<td>Sentences</td>
</tr>
<tr>
<td>Alertness</td>
<td>Alert</td>
</tr>
<tr>
<td>Measurements</td>
<td>Pulse oximetry</td>
</tr>
<tr>
<td></td>
<td>PEF (% of predicted by height)</td>
</tr>
</tbody>
</table>
Asthma Update

- Evaluation
  - CXR
    - Use is variable in evaluation of asthma
      - 14-56%
    - Predictors of pathological films
      - Fever
      - Hypoxia
      - Focal rales
      - 4.9% positive in suspicious patients
    - Potential risk
      - Radiation
      - False positive results
      - Have a high threshold for imaging
    - Laboratory testing
      - Rarely helpful in the evaluation and treatment
Asthma Update

- **Standard Tx**
  - Short acting B-agonists (SABA)
    - Albuterol or levoalbuterol
    - Bronchodilation or relaxation of the smooth muscle
    - Mild to moderate asthma
      - MDI with spacer over nebulizers
      - Shorter LOS and less tachycardia
    - In severe asthma nebulizers necessary
  - Continuous nebulized SABA
    - Severe exacerbations or poor response to back-to-back dosing
## Asthma Update

### Albuterol Dosing

<table>
<thead>
<tr>
<th>Weight</th>
<th>MDI</th>
<th>Nebulizer Intermittent</th>
<th>Nebulizer Continuous</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5 kg</td>
<td>2 puffs</td>
<td>1.25 mg</td>
<td>5 mg/hr</td>
</tr>
<tr>
<td>5-10 kg</td>
<td>4 puffs</td>
<td>2.5 mg</td>
<td>10 mg/hr</td>
</tr>
<tr>
<td>10-20 kg</td>
<td>6 puffs</td>
<td>3.75 mg</td>
<td>15 mg/hr</td>
</tr>
<tr>
<td>&gt;20 kg</td>
<td>8 puffs</td>
<td>5 mg</td>
<td>20 mg/hr</td>
</tr>
</tbody>
</table>
Asthma Update

- Standard Tx
  - Ipratropium Bromide
    - Associated with lower admission rates for children with severe exacerbations and may reduce LOS
    - Relieves cholinergic bronchomotor tone and decreases mucosal edema and secretions
    - Multidose protocols effective
    - NNT to prevent one admission 7 in severe group, 12 in intermediate
      - Cost effective
## Asthma Update

**Ipratropium Bromide Dosing**

<table>
<thead>
<tr>
<th>Weight (kg)</th>
<th>Nebulizer</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10 kg</td>
<td>250 micrograms X 3 doses</td>
</tr>
<tr>
<td>&gt;10 kg</td>
<td>500 micrograms X 2 doses</td>
</tr>
</tbody>
</table>
Asthma Update

- Standard Tx
  - Corticosteroids
    - Reduce airway inflammation
  - Benefit
    - Moderate to severe cases
    - Administer early
      - Effect within 2 hours
    - Reduce hospitalization rates and relapse visits
  - Mild exacerbations should receive steroids if the have an incomplete response to inhaled SABA
Asthma Update

- Corticosteroid Dosing
  - Oral administration preferred
    - Prednisone or Prednisolone 2 mg/kg
  - Consider Dexamethasone
      - Similar relapse rates with less vomiting
        - 1-2 days dosing
        - Better compliance
        - IV dosing po
        - 0.3-0.6 mg/kg
  - Inhaled Corticosteroids
    - Chronic
<table>
<thead>
<tr>
<th></th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Albuterol</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery device</td>
<td>MDI with valved holding chamber</td>
<td>MDI with valved holding chamber or nebulizer</td>
<td>Nebulizer</td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>Intermittent treatment every 20 min up to 3 doses in 60 min</td>
<td>Intermittent or continuous treatment</td>
<td></td>
</tr>
<tr>
<td><strong>Dosing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;5</td>
<td>2 Puffs</td>
<td>1.25 mg (intermittent)</td>
<td>5 mg/h</td>
</tr>
<tr>
<td>5–10</td>
<td>4 Puffs</td>
<td>2.5 mg</td>
<td>10 mg/h</td>
</tr>
<tr>
<td>10–20</td>
<td>6 Puffs</td>
<td>3.75 mg</td>
<td>15 mg/h</td>
</tr>
<tr>
<td>&gt;20</td>
<td>8 Puffs</td>
<td>5 mg</td>
<td>20 mg/h</td>
</tr>
<tr>
<td><strong>Ipratropium bromide</strong></td>
<td>(Mix with albuterol)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comment</td>
<td>Not proved effective</td>
<td>Likely effective when added to β-agonist</td>
<td>Effective, particularly multiple doses</td>
</tr>
<tr>
<td><strong>Delivery device</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;10</td>
<td>250 µg x 3 doses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;10</td>
<td>500 µg x 2 doses</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Systemic corticosteroids</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comment</td>
<td>Consider if incomplete response to initial therapy</td>
<td>Administer as early as possible for maximal benefit</td>
<td></td>
</tr>
<tr>
<td>Route</td>
<td>Oral</td>
<td>Oral route as effective as parenteral</td>
<td></td>
</tr>
<tr>
<td>Dose</td>
<td>Prednisone or prednisolone</td>
<td>Prednisone or prednisolone or methylprednisolone</td>
<td>2 mg/kg (max 60 mg)</td>
</tr>
<tr>
<td></td>
<td>2 mg/kg (max 60 mg)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Asthma Update

- Standard Tx
  - Reassess the patient
    - If incomplete or poor response further treat with SABA and consider admission
  - Consider adjunctive treatments
Asthma Update

- Adjunctive Tx
  - Magnesium Sulfate
    - Improved pulmonary function and reduced hospitalization rates
    - 50-75mg/kg IV Max 2 g
Asthma Update

- Adjunctive Tx
  - Heliox-oxygen-delivered SABA 70:30 or 80:20
    - Thought to improve drug delivery to the lower airways secondary to lower density /airflow resistance
    - May improve outcomes in severe exacerbations
Asthma Update

- Adjunctive Tx
  - Systemic B-agonists
    - Can be used in severe exacerbations*
      - Epinephrine SQ or IM
        - 0.01 mg/kg, max 0.5mg
      - Terbutaline SQ or IV*
        - 12 micrograms/kg
Asthma Update

- Adjunctive Tx
  - BIPAP
    - Well tolerated and may reduce need for ICU admission
    - Benefits patients tiring from increased work of breathing and impending respiratory failure
    - IPAP Start 8-10 cm H2O then increase as needed to decrease work of breathing (10-16cm)
    - EPAP Start at 2-4 cm H2O (10cm)
    - At least 2cm differential
Asthma Update

- Disposition
  - Clinical Decision
  - Go back to PASS
Asthma Update

- NAEPP guidelines recommend ED providers consider initiating controller medications to appropriate patients
  - Many patients don’t have or don’t utilize appropriate follow up
  - Some primary care clinicians are not following the guidelines with these patients
  - *Briefly assess asthma control*
### Asthma Classification


#### Age ≥ 12 years – Adults

<table>
<thead>
<tr>
<th>COMPONENTS OF SEVERITY</th>
<th>Classification of Asthma Severity</th>
<th>Intermittent</th>
<th>Persistent</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Impairment</td>
<td></td>
<td></td>
<td>Persistent</td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td></td>
<td>≤2 days/wk</td>
<td>&gt;2 days/wk not daily</td>
<td>Daily</td>
</tr>
<tr>
<td>Nighttime Awakenings</td>
<td></td>
<td>≤2x/month</td>
<td>3-4x/month</td>
<td>&gt;1x/wk not nightly</td>
</tr>
<tr>
<td>SABA Use for Symptoms</td>
<td></td>
<td>≤2 days/wk not daily</td>
<td>Daily</td>
<td>Several times daily</td>
</tr>
<tr>
<td>Interference with Normal Activity</td>
<td></td>
<td>None</td>
<td>Minor limitation</td>
<td>Some limitation</td>
</tr>
<tr>
<td>Lung Function</td>
<td></td>
<td>Normal FEV1, between exacerbations</td>
<td>&gt;80% Normal</td>
<td>60-80% Reduced 5%</td>
</tr>
<tr>
<td>FEV1/FEV1/FVC</td>
<td></td>
<td>Normal</td>
<td>&gt;80% Normal</td>
<td>60-80% Reduced 5%</td>
</tr>
<tr>
<td>Risk</td>
<td>Exacerbations requiring oral steroids</td>
<td>0-1/year</td>
<td>≥2/year</td>
<td>Consider severity &amp; interval since last exacerbation. Frequency &amp; severity may fluctuate over time for patient of any severity class.</td>
</tr>
<tr>
<td>Recommended Step for Initiating Treatment</td>
<td></td>
<td>Step 1</td>
<td>Step 2</td>
<td>Step 3</td>
</tr>
</tbody>
</table>

#### Treatment recommendation

**Step 1:** Short-acting beta agonist PRN

**Step 2:** Low-dose inhaled corticosteroid

**Step 3:** Low-dose inhaled corticosteroid + long-acting beta agonist, OR medium-dose inhaled corticosteroid

**Step 4:** Medium-dose inhaled corticosteroid + long-acting beta agonist

**Step 5:** High-dose inhaled corticosteroid + long-acting beta agonist AND consider omalizumab for patient with allergies
Asthma Update

- Communication
  - Parent
  - Child: age/development
    - Controller medications at home
    - Improves adherence
      Improving control
    Decreasing exacerbations and ED visits
Bronchiolitis: Epidemiology

- MC lower respiratory tract infection in infants and toddlers
- Pediatric patient exclusively the result of a viral infection, MC RSV
- Hospital Costs $700 million annually
  - 132,00-172,00 hospitalizations
  - Ave 3-4 days
Bronchiolitis: Epidemiology

- Significant decrease in deaths to 500 annually secondary to immunization of high risk infants
- High degree of morbidity
- Risk factors for hospitalization
  - Male sex
  - Chronic illness
  - Lower socioeconomic status
  - Smoke exposure
  - Contact with other children.
Bronchiolitis: Pathophysiology

- Bronchiole obstruction
  - Edema
  - Cellular debris
  - Hyperplastic lymphoid follicles
  - Mucous
  - Results in wheezing

- Degree of obstruction changes as these areas are cleared accounting for the changing clinical picture.
Bronchiolitis: Clinical Features

- Self limited: 7-10 days (28)
- Ubiquitous (90%)
- Can be severe
- Preceded by a 1-3 day hx of URI symptoms, then followed by wheezing and symptoms of respiratory distress.
AAP Bronchiolitis Treatment Guidelines

- 2006 Published in Pediatrics
  - Evidence based
- Improvement in care
- Appropriate decreased resource utilization and costs
- Unfortunately poor adherence
High risk infants are at risk for apneic episodes, severe respiratory distress and respiratory failure.

- AAP Guideline 1b
- “Clinicians should assess risk factors for severe disease........”
Bronchiolitis: Hx

- Special consideration.....
  - Immunodeficiency
  - Cystic fibrosis
  - BPD
  - Hemodynamically significant congenital heart disease
  - Neuromuscular disorders
  - Prematurity/Birth Weight
  - Age less than three months*
  - Hx of Apnea
  - Hydration status
Bronchiolitis: PE

- Sx of respiratory distress
  - Tachypnea
  - Nasal flaring
  - Retractions
  - Grunting
  - Respiratory rate > 60

- Presence of cyanosis
- Episodes of restlessness or lethargy
- Evidence for moderate or severe dehydration
Bronchiolitis: Dx

- Diagnostic Laboratory and radiographic tests are not indicated
- AT THE CORRECT TIME OF YEAR AND IN THE CORRECT AGE GROUP IT IS A CLINICAL DIAGNOSIS

- AAP Guideline 1a
- “Clinicians should diagnosis bronchiolitis and assess disease severity on the basis of hx and pe. Clinicians should not routinely order laboratory and radiographic studies for the diagnosis.”
Bronchiolitis: Dx Special Consideration

- >1 month with fever
  - The risk for SBI is low except for UTI

- <1 month with fever
  - Same/similar risk for SBI as infants this age without bronchiolitis
  - Septic workup
Bronchiolitis: Dx Special Consideration

- Routine radiography not indicated
- May be useful when....
  - Hospitalized children do not improve as expected
  - Severity of disease
  - Another diagnosis likely
Routing testing for specific viral agents does not alter the management or outcome of the illness and is not needed.

- Consider if admitting to reduce nosocomial transmission
Bronchiolitis: Tx

- Symptomatic Treatment
  - Goal to maintain adequate oxygenation and hydration
  - Nasal suctioning beneficial
    - no benefit of deep suctioning
Bronchiolitis: Tx

- Bronchodilators: B2 agonists, epinephrine
  - Not routinely recommended
  - May be of benefit in a subset of patients
    - Hx of atopy or parent/sibling with asthma

- AAP Guideline 2a
  - “Bronchodilators should not be routinely used in the management of bronchiolitis.”

- AAP Guideline 2b
  - “A carefully monitored trial of a-adrernergic or b-adrenergic medications is an option....continue only if there is a documented clinical response to the trial use on an objective means of evaluation.”
Bronchiolitis: Tx

- Corticosteroids
  - Meta-analysis including 2596 children showed no benefits in hospital admission rates, LOS, clinical score after 12 hours, hospital revisit or readmission rates
  - No benefit in admitted mechanically ventilated patients
- AAP Guideline #3
  - Corticosteroid medications should not be used routinely in the management of bronchiolitis.
- Alasari et al. Pediatrics Sept 2013
  - Atopic kids or family history of asthma
  - Decreased LOS 31%
Bronchiolitis: Tx

- Antibiotics
  - Should NOT be routinely used
  - Use only when a coexisting bacterial infection is present and use antibiotic appropriate for that infection

- Antiviral
  - Benefit in only select situations
    - Mechanically ventilated
  - Difficult to give, health risk to care givers, expensive
Bronchiolitis: Tx

- Heliox
  - Meta-analysis showed improved clinical scores at 1 hour but no sustained benefit

- Inhaled glucocorticoids
  - No benefit

- Surfactant
  - In intubated patients, may shorten duration of mechanical ventilation and ICU LOS
Bronchiolitis: Tx

- Chest Physiotherapy
  - No benefit

- Hypertonic Saline
  - 3%-5% safe and effective
  - Associated with decreased LOS for hospitalized patients and improved clinical scores
  - No proven benefit in the ED

- High Flow Nasal Cannula (HFNC)
  - Heated and humidified O2 delivered at 8L-40L
  - Results in decreased rates of intubation in ICU patients
  - Studies small but showing promise
Bronchiolitis: Tx

- Prophylaxis
  - Palivizumab-monoclonal antibody
  - Given monthly injections during RSV season (Nov-March in US)
  - Decreases hospitalizations in high risk children
Child with suspected RSV infection

Clinical diagnosis
- Peak RSV season?
- Born term without serious complications
- Absence of cardiopulmonary or immune disease?
- Absence of significant respiratory distress, apnea, hypoxia, signs of dehydration?
- Child < 2 months

no

Child > 28 days

yes

RSV PCR
- Consider urine culture if febrile
- Consider blood culture if < 60 days
- Consider CXR

no

Full sepsis workup if febrile
- RSV PCR
- Consider CXR

diagnosis of RSV

yes

Improvement after supportive care initiated (e.g., suctioning, oxygen)?

no

Consider DC if:
- well hydrated
- no oxygen requirement
- good follow-up
- no respiratory distress
- no (risk of) apnea

no

Trial of bronchodilators (albuterol, racemic epinephrine)

Clinical improvement?

yes

Continue bronchodilator therapy

no

Consider other therapy (e.g., nebulized 3% saline, ribavirin) after discussion with specialist

Significant symptoms persist?

Admission to hospital if:
- dehydrated
- oxygen requirement
- poor follow-up
- respiratory distress
- (risk of) apnea
Key Points: Asthma

- Knowledge of the current asthma guidelines and understanding how to evaluate for severity of symptoms will improve your asthma care.

- Consider dexamethasone as your first line steroid.

- Consider magnesium and BIPAP for the severe asthmatic.

- Consider addressing home controller medication needs.
Key Points: Bronchiolitis

- The diagnosis and management of routine bronchiolitis in the ED is made clinically and the treatment is supportive.

- RSV testing during season is only beneficial for nosocomial transmission concerns.

- In a subset of patients* a trial of bronchodilator is indicted with continuation and the addition of dexamethasone if responsive.
References

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