Evidence-Based Treatment Of Asthma in the ED

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Objective

To provide an evidence based review of the assessment and management of acute asthma in the Emergency Department.

2007 NHLBI Expert Panel Guidelines for the Diagnosis and Management of Asthma

Cochrane Database of Systematic Reviews
Patient Assessment
Assessment

**Essentials:**

- Immediate triage
- Treatment before assessment complete
- Targeted history and physical
- Objective lung function measurement
- Diagnostic studies not required in most patients and should *never* delay treatment

Assessment

Objectives of the history are to determine:
- Time of onset, any potential precipitants
- Severity compared with previous events
- ED visits, episodes of respiratory failure
- Other potentially complicating illnesses
- All current medications

Assessment

Objectives of the examination are to:

- Assess the severity of the exacerbation
- Immediately identify respiratory failure
- Assess the patient’s overall status [alertness, reserve, fluid status]
- Identify possible complications

Assessment Tools

- Arterial blood gases
- Chest radiography
- Pulse oximetry
- Peak expiratory flow rates
Arterial Blood Gas

- Respiratory alkalosis typical
- Inaccurate predictor of outcome
- The information will seldom alter your treatment plan
Arterial Blood Gas

**Role?**
- Unclear diagnosis
- Unresponsive to $R_x$
- Respiratory failure *after* intubation
Chest Radiography

- Adds little to decision making in most patients
- The presence of ‘abnormal’ findings on CXR seldom alters management
- Should not be ordered routinely
Chest Radiography

**Role?**
- Unclear diagnosis
- Unresponsive to $R_x$
- Respiratory failure [after intubation]
- Pneumonia or pneumothorax?
- New onset asthma
Pulse Oximetry

Is there a ‘magic’ cutoff number of the presenting $\text{SaO}_2$ that can be used to reliably predict the need for hospital admission?
Pulse Oximetry

- When a lower value is used – *high specificity, low sensitivity*

- When a higher value is used – *high sensitivity, low specificity*
Pulse Oximetry

- MARC trial assessing the predictive value of the initial pulse-ox reading in 1,040 children ages 2-17.
- The association between hospital admission and \( \text{SaO}_2 \) was examined using logistic regression.

## Pulse Oximetry

<table>
<thead>
<tr>
<th>SaO₂</th>
<th>N</th>
<th>% Admitted</th>
<th>LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>88%</td>
<td>42</td>
<td>73%</td>
<td>12</td>
</tr>
<tr>
<td>90%</td>
<td>28</td>
<td>61%</td>
<td>6.75</td>
</tr>
<tr>
<td>92%</td>
<td>47</td>
<td>55%</td>
<td>4.67</td>
</tr>
<tr>
<td>94%</td>
<td>94</td>
<td>30%</td>
<td>2.7</td>
</tr>
<tr>
<td>96%</td>
<td>157</td>
<td>14%</td>
<td>1.66</td>
</tr>
</tbody>
</table>

Pulse Oximetry

- Easy to get and repeat
- No single number can reliably predict patient outcome. The information should be considered as one piece of the puzzle
- Pulse oximetry should not be used in isolation to drive decision-making

Peak Expiratory Flow Rates

- A PEFR on presentation and at 1 hour is the *single strongest predictor of the need for hospitalization*

- Caveats:
  - Severe airway obstruction may preclude performance
  - Only 65% children 5-18 can cooperate and PEFR is not reliable in children <5 years old

# Peak Expiratory Flow Rates

<table>
<thead>
<tr>
<th>PEFR %Predicted</th>
<th>Severe</th>
<th>Moderate</th>
<th>Mild</th>
<th>Discharge Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;25%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25%-50%</td>
<td>Severe</td>
<td>Moderate</td>
<td>Mild</td>
<td>Discharge Goal</td>
</tr>
<tr>
<td>50%-70%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;70%</td>
<td></td>
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</tbody>
</table>

Pharmacotherapy Essentials

- Short-acting β-agonists
- Corticosteroids to reduce inflammation
- Second line agents in severe disease:
  - Anticholinergics
  - Magnesium
  - Heliox
β-Agonists: MDI vs. Nebulizer?

- 21 trials, 880 children & 440 adults
- No difference in PEFR, FEV$_1$ or admission rates between groups
- One pediatric study found shorter LOS in nebulizer group [no difference in adults]

β-Agonists: MDI vs. Nebulizer?

- Both are equally effective, even in severe asthma
- 6 puffs = 2.5 mg neb
- MDI delivery is substantially cheaper

β-Agonists: *Continuous Delivery*

A recent meta-analysis of 6 trials [n=393] demonstrated:

- No difference in pulmonary function measures at 1, 2 or 3 hours
- No difference in the rate of hospital admission
- A significantly higher incidence of hypokalemia

Rodrigo GJ. *Chest* 2002; 122:160-165.
β-Agonists: *Continuous Delivery?*

- Most clinicians reserve continuous nebulization for the sickest patients
- Large doses of albuterol are generally well tolerated in both adults and children
- May facilitate drug delivery in a busy ED
Do Steroids Prevent Admission?

- 12 studies, n=863 [435 steroid, 428 placebo]
- Patients receiving steroids within 1 hour:
  - Had significantly lower admission rates [OR:0.4, 95% CI: 0.21 to 0.78]
  - Benefit most pronounced for those not on steroids at baseline and in those with severe disease

Do Steroids Prevent Relapse?

- Seven studies [5 PO, 2 IM]
- Patients receiving steroids on ED discharge:
  - Relapsed less frequently in the first 21 days [OR:0.33, 95% CI: 0.13 to 0.82]
  - Patients had less need for β-agonists
  - IM delivery similar to PO in the first 7-10 days

Oral Versus IV?

- Review of 1,847 MARC patients
- 383 [32%] received IV, 810 [68%] PO

Results:
- IV steroid group had more severe asthma
- IV group more likely to be admitted and/or relapse
- Because the route of delivery was not randomized the authors were not able to control for other variables between groups

The Case For Initiating Inhaled Corticosteroids in the ED

- Clear benefit of early treatment with inhaled corticosteroids [ICS]
- Safe without serious side effects
- The initiation of ICS upon ED discharge ensures that the patient is prescribed an effective controller medication
- Adding ICS to oral steroids does not offer additional benefit for the acute event

The Case For Initiating Inhaled Corticosteroids in the ED

The emergency physician can use the “rule of two” to determine if a patient’s asthma is well controlled:

- Use of a rescue inhaler >2 times a week
- Awakening with an asthma attach 2 times a month
- Use of >2 quick-relief β-agonist canisters/year

Anticholinergics

- Relatively weak bronchodilators
- Studies with divergent results

Benefits:
- No significant side effects
- Longer duration of action
Anticholinergics

- More data in children than in adults
- 8 trials investigate the benefit of adding anticholinergics to β-agonist
- 1 dose did not alter admission rates, but improved lung function @ 60 minutes
- Multiple doses in mod/severe disease decreased the rate of hospitalization
- Consider in severe cases, children

Magnesium

- Blocks calcium channels
- Relaxes bronchial smooth muscle
- Inhibits the contractile response to endogenous bronchoconstrictors
Magnesium

- Seven trials, n=665
- Patients receiving Mg++ demonstrated a non-significant improvement in PEFR
- Admission parameters were not altered
- No significant side-effects occurred

Magnesium

Recommendations:
- Not indicated for most patients
- Consider in severe, refractory asthma
- IV administration 2 - 4 grams
- Complications are rare:
  - Burning at the IV site
  - AV block, nausea
Heliox

- Helium – oxygen mixture
- Less dense than air, laminar flow

**Rationale:**
- To delay or prevent intubation
- To decrease ventilator peak pressure in the intubated asthmatic
Heliox

- 4 randomized trials [3 adult, 1 pediatric], total n=288

- Pooled results showed no difference in pulmonary function for either adults or children

Aminophylline

Can we please just bury it once and for all?
# Aminophylline

- 7 studies examined the effect of adding aminophylline to β-agonists in adults
- There was no significant difference in pulmonary function or admission rates
- Higher rate of complications:

<table>
<thead>
<tr>
<th></th>
<th>OR</th>
<th></th>
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<tbody>
<tr>
<td>Dysrhythmias</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>Vomiting</td>
<td>4.2</td>
<td></td>
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</tbody>
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Intubation

- No time, complications significant
- Adequate pre-oxygenation unlikely
- Fluid bolus to rapidly increase preload
- RSI is the preferred technique

**Induction agents choices:**
- Ketamine [1-2 mg/kg IV, 4 mg/kg IM]
- Etomidate [0.3 mg/kg IV]
Mechanical Ventilation

- Complications can be lethal [barotrauma, decreased venous return]
- *Permissive hypercapnea* is used to avoid high intrathoracic pressures:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Tidal Volume</td>
<td>6-8 cc/kg</td>
</tr>
<tr>
<td>Respiratory Rate</td>
<td>6-8 bpm</td>
</tr>
<tr>
<td>Inspiratory Flow Rate</td>
<td>60-90 L/min</td>
</tr>
</tbody>
</table>
Take Home Essentials

- Objective measure of lung function
- Corticosteroids to reduce inflammation
- Emergency physicians need to play a greater role prescribing inhaled steroids
- Adjunctive agents in severe disease
- RSI + permissive hypercapnea
- State-of-the-art care saves lives!
Questions?
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