STATUS ASTHMATICUS!
REASONING THE WHEEZING

CHRISTOPHER S. AMATO, MD, FACEP, FAAP
MORRISTOWN MEDICAL / GORYEB CHILDREN’S HOSPITAL
MORRISTOWN, NJ
ENVISION PHYSICIANS GROUP
Disneyland employees are not allowed to point with one finger, or tell a guest, "I don't know."

There's a basketball court inside the Matterhorn ride.
THE WORLD OF ASTHMA....IT’S A SMALL SMALL WORLD
OBJECTIVES

- Discuss asthma mimics
- Review poor prognostic indicators in asthma
- Discuss 1\textsuperscript{st} and 2\textsuperscript{nd} line therapy principles of and an approach/management for status asthmaticus
- Describe the role of rescue therapies with NIPPV and HFNC in the management of severe asthma
- Discuss the role of Heliox and 3rd line therapies, including theophylline and IV Beta-agonist therapy
- Vocal cord dysfunction (VCD)
  - May also be induced by similar triggers
  - Consider in the difficult to treat
- Exercise Induced Breathlessness
  - Treatment: speech therapy and relaxation techniques
  - Elite athletes prone to either
CASE

- 13 year old presents with a 3d history of cough, worse with activity
- “No one smokes inside the house.”
- Strong family history of asthma
  - T 37.2, RR 26, P 90, PulsOx 94%, Wt.. 25 kg
  - PE Mild tachypnea
  - NO Distress
ASSESSMENT

- Awake, abnormal breathing, normal circulation

- Vital signs:
  - T 37.2, RR 36, P 90, PulsOx 94%, Wt. 60 kg
  - PE Mild tachypnea but no apparent Distress
MARKERS OF SEVERITY

HISTORY OF:

- Severe, rapid progression of symptoms
- Respiratory failure requiring endotracheal intubation or ventilatory support
- Seizures or loss of consciousness
- PICU admission

DISEASE:

- Denial or failure to perceive the severity
- Non-compliance with medications
- Lack of social supports or safety
- Associated psych – i.e. depression
- African American and Hispanic children
WHAT CAN BE DONE THERAPEUTICALLY?

History of Inhalers
FYI

- MDI comes out at 60MPH
- Spacer decreased med deposition to pharynx by 50%
- No difference in admission rate
- Children’s LOS in the ED shorter
  - mean diff: -0.62 hours; 95% CI ( -0.84 to -0.40 )
- No difference for LOS in adults
- Decreased Pulse & tremor in spacer grp
- Each spray = 108 microgram (90 mcg albuterol)

ALBUTEROL 2.5mg neb = ~20 puffs of HFA!

SPACERS VS. “SPACERS”
Higher lung deposition with Respimat® Soft Mist™ Inhaler than HFA-MDI in COPD patients with poor technique

Peter Brand, Bettina Hederer, George Austen, Helen Dewberry, and Thomas Meyer
## HOW MANY PUFFS???
### ACUTE TREATMENTS

<table>
<thead>
<tr>
<th>WEIGHT</th>
<th>NEB (intermittent) q20’</th>
<th>MDI Puffs q20’’</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;10 kg</td>
<td>2.5mg</td>
<td>4</td>
</tr>
<tr>
<td>10-20 Kg</td>
<td>3.75mg</td>
<td>6</td>
</tr>
<tr>
<td>&gt;20</td>
<td>5mg</td>
<td>8</td>
</tr>
</tbody>
</table>

CHOP Guidelines – Dr. Richard Scarfone
THERAPY

- Spacer versus Nebulizer
- Timing of Steroids
- Ipratropium bromide
- Magnesium SO4
Steroids

- Cochrane Review: May 2001
- 12 Studies:
  - 863 Patients
  - 409 Pediatric
- Main outcome: need for admission
Number needed to treat with steroids in the first hour to prevent 1 admission: 6
• No difference in PRAM scores at day 4 or return / admit
• Prednisolone associated with vomiting
NEW STEROID GUIDELINES

- NAEPP (2007) review is 1 to 2 mg/kg/day (maximum 60 mg/day) in 2 divided doses for children < 12 years
- 40 to 80 mg/day for > 12 years and adults
- Oral or intravenous
- Effect within 1 to 3 hours and peaks at 4 to 8 hours.
THERAPY

- Spacer versus Nebulizer
- Timing of Steroids
- Ipratropium bromide
- Magnesium SO4
IPRATROPIUM BROMIDE

- Single dose does not work

- Multiple dose decreases admissions
  - NNT 12 overall 95% CI (8, 32)
  - NNT 7 severe subgroup 95% CI (5, 20)
    - Reduce the need for admission by 25%

Plotnick L. *Cochrane Systematic Reviews* 2008
THERAPY

- Spacer versus Nebulizer
- Timing of Steroids
- Ipratropium bromide
- Magnesium SO4
**MGSO₄**

- **Mechanism of Action**
  - Smooth Muscle relaxation & bronchodilation
  - Inhibits degranulation of mast cells
  - Decreases release of ACH (↓ excitability of muscle fiber membranes)

- **Dose:**
  - 20-100mg/kg (2g max) IV over 20 min
- IV MgSO4 (in addition to standard therapy)
- Improved pulmonary function and ↓ Admission for Children
- Neb MgSO4 – no difference
CONTINUOUS VS. INTERMITTENT NEBS
GREGORY AK. ANN EMERG MED 2012

- 8 trials; n = 461

**Main Results:**
- Continuous nebs benefit in severe disease
- Decreased hospital admission rates (NNT=7)
- Improved pulmonary function @ 2-3 hours
- Side-effects [tremor, ↑HR, ↓K+] similar when compared with intermittent delivery

0.5-1mg/kg/hr.: <20kg = 10-20mg/hr.; 20-30kg = 10-30mg/hr.; >30kg = 15-45mg
B2-AGONISTS: INTRAVENOUS?

- 15 trials, n=584
- IV β2-agonists conferred no advantage over inhaled β2-agonists [in any severity group]
- No difference in autonomic side-effects
3 trials; n = 104

**Main Results:**
- Possible benefit in children
- No benefit identified in adults
- Side effects: tremor, troponin increases

Need adequately powered, high quality clinical trial
Neb epi vs. neb β-agonist: no difference
IV & SQ epi efficacious
0.3 –0.5 mg every 20 minutes for 3 doses
More rapid absorption via IM route
Safe in older asthmatics
7 trials; n = 380

Main Results:

- Improved lung function at six hours when compared with β-agonist and steroids alone.
- No change in admission, LOS, ICU use.
- 3 x increased vomiting
- Narrow therapeutic window to toxic
Non-Invasive Ventilation
NONINVASIVE POSITIVE PRESSURE VENTILATION

PROS
- May improve the delivery of bronchodilators to small airways
- Decreases workload/fatigue (decrease inspiratory muscle activity)
- Treatment to prevent hypercarbic and/or hypoxemic respiratory failure
- Decreased rate of intubation

CONS
- Worsen hyperinflation and air trapping,
- Increase intrathoracic pressure
- Decrease venous return and contribute to barotrauma
HIGH FLOW NASAL CANNULA (HFNC);
KELLY PEDIATR EMERG CARE 2013

- Retrospective review of HFNC for acute respiratory insufficiency in PED to PICU; utilizing an asthma subgroup

- Infant/toddler flow max 7L/min; pediatric max 8L/min; adult max 50L/min
  - 87 patients when HFNC not available, intubation rate 5%
  - 99 patients when HFNC available, 9% use, 5% intubation rate
  - 172 patients when HFNC policy in place, 23% use, 0.6% intubation rate (p=0.03)
HIGH FLOW NASAL CANNULA (HFNC)

- Respiratory muscles rapidly unloaded
- Dyspnea improved
- RR improved
- Gas exchange improved with low inspiratory pressure
- None were intubated
  - 2 failed – PTX & changed to NIV

Nasal high flow in management of children with status asthmaticus: a retrospective observational study. *Ann Intensive Care*. 2017; 7: 55. Florent Baudin, 1,2 Alexandra Buisson,1 Blandine Vanel,1 Bruno Massenavette,1 Robin Pouyau,1 and Etienne Javouhey1,2
WHAT ABOUT HELIOX AND NONINVASIVE VENTILATION

PURCHASING HELIUM BALLOON

PLACE ITEM IN BAGGING AREA. NO ITEMS DETECTED IN BAGGING AREA
HELIOX AND NONINVASIVE VENTILATION (NIV)

- 7x lighter than air
  - Lowers the resistance to gas flow and turbulent flow
  - Potentially decreases the work of breathing by permitting an increase in ventilation

- Perceived benefits
  - Improved deposition of airway particles to the distal airways
  - Up to 50% more drug may be delivered

Jaber Am J Respir Crit Care Med 200;161:1191-2000
HELIOX AND NONINVASIVE VENTILATION (NIV)

- Significant reductions in:
  - Pressure-time index at both PSV
  - Work of breathing
  - PCO2

- NIV with heliox:
  - Reduce patient effort and improve gas exchange

*Jaber Am J Respir Crit Care Med 200;161:1191-2000*
KETAMINE

- Annals of Emergency medicine, 2005
- Double-blind, randomized, placebo-controlled trial
- 68 patients with continued mod-sever symptoms after initial conventional therapy
- No benefit

Retrospective cohort,

Positive fluid balance associated with:

- Longer hospital length of stay
- Longer treatment duration
- Increased risk of supplemental oxygen use

A strong interaction between fluid balance and intrapleural pressure:
INTUBATION

- Progressive lethargy/ apnea/ altered LOC
- Progressive hypoxia
- Progressive pCO2 & worsening acidosis
STEP_WISE THERAPY

- PICU Asthma score
  - q2°
- Created at Le Bonheur

<table>
<thead>
<tr>
<th>Examination component</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
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<tbody>
<tr>
<td>Respiratory rate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-4 y</td>
<td>≤34</td>
<td>35-39</td>
<td>≥40</td>
</tr>
<tr>
<td>4-6 y</td>
<td>≤30</td>
<td>31-35</td>
<td>≥36</td>
</tr>
<tr>
<td>6-12 y</td>
<td>≤26</td>
<td>27-30</td>
<td>≥31</td>
</tr>
<tr>
<td>&gt;12 y</td>
<td>≤23</td>
<td>24-27</td>
<td>≥28</td>
</tr>
<tr>
<td>O₂ requirement</td>
<td>&gt;95% on room air</td>
<td>90%-95% on room air</td>
<td>&lt;90% on room air or any oxygen</td>
</tr>
<tr>
<td>Retractions</td>
<td>None or intercostal</td>
<td>Intercostal and substernal</td>
<td>Intercostal, substernal, and supraclavicular</td>
</tr>
<tr>
<td>Work of breathing (count to 10)</td>
<td>Speaks in sentences, coos and babbles</td>
<td>Speaks in partial sentences, short cry</td>
<td>Speaks in single words/short phrases, grunting</td>
</tr>
<tr>
<td>Auscultation</td>
<td>Normal breath sounds to end-expiratory wheezes only</td>
<td>Expiratory wheezing</td>
<td>Inspiratory and expiratory wheezing to diminished breath sounds</td>
</tr>
</tbody>
</table>
CONCLUSIONS

**Essential:**
- β-agonists via continuous nebulization
- Intermittent anticholinergic therapy
- Early intravenous corticosteroids
- Intravenous magnesium sulfate [2-4 grams]

**Limited evidence:**
- Heliox
- Dissociative-dose ketamine in non-intubated patient
- Ketamine in intubated patient

**Strongly Consider:**
- SQ/IM/IV epinephrine or terbutaline
- Non-invasive ventilation
- Attentive airway management

**No Proven Benefit:**
- Adding inhaled to systemic steroids
- Aminophylline
QUESTIONS???

Dani the asthmatic Muppet