Respiratory Distress beyond the Neonate

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What is the biggest killer of children >1mo & under 5yo worldwide?

1. Diarrhea
2. Respiratory Illnesses
3. HIV/AIDS
4. Measles
The causes of death of children under five, 2000–2003

Under-5 causes of death

- Acute respiratory infections: 19%
- Malaria: 8%
- Measles: 4%
- Diarrhoeal diseases (post-neonatal): 17%
- HIV/AIDS: 3%
- Injuries: 3%
- Others, including noncommunicable diseases: 10%

Neonatal causes of death

- Neonatal causes: 37%
- Other neonatal: 7%
- Neonatal tetanus: 7%
- Preterm birth: 28%
- Congenital anomalies: 8%
- Diarrhoeal diseases: 3%
- Birth asphyxia: 23%
- Severe infections: 26%

*a* Totals are more than 100% due to rounding.
Pediatric Cardiopulmonary Arrests

- 1° Respiratory: 10%
- Shock: 10%
- 1° Cardiac: 80%
Acute Respiratory Emergencies

- Common in infants/children
- If not properly treated can have significant M&M
- Practitioner MUST appreciate unique anatomic & physiologic characteristics of growing infant/child
- Ability to accurately access child in respiratory distress CRITICAL!
Airway positioning children <2yrs
Airway Positioning $\geq 2$ yo

“Sniffing Position”
In the child older than 2 years

Towel is placed under the head
Nasopharyngeal Airway

Contraindications:
- Basilar skull fracture
- CSF leak
- Coagulopathy

Length: Nostril to Tragus
Endotracheal tube as nasal airway

A regular ETT can be cut and used as a nasal airway
Adjuncts: Oral Airways

A. Incorrect
B. Correct
C. Too long
D. Too short

Not for use in AWAKE patient
Always evaluate for signs of respiratory distress

- Tachypnea—often 1st sign esp. in infants
- Seesawing or abdominal breathing
- Head bobbing
- ↑ respiratory effort—retractions, flaring
  - Retraction w/stridor or snoring ≈ upper airway obstruction
  - Retractions w/expiratory wheezing ≈ lower airway
  - Retractions w/grunting & ↑RR ≈ lung tissue disease
First sign of respiratory distress in most children

1. Retractions
2. Tachypnea
3. Oxygen requirement
4. Tachycardia
Tachypnea

- Most common response of child to \( \uparrow \) respiratory needs
- Most common due to hypoxia & hypercarbia
- May also be due to metabolic acidosis, pain, anxiety, or CNS insult
## Normal Resting Respiratory Rates (infants/children)

<table>
<thead>
<tr>
<th>AGE</th>
<th>RATES (breathes/ min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>30-60</td>
</tr>
<tr>
<td>Infant (1-6mo)</td>
<td>30-50</td>
</tr>
<tr>
<td>Infant (6-12mo)</td>
<td>24-46</td>
</tr>
<tr>
<td>1-4 yrs.</td>
<td>20-30</td>
</tr>
<tr>
<td>4-6 yrs.</td>
<td>20-25</td>
</tr>
<tr>
<td>6-12 yrs.</td>
<td>16-20</td>
</tr>
<tr>
<td>&gt;12 yrs.</td>
<td>12-16</td>
</tr>
</tbody>
</table>
• Adept at recruitment of accessory muscles—manifest by retractions & nasal flaring
• Grunting—closure of glottis at end expiration generating PEEP = sign of lower airway ds & an ominous sign
Allow position of comfort!!!

- **Position of comfort** - most adequate anatomic compensation relative to disease state
- **Sniffing position** - upright, lean forward, generate their own jaw thrust to open upper airway (epiglottitis)
- **Tripoding position** - upright, lean forward, support upper thorax by use of extended arms (asthma & lower airway ds)
- **Open mouth** - suggests dysphagia in presence of air hunger
Provide oxygen whenever possible

- **Cyanosis**
  - Ominous- represent either
    - Inadequate oxygenation w/in pulmonary bed OR
    - Inadequate oxygen delivery by CV system

- **Signs of cyanosis**
  - Infant=agitation, irritability, and failure to feed
  - Child=somnolence esp. if hypercarbia as well
What % oxygen does a premature neonate get from 1L per nasal canula

1. 30%
2. 25%
3. 50%
4. >60%
Oxygen Therapy

In an adult 1L flow ≈ 24% FIO2
↑FIO2 by 4% for every 1L flow up to 6 L flow (2L ≈ 28%)

Nasal (neonate) Cannula Conversion
(Gomella-Lange)

<table>
<thead>
<tr>
<th>Flow rate</th>
<th>FIO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 L</td>
<td>34%</td>
</tr>
<tr>
<td>1/2 L</td>
<td>44%</td>
</tr>
<tr>
<td>3/4 L</td>
<td>60%</td>
</tr>
<tr>
<td>1 L</td>
<td>66%</td>
</tr>
</tbody>
</table>

- Oxygen concentrators work best with nasal cannula’s.
## Oxygen Delivery Techniques cont.

<table>
<thead>
<tr>
<th>Device</th>
<th>Flow (L/ min)</th>
<th>% Oxygen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple face mask</td>
<td>6-10</td>
<td>35-60</td>
</tr>
<tr>
<td>Face tent</td>
<td>10-15</td>
<td>35-40</td>
</tr>
<tr>
<td>Venturi mask</td>
<td>4-10</td>
<td>25-60</td>
</tr>
<tr>
<td>Partial rebreathing mask</td>
<td>10-12</td>
<td>50-60</td>
</tr>
<tr>
<td>Oxyhood</td>
<td>10-15</td>
<td>80-90</td>
</tr>
<tr>
<td>Nonrebreather mask</td>
<td>10-12</td>
<td>90-95</td>
</tr>
</tbody>
</table>
Impending Respiratory Failure

- Reduced air entry
- Severe work
- Cyanosis despite $O_2$
- Irregular breathing / apnea
- Altered Consciousness
- Diaphoresis
Teach PPV well before considering teaching intubation.
If considering intubation have a plan of what to do.
If no ventilator available.
Figure 8. One-handed face mask application technique.
Figure 9. Two-rescuer bag-mask ventilation technique may provide more effective ventilation than one-rescuer ventilation when there is significant airway obstruction or poor lung compliance. One rescuer uses both hands to open the airway and maintain a tight mask-to-face seal while the other rescuer compresses the ventilation bag.
Trouble Shooting Ineffective Ventilation: IF chest not rising and/or patient still blue/cyanotic

- Reposition airway
- Verify appropriate mask size & ensure tight seal on face avoiding eyes
- Suction if needed
- Check oxygen source
- Check bag & mask
- Insert ngt or suction stomach if gastric distention
Acute Upper Airway Obstruction

- Main causes include: viral croup, allergic (recurrent croup), foreign body, retropharyngeal abscess, epiglottitis
- Main features of AUAO is stridor
- Diagnosis based on the history and specific feature of each cause
- Treatment is specific for each cause including antibiotics, steroids, intubation, tracheostomy and surgery
- Supportive care include oxygen, airway positioning and humidification
*Croup Treatment*

- **Racemic Epi:** ≤4yo=0.05ml/kg up to max of 0.5ml Q1-2 hours >4yo 0.5ml q3-4 hours
- **Epinephrine:** 0.5ml/kg of 1:1000 solution diluted in 3ml of NSS (max dose ≤4yo=2.5ml/dose; max dose >4yo=5ml/dose)
<table>
<thead>
<tr>
<th>Age</th>
<th>Bacterial Pathogen</th>
<th>Empiric Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1mo</td>
<td>Group B strep, E. Coli, Klebsiella, Pseudomonas, Listeria</td>
<td>Amp + Aminoglycoside OR Amp + Cefotaxime</td>
</tr>
<tr>
<td>1-3mo</td>
<td>H. influ, S. pneumonia, Grp A or B strep, pertussis</td>
<td>Amp + Cefotax</td>
</tr>
<tr>
<td>3mo- 5 yrs.</td>
<td>S. pneumonia, H. influ, Staph aureus, Grp A Strep, pertussis</td>
<td>Cephalosporin + anti-Staph if indicated or pertussis coverage</td>
</tr>
<tr>
<td>&gt;5yo</td>
<td>S. pneumonia, H. influ, Grp A Strep</td>
<td>PCN OR Amp OR Cephalosporin + anti-Staph if indicated or pertussis coverage</td>
</tr>
</tbody>
</table>
Musts to Diagnosis Pneumonia

1. CXR
2. Stethoscope
3. Respiratory Rate
4. Fever, cough
5. 3 & 4
6. All of the above
• Studies have shown doctors, labs, and X-ray’s are not required to drastically reduce mortality due to pneumonia.

• Many lives have been saved by training village health workers to:
  - Count respiratory rates.
  - To administer oral antibiotics for children whose fevers and coughs w/ tachypnea.
Bronchiolitis

- Cough, URI
- Low grade fever
- Apnea in neonate
- Crackles
- Air trapping
- Appropriate to trial bronchodilators but only continue if helps
- Antibiotics NOT indicated or helpful!!
• **Asthma** is primarily an inflammatory disease

![Venn diagram of Asthma factors: Smooth muscle spasm, Airway edema, Mucous plugging]
Needed to Treat Asthma

1. Steroids
2. Spacer for MDI
3. β2 agonist
4. 1 & 3
5. All of the above
Lung Mechanics

- **Hyperinflation**
  - Obstructed small airways cause premature airway closure, leading to air trapping and hyperinflation

- **Hypoxemia**
  - Inhomogeneous distribution of affected areas results in V/Q mismatch, mostly shunt
Assessment

• Findings consistent with impending respiratory failure:
  - Altered level of consciousness
  - Inability to speak
  - Absent breath sounds
  - Central cyanosis
  - Diaphoresis
  - Inability to lie down
  - Marked pulsus paradoxus
Oxygen

- Deliver high flow oxygen, as severe asthma causes V/Q mismatch (shunt)

- Oxygen will not suppress respiratory drive in children with asthma

Fluid

- Judicious use of IV fluid necessary
  - Most asthmatics are dehydrated on presentations - rehydrate to euvoolemia
  - Overhydration may lead to pulmonary edema
  - SIADH may be common in severe asthma

**β-Agonists**

β-receptor agonists stimulate β2-receptors on bronchial smooth muscle and mediate muscle relaxation.

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<thead>
<tr>
<th></th>
<th>Significant β1 cardiovascular effects</th>
<th>Relatively selective β2 effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epinephrine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albuterol/Salbutamol</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terbutaline</td>
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</tr>
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</table>
Metered Dose Inhalers (MDI’s)

- In pts w/ coordinated hand-breathing motion albuterol delivered by MDI with spacer 4-8 puffs every 20 minutes for 3 doses compares favorably w/ nebs 2.5-5mg q 20 minutes
- In pts w/ more severe asthma MDI dosing can be increased to 1 puff q 30-60 seconds

Home-made spacer for bronchodilator therapy in children with acute asthma: randomized trial”
Zar et al Lancet 1999;354:979-82

- **Interpretation**
  - Conventional spacer and sealed 500 ml plastic bottle produced similar bronchodilation
  - Unsealed bottle gave intermediate improvement
  - Polystyrene cup was least effective as a spacer

- **Use of bottle spacers should be incorporated into guidelines for asthma management in developing countries.**

Sealed spacers
- Take 500 ml plastic cold drink bottles
- Cut hole in base to fit size and shape of MDI
- Seal bottle-MDI perimeter w/ glue
- Use opposite end as mouthpiece
Other routes of β agonist

- **Terbutaline** can be given subQ in doses of 0.005-0.01mg/kg (maximum 0.4mg/kg/dose) every 20 minutes × 3 dose (0.01ml/kg of 1mg/cc drug)


- **Epinephrine** SQ may help avoid need for mechanical ventilation in pts w/ status asthmaticus.
  - SQ dose is 0.01cc/kg 1/1000 up to a maximum of 0.5cc every 15-20 minutes × 3-4 doses or Q4hrs prn (max in adults is 0.3cc)
Steroids

- Asthma is an inflammatory disease
- Steroids are a mandatory element of first line therapy regimen (few exceptions only)

Effect of i.v. hydrocortisone vs placebo

Anticholinergics

- Change in FEV$_1$ is significantly greater when ipratropium was added to β-agonists (199 adults)

- Highly significant improvement in pulmonary function when ipratropium was added to albuterol (128 children). Sickest asthmatics experienced greatest improvement
Ipratropium

- Nebulize 250 - 500 \( \mu g \) every 6 hours

Atropine

- Alternative to Ipratropium bromide
- Dose: 0.03-0.05mg/kg/dose
  - (max 2.5mg/dose q 6-8 hours)
- Atropine comes in many different strengths so ✓ yours
Theophylline

- Role in children with severe asthma remains controversial
- Narrow therapeutic range
- High risk of serious adverse effects
- Mechanism of effect in asthma remains unclear
May have a role in selected, critically ill children with asthma unresponsive to conventional therapy:

- Randomized, placebo-controlled, blinded trial (n=163) in children with severe status asthmaticus
- Theophylline group had greater improvement in PFTs and O₂ saturation
- No difference in length of PICU stay
- Theophylline group had significantly more N/V

- Yung M. Arch Dis Child 1998;79(5):405-10
Theophylline another point of view….

- Theophylline when added to continuous nebulized albuterol therapy and IV corticosteroids, is as effective as terbutaline in treating critically ill children…More cost effective…Theophylline should be considered early in the management of critically ill asthmatic children”

Magnesium

- Smooth-muscle relaxation by inhibition of calcium uptake (=bronchodilator)
- Dosage recommendation: 25 - 75 mg/kg i.v. over 20 minutes (May use drip of 25 mg/kg/hour and titrate attempting to maintain magnesium levels of 4-6 mg/dL or if in the developing world maintaining knee jerks—if knee jerk present should not have toxic magnesium levels)
- May be particularly beneficial in pts who are prone to ↓Mg because of prolonged heavy use of Beta 2 agonists
ALL Wheezing NOT Asthma

- Think other dx when treatment fails
- Bronchiolitis or other infection
- Foreign-body aspiration
- Tracheomalacia
- Congenital heart or lung disease
- Pulmonary embolism
- CHF
- Vocal cord dysfunction
- Other forms of extra-thoracic airway obstruction (such as vascular ring or papiloma)

The END
Thank You!