Respiratory Emergencies in Children

Ghazala Sharieff, MD
PEDIATRIC RESPIRATORY EMERGENCIES

Ghazala Q. Sharieff MD, MBA

NORMAL RESPIRATORY RATES

<table>
<thead>
<tr>
<th>AGE</th>
<th>RESPIRATORY RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEWBORN</td>
<td>30-60 BPM</td>
</tr>
<tr>
<td>6 MONTHS</td>
<td>25-40</td>
</tr>
<tr>
<td>1-3 YEARS</td>
<td>20-30</td>
</tr>
<tr>
<td>6 YEARS</td>
<td>18-25</td>
</tr>
<tr>
<td>10 YEARS</td>
<td>15-20</td>
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</tbody>
</table>

YOU’D NEVER USE A PEDIATRIC MASK ON AN ADULT, WHY DO WE ACCEPT THIS?
UPPER RESPIRATORY EMERGENCIES

CROUP

Age: 6 months-3 years highest attack rate
Etiology: Parainfluenza A most common
- RSV, Adenovirus, Influenza A

Symptoms
- 1-3 day history of URI
- Hoarse voice and barking cough
- Fever
- Stridor: if severe inspiratory and expiratory

CROUP

RADIOGRAPHIC FINDINGS

Lateral neck film:
- Hypopharynx overdistension
- Subglottic narrowing
- Irregular and thickened vocal cords
- Normal epiglottis

Frontal (AP) neck film:
- Classic "steeple sign" in subglottic region
CLINICAL CROUP SCORE

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOC</td>
<td>Normal</td>
<td>Restless</td>
<td>Restless</td>
<td>Lethargic</td>
</tr>
<tr>
<td>Stridor</td>
<td>None</td>
<td>When agitated</td>
<td>Mild</td>
<td>Severe</td>
</tr>
<tr>
<td>Air entry</td>
<td>Normal</td>
<td>Mild delay</td>
<td>Moderate</td>
<td>Poor</td>
</tr>
<tr>
<td>Flaring/Retractions</td>
<td>None</td>
<td>Mild</td>
<td>Moderate</td>
<td>Severe</td>
</tr>
<tr>
<td>Color</td>
<td>Normal</td>
<td>Cyanotic</td>
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</tr>
</tbody>
</table>

CROUP TREATMENT

- Cool Mist Humidification
- Racemic Epinephrine
  - 0.25cc of a 2.25% solution in 2cc NS: age <6 mths
  - 0.5cc of a 2.25% solution in 2cc NS: older children
  - Observe for 2-3 hours after administration
- Steroids: Dexamethasone versus inhaled budesonide
  - Dexamethasone Dose: 0.15 - 0.6mg/kg IM/PO/IV
  - 25X more potent than hydrocortisone
  - Long biological half-life—up to 54 hours
  - Should be given to all pts who receive epinephrine
**ORAL VERSUS IM STEROIDS**

DONALDSON D ETAL ACAD EMERG MED 2003

- Prospective trial of 96 pts 3-84 months of age with moderate to severe croup
- Pts received: 0.6 mg/kg of either oral dexamethasone with direct pressure on their thigh or IM dexamethasone + oral placebo
- Phone follow-up obtained 1 and 10 days after visit.
- No difference between groups for proportion of pts with stridor, expiratory sounds, barky cough, sleep patterns, complete resolution of symptoms

**Authors conclude that there is no statistical difference between IM and PO dexamethasone and that the PO form is effective and safe for outpatient management**

Problem with liquid Dexamethasone is that it is not concentrated and comes as 1mg/1cc (IV form is 4mg/1cc)

Use the IV form orally

Crush the 4mg tablet

**MILD CROUP & STEROIDS?**

GEELHOED GC ET AL, BMJ, L996

- 100 pts age 4-122 months with mild croup randomized to receive placebo or a single oral dose of 0.15mg/kg of Dexamethasone
- 8 children from placebo group returned, one was admitted
- Conclusion was that 0.15mg/kg of po Dexamethasone is effective in reducing return to medical care in pts with mild croup
DOSE OF DEX?
DOBROVOLJAC M. EMERG MED AUSTRALASIA 2009

- Previous 1980-1995 study: 0.15mg/kg effective
- 1995: mandatory 0.15mg/kg dex implemented
- Croup visits to the ED stayed the same
- Overall and ICU admission rates declined
- LOS declined
- No sig diff in re-admission rate
- CONCLUSION: 0.15mg/kg is effective in pts with mild to moderate croup

MIST AND CROUP?
NETO G ETAL. ACAD EMERG MED 2002

- 71 Pts 3 months- 6 years of age were enrolled with moderate croup (median croup score of 4)
- Pts received mist or no mist in the ED
- Additional therapy-racemic epi, inhaled budesonide given per treating physician
- Croup scores were measured every 30 minutes for up to 2 hours, HR, RR, O2 sat and patient comfort scores were recorded
- No difference between groups

Inpatient RX after RE
Rudinsky S, Sharieff G etal JEM 201

- 200 subjects admitted after ≥ 2 ED RE doses, 72 (36%) received clinically important inpatient interventions: RE (n = 68 [34%]), heliox (n = 9 [5%]), and supplemental oxygen (n = 4 [2%]).
- Of patients who received inpatient RE, 53% received only 1 dose. No patients underwent intubation or transfer to higher level of care.
INPATIENT RX AFTER RE
RUDINSKY S, SHARIEFF G ETAL JEM 2015

* 112 asymptomatic patients had fewer interventions (14% vs. 63%; \( p < 0.001 \))
* Shorter hospital durations (14.5 vs. 22 h; \( p < 0.001 \))
* Only 14% of the asymptomatic group received RE, with 75% receiving a single dose.
* There were no differences in revisit and readmission rates

CONCLUSIONS
RUDINSKY S, SHARIEFF G ETAL JEM 2015

* Inpatient interventions after \( \geq 2 \) ED doses of RE for croup were infrequent, most commonly RE administration.
* Most patients asymptomatic upon admission require 0–1 inpatient RE doses and may be candidates for outpatient management.

CROUP
WHO TO ADMIT?

* Stridor at rest, despite intervention
* Incomplete response to intervention
* Multiple doses of racemic epinephrine
* Persistent respiratory distress
* Poor social situation
* Inability to tolerate po fluids
PERTUSSIS - IT IS BACK!

- Catarrhal stage: 1-2 weeks
- Paroxysmal stage
  - Babies may not whoop
  - Subconjunctival and intracranial hemorrhage
  - Apnea
- Convalescent stage
- Transmission is via aerosolized droplets
- Incubation time 7-10 days
- Consider this dx in pts with cough that lasts longer than 2 weeks

LOWER RESPIRATORY EMERGENCIES

ASTHMA
RISK FACTORS FOR MORTALITY

- History of previous intubations
- Two or more hospitalizations for asthma in last year
- Three or more ED visits for asthma in last year
- ED visit or hospitalization in past month
- Systemic steroid use

ASTHMA TREATMENT

- ABC’s
- Beta-agonists are the cornerstone - MDI?
- Steroids - 2mg/kg of predone, prednisone, or methylprednisolone
- Anticholinergics - ipratropium bromide
- IM - 0.01cc/kg of 1:1000, max 0.3cc. Consider 1/10 of the code dose of 1:10,000 epinephrine IV
- Terbutaline and magnesium sulfate

MDI WITH Spacer VERSUS NEBULIZER?
LEVERSHA A ET AL. J PEDS, 2000

Randomized, double blind study
60 pts 1-4yrs old, 30 received MDI 600ug with spacer, 30 received 2.5mg nebulized albuterol q20” X 6
Clinical score, HR, RR, wheezing & O2 sats recorded
Spacer had less tachycardia, greater reduction in wheezing, lower admission rates 33% VS 40%
AEROSOL THERAPY AND THE FIGHTING TODDLER: IS ADMINISTRATION DURING SLEEP AN ALTERNATIVE?

- Insufficient cooperation can be a problem in up to 50% of treated children younger than 2 years old.
- When children are crying very little aerosol deposits in the lower airway (.35% nominal dose).
- In vitro study of dose reaching the “lung” from MDI + Spacer in an anatomically correct upper airway model of an infant.
  - Breathing pattern awake and asleep.

Aerosol delivery is 74% greater to a sleeping infant.

ASTHMA CONTINUOUS NEBS?

* In the sick child, do not need to give three treatments q 20 minutes.
* Start continuous therapy with 0.5mg/kg/hr to a maximum of 30 mg total.
**ASTHMA TREATMENT**

- Terbutaline IV
  - 10 ug/kg bolus, then 0.4-10 ug/kg/min
- Magnesium
  - 50-75mg/kg over 20 minutes
  - maximum 2-4 grams
- Heliox - pt must not have high O2 req!
- Intubate with ketamine - 1 mg/kg IV

**BIPAP IN CHILDREN?**

- Nasal BiPAP was used
- Inspired positive airway pressure: 10 cm H2O
- Expired positive pressure: 5 cm H2O
- Inspiratory pressure is adjusted to achieve an end-tidal volume of 6-9 ml/kg
- Only 2/83 pts required intubation. 57/73 went to ICU, 16 weaned off BiPAP in ED and went to the ward

**DEXAMETHASONE VS PREDNISONE?**

- 533 pts between 2 and 18 years of age prospectively enrolled, off-even day randomized trial of patients who required a second dose of albuterol
- Pts either received prednisone 2mg/kg with 4 additional daily doses or Dexamethasone 0.6mg/kg (max 16 mg) in ED and one additional dose to take the next day
- Primary outcome measure was relapse at 10 days
DEXAMETHASONE VS PREDNISONE?
QURESHI F ET AL. J Peds 2001
• 7.4% of 272 patients who received Dexamethasone and 6.9% of 261 patients in the prednisone group relapsed
• Pts who received prednisone had more vomiting, more pts missed ≥ 2 days of school, and more parents missed work
• Authors conclude that dexamethasone has similar efficacy to oral prednisone with greater compliance and less side-effects

DEXAMETHASONE VS PREDNISONE?
QURESHI F ET AL. J Peds 2001
• Not a blinded trial since it is an odd-even day study
• Staff bias as to enrollment in study
• Dexamethasone has a half-life of 36–52 hours, so why not dose it on day three instead?
• Oral Dexamethasone is not concentrated and comes as 1mg/kg
• Orapred tastes like grapes - ? Better compliance with this new formulary

ASTHMA AND STEROIDS
ALTAMIMI. Peds Emerg Care 2006
• Canadian kids 2-16yo, acute episode of mild-mod
• All received salbutamol q 20 mins x 3
• Dex 0.6mg/kg (max 18mg) x 1 then placebo BID or Prednisone 1mg/kg (max 30mg) then BID x 5 days
• Mean time to discharge: Dex 3.5h vs Pred 4.3h
• Admission rate: Dex 9% vs Pred 13.4%
• No diff in # beta-agonist treatments
• Admit rate by day 5: Dex 4.9% vs Pred 1.8%
• Overall admit rate: Dex 14% vs Pred 15%
### IM Dexamethasone for Asthma

**Gordon et al. PEM Care 2007**

- 88 pts 18 months-7 years of age
- Randomized to receive single dose of 0.6mg/kg IM dexamethasone or oral prednisolone 2mg/kg for 5 days
- The primary outcome measure was change in asthma score from ED visit on 4-day follow up

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Interventions</th>
<th>Primary Outcome Measure</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>IM Dexamethasone for Asthma</td>
<td>88 pts 18 months-7 yrs</td>
<td>Single dose 0.6mg/kg IM vs oral 2mg/kg</td>
<td>Change in asthma score</td>
<td>Mean change in total asthma score: 3.6 in dexamethasone vs 3.4 in prednisolone</td>
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<td>5.9% of dexamethasone group admitted within 2-weeks vs 4.1% prednisolone group</td>
</tr>
</tbody>
</table>

### Asthma and Steroids

**Chang Med J Australia Sept 2008**

- 201 kids, mean age 5 yrs
- Randomized to 5 days prednisolone (1mg/kg) vs 3 days prednisolone + 2 days placebo
- 82% followed up
- No diff in % kids symptom-free by day #7
- Admits: 3day – 1
- Additional prednisolone: 3day 8% vs 5 day 5%
- Adverse events: 3day 3 vs 5day 2 (behavioral)
- Similar results for mild, moderate, severe
Review of randomized controlled studies in children with acute asthma

When given in repeated doses, the addition of inhaled anticholinergic agents to beta(2)-agonists improves lung function and reduces the risk of hospital admission by 25%.

Several treatment regimens, namely ipratropium bromide (250 or 500 microg per dose) every 20-60 minutes for two to three doses have been tested with similar beneficial effects.

The addition of a single dose of an inhaled anticholinergic agent to beta(2)-agonists improves lung function but does not prevent hospital admission.

Levalbuterol added as a short-acting b-agonist option

For acute exacerbations, doubling the ICS dose is not recommended

If necessary, 4X ICS for 7 days for pts intolerant of PO

Consideration of adding ICS upon ED discharge

Hospital management-ipratropium no longer recommended

Steroids decreased to 0.5mg/kg BID

The leukotriene receptor antagonists have been shown to be effective in preventing bronchospasm due to cold air and allergens.
ASTHMA
WHO TO ADMIT
• Persistent O2 requirement
• Normal blood gas or acidosis
• Poor response to interventions
• Concurrent pneumonia
• Low threshold if previous intubations
• Inability to tolerate po fluids
• Poor social situation

BRONCHIOLITIS
• Age peak: 2-6 months, up to 2 years
• Winter and spring predominance
• 90% of cases are due to RSV
• 75% of admissions are due to RSV
SIGNS & SYMPTOMS OF BRONCHIOLITIS

- Wheezing
- Retractions
- Rales
- Apnea – especially if < 3 months of age
- Hyper- or hypoventilation
- Cyanosis
- Downward displacement of diaphragm

BRONCHIOLITIS - APNEA
WILLWERTH. ANNALS EMERG MED 2006

- 5 year retrospective study, 1995-2000
- 691 infants <6mo, dx with bronchiolitis and admitted
- Apriori set of risk factors
  - Full term and less than 1 month old
  - Premature (<37 weeks) and now <48 weeks post-conception
  - Witnessed apnea
  - Identified all 19 cases (2.7%)
STEROIDS AND BRONCHIOLITIS?

**CORNELI HM. NEJM 2007**

- 600 children aged 2-12 months of age with a first episode of wheezing received 1mg/kg of dexamethasone vs placebo for moderate to severe bronchiolitis.
- November-April enrollment over a three year period.
- Primary outcome measure was hospital admission after 4 hours of ED observation. Secondary outcome measure was the RACS-respiratory assessment change score.

- Admission rates: 39.7% for dexamethasone group vs 41.0% in control group. Mean 4-hour RACS score was -5.3 in dexamethasone group vs -4.8 for placebo group.
- Steroid use made no difference in outcome even with strong family history of asthma or atopy.

**BRONCHIOLITIS TREATMENT**

- Rhinoprobe can identify up to 75%
- Humidified oxygen
- Deep suctioning
- Trial of Beta-agonist
- Adequate hydration
- Racemic epinephrine
- Heliox
- Hypertonic saline—some studies show decreased LOS
BRONCHIOLITIS CLINICAL CHARACTERISTICS ASSOCIATED WITH HOSPITALIZATION
Corneli, H et. al. Peds Emerg Care Feb 2012

- Analysis of randomized trial of 20 EDs in PECARN involving 598 infants
- Predictors of hospitalization:
  - Initial O2 sat < 94% (best indicator)
  - RR>60
  - Resp distress instrument score > 11

RESPIRATORY DISTRESS ASSESSMENT INSTRUMENT

PREDICTING SAFE DISCHARGES FROM THE ED
MANSBACH J. PEDS 2008

- 2 consecutive bronchiolitis seasons, from 2004 to 2006.
- All patients were <2 years of age
- RESULTS. Of 1436 enrolled patients, 837 (57%) were discharged home from the emergency department.
The following factors predicted safe discharge to home:

- Age of >2 months
- No history of intubation
- A history of eczema
- Age-specific respiratory rates:
  - >45 breaths per minute for 0-1.9 months
  - <43 breaths per minute for 2-5.9 months
  - <40 breaths per minute for 6-23.9 months
- No/mild retractions
- Initial oxygen saturation of 94%
- Fewer albuterol or epinephrine treatments in the first hour, and adequate oral intake.

**Bronchiolitis**

**Who to admit**

- Persistent O2 requirement
- RR >60
- Inability to tolerate fluids
- History suggestive of apnea
- Poor social situation

**Take Home Points**

- Low dose dexamethasone effective for mild to moderate croup
- Be aggressive with albuterol/atrovent
- Consider dexamethasone for asthma
- No routine steroids for bronchiolitis