Respiratory Distress During RSV Season

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Disclosure:

• Carroll King, MD, FAAP has nothing to disclose.
Objectives

At the end of this educational activity, participants should be able to:

1. Review key points of the AAP’s Clinical Practice Guidelines on RSV in the care of children.
2. Discuss the physiology of respiratory distress and the unique anatomic features which impact the course of acute respiratory distress in pediatric patients.
3. Recognize signs of impending respiratory failure and utilize strategies for invasive and noninvasive respiratory support in children.

Epidemiology

• By the age of two years, more than 90% of children will have had RSV.

• For most it will be a mild to moderate infection not requiring hospitalization.

• But RSV bronchiolitis accounts for well over 120,000 hospitalizations per year in the pediatric age groups.
**FIGURE**

RSV is the leading cause of hospitalization of infants aged 1 year or younger

![Graph showing hospitalization rates for various respiratory conditions](image)

Source: McLaurin 2005

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**Second Figure**

![Graph showing the number of infections from different viruses](image)

Number of infections

Specimen year

2004 2005 2006 2007 2008 2009

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Note: The images are placeholders for the actual graphs. The titles of the graphs and the data they present are examples meant to illustrate the structure of the figure captions.
Mortality

• In the past decade, there have been about 250-270 pediatric deaths per year from RSV.

• 94% of the deaths are among infants <1 year.

• In infants that’s ~ 5.5 deaths /100,000 person years.

• Children 1-4 ~ 0.02 deaths/ 100,000 person years

Seasonality

• Throughout the US, RSV season is generally thought to be from November through March and to peak in January or February.

• But...there are regional and climatic variations

• AND last year.... the presence of H1N1 appeared to affect the penetrance and prognosis of RSV
Regional Variations

• We think of RSV as a cold weather phenomenon and that the season goes on forever.

• BUT...
  – Earliest onset and longest season  SOUTH
  – Latest onset and shortest season  MIDWEST

What about the WEST

• A study done at Denver Children’s
  – 1/3 of Colorado communities have a season which is less than 5 months.
  – 1/3 of Colorado communities have a season which is greater than 7 months.

  – MAYBE THE RESULT OF DIFFERENCES IN TEMPERATURE HUMIDITY RELATIONSHIPS
AAP Clinical Guidelines

• Review of the existing research

• Advise on what has been proven, suggested by research or remains unproven.

• Subject to the clinical judgment of treating team

Recommendations

• Clinical diagnosis
• Bronchodilator Use
• Corticosteroid Use
• Ribavirin Use
• Antibiotic Use
• Fluids and Chest Physiotherapy
• Supplemental O2 and pulse ox.
• Palavizumab prophylaxis
• Hand washing
• Tobacco exposure and breast feeding
• CAM
RSV is a Clinical Diagnosis

**History**
- Risk factors for severe disease
  - Prematurity
  - Underlying immune deficit
  - Significant cardio pulmonary disease
  - Chronic lung disease
- Establish ill contacts and prodrome
- Time course
  - Symptoms peak at 3-4 days

**Physical**
- Rhinorrhea, tachypnea, wheeze, increased respiratory effort.
- Tachypnea
  - The lack of tachypnea for age is highly suggestive that LRTI is absent or mild
- Signs of physical stress

Lab Tests and CXR

- CBC ?.....not helpful
- Electrolytes?...not helpful in well-hydrated
- Viral panel or RSV? ....confirms diagnosis
  - May have some utility in determining cohorting
  - NOT useful for determining isolation
- CXR?...probably not useful
  - One study suggests a positive CXR may predict severity.
  - Another study suggests kids are more likely to get ABX with no change in length of symptoms
Bronchodilators

• Not recommended routinely.

• BUT.... Clinical experience suggests that for some kids these may reduce work of breathing.

• SO

Bronchodilator TRIALS

• Time and/or dose limited

• Assessment before and after treatment

• Agents
  – Some evidence that racemic Epi is better than albuterol
  – No evidence that either is effective
Corticosteroids

• Cochrane Analysis
  – No benefit in terms of clinical score
  – No benefit in terms of LOS
  – For outpatients, no effect on hospitalization rate

Ribiviran

• Why not?
  – High cost
  – Risk to health care workers
  – Insanely cumbersome delivery system makes it unavailable to the sickest kids.
  – It makes many kids wheeze
  – Studies are few, small and mostly show no benefit
    • 4 of 11 studying acute RSV showed minor benefits
    • 1 of 4 studying long-term outcome showed fewer episodes of wheezing in year following... not beyond
Additional Treatments

• Chest Physiotherapy
  – RSV bronchiolitis is characterized by increased mucus production, increased insensible fluid loss and sloughing of airway epithelium, all of which may contribute to plugging.
  – Cochrane Review found 3 RCTs looking at CPT in bronchiolitis with no benefit found for percussion or vibratory CPT.
  – Nasal suctioning provided transient symptomatic relief; there is no justification for deep suctioning in the un-intubated patient.

Additional Treatments

• IV Fluids
  – An assessment of hydration status and ability to take oral fluids should be done on any patient suspected of bronchiolitis.
  – If respiratory rate 60-70 bpm, the ability to feed may be compromised, especially if nasal secretions are copious.
  – Increased risk of aspiration
  – Increased ADH secretion in known to be present in bronchiolitis patients
Supplemental O2 and Pulse Ox

• Add O2 if sats persistently fall below 90%
  – In previously healthy patients
  – Who are NOT in increasing respiratory distress.

• May discontinue O2 if sats are above 90%
  – In patients with minimal respiratory distress
  – Who are feeding well

90% !!!!!!
Handwashing

- Most important step in prevention of nosocomial spread
- Alcohol based hand cleaners are preferred
- Use of gloves, as well as gowns for direct contact reduce spread
- Masks do not seem to impact spread
Handwashing

• RSV-RNA has been found in air samples as far away as 22 feet

• Viral particles on surfaces, (ie toys, bedrails) may remain viable for hours.

Treatment of respiratory failure

The critical period before the patient needs to be intubated

• Prevention
  • Incentive spirometry
  • Mobilization
  • Humidified air
  • Pain control
  • Turn, cough, deep breathe

• Treatment
  • Medications
    • Albuterol
    • Theophylline
    • Steroids
  • CPAP, BiPAP, IPPB
  • Intubation
After you’ve intubated

RELAX.....
Vent Settings to improve Oxygenation

• **FIO₂**
  • Simplest maneuver to quickly increase $P_aO_2$
  • Long-term toxicity at >60%
    • Inadequate oxygenation despite 100% FiO₂ usually due to pulmonary shunting

• **PEEP**
  • Collapse – Atelectasis
  • Pus-filled alveoli – Pneumonia
  • Water/Protein – ARDS
  • Water – CHF
  • Blood – Hemorrhage
Vent Settings To Improve Oxygenation

• **PEEP**
  • Increases FRC
  • Recruits collapsed alveoli and improves V/Q matching
  • Enables maintenance of adequate PaO2 at a safe FiO2 level

• **DISADVANTAGES**
  • Increases intrathoracic pressure
  • May lead to ARDS or pneumothorax

Vent settings to improve ventilation

• **Respiratory rate**
  • Max RR at 35 breaths/min
  • Efficiency of ventilation decreases with increasing RR
    • Decreased time for alveolar emptying

• **TV**
  • Goal of 6-8 ml/kg
  • Risk of volutrauma

• **Permissive hypercapnea**
What is non-invasive ventilation

• Modalities
  – Negative pressure: inspiration → lowers pressures surrounding chest wall, augments tidal volume, more physiologic
    • Iron lung
    • Cuirass
  – Positive pressure (NIPPV): generates positive pressure flow to meet need in spontaneously breathing patient
    • Current standard

CPAP and BiPAP

CPAP is essentially constant PEEP; BiPAP is CPAP plus PS

• Parameters
  • CPAP - PEEP set at 5-10 cm H2O
  • BiPAP - CPAP with Pressure Support (5-20 cm H2O)
  • Shown to reduce need for intubation and mortality in COPD pts

• Indications
  • When medical therapy fails (tachypnea, hypoxemia, respiratory acidosis)
  • Use in conjunction with bronchodilators, steroids, oral/parenteral steroids, antibiotics to prevent/delay intubation
  • Weaning protocols
  • Obstructive Sleep Apnea
Modes of Bi-PAP

- Spontaneous: response to threshold level of patient inspiratory flow to provide IPAP with extra flow, EPAP after peak
- Spontaneous/Timed: cycle added in event of apnea
- Timed: intermittent pulses at set rate only
- Continuous PAP (CPAP)

Problems with Bi-PAP

- Problems:
  - infant may have difficulty achieving sufficient inspiratory flow to trigger
  - Mask leak prolongs inflation time
Full Face Mask

Nasal Prong Devices
Interfaces for NIPPV

Nasal
- Advantages
  - Less aspiration risk
  - Easier secretion clearance
  - Less dead space
  - Easier fit in adults
- Disadvantages
  - Mouth leak
  - Higher resistance through nasal passages
  - Nasal irritation
  - Potential nasal obstruction
  - Fit in infants?

Oronasal
- Advantages
  - Better control of mouth leak
  - Better for mouth breathers
- Disadvantages
  - More dead space
  - Claustrophobia
  - Higher aspiration risk
  - More difficulty in speaking
  - Risk if vent malfunction
  - Greater sedation need in kids?

NIPPV: Potential Indications

- Cardiogenic pulmonary edema
- Hypercarbic respiratory failure/COPD
- Hypoxemic respiratory failure
- Peri-extubation
- Immunocompromised patients
- Asthma
NIPPV: Contraindications

– Significant altered mental status/inability to protect airway
– Hemoptysis
– Facial injuries
– NP obstruction
– Airway foreign bodies
– Significant cardiovascular instability
– Apnea

NIPPV: Potential Complications

– Acute unrecognized deterioration
– Nasal/facial erosions
– Aspiration
– Abdominal distention (GE sphincter pressure up to 25 cmH₂O)
NIPPV: What is the evidence for its benefit?

- Fifteen suitable randomized controlled trials for COPD
- Eight suitable RCTs in AHRF
- 2 major meta-analyses
- No pediatric RCTs

NIPPV Meta-Analysis: Effect on ICU Mortality in COPD

-- Significant mortality benefit with NIPPV for COPD
(Lightowler JV, et al., BMJ 2003;326:185)
Impact of NIPPV vs. Intubation on Nosocomial Pneumonia

- NPPV associated with decreased nosocomial pneumonia/infections

Why NIPPV Might Work Better in Children

- Immature chest wall more highly compliant
- Predicted FRC closer to total lung capacity
- Increased pharyngeal tone needed at expiration to maintain FRC
- Fewer fatigue-resistant muscle fiber types in infant diaphragm
- Prone to asynchrony of thorax and abdomen = retractions

Marginal increase in positive pressure support may be more helpful in child
NIPPV: Conclusions

- NIPPV offers potential benefits for:
  - Acute/chronic hypercarbic respiratory failure
  - Acute hypoxemic respiratory failure-less certain
  - Immuno-compromised host to avoid intubation
  - Post-extubation failure: high risk for deterioration

- Benefit of NIPPV in children
  - Anecdotal-hypercarbia/AHRF
  - Likely helps in selected cases to avoid intubation or re-intubation
  - We need a randomized study!

QUESTIONS??