AMERICAN COLLEGE OF EMERGENCY PHYSICIANS
SCIENTIFIC ASSEMBLY
1999

Pediatric Respiratory Emergencies: An Update

Respiratory emergencies are common and often life-threatening reasons for children to present to the emergency department. The lecturer will use case scenarios to illustrate new concepts in the pathophysiology of common pediatric respiratory emergencies, effective recognition of these entities and advances in management.

- Discuss the new concepts in pneumonia, bronchitis, bronchiolitis, asthma, croup, and epiglottitis.
- Determine the correct antimicrobial or other treatment modality.

TU-76
Tuesday, October 12, 1999
9:00 AM - 10:55 AM
Room # N223
Las Vegas Convention Center

FACULTY

Richard M Cantor, MD, FACEP

Associate Professor, Emergency Medicine/Pediatrics, University Hospital, SUNY Health Science Center, Syracuse, New York; Director, Pediatric Emergency Services and Medical Director, Central New York Poison Control Center

PEDIATRIC RESPIRATORY ILLNESS: CASE PRESENTATIONS AND POINTS FOR DISCUSSION

Richard M. Cantor, MD FAAP/FACEP
Associate Professor of Emergency Medicine and Pediatrics
Director, Pediatric Emergency Services
University Hospital
Syracuse, New York

1999 ACEP Scientific Assembly
Las Vegas

PATHOPHYSIOLOGY OF PEDIATRIC RESPIRATORY DISORDERS

UPPER AIRWAY CONSIDERATIONS

Small caliber in young infants, with markedly greater resistance
Obligate nasal breathers
Relative macroglossia
Flexible and compressible tracheal cartilage

LOWER AIRWAY CONSIDERATIONS

Small caliber, small numbers. less vascularity
Poor central respiratory control
Fatiguable diaphragm, compromise of tidal volume by gastric distention
Compliant chest wall

SIGNS OF RESPIRATORY DISTRESS

Tachypnea
Accessory muscle recruitment/ retractions (nasal flaring)
Grunting (self qenerated end expiratorv pressure)
Position of comfort (sniffing,tripoding)
Pulsus paradoxicus
Cyanosis (late finding)
Poor air entry in general

SIGNS OF IMPENDING RESPIRATORY FAILURE

Decreased LOC/fatigue
Increased work/rate (retractions grunting)
-Poor color, diaphoresis
Decreased air entry
Apnea
Acidosis, hypercapnia/hypoxemia

UPPER AIRWAY DISORDERS

CASE

A 4 year old child in good health develops a sore throat and fever. He has no appetite. Three hours later, he complains of trouble swallowing and has stridor. He is brought to the ED by his parents. He has vital signs as follows: respirations 3040, pulse 140, temperature 39.5C. He is anxious, sitting up, and drooling. You begin your care.

SIGNS OF RESPIRATORY DISTRESS IN THIS CHILD
- Stridor
- Tachypnea
- Tachycardia
- Anxiousness

What findings assist in differentiating between upper and lower respiratory disease?

SIGNS OF UPPER TRACT DISEASE
- Stridor
- Dysphagia
- Drooling

What are the differential diagnoses at this point?

CAUSES OF STRIDOR
- Peritonsillar abscess
- Retropharyngeal abscess
- Epiglottitis
- Foreign Body Obstruction
- Croup

FEATURES OF VARIOUS UPPER AIRWAY DISORDERS

DISEASE	AGE GROUP	CHARACTERISTICS
Severe tonsillitis	Late preschool or school age	Gradual
Peritonsillar abscess	Usually >8 yr	Sudden increase in temperature, toxicity and distress with unilateral throat pain, " hot potato speech"
Retropharyngeal abscess	Infancy to 3 yr	Fever, toxicity, and distress after preceding URI or pharyngitis
Epiglottitis	2-7 yr	Acute onset of hyperpyrexia, with distress, dysphagia, and drooling
Croup	3 months to 3 yr	Gradual onset of stridor, barking cough, after mild URI
Foreign body aspiration	Late infancy to 4yr	Choking episode resulting in immediate or delaved respiratory distress

What *immediate steps must be taken?*

ACCEPTABLE INTERVENTIONS
- Supplemental oxygen
- Position of comfort
- Prepare airway equipment
- Alert OR, anesthesiologist, and surgeon
- Move child to OR under careful supervision

UNACCEPTABLE INTERVENTIONS
- Upsetting the child
- Forcing he/she to lie down
- Vigorous oral exam
- Gagging with tongue blade
- Unattended periods (XRays)

What would you do if the patient suffers a respiratory arrest?

RECOMMENDED INTERVENTIONS
- Airway maneuvers
  - Chin lift
  - Jaw thrust
- Bag valve mask ventilation
- Down-sized endotracheal intubation

INPATIENT PRIORITIES IN EPIGLOTITTIS
- Controlled intubation and culture in the OR
- Blood cultures
- IV antibiotics effective vs. H. flu
- ICU admission

CASE

A 3 year old was in his usual state of good health when he developed a fever and a runny nose. He began to have a barking cough and his voice became hoarse. He also had decreased appetite, but would drink liquids. Several hours later, his mother noted the onset of a crowing sound when he breathed, and he became irritable. He was brought to the ED by his mother.

His vital signs are: respirations 30, pulse 140, blood pressure 88/palp, and temperature 38.4. He is sitting in his mother's arms and is anxious with obvious stridor at rest. He has decreased breath sounds bilaterally, with intercostal and substernal retractions.

What is your differential diagnosis at this point?

POSSIBLE ETIOLOGIES
- Croup
- Foreign body
- Epiglottitis
- Congenital laryngeal lesion

How can one appropriately (and reproducibly) gauge the degree of respiratory distress seen in this patient?

CLINICAL CROUP SCORE

	0	*1*	2
Inspiratory breath sounds	Normal	Harsh with ronchi	Delayed
Stridor	None	Inspiratory	Inspiratory and expiratory
Cough	None	Hoarse cry	Bark
Retractions and flaring	None	Flaring and suprasternal retractions	As under 1 plus subcostal and intercostal retractions
Cvanosis	None	In air	In 40% 02

A score of 4 or more indicates moderately severe airway obstruction
A score of 7 or more, particularly when associated with PaC02 >45 and PaO2<70 (in room air) indicates impending respiratory failure.

What interventions are indicated at this time?

STEPS TO BE TAKEN
- Supplemental cool mist and oxygen if necessary
- Allow the child to assume a position of comfort
- Prepare airway adjuncts
- Place on a monitor
- Lateral neck x-ray if stable

What about steroids in croup?

USE OF DEXAMETHASONE IN THE OUTPATIENT MANAGEMENT OF CROUP

Previous studies have shown that IM steroids shorten the duration and severity of illness in hospitalized patients with croup. The authors of this study attempted to determine if dexamethasone has a role in the outpatient management of these patients as well.

Patients 6 months to 5 years of age with a Croup Score of at least 2 and a disposition of discharge were randomized in a double blind fashion to receive a single IM shot of dexamethasone, 0.6 mg/kg, or an equal volume of normal saline prior to discharge to the ED. Patients were excluded if they required more than 1 racemic epinephrine treatment. Patients were followed-up by telephone 1 day and 7 to 10 days after discharge. Secondary outcomes included the parents' perception of how the child was doing in 24 hours

Of the 38 patients within the study group, 19 received steroids. The number of patients requiring racemic epinephrine was similar in both groups. Five patients sought additional medical attention within 48 hours Four of the five patients had received placebo. At the 24 hour follow-up, significantly

more patients in the dexamethasone group had a score consistent with improvement compared with placebo.

The authors conclude that the use of dexamethasone was associated with the reduction in severity of illness within 1 day after treatment. They recommended its use within the Emergency Department.

Cruz MN, Pediatrics, *96:220-223,* 1995.

THOUGHTS ABOUT STEROIDS IN CROUP

Currently recommended although some dispute the research
Best administered IM
Decadron, 0.6 mg/kg, single dose (12-24 hour half life)
2-3 day therapy is also utilized

The child becomes more agitated and becomes less well oxygenated. His retractions worsen and his color is pale. What can you do next?

SECONDARY STEPS FOR MODERATE TO SEVERE CROUP

Racemic epinephrine aerosol
Reassure comfort and calm
Increase 02 source
Arrange admission

DOES THE USE OF VAPONEPHRINE ALWAYS MANDATE ADMISSION ?

Classic teaching is that many patients, after receiving Vaponephrine, will improve, only to worsen 2-4 hours later (the “rebound phenomenon”)

SAFETY AND EFFICACY OF NEBULIZED RACEMIC EPINEPHRINE IN CONJUNCTION WITH ORAL DEXAMETHASONE AND MIST IN THE OUTPATIENT TREATMENT OF CROUP

Attempted to identify patients, who after treatment with RE and oral steroids, may safely be discharged home after a period of observation
Prospective, 55 patients, whose stridor did not resolve after mist therapy X 20 minutes
Study patients, after receiving RE, received 0.6 mg/kg dexamethasone PO and mist
Study patients who were clinically well after 3 hours were discharged home and contacted at 48 hours
30 patients (55%) had sustained responses and were discharged home after 3 hours
No recurrence of respiratory distress or return visits were reported
The authors conclude that patients with croup who are treated with RE, oral steroids, and mist may safely be discharged home if clinically well after 3 hours of observation

Ledwith ***CA. Annals of Emergency Medicine 1995;*** *25:331.*

RACEMIC EPINEPHRINE IN THE TREATMENT OF CROUP: CAN WE IDENTIFY CHILDREN FOR OUTPATIENT THERAPY?

Children < 13, years of age with croup evaluated prospectively using a croup scoring system
61 patients with persistent stridor at rest after mist therapy (20 minutes) who received nebulized RE and IM Dexamethasone were enrolled
Patients were observed in the ED while croup scores were assessed at 15, 60, 120, and 180 minutes
Croup scores significantly Improved throughout the observation period in 51% of patients discharged from the ED

Only 1 patient returned within 46 hours for further therapy
The maximal benefit from RE therapy seen at 60 minutes
If a child had persistent resting stridor or a croup score >2 at that time, hospitalization was inevitable

Prendergast M. American Journal of Emergency Medicine 1994; 12:613.

A Word About Budesonide

NEBULIZED BUDESONIDE FOR CHILDREN WITH MILD TO MODERATE CROUP

Recent evidence has strongly supported the use of steroids in children with croup. The study was carried out involving 54 children with croup who were randomized to receive 2 mgs of nebulized budesonide or nebulized saline. Ages ranged from 3 months to 5 years. Children with severe croup scores were excluded.

The median croup score was significantly lower at the final assessment in children given budesonide than in those given placebo. Children given budesonide were also discharged from the ED significantly earlier than children given placebo. None of the children receiving this inhalant steroid bounced back for admission.

The authors state that nebulized budesonide results in a prompt, important clinical improvement in children with mild to moderate croup. Further studies are indicated to help further outline the reliability of this drug in selected patients.
Klassen TP, ***New England Journal*** of Medicine, *331:285-289,* 7994.

NEBULIZED BUDESONIDE IS AS EFFECTIVE AS NEBULIZED ADRENALINE IN MODERATELY SEVERE CROUP

Nebulized adrenaline has been shown to be effective in the treatment of moderately severe croup. How does nebulized budesonide stack up when compared in a randomized, double blinded study of 56 hospitalized children with croup?

Children 6 months to 6 years of age were assessed using a croup symptom score at various intervals over a 1 day period. Patients received either budesonide (2 mg per 4 cc's) or L-adrenaline (4 mg per 4 cc's) via nebulization. The primary outcome measure was the change in the total croup score.

There was no significant difference in baseline features within both groups. All patients had significant improvement from baseline, and there was no difference between the 2 treatments as measured by change in croup scores, change in OSAT, duration of hospitalization, and adverse effects. The authors conclude that their study does not show any difference in efficacy and safety between nebulized budesonide and nebulized adrenaline

Fitzgerald D, *Pediatrics, 97:722-725,* ***1996.***

CASE

A 7 year old is transported by ALS after being hit by a car while riding his bicycle. He arrives unconscious, with irregular respirations. His blood pressure is 100170 with a pulse rate of 100/minute. He has a large left parietal hematoma, along with bruising at his LUQ and his proximal femur. Neurological testing reveals weakness on the right and signs of extensor posturing when confronted with noxious stimuli.

CASE

- Problems Inherent to this case:
  - Unstable airway
  - Hypovolemia
  - Increased ICP
- Therapeutic goals
  - Oxygenate and ventilate
  - Control ICP

RAPID SEQUENCE INTUBATION IN INFANTS AND CHILDREN

PROBLEMATIC INTUBATION SCENARIOS

- Seizures
- Combativeness
- Inadequate muscle relaxation
- Agitation

PREPARATION: SOAP ME

- Suction
- Oxygen
- Airway Equipment
  - Oral and nasal airways
  - BVM devices and masks
  - Endotracheal tubes and stylets
  - Laryngoscope handles and blades
  - Magill forceps
  - Surgical airway equipment
  - Tracheostomy tubes
- Pharmacology
  - Atropine
  - Lidocaine
  - Sedatives
  - Neuromuscular blocking agents
- Monitoring Equipment
  - Cardioresp/pulse ox
  - End tidal CO2 detector or monitor
- Other
  - Surgical airway available and physician who can perform it

PREMEDICATION

- Atropine
  - (0.02 mg/kg IV, 0.1 mg minimum dose)
  - To affect the bradycardia which is caused by vagal stimulation of ETI
  - Used in succinyl choline patients

Lidocaine
(1.5mg/kg IV)
Attenuate adrenergic response to laryngoscopy
Decrease rise in intracranial and intraocular pressure

Defasciculating dose of neuromuscular blocker (controversial)
Pancuronium (0.01 mglkg IV)
Vecuronium (0.01 mglkg IV)
Succinyl choline (0.1 mg/kg IV)

SEDATION

Thiopental
Short acting/rapid onset: IO-20 seconds
Reduces ICP
Dose: 2-5 mglkg IV
Causes vasodilation, impairs myocardial contractility
Avoid in hypotensive and hypovolemic patients
Causes respiratory depression

Methohexital
Short acting barbiturate
Respiratory depression
1.5 mglkg IV

Diazepam
Long acting
Resp depression
0.2-0.4 mglkg IV

Lorazepam
Long acting
Used in status epilepticus
0.1-0.4 mglkg IV

Midazolam
Short acting
Resp depression
0.05-0.4 mglkg IV

Fentanyl
Synthetic short acting narcotic analgesic
Rapid analgesia and sedation, lasting 30 minutes to 4 hours
Dose: 30-l 50 mcg/kg
May cause chest wall rigidity if injected rapidly
Associated with dose dependent respiratory depression

Etomidate
Short acting non barbiturate
Decreases ICP
May be drug of choice in hypotensive trauma patient

Ketamine

A dissociative anesthetic that produces rapid sedation, amnesia, and analgesia
Causes sympathomimetic discharge, useful in the hypotensive trauma patient
Also useful in severe refractory bronchospasm
Dose l-2 mg/kg

Disadvantages include:
- ICP elevation
- Hallucinations
- Excessive airway secretions (use atropine)
- Laryngospasm

NEUROMUSCULAR BLOCKERS

DEPOLARIZING

Succinyl Choline
- 2 mglkg IV
- Effects seen in 15- 30 seconds
- Duration of 3-5 minutes
- Muscle fasciculations result in increase ICP, intraocular pressure and K+
- Also causes bradycardia and increased secretions
- These effects increse dramatically with second dose
- Switch to other agents

NON DEPOLARIZING

Pancuronium
- Effects in 2-3 minutes
- Duration 45-90 minutes
- 0.1-0.2 mglkg

Vecuronium
- Effects in 30-90 seconds
- Duration 25- 60 minutes
- Causes myopathy in children on steroids
- 0.1-0.2 mg/kg

Rocuronium
- Effects in 30-60 seconds
- Duration 25-60 minutes
- May be current non depolarizer of choice
- 0.6-I .2 mglkg

Atacurium
- Effects in 2-4 minutes
- Duration 25-40 minutes
- Associated with histamine release (flushing and hypotension)
- 0.5 mg/kg

Mivacurium
- Effects in 30-60 seconds
- Duration 12-30 minutes
- Histamine reaction
- 0.15-0.3 mg/kg

CONTRAINDICATIONS TO RSI
- Belief that intubation or BVM ventilation may be unsuccessful
- Major facial or laryngeal trauma
- Upper airway obstruction

CONTRAINDICATIONS TO RSI
- Succinylcholine
  - Crush injuries, penetrating eye Injuries
- Nondepolarizing agents
  - Myasthenia gravis

Thiopental
Status asthmaticus
Ketamine
Hypertension, head injury

CASE

A 2 year old child was in good health until he developed a slight cold. His mother states that he started coughing and developed stridor while at play. He is anxious and agitated. His temperature cannot be obtained. His respiratory rate is 30 breaths per minute with prolonged inspiratory time. He is tachycardic (140). He has intermittent cyanosis and retractions.

DIFFERENTIAL DIAGNOSIS
Foreign body obstruction
Epiglottitis
Croup (spasmodic)

THERAPEUTIC STEPS
Supplemental, non-threatening oxygen
Position of comfort
Obtain directed history
Order x-rays, constant medical supervision
Assemble airway equipment

QUESTIONS
What is the management of the patient with foreign body aspiration with:
Partial obstruction?
Complete obstruction?

BASIC LIFE SUPPORT (BLS) MANEUVERS

MANEUVER	NEONATE	INFANT	CHILD
AIRWAY	Head Neutral	Head Tilt-Chin Lift Jaw Thrust if Trauma Present	Same as infant
BREATHING Initial	40-60/min	Two Breaths at l-1 112 See/Breath 20 Breaths/ Minute	Same as infant
CIRCULATION Pulse Check	Brachial/Fem/ Heart	Brachial/Femoral	Carotid
COMPRESSION			
SITE	Sternum Below Nipple Line	Lower Half Sternum	Same as infant
WIDTH	2 Fingers or Thumbs	2-3 Fingers	Heel of one hand
DEPTH	112 - 3/4 in	1/3-1/2 depth of chest	Same as infant
RATE	120/min	At least 1 00/min	100/min
COMPRESSION-VENTILATION RATION	3:1	5:1 (Pause for ventilation)	Same as infant
FOREIGN BODY AIRWAY OBSTRUCTION	Suction	Back blows and chest thrusts	Heimlich maneuver

LOWER AIRWAY DISORDERS

CASE

A 2 month old infant arrives with nasal congestion and cough for three days. There has been post-tussive emesis. No fever. The child has been interested in eating, with good urine output throughout. No rash, irritability or diarrhea is described. Others within the home have colds. The birth history is unremarkable. The child has had no immunizations as yet. The family history is positive for asthma in two cousins.

On exam alert, interactive, and hydrated. During observation and examination, the child demonstrates episodes of staccato cough, which are self sustaining. T 38C, RR 40, with a HR 120. HEENT exam-clear rhinorrhea and an injected pharynx. There are subconjunctival hemorrhages. The chest demonstrates mild retractions, with a suggestion of mild expiratory prolongation. The lungs are essentially clear. There is no murmur.

What *is the significance of a cough in infants less than 2 months of age?*

COUGH IN THE YOUNG INFANT

- Usually benign in nature, overestimated by the parent
- If documented however, may indicate the presence of underlying pathology
- In many cases is the first symptom of a congenital airway or pulmonic anomaly

What is the differential diagnosis for an afebrile cough in this age group?

CONGENITAL CAUSES OF COUGH: YOUNG INFANTS

- Vascular ring
- Lobar Emphysema
- Pulmonary Cysts
- Chronic Aspiration Syndromes (TEF, GER)
- Foreign Body Aspiration
- Cystic Fibrosis

INFECTIOUS CAUSES OF COUGH: YOUNG INFANTS

- Chlamydia
- Pertussis
- Bronchiolitis
- Bacterial Pneumonia

PERTUSSIS

EPIDEMIOLOGY

- Highly communicable (99% attack rate)
- 1988-present: tenfold increase in both cases and local epidemics
- Reported cases (carriage) in hospital personnel

MORBIDITY-MORTALITY

- Apnea
- Pneumonia
- Seizures
- ?SIDS

CLINICAL MANIFESTATIONS

Infection secondary to inhalation of B. pertussis
Duration of illness: 6-8 weeks
Three stages of symptomatology: Catarrhal. Paroxysmal, Convalescent
Incubation period = 6-20 days

CATARRHAL STAGE (l-2 WEEKS)

Rhinorrhea, lacrimation
Mild cough
Conjunctival injection
Low grade fever

PAROXYSMAL STAGE (2-4 WEEKS)

Repetitive paroxysms of forceful coughs during a single expiration, followed by a massive inspiratory effort (whoop)
Cyanosis, bulging eyes, tongue protrusion, salivation, lacrimation, neck vein distention
Post-tussive emesis commonly occurs
Attacks triggered by yawning, eating, drinking
Infants characteristically lack the whoop

CONVALESCENT STAGE (1-2 WEEKS)

Less frequent paroxysms, decreasing in severity
The cough may persist for months

COMPLICATIONS

Otitis media
Pneumonia: responsible for 90% of mortality in children < 3 years of age; usually a secondary event (S. pneumoniae)
Subarachnoid /intraventricular/subconjunctival hemorrhages
Umbilical/inguinal hernias

CLUES TO THE DIAGNOSIS

Witnessing a paroxysm
Leukocytosis (2050,000) with marked lymphocytosis (70%) during the paroxysmal stage
Immunofluorescent antibody (IFA) staining of nasopharyngeal secretions

TREATMENT

Maintain hydration; supplemental oxygen during paroxysms
Avoid suctioning or any form of oral stimulation
Erythromycin (50 mg/kg/day) eliminates organisms from the nasopharynx in 3-4 days
Antibiotic therapy does NOT shorten the paroxysmal stage

CLINICAL AND MICROBIOLOGIC FEATURES OF CHILDREN PRESENTING WITH PERTUSSIS TO A CANADIAN PEDIATRIC HOSPITAL DURING AN ELEVEN YEAR PERIOD

A study outlining the characteristics and clinical findings involved with 975 cases of pertussis between 1980 and 1990. Peak occurrences were in the late summer and early autumn. The overall median patient age was 30 months, but there were specific peaks in the those younger than 6 months and older than 5 years. Nearly one-fourth of the patients were admitted to the hospital and stayed for an average of 5 days. Coughing was nearly universal at the time of admission, but only 44% of patients had a typical whoop. Episodic apnea was the most frequent finding in infants younger than 6 months of age. Of interest, three-fourths of the children had apparently received age appropriate vaccination. Seventeen patients required ICU monitoring, and 12 of them received ventilation.

This case series demonstrates the severity and complication risk of pertussis when involving children younger than 6 months of age. A high degree of suspicion must be maintained in all cases of paroxysmal coughing when seen in infancy The authors advise admission of these patients to the hospital for careful observation to rule out the potential for apnea.
Gordon M, *Pediatr Infect Dis* ***Journal,*** *13:617-622,* ***1994.***

DISPOSITION OF SUSPECTED CASES IN THE ED
- Children under 6 months-admit for observation, apnea monitoring
- No fixed current guidelines for the older patient

CHLAMYDIA

CHLAMYDIAL PNEUMONITIS
- Accounts for 1573% of afebrile pneumonia in infants 3 to 11 weeks of age
- Transmission during cervical passage; rates of colonization 2.37%
- Of infants colonized, 50-75% will develop conjunctivitis.1 1-29% will develop pneumonia

CHLAMYDIAL PNEUMONITIS
- History of conjunctivitis or mucoid rhinorrhea, followed by gradually worsening tachypnea and staccato cough
- Most infants are afebrile
- Auscultation-coarse rales or minimal wheezing
- CXR-hyperexpansion and interstitial infiltrates

CHLAMYDIAL PNEUMONITIS
- WBC normal; 70% have eosinophil counts> 300/mm3
- Diagnosis by perinatal history, clinical picture and eosinophilia
- Direct culture from NP swabs (antigen tests are not reliable)
- Treatment
  - Erythromycin estolate- 10mg/kg every 8 hours for 14 days

How helpful are laboratory investigations?

LAB WORK UP FOR INFANT WITH COUGH
- CBC
  - Left shift-bacterial disease
  - Lymphocytosis-Pertussis
  - Eosinophils -Chlamydia
- Cultures
  - Blood
  - Nasal- Chlamydia, Pertussis, and RSV

What factors influence fhe disposition of these patients?

ADMISSION CRITERIA FOR THE YOUNG INFANT WITH COUGH
- Hypoxemia (RSV) / toxic appearance / apnea(RSV)
- Inability I inadvisability of oral intake
- History of prematurity or failure to thrive
- Suspicion of paroxysms of Pertussis
- Parental unreliability

CASE

A 5 month old has had a cold for three days and develops a dry cough and noisy breathing. The mother states that he stopped breathing and turned blue twice today. Each episode lasted for a few seconds, and he was revived by "blowing in his face." He has had a decrease in oral intake and seems to have a hard time sucking on the bottle.

Vital signs: RR 60-70, BP 98 palp, HR 160, T 38.4C. He is in obvious respiratory distress with nasal flaring, grunting, rapid respirations, and sternal and intercostal retractions. His skin color is pale and dusky. Breath sounds are noted to be decreased bilaterally, with wheezing heard throughout the lung fields. His mucous membranes are dry, and he seems "fussy" and irritable.

What is the most likely diagnosis?

BRONCHIOLITIS

Transmitted by direct secretive contact and aerosolization of Respiratory Syncitial Virus (**RSV**)
May also be caused by parainfluenzae, adenovirus or influenzaevirus
The virus is replicated in the small bronchiole

RSV

Causes intramural secretions and airway edema
Certain individuals respond by producing IgE-RSV complexes which facilitate the generation of a bronchospastic component
May explain why certain individuals have a more severe presentation and respond to bronchodilators

RSV

A wintertime disease
Incidence of 11.4/100 children during the first year of life
More common in poor, crowded, smoke exposed, non breast-fed infants

RSV- CLINICAL PICTURE

Prodromal URI for 3-5 days with a worsening cough, decreasing oral intake
Fever is low grade but may be elevated in the presence of OM (quite common in RSV)
Usually an older sibling in the home has a "cold"

RSV- CLINICAL PICTURE

Varying degrees of distress- from rhinorrhea and mild cough to full blown ventilatory failure
Tachypnea, retractions, hyperinflation, wheezing and rales
Liver displacement secondary to hyperinflation
Dehydration and listlessness in severe cases

What investigations would you perform in the ED?

WORK-UP OF THE RSV INFANT

CBC is usually nonspecific
Oximetry is mandatory on presentation and throughout ED course
CXR
Protean findings. including hyperinflation with flattened diaphragms, interstitial edema atelectasis/infiltrates, peribronchial cuffing
RSV washings are the gold standard

What therapeutic modalities may be employed in the management of this case?

RSV TREATMENT
- Supplemental oxygen as necessary (canula or mask)
- Cardiac and apnea monitor if ill appearing
- Intravenous fluids if indicated

RSV TREATMENT
- Trial of nebulized Albuterol
  - Will be helpful in some patients
  - If response is favorable, administer every 20-30 minutes
  - Literature is mixed regarding efficacy of Beta 2 agonists in RSV

EFFICACY OF BRONCHODILATOR THERAPY IN BRONCHIOUTIS: A META ANALYSIS

The usefulness and efficacy of bronchodilators in patients with bronchiolitis is not proven. In this meta analysis, all randomized placebo controlled trials done in the past were analyzed to help answer this question.

The search involved 89 publications of which 15 met selection criteria. Data were pulled from 8 studies of children with first time wheezing. The relative risk for score plus or minus improvement was 0.76 in favor of treatment. Hospitalization was not effected by the use of bronchodilators. The results for oxygen saturation were unable to be pulled.

From this meta analysis it is apparent that bronchodilators result in modest, short term improvements in patients with mild or moderately severe bronchiolitis. More placebo controlled studies are needed. It is important in all research to distinguish patients with first time wheezing.

Kellner ***JD. Arch Pediatr Adolescent Medicine*** *150:1166-1* ***172, 1996.***

RSV TREATMENT
- Oral/IV steroids
  - No controlled studies
  - May be helpful in bronchospastic patient subset
  - Prednisone, 2mg/kg/day PO or Solumedrol, 1mg/kg/dose IV

RSV TREATMENT
- Epinephrine
- Several studies have shown inhaled epi to be effective, and more effective than albuterol
- Combination of antiinflammatory and bronchodilating effects
- Dosage varies- usually 0.25-0.5 ml racemic epi 2.25%

RSV TREATMENT
- Ribovarin
  - Expensive and difficult to utilize
  - Indicated for:
    - Severe cases (vent candidates)
    - History of CHD, BPD, CF. Immune deficiency
    - Age< 6 weeks, history of prematurity

RSV-DISPOSITION
- Most resolve as outpatients
- Many do well at home on Beta 2 agonists (liquid preparations) +/- steroids
- Predictors of hospitalization (AJDC 145:151, 1991)
  - Toxic or ill appearance
  - Age less than 3 months (Apnea)
  - Saturations less than 95%

Atelectasis on CXR

CASE

A 3 year old has had a cold for three days. She has progressively developed a poor appetite and decreased oral intake. What began as a nocturnal cough has progressed to a constant pattern. Today she began wheezing and breathing rapidly. The PMH is negative. Immunizations are current. There is a positive family history for asthma.

On exam, you note a well developed 4 year old in obvious respiratory distress. Vital signs are: respirations 48, pulse 160, blood pressure 92/78, and temperature 40C. She is sitting forward when she breathes with marked intercostal retractions. She is using cervical and abdominal accessory muscles for respiration. Air entry is fair. Expiration is prolonged. Wheezing and rales are heard in all lung fields.

What are the differential diagnoses for wheezing in this age group?

CAUSES OF WHEEZING IN CHILDREN
- Asthma
- Foreign Body Obstruction
- Bronchiolitis
- Pneumonia With Bronchospasm
- Pulmonary Edema

What should be done now?

INTERVENTIONS FOR THE WHEEZING CHILD
- Oxygen by mask or nasal prongs
- Inhalation of nebulized Beta 2 adrenergic agents

What investigations should you perform?

EVALUATION OF THE WHEEZING CHILD
- Assessment of ventilation by auscultation
- Oximetry/PEFR
- Determine the cause of this particular attack
  - Intercurrent viral illness (URI)
  - Intercurrent bacterial disease (pneumonia, strep pharyngitis, otitis media)
  - Environmental stimuli (nicotine, weather change, fibers or pets in the home)

EVALUATION OF THE WHEEZING CHILD
- Negative historical issues
  - Past history of sudden severe exacerbations
  - 2 or more hospitalizations in past year/3 or more ED visits in past year
  - Current use or recent withdrawal of systemic corticosteroids
  - Medical comorbidity or psychosoial problems

EVALUATION OF THE WHEEZING CHILD
- Pulse oximetry
  - Has become the fifth vital sign
  - Not sensitive for predicting poor outcome
  - Normal pulse oximetry does not rule out significant disease
  - Variation in what IS considered “normal”

What is the role of each of the following in the management of this case:

a. *Inhalant Beta2 Agonists*

BETA AGONISTS

Delivered over a short time with flow rates of 6-8ml/min
Albuterol (Proventil, Ventolin), Fenoterol, and Terbutaline
Activate adenyl cyclase, increase cAMP, reduce myoplasmic calcium, facilitating bronchodilation
Epinephrine and isoproterenol are relatively nonspecific (Beta 1 and 2)

BETA AGONISTS

Nebulization more effective than oral routes
Wide therapeutic indexes allow frequent (continual or q 20 min) administration (only 10% actually reach the distal airways)
The superiority of frequent, high dosing is well documented

ALBUTEROL

0.15-0.3 mg/kg (max 10 mg) in 3 cc saline via nebulizer
Insert reads q 2-3 hours but in the ED may be given q 15-20 minutes
Peak onset of action within 15-20 minutes
Continuous nebulization (0.5 mg/kg/hr, max 15 mg) is also effective

EFFICACY OF ALBUTEROL ADMINISTERED BY NEBUUZER VERSUS SPACER DEVICE IN CHILDREN WITH ACUTE ASTHMA

An attempt to compare the response to inhaled Albuterol administered by nebulizer as opposed to the response utilizing a metered dose inhaler/spacer device
The authors measured OSAT's, FEV-1, and general clinical status
Involved 33 children, 6-14 years
Study clearly showed that there was no difference in the clinical effects generated by the nebulized versus MDI-spacer group
Concluded that spacers and nebulizers are equally effective means of delivering beta-2 agonists to children with acute asthma

Kerem, ***E. Journal of Pediatrics*** *123:313-317,* ***1993.***

THE USE OF NEBULIZED ALBUTEROL IN WHEEZING INFANTS

Involving 25 infants (2-24 months), patients were randomly assigned to two identical treatment groups receiving either nebulized Albuterol (0.15 mg/kg) or placebo (saline)
Assessment after treatment included a wheeze and retraction score, RR and HR, and pulse oximetry
Comparison of the two groups clearly demonstrated a significant improvement in both clinical status and OSAT's in the group receiving nebulized Albuterol
In certain infants, a decrease in OSAT after the first nebulized treatment was noted, which resolved with further therapeutic interventions
Study clearly supports the use of nebulized albuterol in the treatment of wheezing Infants

Schweich, PJ. ***Pediatric Emergency Care*** *8:184-188,* ***1992.***

TERBUTALINE

0.1% solution given in a dose of 0.03ml/kg/dose diluted in 2-4ml NS
May be administered every 20 minutes
Peak action in 30 minutes
Parenteral- 0 01 ml/kg/dose q 20 minutes subcutaneously

ANTICHOLINERGICS

Decrease cyclic GMP, inhibiting smooth muscle contraction
Ipatropium bromide (Atrovent) acts on larger sized airways
Dose: 0.25-0.5 mg/dose with first and third inhaled beta agonist doses, then q2-4 hours
Systemic absorption is poor
May be most helpful in children already receiving Albuteral treatments pre-presentation (synergism ?)

EFFICACY OF NEBULIZED IPRATROPIUM IN SEVERELY ASTHMATIC CHILDREN

Recent publications have advocated the use of nebulized ipratropium as an adjunct in the treatment of the moderate to severe asthmatic child. The study was carried out to determine the effect of adding this agent to standard therapy when compared to standard therapy alone for acute to severe asthma. Children were chosen if their PEFR was less than 50% predicted. 90 children aged 6 to 18 years were randomly assigned to two groups in a prospective double blinded study. All children received nebulized albuterol solution every 30 minutes, and all received oral steroids with a second dose of albuterol. Group one patients received ipratropium, with the first and third dose of albuterol, those in group 2 received saline. Every 30 minutes up to 120 minutes pulmonary functions were measured.

Children in the ipratropium group had a significantly greater improvement in percent of predicted PEFR than the placebo group at 60 minutes, 90 minutes, and 120 minutes. The improvement in percent predicted FEV1 was significantly greater for children in the ipratropium group only at 120 minutes. With regard to admissions, 9 children (20%) from the ipratropium group and 14 (31.1%) from the control group were noted. No significant adverse effects were noted.

The authors conclude that they detected significant improvement in pulmonary function studies over 120 minutes in children with severe asthma who received ipratropium compared to albuterol alone.

Qureshi ***F. Annals of Emergency Medicine*** *1997;29:205-211*

What is the role of each of the following in the management of this case:

b. Steroids

STEROIDS

Block the release of inflammatory substances by indirectly blocking phospholipase A2 activity
May also increase the number and activity of Beta-receptors; a direct bronchodilator effect has been demonstrated
Hospitalization rates are decreased with early administration

CONTROLLED TRIAL OF ORAL PREDNISONE IN THE E.D. TREATMENT OF CHILDREN WITH ACUTE ASTHMA

A study of the efficacy of oral steroids in the ED treatment of asthmatics 1-17 yrs
Children were evaluated and assigned a pulmonary index based on clinical status
The study group = patients whose pulmonary index was considered to be “moderate”
Patients randomized into groups receiving either 2 mg/kg of oral Prednisone or a placebo in a double-blinded manner (n=75)
Subsequent treatments were Identical utilizing aerosolized beta-agonists
Overall admission rates were 31% for the Prednisone group and 49% for the placebo group
Within the subset of sickest patients. 32% of the Prednisone patients required hospitalization vs. 72% of the placebo group
When decision making regarding admission was extended to a 4 hour time window, the majority of the Prednisone recipients were discharged

Conclude that oral Prednisone, within 4 hours of administration, reduced the need for hospitalization among a subset of children with moderate to severe asthma

Scarfone, RJ. *Pediatrics 92:513-518,* ***1993.***

STEROIDS

Oral route= IV route in moderate disease
Solumedrol (methylprednisolone)- 1-2 mg/kg/dose q 6h IV
Solu-Cortef (hydrocortisone)- 5mg/kg/dose q 6h IV
Prednisone- 2mg/kg/day divided BID orally for 5 days
Short courses not associated with side effects or the need for tapering

What is the role of each of the following in the management of this case:

c. CXR

CXR IN THE ASTHMATIC CHILD

Often of little value
May have some yield in:
Highly febrile patients
Patients critically ill or who do not respond to therapy
First time wheezers
Patients suspected of having an air leak

CHEST RADIOGRAPHY IN THE INITIAL EPISODE OF BRONCHOSPASM IN CHILDREN: CAN CLINICAL VARIABLES PREDICT PATHOLOGIC FINDINGS?

It is commonly taught in many pediatric emergency programs that all first time wheezers receive chest radiography. This is a study to determine whether historical or clinical variables can discriminate among children who experience a first episode of bronchospasm, with chest radiography findings that are either normal or pathologic.

Performed prospectively, all patients aged newborn to 18 years presenting to the Emergency Department with their initial wheezing episode were enrolled. 633 patients presented during the study period. Pathologic radiographic findings were identified in 39 (6.2%). Normal radiographs were noted in 25% of patients and evidence of RAD was noted in 66% No single variable accurately predicted all pathologic radiographs. A model was designed which identified 9 variables in hopes of accurately discriminating among patients. These variables included history of cough, abrupt onset, history of runny nose, family history of asthma, family history of eczema, and rales, wheezes, and retractions, This model correctly identified 97% of the x-rays with findings of RAD, however, it failed to identify patients with pathologic chest radiographs.

The authors conclude that no clinical variables that were studied accurately identified patients with pathologic radiography. Continued use of chest radiography as a diagnostic intervention in the initial episode of childhood bronchospasm is therefore recommended.

Walsh-Kelly CM Annals of Emergency Medicine *1996;28:391-395*

What is the role of each of the following in the management of this case:

d. ABG

BLOOD GASES IN THE ASTHMATIC

Indications
The severely hypoxemic
Patients not responding to therapy
Altered consciousness
CO2 levels must be adjusted relative to work of breathing and respiratory rate

What is the role of each of the following in the management of this case:

e. Theophylline

THEOPHYLLINE

Forgotten but not gone
Side effects limit its usefulness in outpatients; there is still a role in the acute setting however
A weaker bronchodilator than Beta agents
Indicated in refractory status asthmaticus

THEOPHYLLINE

Loading dose (Aminophylline)
5-7 mg/kg over 20 minutes IV
Maintenance dose
Infusion of 0.7-0.9 mg/kg/hr IV
Serum levels should be obtained after the loading dose and throughout maintenance
Toxicity seen in levels > 40 (nausea, vomiting, tremor, tachycardia)

CASE

A 3 year old has had a fever and cough for several days. The cough is nonproductive but the mother reports hearing “rattling” in the child’s chest. This morning she was very warm to the touch, had a poor appetite, and began vomiting and breathing fast. Her past history is negative for respiratory problems. Immunizations are current.

Her vital signs are: pulse 140, BP 96/76, and temperature 40.2C. Respirations are shallow at 60 She appears sleepy, responding to voice, while lying in her mother’s lap. She has moderate retractions Skin color is dusky. Mucus membranes are dry. Air entry is fair, with rales heard at both bases. There is no wheezing. Her neck is supple. The abdomen is non tender, without hepatosplenomegaly.

What interventions are immediately indicated?

INTERVENTIONS
- Supplemental oxygen and monitor
- Intravenous access and fluid administration

What investigations would you perform?

WORKUP OF TOXICITY AND RESPIRATORY DISTRESS
- Oximetry and ABG's
- CBC, SMA7. Blood Cultures
- CXR
- Consider a spinal tap

CASE PROGRESSION
- CBC shows WBC 21 K with 15% Bands
- ABG in 40% 7.35/pCO2 45/pO2 120/ BE -3
- Lytes WNL, BUN 23
- CXR shows.

What is the most likely diagnosis; etiology?

PATHOGENS IN PEDIATRIC PNEUMONIA
Less than 1 month
- Group B strep
- E coli
- Klebsiella
- RSV
- Chlamydia

PATHOGENS IN PEDIATRIC PNEUMONIA
1 to 3 months
- H flu
- S pneumo
- Group A strep
- Pertussis
- RSV
- Chlamydia

PATHOGENS IN PEDIATRIC PNEUMONIA
3 months to 5 years
- S pneumo
- H flu
- Group A strep
- Pertussis
- RSV
- Adenovirus /Paraflu

PATHOGENS IN PEDIATRIC PNEUMONIA
5 years and older
S pneumo
Mycoplasma
H flu
Group A strep
Adenovirus

What *factors determine the disposition of this patient?*

CRITERIA FOR ADMISSION FOR CHILDREN WITH PNEUMONIA
Ability to oxygenate, ventilate, and hydrate
History of chronic disease or immune deficiency
Parental competence