

Respiratory tract infection in children

- To know how common this problem in pediatric medicine.
- How to differentiate between upper respiratory tract infection and lower respiratory tract infection.
- To know epiglottitis in details (History, physical examination, etiology, differential diagnosis, management).
- To know the pneumonia (bacterial vs viral)

Objectives

MANAGEMENT OF COMMUNITY ACQUIRED PNEUMONIA IN CHILDREN

- Clinical features (How do children with CAP present?)
- Etiology – Causes of CAP (virus, bacterial, atypical organism) does the etiology alter by age.
- Investigations.
- Severity assessment
- Managements
- Complications of CAP pneumonia (pneumatocele necrotizing pneumonia)

Objectives

Pulmonary TB



- Local Epidemiology vs. inherited epidemiology
- Diagnosis, Intervention, managements.
- How to approach children with PPD (children and family)

Objectives

INTRODUCTION

- Children have about 6 respiratory infection per year
- They are the the greatest of all causes of medical morbidity in pediatrics.
- Majority of acute respiratory infections are URTI but infection of lower respiratory tract are sufficiently frequent to pose almost daily problems for clinician caring for children
- Large number of different miroorganisms are capable of infecting the lower respiratory tract produces several respiratory syndromes and illnesses.

Children who have RTI more than 6 times a year
→ their immunity need to be investigated

Upper RTI more than lower RTI but cause less burden on children and their families

Etiology

- Viral: Influenza, Parainfluenza, RSV, Rhinovirus, Enterovirus, Corona, Measles, Varicella, Adeno, EBV, CMV, Herpes
- Mycoplasma: *M. pneumoniae*
- Rickettsia: *Coxiella burnetii* (Q fever)
- Chlamydia

Q fever is very **rare** but you should think about it when you have child with persistent fever

Fungi and parasites affect only immunocompromised children (like child with leukemia, child who's taking steroid for nephrotic syndrome..etc.)

Etiology (CONt.)

- Bacterial: staph, H flu, Pneumococcus
- Fungi: Candida, Histoplasma, Aspergillus
- Parasites: *Pneumocystis carinii*, Toxoplasmosis

TABLE 13.2. Common causes of upper airway obstruction in children.

Anatomic

- Altered level of consciousness (airway muscle laxity)
- Postextubation airway obstruction
- Tonsillar hypertrophy
- Subglottic stenosis (acquired or congenital)
- Macroglossia
- Vocal cord paralysis
- External or internal compression
- Tumor
- Hemangioma
- Hematoma
- Cyst
- Papilloma
- Vascular rings and slings

Infectious

- Laryngotracheobronchitis (croup)
- Peritonsillar abscess
- Retropharyngeal abscess
- Bacterial tracheitis
- Supraglottitis (epiglottitis)
- Infectious mononucleosis

Miscellaneous

- Postextubation airway obstruction
- Angioedema
- Foreign body aspiration
- Airway trauma

Common causes of upper airway obstruction in children can be divided as anatomical, external & internal obstruction, infectious and miscellaneous

Upper airway obstruction illnesses

• INFECTIOUS CAUSES

Epiglottitis

Laryngotracheobronchitis (**Croup**)

Bacterial tracheitis

Diphtheria

Retropharyngeal abscess

Peritonsillar abscess

Upper airway obstruction illnesses

• NONINFECTIOUS CAUSES:

Foreign body

Trauma

Angioneurotic edema

Hypocalcemic tetany

Caustic burns

Upper airway obstruction illnesses

Acute Epiglottitis

- Life-threatening condition characterized by upper airway inflammation and obstruction.
- infection of epiglottis and supraglottic structures.
- High risk of death(7%)
- Most common in male (ration of 2.5 to 1).
- may occur at any age.
- Age incidence 2-7 Y
- Vulnerable population include infants less than 12 months elderly more than 85 years old

Nowadays, we're rarely seen Acute epiglottitis except atypical epiglottitis due to influenza B vaccine

Atypical epiglottitis does not present with the classical picture of epiglottitis and happens to children who have not taken all doses of HiB vaccine

Acute Epiglottitis

- **Caused by almost always H. Influenza type B(HiB) 90%**
- No seasonal predilection in incidence of epiglottitis .
- Risk factors:
 - absence of immunization against HiB
 - immunocompromised state
 - smoking

Acute Epiglottitis

- Pathology:
 - Direct invasion by HiB
 - ↓
 - Cellulitis with marked edema of the epiglottis, aryepiglottic folds, ventricular band and arytenoid.
 - ↓
 - Edema increase the epiglottis curls posteriorly and inferiorly
 - ↓
 - Airway obstruction
- (Inspiration tend to draw the inflamed supraglottic ring into the laryngeal inlet)

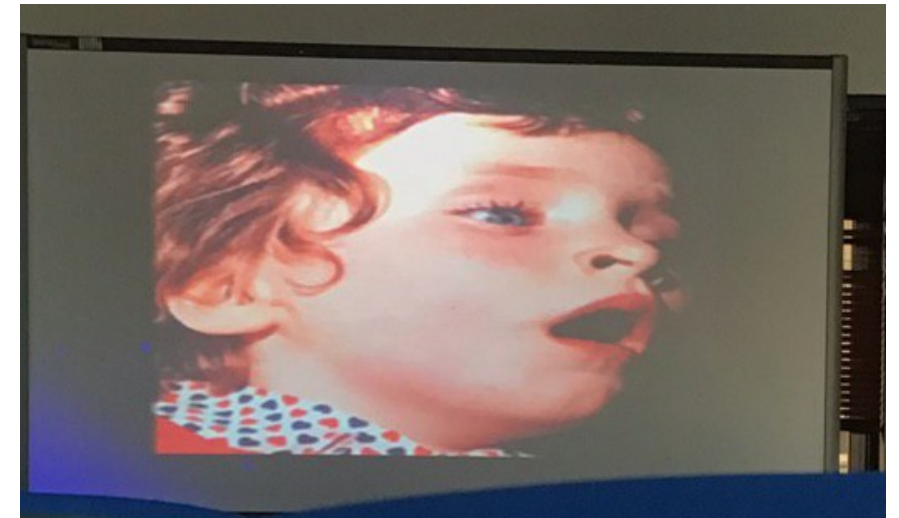
Acute Epiglottitis

● Clinical features:

- Sore throat, followed by Odynophagia accompanied by drooling, retching and difficulty breathing
- Voice is not hoarse but speech is muffled
- Cough is not croupy
- Stidor
- Marked Fever(38.8-40C)
- Child assuming posture that maximize the increase in diameter of the obstructed airway(Sitting & leaning forward with hyperextension of the neck and protrusion of the chin)

Voice is **not** hoarse but speech is muffled (MCQ)

Classical picture of child with acute epiglottitis



55

Normal

Abnormal

Acute Epiglottitis

- Lateral Neck: Thumb sign
- Treatment

Avoid stimulation of the child. This includes radiographs, drawing bloods, starting IVF until secure airway established

Emergency Intubation: Elective nasopharyngeal intubation (ETT 0.5mm smaller than that required is recommended)

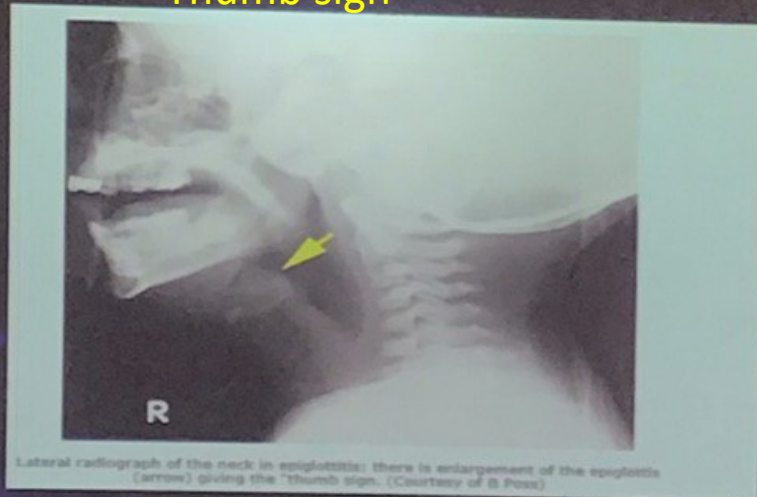
I.V Ceferuxime or cefotaxime for 7 days

NO steroid

Criteria for extubation: Aferbril
swallowing comfortable

- It's clinical diagnoses (no need for X-ray)
- 1st step you should secure the airway
- Don't do emergency intubation (it should be elective)
- Better to do nasopharyngeal intubation with **0.5 mm smaller** than that required for the age
- Give IV antibiotic for 7 days
- **NO steroid**

Thumb sign



Lateral radiograph of the neck in epiglottitis: there is enlargement of the epiglottis (arrow) giving the thumb sign. (Courtesy of B. Poss)

CROUP

- Age: 6 months - 3 years
- More in fall winter and spring
- URI (Rhinorrhea, Mild to moderate fever)
- Progress to inspiratory stridor, hoarseness and croupy cough
- Rib cage and abdominal asynchrony occurs as the condition deteriorates

Am review Resp dis, 1990;142,540-544

Start as symptoms of URI then progress to inspiratory stridor , hoarseness and croupy cough then breath with asynchrony of rib cage and abdomen movement (bending respiratory failure) → send the child to PICU

Upper airway obstruction illnesses CROUP

• Etiology:

Parainfluenza 1 (most common),
2 (less frequent), 3 (less common)
influenza
RSV
Adeno, rhino, entero, herpes
M Pneumonia

CROUP

- Most children have mild disease
- Last 7-14 days
- Among children admitted with croup less than 1% require intubation
- Lateral neck X-ray: Narrowing of subglottic area

CROUP

● Treatment:

Moist air
Oxygen
IV fluid

Steroid therapy: IM, PO, Inhalation (suppression of the local inflammatory reaction, shrinking of lymphoid swelling and reduction in capillary permeability)

0.6mg/kg IM

Aerosols: Racemic epi. ; increase the airway diameter within 30 mins, however the effect is short lived lasting for 2 hours

Steroid is the mainstay therapy any form will benefit the patient but we always give 0.6 mg/kg intramuscular
We may also give racemic epi, but we should monitor the child for two hours for rebound constriction.

steeple sign



Fig 2. AP radiograph of the neck in patient with LTB showing narrowing in the subglottis ("steeple sign"). (Photo courtesy of the Department of Radiology, University of Texas Medical Branch at Galveston.)

You have only to compare between croup and epiglottitis

Table 13.3. Infectious causes of upper airway obstruction.

	Croup	Epiglottitis	Bacterial tracheitis	Retropharyngeal abscess
Onset	Gradual	Rapid onset 6-12 hr	Viral prodrome followed by rapid deterioration	Viral prodrome followed by rapid deterioration
Typical age at onset	6 months to 4 years	2-8 years	6 months to 8 years	<5 years
Seasonal occurrence	Late fall to winter	Throughout the year	Fall to winter	Throughout the year
Causative agents	Parainfluenza, respiratory syncytial virus, influenza A	Haemophilus influenzae type b (classically), Streptococcus pneumoniae, GABHS	Staphylococcus aureus (classically), GABHS, Streptococcus pneumoniae	Anaerobic bacteria, GABHS, Staphylococcus aureus
Pathology	Subglottic edema	Inflammatory edema of supraglottis	Thick, mucopurulent, membranous tracheal secretions	Abscess formation in the deep cervical fascia
Fever	Low-grade	High fever	High fever	High fever
Cough	"Barking" or "seal-like"	None	Usually absent	Usually absent
Sore throat	None	Severe	None	Severe
Crusting	None	Frequent	None	Frequent
Posture	Any position	Sitting forward, mouth open, neck extended ("tripod position")	Any position	Sitting forward, mouth open, neck extended ("tripod position")
Voice	Normal or hoarse	Muffled	Normal or hoarse	Muffled
Appearance	Non-toxic	Toxic	Toxic	Toxic

Note: GABHS, group A β -hemolytic Streptococcus.

Middle East Respiratory Syndrome Coronavirus (MERS-CoV)

- What is Middle East respiratory syndrome (MERS)?
MERS is a coronavirus (named for the crown-like projections on the virus surface).
- Coronaviruses are very common and usually cause colds and mild upper respiratory infections but can also cause severe illness like the 2003 SARS-CoV.
- MERS is related to but is not the same as SARS.
- First identified— late 2012 in Saudi Arabia



Signs and Symptoms of MERS

- Fever > 38C (100.4F)
- Cough
- Shortness of breath
- Malaise
- Vomiting
- Diarrhea
- Pneumonia
- Incubation period about 5.2 days but can range up to 14 days.
- Symptoms range from mild – severe.
- Mean age: 56

Ongoing Concerns



- Exact route of transmission is still unclear.
- High attack-rate.
- No definitive treatment yet.
- Documented nosocomial transmission from patient to patient and from patient to healthcare workers.
- Few definitive lab tests and surveillance tools available

PNEUMONIA

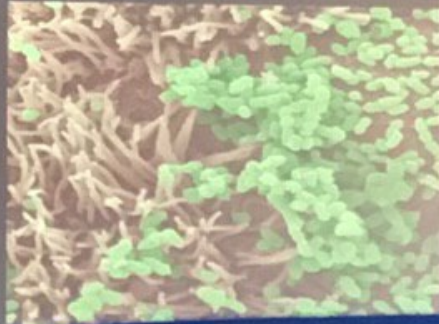


Factor relating to the etiology:

- 1) **Host normal or compromised.**
- 2) **Age**
- 3) **Season**
- 4) **Environment: animate (human and animals) and inanimate.**

- **Innate immunity in the lung is truly amazing.** The lung has ~100 square meters of surface area (roughly the size of a tennis court) and is directly exposed to the outside environment with every breath we take. Despite this, the lower airway is normally sterile. There are many levels of innate immunity that keep the lung free of pathogens, including

- 1 filtering in the upper airways,
- 2 mucociliary clearance,
- 3 antimicrobial factors



So any abnormalities in one of these three is a risk factor for pneumonia

PNEUMONIA

Etiology:

Bacterial: S. pneumonia, H flu, Staph, GAS, TB.

Viral: RSV, parainfl (1,2,3), Inf, adeno, rhino, entero.

Immuno-compromised: Broader spectrum of etiological agents: fungi, gram negative bacilli, pneumocystis carini. anaerobes, CMV.

It may start as viral infection then goes to secondary bacterial infection. Adeno and RSV can cause permanent damage to the lung parenchyma.

Most Common Causes of Pneumonia in Immunocompetent & Immunocompromised Children over 1 month of Age

	IMMUNOCOMPETENT	IMMUNOCOMPROMISED
• Bacterial	<i>Streptococcus pneumoniae</i> <i>Haemophilus influenzae</i> <i>Staphylococcus aureus</i> Group A <i>Streptococci</i> <i>Bordetella pertussis</i> <i>Moraxella catarrhalis</i> <i>Yersinia pestis</i> <i>Pasteurella multocida</i> <i>Brucella</i> spp. <i>Francisella tularensis</i> <i>Neisseria meningitidis</i> <i>Salmonella</i> spp.	<i>Pseudomonas</i> spp. Enterobacteriaceae <i>Legionella pneumophila</i> <i>Nocardia</i> spp. <i>Rhodococcus equi</i> <i>Actinomyces</i> spp. Anaerobic bacteria <i>Enterococcus</i> spp.
• Bacteria – Like Agents	<i>Mycoplasma pneumoniae</i> <i>Chlamydia pneumoniae</i> <i>Chlamydia trachomatis</i> <i>Chlamydia psittaci</i> <i>Coxiella burnetii</i> <i>Rickettsia rickettsii</i>	

VIRAL PNEUMONIA

Most common cause of LRTI, RSV, parainfl (1,2,3), inf, adeno, rhino, entero.

Treatment:

Difficult to distinguish from bacterial pneumonia.

Oxygenation and ventilatory assistance in severe cases.

Clinical case

January.....ahmed 1 months.....

- An older brother with an upper respiratory tract infection
- 3 days of rhinorrhoea and cough accompanied by low grade fever.
- Admitted to the Emergency Department for an episode of apnoea with mild respiratory distress with retractions and reduced oral intake of fluid (<50%)in the last 12 hrs

CLINICAL DEFINITION

The diagnosis of bronchiolitis is a clinical one based on typical history and findings on physical examination. Clinicians in different countries use different criteria to diagnose acute bronchiolitis.

A consensus guidelines panel reported a 90% consensus on the definition of bronchiolitis as a seasonal viral illness characterized by fever, nasal discharge and dry, wheezy cough.

On examination there are fine respiratory crackles and/ on high pitched expiratory wheeze.

ERS

Bronchiolitis: Definition



Age <24 months

Signs of viral infection
+
Wheeze

American Academy of Pediatrics.
2006; 118(4):1774-1793



Age <12 months

Signs of viral infection
+
widespread crackles
+/-
wheeze

Everard, Ped Clin N Am 2009;56:119

BRONCHIOLITIS

Lower respiratory tract infection in children < 24 months of age.

It involves large and small airways
tracheobronchitis, bronchiolitis and alveolar and interstitial lung involvement (pneumonia).

Etiology:

Viral: RSV; adenovirus (3,7,21), influenza;
parainfluenza (3); rhinovirus; mumps.

Others: Mycoplasma pneumoniae.

RSV season?

- Ubiquitous throughout the world
- Seasonal outbreaks
 - Temperate **Northern hemisphere**: November to April, peak January or February
 - Temperate **Southern hemisphere**: May to September, peak May, June or July
 - Tropical Climates: **rainy season**
 - **In Saudi Arabia RSV appears in November and the seasonal peak occurs during Jan. & Feb.**

BRONCHIOLITIS (cont.)

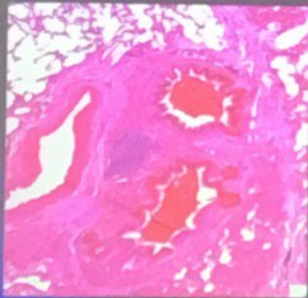
C/P: Usually in mid-winter.

Fever, rhinitis, cough, dyspnea poor feeding and vomiting.

P/E: tachypnea, chest retractions and wheezing.
Mild conj. and otitis media.

CXR: non-specific, air trapping, atelectasis, and consolidation.

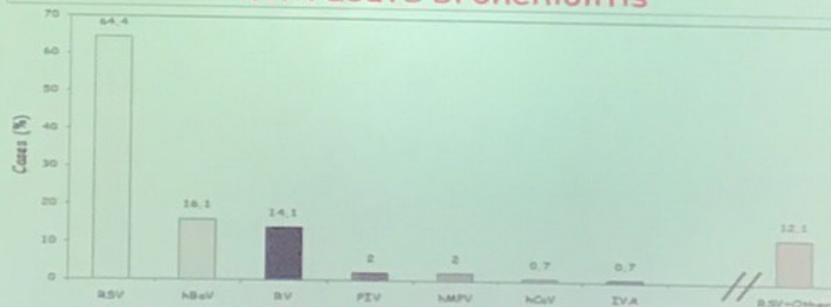
Pathophysiology



- Upper → lower airways
 - Peribronchiolar mononuclear infiltration
 - Epithelial necrosis
 - Airway plugging
 - Hyperinflation, atelectasis, V/Q mismatching
 - Hypoxemia, work of breathing

ERS

Distribution of identified virus in 182 infants with acute bronchiolitis



Midulla et al. Arch Dis Child 2010;95(1):35-41.

RSV is the most common causative organism

BRONCHIOLITIS (cont.)

Pathology: Inflammation of small bronchi and bronchioles, sloughing of resp. ciliated epi.

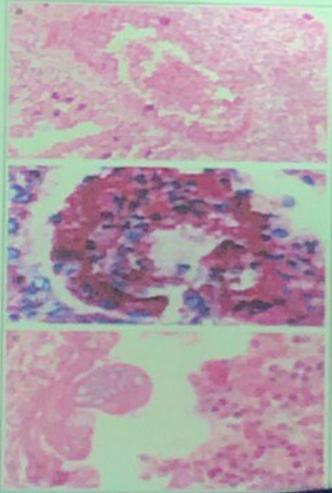
The bronchioles are plugged with fibrin and mucus – bronchiolar obst. – increase work of breathing + **V/Q mismatching – hypoxemia.**

CO₂ retention is uncommon, but if present it may lead to assisted ventilation.

ERS

Pathogenesis

- Mechanical occlusion of terminal and respiratory bronchiole with mucus, fibrin, epithelial cells and inflammatory cells.
- Effects of the immunological reaction and of inflammatory mediators.



Medium-size airway with intraluminal dead epithelium, inflammatory cells and amorphous debris

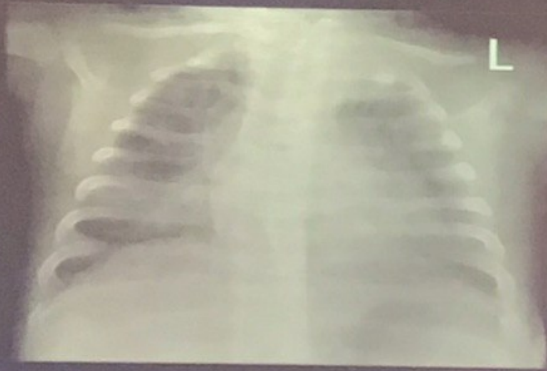
Intraluminal debris includes mucus, fibrin, epithelial cells and inflammatory cells.

Intrabronchiolar syncytia adjacent to intraluminal cellular debris

Modern Pathology 2007; 20:108-119

Bronchiolitis: *clinical manifestations*

- Exposure to children or adults with a respiratory viral infection.
- The initial symptoms are rhinorrhoea, cough and sometimes low grade fever. In 18% of cases the first clinical symptom could be episodes of apnoea.
- With the relief of fever the child manifests tachypnoea, retractions, nasal flaring, rales and hypoxemia
- Dehydration and metabolic acidosis.
- Syndrome of inappropriate secretion of antidiuretic hormone is common with severe respiratory distress.
- It is a dynamic disease and its clinical characteristics can quickly change



CXR shows Air trapping

BRONCHIOLITIS (cont.)

Complications:

Atelectasis, apnea and respiratory failure. Bronch obliterations (esp. with adeno) &.myocarditis

Majority: Mild to moderate disease lasting 3-10 days.
2% require hospitalization; of those 3-7% develop respiratory failure and 1% die.

High risk:

Children with Cardiopulmonary disease (e.g. BPD, CF, VSD), immune deficiency and neonates.

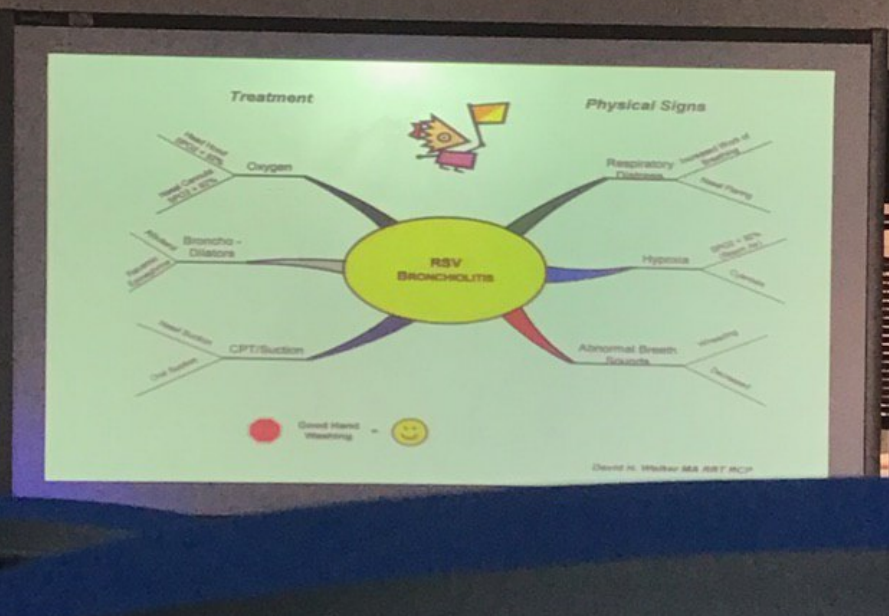
Tachypnea → muscle fatigue → apnea

RISK FACTORS OF SEVERITY

- Prematurity
- Low birth weight
- Age less than 6-12 weeks
- Chronic pulmonary disease
- Hemodynamically significant cardiac disease
- Immunodeficiency
- Neurologic disease
- Anatomical defects of the airways

ENVIRONMENTAL RISK FACTORS

- Older siblings
- Concurrent birth siblings
- Native American heritage
- Passive smoke exposure
- Household crowding
- Child care attendance
- High altitude



RSV bronchiolitis
 Signs: respiratory distress, hypoxia and abnormal breathing.
 Treatment: oxygen, bronchodilator and chest physiotherapy / suction

- ERS
- Bronchiolitis: "Indications for hospitalization"**
- Prematurity
 - Age <3 months
 - Apnoea
 - Severe underlying conditions
 - Poor feeding (less than 50%)
 - Respiratory distress (RR >60/min, nasal flaring, retractions) and cyanosis
 - Oxygen saturation <92%
- Phase of illness should be considered in the decision for timing of review or admission to hospital
- Scottish Intercollegiate Guideline Network, 2006

BRONCHIOLITIS (cont.)

Treatment:

Admit: if sig respiratory distress, dehydration, underlying disease.
O2 sat, CXR, NP aspirate.
Oxygen, IPPV (apnea, fatigue)
IV fluid
BD: 30% respond to salbutamol.
Steroids: **not recommended**.
Ribvirin : for RSV, Inf A & B to high risk group, given nebulization 12-18 hr/day for 3-7 days
Recemic epi: .

Ribvirin has teratogenic effect that may affect the drug giver ex; nurses

Pediatrics (2002) 110, 644-647
DOI: 10.1097/00006123-200211000-00015

ORIGINAL ARTICLE

Martin Chaloupeau
Lawrence Fain-El-Hellou
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Rib fractures after chest physiotherapy for bronchiolitis or pneumonia in infants



Table 1. Summary of medical histories and radiological signs

Case	Age (months) at the time of chest physiotherapy	Chest physiotherapy indication	Age (months) at the time of rib fracture diagnosis	Fractured ribs
1	1	Bronchiolitis	2	Left ribs 10 to 12
2	1	Pneumonia	2	Posterior right ribs 10, 12
3	2	Bronchiolitis	3	Posterior left ribs 10, 12
4	2	Bronchiolitis	3	Anterior left ribs 10, 12
5	6	Bronchiolitis	7	Anterior right ribs 10, 12

TABLE 1
**Prophylaxis with Palivizumab
 or RSV-IG*— Categories of Risk**

Infants and children less than two years of age with known CLD who required medical therapy for CLD within six months of the anticipated start of the RSV season.

Preterm infants born at 28 weeks of estimated gestational age or earlier may benefit from prophylaxis during their first RSV season, whenever that occurs during the first year of life, even if CLD is not present.

Preterm infants born at 29 to 32 weeks of estimated gestational age or earlier may benefit from prophylaxis during their first RSV season, whenever that occurs during the first six months of life, even if CLD is not present.

Infants born at 32 to 35 weeks of estimated gestational age must have two of the following risk factors to be candidates for prophylaxis: attendance at a child-care center, school-aged siblings, exposure to environmental pollution, abnormalities of the airways, or severe neuromuscular problems.

RSV-IG = intravenous RSV immune globulin (RespiGam); CLD = chronic lung disease; RSV = respiratory syncytial virus.

*—RSV-IG is contraindicated in children with cyanotic congenital heart disease.

Palivizumab (monoclonal antibody) for high risk babies e.g.; preterm babies , baby with congenital heart disease, cystic fibrosis and immunodeficiency.

PREVALENCE OF BACTERIAL INFECTION IN CHILDREN WITH A DOCUMENTED RESPIRATORY SYNCYTIAL VIRUS LOWER RESPIRATORY TRACT INFECTION

METHODS

In this retrospective study¹¹ the authors reviewed the medical records of children aged <6.5 yrs discharged between July 1, 2000 and June 30, 2002 with a documented diagnosis of respiratory syncytial virus (RSV) infection. The presence and degree of fever at the time or before admission, complete and differential blood cell count and culture results (cerebrospinal fluid, blood culture, suprapubic aspiration urine, catheterized urine) obtained on the first day of hospitalization were assessed.

RESULTS

A total of 912 patients with a median age of 135 days (range 6–2,398 days) were selected. Fever was present at or before admission in 828 (89.9%) of the 912 patients. None of the 63 (95.5%) patients aged <30 days, and none of the 135 (89.4%) patients aged 30–90 days had positive blood cultures. Urine cultures were positive in six of 45 patients aged <30 days, 14 of 84 patients aged 30–90 days and eight of 95 patients aged >90 days. Cerebrospinal fluid cultures obtained in 57.6% of febrile patients aged <30 days, 29.9% of patients aged 30–90 days and 4.4% of patients aged >90 days were negative.

CONCLUSIONS

Concurrent serious bacterial infections appear to be rare in children with a documented RSV lower respiratory tract infection. Blood and cerebrospinal fluid cultures may not be necessary in nontoxic-appearing infants and young children with fever and a documented RSV lower respiratory tract infection, even in those aged <3 months.

Bronchiolitis: discharge criteria

- Oxygen saturation stably remains >90-94%
- Absence of respiratory distress
- Adequately oral intake to prevent (>75% of usual intake) to prevent dehydration
- Adequate parental care and family education

Never ever discharge patient if oral intake less than 50% of usual intake

MYCOPLASMA PNEUMONIA

- Peak incidence 5-15 year (account for 75% of pneumonia in this age group)
- C/P: Insidious onset of fever, headache and sore throat followed by dry cough that can last for months.
- Other organs: Meningoencephalitis, carditis, migratory arthralgia and arthritis, hemolytic anemia, +ve coomb's and cold agglutinins.

MYCOPLASMA PNEUMONIA (cont.)

Investigations:

- CXR: Not specific, unilateral or bilateral disease, 20% has pleural effusion.
- CBC: WBC is usually normal.
- Cold agglutinin > 1:64.
- Serology: 4 fold increase in CFT.

Treatment: Erythromycin, may not alter the duration or sequela (may decrease the duration of cough).

BACTERIAL PNEUMONIA

Etiology:

Neonatal period: GBS, listeria monocytogenes and gram -ve bacilli.

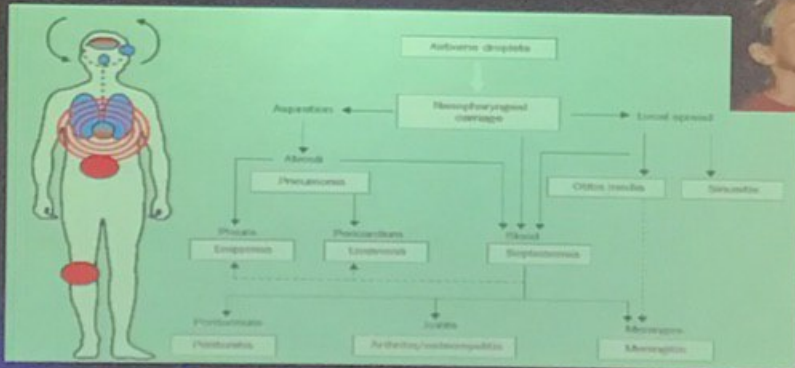
After neonatal period: S pneumoniae, H. flu type B, staph. Aureus, GAS.

Mycoplasma is quite common >5y.

After age of 4 – 5 years: S. pneumoniae and mycoplasma responsible for the majority of cases.

Bacterial adhesion and invasion:

- *Streptococcus pneumoniae* -



BACTERIAL PNEUMONIA (cont.)

Pathology:

Normally the resp. tract is **sterile** below the vocal cords. Pneumonia result from asp. Of pathogen to lower resp. tract. Concurrent viral infection aid this process (present in 30-50% of cases) esp. RSV, measles and influenza.

BACTERIAL PNEUMONIA (cont.)

C/P: Fever, chills, cough, chest and abdominal Pain.
Younger infants less specific symptom and signs

Diagnosis:

CBC – dif, cold agglutinin

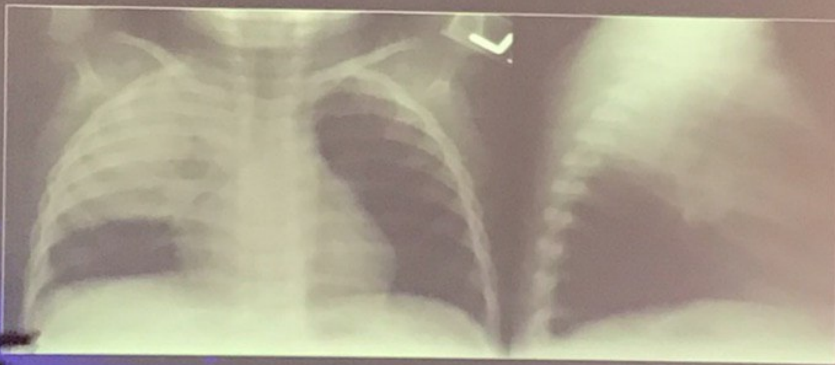
CXR

Blood culture, sputum in older children

Treatment:

- 1) Adequate oxygenation.
- 2) Depends on severity and age. Ampicillin or amoxicillin (10-30% of H flu are resistance) cefuroxime 75-100mg/kg/day
- 3) Older child: Penicillin or macrolides =>erythromycin (clarithromycin or zithromax)

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What are the indications for transfer to intensive care?

There are two main scenarios when a child is likely to need admission to an intensive care unit:

- (1) When the pneumonia is so severe that the child is developing severe respiratory failure requiring assisted ventilation;
- (2) A pneumonia complicated by septicaemia.

Key features that suggest a child requires transfer include:

- ✓ Failure to maintain oxygen saturation $>92\%$ in fractional inspired oxygen of >0.6
- ✓ Shock
- ✓ Rising respiratory and pulse rate with clinical evidence of severe respiratory distress and exhaustion, with or without a raised arterial carbon dioxide tension
- ✓ recurrent apnoea or slow irregular breathing.

What are the indications for referral and admission to hospital?

- Significant tachycardia for level of fever (values to define tachycardia vary with age and with temperature)
- Prolonged central capillary refill time >2 s
- Difficulty in breathing;
- Intermittent apnoea, grunting;
- Not feeding;
- Chronic conditions (eg, congenital heart disease, chronic lung disease of prematurity, chronic respiratory conditions leading to infection such as cystic fibrosis, bronchiectasis, immune deficiency).

Features of severe disease in an older child include:

- Oxygen saturation $<92\%$, cyanosis
- Respiratory rate >50 breaths/min
- Significant tachycardia for level of fever (values to define Tachycardia vary with age and with temperature)
- Prolonged central capillary refill time >2 s
- Difficulty in breathing; grunting
- Signs of dehydration
- chronic conditions (eg, congenital heart disease, chronic lung disease of prematurity, chronic respiratory conditions leading to infection such as cystic fibrosis, bronchiectasis, immune deficiency)

BACTERIAL PNEUMONIA (cont.)

Complications:

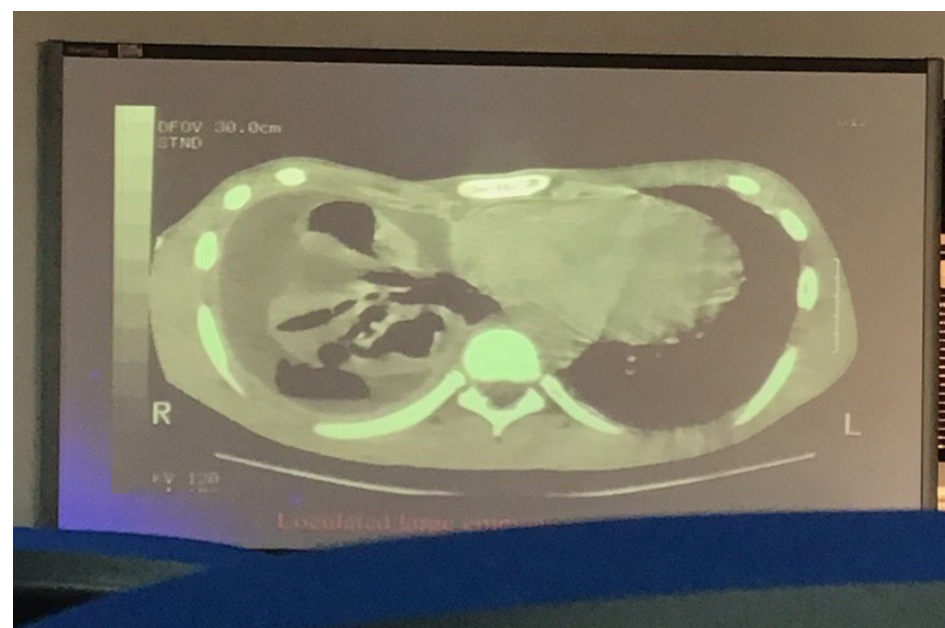
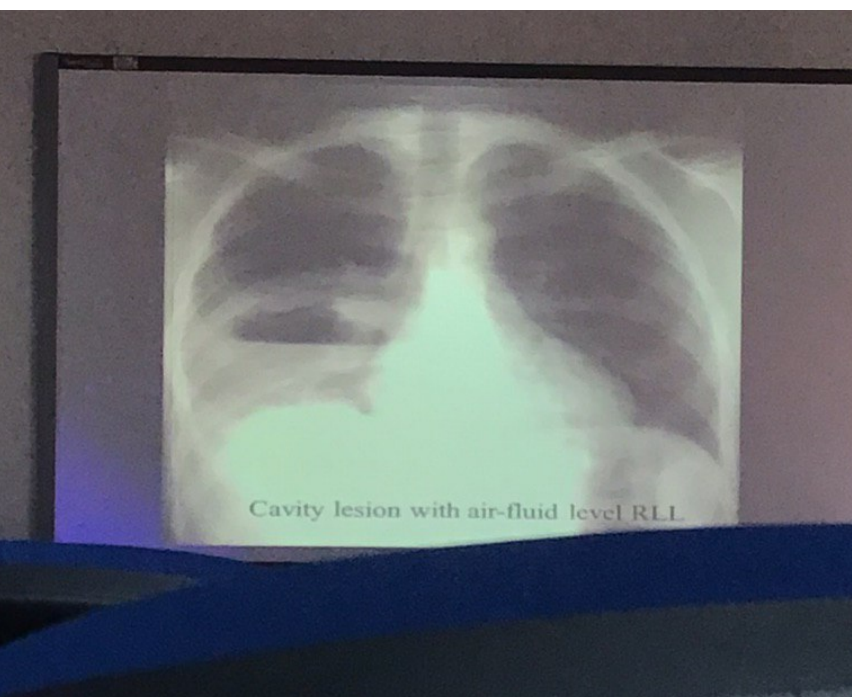
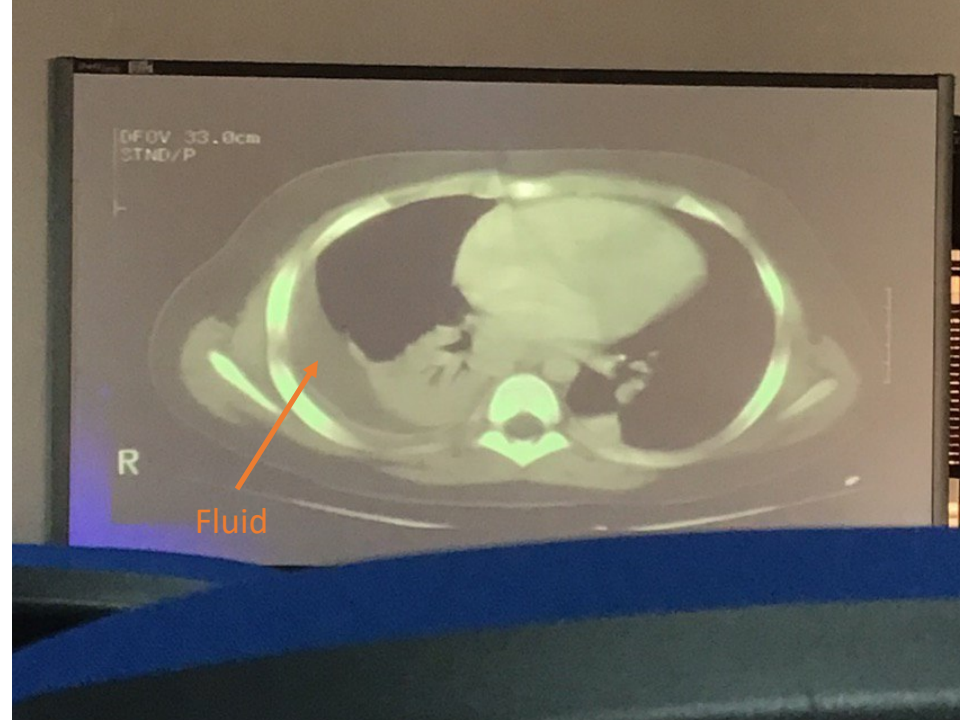
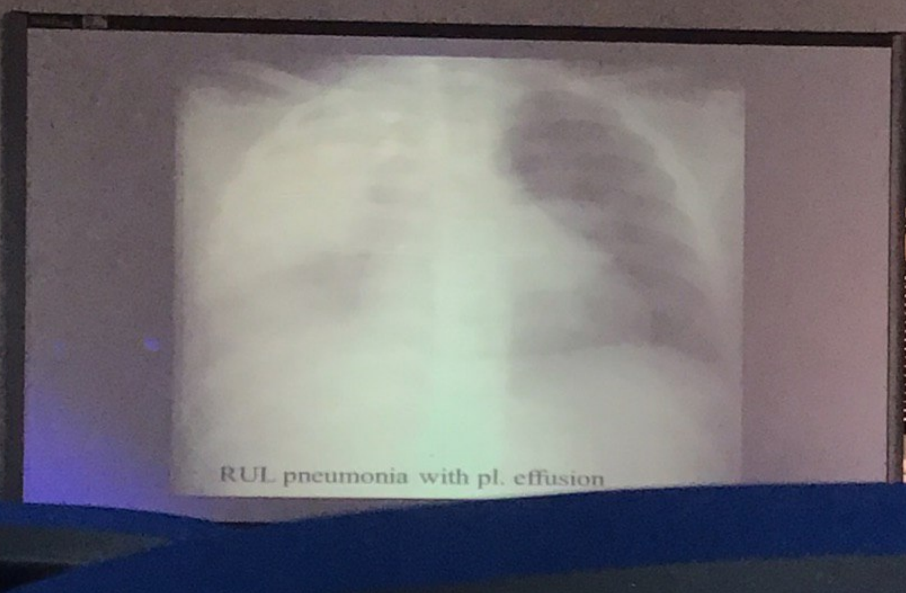
1) Parapneumonic effusion:

Esp. with *S. aureus*, *H flu*, *S pneumoniae*. Can be thin transudate or thick exudates (empyema)

Send pl fluid for cell count, glucose, protein, pH, LDH and culture.

Empyema WBC $> 15,000/\text{mm}^3$, protein >3 g/dl, pH <7.2

Management: ABX + drainage, recovery is slow, fever continue for 1 – 2 weeks.



2) **Pneumatocoles:** Thin wall cavity, complicate 40% of staph pneumonia, unusual with other types. Usually asymptomatic unless rupture – pneumothorax or pyothorax. Resolve spontaneously within 3 months

2) **Lung abscess:** Esp in aspiration pneumonia in mentally retarded children. Esp. in the dependent portion of the lung.

- Growth: mixed anaerobic bacteria

Treatment: Pen G, clinda or flagyl.



The predisposing factors to necrotizing pneumonia include

- Congenital cysts
- Sequestrations
- bronchiectasis,
- neurological disorders
- Immunodeficiency

certain serotypes of pneumococcal disease are more likely to lead to necrotizing pneumonia and abscess formation than others

- S aureus with Pantone Valentine leukocidin toxin can lead to severe lung necrosis with a high risk of mortality

So we should follow the child who got pneumonia for one year

3. Septicaemia and metastatic infection

Children can present with symptoms and signs of pneumonia but also have features of systemic infection. Children with septicaemia and pneumonia are likely to require high dependency or intensive care management. Metastatic infection can rarely occur as a result of the septicaemia associated with pneumonia.

Osteomyelitis or septic arthritis should be considered, particularly with S aureus infections.

4. Haemolytic uraemic syndrome

S pneumoniae is a rare cause of haemolytic uraemic syndrome.

A recent case series found that, of 43 cases of pneumococcal haemolytic uraemic syndrome, 35 presented with pneumonia and 23 presented with empyema. Although a rare complication, in cases with pallor, profound anaemia and anuria, this should be considered

TUBERCULOSIS

- ✓ The vast majority of childhood TB occur in children < 4 y usually after exposure to an infected adults.

(i.e. children infected with TB always have an adult with active TB in their environment).

- ✓ Transmission is by droplet nuclei

TUBERCULOSIS (Cont.)

- ✓ Its distribution is worldwide
- ✓ Multi-drug resistance has emerged as an important clinical problem
- ✓ Infection in patients with HIV infection initially lead to increases in the number of cases

TUBERCULOSIS (Cont.)

- Adults with cavity harbor a great no. of bacilli for long time. They become non-infectious 2 weeks after therapy.
- Children with primary TB are rarely infectious, TB bacilli are sparse, but they are the long term reservoir of infection in the population.

TUBERCULOSIS (Cont.)

Etiology:

- Mycobacterium tuberculosis & M. bovis
Culture takes 4-6 w, sensitivity another 4 w.
- Radiometric methods, detection & sensitivity 4-10 d.
- By DNA probes detection within 2 hrs.

Problems in the diagnosis of TB

- **Active disease**

- *M. tuberculosis* is difficult to isolate: even with good microbiological facilities, the bacillus is recovered in only 50-60% of cases

- **Latent infection**

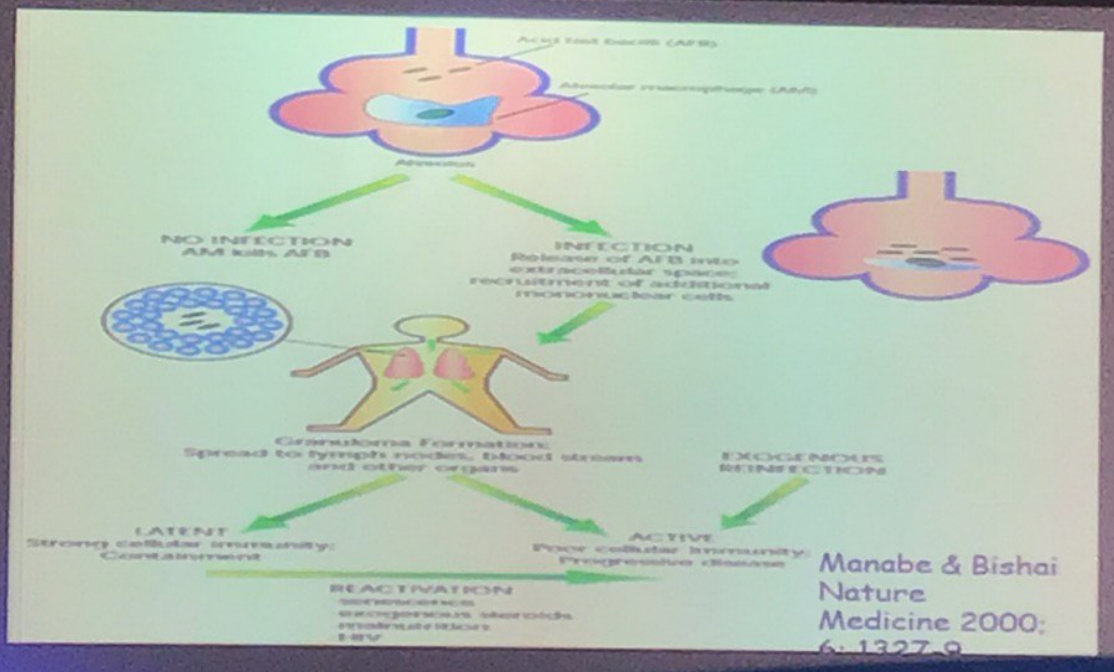
- *M. tuberculosis* cannot be cultured from latently infected individuals: no gold standard

Clinical features

- > insidious onset
- > weight loss
- > anorexia
- > fever
- > hepatosplenomegaly
- > Headache almost always = meningitis
- > abdominal pain and tenderness usually = peritonitis.
- > Skin and eye tubercles (Tuberculous Uveitis)

PPD: – ve in 30%

CXR: may be characteristic.



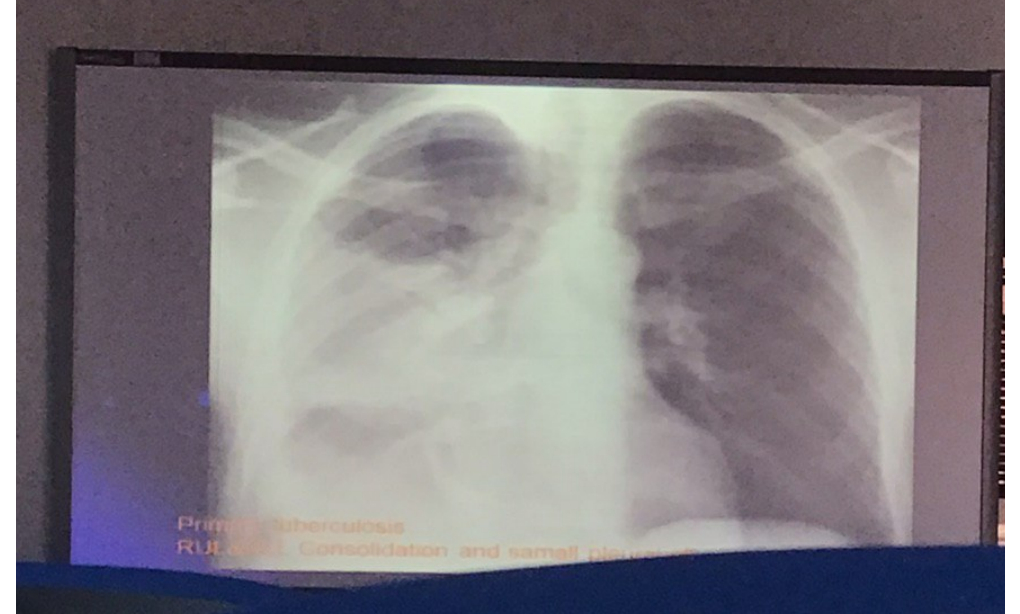
Timetable of disease after primary infection in children

- **3-8 weeks:**
 - TST response
 - Hypersensitivity reactions
 - Erythema nodosum
- **1-3 months:**
 - Hematogenous spread (meningitis and miliary in infants)
- **3-7 months:**
 - Bronchial disease (< 5 years)
 - Pleural effusions (>5 years)
- **1-3 years:**
 - Osteo-articular disease
 - Calcifications
 - Adult-type disease
- **> 3 years:**
 - Reactivation

Diagnosis of TB infection

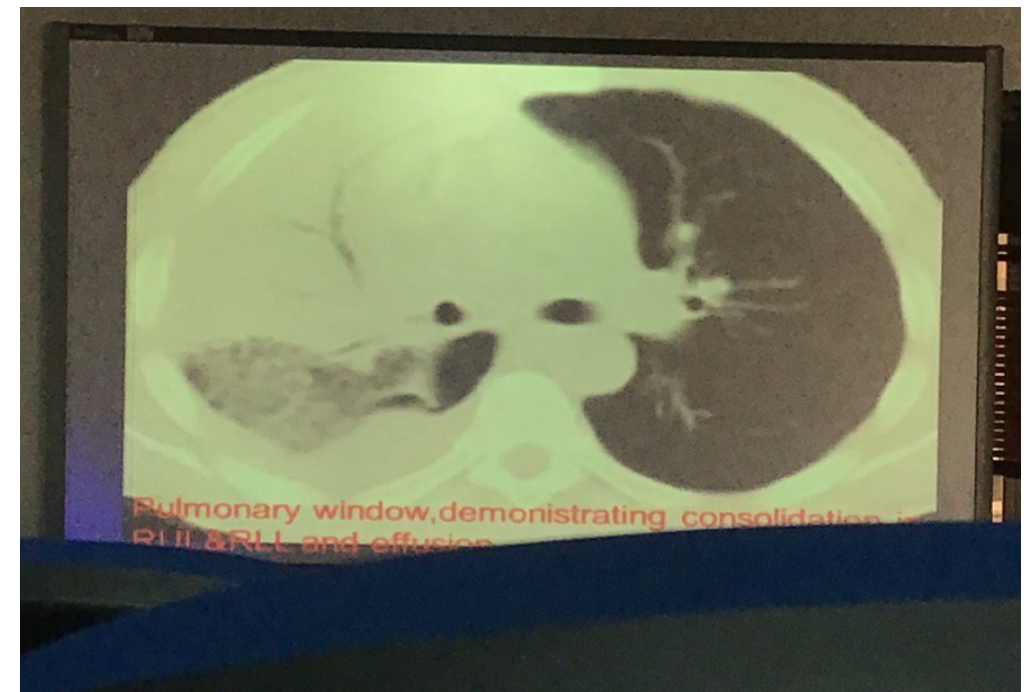
- Diagnosis of latent TB infection relies on the Tuberculin Skin Test (TST)
- Poor specificity
 - False +: BCG vaccination, environmental mycobacterial exposure
 - False -: malnutrition
- Operational drawbacks + return visit
 - Need for a more rapid and accurate test for latent TB infection

Think of TB for any patient that has been treated as pneumonia without improvement



BCG

- BCG vaccination is effective against severe forms of TB (meningitis and miliary TB)
- TB testing is not required before BCG vaccination in young children
(Bothamley, BMJ 2 August 2003)
 - BCG can be used as a diagnostic test for TB (Koch phenomenon)
 - Complications are rare and are not more common in TB patients (10371 / 1.5 billion BCG)
- BCG vaccination is not recommended in HIV-positive children



Complications

Most occur in the 1st year.

- 1) Miliary TB & TB meningitis: not later than 3-6 mo. after initial infection.
- 2) Endobronchial TB: within 9 mo.
- 3) Bones or joints: within 1 y.
- 4) Renal: 5-25 y.
- 5) Secondary reactivation.

Suggested criteria for diagnosis of TB in children

Suspected/probable

Any three of the following:

1. History of contact with an adult with suspected or proven
2. Symptoms and signs of TB such as persistent fever, cough, weight loss, failure to thrive, anorexia, respiratory distress, decreased breath sounds, rales on chest examination, lymphadenopathy, etc.
3. Positive Mantoux or PPD more than 10mm of indurations
4. Chest radiographic Findings such as an infiltrate or Lymphadenopathy

Confirmed

- A positive AFB smear or culture of gastric aspirate or other body fluid or
- Histological Findings consistent with TB

Treatment

- **First line** : INH, rifampin, pyrazinamide ethambutol and streptomycin
- **Second line** : para-aminosalicylic acid, ethionamide, caperomycin, kanamycin and cycloserine.

Treatment



- INH + rifampin X 9 mos. will cure 98%.
- Shorter courses (6 mos.) using more drugs; INH, rifampin and pyrazinamide for 2 mos. followed by 4 mos. of INH and rifampin.

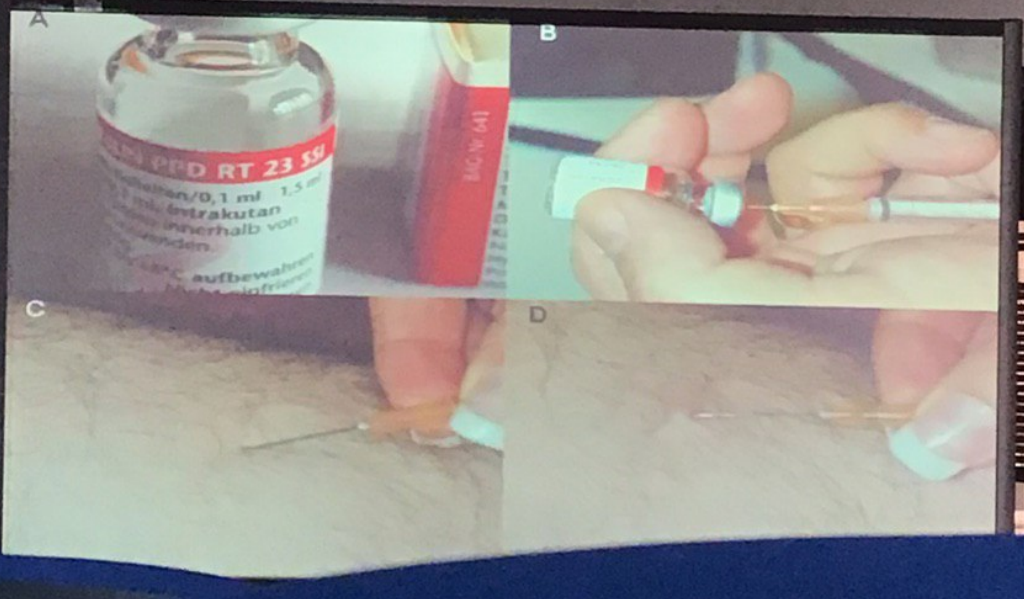
The 9 mos. approach is the one recommended for children.

Treatment

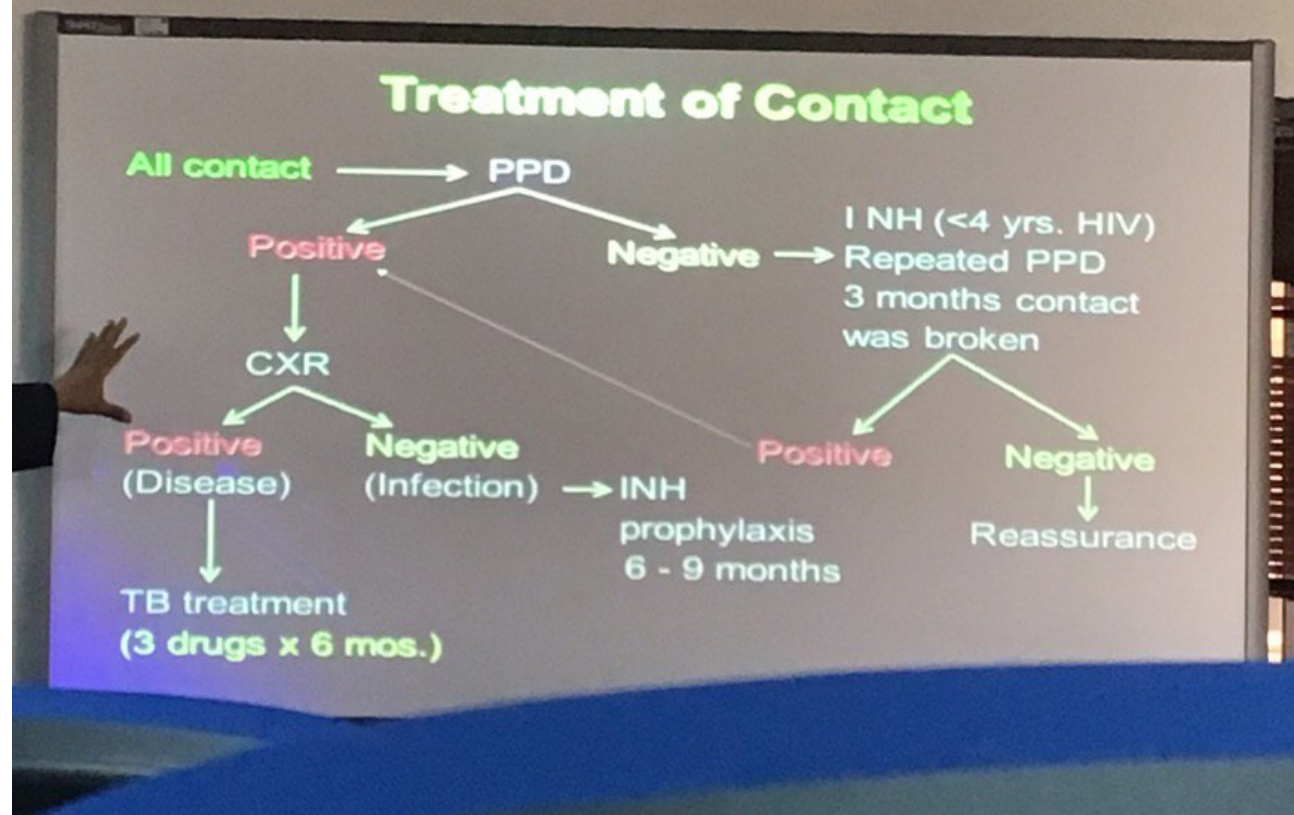
STEROIDS

Use only with anti-TB med indicated in:

- 1) TB meningitis and increased ICP due to brainstem inflam and resultant HC.
- 2) Endobronchial TB → collapse or air trapping.
- 3) Miliary TB with pericarditis, pleural effusion or peritonitis.



Look for induration not the redness



If PPD -ve : For child less than 4 years give isoniazid for 3 months

If PPD and CXR are +ve → treatment for **one year** (6 months in Europe)

