Pediatric Respiratory Emergencies

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Respiratory Emergencies

Download

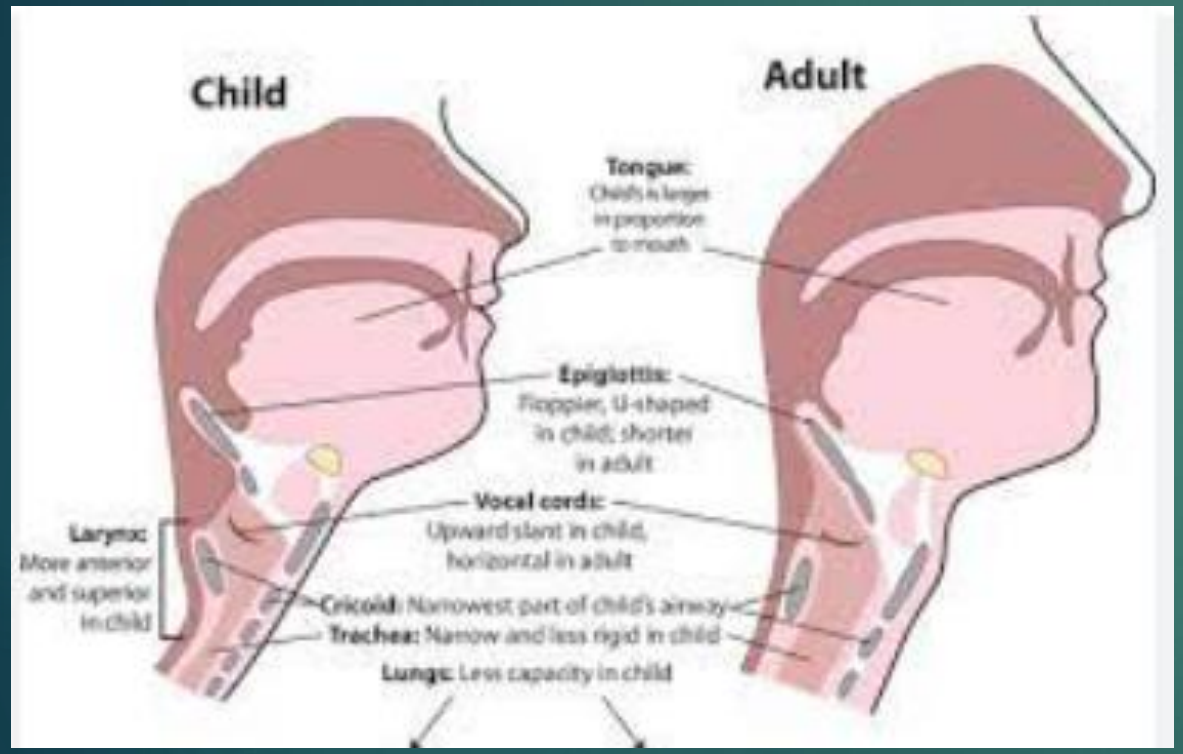
- Upper Airway Obstruction
  - Croup
  - Epiglottitis
  - Foreign Body Aspiration
  - Anaphylaxis
  - Peritonsillar or retropharyngeal abscess
- Lower Airway Obstruction
  - Asthma
  - Bronchiolitis
- Lung Tissue Disease
  - Pneumonia
  - Pulm Edema
    - CHF
    - ARDS
    - Sepsis
    - Pulm Contusions
- Disordered Control of Breathing
  - Neurologic Disorders

Kids are not little Adults

Child vs Adult

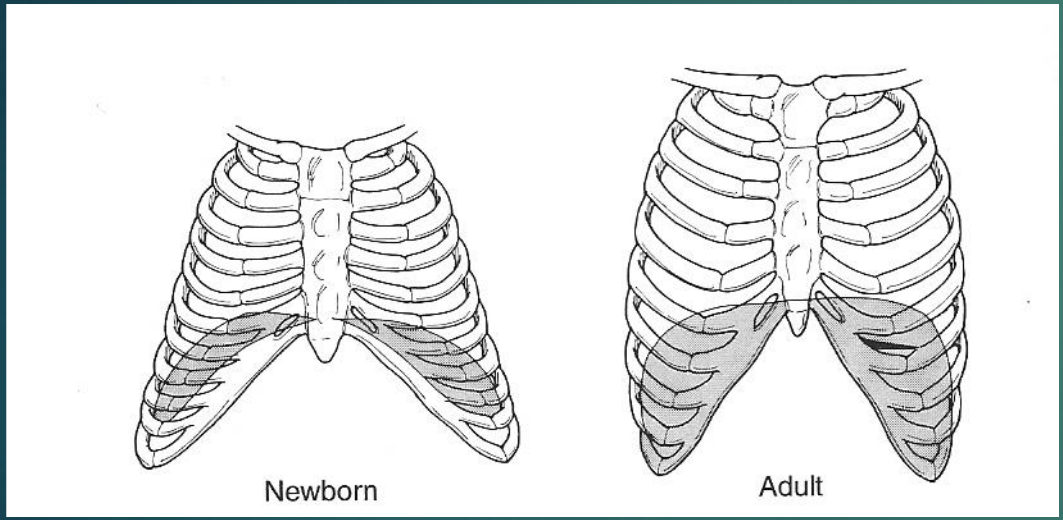
- Head to Body ratio and relative size and location of anatomic features make children more susceptible to head and abdominal injury
- Underdeveloped anatomy leads to chest pliability and less protection of thoracic cage and less effective use of accessory muscles
- Arrest – Cardiac arrest typically results from untreated respiratory arrest

Airway: Child vs Adult



- **NOSE:** Generally smaller, increased resistance, Smaller septum & nasal bridge is flat and flexible . . . Obligatory nose breathers
- **VOCAL CORDS:** located at C3-4 versus C5-6 in adults . . . Larynx is more anterior
  - Contributes to aspiration if neck is hyperextended
- **CRICOID RING** Is the narrowest part of the airway instead of vocal cords
- **AIRWAY DIAMETER** is 4 mm vs.. 20 mm in adult
- **TRACHEAL RINGS** more elastic & cartilaginous, can easily crimp off trachea
- More **SMOOTH MUSCLE**, makes airway more reactive or sensitive to foreign substances

Thorax - Child vs Adult



- Horizontal ribs – more diaphragmatic breathing
- Flatter Diaphragm
- Ribs & Sternum is cartilage - less stability of chest wall, requires more use of diaphragm
- Less pulmonary reserve
- Heart takes up more thoracic space
- Poor accessory muscle development
- Larger abdominal organs - pushes up diaphragm

Upper Airway Disease

Croup
Foreign Body
Epiglottitis
Bacterial Tracheitis

Noise during Inspiration

Proximal to Thoracic Inlet

Nose – Pharynx – Larynx

Awake/Crying

- If child Improves
  Nose/Pharynx
- If child Deteriorates
  Larynx

Lower Airway Disease

Asthma
Bronchiolitis
Pneumonia
Foreign Body

Noise during Exhalation

Distal to Thoracic Inlet

Trachea, Bronchi, Peripheral Airways

First sign of respiratory distress in most children

- 1. Tachypnea
- 2. Retractions
- 3. Cyanosis
- 4. Tachycardia
- 5.Position:"Sniff" & "Tripod"
- 5. Altered mental status

a. Agitation and irritability

b. Lethargy and decreased responsiveness

Aspirated Foreign Body

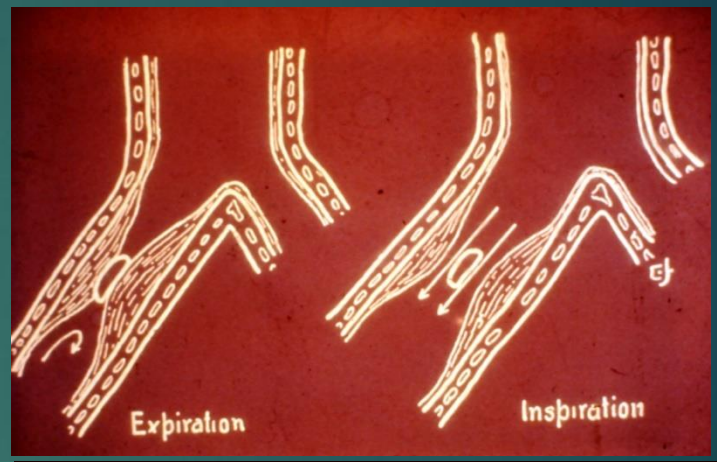
- Basics
  - Common among the 1-3 age group who like to put everything in their mouths
  - Running or falling with objects in mouth
  - Inadequate chewing capabilities
  - Common items - gum, hot dogs, grapes and peanuts

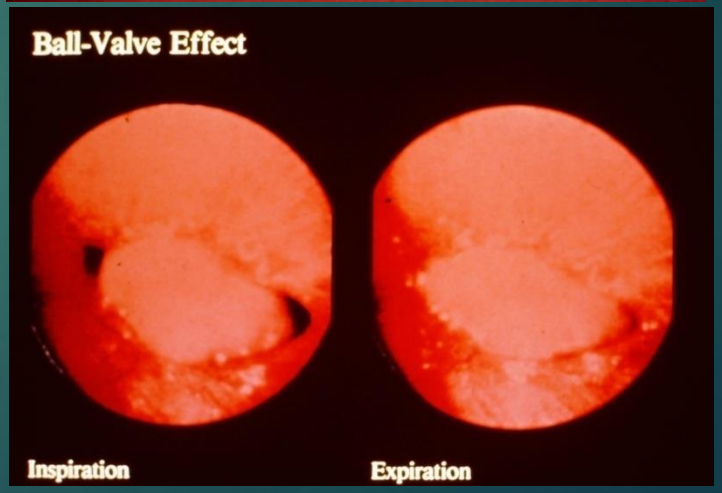
- ***In a large case series of FBA aspirations in children, the sites of the FB were as follows :***

- ***Larynx*** – 3 percent
- ***Trachea/carina*** – 13 percent
- ***Right lung*** – 60 percent (52 percent in the main bronchus, 6 percent in the lower lobe bronchus, and <1 percent in the middle lobe bronchus)
- ***Left lung*** – 23 percent (18 percent in the main bronchus and 5 percent in the lower bronchus)
- ***Bilateral*** – 2 percent

Aspirated Foreign Body

- Assessment
  - Complete obstruction will present as apnea
  - Partial obstruction may present as labored breathing, retractions, and cyanosis
  - Objects can lodge in the lower or upper airways depending on size
  - Object may act as one-way valve allowing air in, but not out

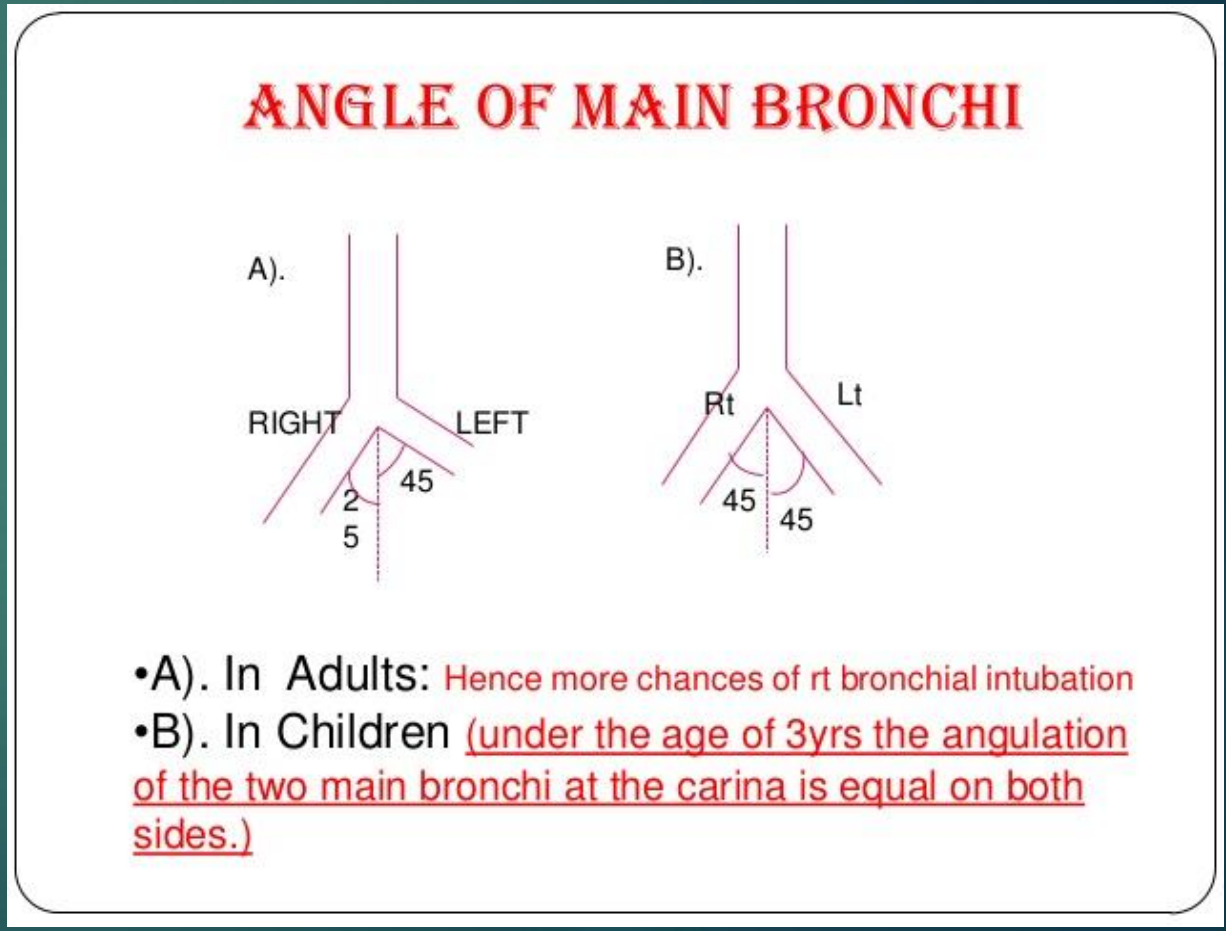




TRACHEOBRONCHIAL FOREIGN BODY

ANATOMY

- Right main bronchus:
  - 5 cm long, wider, shorter & more vertical than the Left main bronchus
  - It makes 25-30^0 with carina
- Left main bronchus:
  - 5.5cm long,2-3mm narrower then the Right main bronchus
  - more horizontal & making an angle of 45^0 with trachea



Signs and symptoms

- More commonly, children with FBA present with partial airway obstruction.
- The most common symptom is cough, followed by tachypnea and stridor, often with focal monophonic wheezing or decreased air entry.

- *The classic triad of wheeze, cough, and diminished breath sounds is not universally present.*

- ***Laryngotracheal FBA*** are uncommon (5 to 17 percent of FBs) but are ***particularly likely to be life-threatening.***
- Symptoms include stridor, wheeze, and dyspnea, and sometimes hoarseness.
- FBs in this location are most likely to present with acute respiratory distress, which must be addressed promptly.
- Laryngeal FBs or large penetrating FBs with sharp edges also may cause symptoms related to the esophagus.

Large bronchi

- The usual symptoms are coughing and wheezing. Hemoptysis, dyspnea, choking, shortness of breath, respiratory distress, decreased breath sounds, fever, and cyanosis may also occur .

- The right main bronchus is the most common location (45 to 55 percent of FBs), followed by left bronchus (about 30 to 40 percent of FBs), and bilateral bronchi (1 to 5 percent).

- Lower airways – Children with these FBs may have little acute distress after the initial choking episode.

History of choking

- A witnessed episode of choking, defined as ***the sudden onset of cough and/or dyspnea and/or cyanosis in a previously healthy child***, has a sensitivity of 76 to 92 percent for the diagnosis of FBA .

- The choking phase occurs immediately after the episode and lasts a few seconds to several minutes. The acute episode usually is self-limited and may be followed by a symptom-free period, which must not be misinterpreted as a sign of resolution since it may delay the diagnosis .

Suspected FBA

- All children with suspected FBA who are stable should undergo a focused history and physical examination, followed by plain radiography of the chest.

- The caregivers should be specifically asked about a history of a choking episode in the hours or days prior to symptom onset.

- ***A moderate or high suspicion of FBA*** is appropriate for all children with a witnessed FBA (regardless of symptoms), as well as for young children with suspicious respiratory symptoms or characteristics on imaging, especially if there is a history of choking. Suspicious symptoms include cyanotic spells, dyspnea, stridor, sudden onset of cough or wheezing (often focal and monophonic), and/or unilaterally diminished breath sounds.

- ***A low suspicion of FBA*** is appropriate if none of the above features are present. In this case, normal results of plain radiographs are sufficient to exclude radiopaque FBA, and lessen (but not completely eliminate) the concern for a radiolucent FBA. However, such patients should be observed, with follow-up in two to three days, and further evaluation (eg, bronchoscopy) if symptoms persist or progress.

Plain radiographs

- Plain radiographic evaluation of the chest may or may not be helpful in establishing the diagnosis of FBA, depending upon whether the object is radio-opaque, and whether and to what degree airway obstruction is present.
- The diagnosis of FBA is easily established with plain radiographs when the object is radio-opaque (about 10 percent of FBs)
- However, most objects aspirated by children are radiolucent (eg, nuts, food particles) , and are not detected with standard radiographs unless aspiration is accompanied by airway obstruction or other complications .
- Ideally, both inspiratory and expiratory radiographs should be obtained.

- ***As a result, normal findings on radiography do not rule out FBA, and the clinical history is the main determinant of whether to perform a bronchoscopy***.
- ***CT Scan ??***

In children with lower airway FBA, the most common radiographic findings in lower airway FBA are:

- *•Hyper inflated lung*
- *•Atelectasis*
- *•Mediastinal shift*
- *•Pneumonia*
- *Pulmonary abscesses and bronchiectasis are late manifestations of a retained airway*

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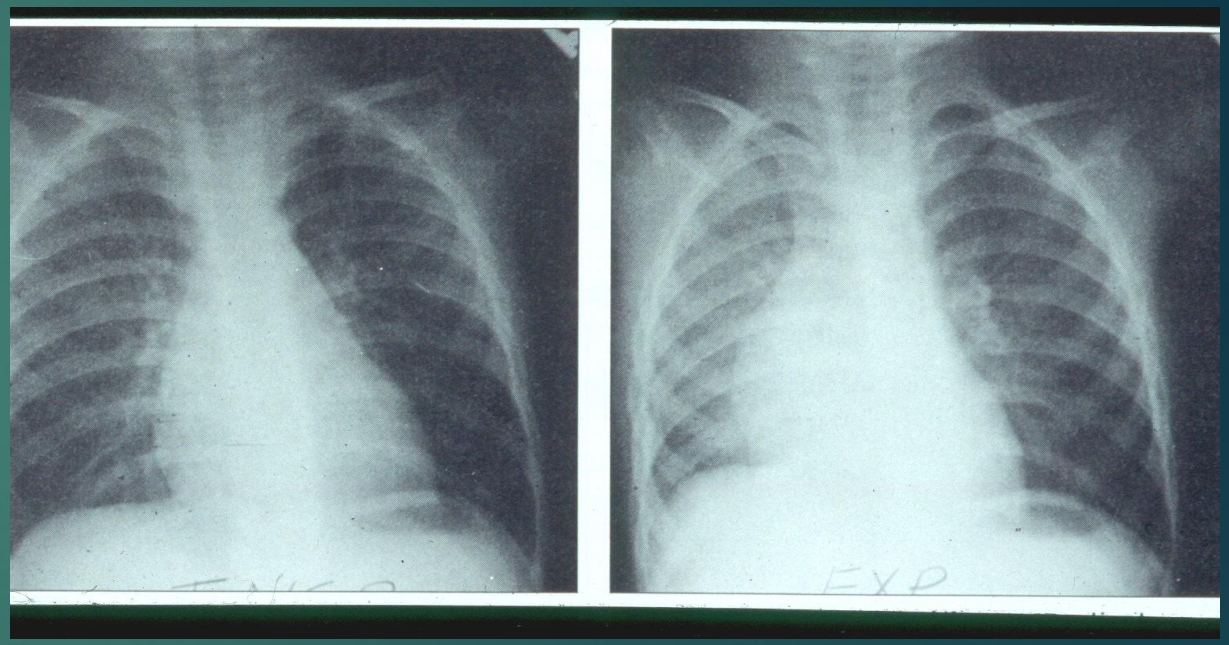


Inspiratory film on left, expiratory film on right ;
Foreign body in left mainstem bronchus

Atelectasis

After Removal

Life-threatening FBA

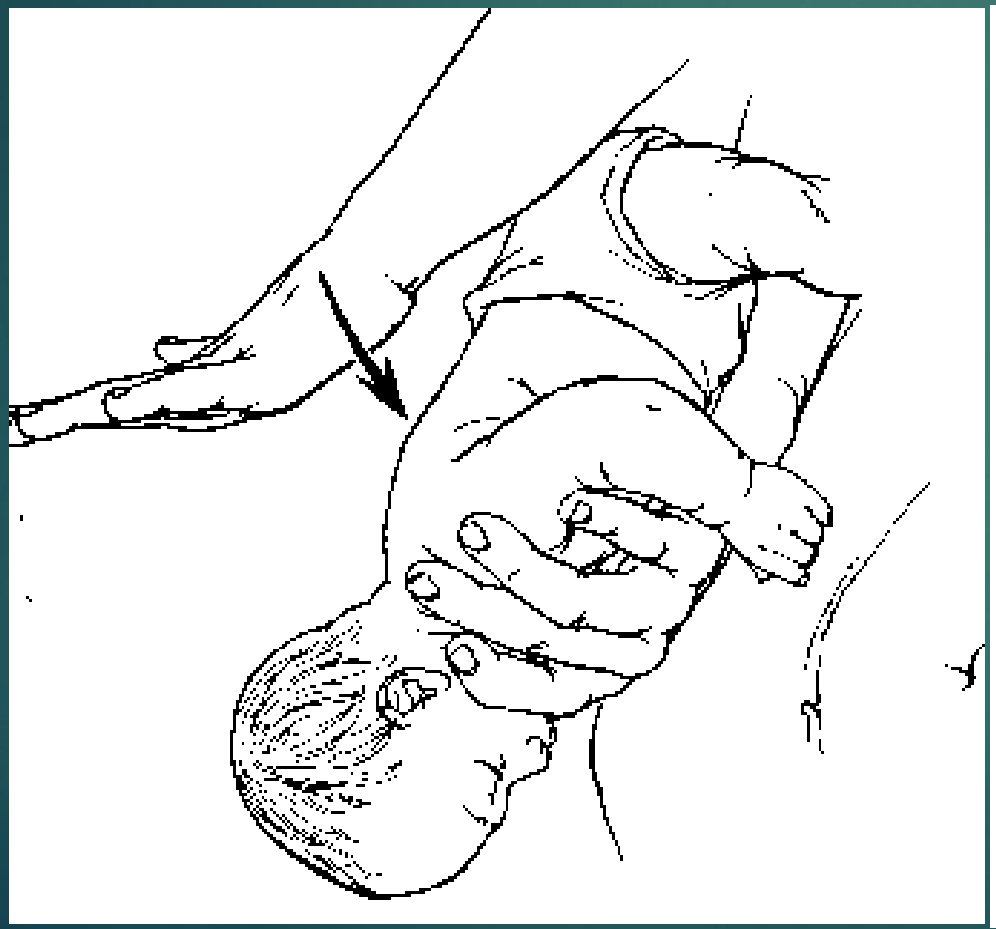
- If a child presents with complete airway obstruction (ie, is unable to speak or cough), dislodgement using back blows and chest compressions in infants, and the Heimlich maneuver in older children, should be attempted.

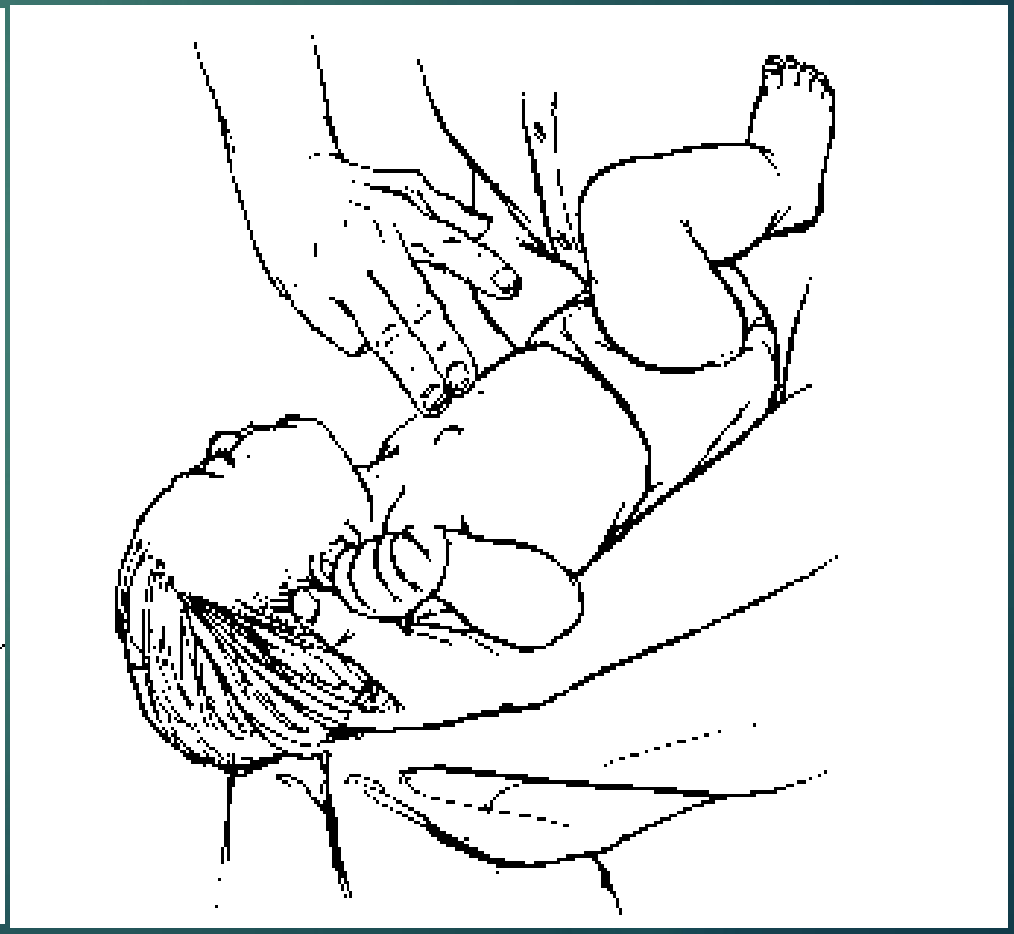
- In contrast, these interventions should be avoided in children who are able to speak or cough since they may convert a partial to a complete obstruction.

For the same reason "blind" sweeping of the mouth should be avoided.

Heimlich maneuver

Back Blow & Chest Thrust in an Infant





MANAGEMENT

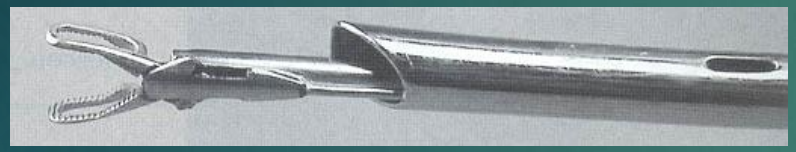
- When the obstructing FB is below the larynx and does not move with the AHA recommended procedures, intubation may permit some ventilation until rigid bronchoscopy is possible.

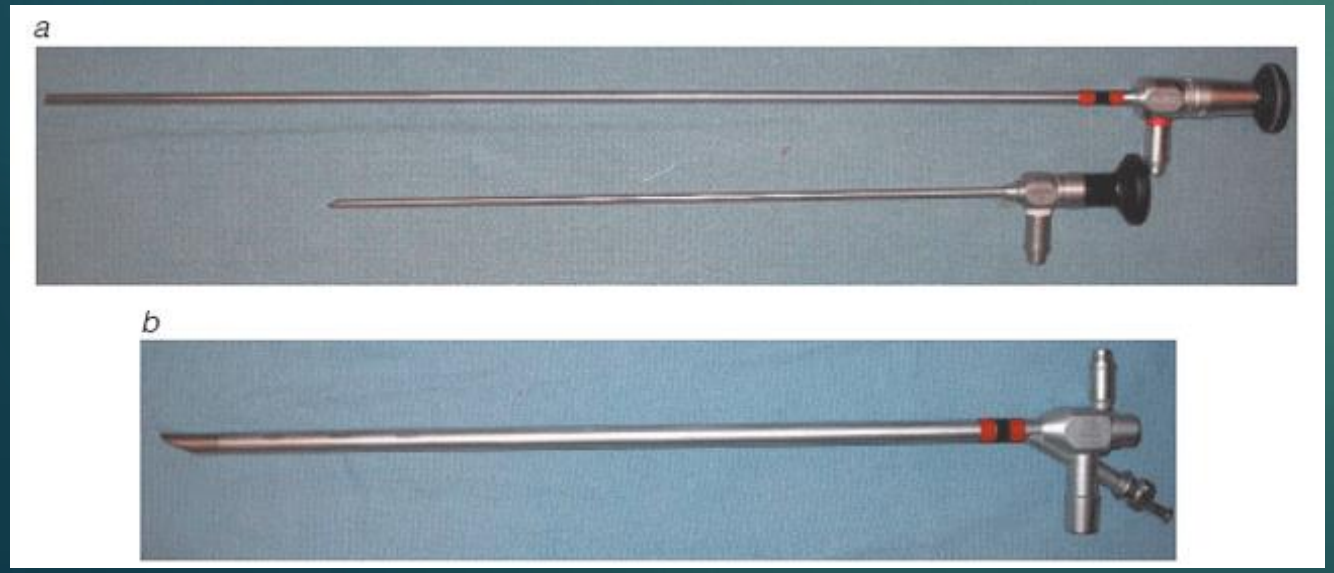
- The administration of oxygen and other life-sustaining care should be provided until bronchoscopy can be performed.

Bronchoscopy

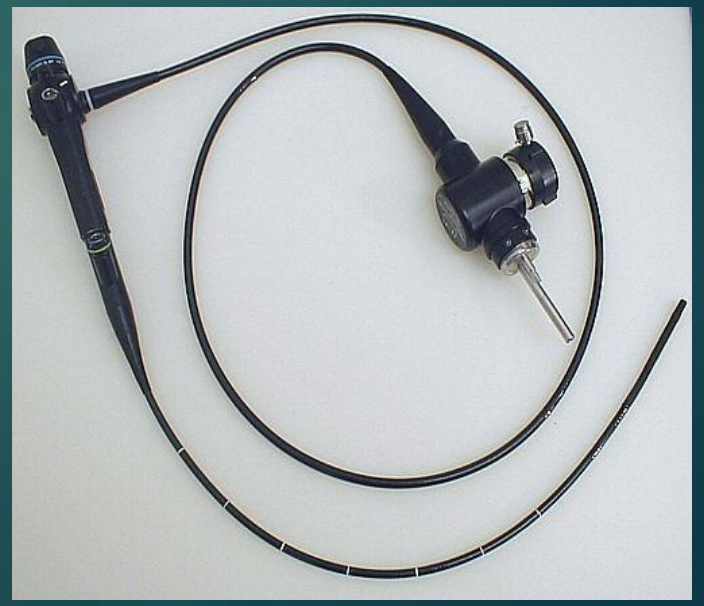
American Thoracic Society still recommends rigid bronchoscopy for removal

The Ultimate Diagnostic Tool

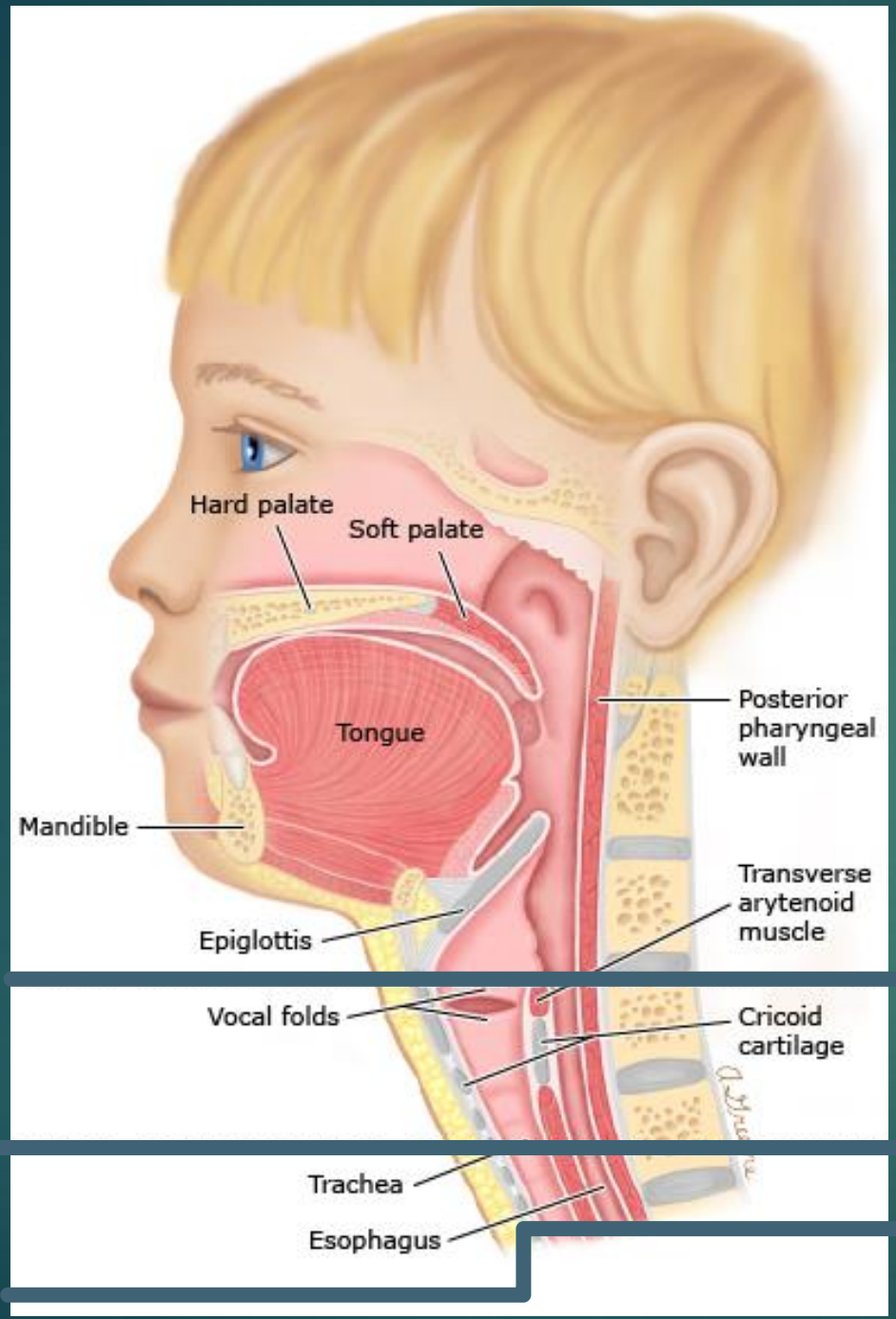




What About Flexible Bronchoscopy?



Stridor



Supraglottic Area (Insp. Stridor)

- Anaphylaxis
- **Epiglottitis**
- Retropharyngeal/Peritonsillar Absess
- **Laryngomalacia**
- Congenital Malformation
- Tumor of oral cavity or pharynx

Glottic & Subglottic Area (Insp. Stridor)

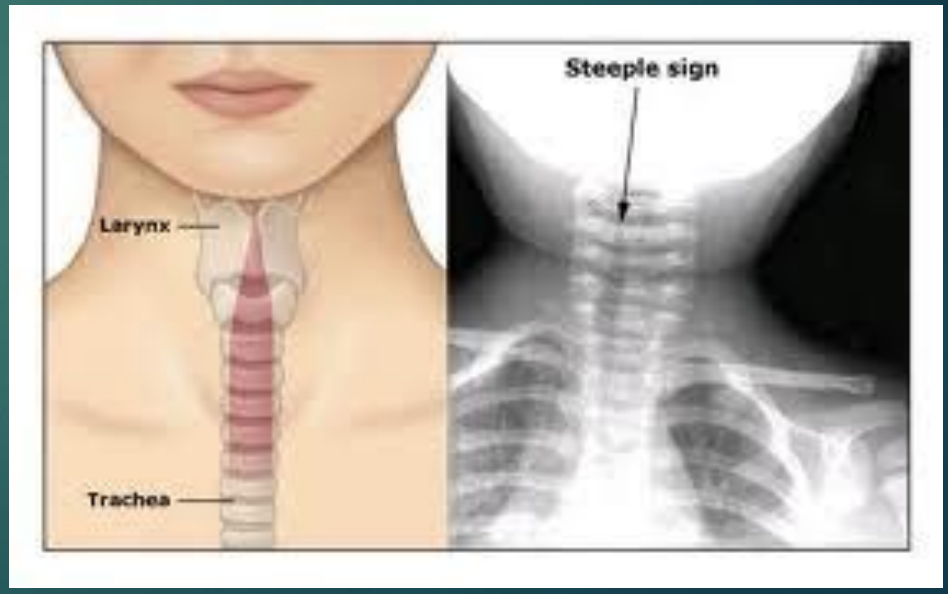
- **Laryngotracheitis (croup)**
- Tracheomalacia
- Anaphylaxis
- **Foreign Body in Airwdy**
- Subglottic Stenosis
- **Bacterial tracheitis**
- Vocal Cord Paralysis

Intrathoracic Area (Exp Stridor and/or Wheezing)

- **Infection (bacterial tracheitis, bronchitis)**
- **Foreign Body in Airway or Esophagus)**
- Anaphylaxis
- Congenital Malformation
- Tumor

Croup

- Upper respiratory viral infection
- Occurs mostly among ages 6 months to 3 years
- More prevalent in fall and spring
- Edema develops, narrowing the airway lumen (Steeple Sign)
- Severe cases may result in complete obstruction



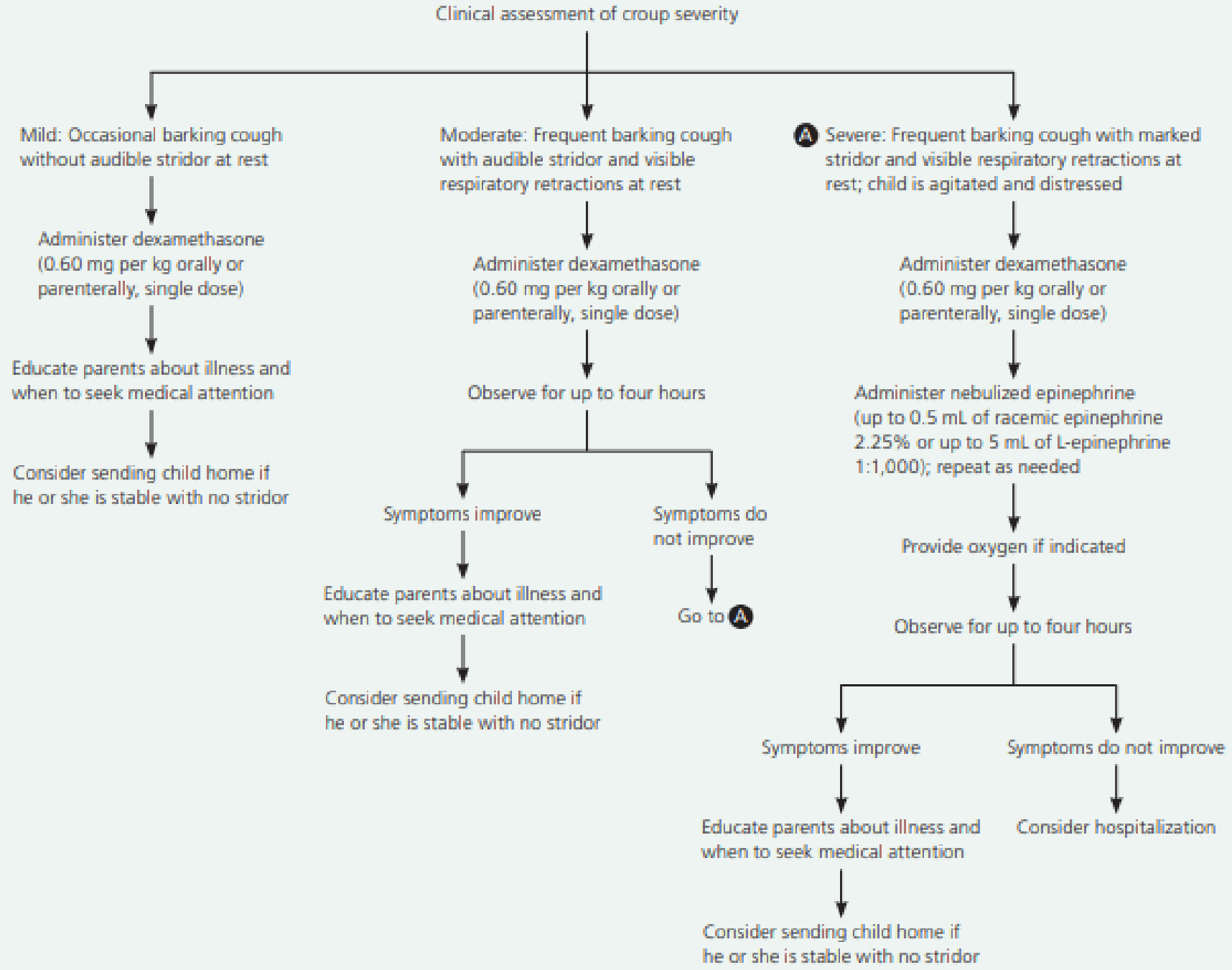
Croup

- Physical exam/Assessment
  - Tachycardia, tachypnea
  - Skin color - pale, cyanotic, mottled
  - Decrease in activity or LOC
  - Fever
  - Breath sounds - wheezing, diminished breath sounds
  - Stridor, barking cough, hoarse cry or voice
  - Any difficulty swallowing?
  - Drooling present

Croup

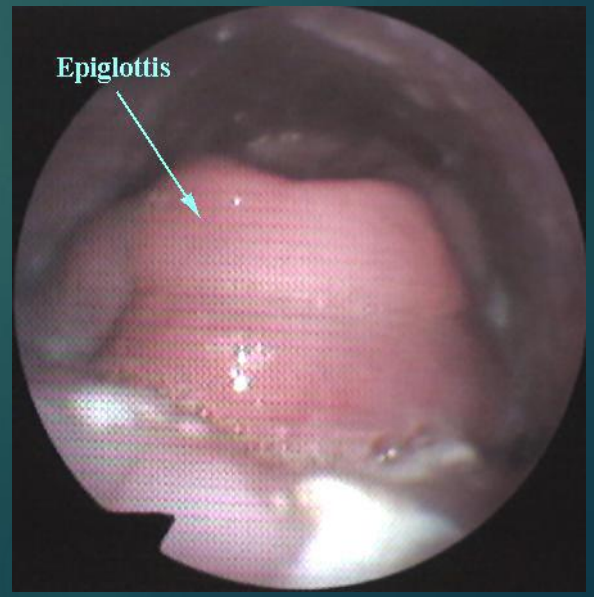
- Management
  - Assess & monitor ABC's
  - High flow humidified O2; blow by if child won't tolerate mask
  - Limit exam/handling to avoid agitation
  - Be prepared for respiratory arrest, assist ventilations and perform CPR as needed
  - Do not place instruments in mouth or throat
  - Rapid transport
  - *HUMIDIFICATION THERAPY??*
  - CORTICOSTEROIDS
  - EPINEPHRINE

Outpatient Management of Croup in children



Epiglotitis

- Bacterial infection and inflammation of the epiglottis
- Usually occurs in children 3-6 years of age
- Can occur in infants, older children, & adults
- Swelling may cause complete airway obstruction
- Thumb sign
- True medical emergency



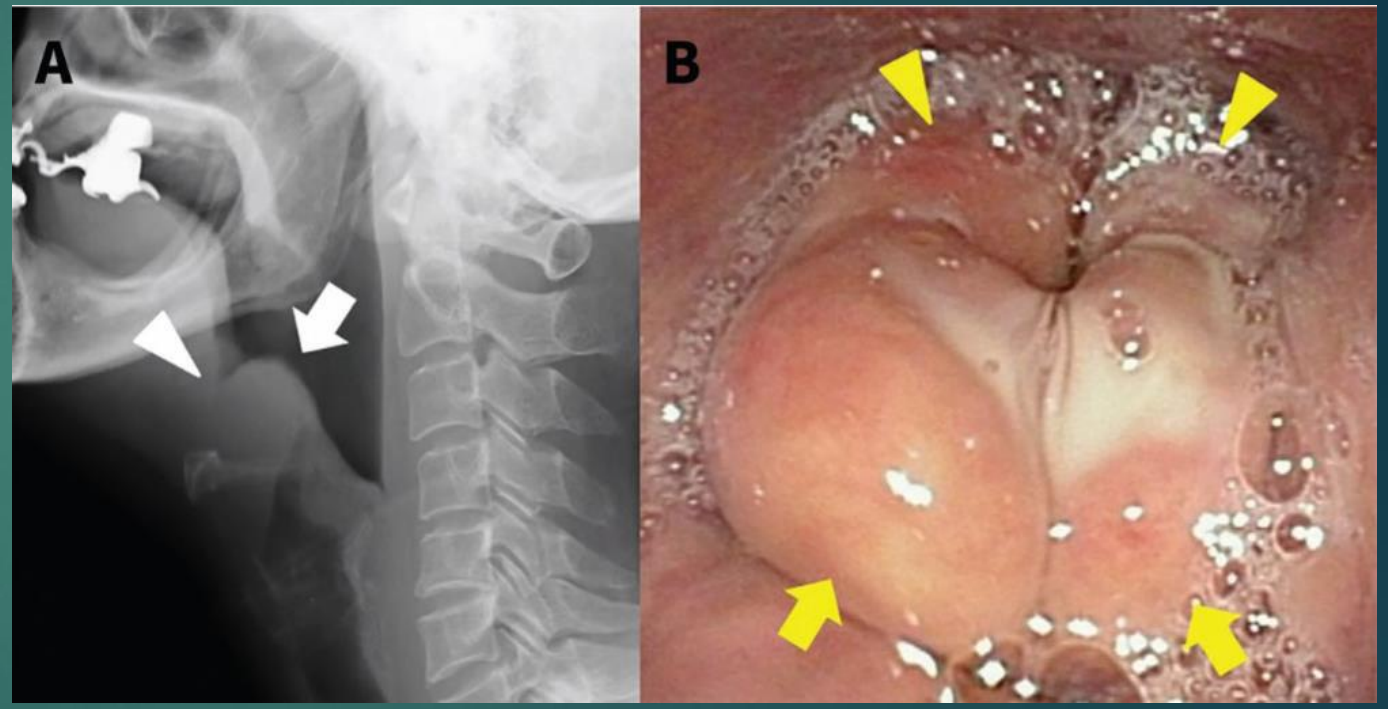
Epiglotitis

- Assessment/History
  - When did child become ill?
  - Has it suddenly worsened after a couple of days or hours?
  - Sore throat?
  - Will child swallow liquids or saliva?
  - Is drooling present?
  - High fever (102-103 degrees F)
  - Onset is usually sudden

- Signs & Symptoms
  - May be sitting in Tripod position
  - May be holding mouth open, with tongue protruding
  - Muffled or hoarse cry
  - Inspiratory Stridor
  - Tachycardia/tachypnea
  - Pale, mottled, cyanotic skin
  - Anxious, focused on breathing lethargic
  - Very sore throat
  - Nasal Flaring
  - Look very sick with high fever

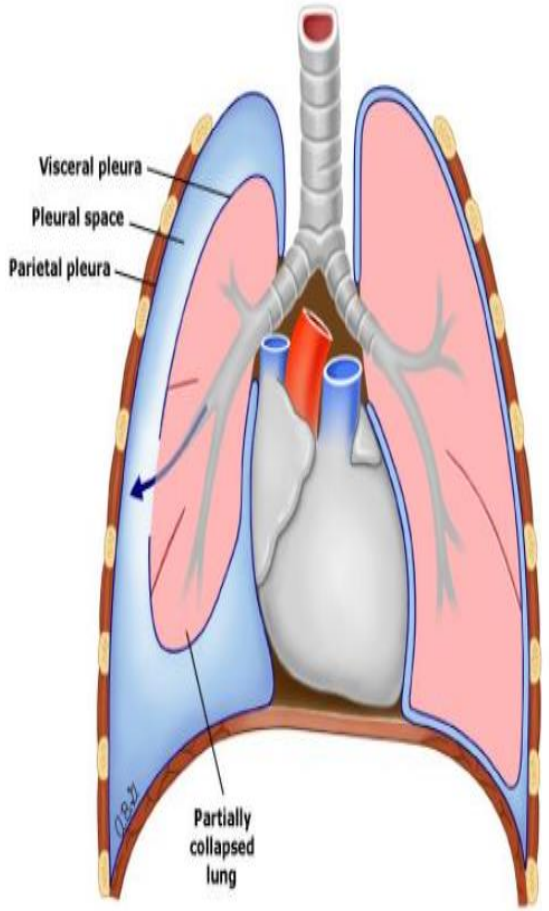
Epiglotitis

- Management
  - Assess & monitor ABC's
  - Do not make child lie down
  - Do not manipulate airway
  - High flow humidified O2; blow by if child won't tolerate mask
  - Limit exam/handling to avoid agitation
  - Be prepared for respiratory arrest, assist ventilations and perform CPR as needed
  - Transfer of Children's Hospital
  - **Intubation**
  - **IV Antibiotics**
  - **Steroids ???**
  - **Nebulised Adrenaline??**

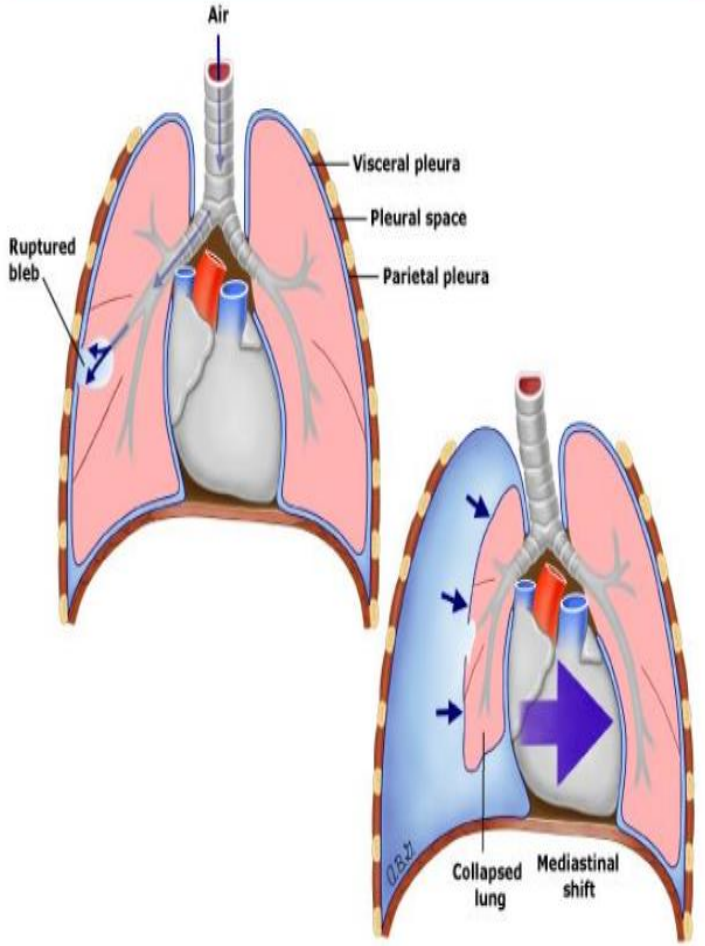


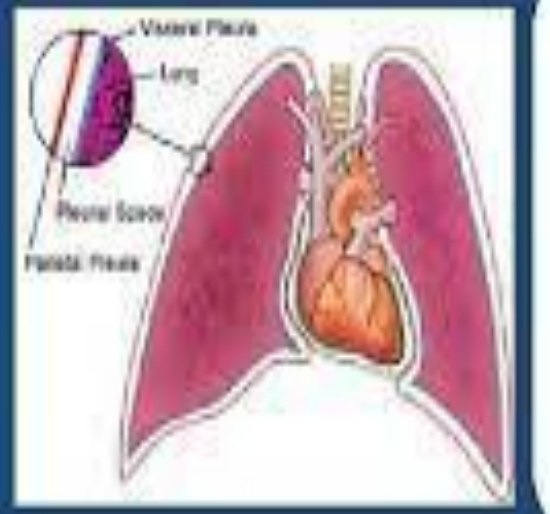
PNEUMOTHORAX

Simple pneumothorax



Tension pneumothorax

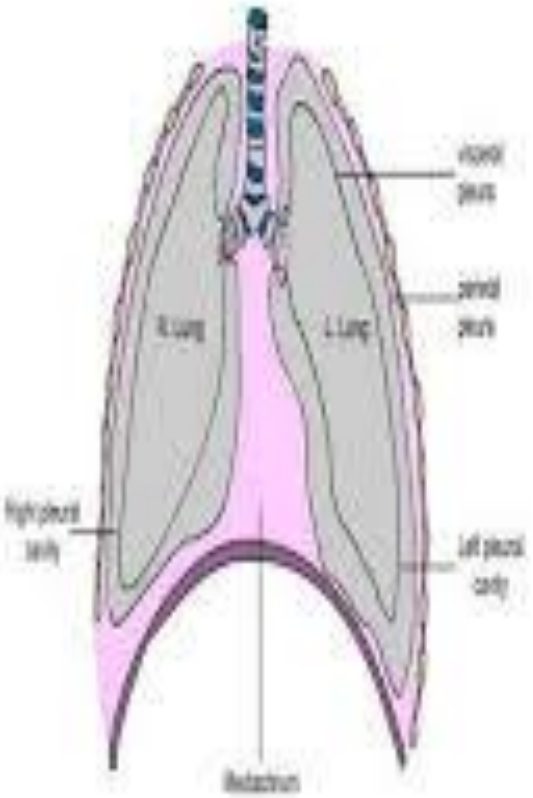




In the normal pleural space there is approximately **0.1 - 0.2 mL/kg** body weight of pleural fluid (PF)

Pleura types

- There are **two types** of pleura :
  - * **visceral** pleura
  - * **parietal** pleura
- The parietal pleura is **subdivided into**
  - * mediastinal pleura
  - * costal pleura
  - * diaphragmatic pleura
  - * cervical pleura

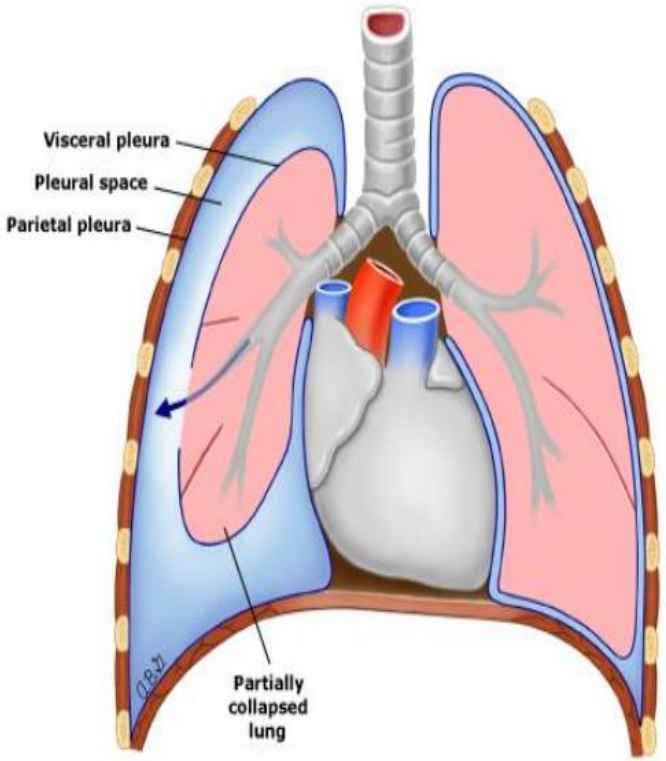


Etiology

- Traumatic
  - blunt, crush, or penetrating trauma to the chest
  - injury from a diagnostic or therapeutic procedure;
  - consequence of mechanical ventilation.
- Spontaneous
  - Primary spontaneous pneumothorax
  - Secondary spontaneous pneumothorax

Causes of non-traumatic spontaneous pneumothorax

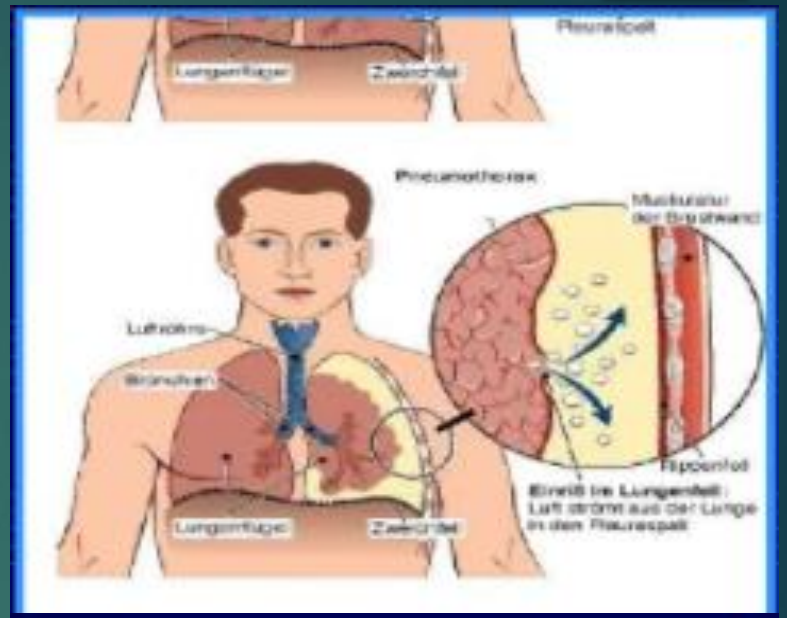
Primary pneumothorax
Asthenic body habitus/subpleural blebs
Drug use
Cigarette smoking
Snorting cocaine
Smoking marijuana
Increased transpulmonary pressure
Valsalva maneuver
Diving, military flying

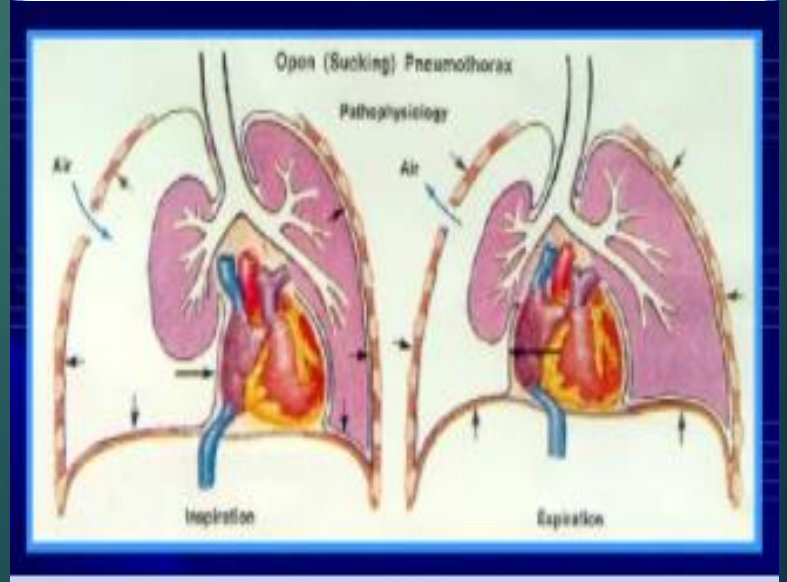


Secondary pneumothorax
Airway disease
Cystic fibrosis
Asthma
COPD
Infection
Pneumocystis jirovecii (carinii)
Tuberculosis
Necrotizing pneumonia
Congenital lung disease
Congenital pulmonary adenomatous malformation
Congenital lobar emphysema
Interstitial lung disease
Sarcoidosis
Langerhans cell granulomatosis
Other
Connective tissue/inflammatory disease
Marfan syndrome
Ehlers-Danlos syndrome
Juvenile idiopathic arthritis
Polymyositis or dermatomyositis
Birt-Hogg-DubÃ© syndrome
Other
Malignancy
Primary lung cancer
Metastatic disease
Airway obstruction
Foreign body aspiration
Thoracic endometriosis
Catamenial pneumothorax

MECHANISMS OF PNEUMOTHORAX

- Acute increase in transpulmonary pressure
- Defects in visceral pleura
- Catamenial pneumothorax





CLINICAL FEATURES

- **History**
- *A small pneumothorax may be asymptomatic.*
- *sudden onset of dyspnea and pleuritic chest pain*
- *The pain often resolves spontaneously during the first 24 hours, even if the pneumothorax persists*
- *A dry or nonproductive cough*
- *The history should investigate potential causes of secondary pneumothorax*
- *The presence of apical blebs supports the diagnosis of primary spontaneous pneumothorax (PSP). Otherwise, PSP is largely a diagnosis of exclusion.*

Physical Examination

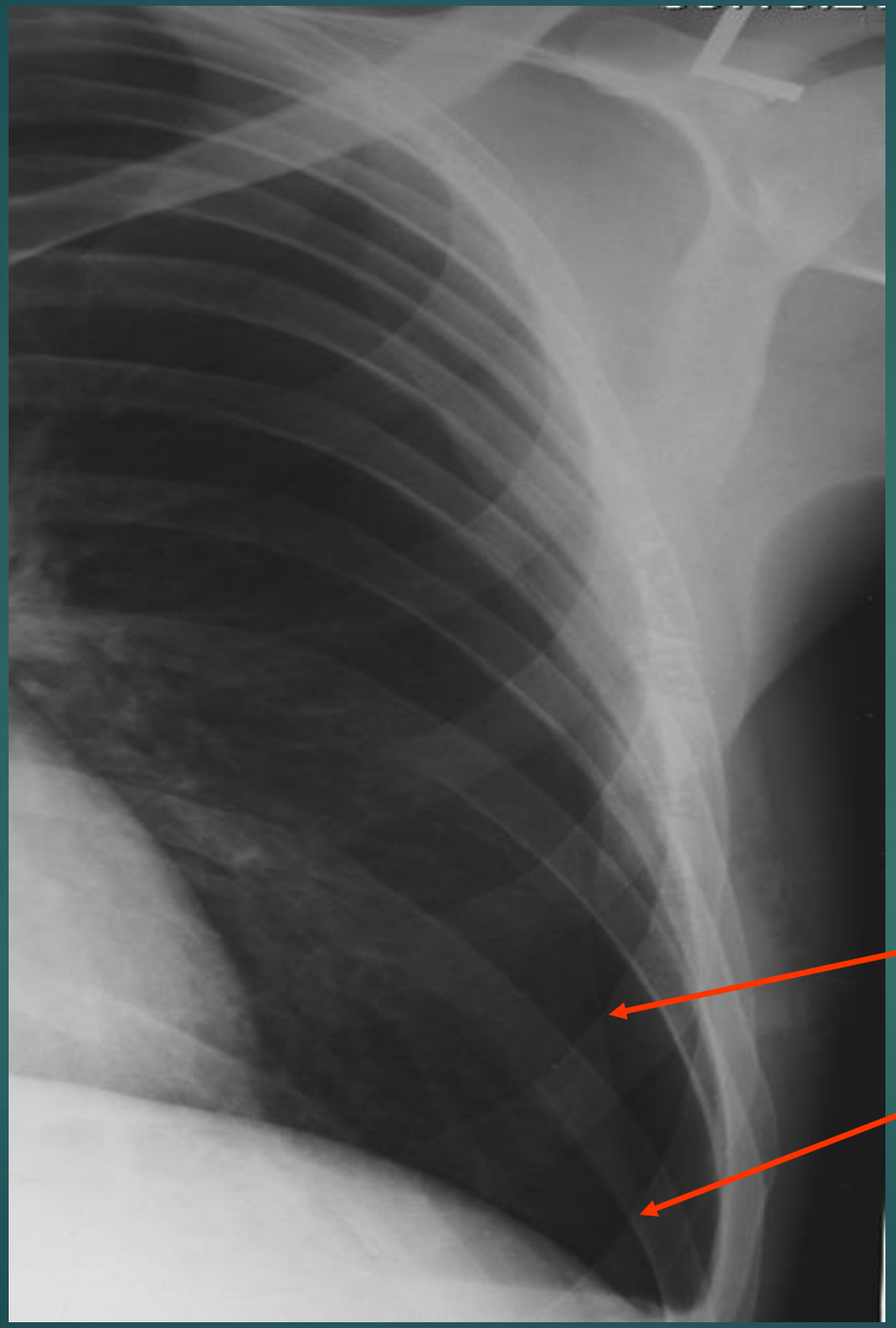
- *decreased chest excursion, diminished breath sounds, hyperresonant percussion, and decreased vocal fremitus on the affected side. Other signs of respiratory compromise may include tachypnea, increased work of breathing, and cyanosis.*

- *Signs suggestive of* ***tension pneumothorax*** *include deviation of the trachea towards the contralateral side. Other signs of tension pneumothorax include tachycardia, hypotension, and cyanosis .*

- *Heart sounds may be diminished and the apical impulse shifted to the contralateral side.*

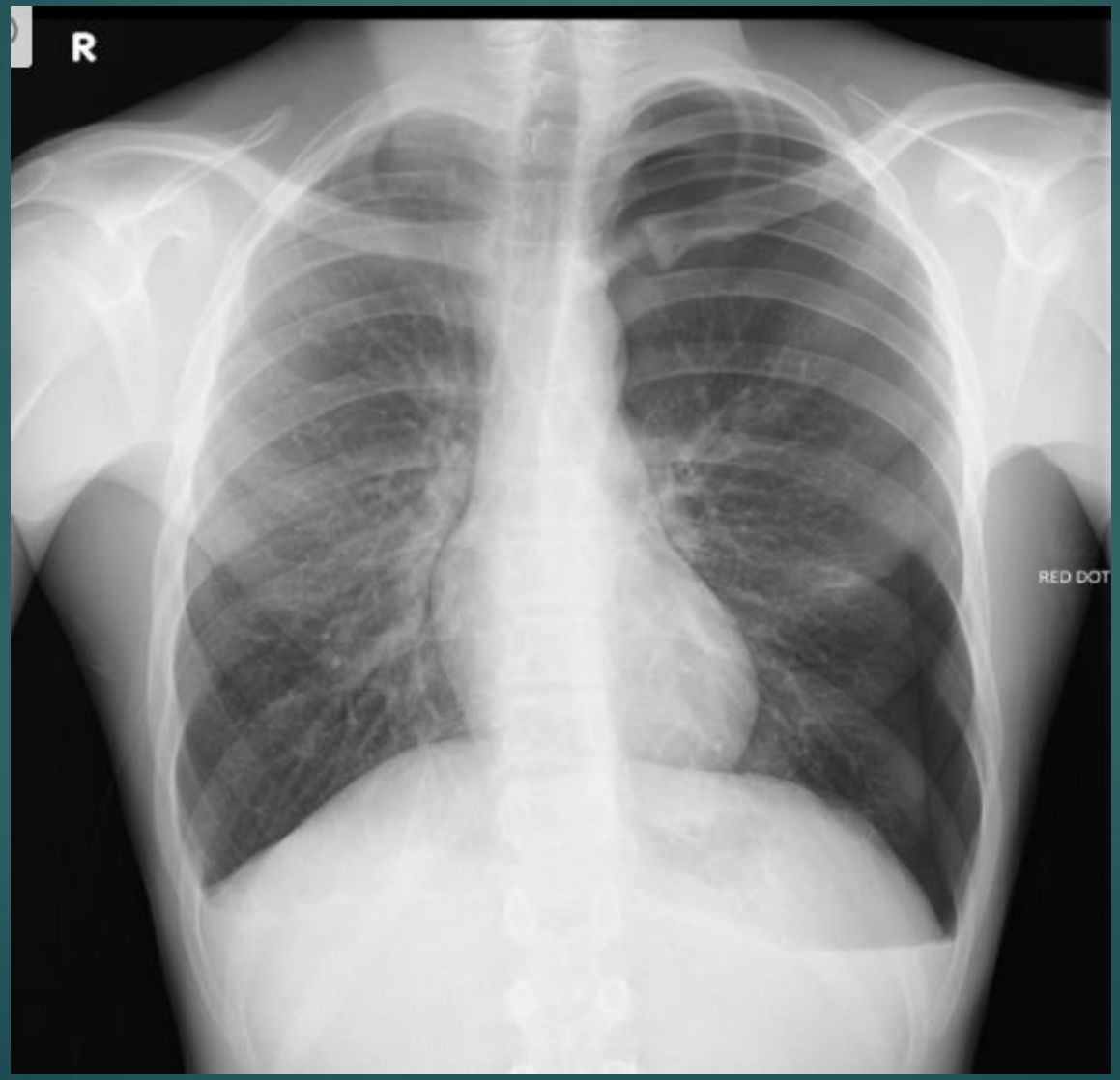
DIAGNOSIS

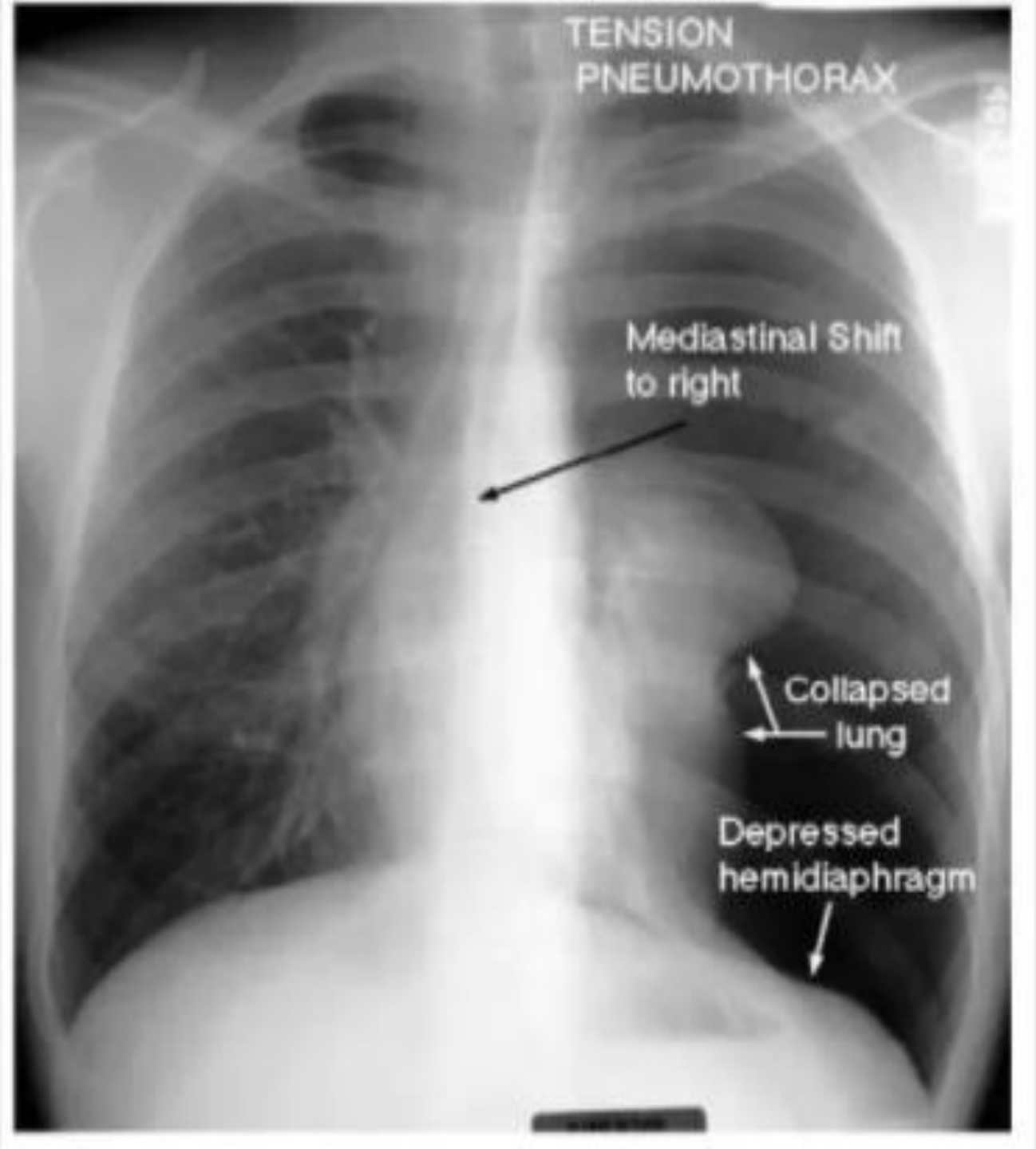
- **CXR**
- AP and lateral
- **Computed tomography**
- Computed tomography (CT) scanning is not necessary unless abnormalities are noted on the conventional chest radiograph that require further assessment.
- conditions that complicate interpretation of the conventional radiograph
- detection of small apical blebs
- in assessing chest tube placement when needed

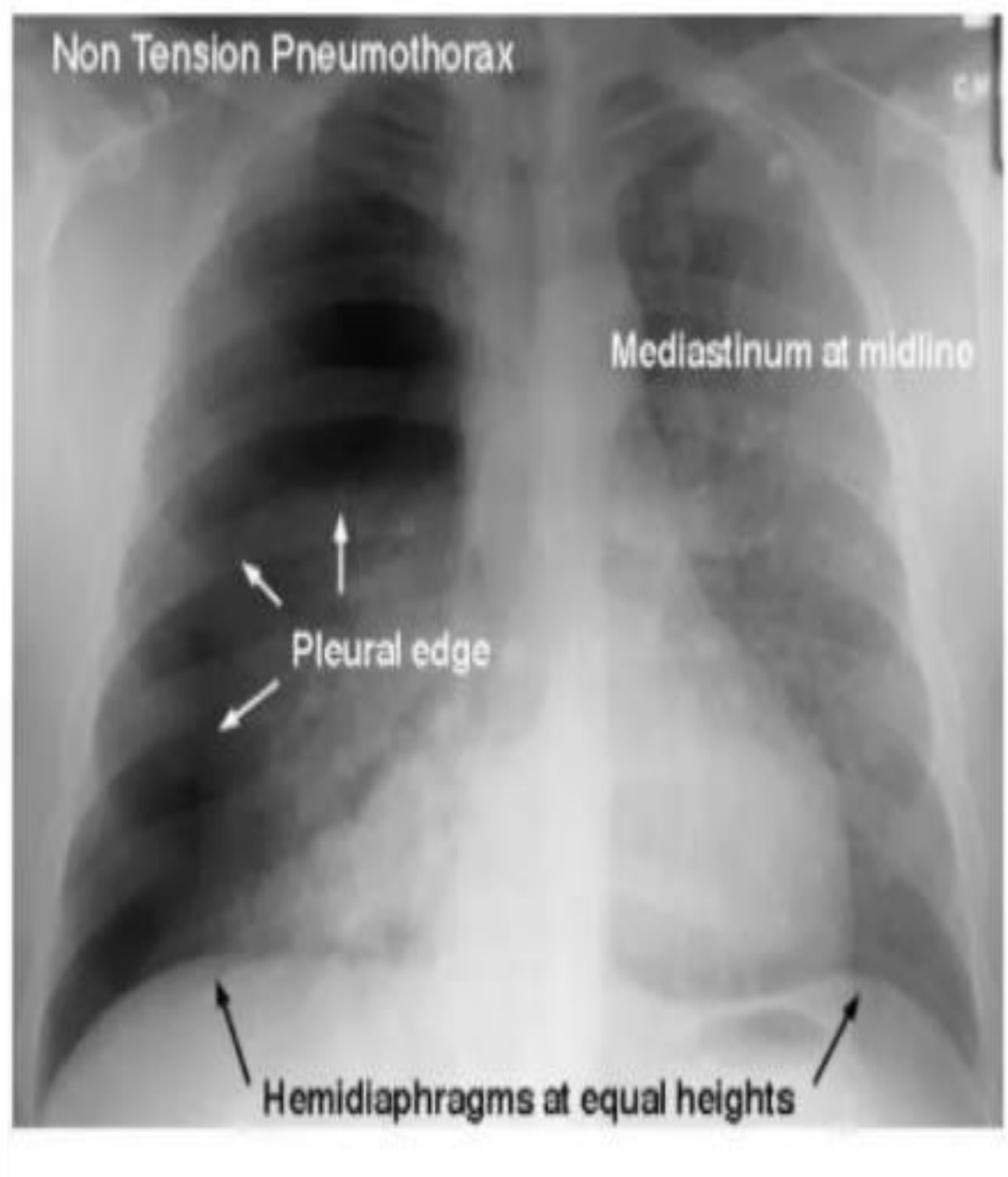


Note absence of lung markings lateral to this line

Simple Left Pneumothorax



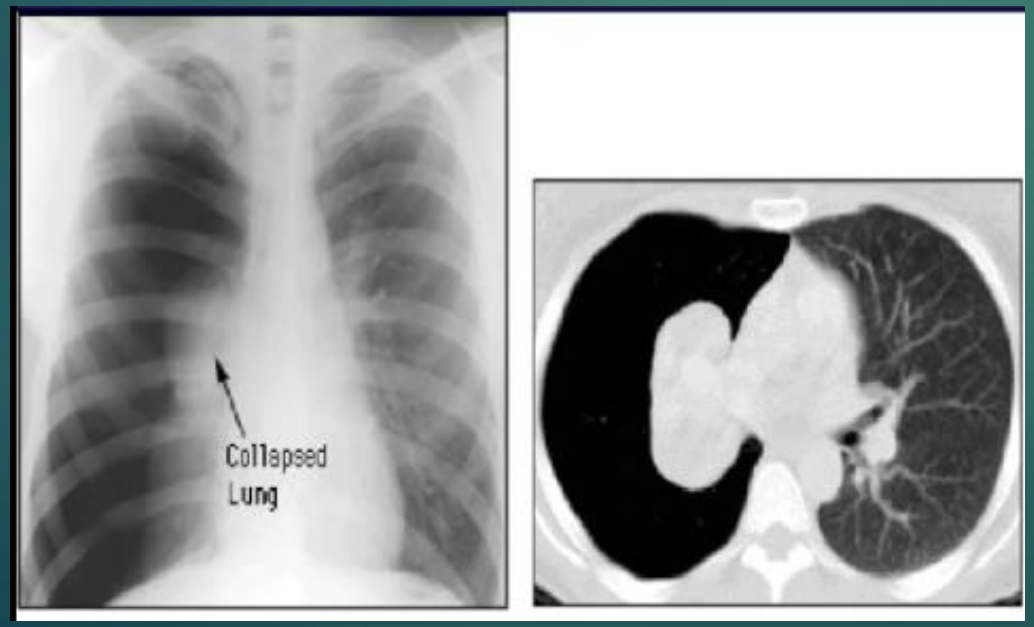

TENSION
PNEUMOTHORAX
Mediastinal Shift
to right
Collapsed
lung
Depressed
hemidiaphragm


Non Tension Pneumothorax
Mediastinum at midline
Pleural edge
Hemidiaphragms at equal heights

Imaging- Plane chest X-ray film

- Establishing the diagnosis
- The characteristics of pneumothorax
  - Pleural line
  - No lung markings in pneumothorax
- The outer margin of visceral pleura separated from the parietal pleura by a lucent gas space devoid of pulmonary vessels

CT scanning



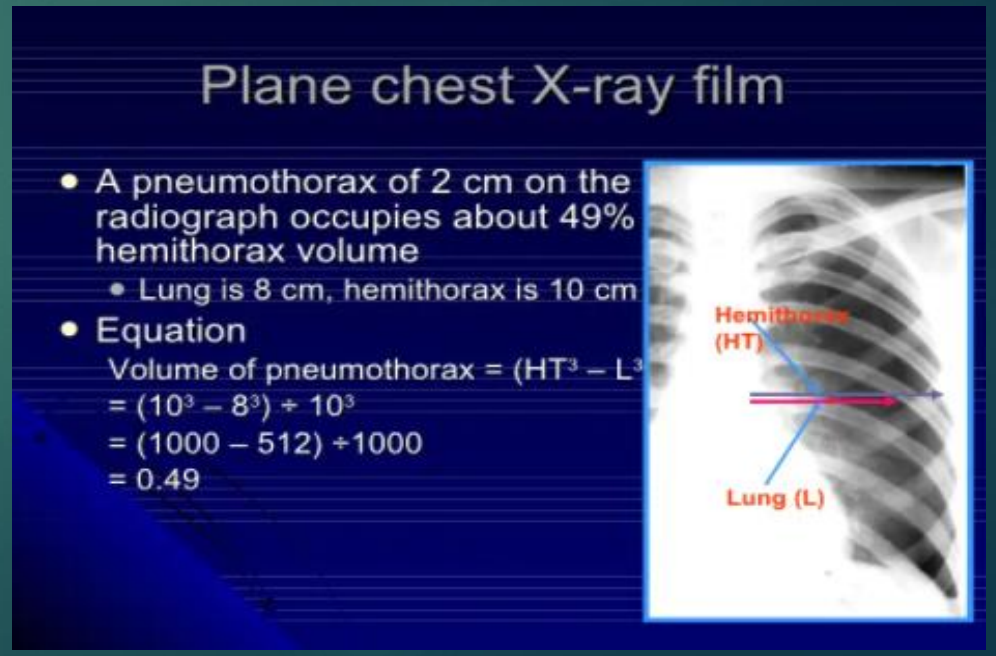
Congenital lobar emphysema

Skin fold

...DIAGNOSIS

- *In infants, anteroposterior radiographs typically are obtained in the supine position. In this position, the pneumothorax is difficult to detect because the air accumulates anteriorly. However, if the pneumothorax is large, the affected side may appear hyperlucent.*
- *Detection of smaller pneumothoraces may be improved by obtaining a radiograph taken with the infant in a* ***lateral decubitus position****, with the affected side up.*

- ***Transillumination of the chest***
- ***Estimation of size***
- ***Blood gas and pulse oximetry***
- ***Bedside ultrasound***



Stable patients with small pneumothorax

- *For clinically stable patients with an initial primary spontaneous pneumothorax (PSP) that is small (ie, occupying <30 percent of the hemithorax), we recommend observation in hospital.. The pneumothorax should be reassessed by chest radiograph in 6 to 12 hours. If the PSP is resolving during the first 12 hours and the patient has no pain or respiratory distress, observation may be continued on an outpatient basis. Younger patients (eg, under 12 years of age) should be observed for longer. we would generally place a thoracostomy tube within 24 to 48 hours if the pneumothorax is not improving and earlier if it is increasing in size.*

- ***Supplemental oxygen – Nitrogen washout***

- ***Analgesics, antitussives, and other supportive care are provided if necessary.***

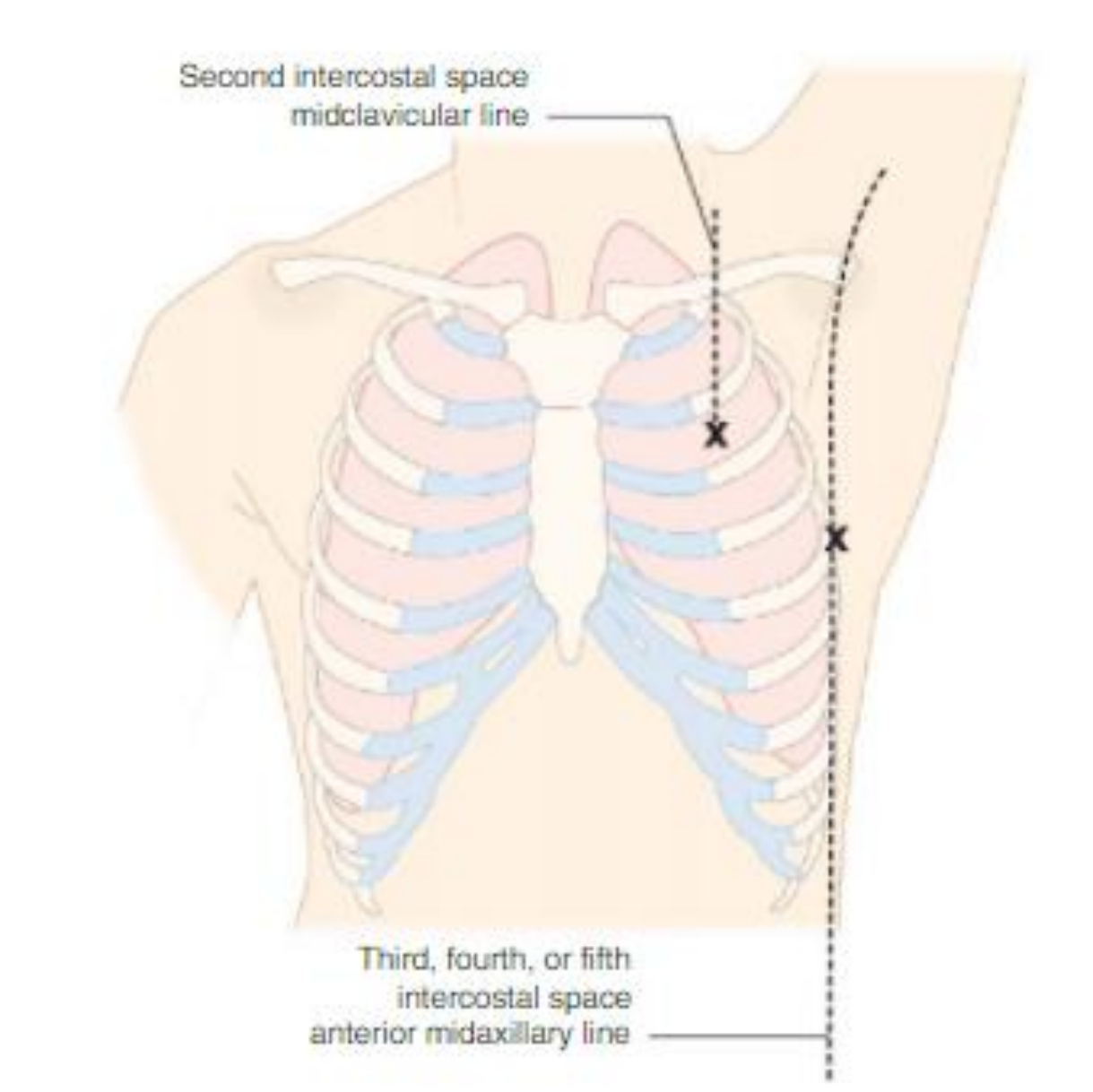
Stable patients with large pneumothorax

- *For patients with a first occurrence of a pneumothorax that is large (eg, occupying >30 percent of the hemithorax), we suggest needle aspiration, in addition to hospital admission and supplemental oxygen.*

- *If no further air can be aspirated, the stopcock is closed and the catheter is secured to the chest wall. A chest radiograph should be obtained after four hours of observation. If adequate expansion has occurred, the catheter can be removed and the patient observed for an additional two hours. Although an adult patient can be discharged if the lung remains expanded on the chest radiograph at this time , we recommend that children who require aspiration of a pneumothorax continue to be observed in the hospital for at least 24 hours with close monitoring or telemetry. A repeat chest radiograph should be obtained prior to considering hospital discharge.*

- *In patients treated with needle aspiration, the air will reaccumulate in 20 to 50 percent because of a persistent air leak, so close follow-up with serial chest radiographs is required .*

- *If the air reaccumulates, these patients should be treated with thoracostomy tube.*

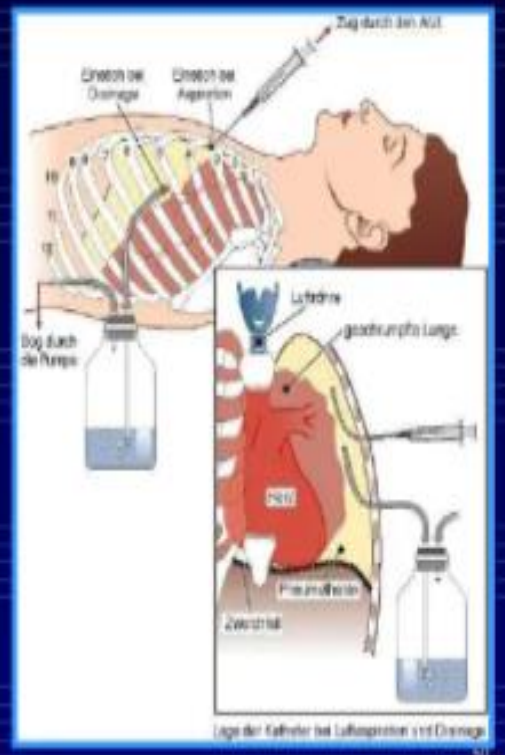

Second intercostal space
midclavicular line
Third, fourth, or fifth
intercostal space
anterior midaxillary line

Unstable Patients

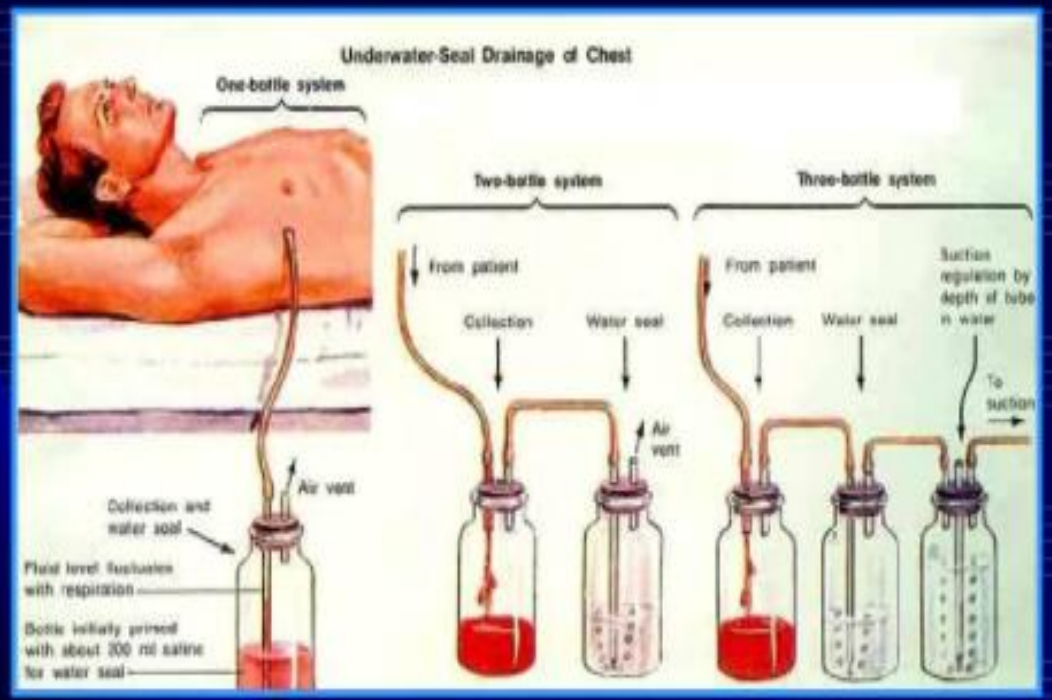
- *For patients with significant dyspnea, hypoxemia, or pain, we suggest thoracostomy tube or pigtail catheter insertion, in addition to hospital admission and supplemental oxygen.*
- *A thoracostomy tube requires the use of a one-way Heimlich valve or water seal device to prevent reaccumulation of air. If the lung does not fully expand after drainage, suction should be applied to a water seal device. Early use of strong suction is not recommended, because rapid expansion of the lung is associated with a risk of reexpansion-induced pulmonary edema.*
- *If no bubbles emanate from the thoracostomy tube for 12 hours or more, we recommend clamping the chest tube for an additional 24 hours to observe whether air reaccumulates, although the utility of this approach is unproven. The chest tube can be removed after 24 hours if there is no radiographic or clinical evidence of recurrence of the pneumothorax. We generally repeat the chest radiograph 12 to 24 hours after removal of the chest tube.*

Catheter aspiration

- Catheter aspiration of pneumothorax can be used where the equipment and experience is available



Intercostal tube drainage



Patients with underlying lung disease

- *For most patients with a large pneumothorax due to underlying lung disease (SSP), we suggest thoracostomy tube or pigtail catheter insertion.*

- *Needle aspiration is a reasonable alternative for selected patients who are stable and have moderate-sized pneumothorax*

Patients with recurrent pneumothorax

- *Patients with recurrent PSP or SSP (either ipsilateral or contralateral) should have their lung expanded with a tube thoracostomy, then undergo surgical intervention.*

- *Pleurodesis is typically performed during the thoracotomy procedure to help prevent additional recurrences.*

Failure to reexpand or recurrence

Indications for surgical intervention

- ***Primary spontaneous pneumothorax (PSP)***

- *•A first PSP and an air leak that fails to resolve after approximately five days of thoracostomy drainage. This is the time period typically suggested for adults but is based on panels of experts rather than empiric evidence . In patients with a first PSP, the presence of small apical blebs on (CT) is not an indication for immediate surgical intervention, but we observe such patients closely and tend to move more quickly to surgical intervention if the patient does not improve with conservative management.*

- *•Recurrence of PSP (either ipsilateral or contralateral).*

Secondary spontaneous pneumothorax (SSP)

- *We suggest surgical intervention and a preventive intervention (eg, video-assisted thoracoscopic surgery [VATS] with pleurodesis) in the following groups of patients:*
- *•Recurrent SSP (either ipsilateral or contralateral).*
- *•Patients with cystic fibrosis and recurrence of a large SSP . Pleurodesis using mechanical abrasion rather than chemical pleurodesis is preferred and does not preclude subsequent lung transplantation.*
- *•Patients with a first episode of SSP due to other causes, if the underlying lung disease is severe, progressive, persistent, or is known to be associated with recurrent pneumothoraces. As examples:*
- *-We perform a preventive intervention for patients with bullous lung disease.*
- *-We do not usually perform preventive interventions for patients with mild or moderate asthma after a first occurrence of pneumothorax. Instead, the primary treatment for such patients is to optimize asthma treatment.*
- *-Children with necrotizing pneumonia are treated with proper antibiotics and pleural space suctioning. If they develop bronchopleural fistula, surgical intervention is warranted.*

Pleurodesis

pleurodesis may be indicated for the first episode of a secondary pneumothorax, due to the high incidence of recurrence that could be life-threatening . With no underlying lung disease (primary pneumothorax), the procedure is usually reserved for a recurrence.

Pleurodesis also is recommended for individuals who participate in activities associated with increased risk of pneumothorax, such as deep sea diving or flying in small, unpressurized aircraft.

Surgical Technique

Resolution of pneumothorax

- *Once a pneumothorax has resolved after conservative management or thoracostomy tube, the patient can be discharged, with instructions to return for any new symptoms. For patients managed conservatively, we do not repeat imaging unless the patient develops new symptoms. For patients who had a thoracostomy tube, the pneumothorax should be reevaluated by chest radiograph within 12 to 24 hours after removal of the thoracostomy tube.*

- *All patients with resolved PSP or SSP should be strongly advised not to smoke tobacco.*

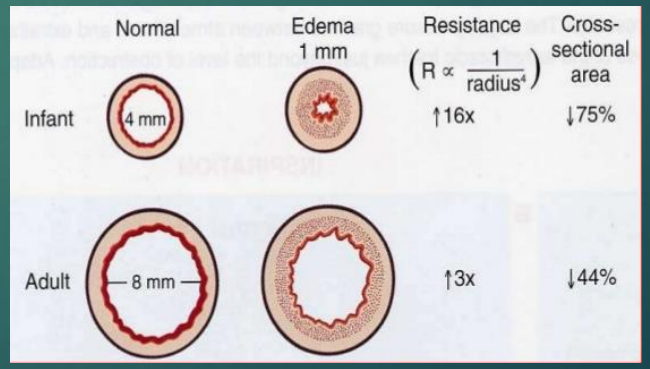
- *avoidance of air travel until at least 2 week after full resolution of the pneumothorax.*

- *Activities such as deep sea diving or flying in small, unpressurized aircrafts are associated with increased risk of pneumothorax and should be avoided in individuals who did not undergo pleurodesis.*

Complications

Lower Airway Disease

- Narrower trachea and bronchi
- Poiseulle's Law - Edema



If radius is halved, resistance increases 16x

BRONCHIOLITIS

- *Bronchiolitis is a disease of small bronchioles with increased mucus production and occasional bronchospasm, sometimes leading to airway obstruction. It is most commonly caused by a viral lower respiratory tract infection*

- *most commonly seen in infants and young children*

Etiology

- *Respiratory syncytial virus (RSV) is a primary cause of bronchiolitis*
- *human metapneumovirus,*
- *parainfluenza viruses,*
- *influenza viruses,*
- *adenoviruses,*
- *rhinoviruses,*
- *coronaviruses,*
- *and, infrequently, Mycoplasma pneumoniae.*
- *Viral bronchiolitis is extremely contagious.*
- *hand carriage of contaminated secretions is the most frequent mode of transmission.*

Epidemiology

- *Bronchiolitis occurs almost exclusively during the first 2 years of life, with a peak age at 2-6 months.*
- *premature infants and children with chronic lung disease of prematurity, hemodynamically significant congenital heart disease, neuromuscular weakness, or immunodeficiency are at increased risk of severe, potentially fatal disease.*
- *Children acquire infection after exposure to infected family members, who typically have symptoms of an upper respiratory tract infection, or from infected children in day care.*

Clinical manifestations

- *Bronchiolitis caused by RSV typically has an incubation period of 4-6 days.*
- *classically presents as a progressive respiratory illness similar to the common cold in its early phase, with cough and rhinorrhea*
- *It progresses over 3-7 days to noisy, raspy breathing and audible wheezing.*
- *There is usually a low grade fever accompanied by irritability, which may reflect the increased work of breathing.*
- *young infants infected with RSV may not have a prodrome and may have apnea as the first sign of infection.*

- *Physical signs of bronchiolar obstruction include :*

prolongation of the expiratory phase of breathing, nasal flaring, intercostal retractions, suprasternal retractions, and air trapping with hyperexpansion of the lungs.

- *During the wheezing phase: percussion of the chest usually reveals only hyperresonance,*
- *auscultation usually reveals diffuse wheezes and crackles throughout the breathing cycle.*

With more severe disease, grunting and cyanosis may be present.

Laboratory

- ***Routine laboratory tests are not required to confirm the diagnosis.***

- *Pulse oximetry is adequate for monitoring oxygen saturation.*

- *Frequent, regular assessments and cardiorespiratory monitoring of infants are necessary because respiratory failure may develop precipitously in very tired infants even though blood gas values taken before rapid decompensation are reassuring.*

- *polymerase chain reactions for RSV, parainfluenza viruses, influenza viruses, and adenoviruses are sensitive tests to confirm the infection. is helpful for cohorting children with the same infection but is not necessary to make the diagnosis of bronchiolitis.*

Imaging studies

- *Chest radiographs are not always necessary*
- *but frequently show signs of lung hyperinflation, including increased lung lucency and flattened or depressed diaphragms.*
- *Areas of increased density may represent either viral pneumonia or localized atelectasis.*

Treatment

- *supportive therapy, including respiratory monitoring, control of fever, hydration, upper airway suctioning, and, if needed, oxygen administration.*
- *Indications for hospitalization include:*
- *moderate to marked respiratory distress,*
- *hypoxemia,*
- *apnea,*
- *inability to tolerate oral feeding,*
- *and lack of appropriate care available at home.*

- *Among hospitalized infants, supplemental oxygen by nasal cannula is often necessary, but intubation and ventilatory assistance for respiratory failure or apnea are required in 10% of these infants.*

…Treatment

- *Bronchodilators, corticosteroids, chest physiotherapy,*
- *and hypertonic saline are seldom effective and*

“ are not generally recommended ”

- *Likewise, antibiotics should be avoided unless there is strong suspicion for concomitant bacterial infection.*

Complications and prognosis

- *Most hospitalized children show marked improvement in 2-5 days with supportive treatment alone*

- *Apnea is a major concern for very young infants with bronchiolitis.*
- *Most cases of bronchiolitis resolve completely.*
- *Recurrence is common but tends to be mild and should be assessed and treated similarly to the first episode.*

- *The incidence of asthma seems to be higher in children hospitalized for bronchiolitis as infants.*
- ***There is a 1-2% mortality rate, highest among infants with preexisting cardiopulmonary or immunological impairment.***

Prevention

- *Monthly injections of palivizumab, an RSV-specific monoclonal antibody, initiated just before the onset of the RSV season confers some protection from severe RSV disease.*

- *Palivizumab is indicated for some infants with prematurity (born before 29 weeks, 0 days' gestation), chronic lung disease of prematurity, and those with hemodynamically significant cyanotic and acyanotic congenital heart disease in the first year of life, and rarely in the second year of life.*

- *Immunization with influenza vaccine is recommended for all children older than 6 months and may prevent influenza-associated disease.*

PNEUMONIA

- *Pneumonia is an infection of the lower respiratory tract that involves the airways and parenchyma, with consolidation of the alveolar spaces.*

- *Pneumonitis is a general term for lung inflammation that may or may not be associated with consolidation.*

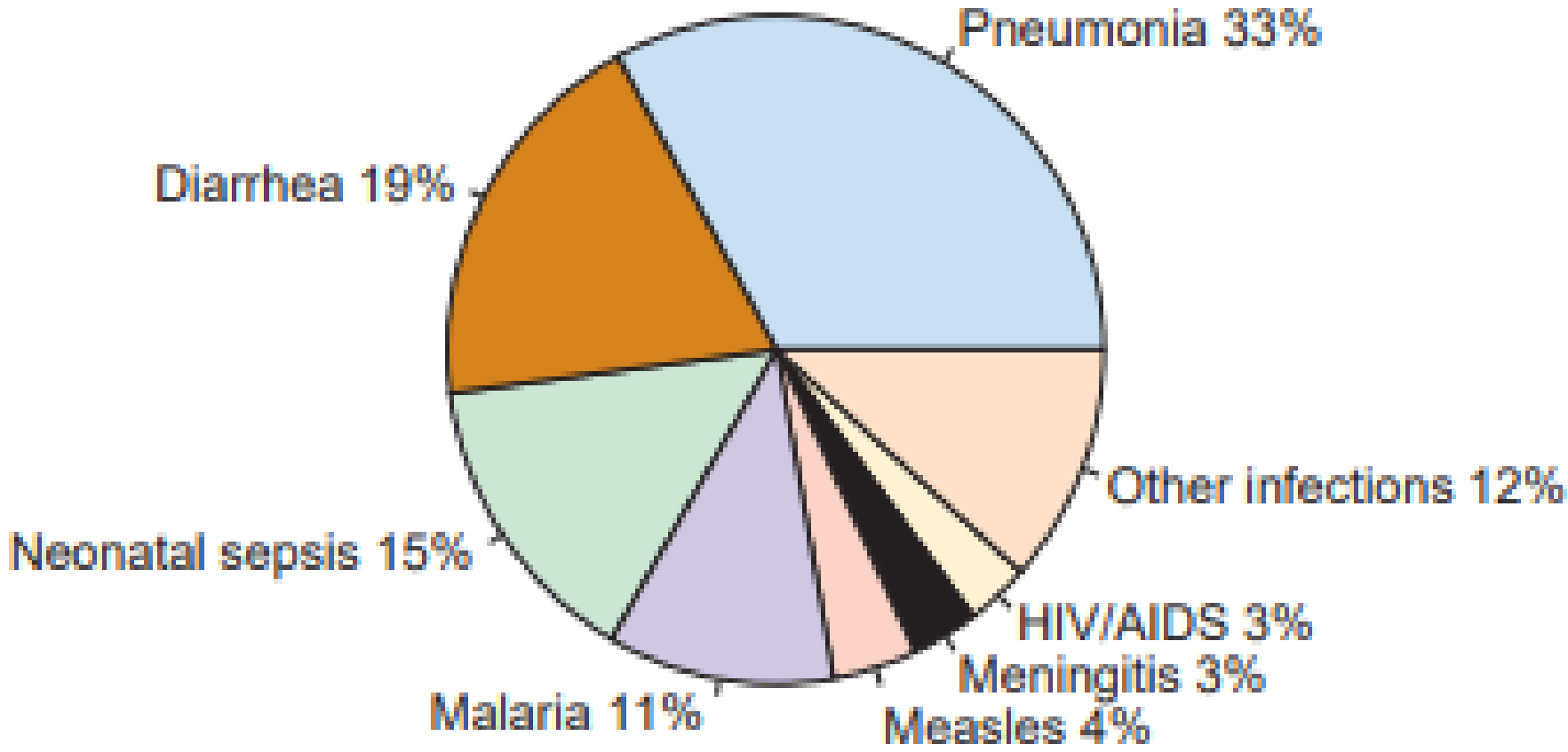


Fig. 428.1 Pneumonia is the leading infectious killer of children worldwide, as shown by this illustration of global distribution of cause-specific infectious mortality among children younger than age 5 yr in 2015. Pneumonia causes one-third of all under-5 deaths from infection. *(From World Health Organization and Maternal and Child Epidemiology Estimation Group estimates, 2015.)*

- *Lobar pneumonia describes pneumonia localized to one or more lobes of the lung.*
- *Bronchopneumonia refers to inflammation of the lung that is centered in the bronchioles and leads to the production of a mucopurulent exudate that obstructs some of these small airways and causes patchy consolidation of the adjacent lobules*
- *Interstitial pneumonitis refers to inflammation of the interstitium, which is composed of the walls of the alveoli, the alveolar sacs and ducts, and the bronchioles. Interstitial pneumonitis is characteristic of acute viral infections but may also be a chronic inflammatory or fibrosing process.*
- *Atypical pneumonia describes patterns typically more diffuse or interstitial than lobar pneumonia.*

Table 428.3	Pneumonia Etiologies Grouped by Age of the Patient
AGE GROUP	**FREQUENT PATHOGENS (IN ORDER OF FREQUENCY)**
Neonates (<3 wk)	Group B streptococcus, *Escherichia coli*, other Gram-negative bacilli, *Streptococcus pneumoniae*, *Haemophilus influenzae* (type b,* nontypeable)
3 wk-3 mo	Respiratory syncytial virus, other respiratory viruses (rhinoviruses, parainfluenza viruses, influenza viruses, human metapneumovirus, adenovirus), *S. pneumoniae*, *H. influenzae* (type b,* nontypeable); if patient is afebrile, consider *Chlamydia trachomatis*
4 mo-4 yr	Respiratory syncytial virus, other respiratory viruses (rhinoviruses, parainfluenza viruses, influenza viruses, human metapneumovirus, adenovirus), *S. pneumoniae*, *H. influenzae* (type b,* nontypeable), *Mycoplasma pneumoniae*, group A streptococcus
≥5 yr	*M. pneumoniae*, *S. pneumoniae*, *Chlamydophila pneumoniae*, *H. influenzae* (type b,* nontypeable), influenza viruses, adenovirus, other respiratory viruses, *Legionella pneumophila*

CLINICAL MANIFESTATIONS

- *Age is a determinant in the clinical manifestations of pneumonia. **Neonates** may have fever or hypoxia only, with subtle or absent physical examination findings.*

- ***With a young infant**, apnea may be the first sign of pneumonia.*

- *Fever, chills, tachypnea, cough, malaise, pleuritic chest pain, retractions, —because of difficulty breathing or shortness of breath—are common in **older infants and children**.*

- *Viral pneumonias* *are generally associated more often with cough, wheezing, or stridor; fever is less prominent than with bacterial pneumonia. Mucosal congestion and upper airway inflammation suggest a viral infection*

- *Bacterial pneumonias* *are typically associated with higher fever, chills, cough, dyspnea, and auscultatory findings of lung consolidation.*

- *Atypical pneumonia* *in young infants is characterized by tachypnea, cough, and crackles on auscultation. Concomitant conjunctivitis may be present in infants with chlamydial pneumonia.*
- *Other signs of respiratory distress include nasal flaring, intercostal and subcostal retractions, and grunting*

- *Asymmetry or shallow breathing may be due to splinting from pain.*
- *Hyperexpansion, common in asthma but also frequently accompanying viral lower respiratory infections,*
- *Poor diaphragmatic excursion may indicate hyperexpanded lungs or an inability for expansion due to a large consolidation or effusion.*
- *Dullness to percussion may be due to lobar or segmental infiltrates or pleural fluid.*
- *localized crackles, rhonchi, and wheezes may help one detect and locate pneumonia.*

- *PCR* *(Viral respiratory pathogens, M.pneumonia)*
- *bronchoscopy with bronchoalveolar lavage*
- *brush mucosal biopsy*
- *needle aspiration of the lung*
- *open lung biopsy*
- *When there is a pleural effusion or empyema, a thoracentesis to obtain pleural fluid can be diagnostic and therapeutic.*

CXR

- *Bacterial pneumonia characteristically shows lobar consolidation or a round pneumonia, with pleural effusion in 10-30% of cases .*
- *Viral pneumonia characteristically shows diffuse, streaky infiltrates of bronchopneumonia and hyperinflation.*
- *Atypical pneumonia, as with M. pneumoniae and C. pneumoniae, shows increased interstitial markings or bronchopneumonia.*

- ***Hilar lymphadenopathy*** *is uncommon with bacterial pneumonia but may be a sign of tuberculosis, endemic mycoses, autoimmune conditions, or an underlying malignant neoplasm*

- *Decubitus views or ultrasound should be used to assess the size of pleural effusions and whether they are freely mobile.*

- ***Computed tomography (CT)*** *is used to evaluate serious disease, lung abscesses, bronchiectasis, and effusion characteristics.*

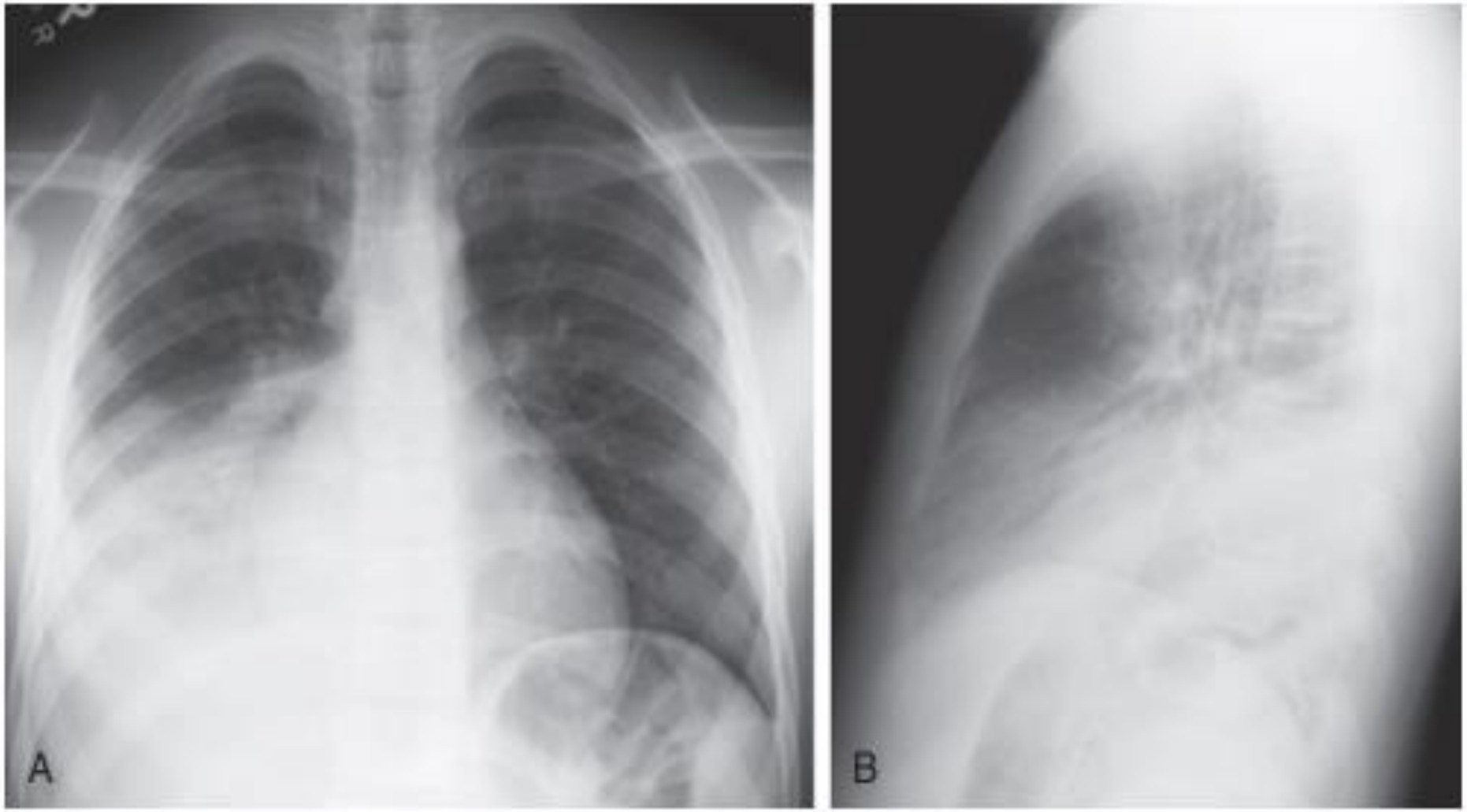


FIGURE 110.1 Acute lobar pneumonia of the right lower lobe in a 14-year-old boy with fever and cough. **(A)** Posteroanterior and **(B)** lateral chest radiographs demonstrate right-lower-lobe airspace consolidation, which obliterates the silhouette of the right heart border. (From Kelly MS, Sandora TJ. Community-acquired pneumonia. In: Kliegman RM, Stanton BF, St. Geme III JW, Schor NF, eds. *Nelson Textbook of Pediatrics*. 20th ed. Philadelphia: Elsevier; 2016. Fig. 400.3.)

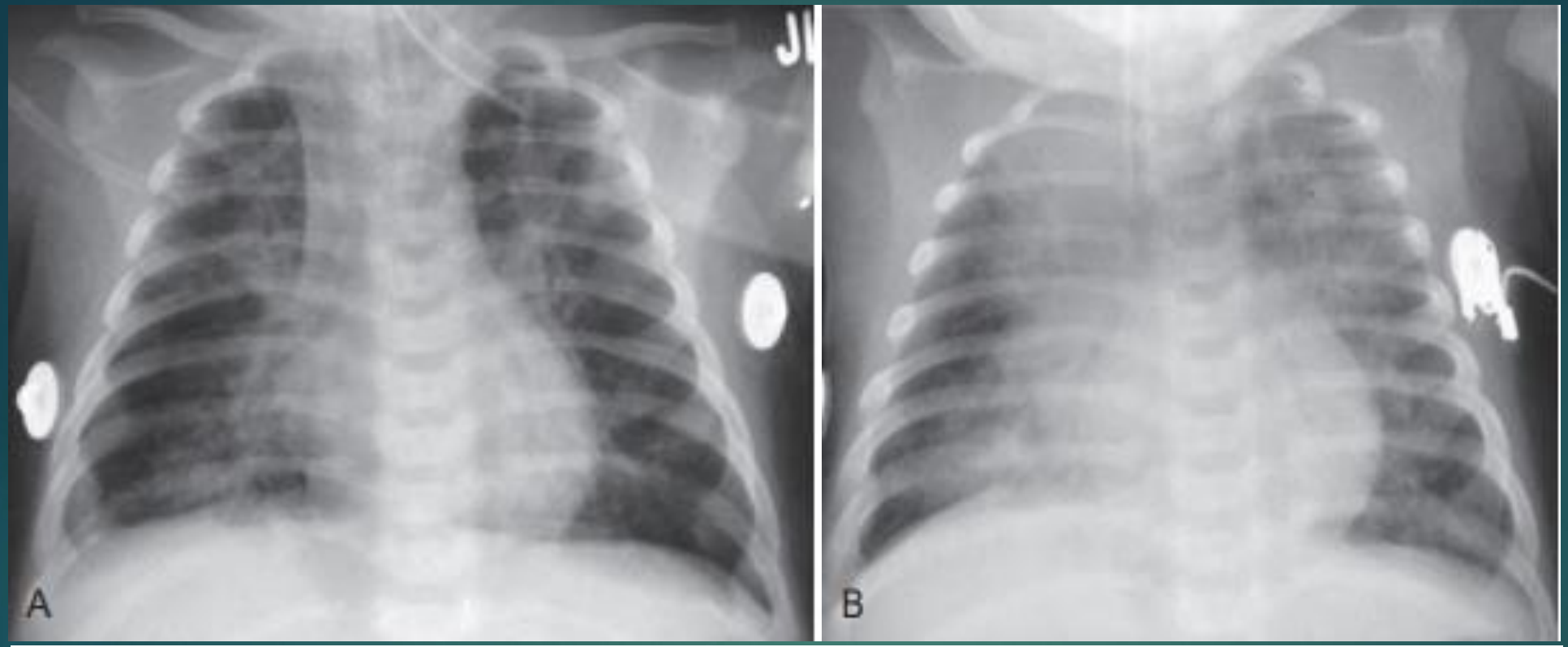


Fig. 428.2 **A,** Radiographic findings characteristic of respiratory syncytial virus pneumonia in a 6 mo old infant with rapid respirations and fever. Anteroposterior radiograph of the chest shows hyperexpansion of the lungs with bilateral fine air space disease and streaks of density, indicating the presence of both pneumonia and atelectasis. An endotracheal tube is in place. **B,** One day later, the anteroposterior radiograph of the chest shows increased bilateral pneumonia.

Anteroposterior view of chest in a three-year-old boy undergoing treatment for constipation with mineral oil e diagnosis of bronchopneumonia refractory to antibiotics. Coalescent opacities in both lungs, with "butterfly wing" distribution. In the clinical context, such a finding allows for the diagnosis of lipoid pneumonia, with no need for biopsy.

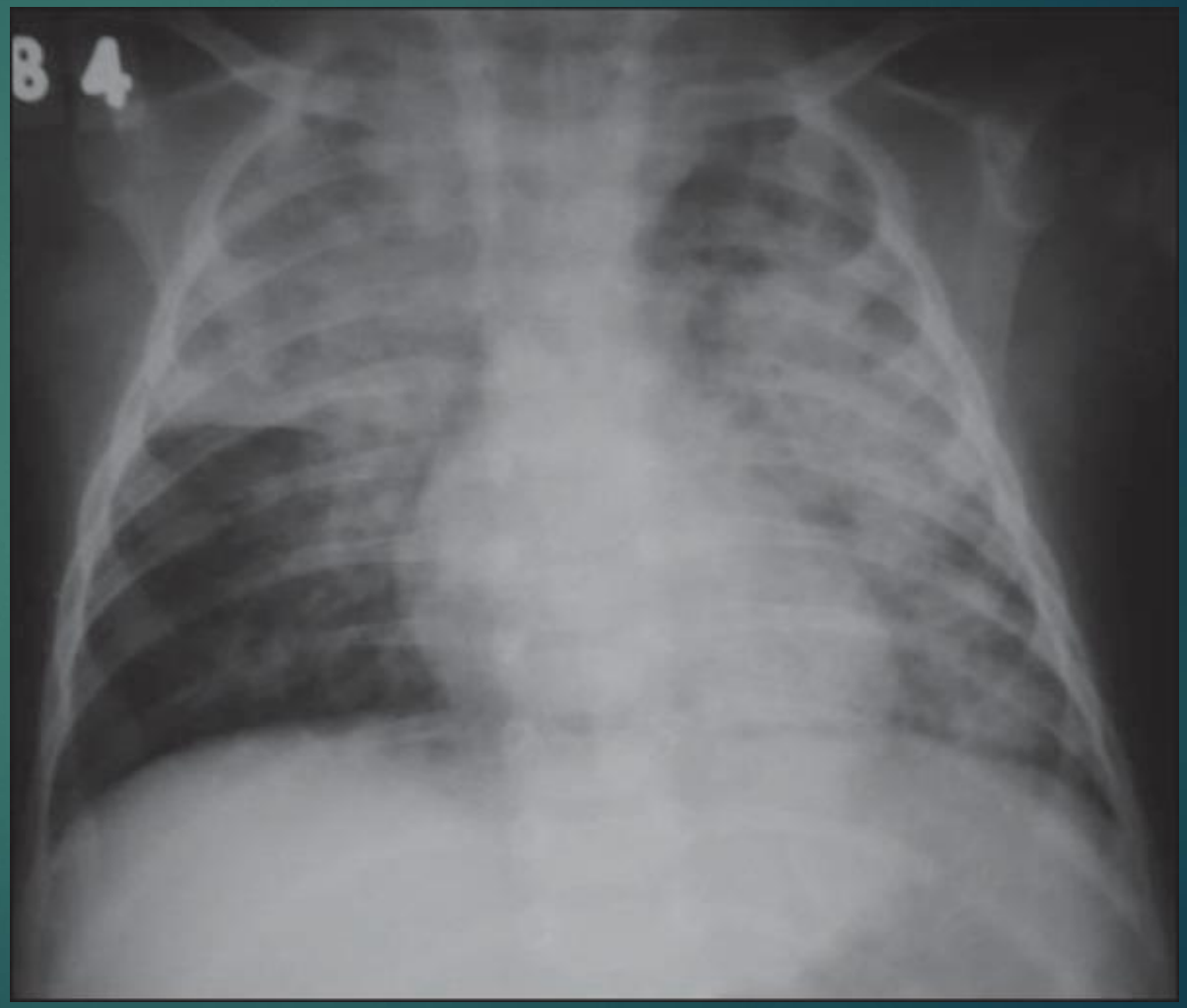


Table 428.5	Differential Diagnosis of Recurrent Pneumonia
HEREDITARY DISORDERS	
Cystic fibrosis	
Sickle cell disease	
DISORDERS OF IMMUNITY	
HIV/AIDS	
Bruton agammaglobulinemia	
Selective immunoglobulin G subclass deficiencies	
Common variable immunodeficiency syndrome	
Severe combined immunodeficiency syndrome	
Chronic granulomatous disease	
Hyperimmunoglobulin E syndromes	
Leukocyte adhesion defect	
DISORDERS OF CILIA	
Primary ciliary dyskinesia	
Kartagener syndrome	
ANATOMIC DISORDERS	
Pulmonary sequestration	
Lobar emphysema	
Congenital cystic adenomatoid malformation	
Gastroesophageal reflux	
Foreign body	
Tracheoesophageal fistula (H type)	
Bronchiectasis	
Aspiration (oropharyngeal incoordination)	
Aberrant bronchus	

Table 428.6	Factors Suggesting Need for Hospitalization of Children With Pneumonia

Age <6 mo
Immunocompromised state
Toxic appearance
Moderate to severe respiratory distress
Hypoxemia (oxygen saturation <90% breathing room air, sea level)
Complicated pneumonia*
Sickle cell anemia with acute chest syndrome
Vomiting or inability to tolerate oral fluids or medications
Severe dehydration
No response to appropriate oral antibiotic therapy
Social factors (e.g., inability of caregivers to administer medications at home or follow-up appropriately)

Treatment

- *Presumed pneumococcal pneumonia can be treated with high-dose ampicillin therapy even with high-level penicillin resistance.*
- *Ceftriaxone and/or vancomycin can be used if the isolate shows high-level resistance and the patient is severely ill.*
- *For infants 2-18 weeks old with afebrile pneumonia most likely caused by C. trachomatis, a macrolide is the recommended treatment.*
- *Oseltamivir or zanamivir should be used if influenza is identified or suspected, ideally within 48 hours of symptom onset.*

TABLE 110.3 Antimicrobial Therapy for Pneumonia Caused by Specific Pathogens*

PATHOGEN	RECOMMENDED TREATMENT	ALTERNATIVE TREATMENT
Streptococcus pneumoniae with MIC for penicillin ≤2.0 µg/mL	Ampicillin or penicillin IV; amoxicillin PO	Ceftriaxone, cefotaxime, clindamycin, or vancomycin IV; Cefuroxime, cefpodoxime, levofloxacin,† or linezolid PO
S. pneumoniae with MIC for penicillin ≥4.0 µg/mL	Ceftriaxone IV; levofloxacin† or linezolid PO	Ampicillin, levofloxacin,† clindamycin, or vancomycin IV; clindamycin PO
Group A streptococcus	Penicillin or ampicillin IV; amoxicillin or penicillin PO	Ceftriaxone, cefotaxime, clindamycin, or vancomycin IV; clindamycin PO
Group B streptococcus	Penicillin or ampicillin IV; amoxicillin or penicillin PO	Ceftriaxone, cefotaxime, clindamycin, or vancomycin IV; clindamycin PO
Haemophilus influenzae	Ampicillin IV or amoxicillin PO if β-lactamase negative; ceftriaxone or cefotaxime IV or amoxicillin-clavulanate PO if β-lactamase positive	Ciprofloxacin† or levofloxacin† IV; cefdinir, cefixime, or cefpodoxime PO
Mycoplasma pneumoniae, Chlamydophila pneumoniae, or *Chlamydia trachomatis*	Azithromycin IV or PO	Erythromycin or levofloxacin IV; clarithromycin, erythromycin, doxycycline,† or a fluoroquinolone† PO
Staphylococcus aureus, methicillin susceptible (MSSA)	Cefazolin, oxacillin, or nafcillin IV; cephalexin PO	Clindamycin or vancomycin IV; clindamycin PO
S. aureus, methicillin resistant (MRSA)	Clindamycin or vancomycin IV; clindamycin PO	TMP-SMX or Linezolid IV or PO
Gram-negative aerobic bacilli (except *P. aeruginosa*)	Cefotaxime or ceftriaxone with or without an aminoglycoside IV; amoxicillin-clavulanate, cefdinir, or cefixime PO	Piperacillin-tazobactam plus an aminoglycoside‡; fluoroquinolone† PO
P. aeruginosa	Ceftazidime IV with or without an aminoglycoside‡; ciprofloxacin† if susceptible PO	Piperacillin-tazobactam IV with or without an aminoglycoside‡
Herpes simplex virus	Acyclovir IV	

COMPLICATIONS

- *Parapneumonic effusion*
- *Empyema*
- *Pneumatocele*
- *Bronchiectasis*
- *lung abscess*
- *Unilateral hyperlucent lung, or Swyer-James syndromehiolitis obliterans*

PROGNOSIS

- ***Most children recover from pneumonia rapidly and completely, although radiographic abnormalities may persist for 6-8 weeks.***

- *In a few children, symptoms may last longer than 1 month or may be recurrent. In such cases, the possibility of underlying disease must be investigated further.*

PREVENTION

- *Annual influenza vaccine*
- *H. influenzae type b and S. pneumoni*

- *RSV infections can be prevented by use of palivizumab*
- *Handwashing before and after every patient contact and use of gloves for invasive procedures are important measures to prevent nosocomial transmission of infections.*


Thank You
Thank You
Thank You!!!!