ANPH 252: Anatomy and Pathology 2

Pathology of the Respiratory System

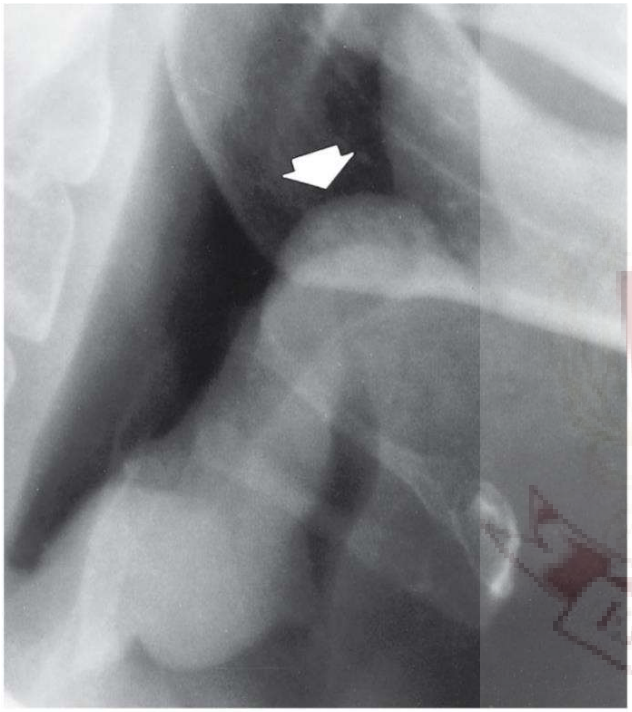
MRT Program

Pediatric Upper Respiratory Tract Diseases

1. **Epiglottitis** – a bacterial infection of the epiglottis that can be fatal within hours of onset. Treated with an endotracheal tube or tracheostomy. Vaccinations, specifically Hib have decreased cases by 95%

2. **Croup** – a childhood form of sub-glottis viral laryngitis that causes a barking cough. Treated with antibiotics.

Epiglottitis



from Podgore JK, Bass JW. *J Pediatr* 88:154-155, 1976.

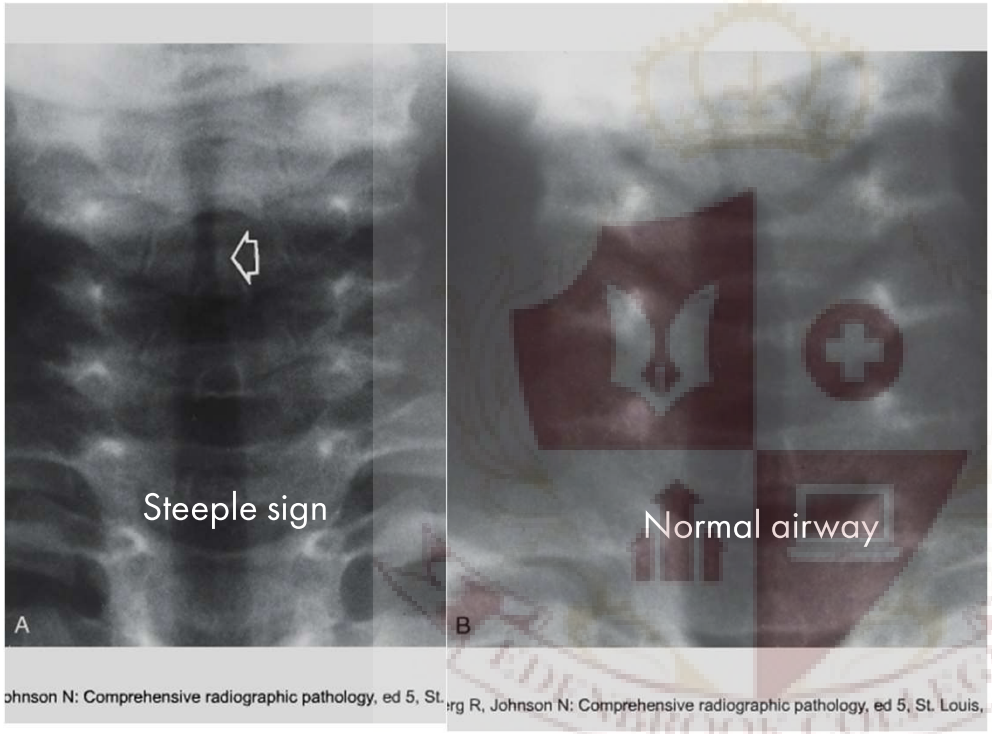
Eisenberg (6th ed.) fig. 3-14

- In the past, it affected mainly young children, but with vaccinations, it now affects older children and adults as a bacterial infection
- Patients may have fever, throat pain, dysphagia, drooling and stridor
- Stridor (a high- pitched sound) is the last sign and indicates a narrowed or obstructed airway. It is a surgical emergency.

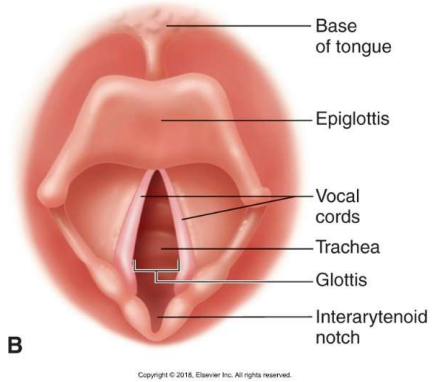
Croup

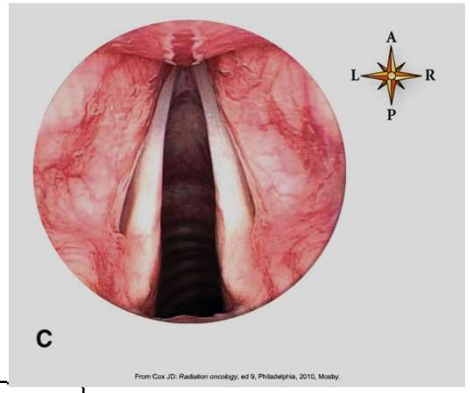
- A viral infection in young children that causes inflammatory obstructive swelling near the larynx
- Produces a barking cough

Croup



ohnson N: Comprehensive radiographic pathology, ed 5, St. rg R, Johnson N: Comprehensive radiographic pathology, ed 5, St. Louis,



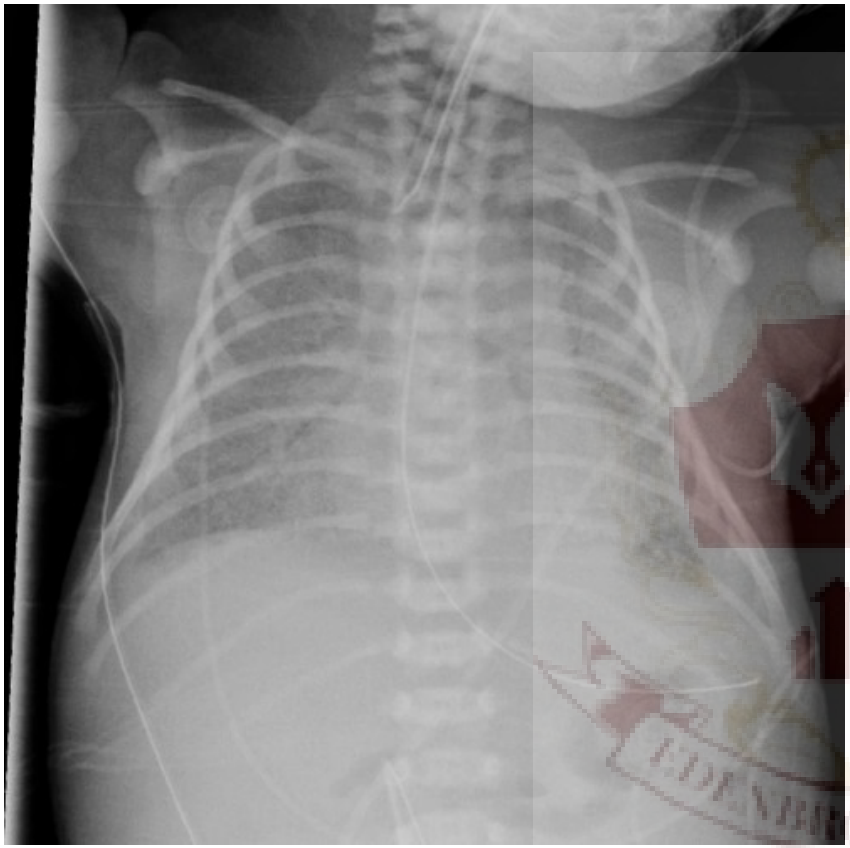


Radiographic imaging shows "steeple sign", indicating a narrowed airway

Eisenberg 3-13, and Patton and Thibodeau fig. 17-6

Infant Respiratory Distress Syndrome

- Previously called hyaline membrane disease
- A syndrome in premature babies as their lungs are not fully developed, and they are not producing surfactant
- *surfactant prevents the collapse of alveoli
- It is the leading cause of death in premature infants
- Is treated by oxygen via CPAP (continuous positive airway pressure) and IV fluids
- If the condition worsens, the baby will be intubated and placed on a ventilator
- Surfactant (synthetic or animal sourced) can be delivered through the breathing tube



Case courtesy of Dr. Jeremy Jones, Radiopaedia.org, rID: 23896

- Radiographically, a chest x-ray demonstrates decreased lung volumes, a "ground glass" appearance to the lungs and an air bronchogram
- The thorax is bell-shaped
- The ground glass appearance is due to the uniform infiltrate within the lungs
- The air bronchogram appears as the infiltrate outlines the airways, because they remain air filled

Technical Consideration for Chest Pathologies

- The **same** technical factors should be used for all mobile chest x-rays done on a given patient so that density changes can be attributed to true pathologic findings

- Chest x-rays should be done **upright** when possible

Additive Versus Subtractive Chest Pathology

Additive respiratory pathologies add fluid or tissue to the lung field, such as pulmonary edema

Subtractive respiratory pathologies increase the amount of aeration in the chest, such as emphysema

Pulmonary Edema

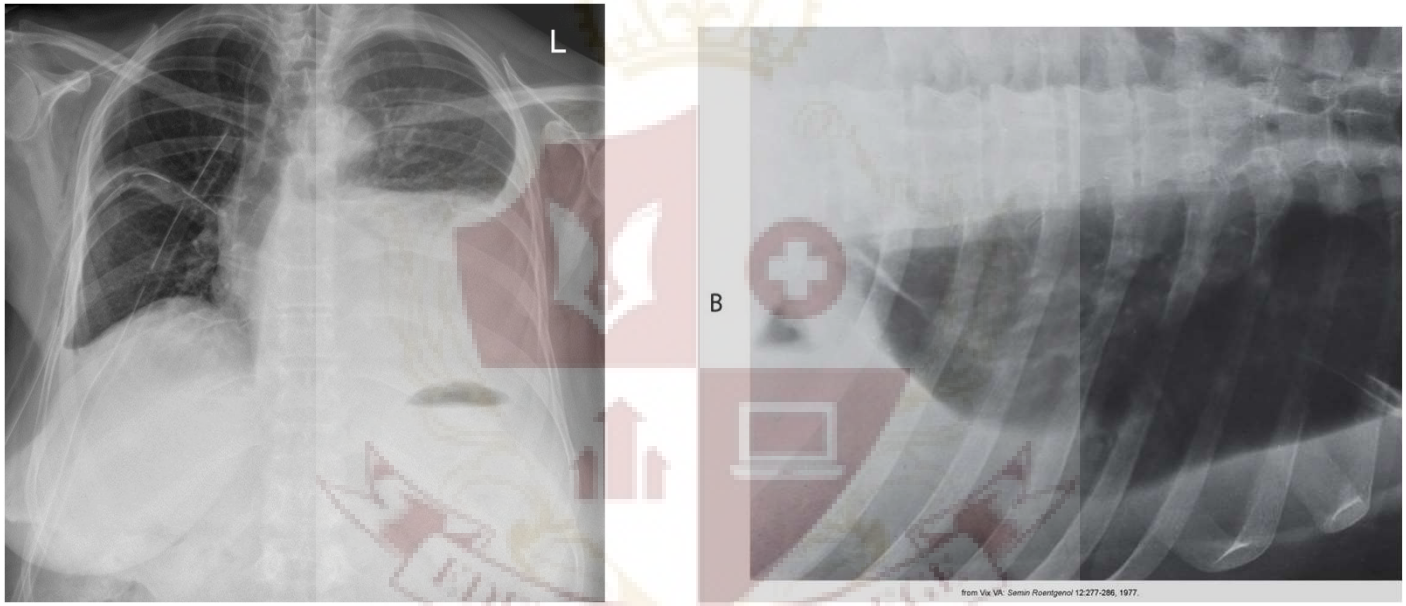


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from Fraser RG, Pare JAP: *Diagnosis of diseases of the chest*, Philadelphia, 1979, Saunders.

Eisenberg 7-21 and 7-22

Pleural Effusion



https://upload.wikimedia.org/wikipedia/commons/8/88/14-02-Erguss_im_Stehen.png

Eisenberg fig. 3-91 B

Traumatic respiratory disease

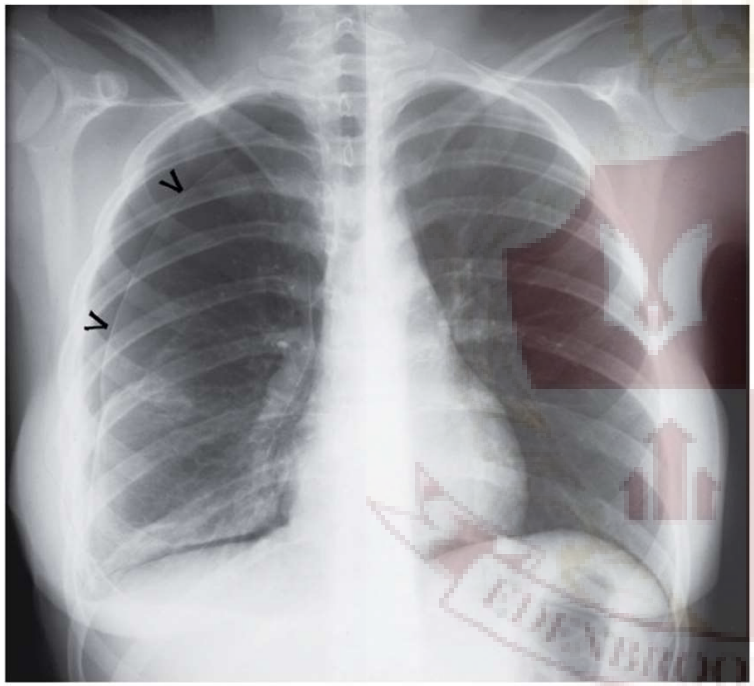
- 25% of all trauma deaths are from chest injuries
-
- Acute respiratory distress may require the immediate placement of a chest tube

- Changes are frequent in the first 24-48 hours so multiple chest x-rays are ordered to assess ongoing damage resulting from penetrating, compressive, or decelerating mechanisms

Kowalczyk, N. (2014). Radiographic Pathology for Technologists (6th ed.). Maryland Heights, MO: Elsevier Mosby. (pg. 404)

Pneumothorax

A


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B

Eisenberg 6th ed. Fig. 3-85

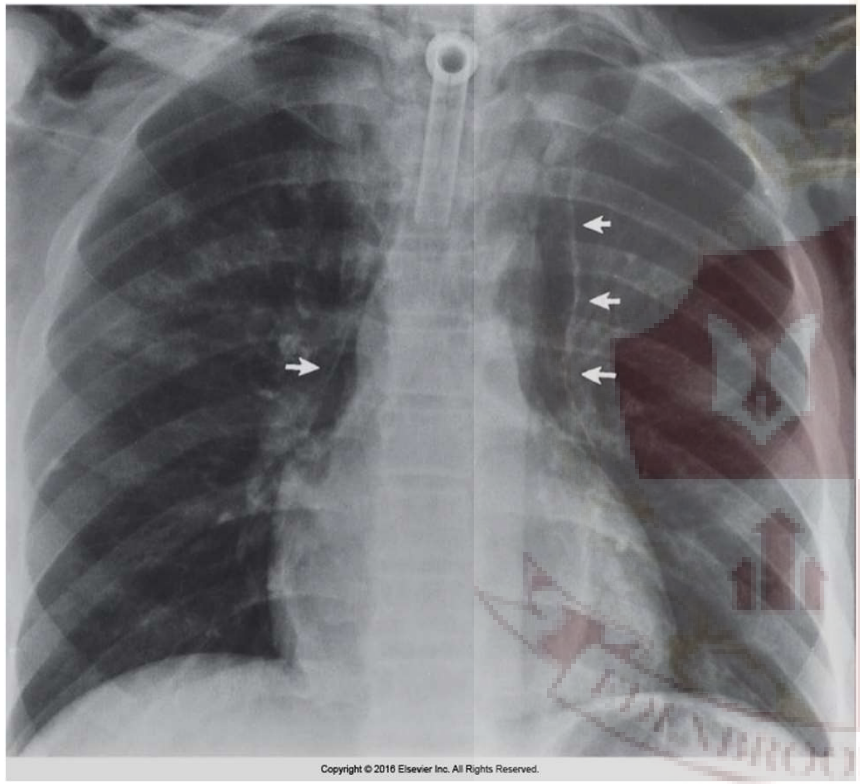
Tension Pneumothorax



Large right pneumothorax with evidence of tension - mediastinal shift to the left and slight hyperexpansion of the right hemithorax.

Case courtesy of Dr Ana Brusic, Radiopaedia.org, rID: 60551

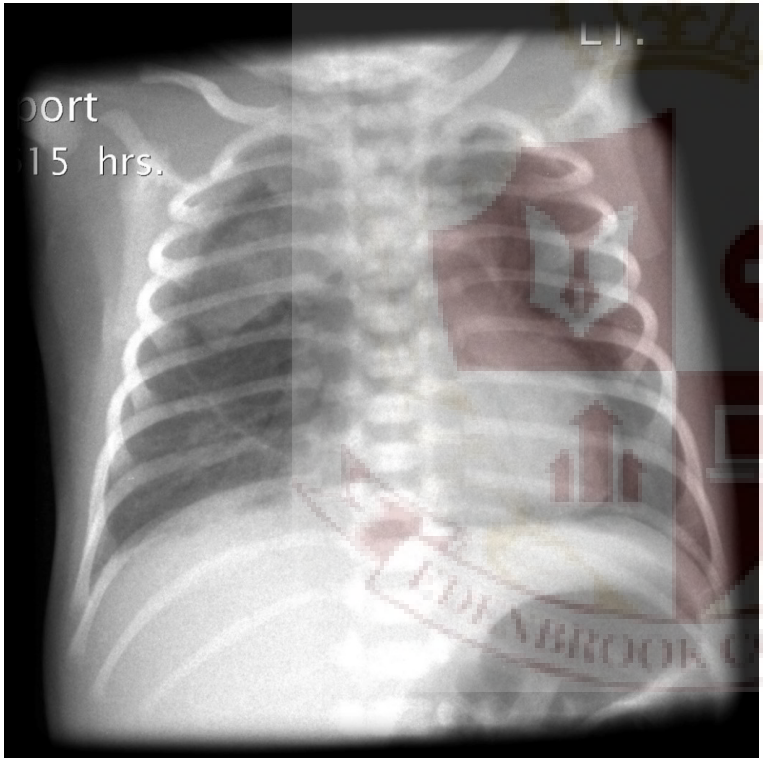
Pneumomediastinum



- Usually caused by chest trauma or perforation in the esophagus or tracheobronchial tree
- May arise spontaneously as a result of severe coughing, vomiting or straining.
- May resolve on its own, but may require surgery

Eisenberg 6th ed. Fig. 3-81 – mediastinal pleura is displaced laterally. Patient also has subcutaneous emphysema

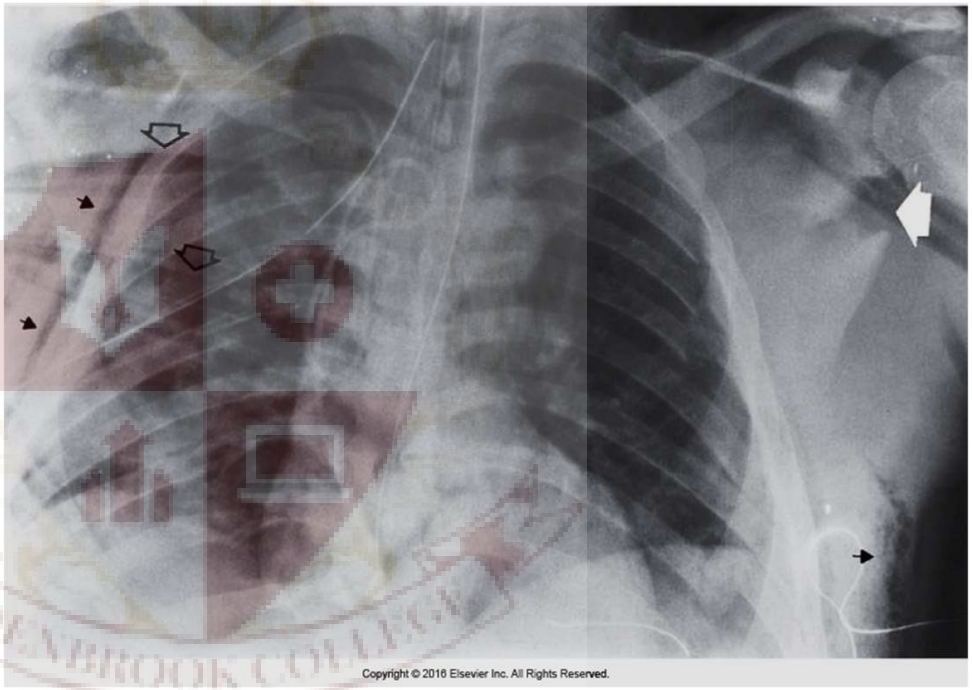
Pneumomediastinum



- Pneumomediastinum in a neonate with gas outlining the thymus

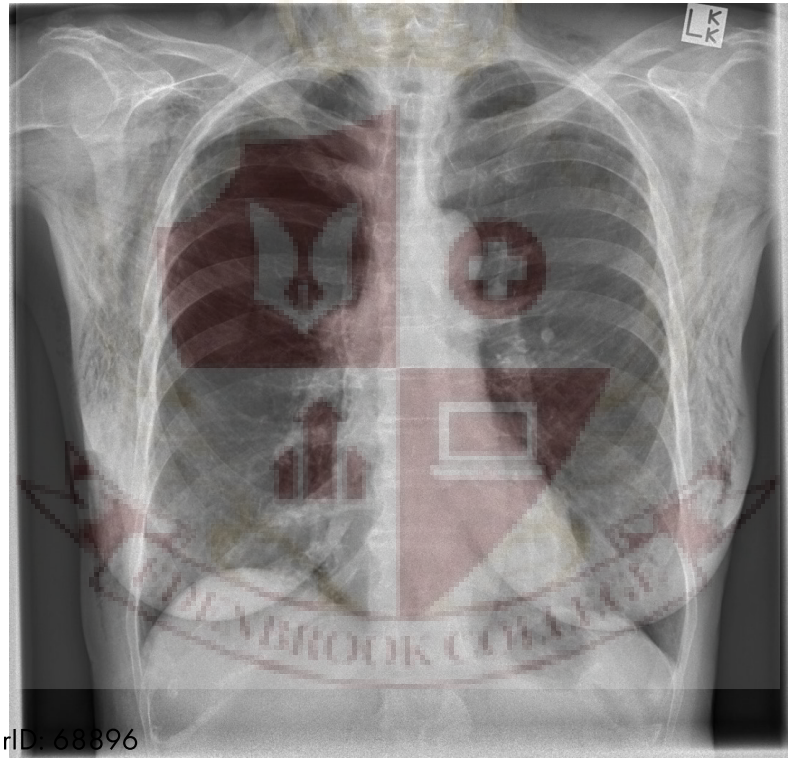
Subcutaneous Emphysema

- Air that has been forced into the chest wall as a result of penetrating or blunt trauma.



Eisenberg 6th ed. Fig. 3-83: the "open arrows" point to air between muscle bundles. What is the white arrow pointing to?

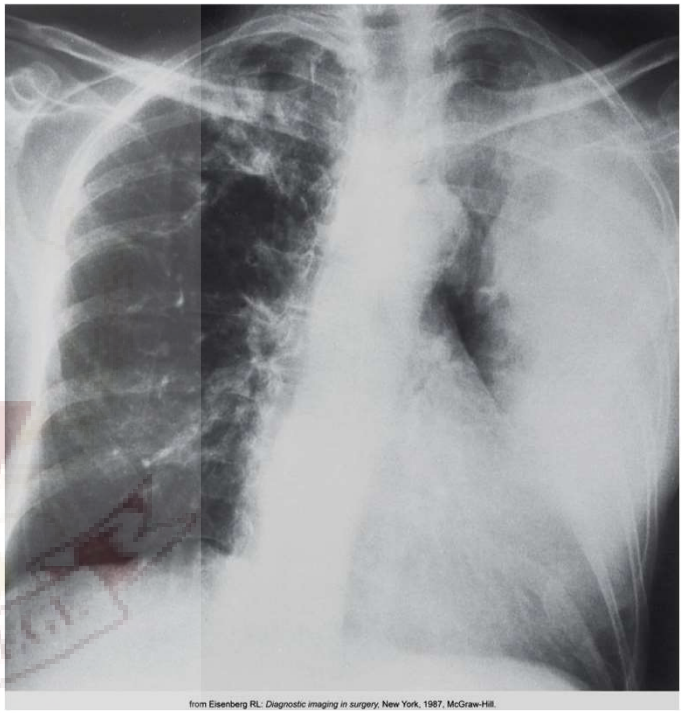
Subcutaneous Emphysema



- Case courtesy of Dr. Liam Pugh, Radiopaedia.org, rID: 68896

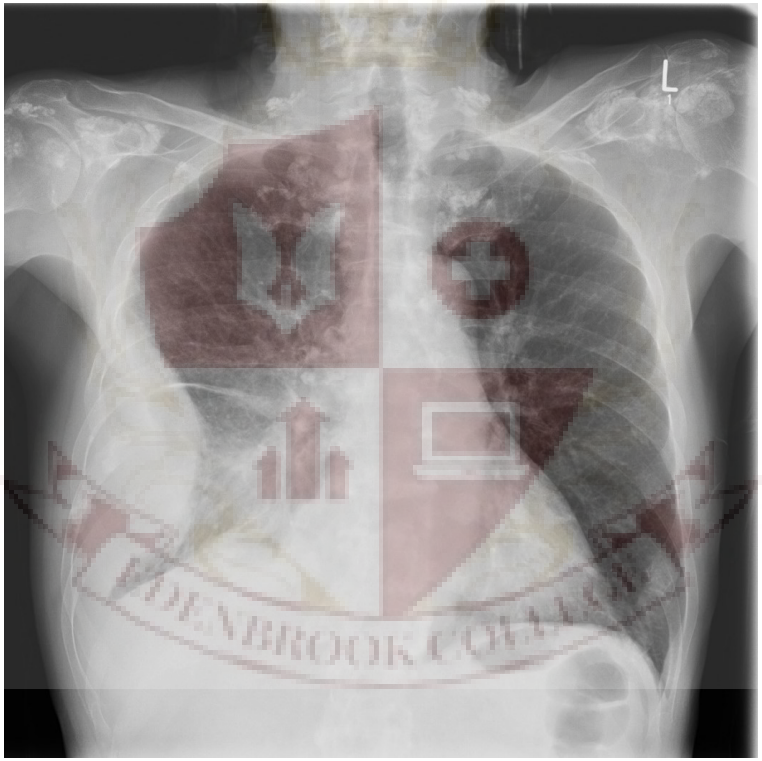
Emphysema

- Infected liquid or pus that has spread to the pleural space from an infection elsewhere in the body
- Needle aspiration may be done if location is close to the chest wall
- Looks the same as a pleural effusion unless it becomes loculated, which may happen with time



Eisenberg 3-92

Emphysema

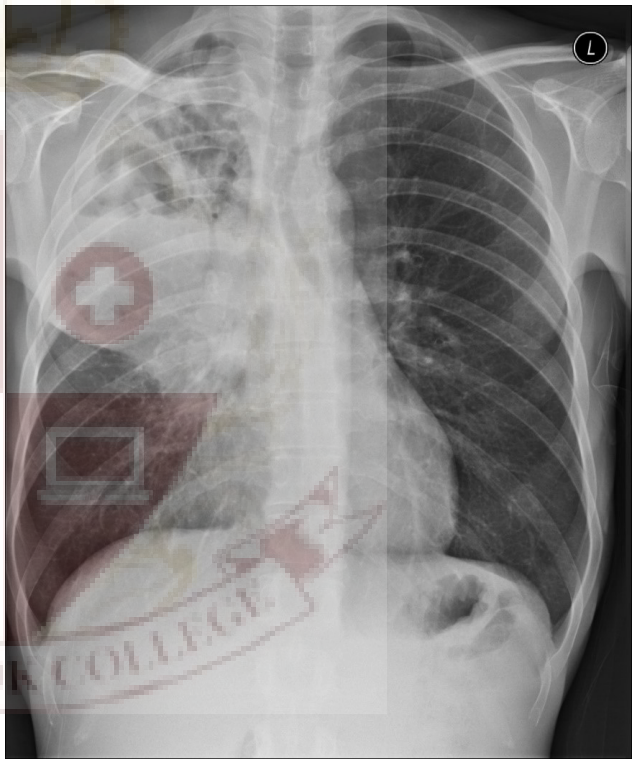


- Case courtesy of Dr Chitu Ciprian, Radiopaedia.org, rID: 20232

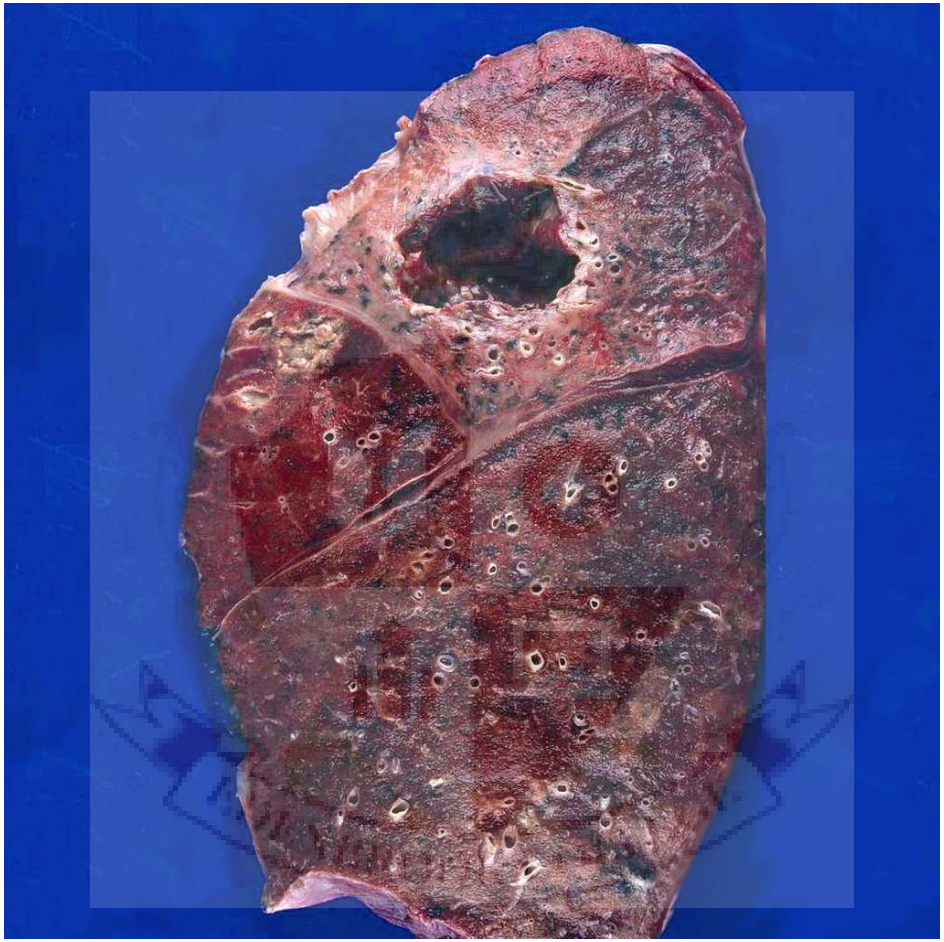
Lung Abscess

- Lung abscesses are circumscribed collections of pus within the lungs. They are often complicated to manage and difficult to treat and, in some cases, may be life-threatening.

Image shows right upper zone consolidation with cavitating features and gas-fluid level. No abnormalities in left lung. Cardiac silhouette normal.

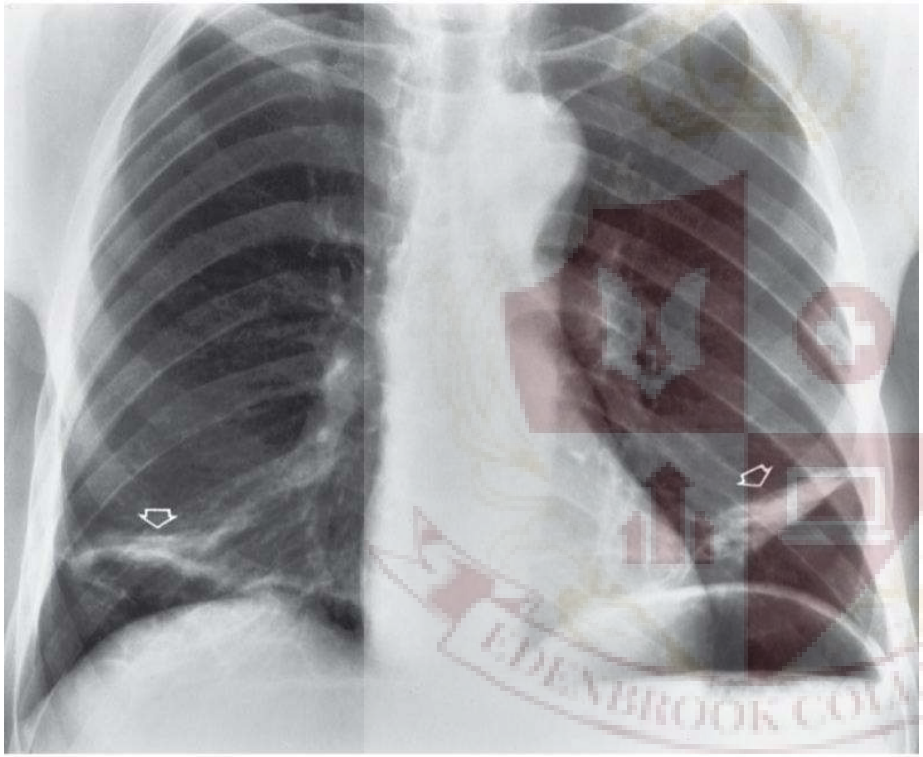


Case courtesy of Dr Derek Smith, Radiopaedia.org, rID: 34806



Case courtesy of Dr Yale Rosen, Radiopaedia.org, rID: 9284

Atelectasis

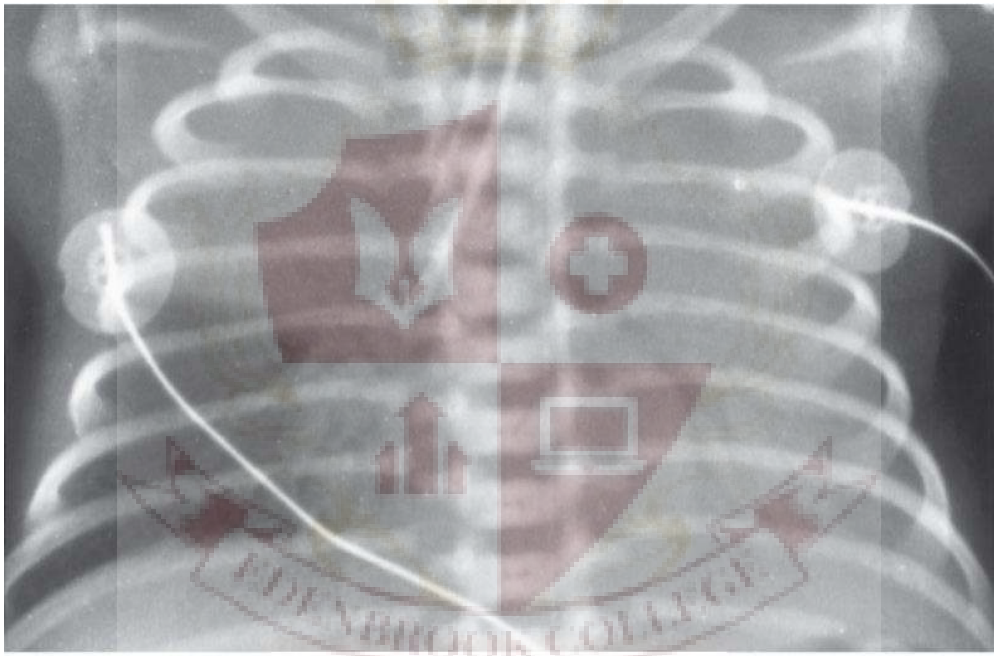


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Eisenberg 3-77	Shifting interlobar fissures

- A reduction or absence of air in a portion of the lung
- Usually caused by a bronchial obstruction, but other causes include pneumothorax, tumors, abscesses
- Placement of an endotracheal tube below the carina will also cause atelectasis. Did you know why?

Atelectasis

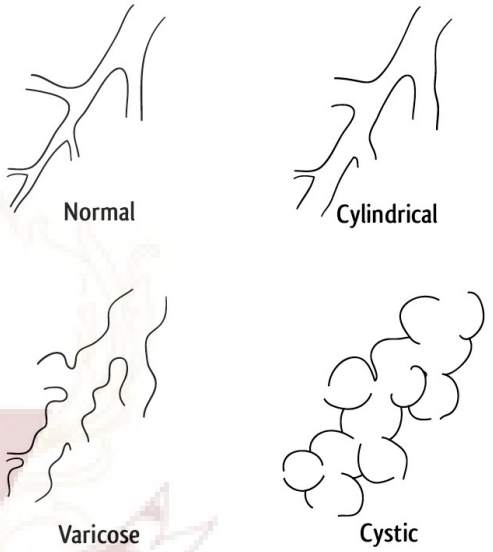

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Eisenberg 3-76: improperly positioned endotracheal tube

Bronchiectasis



Eisenberg fig. 3-40 and 3-41



Case courtesy of Assoc Prof Frank Gaillard, Radiopaedia.org, rID: 8863

- Permanent dilatation of one or more large bronchi due to destruction of the muscular walls
- Usually caused by chronic inflammation



Eisenberg 6th ed. Fig. 3-41 – chronic **bronchiectasis** with severe dilation of the basal bronchi of left lower lobe

Cystic Fibrosis


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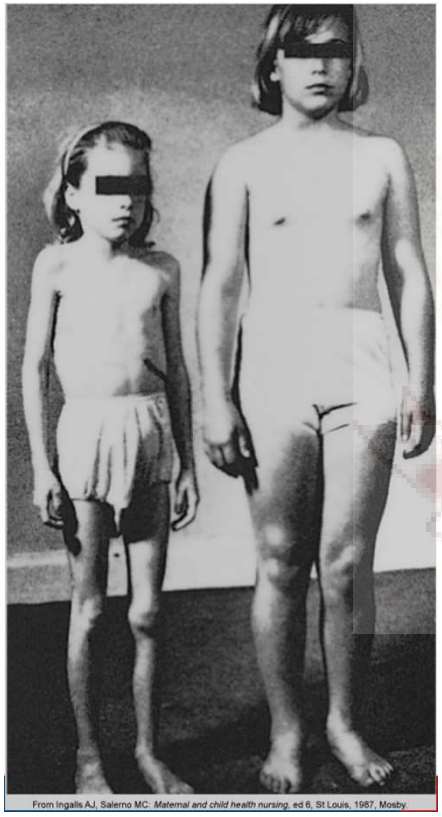
Eisenberg 3-11

- Abnormal production and reabsorption of Na+ and Cl-.
- Patients produce profuse amounts of viscous mucous that clogs many organs such as lungs and tracheobronchial tree, as well as the small bowel, pancreas, and biliary tree
- Localized areas of lung collapse result
- Lung markings increase, and lungs appear hyperinflated

- Trapped bacteria cause repeated lung infections
- Bronchiectasis, cysts, and abscesses are common by age 10
- Pancreatic digestive enzymes cannot reach the duodenum so weight loss is common
- Patients sweat 2-3 times more than normal
- A "sweat test" will show excessive levels of chloride on the skin.
- Antibiotics, bronchodilators, and chest tapping can be used to control the condition

Cystic Fibrosis

Fig. 3-10 6th ed. Patton and Thibodeau



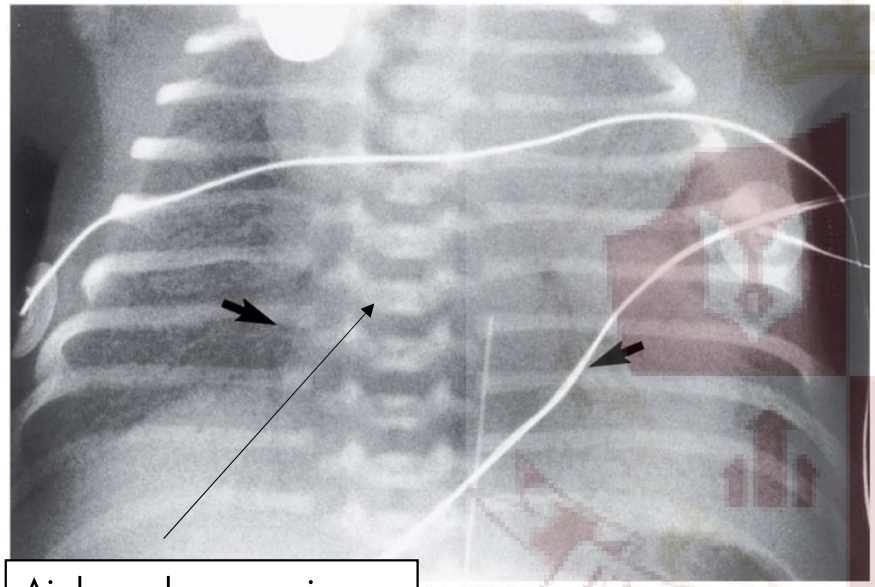
"Clubbing" of distal extremities



Jerry Nick, M.D. - http://knol.google.com/k/jerry-nick-m-d/cystic-fibrosis/UtI7gr91/HU2bIw
12 December 2009

Barrel chest, clubbed fingers, and cyanosis are common signs and symptoms as the disease progresses

Hyaline Membrane Disease (IRDS)



Air bronchogram sign

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Eisenberg Fig. 3 -12

Leading cause of death in premature infants - 5000 annually

Caused by a lack of surfactant in the alveoli

Can be treated with artificial surfactant

Incorrect technique (low mA) can mimic this pathology

Air Bronchogram



Sait Digital library

© MRT Program, Anderson College

Pneumonia

- An acute inflammation of the lungs caused by either bacterial or viral pathogens
- Lungs become plugged with thick fluid known as exudate
- More common in people with compromised immune system
- Characterized by high fever, chills, headache, cough, and chest pain

Pneumonia

- Radiographic appearance varies depending on which part of the lungs is affected

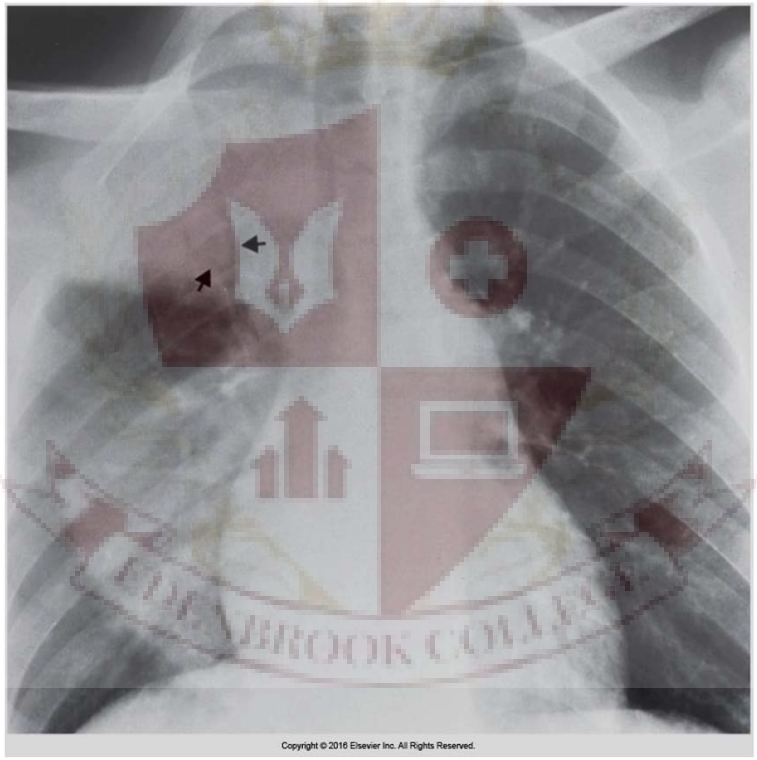
- Generally treatment includes antibiotics, rest, hydration, corticosteroids, and deep-breathing techniques

Pneumonia

- Four types include:

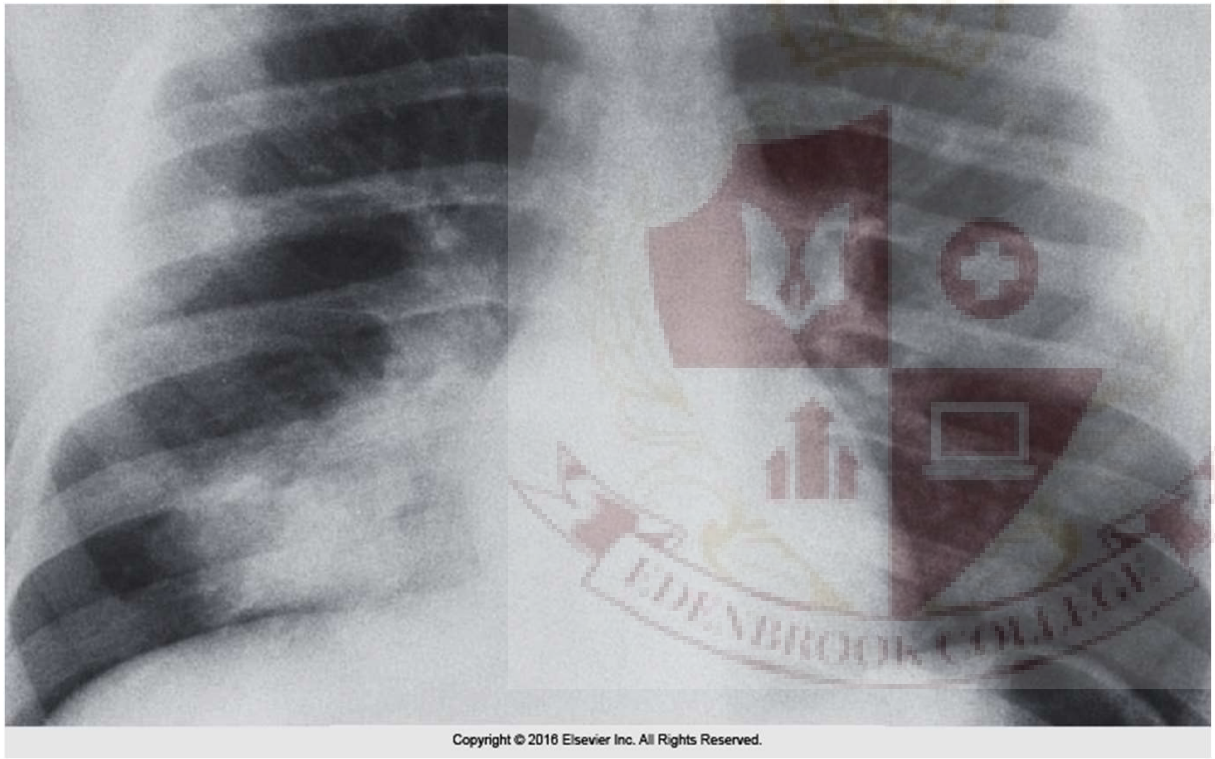
1. Alveolar – (pneumococcal bacteria)
2. Bronchopneumonia – (bacterial – from normal throat flora)
3. Interstitial - (viral)
4. Aspiration – (bacterial)

Alveolar (pneumococcal) Pneumonia



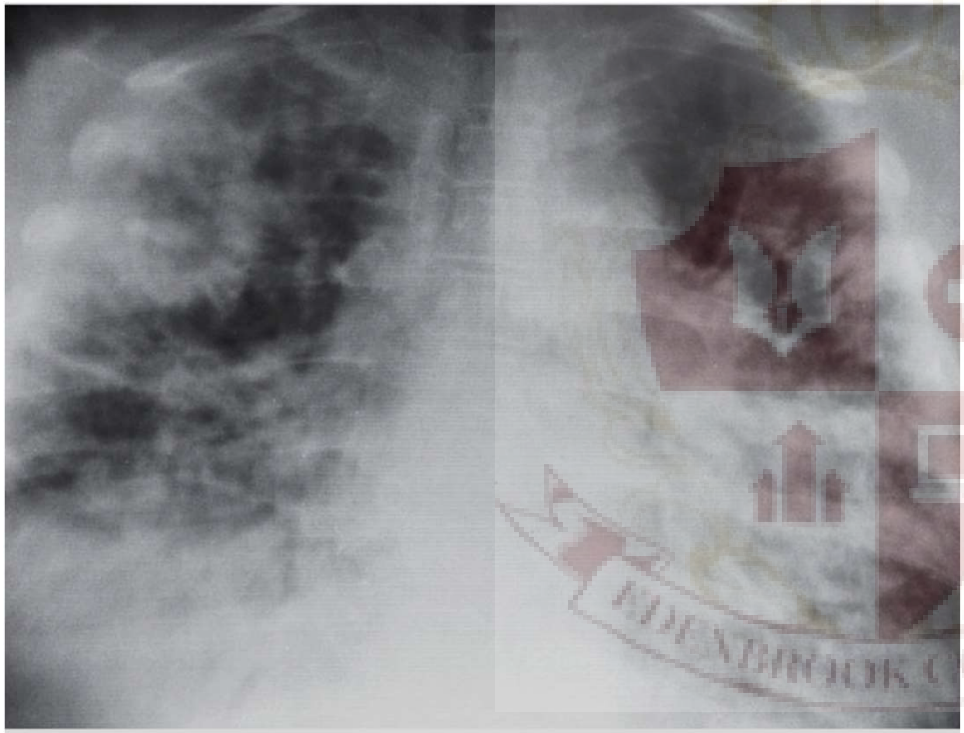
Alveolar air is replaced by inflammatory exudate giving rise to air bronchogram sign

Bronchopneumonia


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- Originates in bronchial mucosa, and spreads to adjacent alveoli.
- Tends to be self-limiting, so patchy consolidations are small and close to the bronchial tubes

Interstitial (viral) Pneumonia

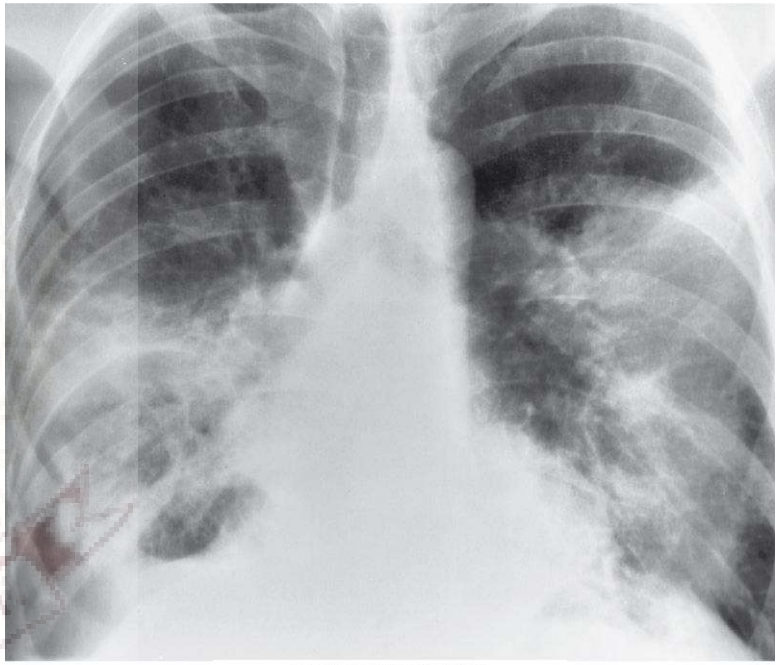


from Eisenberg R: *Atlas of signs in radiology*, Philadelphia, 1984, Lippincott.

Affects all aspects of the alveola, that creates a linear pattern through-out the affected lungs

Aspiration Pneumonia

- Caused by aspiration of gastic or esophageal contents
- May be caused by esophageal obstructions, CA, strictures, or swallowing problems, ETOH overdose; or general anesthesia, tracheostomy, coma, or trauma
- Causes multiple alveolar consolidations throughout the lungs


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Tuberculosis

- A disease caused by Myobacterium tuberculosis
- More common in developing countries, less in Western industrialized nations
- It can affect multiple organs, but the lungs are the most common site for primary infection, spreading to other organs from there

Tuberculosis

- Tuberculosis bacterium is usually spread through droplet or airborne contamination. It can last for long periods of time outside the body as long as it is not exposed to sunlight.

- In the lungs, WBC's surround the bacterium, and the body encapsulates these collections in fibrous tissue which creates "tubercles".

- If the tubercular lesions become large enough they will eventually show up on a chest x-ray, usually in the apical region of the lungs.

Tuberculosis

- If TB progresses the bacilli kill inflammatory cells in the center of the tubercles and they become filled with necrotic tissue which causes swiss-cheese- like masses in the lung

  Eventually adjacent tubercles combine to form larger and larger cavitations with air/fluid levels.

  Tubercles that impact vasculature can lead to hemorrhage and hemoptysis

  Symptoms include productive cough and fever, severe chills, headache, chest pain

Tuberculosis

- Primary tuberculosis has declined because of screening and prevention programs

  Secondary TB (post-primary) is a reactivation of a dormant tubercle caused by a decrease in immune system function, and occurs years later

Tuberculosis

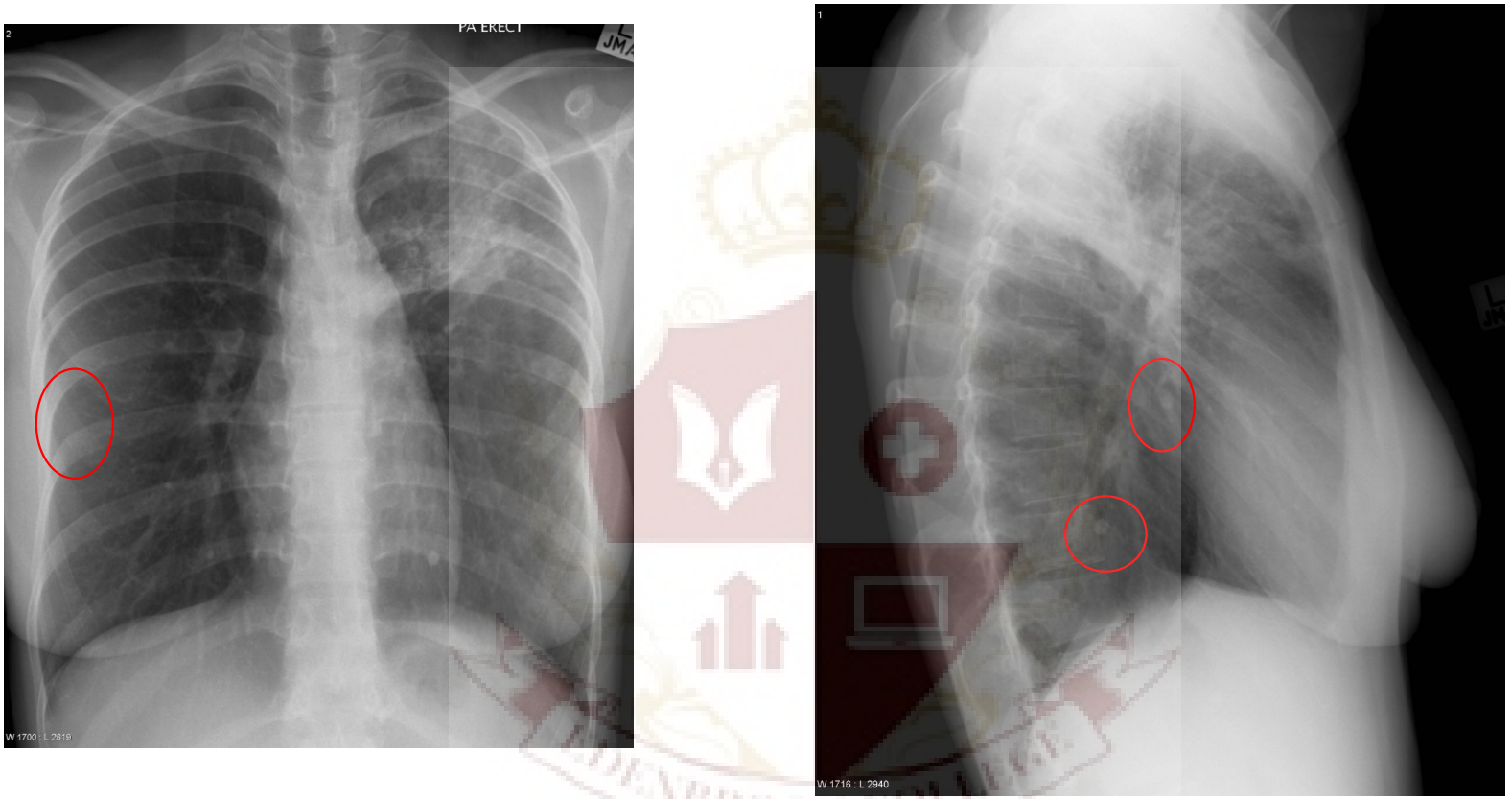
- A mantoux test can be done to determine TB exposure; a modified bacillus is injected under the skin. If the patient has been exposed in the past, the injection site will swell up within 2-3 days, indicating that the individual has developed antibodies for TB

- The mantoux test will not test positive during or up to 10 weeks after an acute infection.

Tuberculosis



Eisenberg fig. 3-28



Chest x-ray demonstrates consolidation in the left upper lobe. Two densely calcified granulomas are also present on the left, one near the hilum and the second in the left lower lobe.

Case courtesy of Assoc Prof Frank Gaillard, Radiopaedia.org, rID: 12569

Chronic Obstructive Pulmonary Disease (COPD)

- A group of obstructive airway diseases:

1. Chronic bronchitis - Widespread inflammation and thickening of bronchial walls, causing decreased airflow and decreased elasticity in alveolar walls

2. Emphysema – destructive changes in the bronchioles leading to destruction of alveoli and hyperinflation of the lungs

COPD

- Most cases are caused by smoking.
- Other causes include infection, genetics and long-term exposure to air pollution
- No cure, but can be slowed by removing/ reducing exposure to risk factors

Chronic Bronchitis

- Symptoms:

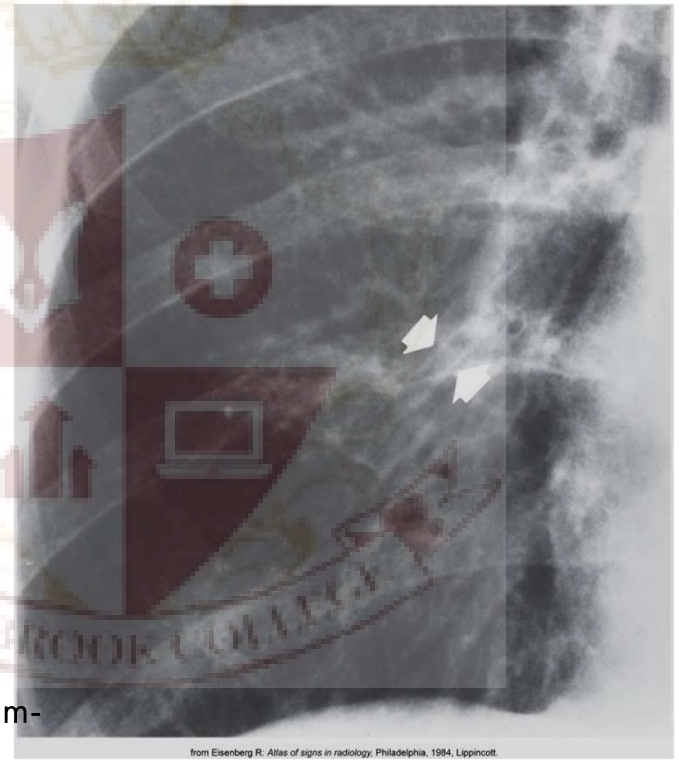
➢ Chronic cough is the first symptom. Coughs persist for 3/12 months each year for 2 years is defined as chronic bronchitis

➢ Shortness of breath. Patient feels out of breath or like they can't get enough air in. Worse on exertion and worsens over time

➢ Viscous mucous causes increase in sputum, and a severe, chronic, productive cough

➢ Over time narrowing of the airways leads to hyperinflation of the lungs, and depressed diaphragm

Chronic Bronchitis



Eisenberg (6th ed.) fig 3-35 "tram-lines" caused by thickening of bronchi walls

Chronic Bronchitis

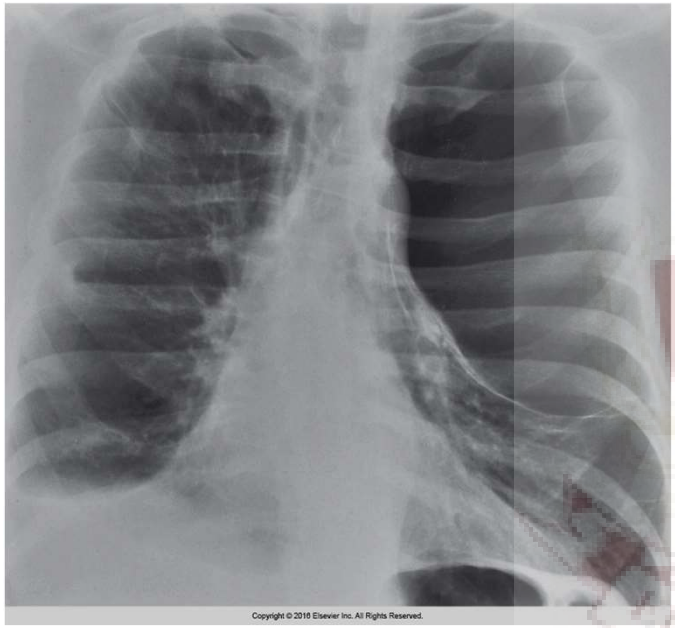
- Imaging shows:

  - Increased bronchovascular markings
  - Hyperinflation
  - Depressed diagphragm

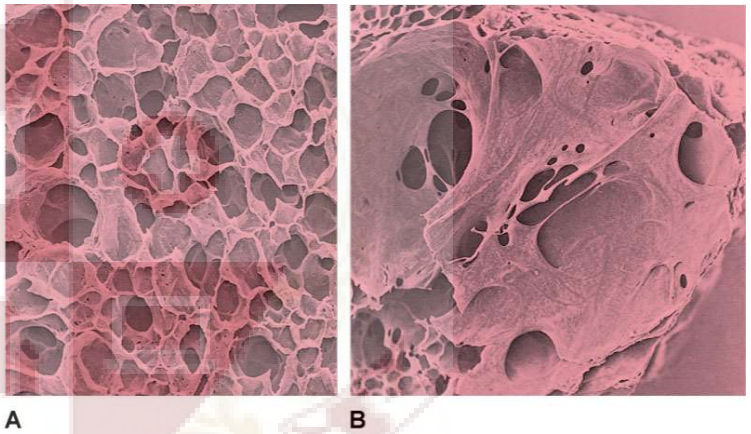
Emphysema

- Irreversible crippling destruction of smaller airways that leads to increased volume of air in the lungs. Closely associated with heavy cigarette-smoking.
- Damaged cilia can't sweep away foreign particles, so mucosal inflammation develops, and excess mucous plugs airways
- Exhalation becomes difficult, and trapped air overinflates the alveoli leading to rupture, and causing focal regions of emphysema with no wall, larger than 1-2 cm called bullae (singular is bulla)
- Surface area decreases within the lungs and gas exchange is compromised. Spontaneous pneumothorax and atelectasis can occur when bullae rupture
- The heart enlarges as it tries to compensate for decreased lung function

Emphysema

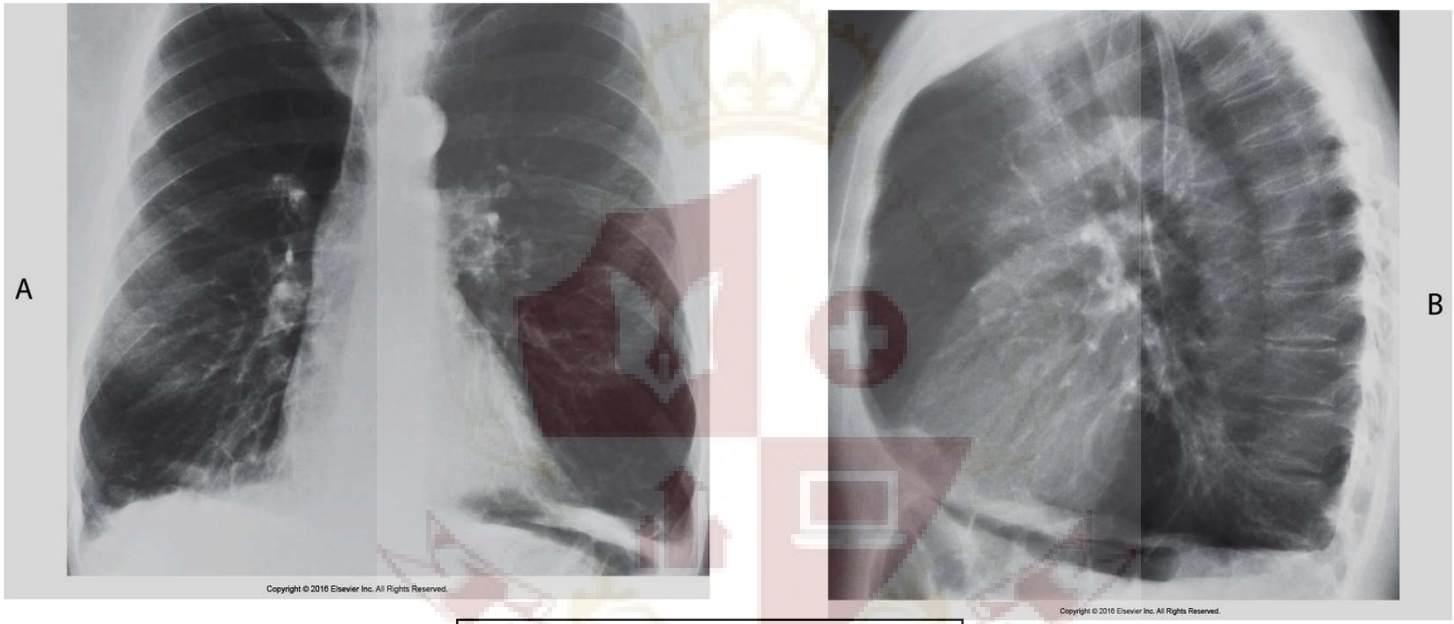


Eisenberg (6th ed.) fig. 3-37 showing large bulla, hyperinflation, and blunted lung bases associated with advanced emphysema



Patton and Thibodeau (6th ed) page 465

Emphysema

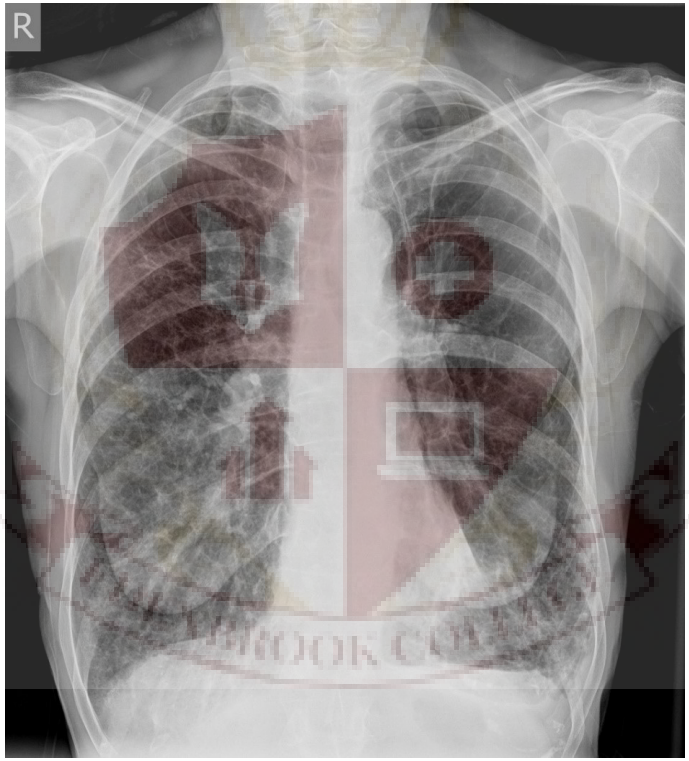


Eisenberg (6th ed) fig. 3-36

Radiographic appearances include:

Over-inflation of the lungs, bullae formation, blunted lung bases, retrosternal air, and increased pulmonary vasculature

Emphysema



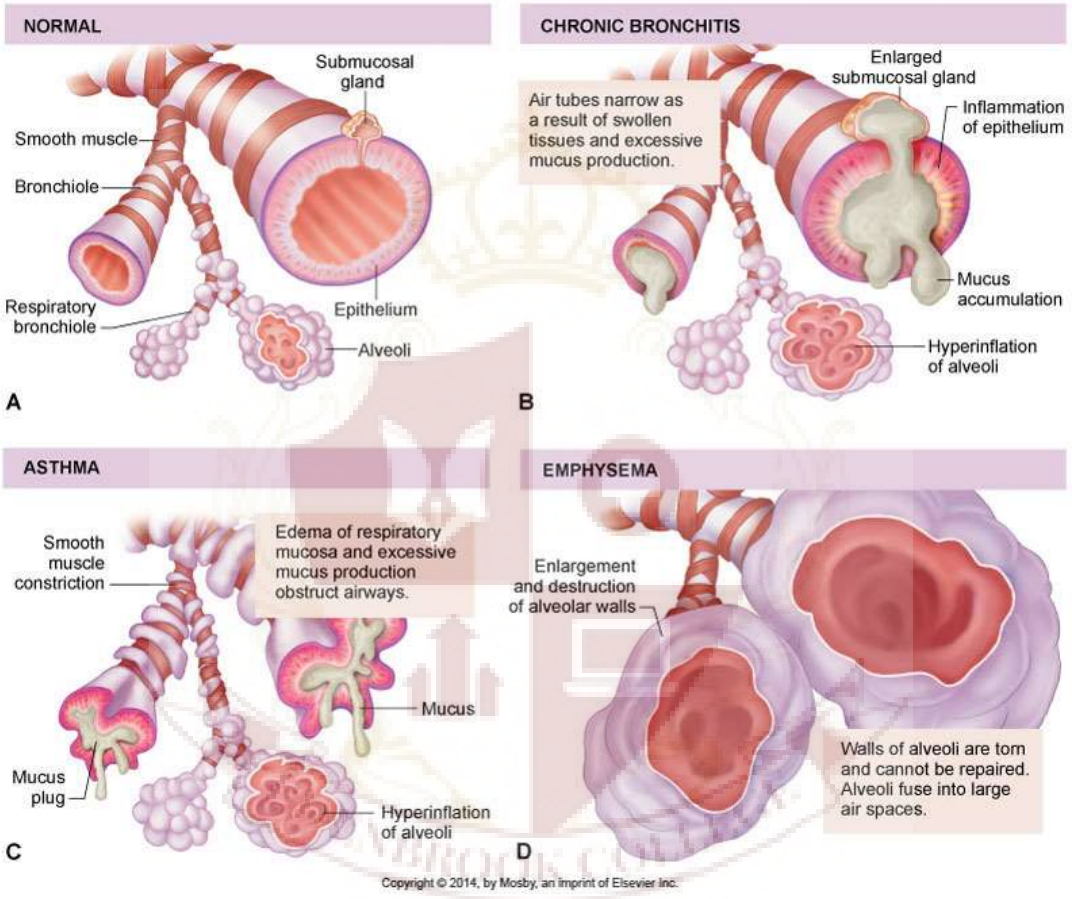
- The lungs are markedly hyperinflated.
- Flattening of the diaphragm.
- Bullous change in the left upper lobe.
- The heart has an elongated appearance.

- Case courtesy of Dr Ian Bickle, Radiopaedia.org, rID: 50326

Asthma: Reactive Airway Disease

- Common chronic disease
- Characterized by wheezing, shortness of breath, chest tightness, cough
- These bronchospasms, increased production of mucous, and narrowing of airways occur in response to environmental triggers such as allergens, pollution, cold air or exercise/exertion
- Uncontrolled asthma will scar bronchial tubes so bronchodilators and anti-inflammatory inhalers are treatments of choice

COPD



Patton and Thibodeau (7th ed.) fig. 17-14