Chest X-ray Interpretation

Denise Ramponi, DNP, FNP-C, ENP-BC, FAANP, FAEN
Robert Morris University & Heritage Valley Health System
Pittsburgh, PA

Disclosures

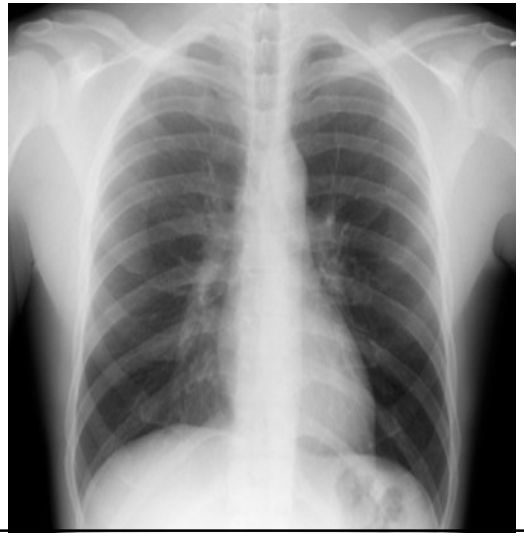
- Denise Ramponi, DNP, FNP-C, ENP-BC, FAANP, FAEN is a Speaker for Practitioner Education Associates, Advanced Practice Education Associates, & ThriveAP for Procedure workshops
- All relevant financial relationships have been mitigated
- No unlabeled/unapproved uses of drugs or products referenced will be discussed

Learning Objectives

- Describe the important components in interpretation of chest radiographs
- Describe findings to identify normal and abnormal findings in chest radiographs
- List findings to accurately identify common pathology in chest radiographs

Chest X-ray: Standard Views

- Postero-anterior (PA):
  - On inspiration – diaphragm descends to 10th rib posteriorly
    - If diaphragm is not at the 8th rib = lung hypoinflation (e.g., respiratory depression)
    - If diaphragm is past the 12th rib = hyperinflation (e.g.,



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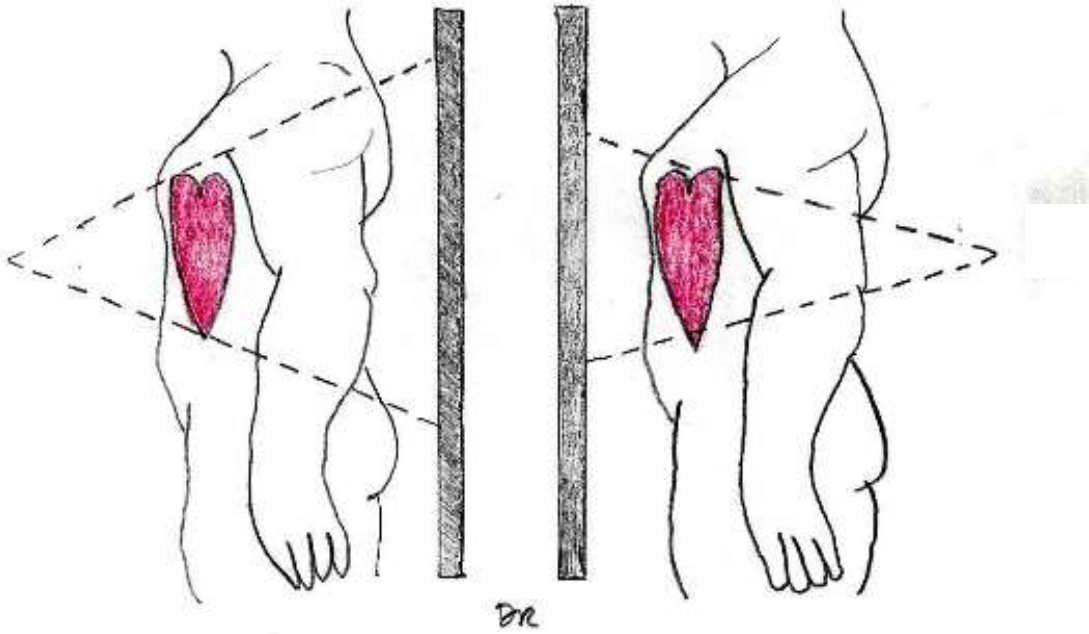
AP vs. PA



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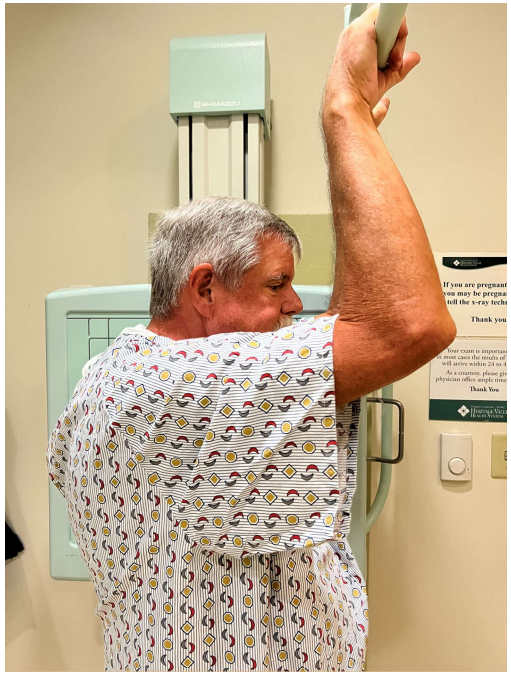
Lateral Film



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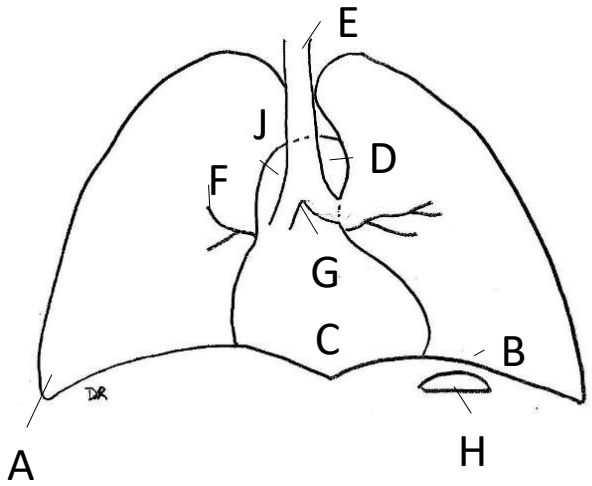
AP View - Portable

- When the patient is unable to tolerate routine views with patient sitting or supine
- No participation from the patient
- Film is against the patient's back (supine)

Chest Landmarks - PA



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- A – costophrenic angle
- B- L diaphragm
- C- heart
- D- aortic arch
- E- trachea
- F- hilum
- G- carina -*cartilaginous ridge within the trachea (usually at the level of the 4th or 5th thoracic vertebrae)*
- H- stomach bubble
- J- ascending aorta

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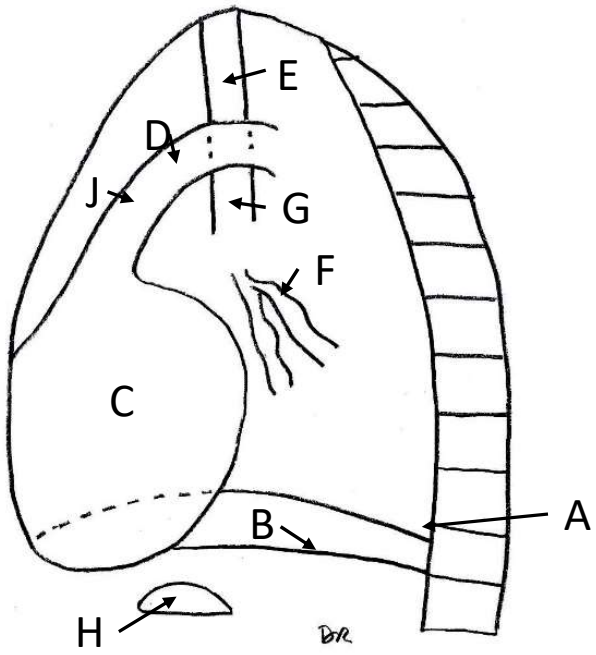
Chest Landmarks - Lateral



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Systematic Approach to CXR Interpretation

- A – Assessment of Quality
- B – Bones and Soft Tissue
- C – Cardiac
- D – Diaphragms
- E – Effusions
- F – Fields and Fissures
- G – Gosh, this can be overwhelming 😳!
- H – Hila and Mediastinum
- I - Impression

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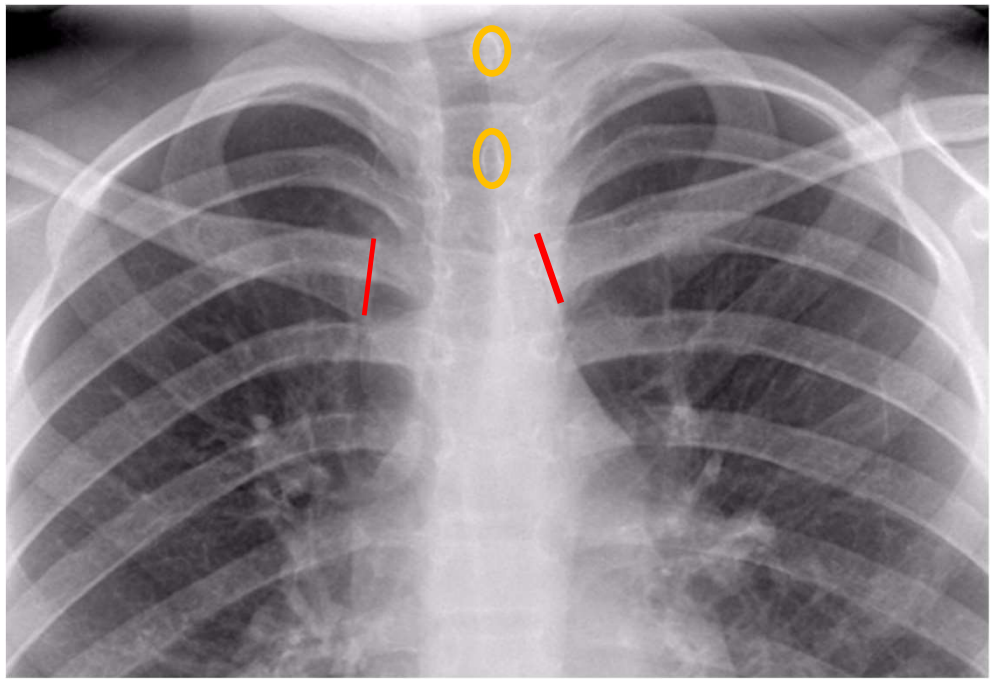
A – Assessment of Quality

- Position
- Inspiration
- Exposure
- Rotation



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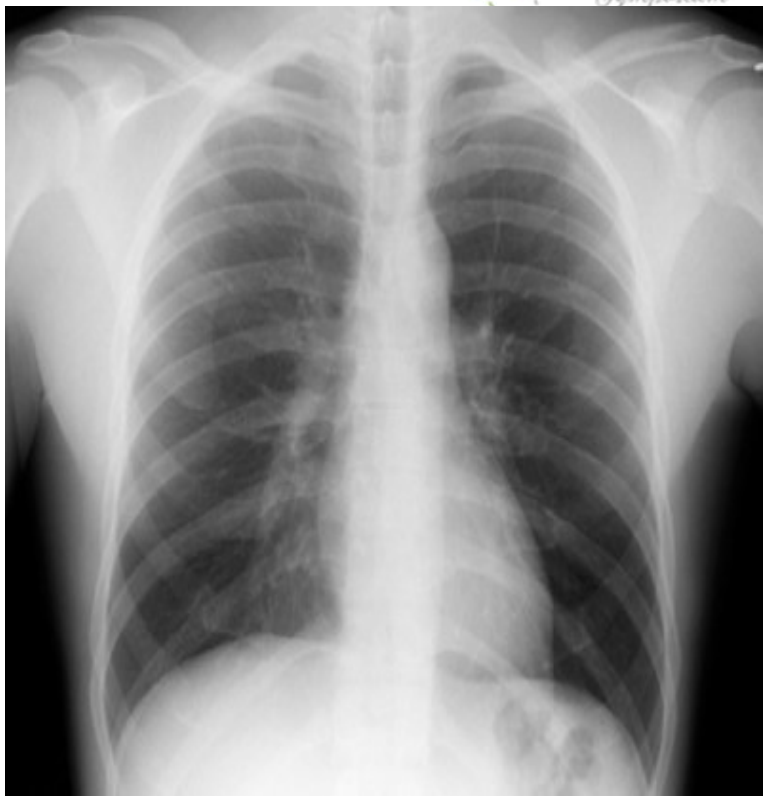
Inspiration

- Counting ribs – 1 & 2 are above the clavicle
- Full inspiration:
- 8 ribs (10 ideal) – Posterior
- 5-6 ribs - Anterior



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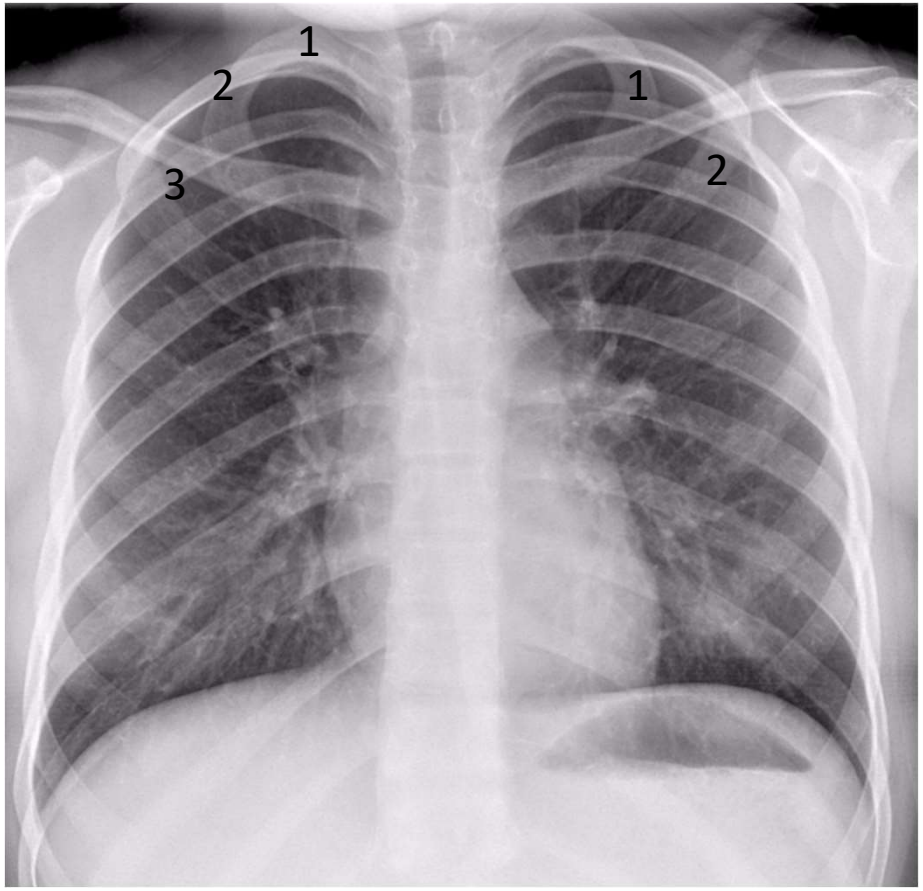
Counting Ribs



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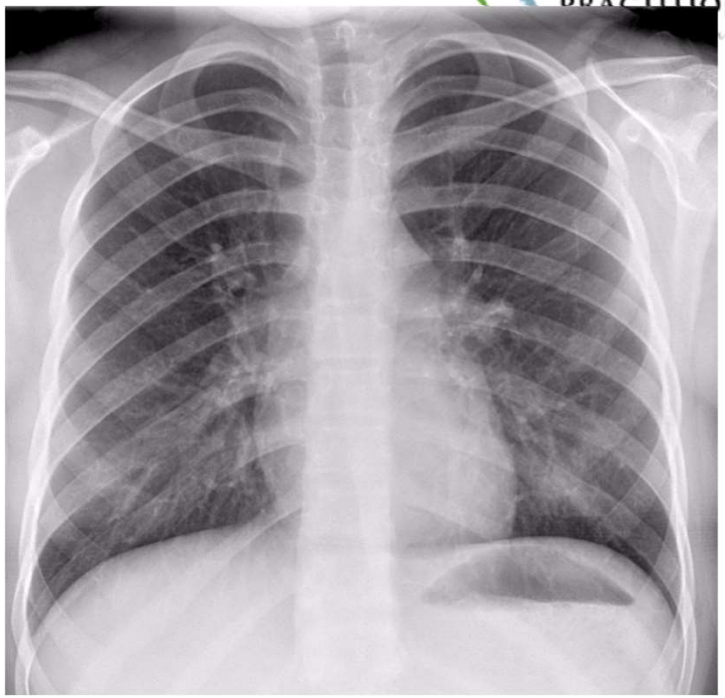
Penetration or Exposure

- Thoracic Vertebrae are just visible behind heart
- Left diaphragm should be visible at the edge of the spine



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Penetration or Exposure

Under Penetrated

Over Penetrated

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B – Bones and Soft Tissue

- Subcutaneous Air
- Fractures
- Osteoporosis
- Metastatic Lesions
- Foreign Body

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Bones and Soft Tissue

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Rib fractures

- Chest radiograph obtained solely to exclude complication such as pneumothorax
- Oblique views of the ribs are not necessary; clinical management is rarely altered by seeing rib fractures

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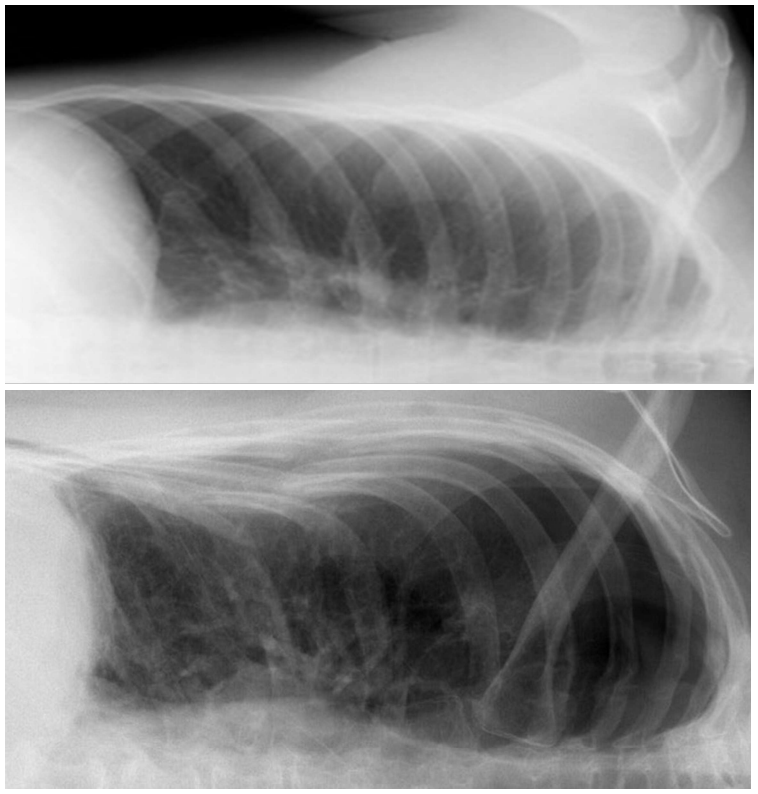
Rib Fractures



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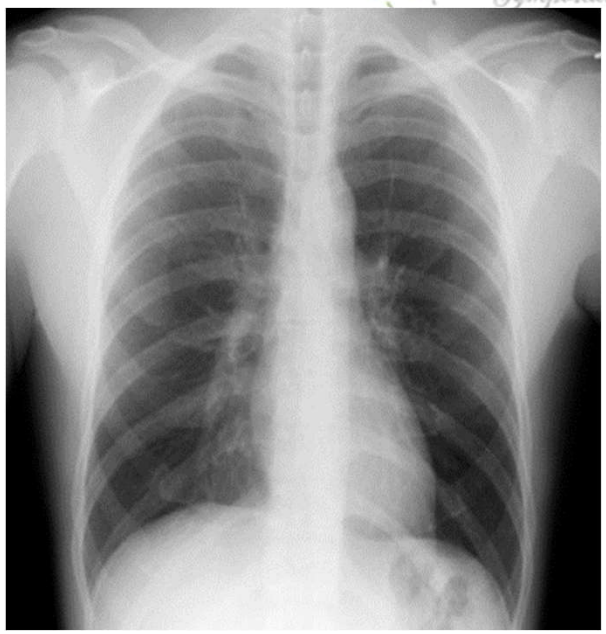
C - Cardiac

- Silhouette Sign
- Dextrocardia
- Heart size <50% of the diameter on the PA view



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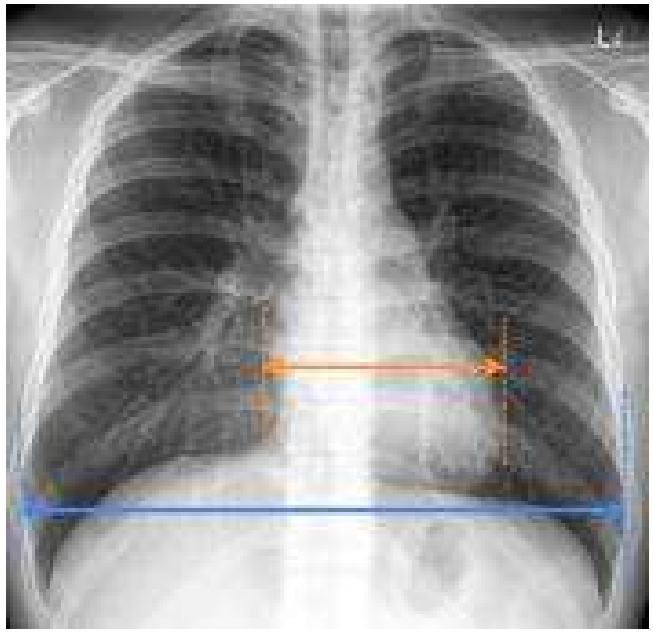
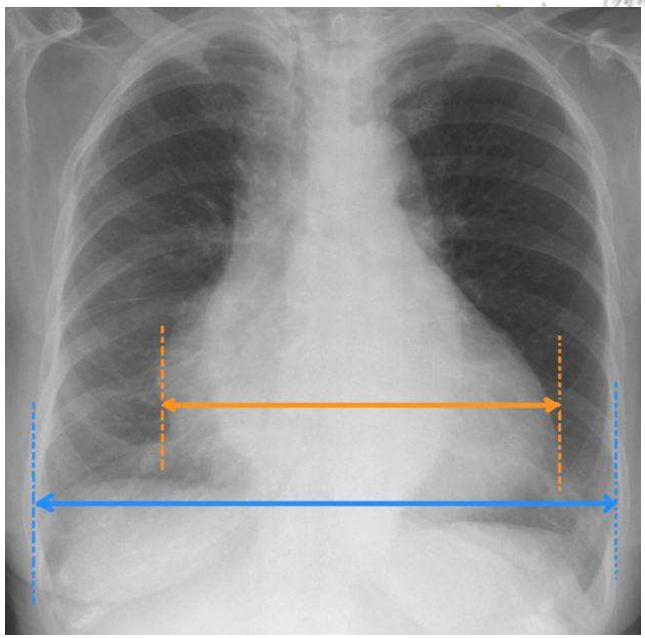
Cardio-thoracic ratio





https://radiopaedia.org/articles/cardiothoracic-ratio?lang=us

Extracardiac causes for CTR>50%

- Portable AP films
- Obesity
- Pregnancy
- Ascites
- Straight back syndrome
- Pectus excavatum

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Cardiomegaly & AP film

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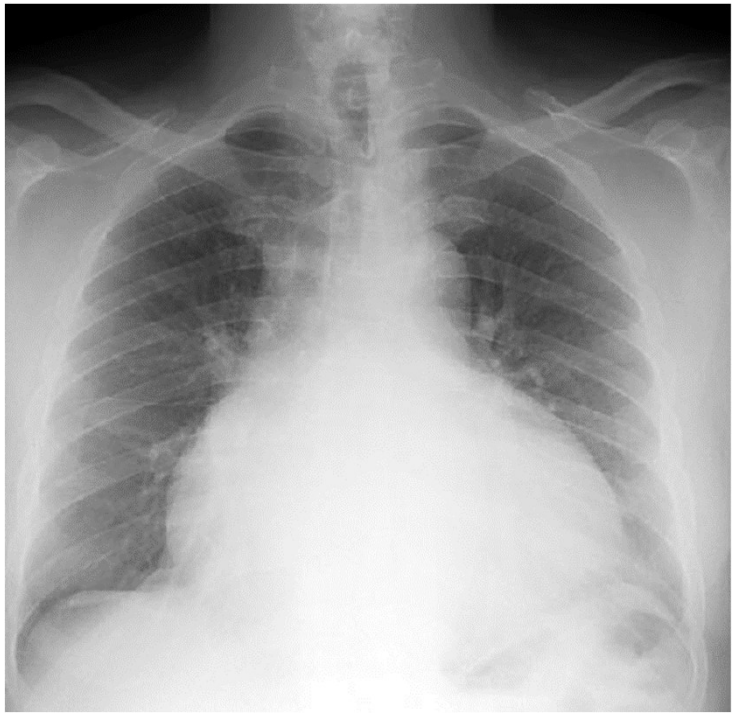
C - Cardiac



- Pericardial Effusion
- Water Bottle Sign

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Dextrocardia

- *Dextrocardia situs inversus:* heart is a mirror image of normal placement
- *Dextrocardia situs totalis* - all visceral organs are mirrored
- Incidence - 1 in 12,000 people

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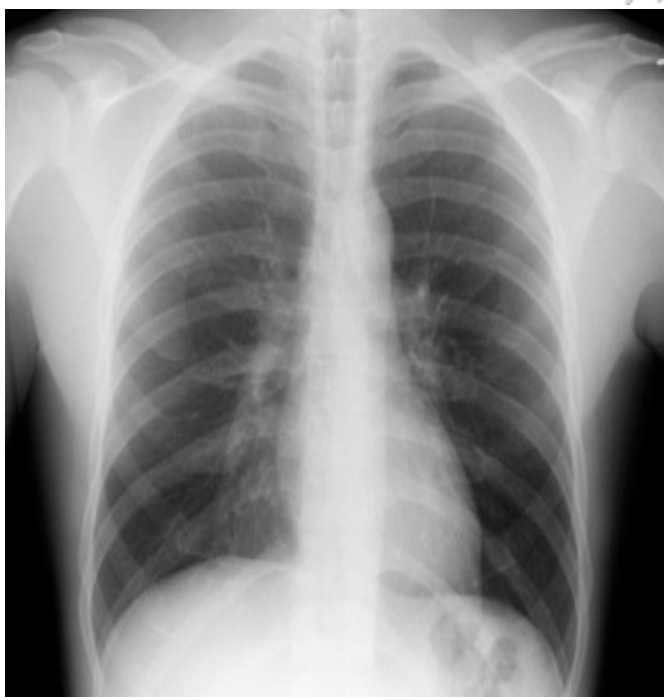
D - Diaphragms

- Right higher than the left
- Visible from costophrenic angles to spine
- Flat in asthma or COPD
- Free Air



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D- Diaphragm

- Pneumoperitoneum
  - Perforated viscous

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Free Air

- Air will rise to the highest part of the abdomen

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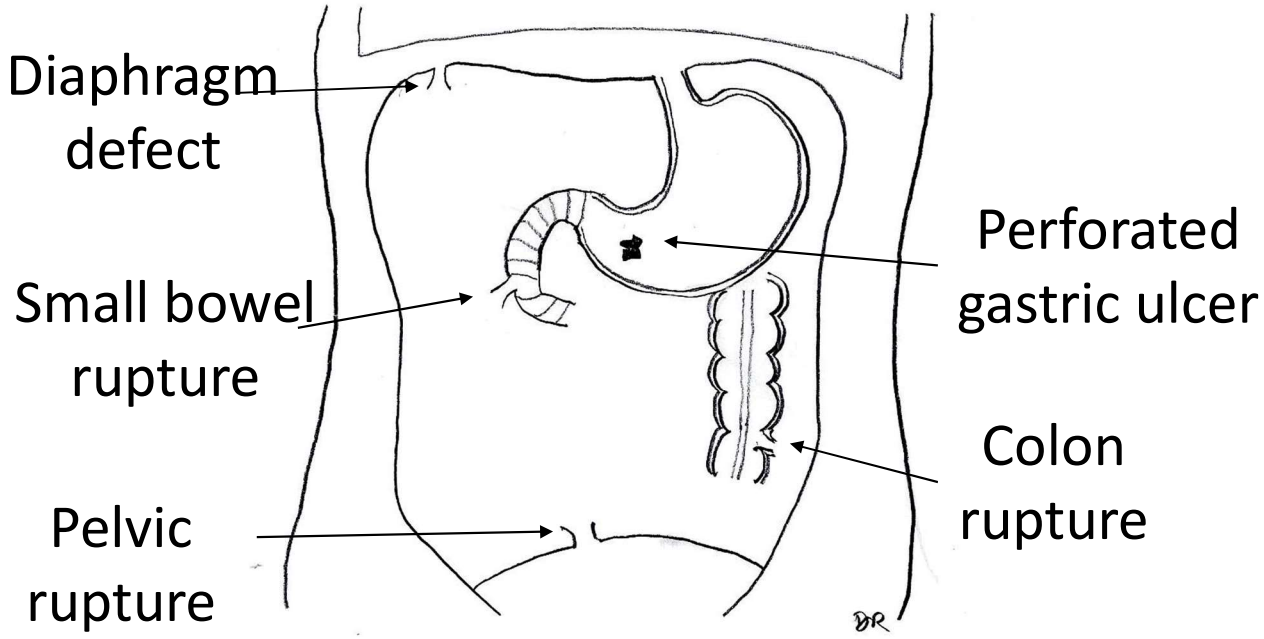
Causes of Free Air



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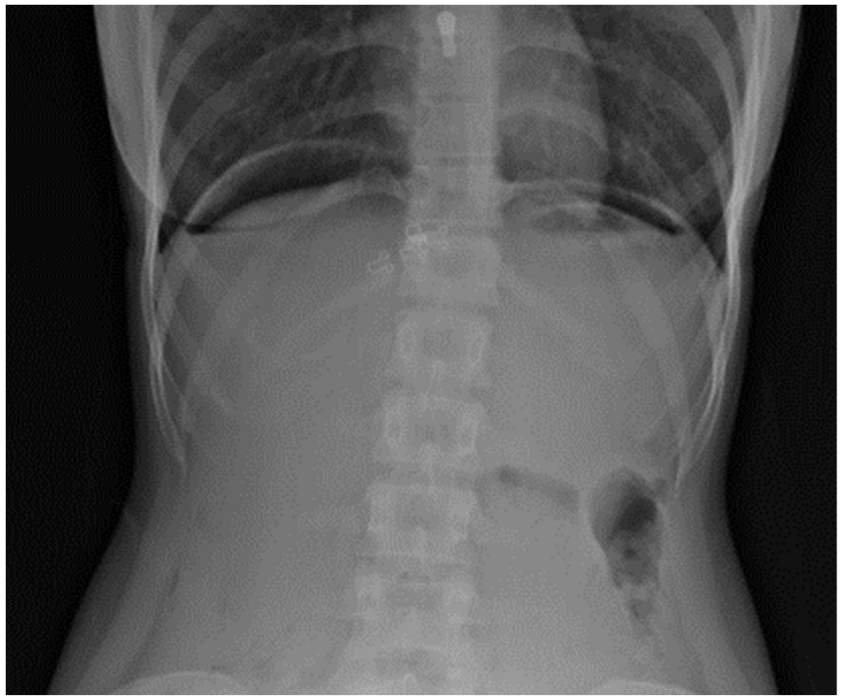
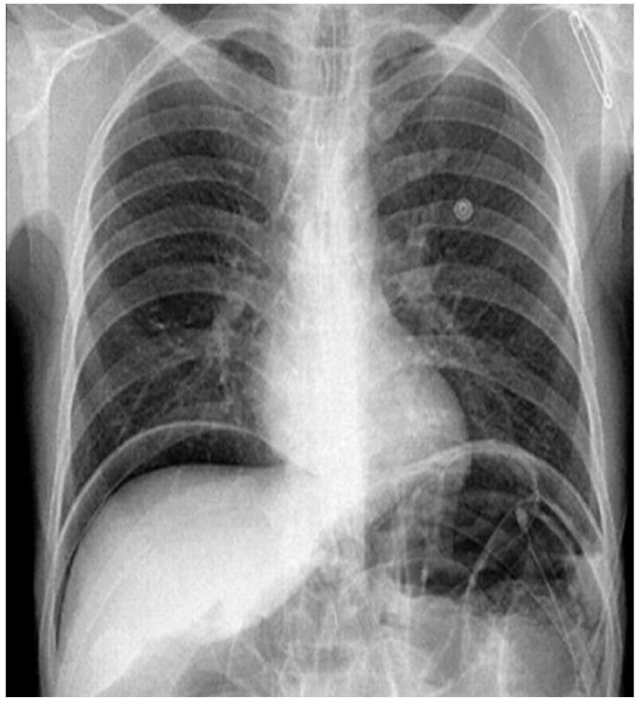
Pneumoperitoneum - Free Air





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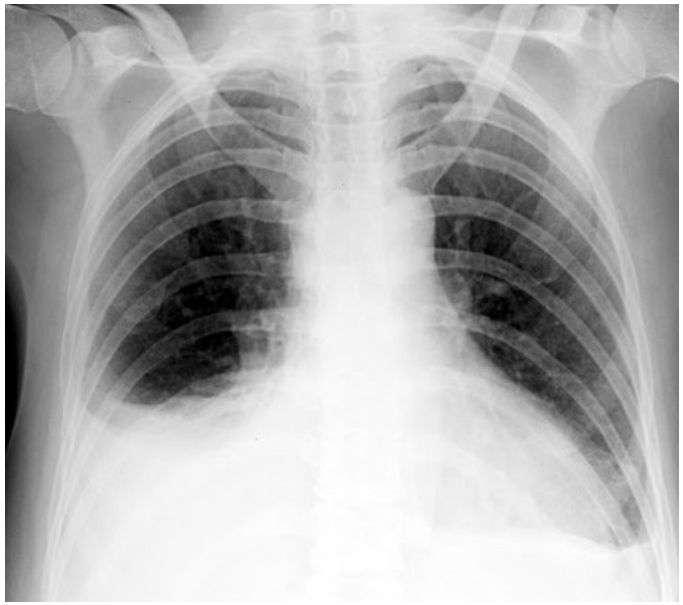
E - Effusions

- Costophrenic Angles
- Meniscus Sign
- White Out
- Hemothorax
- Chylothorax
- Malignancy



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E - Effusions

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E - Effusion

- White out
- Hemothorax
- Chylothorax

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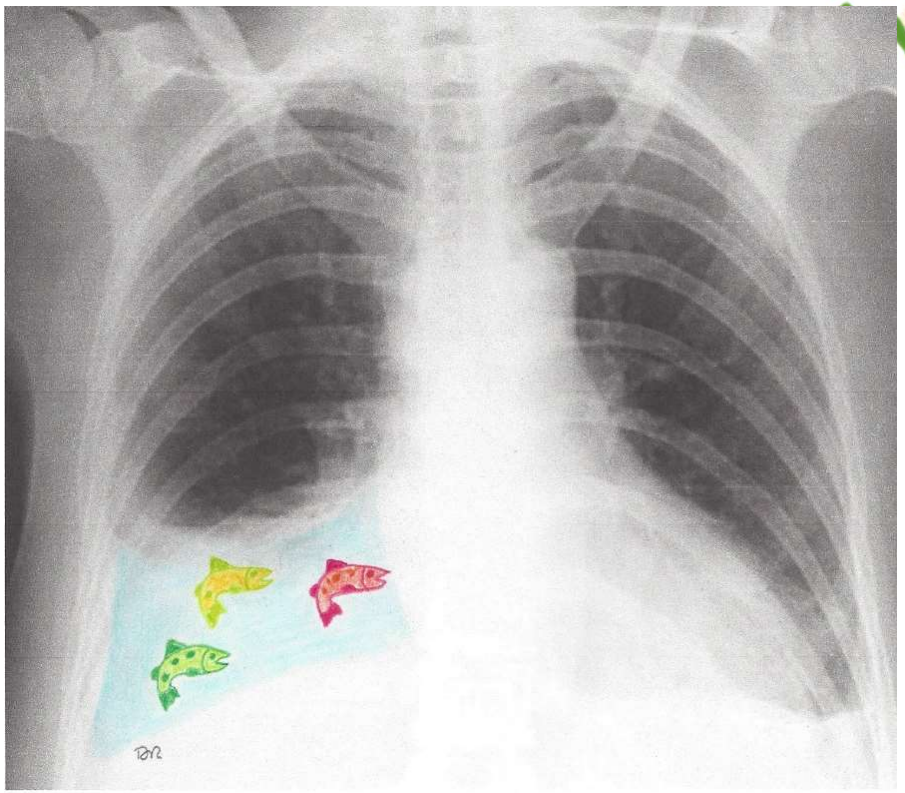

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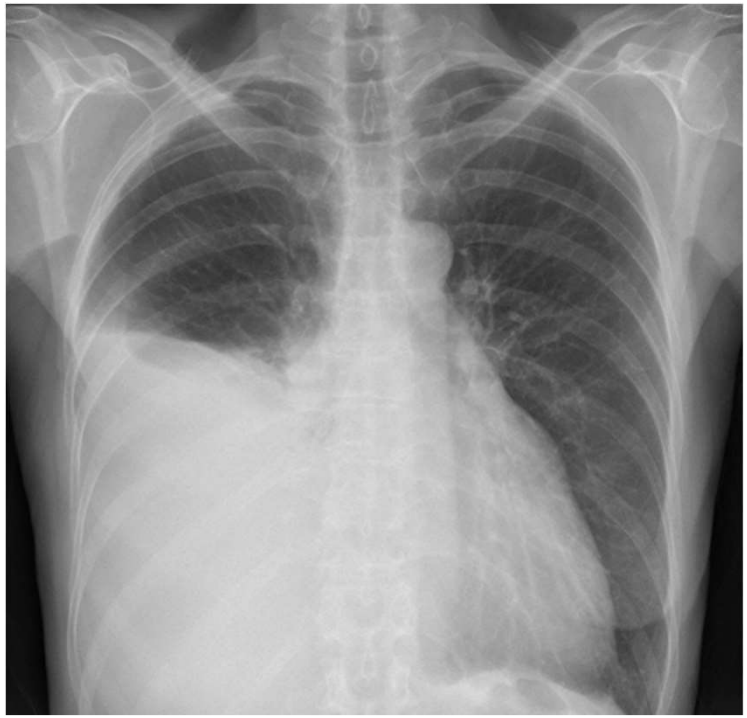
E - Pleural Effusion



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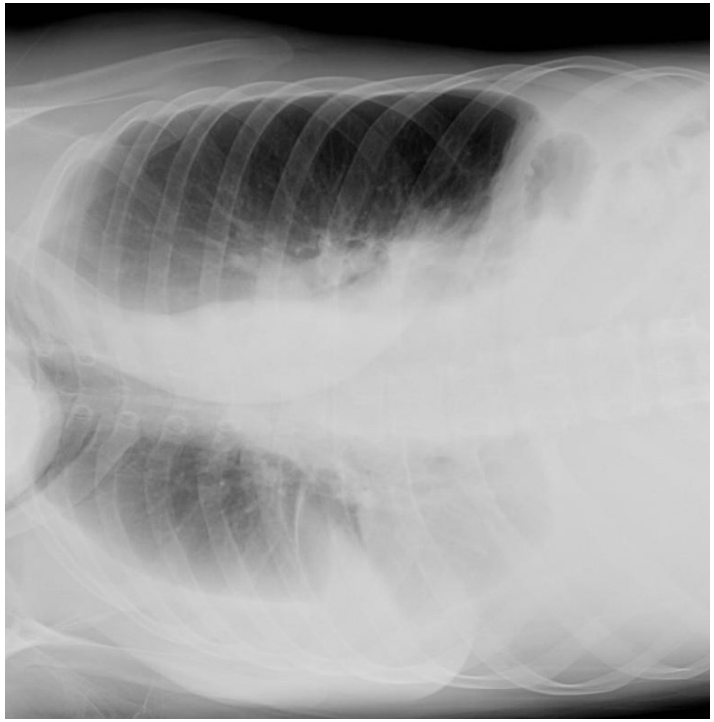
Right Lateral Decubitus film



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Left Sided Pleural Effusion

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F – Fields and Fissures

- Mass
- Infiltrates
- Pneumothorax
- Lung markings to the periphery
- Atelectasis

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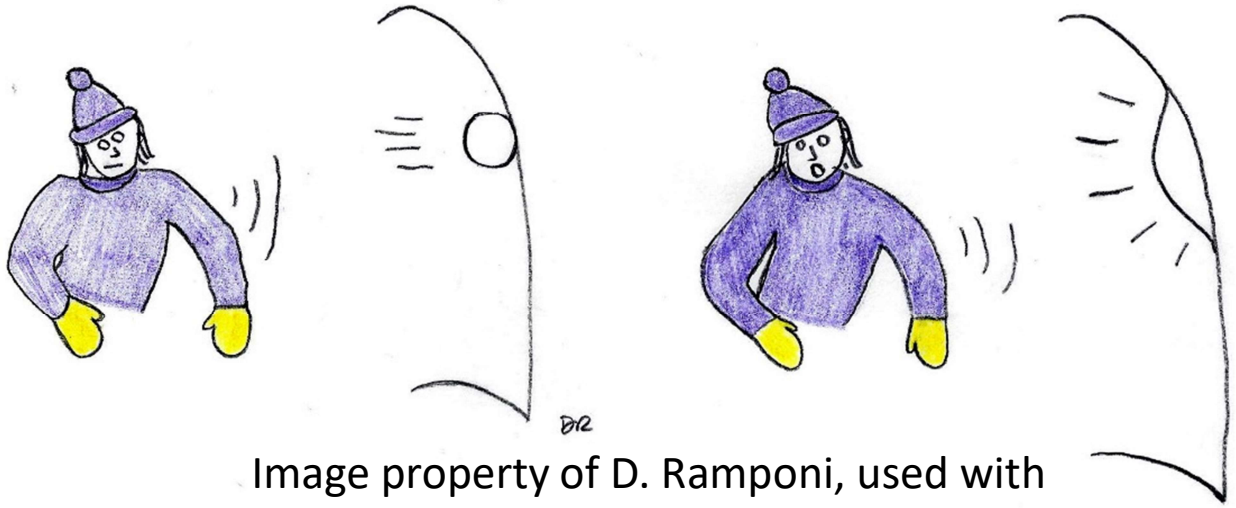
Snowball Sign

Is nodule arising from lung or surrounding structure?



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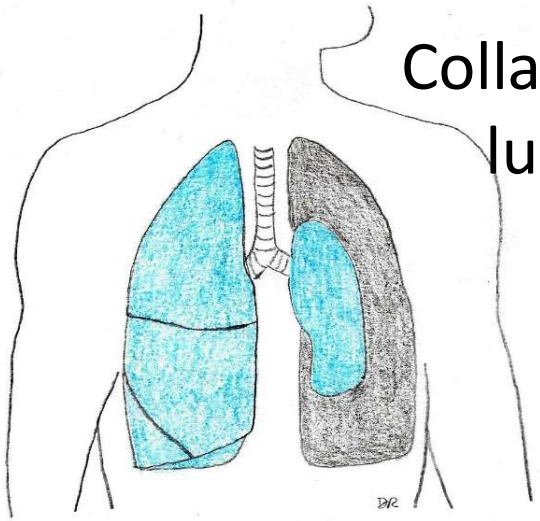
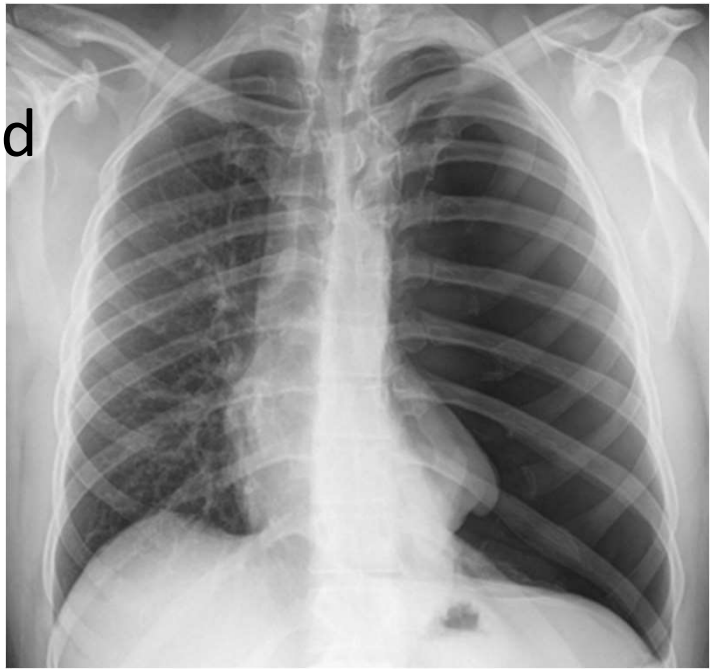
Pneumothorax



Collapsed lung



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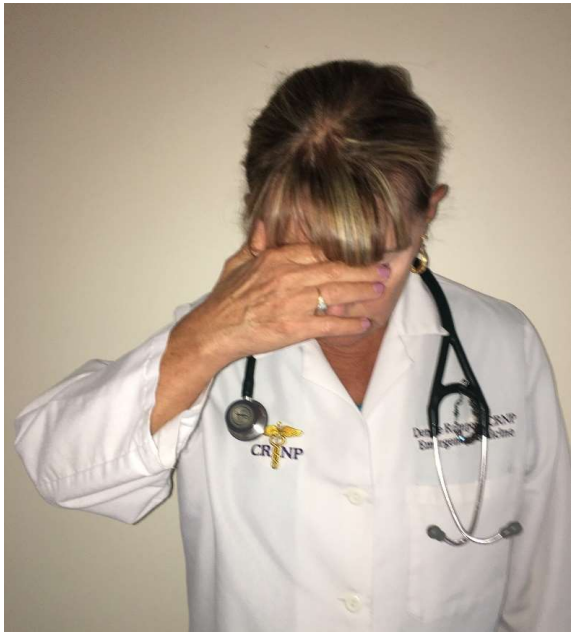
G – Gosh this can be overwhelming!



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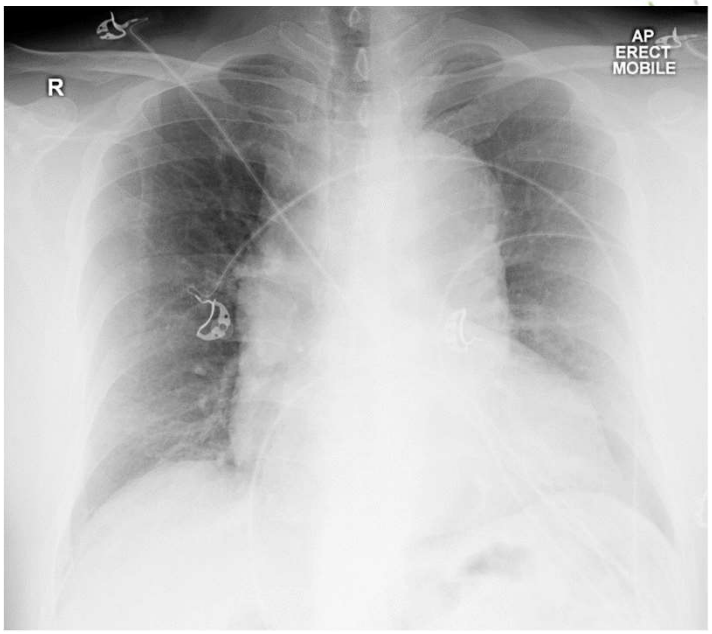
H- Hila and Mediastinum

- Lymphadenopathy
- Masses
- Calcifications
- Tracheal Deviation
- Widening



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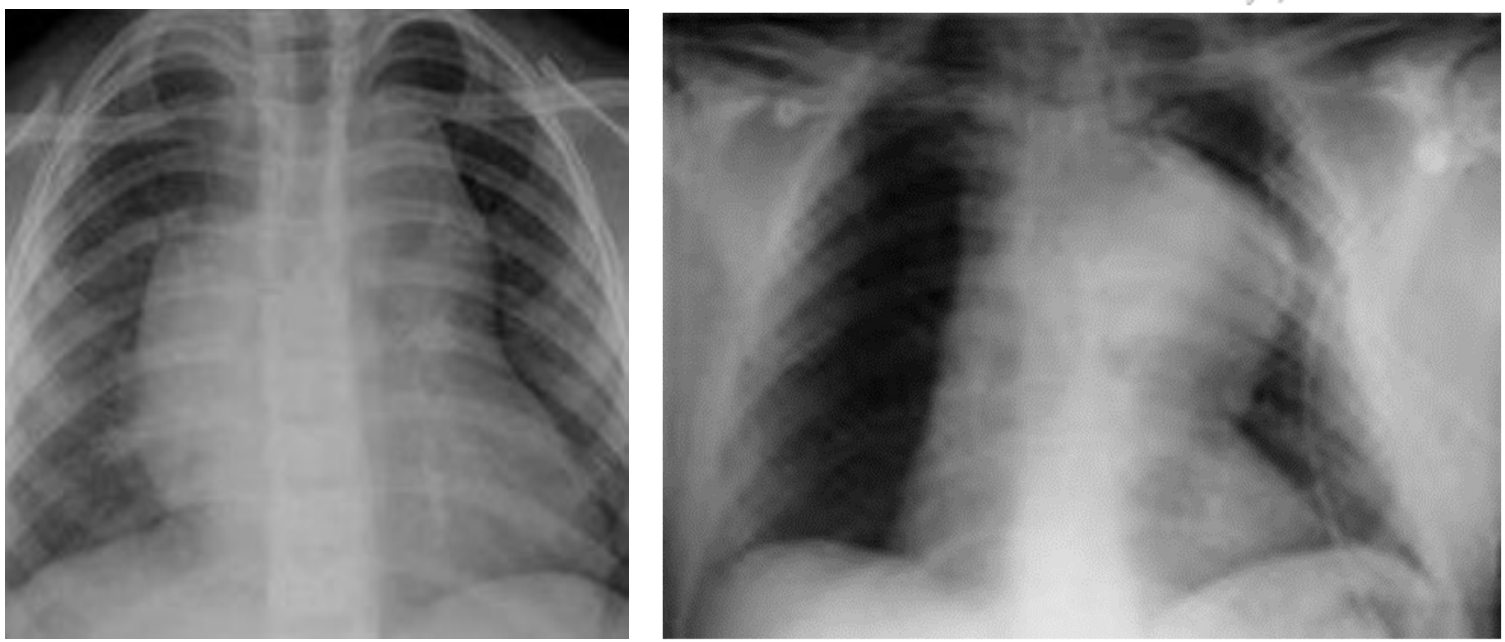
Widened Mediastinum



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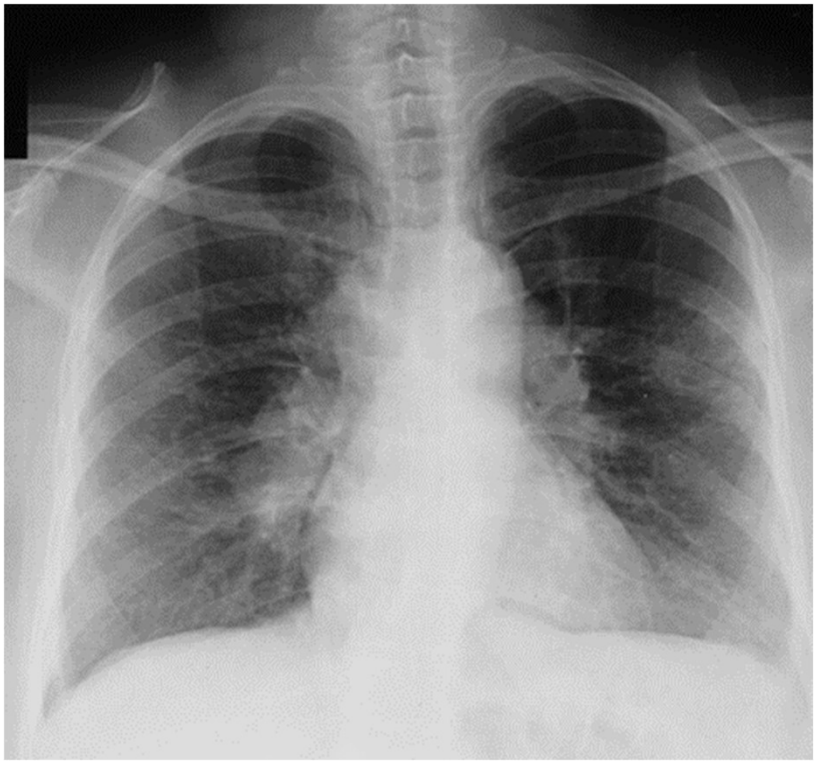
Perihilar Lymphadenopathy



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I – Impression

- Bring it all together
- Clinical indication for ordering study
- Review with the radiologist
- Double check name and date

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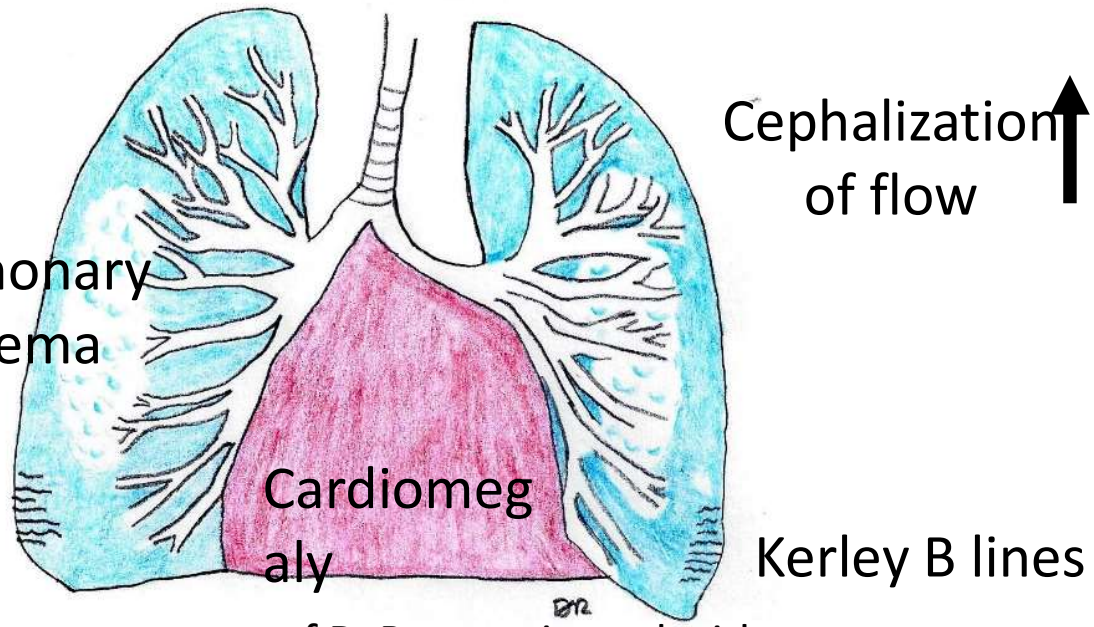
Congestive Heart Failure



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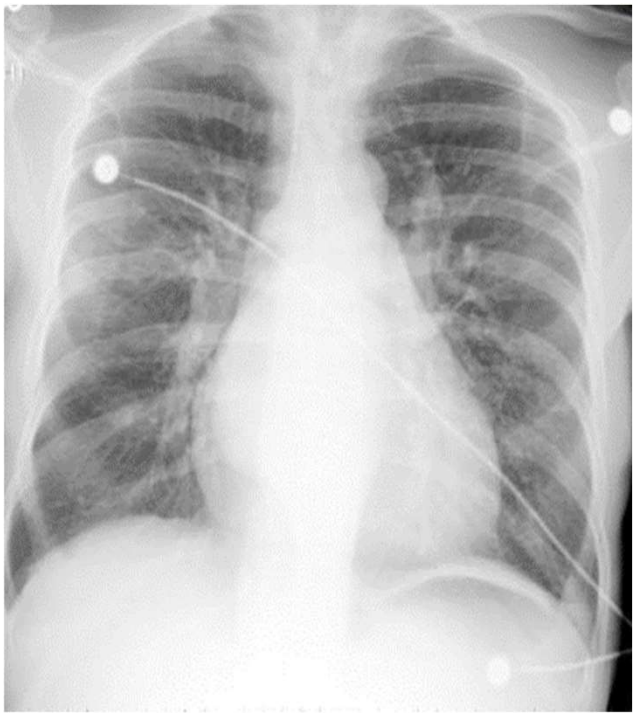
Progression of CHF

- Stage I "Vascular Phase"
  - Cardiomegaly
  - Pulmonary vascular redistribution
    - Cephalization
    - Vascular pedicle broadens



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Cephalization

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- Pulmonary Vessels are more prominent in the upper lobes
- Upright film only

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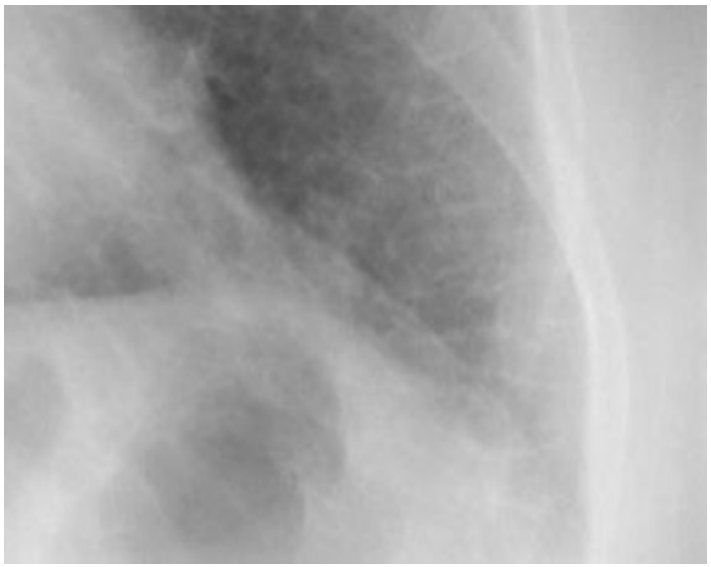
Progression of CHF

- Stage II "Interstitial Phase"
  - Kerley B Lines
  - Short 1-2 cm white lines at lung periphery horizontal to pleural surface
  - Perihilar haze



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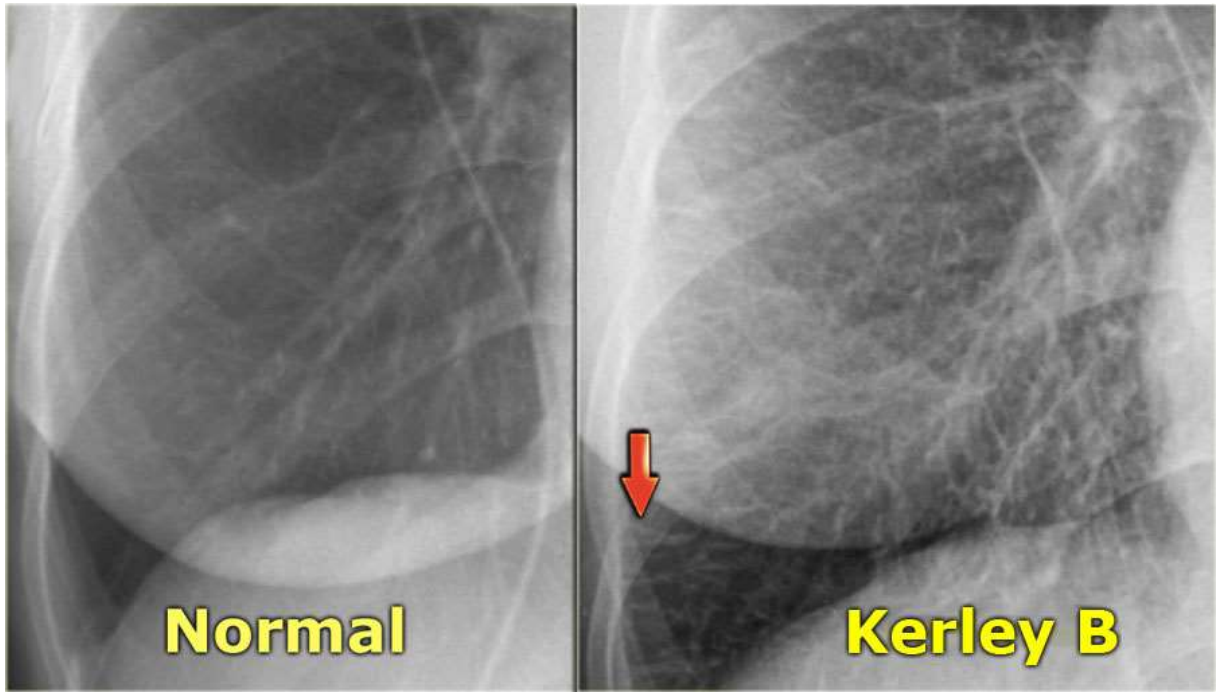
Fluid leaking into interstitium



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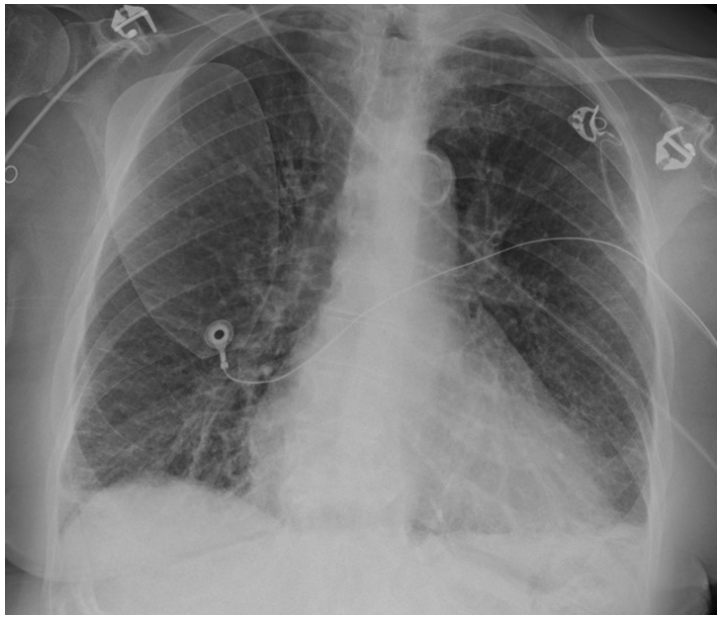
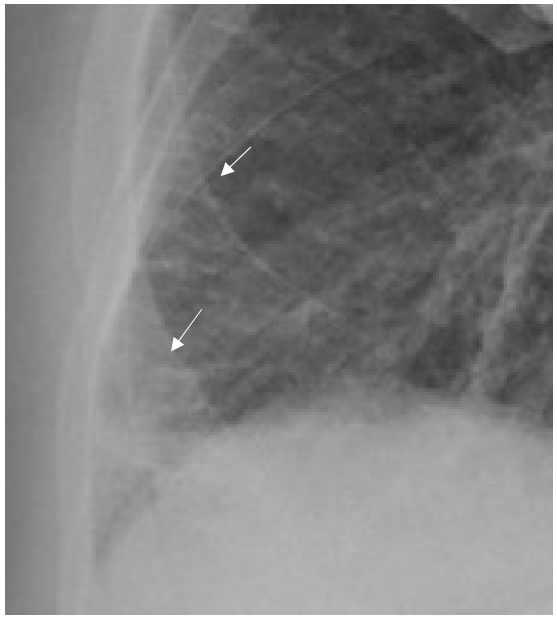
Kerley B lines





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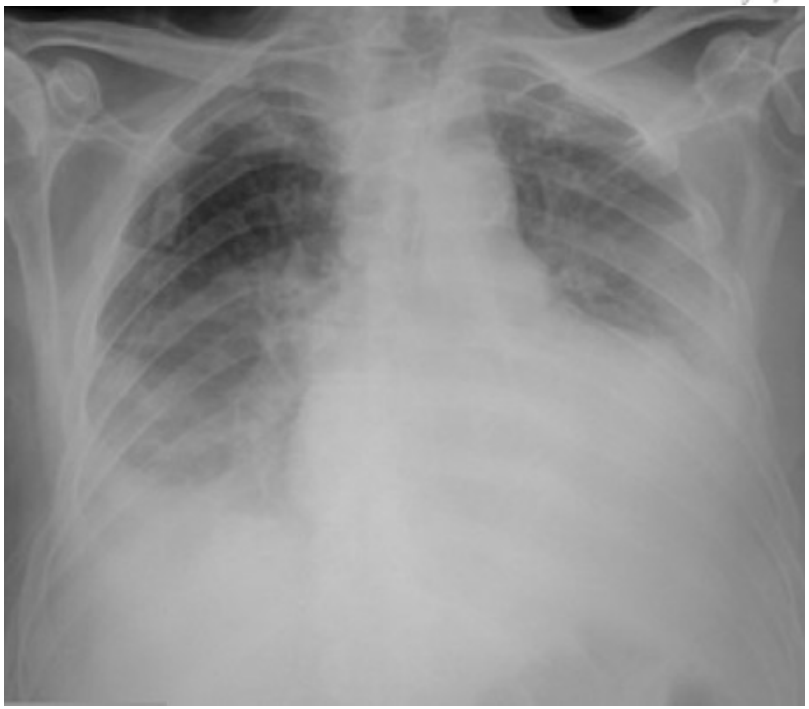
Progression of CHF

- Stage III "Alveolar Phase"
  - Cottonwool
  - Acute pulmonary edema
  - Pleural Effusions



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Bat Wing edema

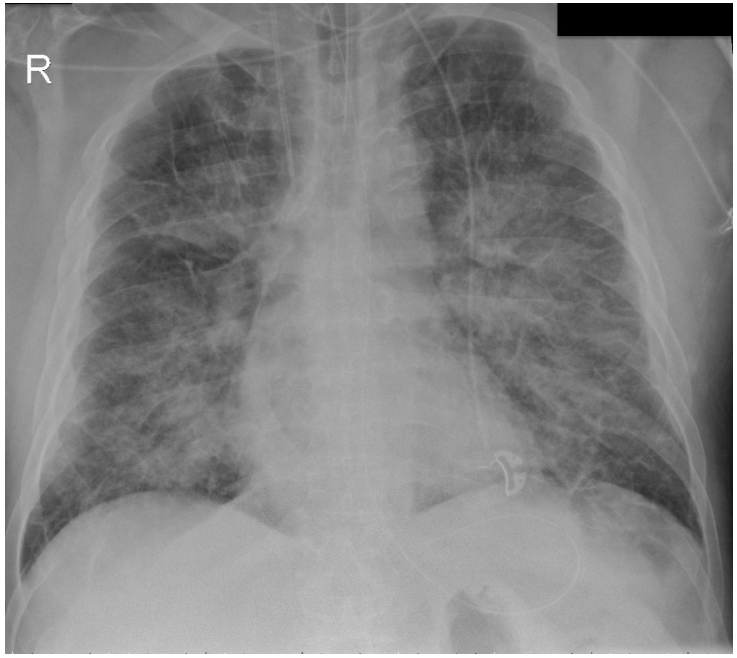

Image courtesy of Assoc Prof Craig Hacking, Radiopaedia.org, rID: 66373

- *Bat wing edema* = central, **alveolar edema**
- < 10% of cases of pulmonary edema occurs with rapidly developing severe cardiac failure
  - Acute mitral insufficiency
  - Renal failure

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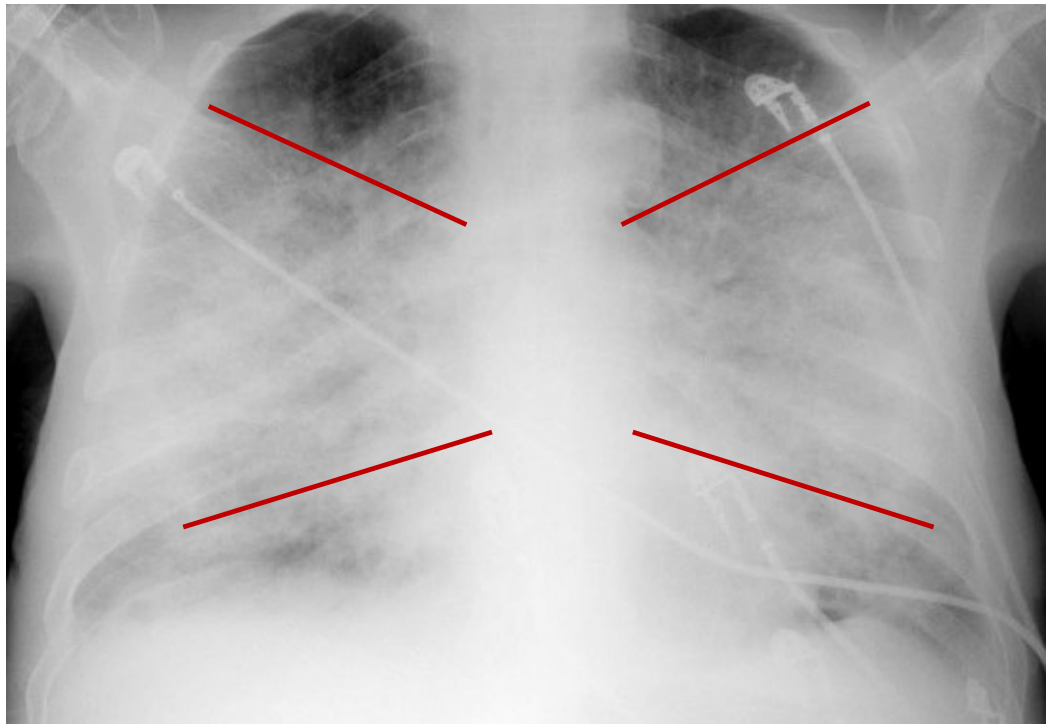
CHF – Bat wing edema



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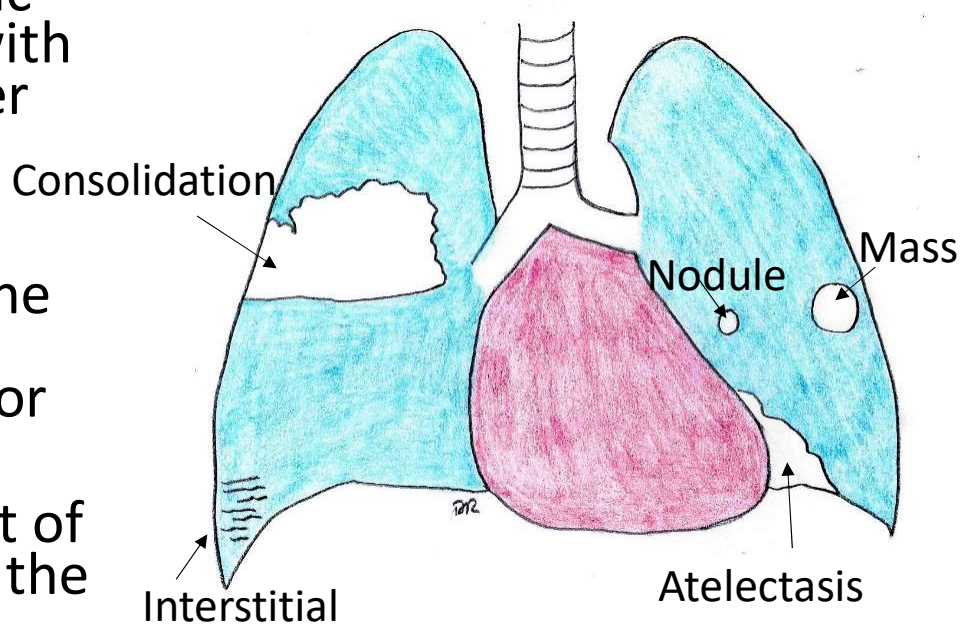
Consolidation, Atelectasis, Interstitial involvement

- **Consolidation** - any pathologic process that fills the alveoli with fluid, pus, blood, cells or other substances
- **Infiltrate** – more diffuse
- **Interstitial** - involvement of the supporting tissue of the lung parenchyma resulting in fine or coarse reticular opacities
- **Atelectasis** - collapse of a part of the lung due to a decrease in the amount of air resulting in volume loss and increased density



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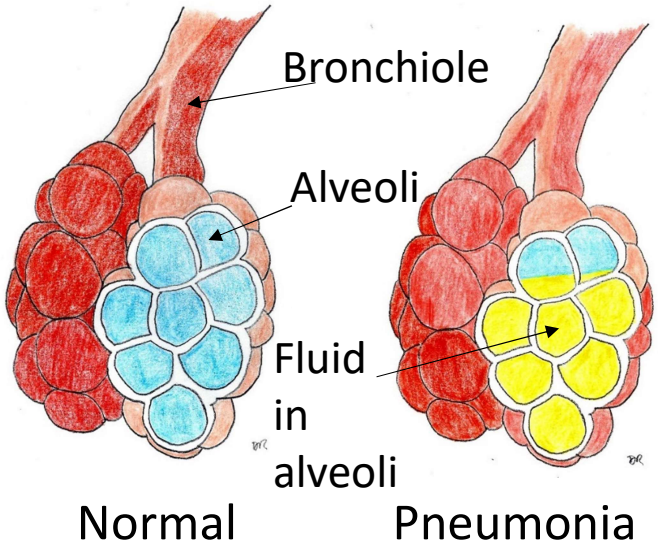
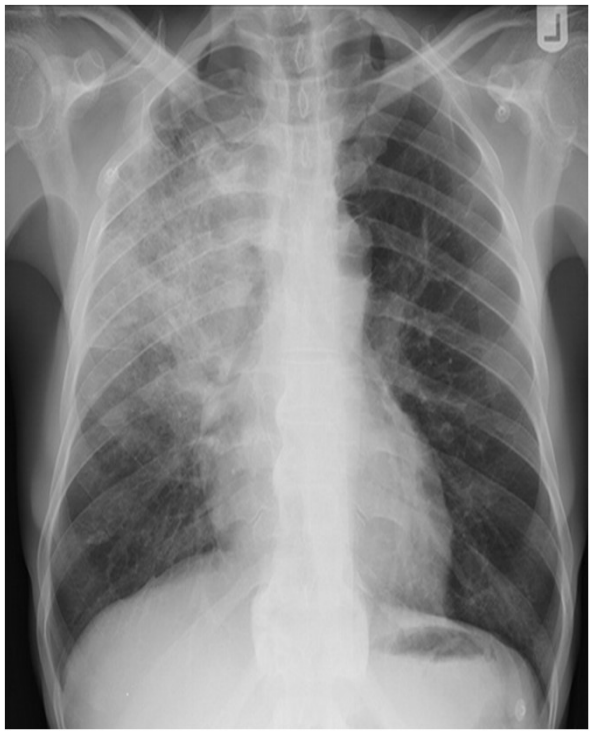
Consolidation vs. Infiltrate





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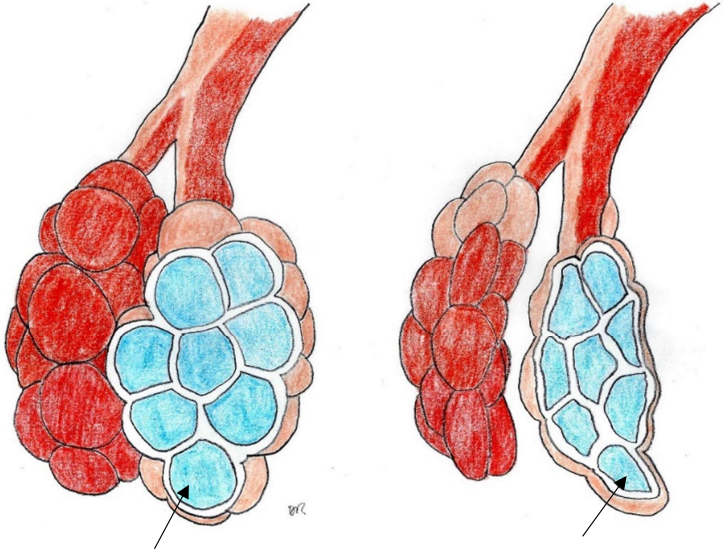
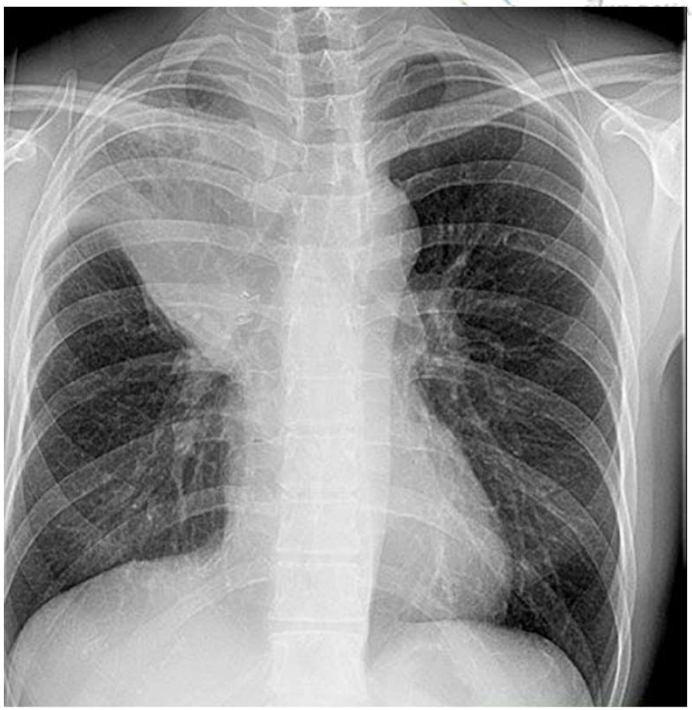
Atelectasis



Normal alveoli

Collapsed alveoli



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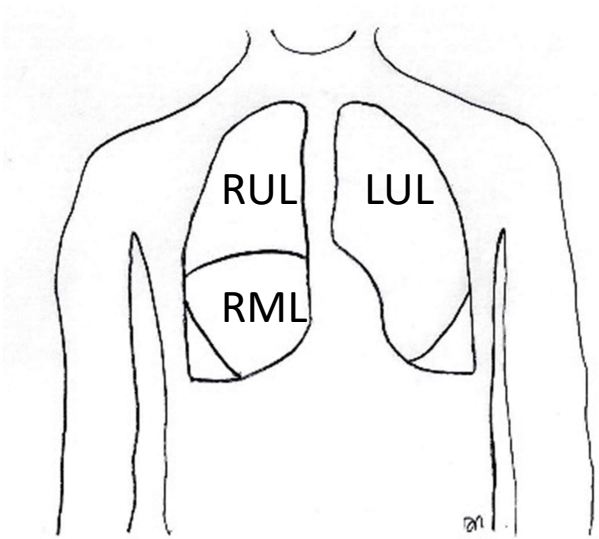
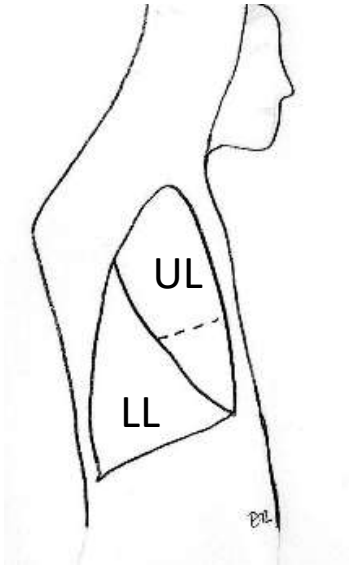
Surface Anatomy





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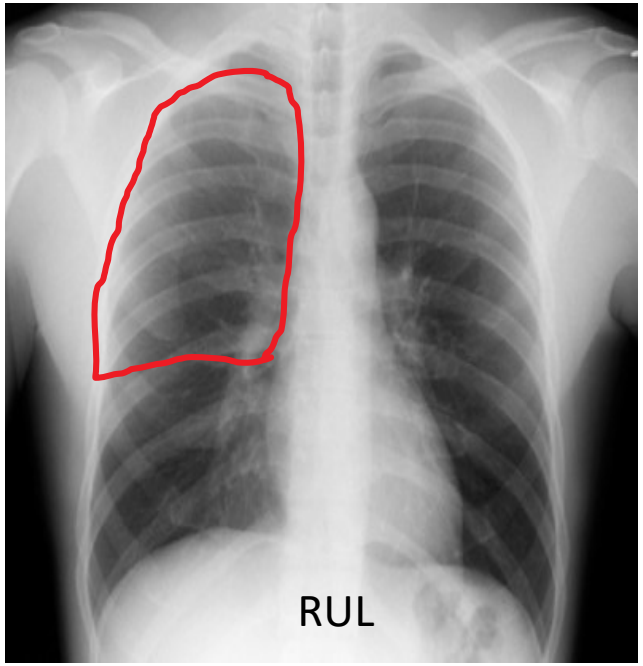
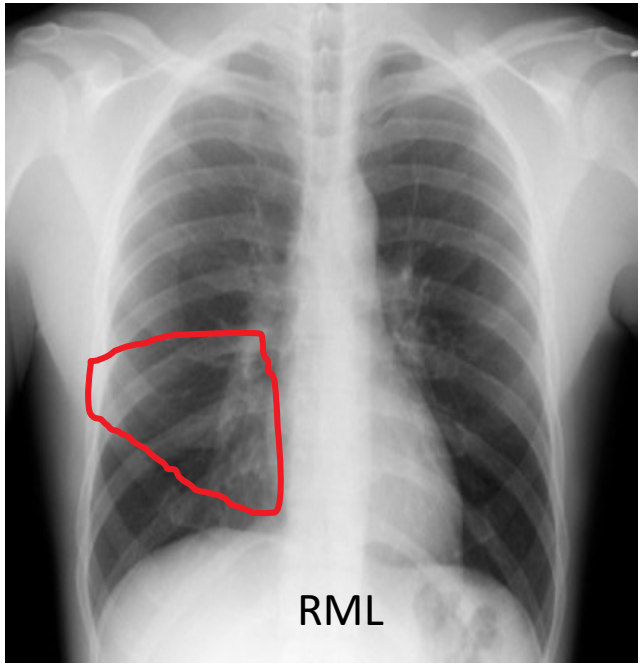
Right Lung – RUL/RML





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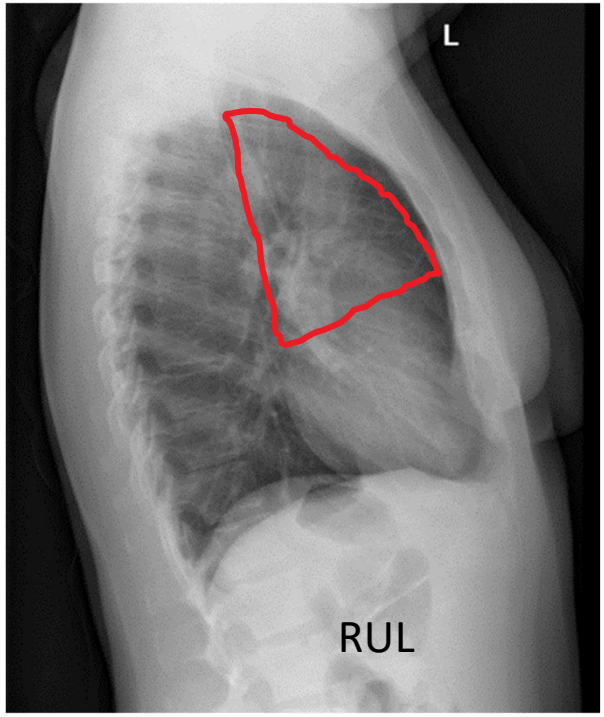
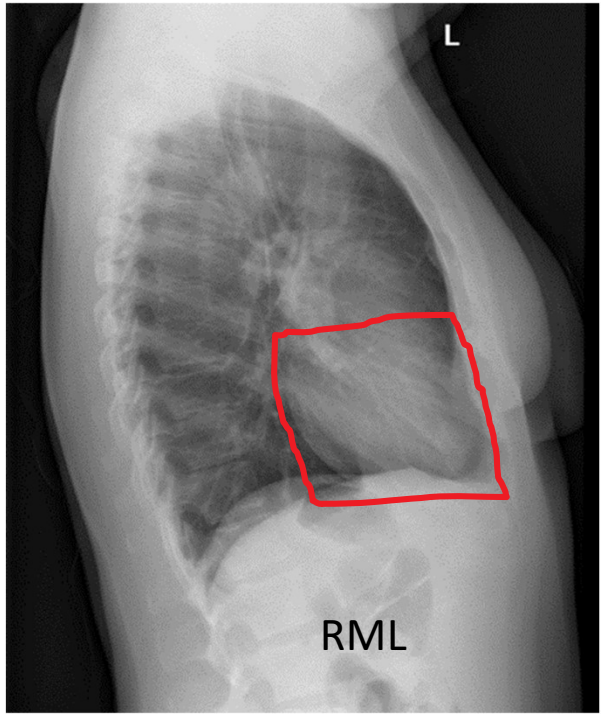
Right Lung – RUL/RML





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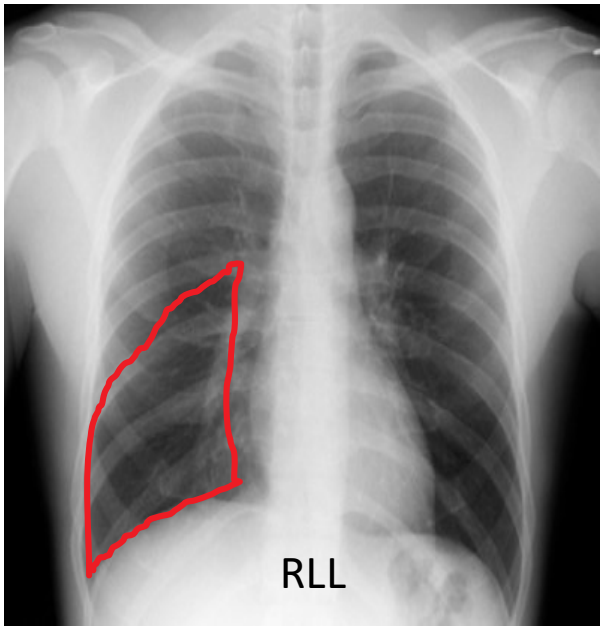
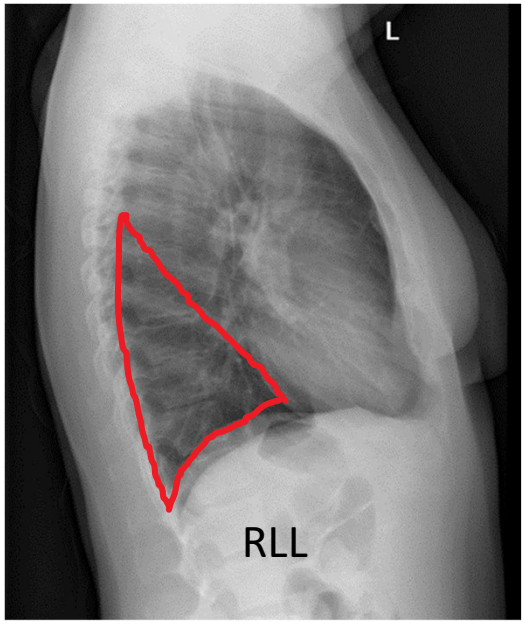
Right Lung – RLL/Diaphragm





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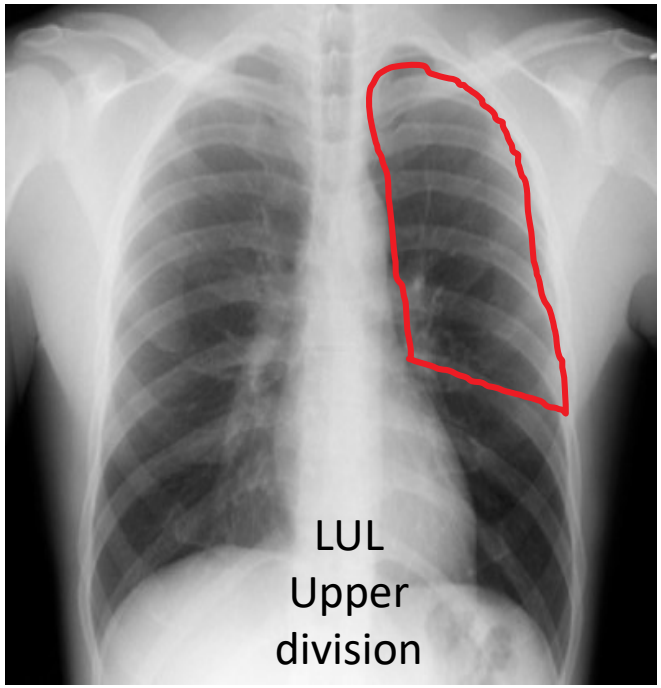
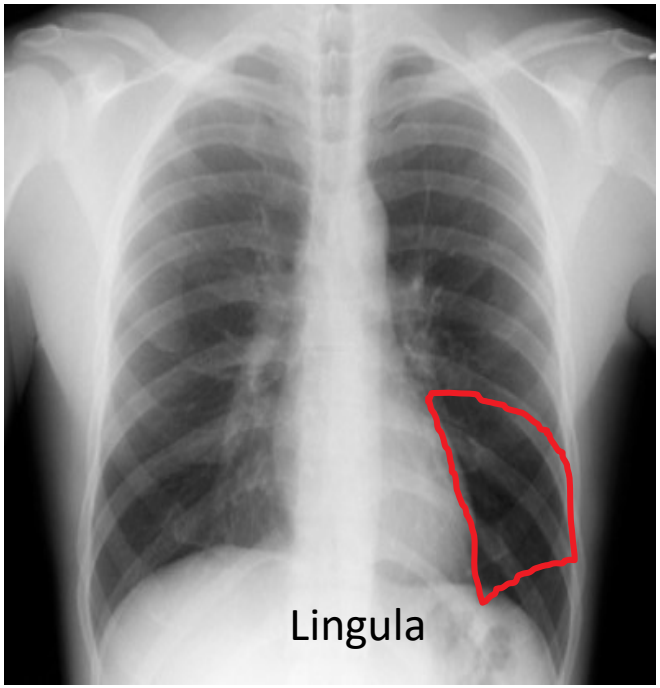
Left Lung – LUL/Lingula





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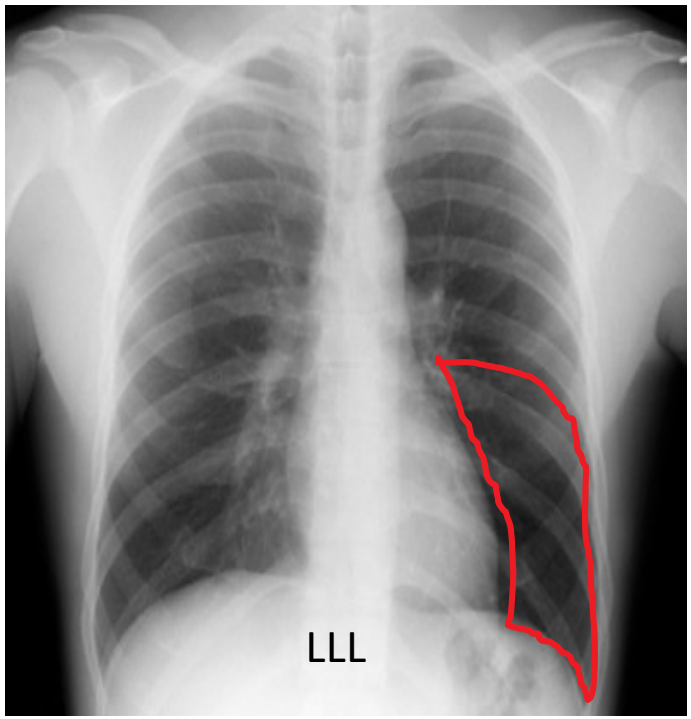
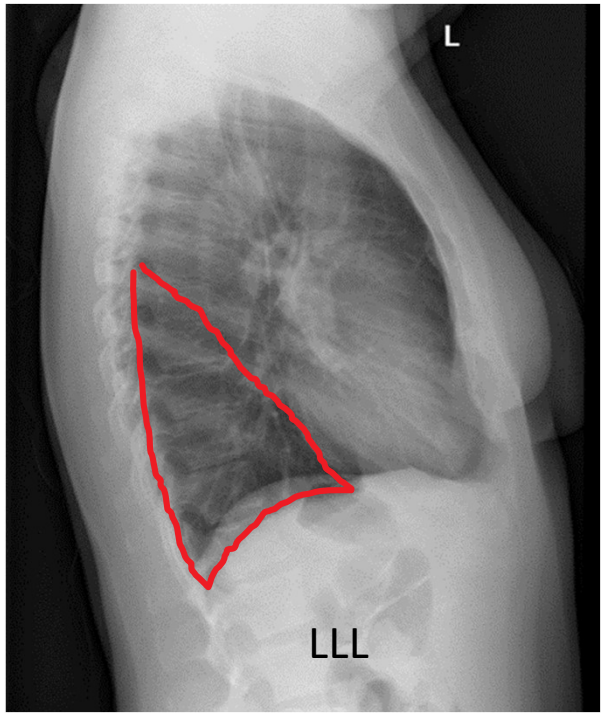
Left Lung - LLL





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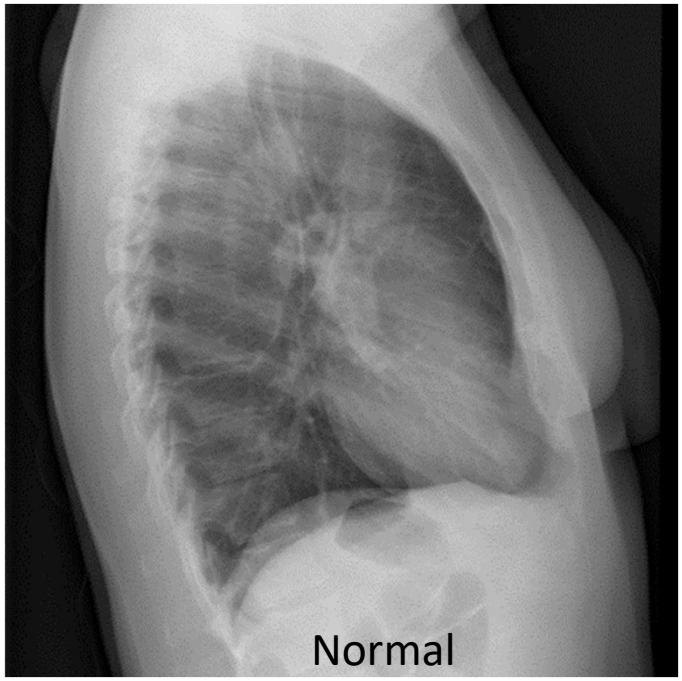
Spine Sign



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Clues to consolidation

Ill Defined	Consolidation suspected
Right heart border	Right middle lobe
Left heart border	Left upper lobe (lingula)
Diaphragms or Spine sign	Lower lobes

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Silhouette Sign

- Loss of a cardiac border may indicate a lung abnormality adjacent to that anatomical structure
- Obscuration of right border of heart (arrows) due to density of another tissue

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Consolidation vs. Infiltrate

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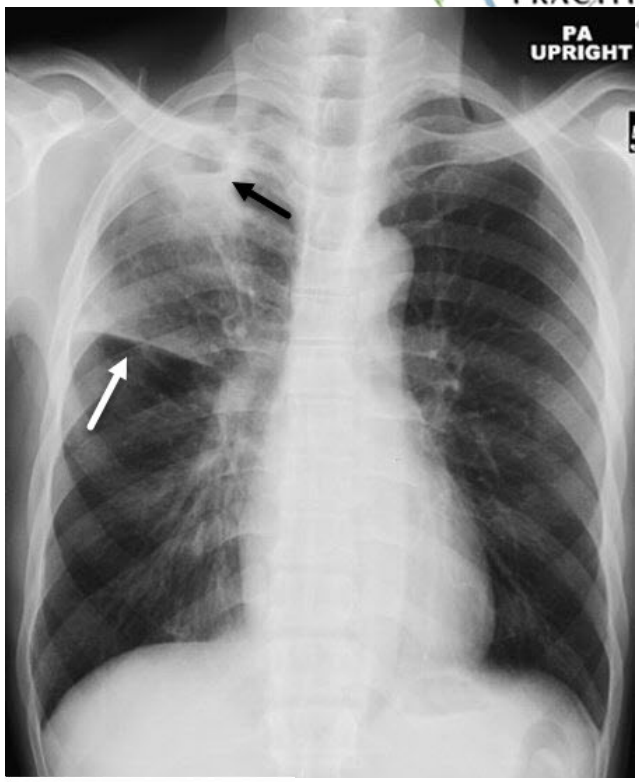
Cavitary pneumonia



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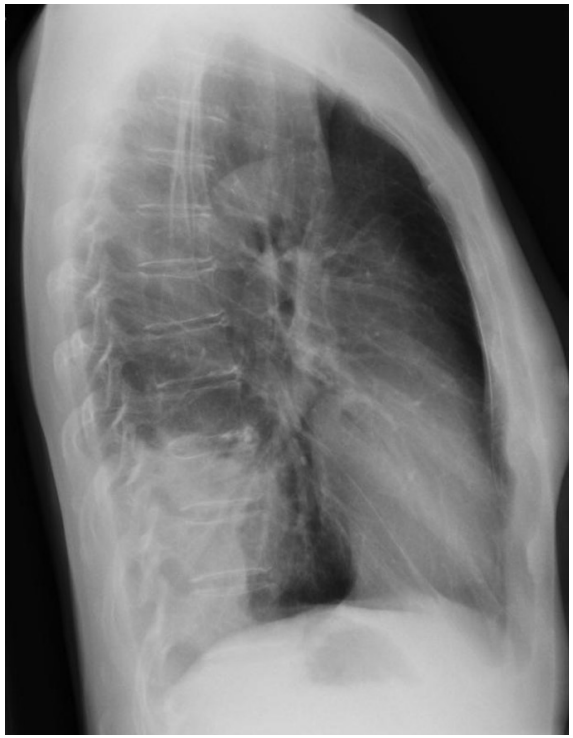
Infiltrate (Spine sign)



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Mass vs. Infiltrate

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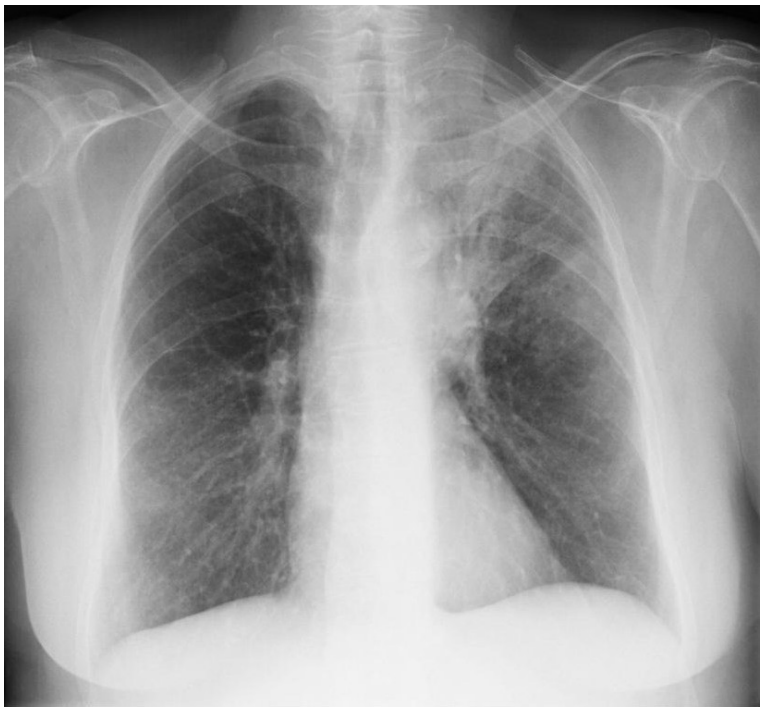
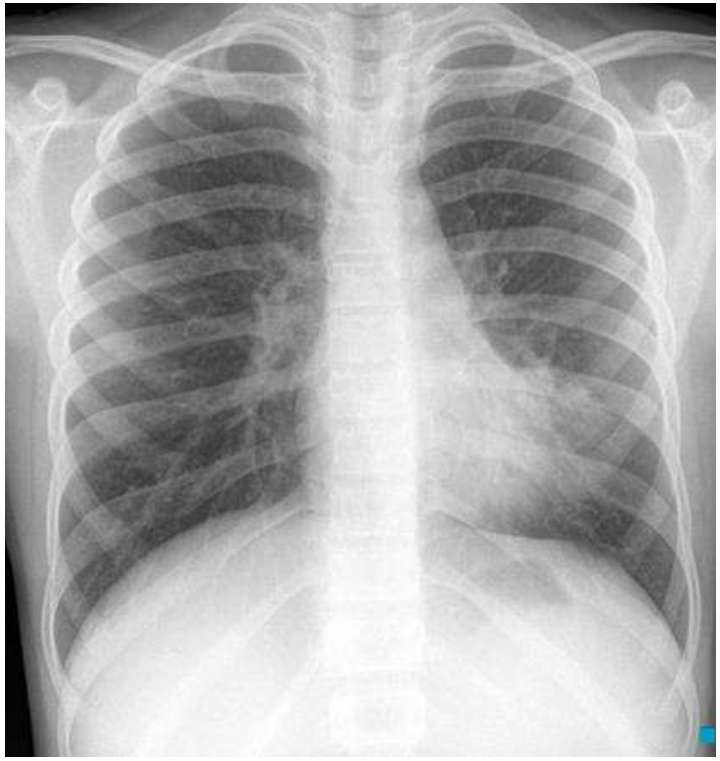
Infiltrate



Images courtesy of Dr Sajoscha Sorrentino, Radiopaedia.org, rID: 14977

Infiltrate



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Infiltrate (Spine sign)

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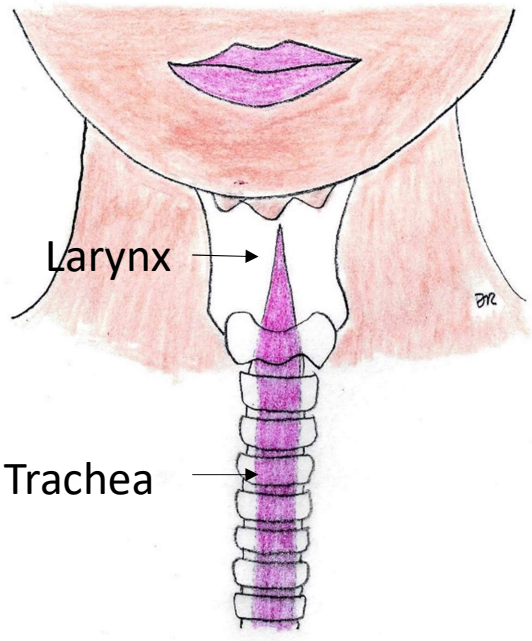
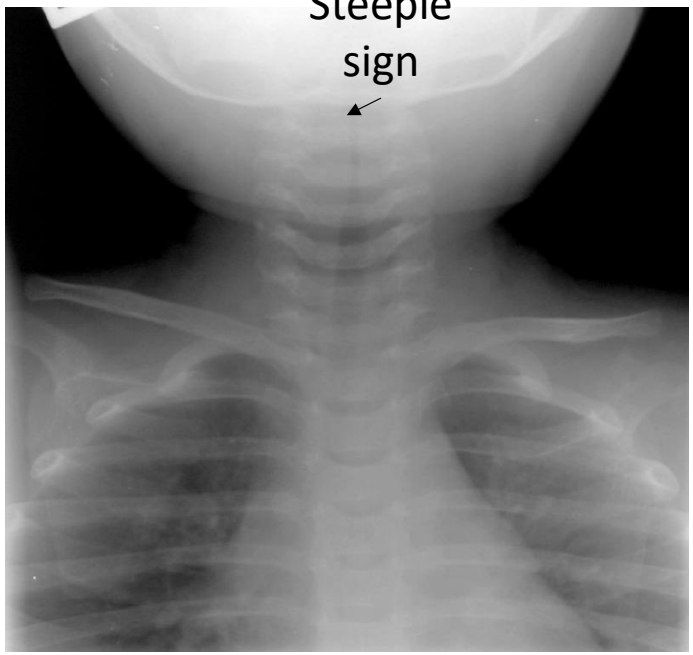
Croup – Steeple Sign





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Fever, barky cough

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Pneumothorax
Consider expiratory film if small

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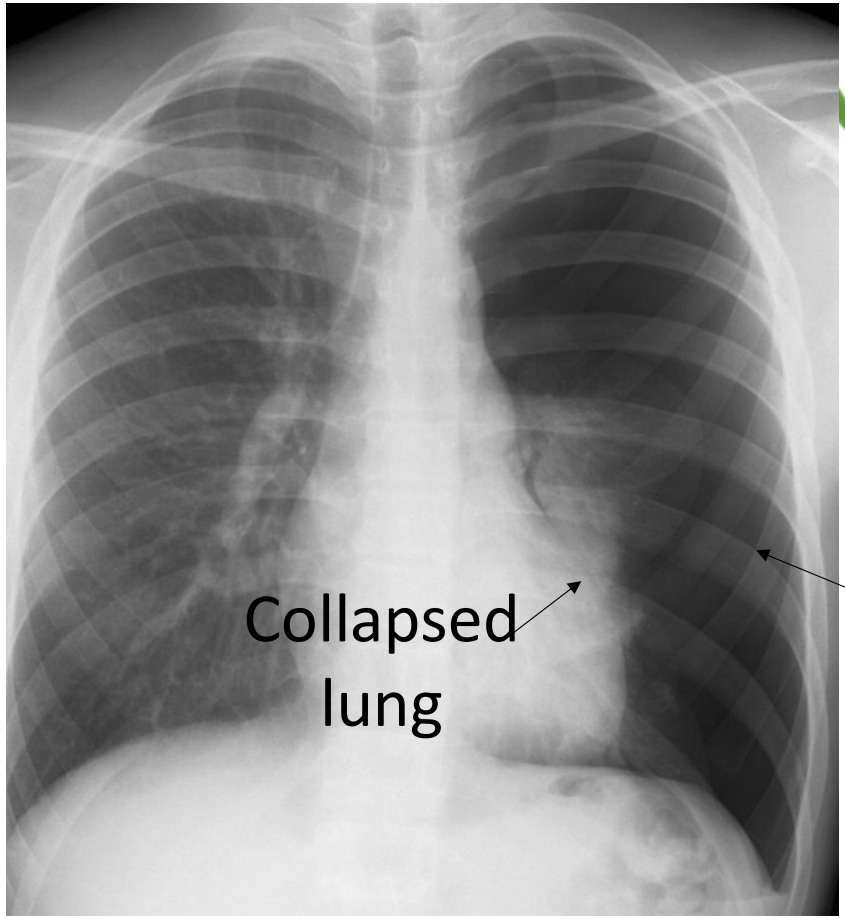

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Expiration Views

- Air trapping conditions:
  - Pneumothorax
  - Foreign body aspiration – if you hear a unilateral wheeze that does not clear with coughing!

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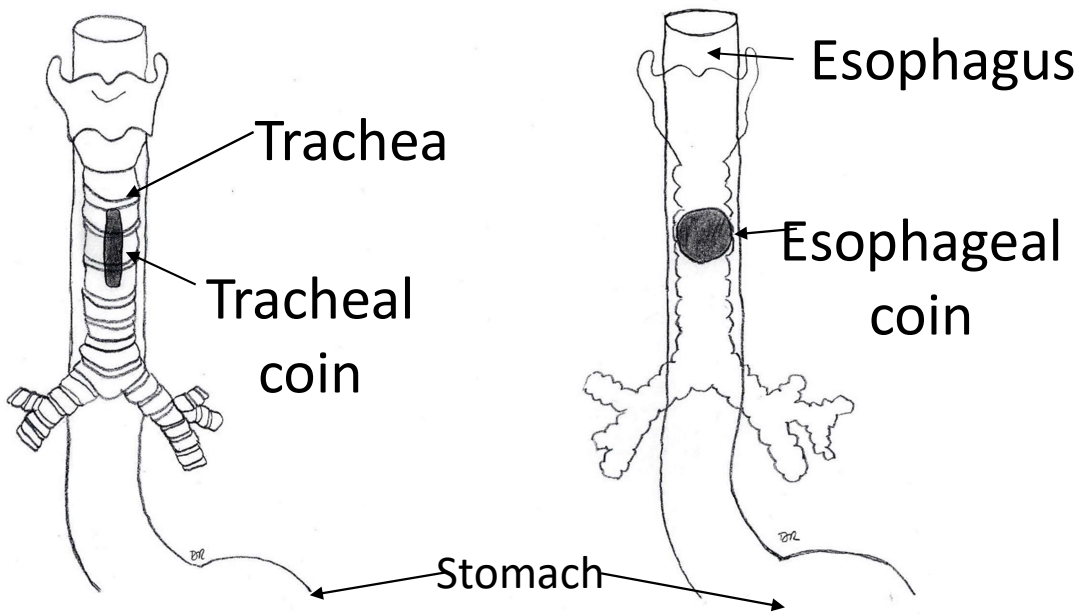
Foreign Body



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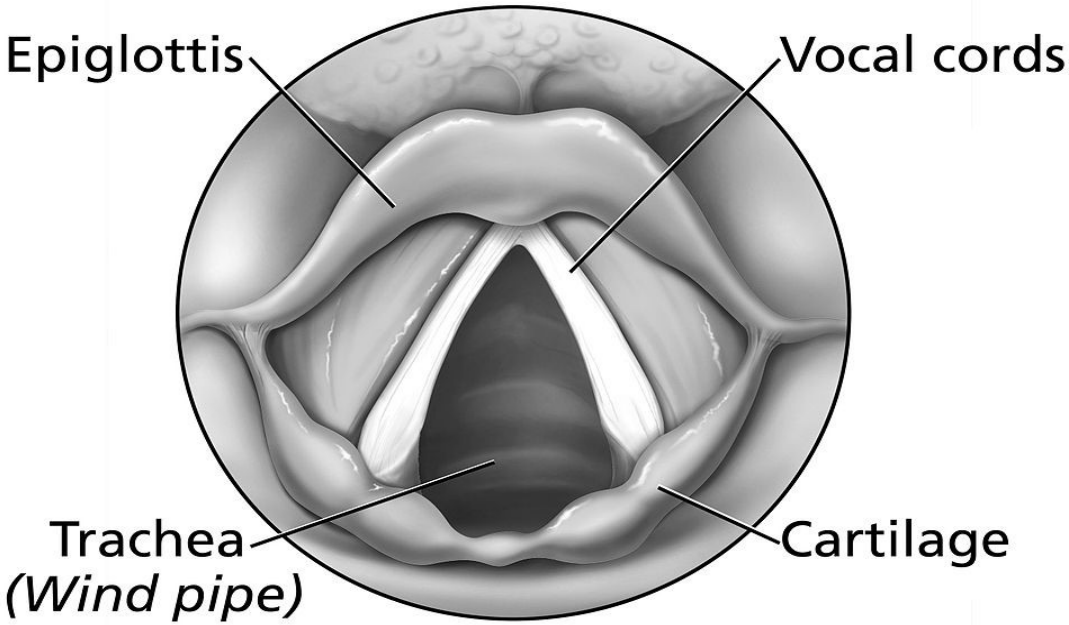
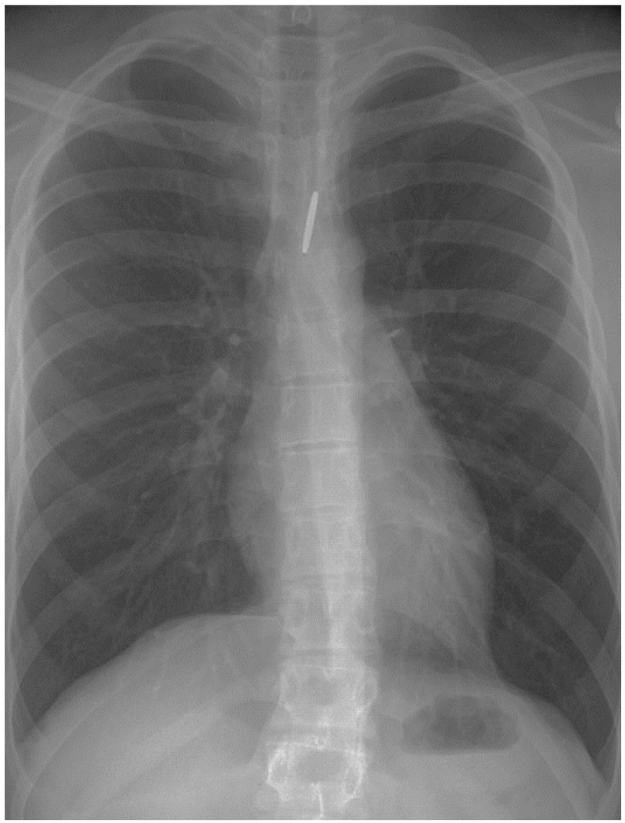


https://commons.wikimedia.org/wiki/File:Larynx_(top_view).jpg

80



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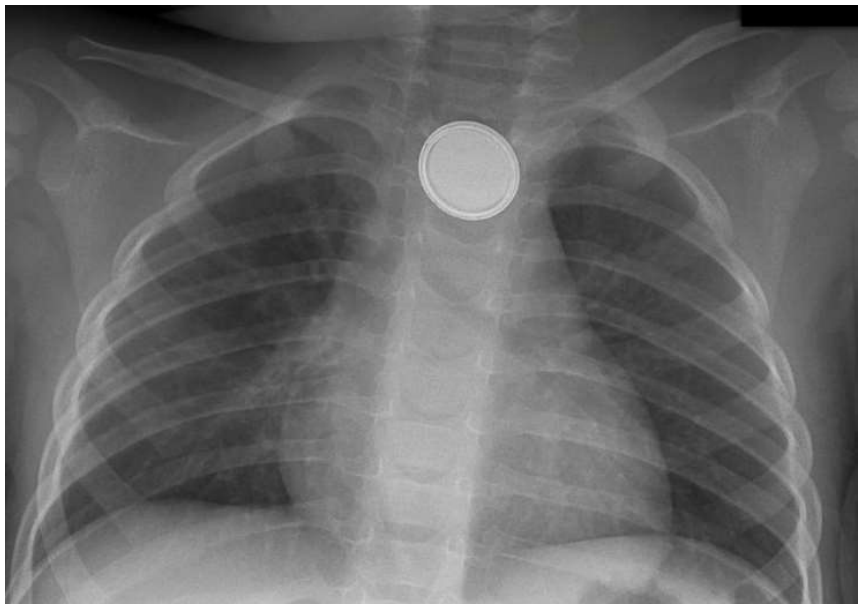
Coin vs. Button Batteries



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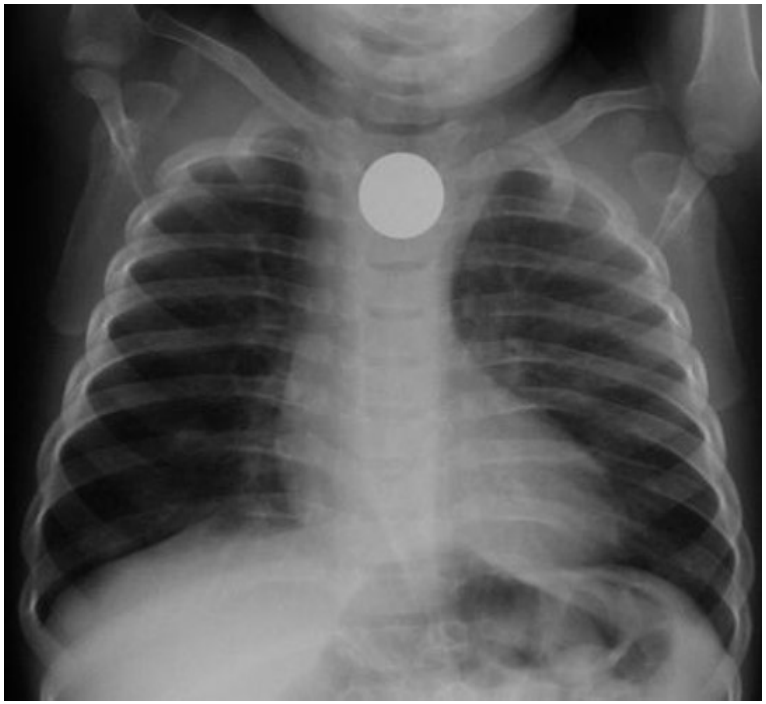

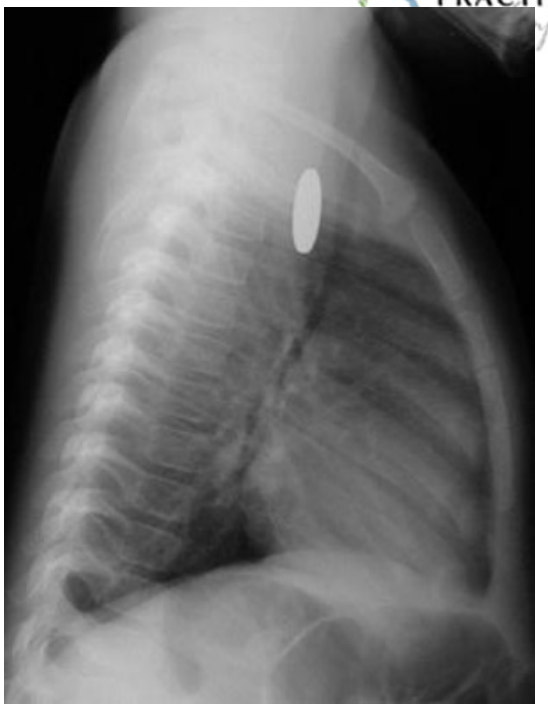

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Asthma

- **Hyperinflation**
- Mucus plugging can lead to atelectasis
- Interstitial inflammation
  - Hyperinflation – with flat diaphragm down to the 11th rib
  - Prominent interstitial markings (scarring) – from inflammation

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COPD

- **Hyperinflation (loss of interstitial tissue/darker-more air)**
  - Low set diaphragm/ 12th rib
  - Increased AP diameter
  - Vertical heart
  - Blunted costophrentic angles

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COPD

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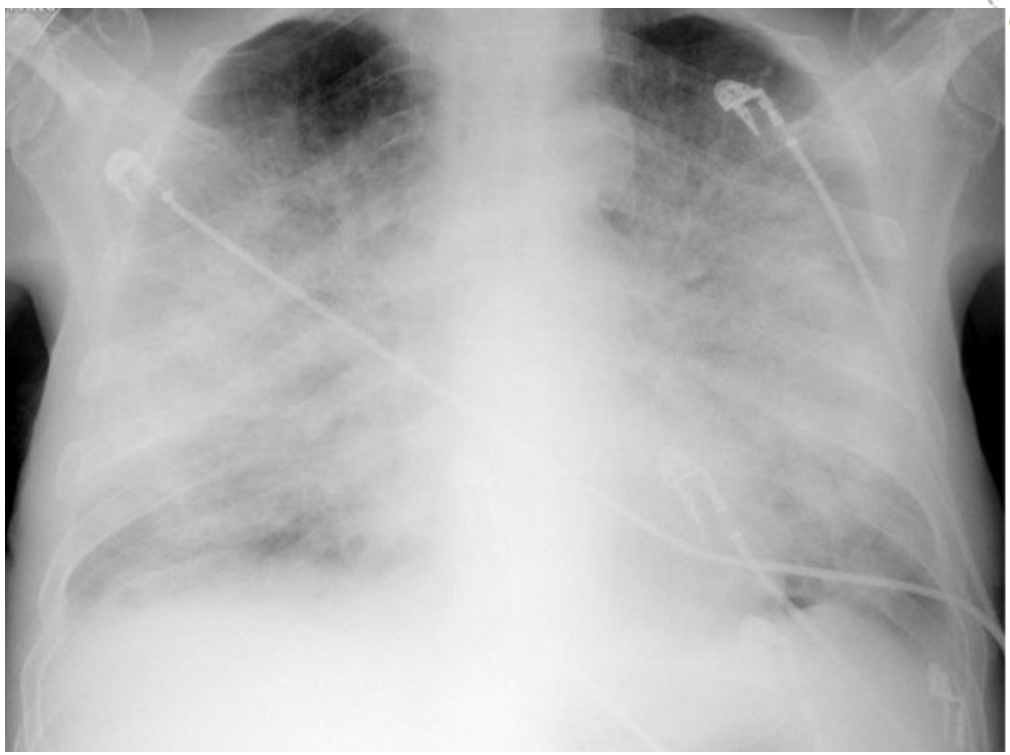
Practice

Shortness of breath



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History CA Lung with SOB

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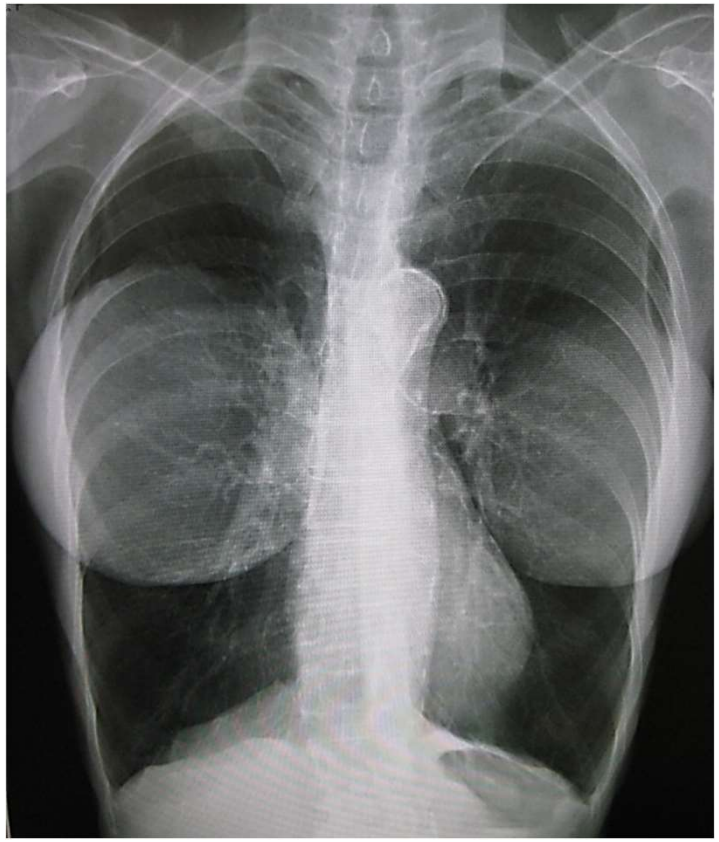
58 yr old female with cough



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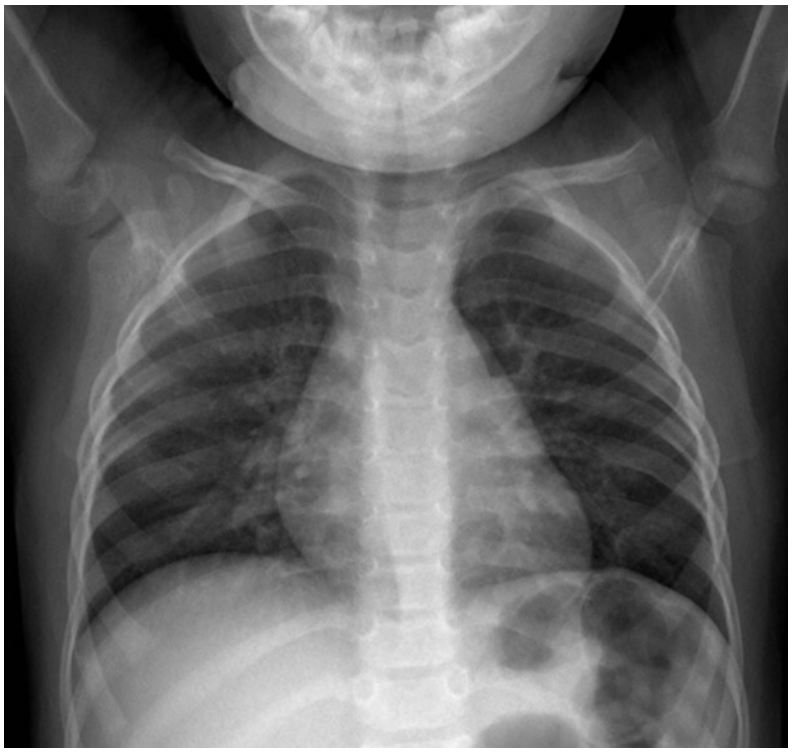
Fever, cough, short of breath



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4 yr old difficulty swallowing

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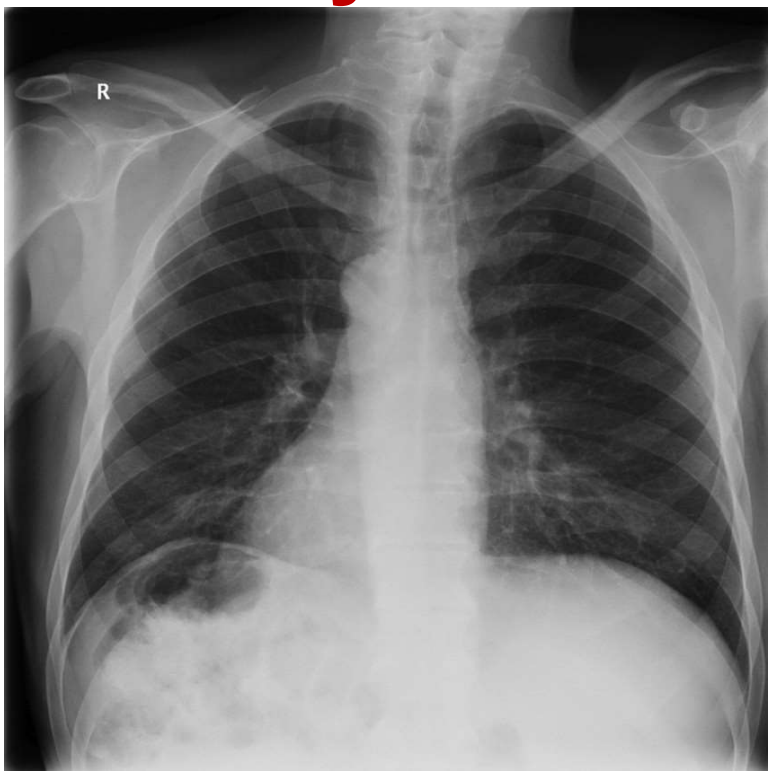
Routine chest x-ray



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Fever, cough

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Fever, wheezing

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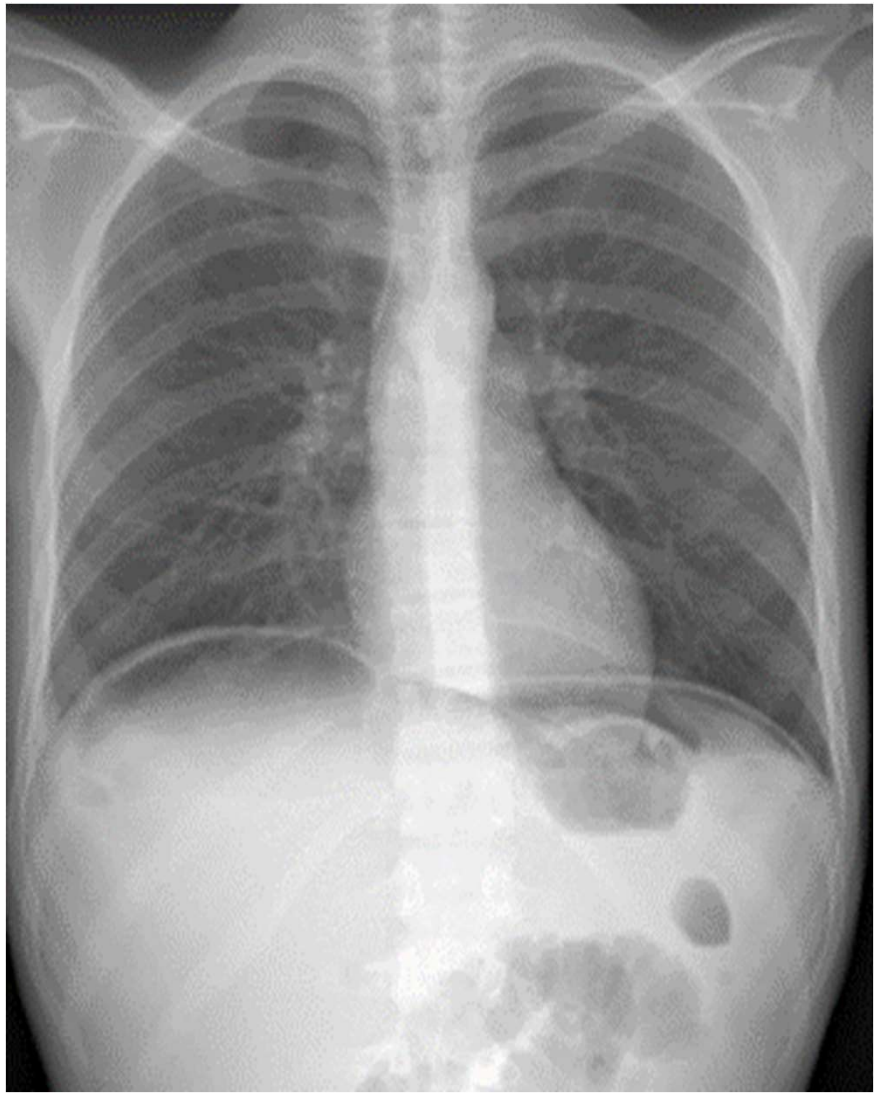

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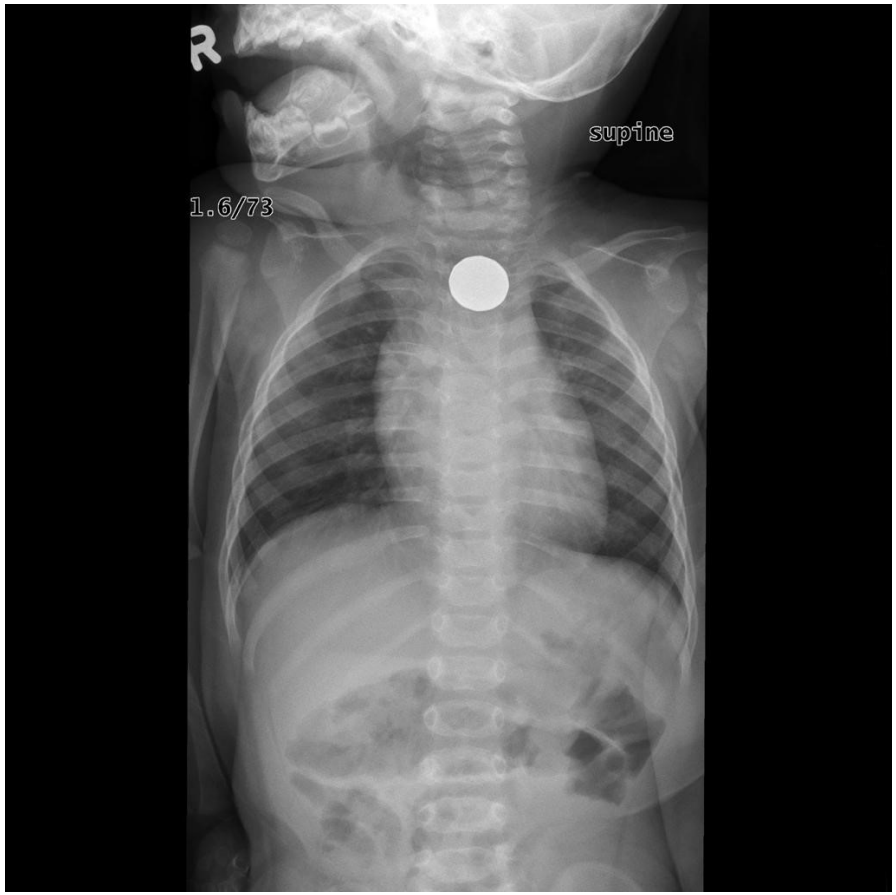
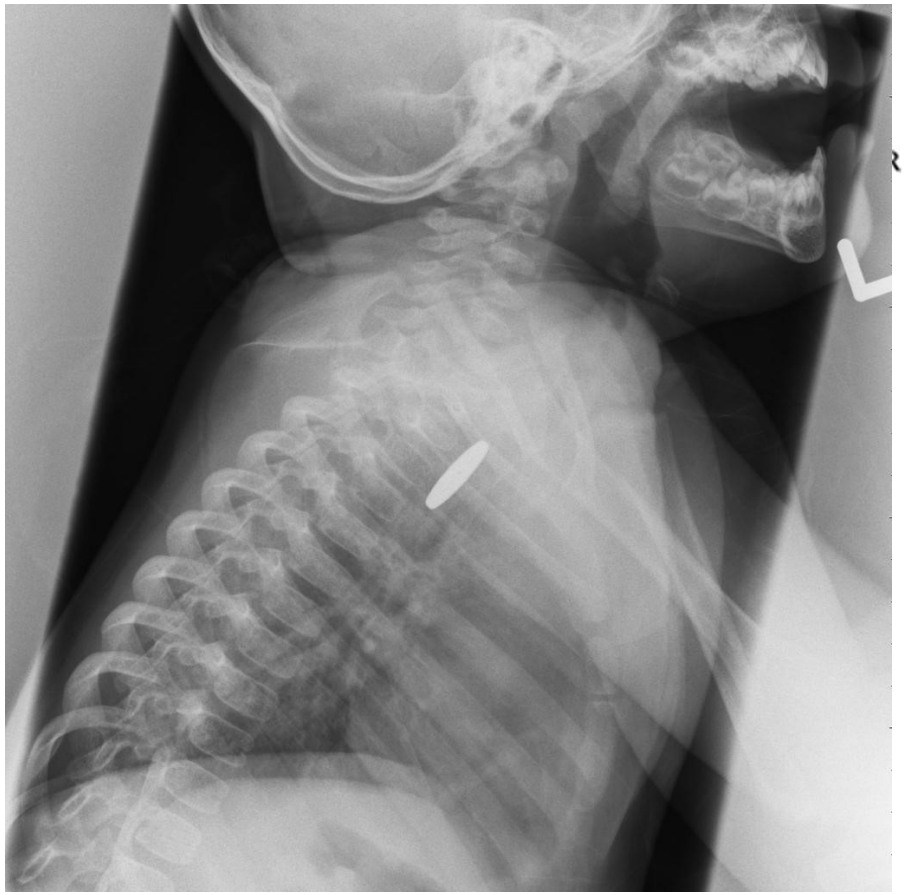
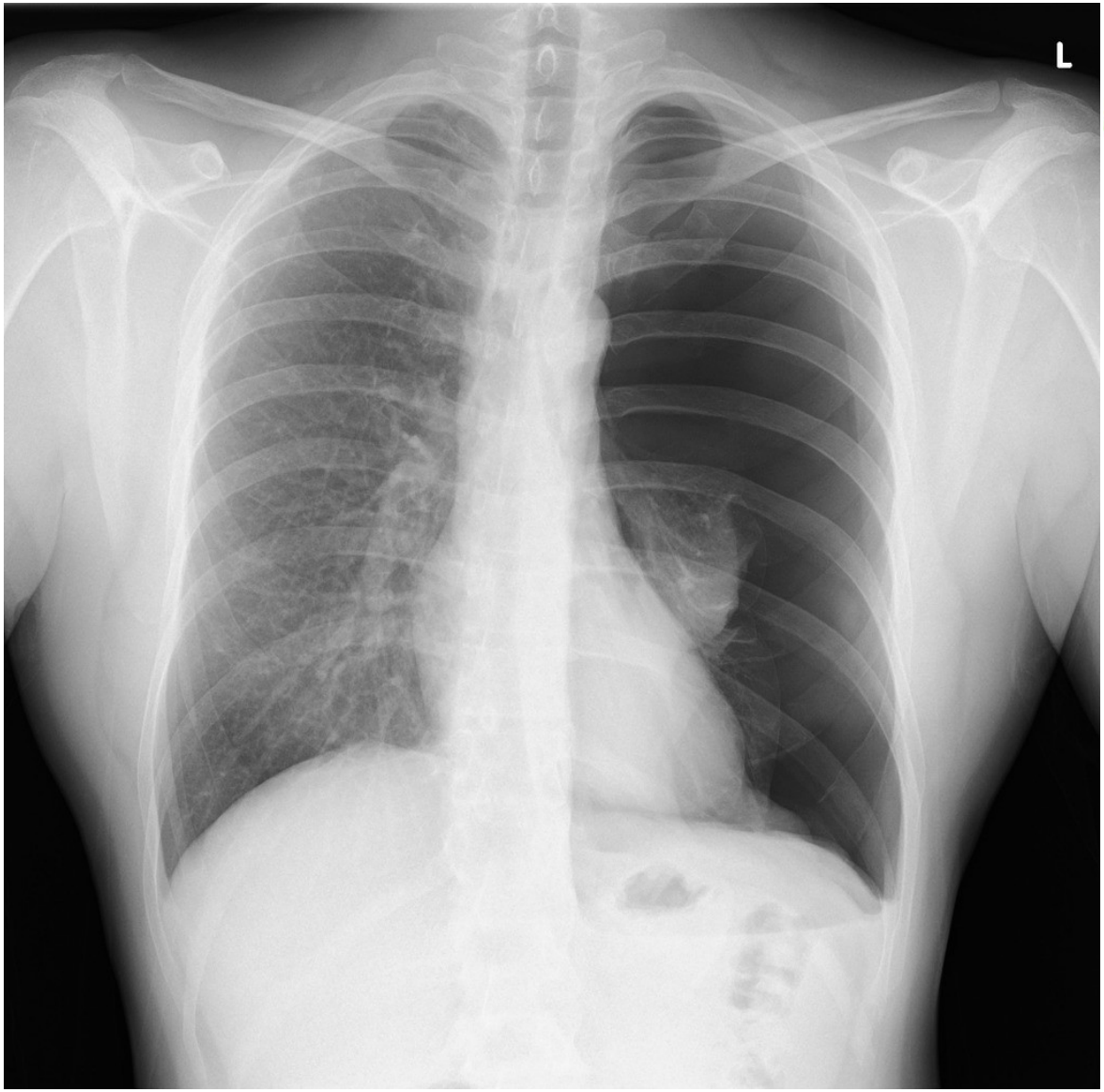




Gaillard F, Coin in esophagus. Case study, Radiopaedia.org (Accessed on 28 Jun 2023)
https://doi.org/10.53347/rID-7905



Gorrochategui M, Ramsey, MD A, Niknejad M, et al. Pneumothorax. Reference article, Radiopaedia.org (Accessed on 28 Jun 2023) https://doi.org/10.53347/rID-4578

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