M3 Chest Radiology

Objectives

-How the image is created and captured

-Anatomy of the chest radiograph

-A systematic approach

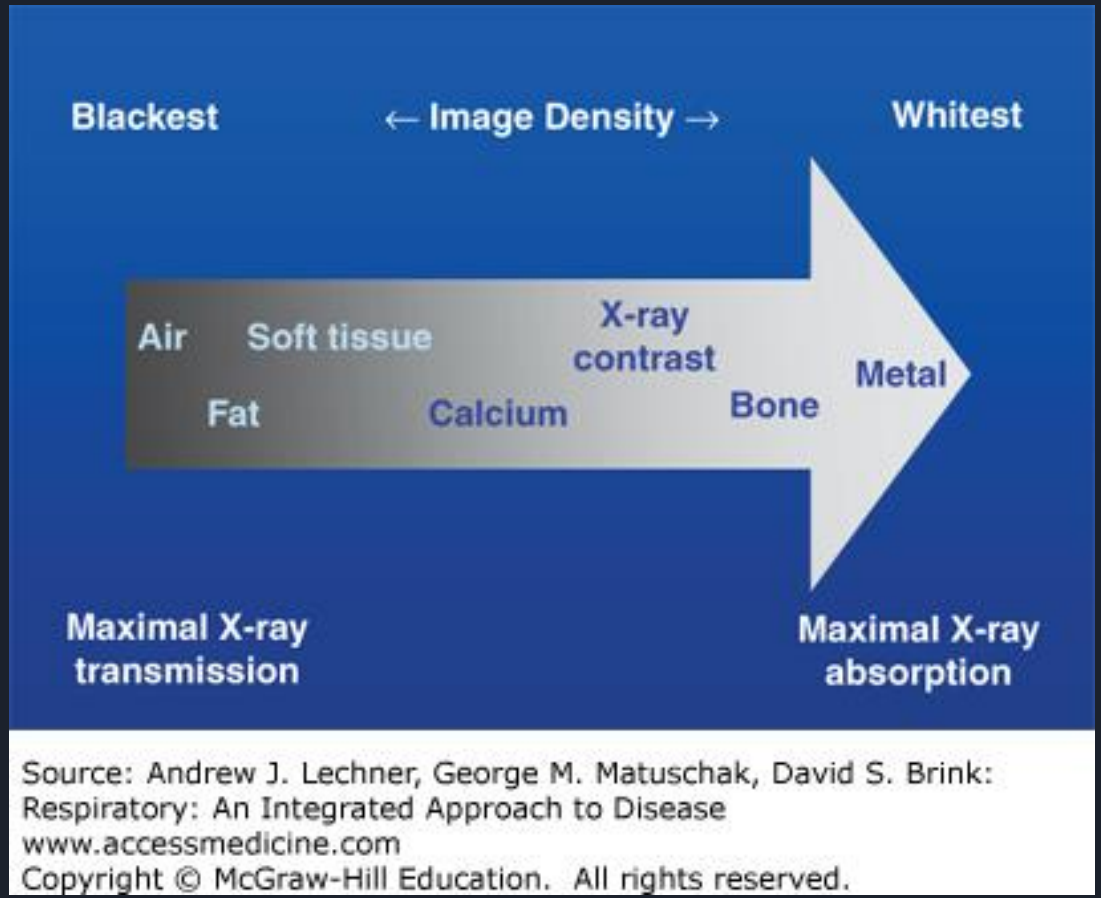
-High yield example cases

Differences in Density Produce Contrast and the Image

- Air
- Fat
- Soft Tissue
- Bone
- Metal

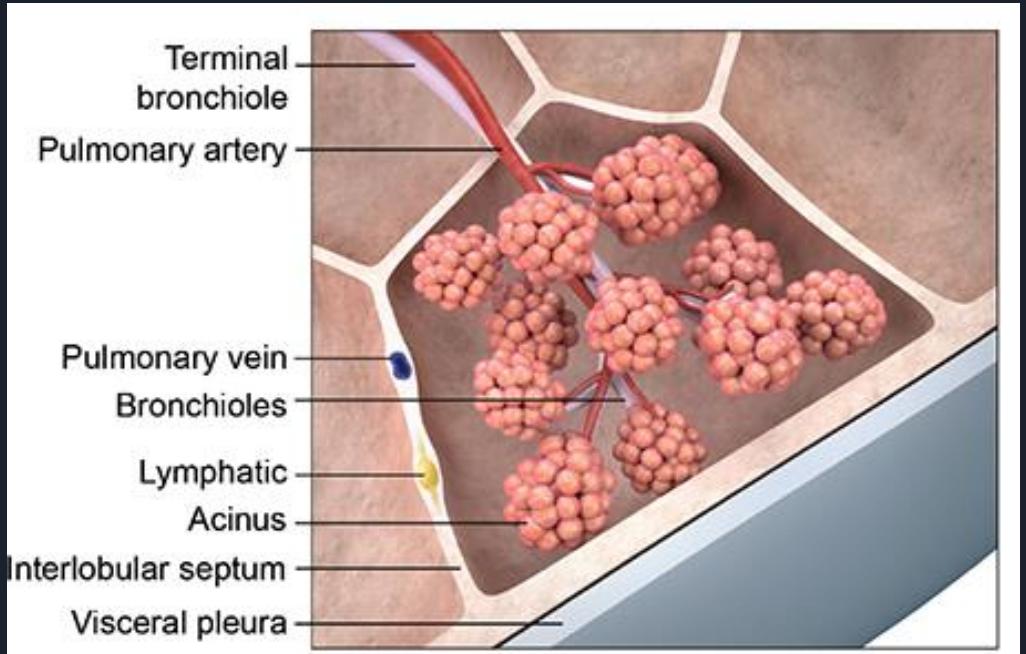
-The five basic densities which can be differentiated by plain radiographs

-Objects can only be identified by contrast between these densities

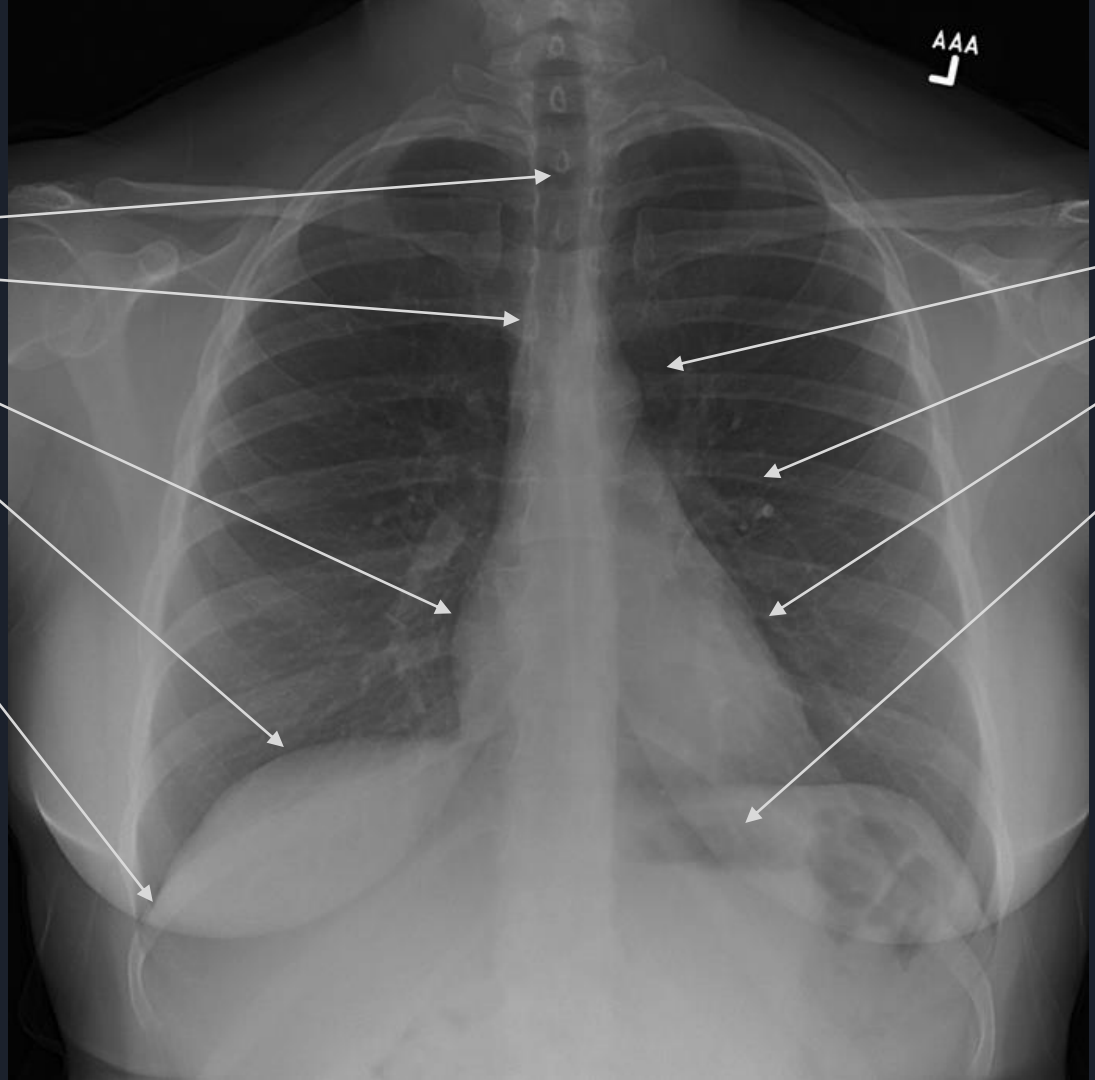


Source: Andrew J. Lechner, George M. Matuschak, David S. Brink: Respiratory: An Integrated Approach to Disease
www.accessmedicine.com

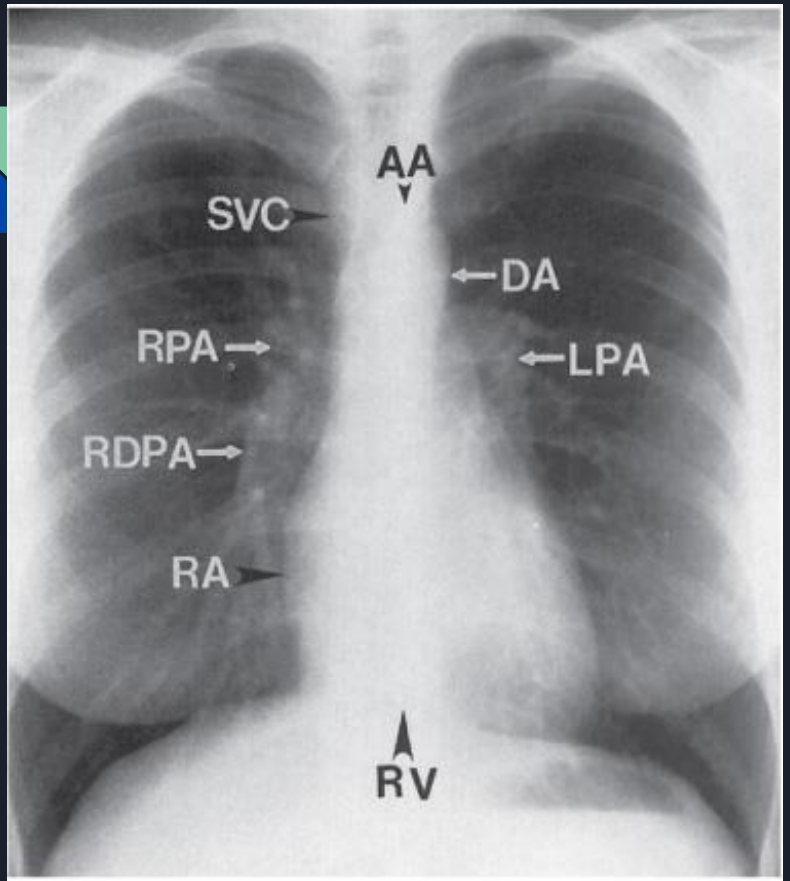
Secondary Pulmonary Lobule



- Trachea
- SVC
- RA
- Liver
- Right CPA

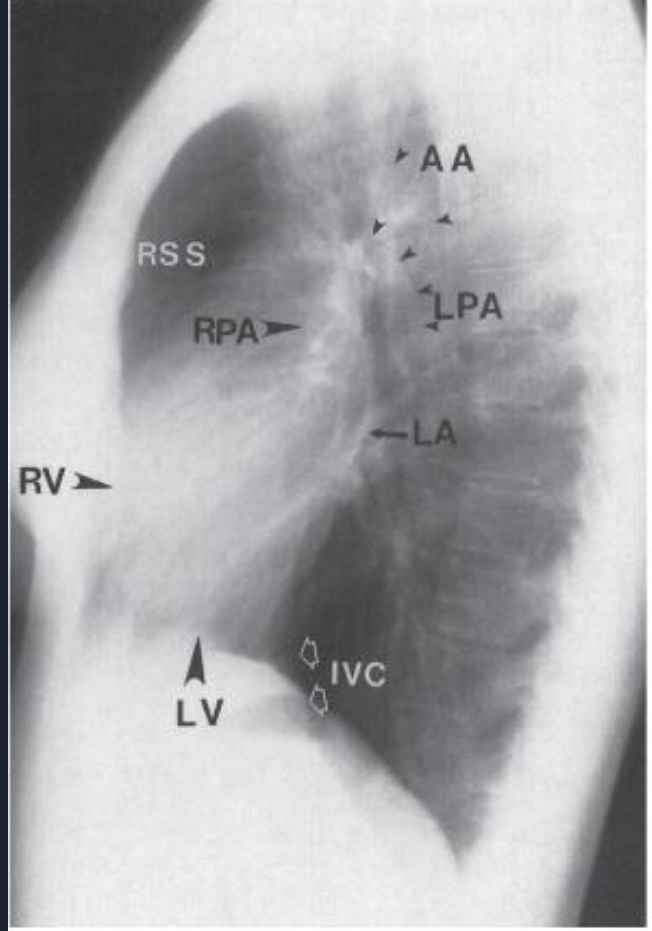


- Aortic knob
- Left hilum
- Left heart border(LV)
- Gastric air bubble



A

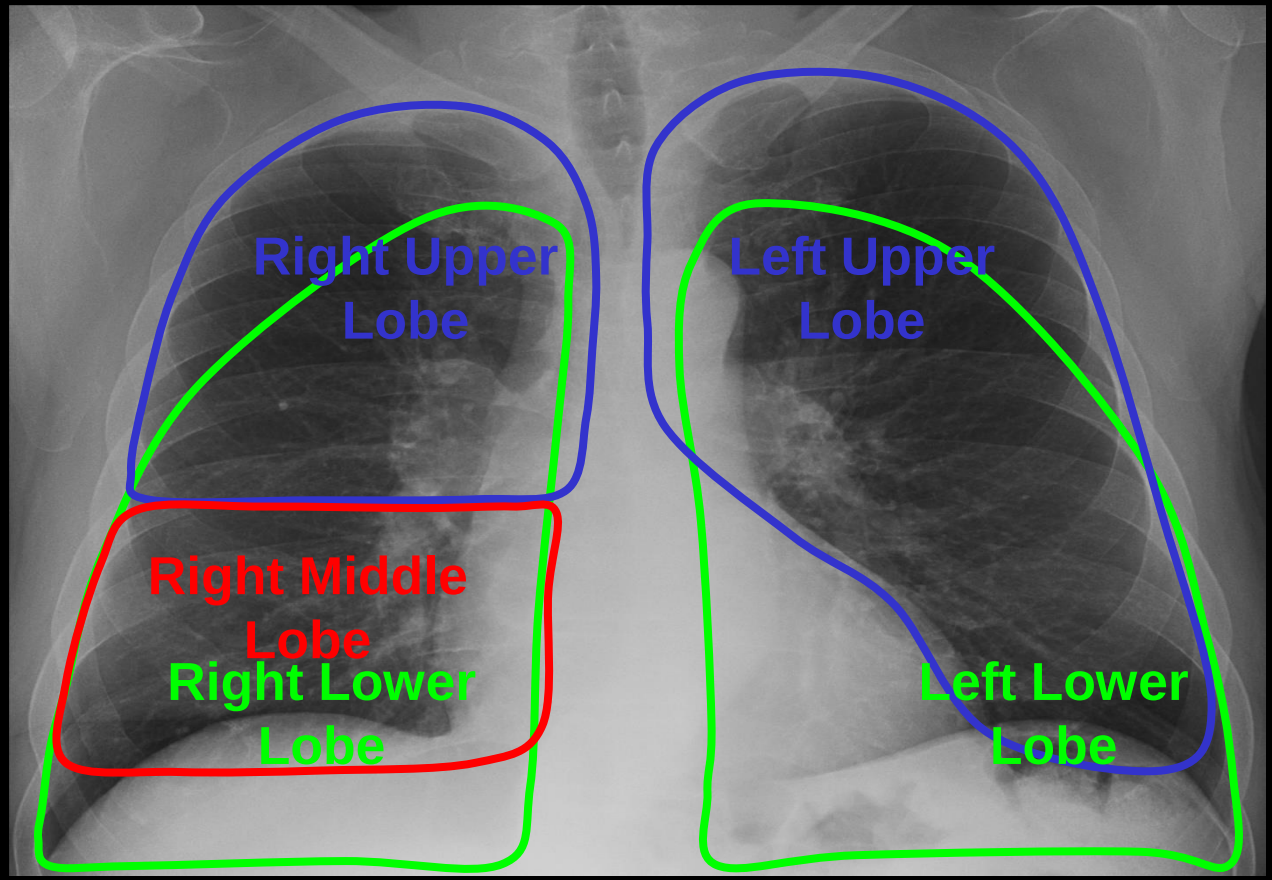
Source: Chen MYM, Pope TL, Ott DJ: *Basic Radiology, 2nd Edition*: http://www.accessmedicine.com



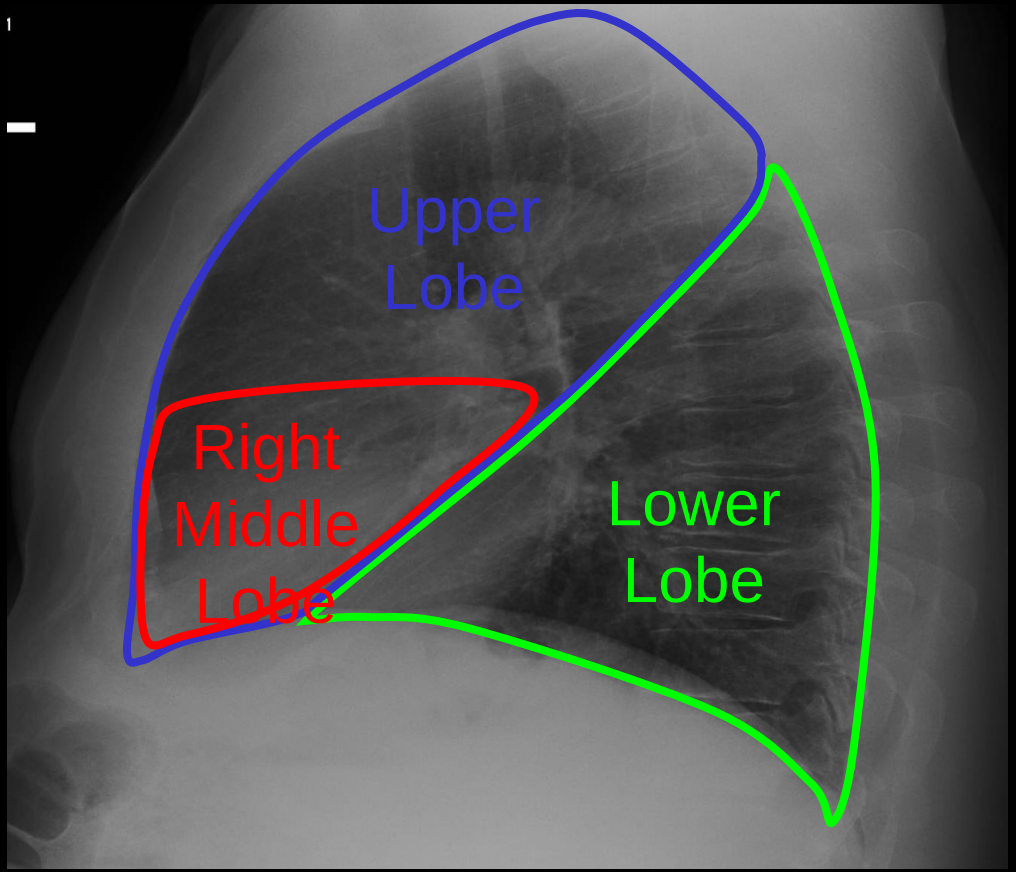
B

Source: Chen MYM, Pope TL, Ott DJ: *Basic Radiology, 2nd Edition*: http://www.accessmedicine.com

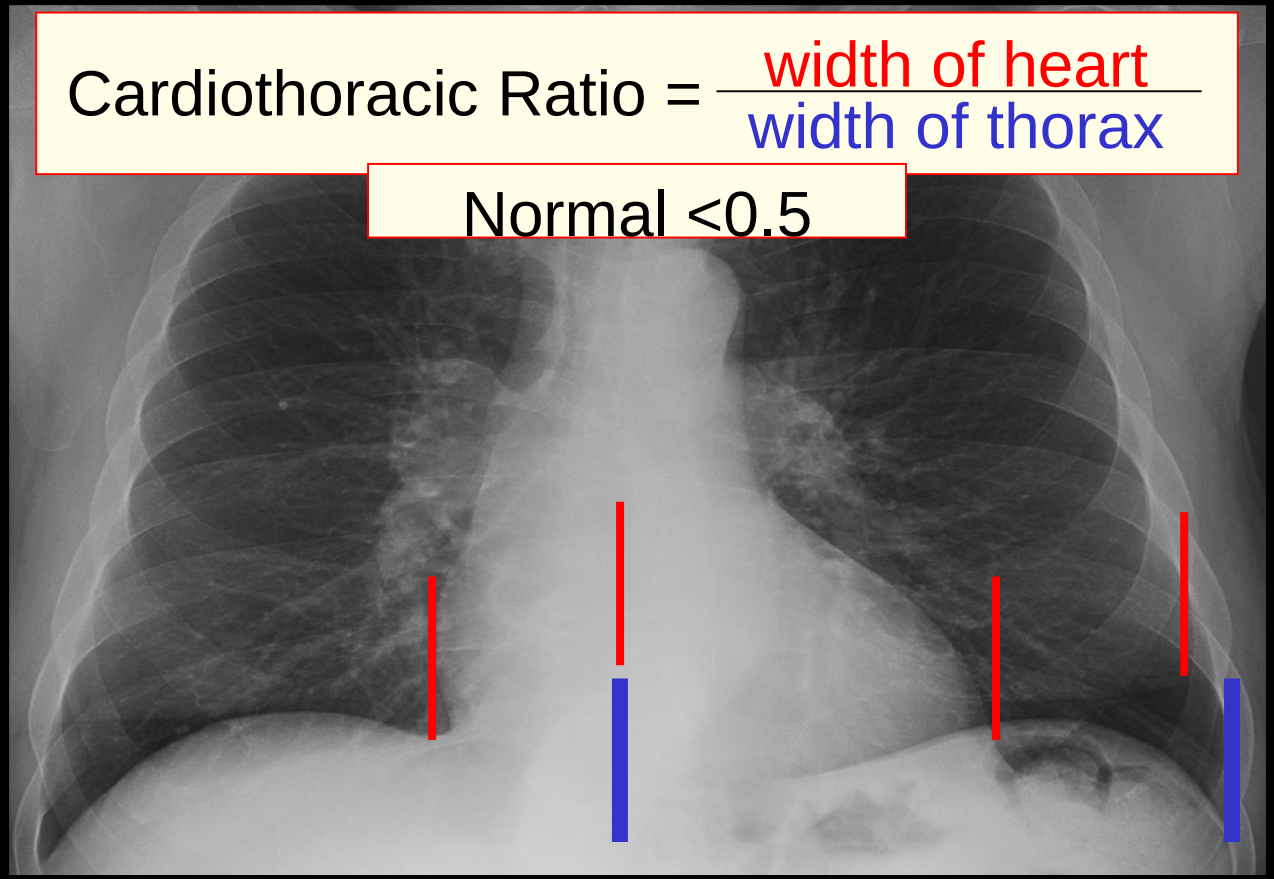
Lobar Anatomy - Frontal Chest Radiograph



Lobar Anatomy - Lateral Chest Radiograph



Normal Heart Size



Chest Positioning- PA vs AP

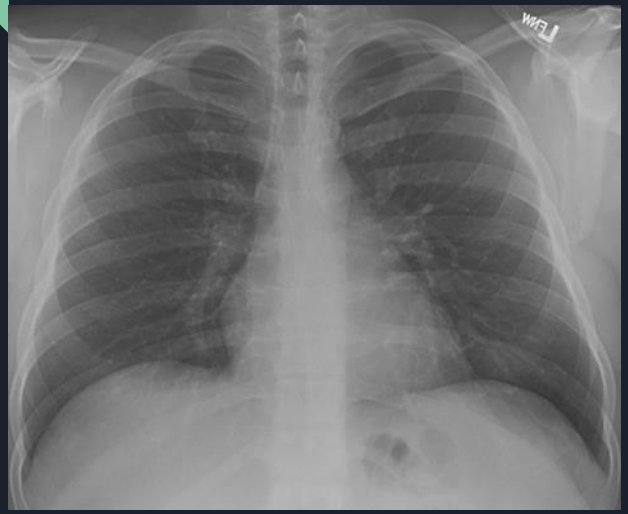
Chest Positioning - PA

- Patient is facing cassette and x-ray tube is 6 feet away
- Distance diminishes effect of beam divergence and magnification
- Patient positioning: Standing, arms akimbo, scapulae rotated forward

Chest Positioning - AP

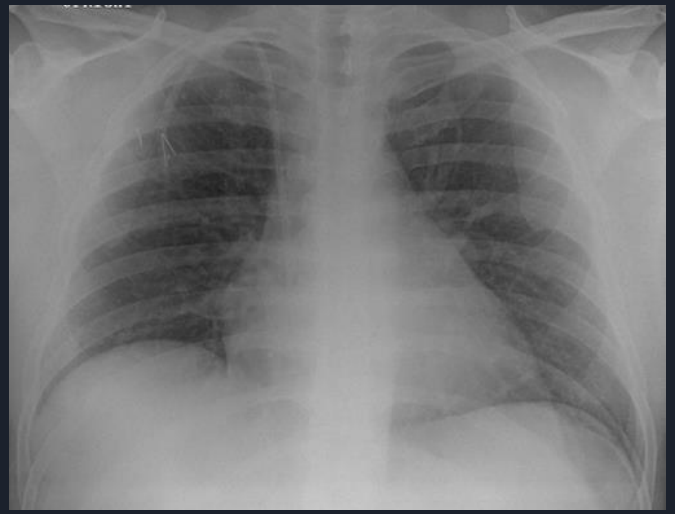
- Patient can be sitting upright or supine
- On supine film, there is more equalization of pulmonary vasculature
  - Heart shadow is larger because it is an anterior structure

Which is AP and PA?



PA

-scapula are rotated away
-upright
-magnification <5%



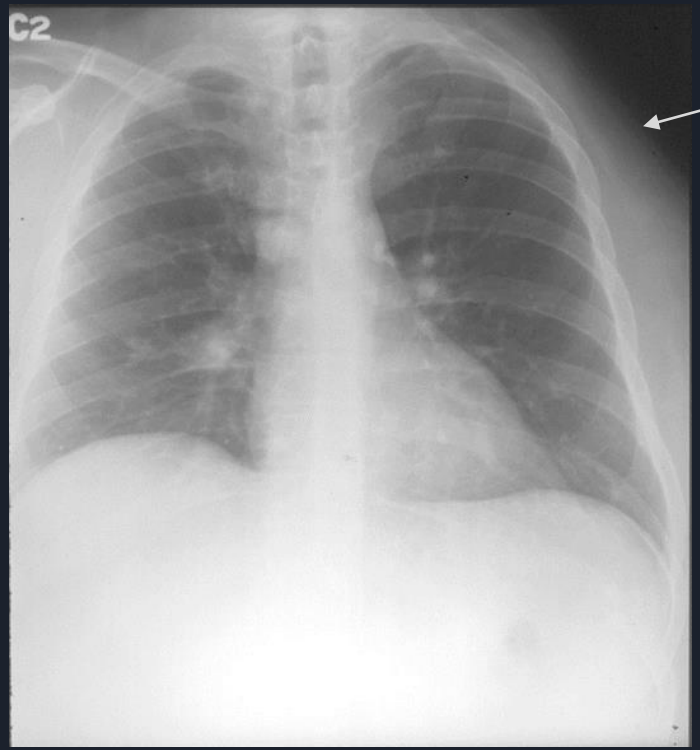
AP

-scapula are present
-magnification > 10%

Systematic Approach

- Four Corners
- Outside In
- Trachea/Mediastinum
- Top to Bottom
- Side to Side

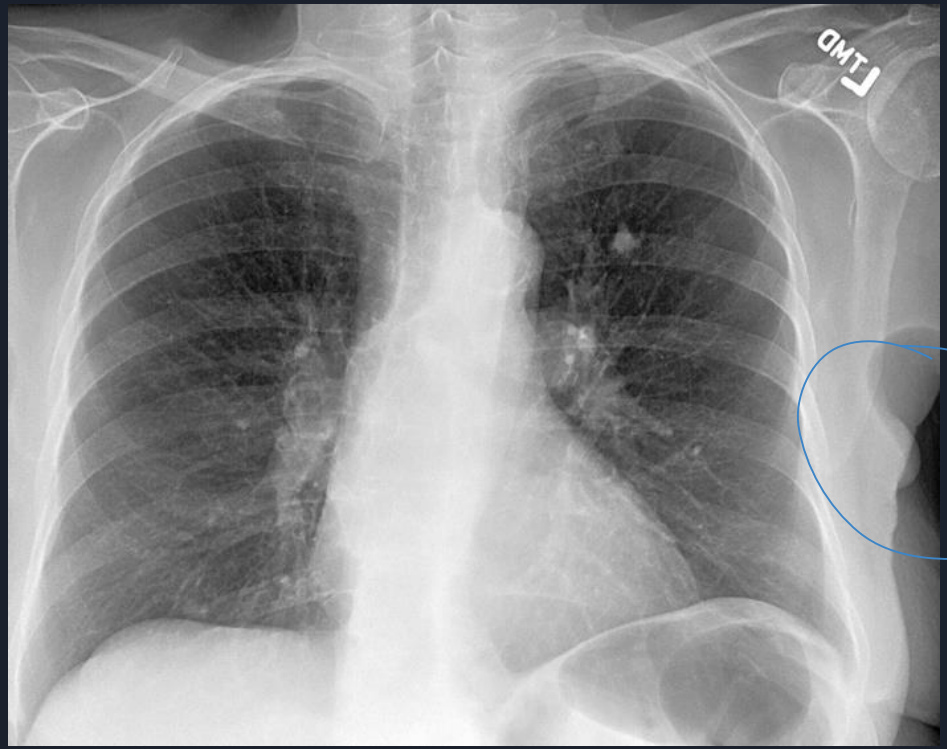
Check the Corners



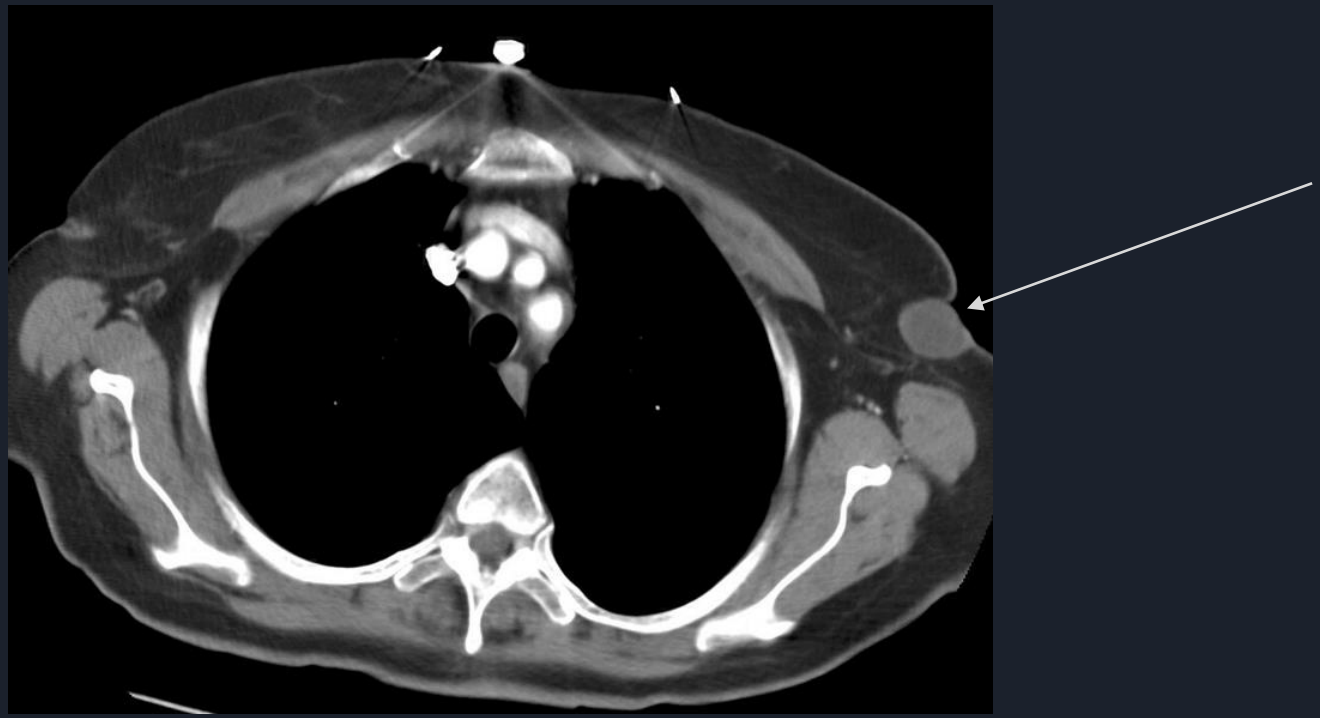
No scapula

What's missing?

Outside In

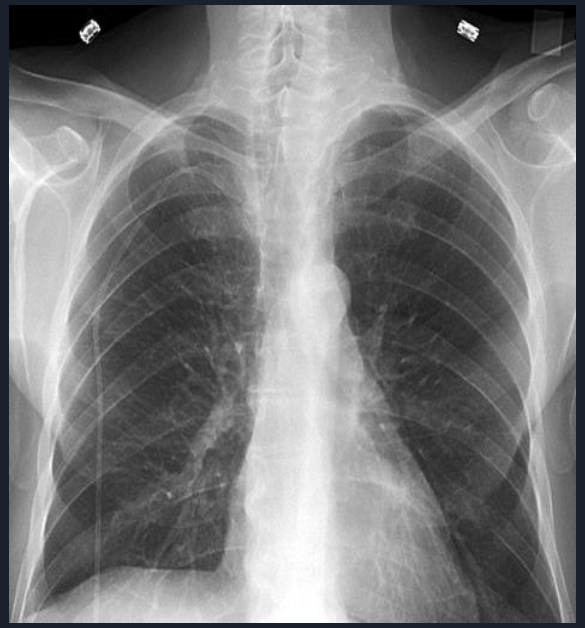


Where's the abnormality?



Left Axillary Mass

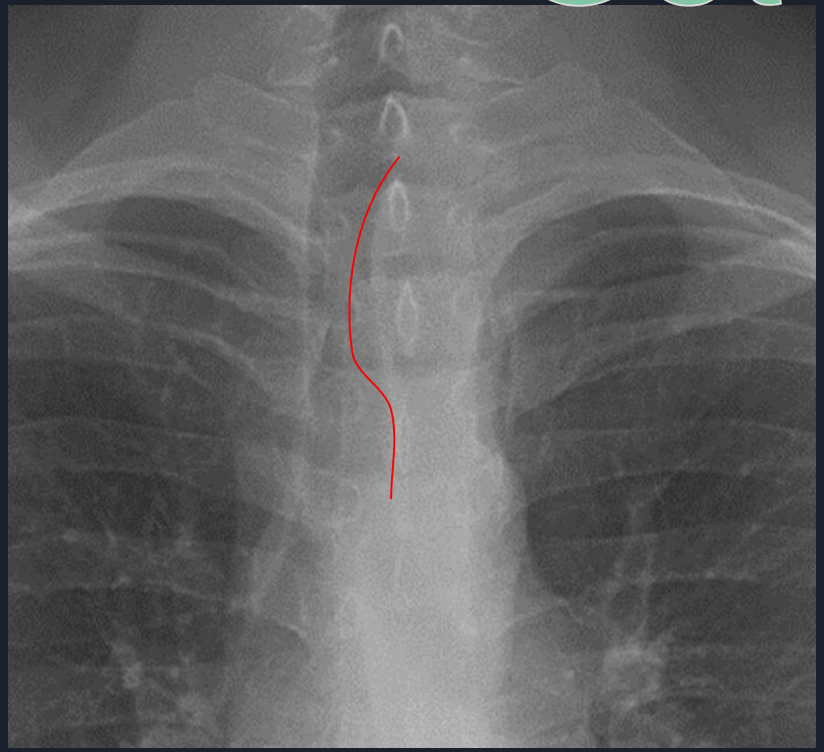
Check the Trachea and Mediastinum



Vertebrae should get darker as you go inferiorly = Spine Sign

Check the Trachea

Get a CT



Compare Top to Bottom

RUL Atelectasis

Lingular PNA

Areas where we miss

-Apices

-Hila

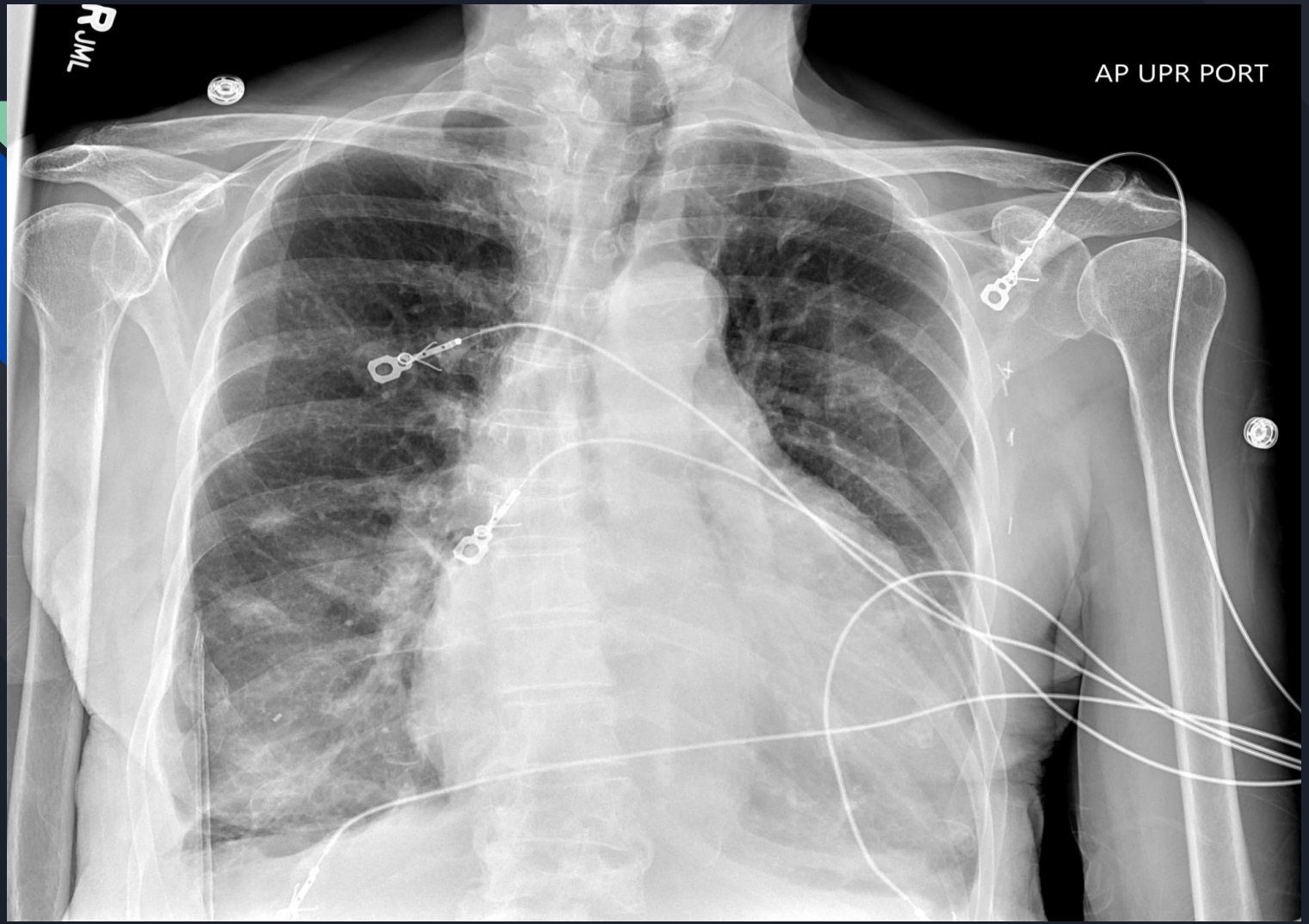
-Mediastinum

-Below the Diaphragm

-The corners

Case 1

- 83 year old Female
- Chest pain, dyspnea, hypotension


RJML
AP UPR PORT

Diagnosis

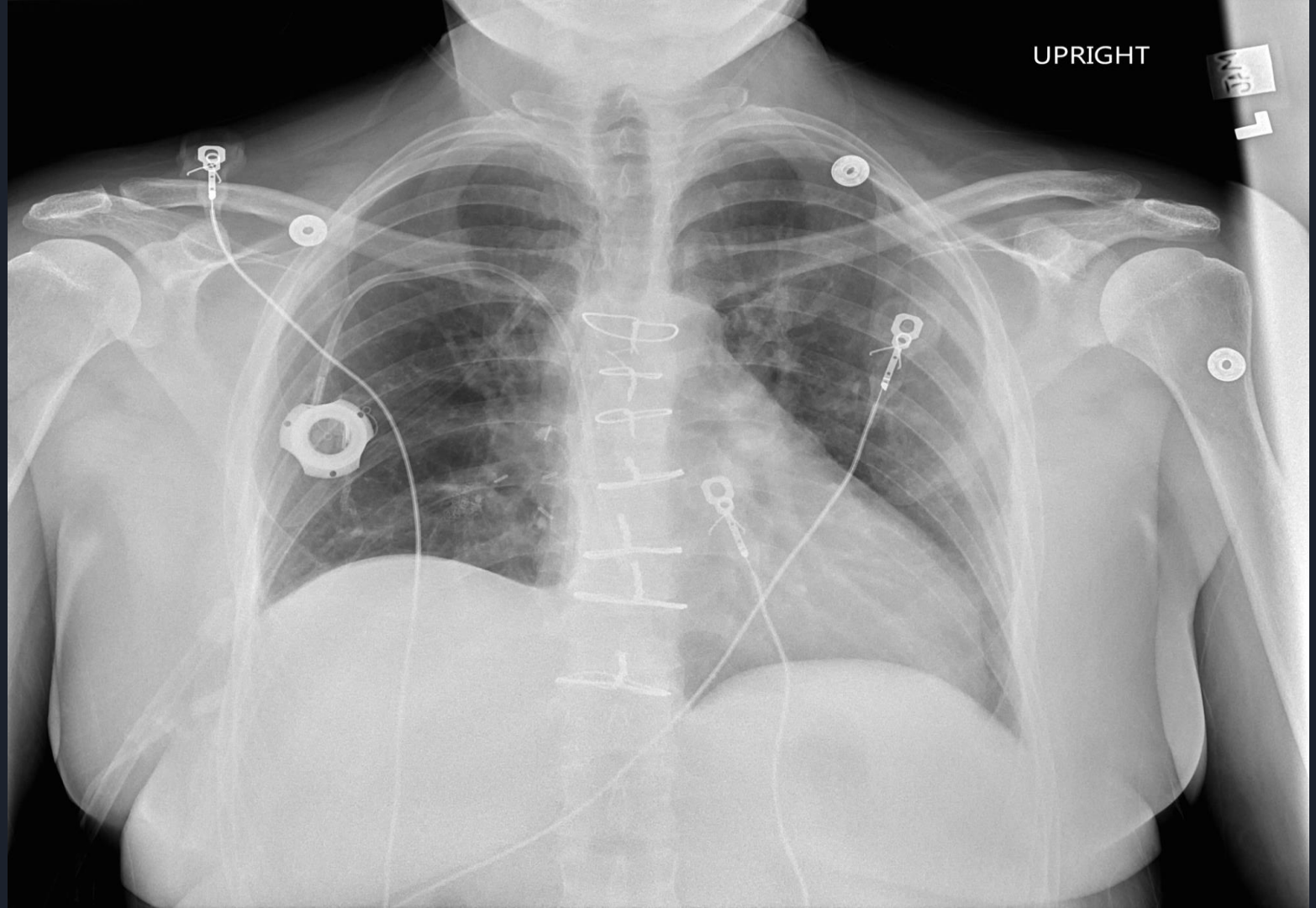
- Large pericardial effusion with signs of tamponade
- Due to diffuse large B cell lymphoma in this patient

Discussion

- Cardiac tamponade is a **life threatening condition**
  - accumulation of fluid in the pericardial cavity
  - results in reduced cardiac output (increasing filling resistance).
- Can see the **Beck Triad** clinically:
  - Muffled heart sounds, jugular venous distension, and hypotension.
- Causes (not exhaustive):
  - transudate (CHF, renal failure)
  - exudative (TB, empyema)
  - hemorrhagic (trauma, malignancy, coronary rupture)
  - malignancy, pericarditis, viral
- Possible **CXR findings**:
  - Cardiomegaly
- Possible **CT findings**:
  - pericardial effusion
  - venous enlargement (IVC, SVC, hepatic veins, etc), contrast reflux into the IVC/heaptic veins
  - collapse of the RV or RA, bowing of the intraventricular septum.
- Echocardiography is the gold standard.
- Treatment:
  - Expedient drainage, treatment of underlying cause

Case 2

- 33 year old female
- Dyspnea, increasing O2 requirement


UPRIGHT

Diagnosis

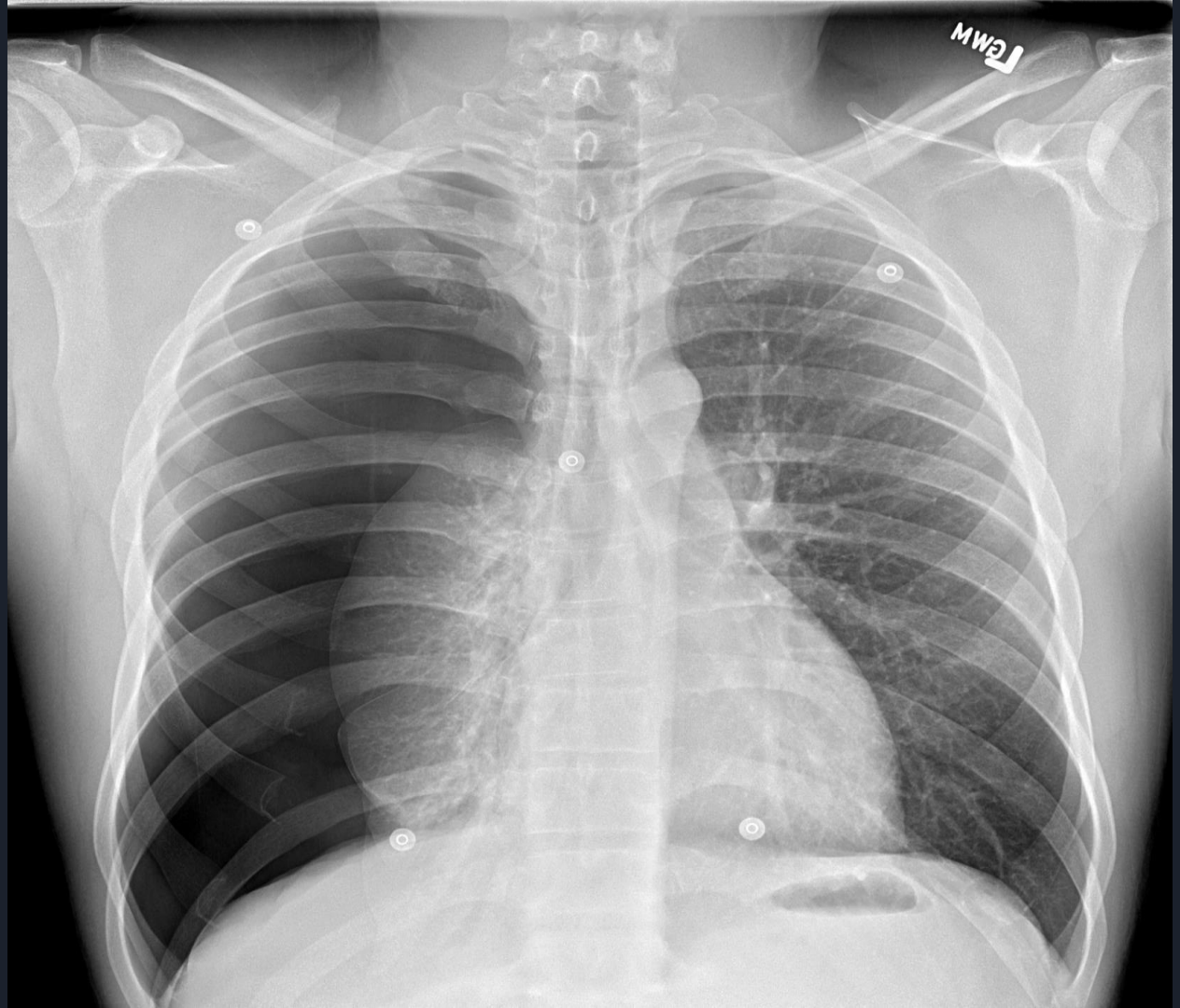
- Acute Pulmonary Thromboembolism
- Due to hx of Lupus and antiphospholipid syndrome

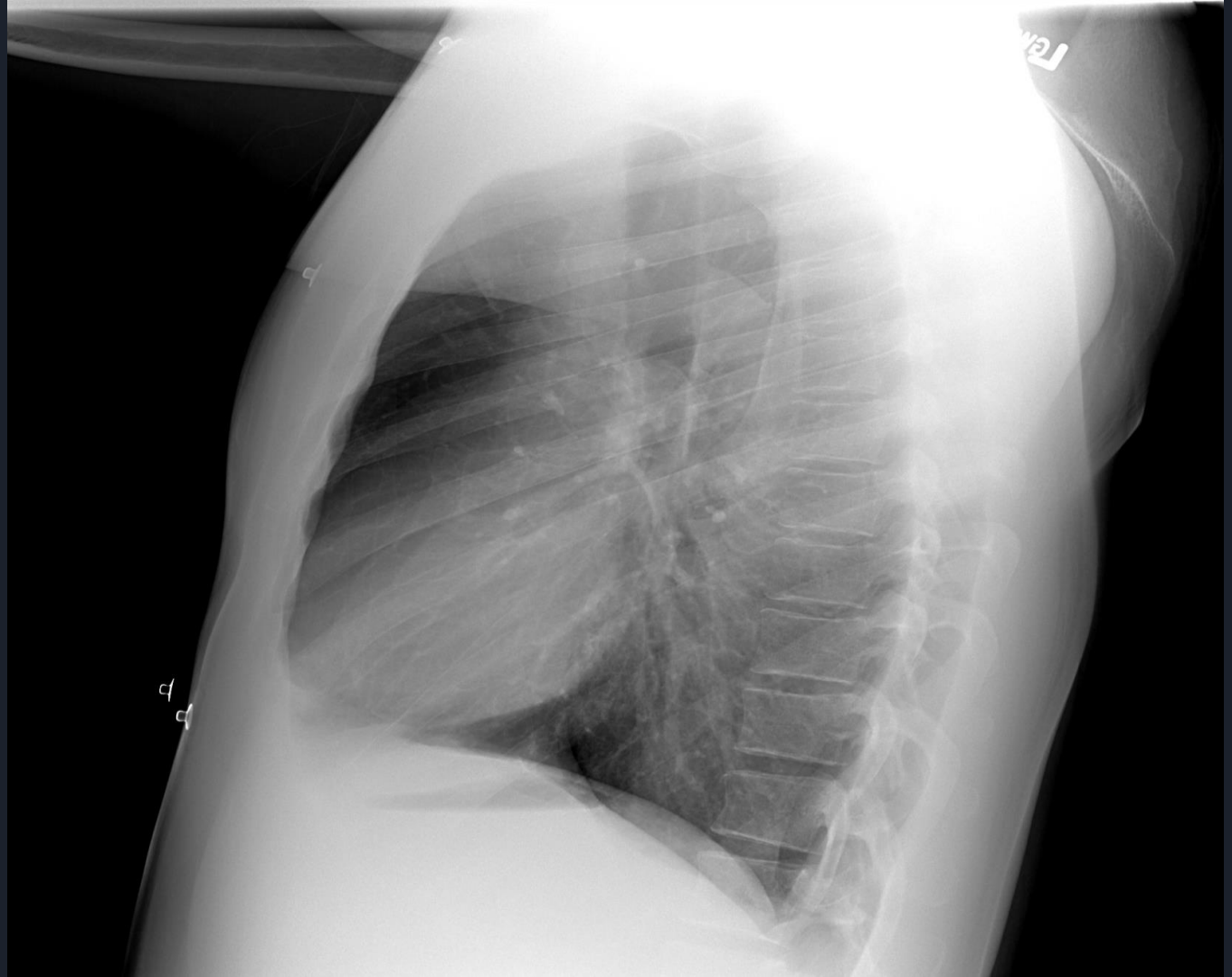
Discussion

- Spectrum of clinical presentations:
  - dyspnea, chest pain, syncope, obstructive shock and sudden death
- Most common source of PE is DVT
- Risk factors (**Virchow triad**):
  - DVTs, OCPs, surgery, primary hypercoagulabilities, malignancies, pregnancy, prolonged bed rest/immobility
- **CXR findings**:
  - **Most common finding is a normal CXR**.
  - Rarely can see **Hampton hump** (peripheral wedge shaped infarct of the lung) and **Westermark sign** (regional lack of pulmonary vasculature)
- **CT findings**:
  - **Pulmonary arterial filling defects** are diagnostic
- Nuclear Medicine V/Q scanning can be useful for those with poor renal function who cannot tolerate IV contrast
- Treatment:
  - Anticoagulation, thrombolytics, IVC filter

Case 3

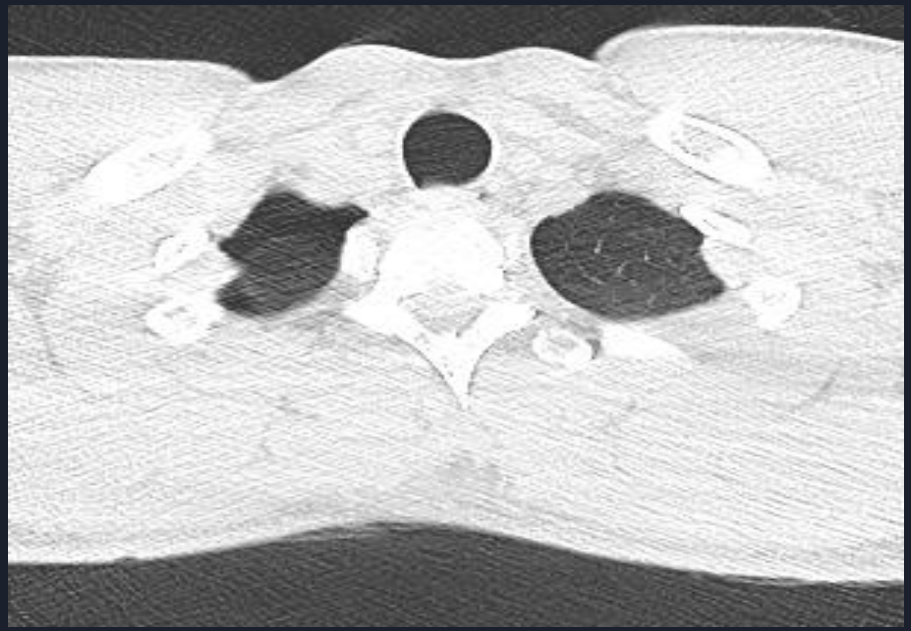
- 32 year old male
- Chest pain, dyspnea, borderline hypotension

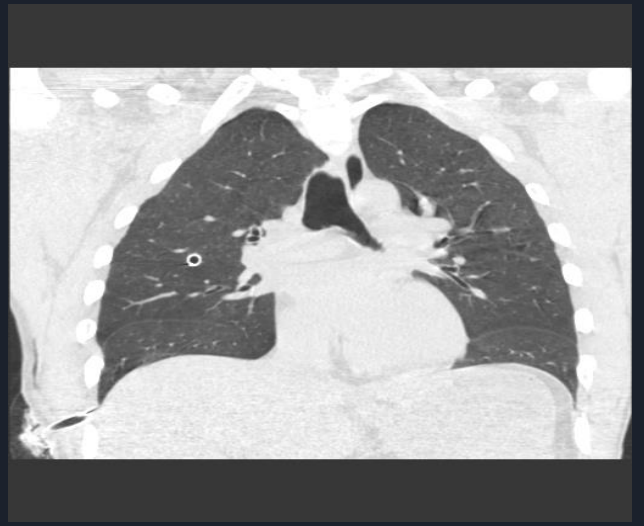

GMW

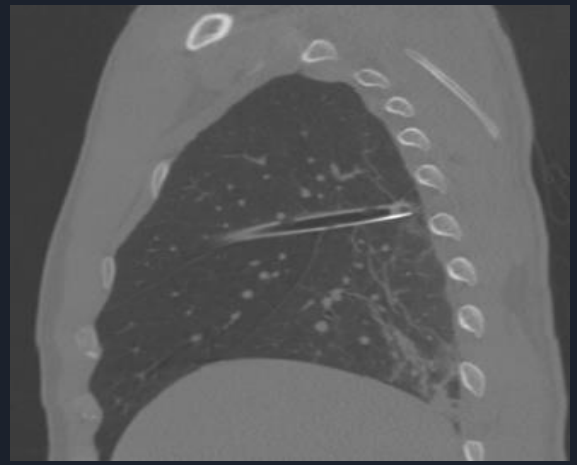


Diagnosis

- Spontaneous Tension Pneumothorax





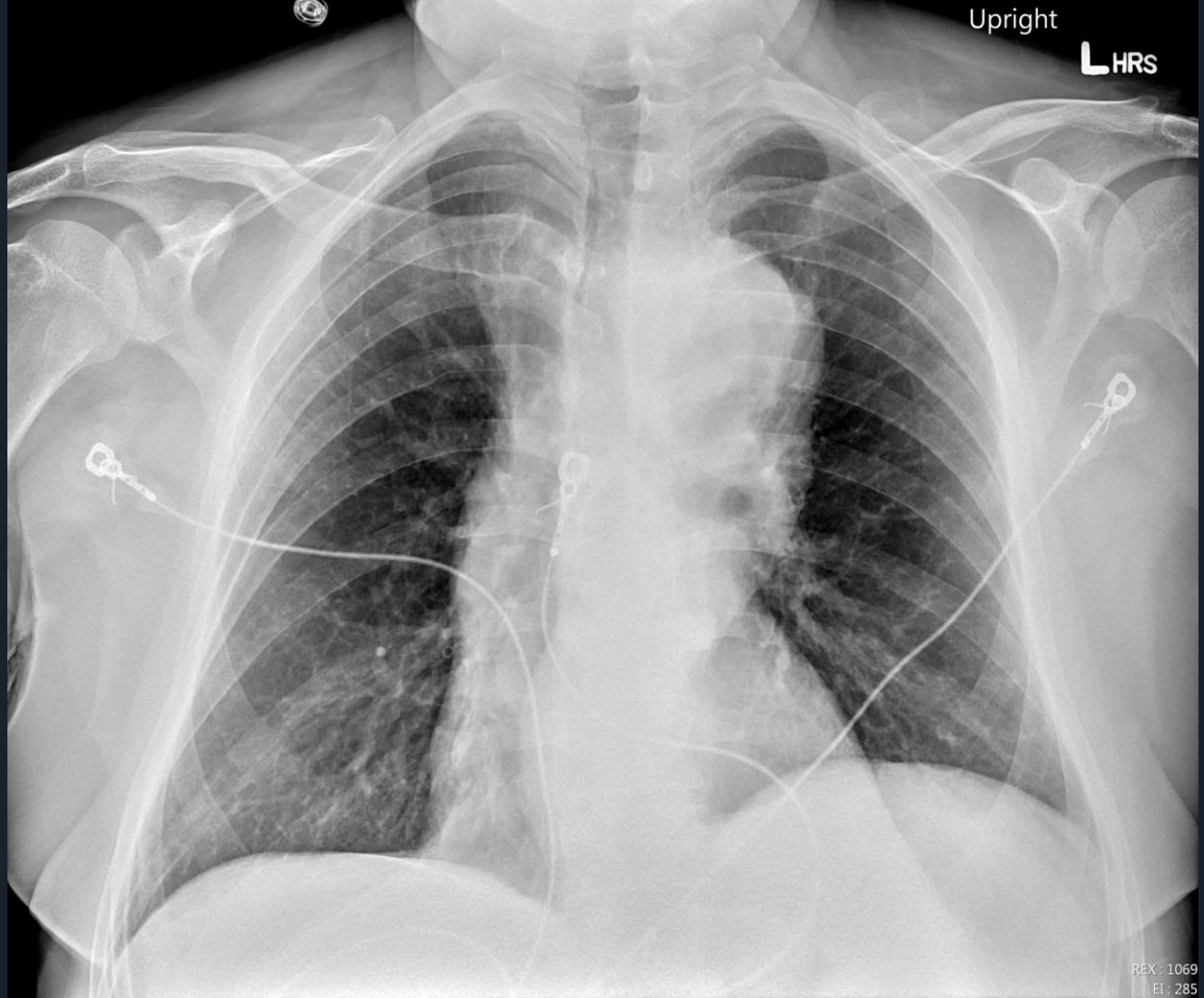


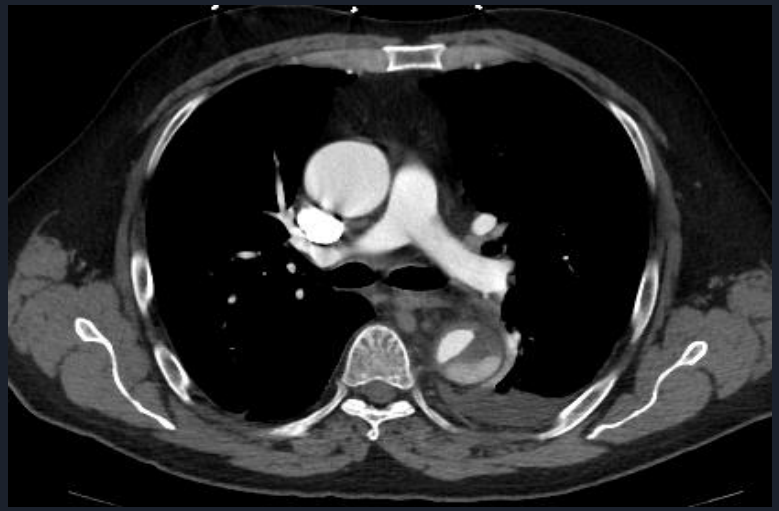
Discussion

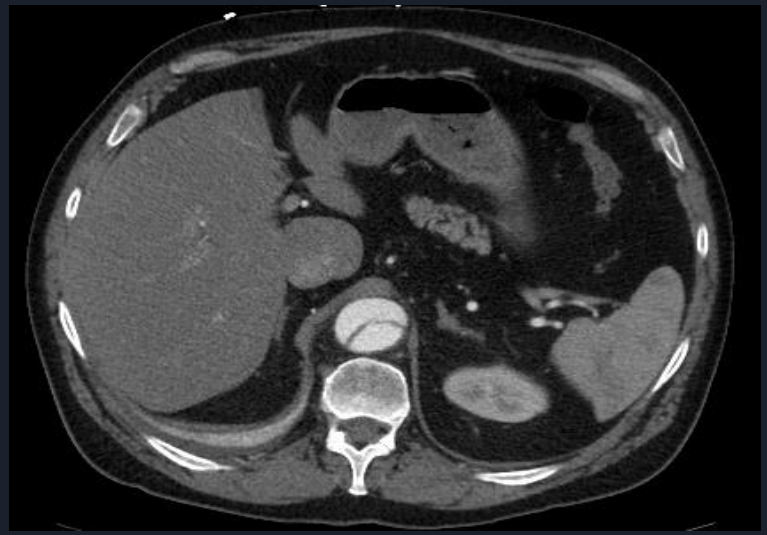
- Pneumothorax is presence of air in the pleural space.
- **Tension pneumothorax** results when the intrapleural pressure rises, compressing the mediastinal structures causing decreased venous return to the heart (**obstructive shock**)
- Primary spontaneous
  - Marfan, Ehlers-Danlos, etc
- Secondary spontaneous
  - underlying cystic lung disease (emphysema, bullae, etc)
  - parenchymal necrosis (lung abscess, cavitating neoplasm)
- Iatrogenic
  - lung biopsy, ventilator barotrauma.
- Trauma is another frequent common cause.
- **CXR findings:**
  - Visible pleural edge, pleural space more lucent than adjacent lung, no lung marking lateral to the pleural edge.
  - If patient is **upright** and the air is not loculated, air will collect along the **lung apex**.
  - If **supine**, air will usually collect along the anterior chest wall, often resulting in the "**deep sulcus sign**".
- If unclear/indeterminate, obtain lateral decubitus radiographs. The side of concern should be up
- CT is the gold standard
- Treatment:
  - Depends on many factors, but often includes placement of a chest tube.
  - Surgical or chemical pleurodesis is usually reserved for refractory or recurrent cases.

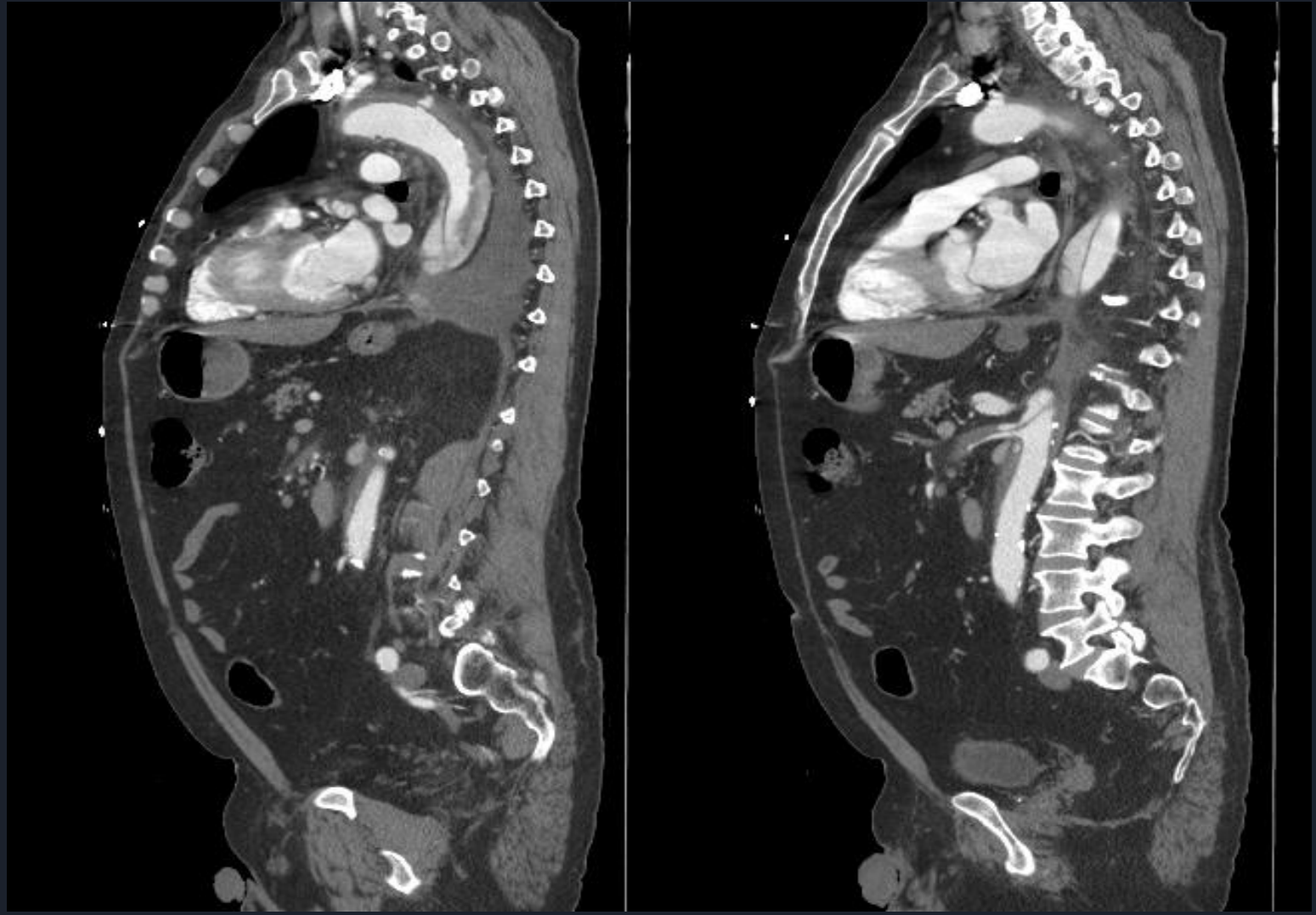
Case 4

- 61 year old male
- Chest pain radiating to the back


Upright
L HRS
REX : 1069
EI : 285







Diagnosis

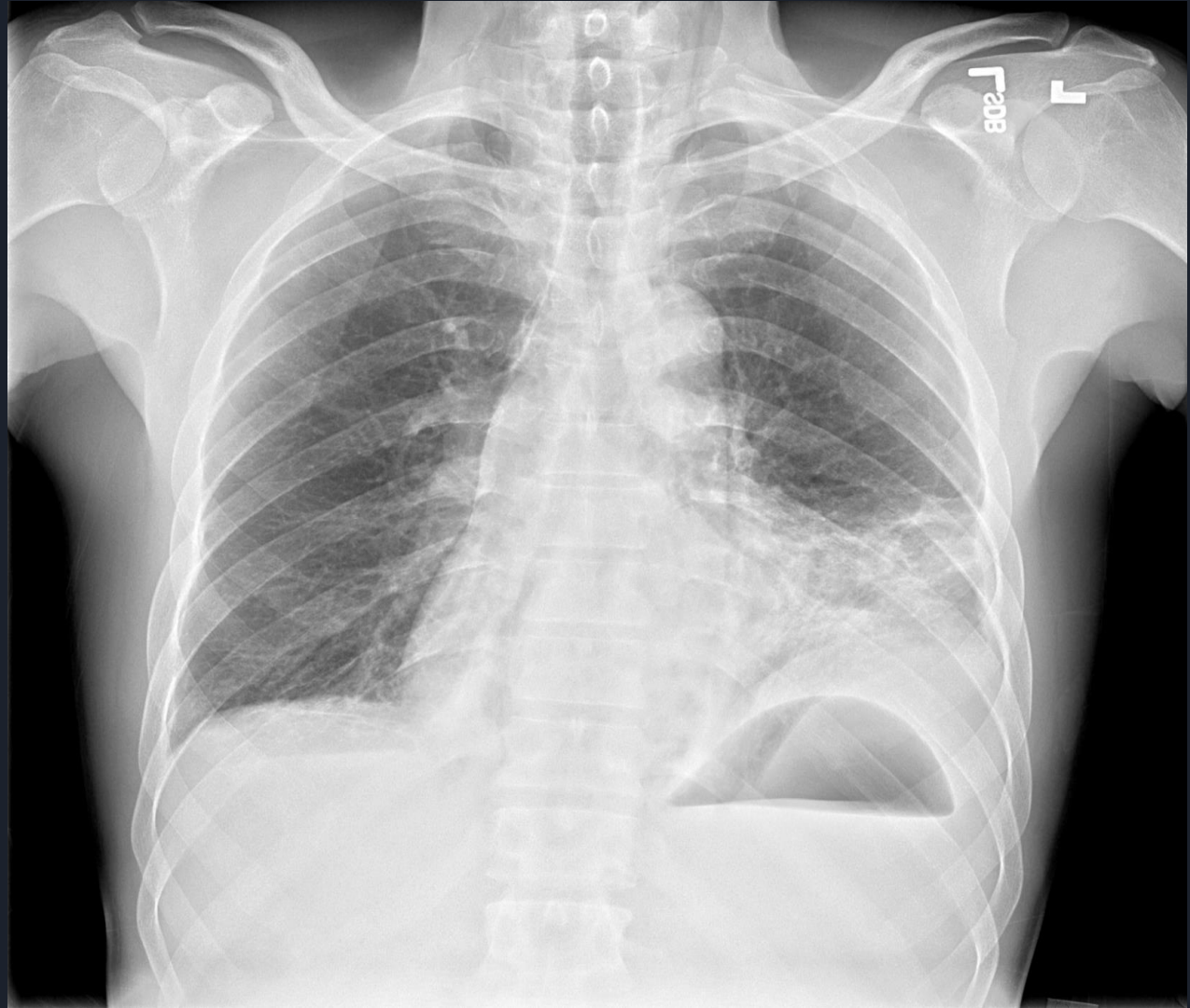
- Stanford type B (De Bakey type III) Aortic Dissection

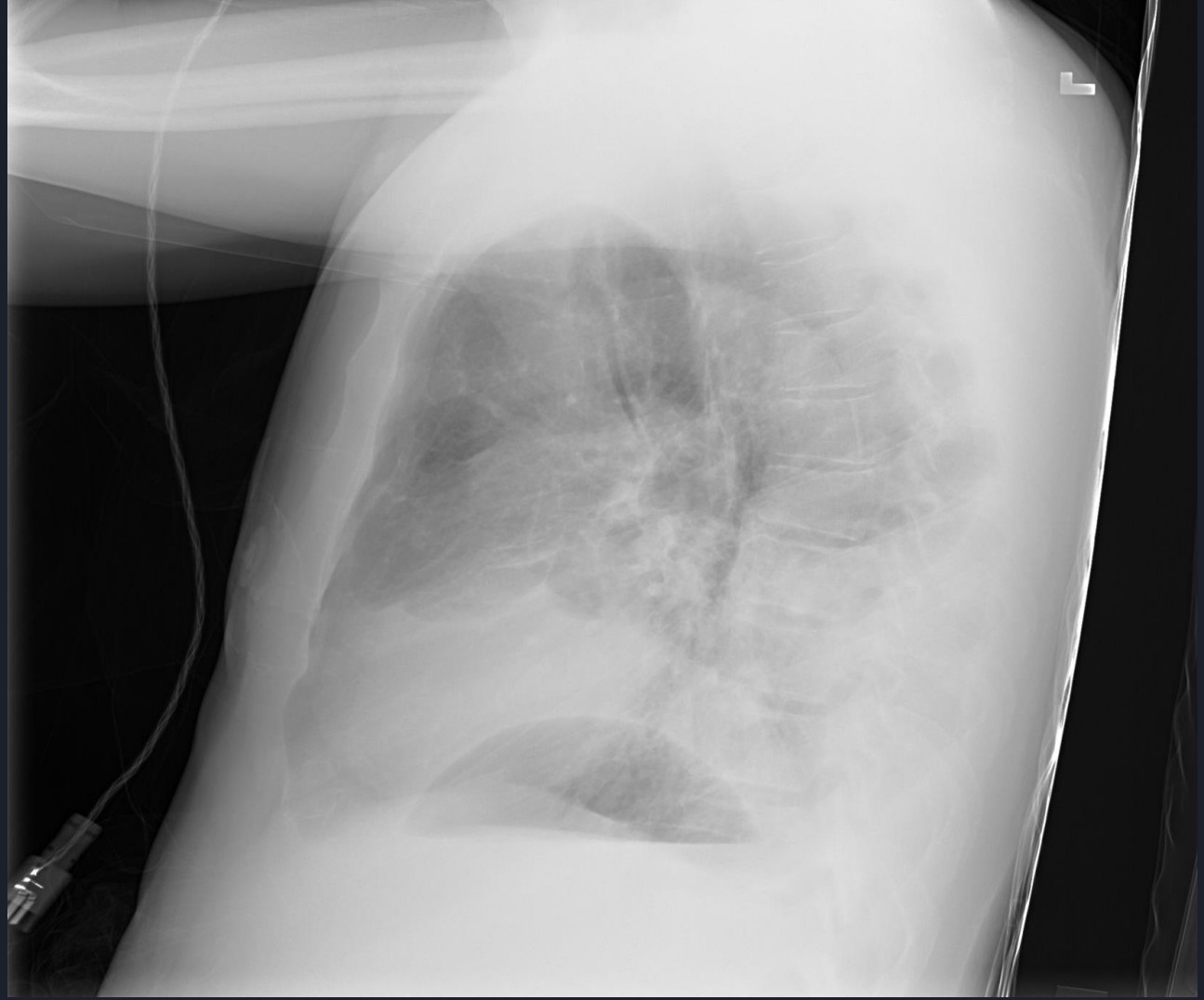
Discussion

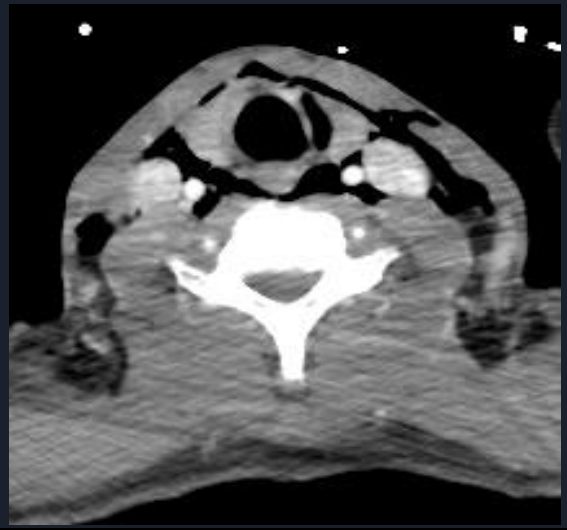
- **Aortic dissection** occurs when blood enters the medial layer of the aorta forming a second lumen within the wall, usually through a tear or ulceration
- Most common cause:
  - **HTN and aortic stenosis**
- Other predisposing factors:
  - connective tissue disease (Marfan, Elhers-Danlos), aortic coarctation, Turner syndrome, trauma, intraaortic baloon pumps (iatrogenic)
- Classified by the **Standford (A/B) and De Bakey (I, II, III)** systems.
- Complications:
  - limb ischemia, abdominal organ ischemia, stroke, or paraplegia (Artery of Adamkiewicz)
- **CXR findings**
  - widening of the superior mediastinum, double aortic contour, or irregular aortic contour. Can also be seen with aneurysm,
- **CT angiography** is essential for:
  - delineating type, anatomy, and complications.
- MRA, conventional angiography, and TEE have a more limited role.
- Treatment:
  - **Aggressive BP control.**
  - Type A and complicated type B dissections are usually immediately surgically repaired.

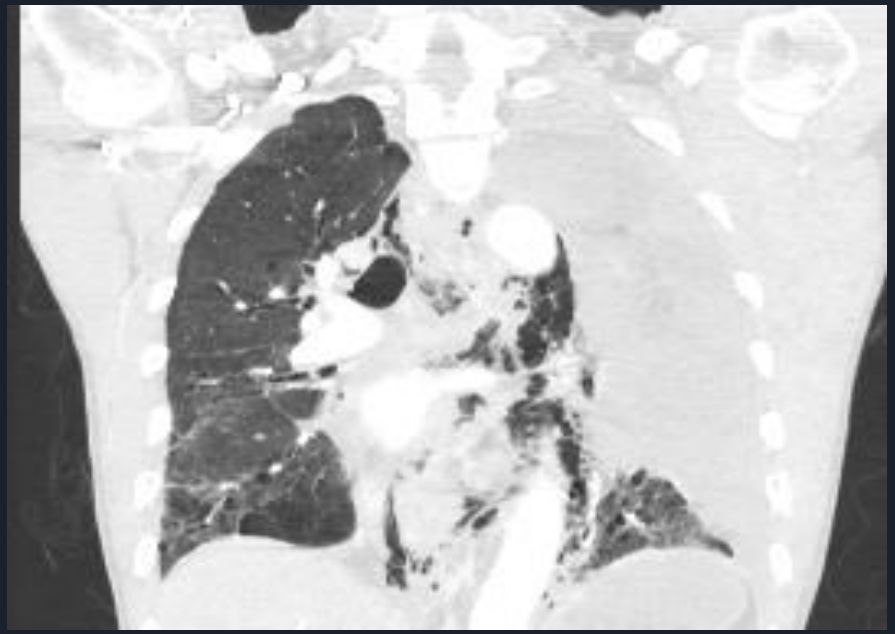
Case 5

- 56 year old male
- Chest pain, protracted vomiting



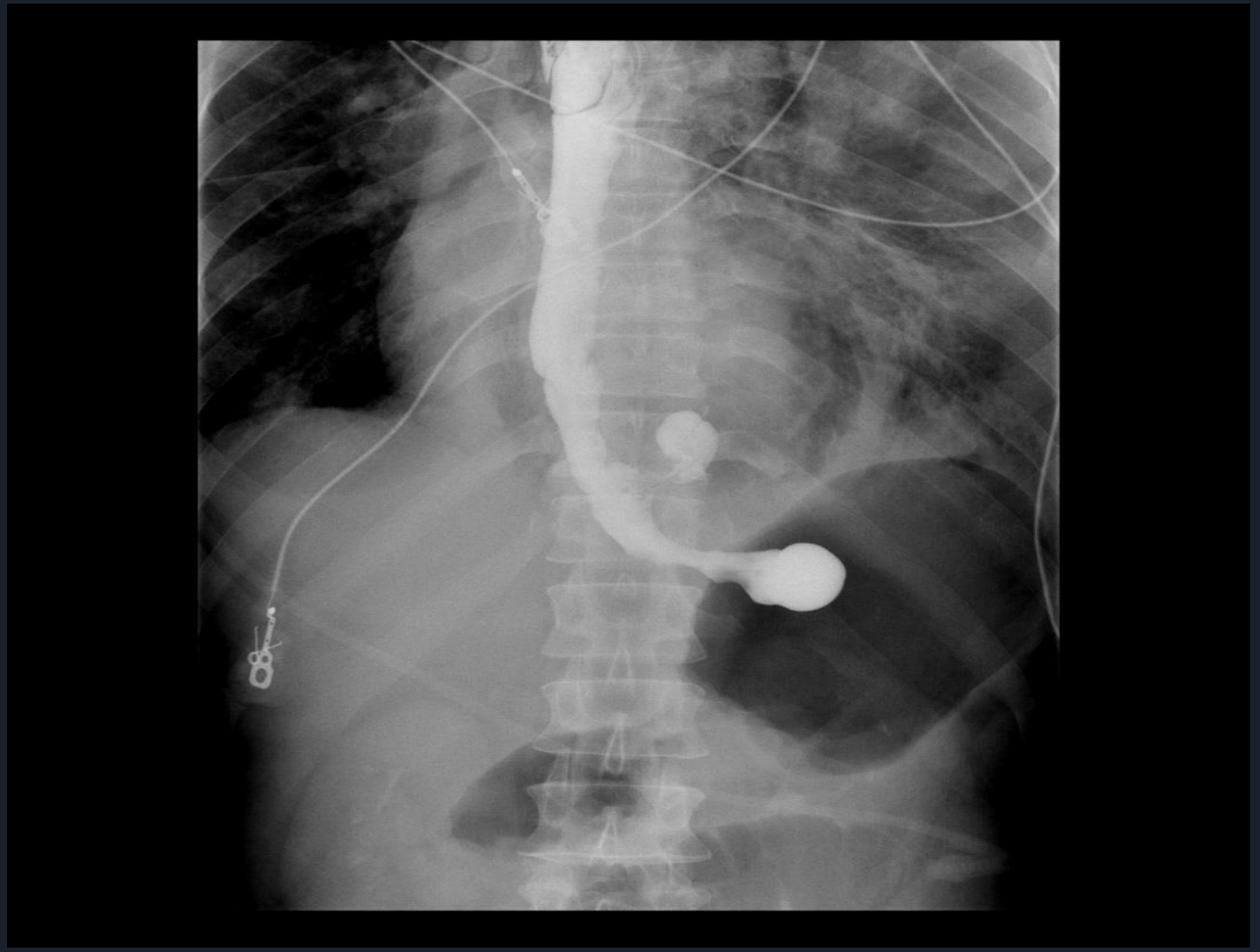






Diagnosis

- Boerhaave syndrome (pneumomediastinum/mediastinitis due to esophageal rupture)

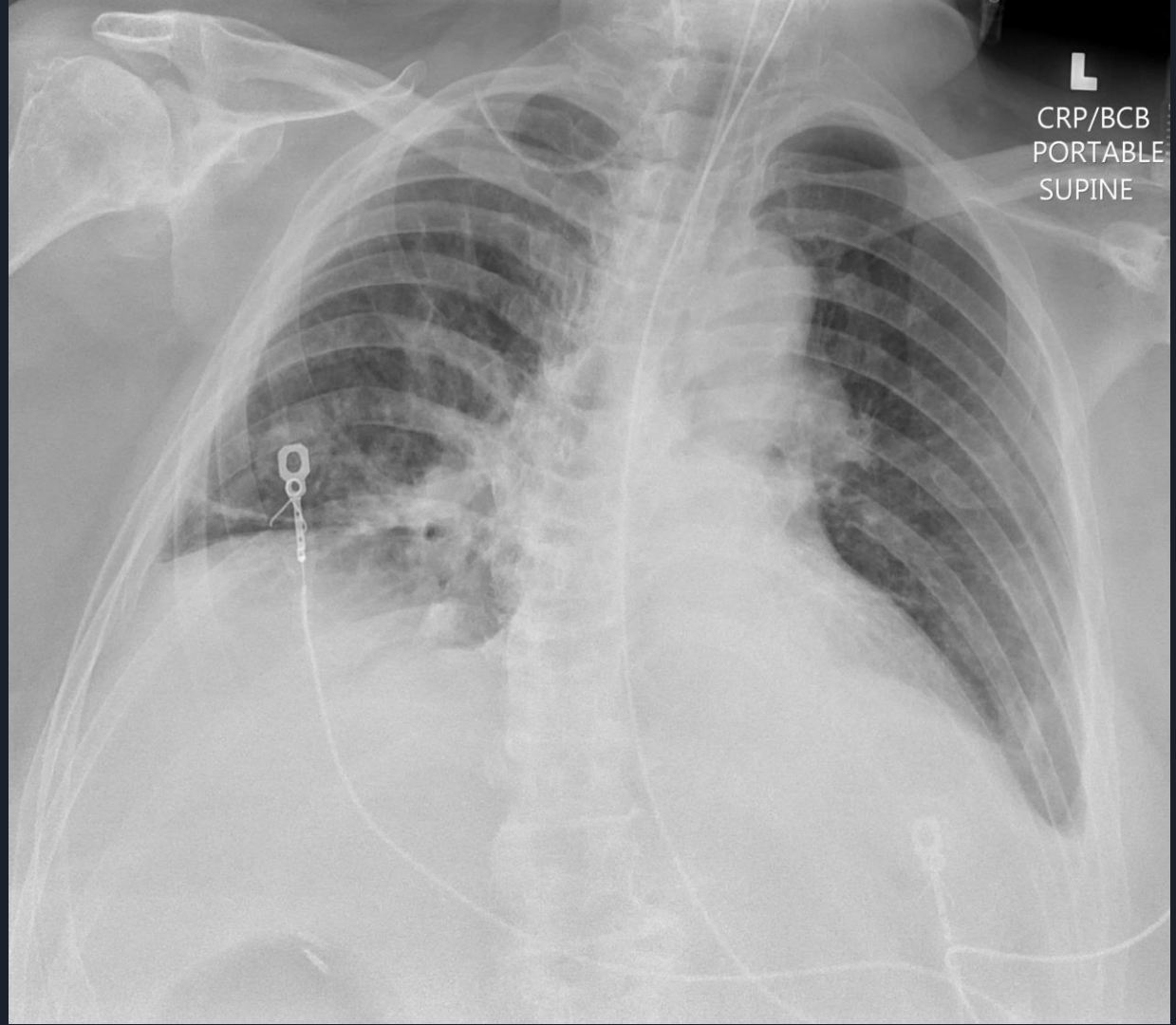


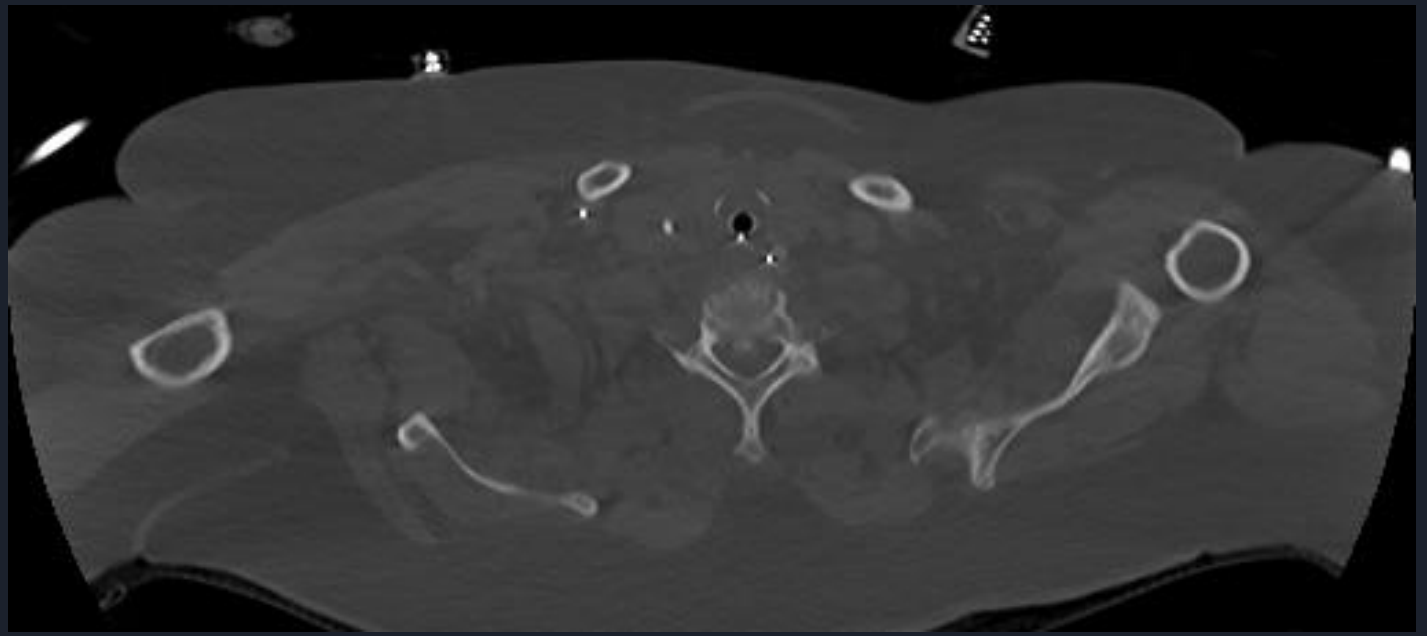
Discussion

- **Pneumomediastinum** is the presence of extraluminal gas in the mediastinum.
- **Mediastinitis** is inflammation of the mediastinal tissues.
- Common causes of pneumomediastinum:
  - trauma, iatrogenic (surgery, endoscopy, barotrauma), tracheobronchial perforation, pneumonia, descending retropharyngeal infections, esophageal perforation
- Acute mediastinitis is rare but has a high mortality:
  - esophageal perforation, descending retropharyngeal infection, or complication after cardiac surgery
- **CXR findings**:
  - abnormal collections of gas in the mediastinum which can be seen outlining the vessels, bronchial structures, pericardium, or tracking into the neck.
  - Medial pneumothorax can have a similar appearance.
- CT is far more sensitive.
- Treatment depends on underlying cause.

Case 6

- 68 year old female
- Line placement following code blue


L
CRP/BCB
PORTABLE
SUPINE



Diagnosis

- Malpositioned right internal jugular CVC

Discussion

- Many different types of and approaches for different supportive devices, which will be covered in more detail in another lecture.
- CVC Placement complications
  - pneumothorax, hemothorax, infection, arterial placement, venous malposition, retained guidewires or catheter fragments, perforation, mediastinal hematoma
- Optimal position:
  - mid SVC or at the cavoatrial junction.
  - Some exceptions include swan-ganz catheters and certain types of HD catheters.
- Venous malposition (as in this case)
  - generally a benign complication, can be resolved with re-positioning or replacement.
  - It can be problematic in certain circumstances. For example infusion of
  - caustic substances (chemotherapy, TPN) through small vessels may cause phelbitis
  - malpositioned hemodialysis catheters may not function (require high flow)
  - catheters deep in the RA/RV may cause arrhythmia, can lacerate RA in kids
- Other lines/tube complications, which will be covered in another module, can cause significant morbidity and mortality.

Thanks!

- Questions?