MAYO CLINIC

Mayo Clinic Center for Tuberculosis

TB as Seen on A Chest X-ray

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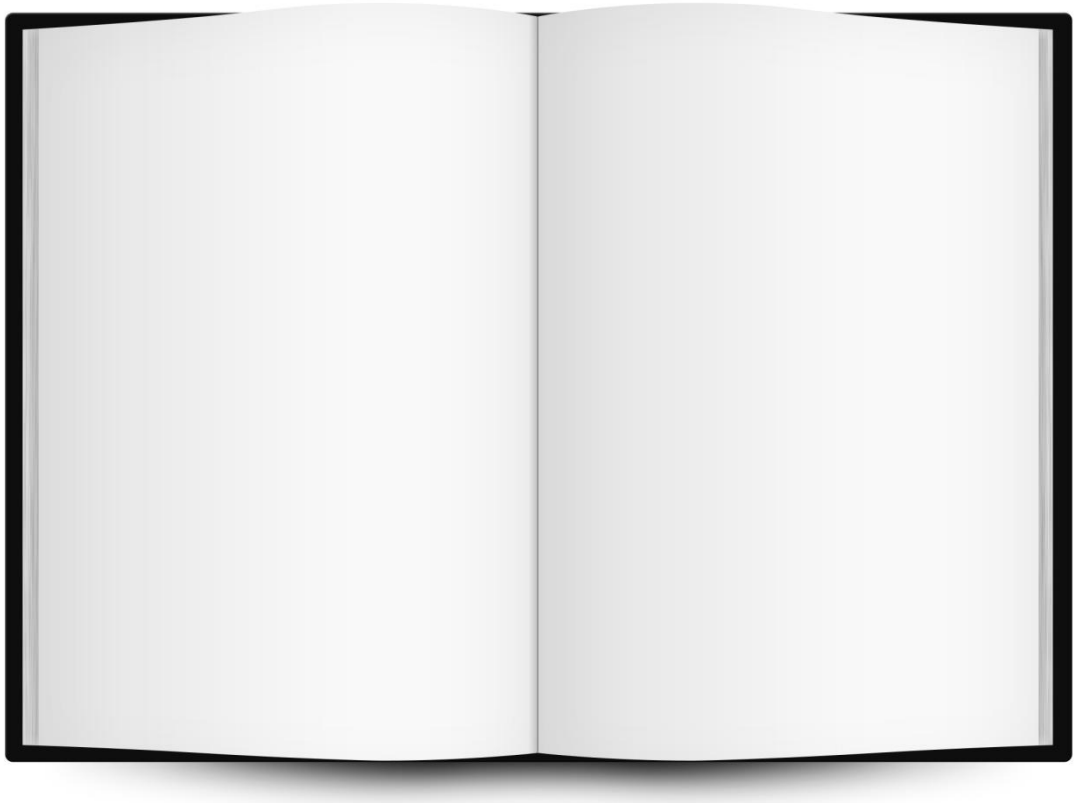
TB Tri-State Clinical Intensive, Dearborn, MI, September 29, 2016

Disclosures

- None relevant



Objectives

- You will
  - Be able to identify **major structures** on a normal chest x-ray
  - Identify and correctly name **major CXR abnormalities** seen commonly in TB
  - **Recognize chest x-ray patterns** that suggest TB & when you find them

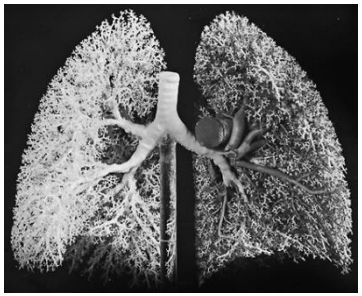
Basics of Diagnostic X-ray Physics

- X-rays are directed at the patient and variably absorbed
  - When not absorbed
    - Pass through patient & strike the x-ray film **or**
  - When completely absorbed
    - Don’t strike x-ray film **or**
  - When scattered
    - Some strike the x-ray film

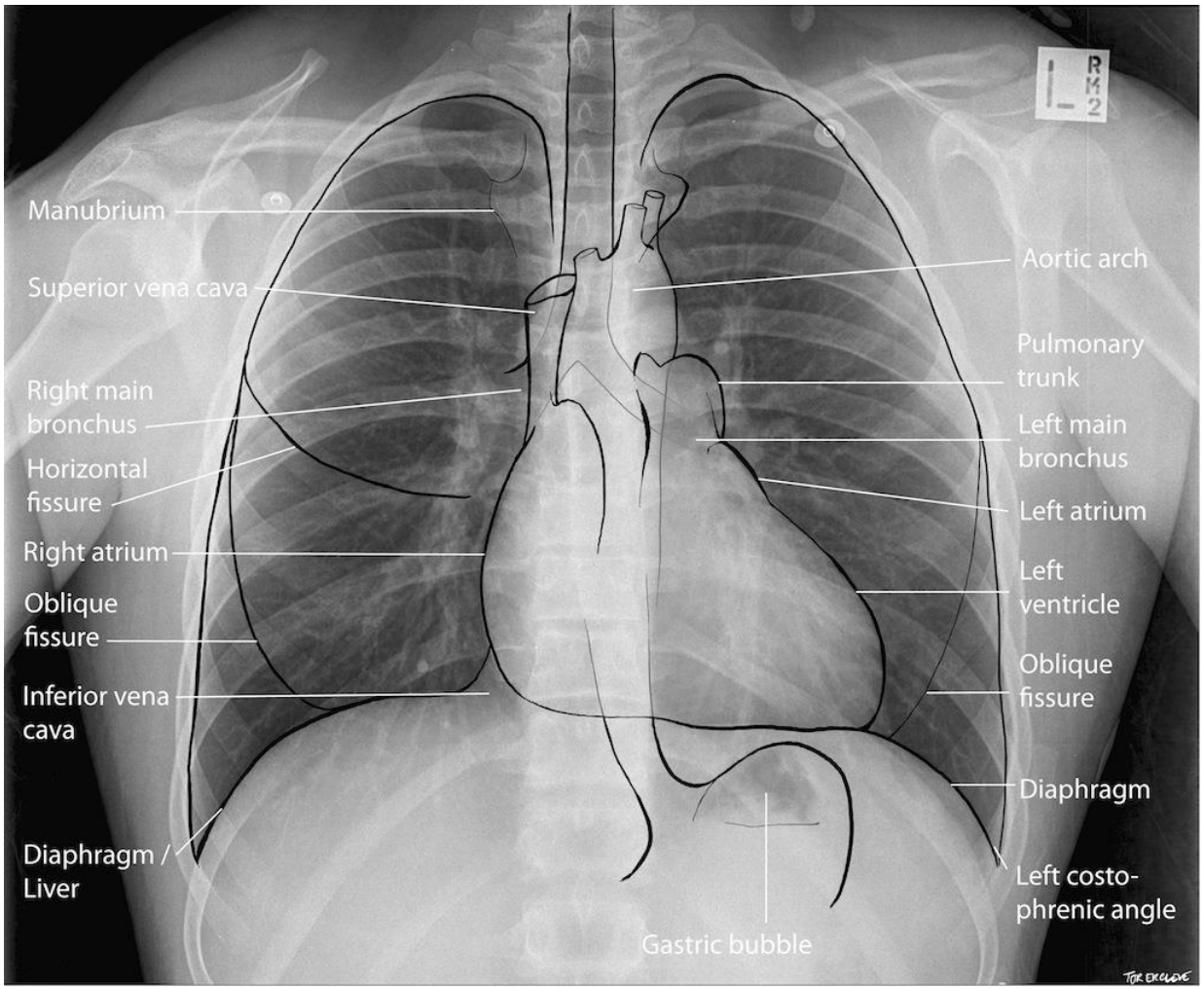
Absorption

- Absorption depends on the
  - Energy of the x-ray beam
  - Density of the tissue

Shade / Density

- Whitest = Most Dense
  - Metal 
  - Contrast material (dye)
  - Calcium
  - Bone 
  - Water
  - Soft Tissue 
  - Fat
  - Air / Gas
- Blackest = Least Dense

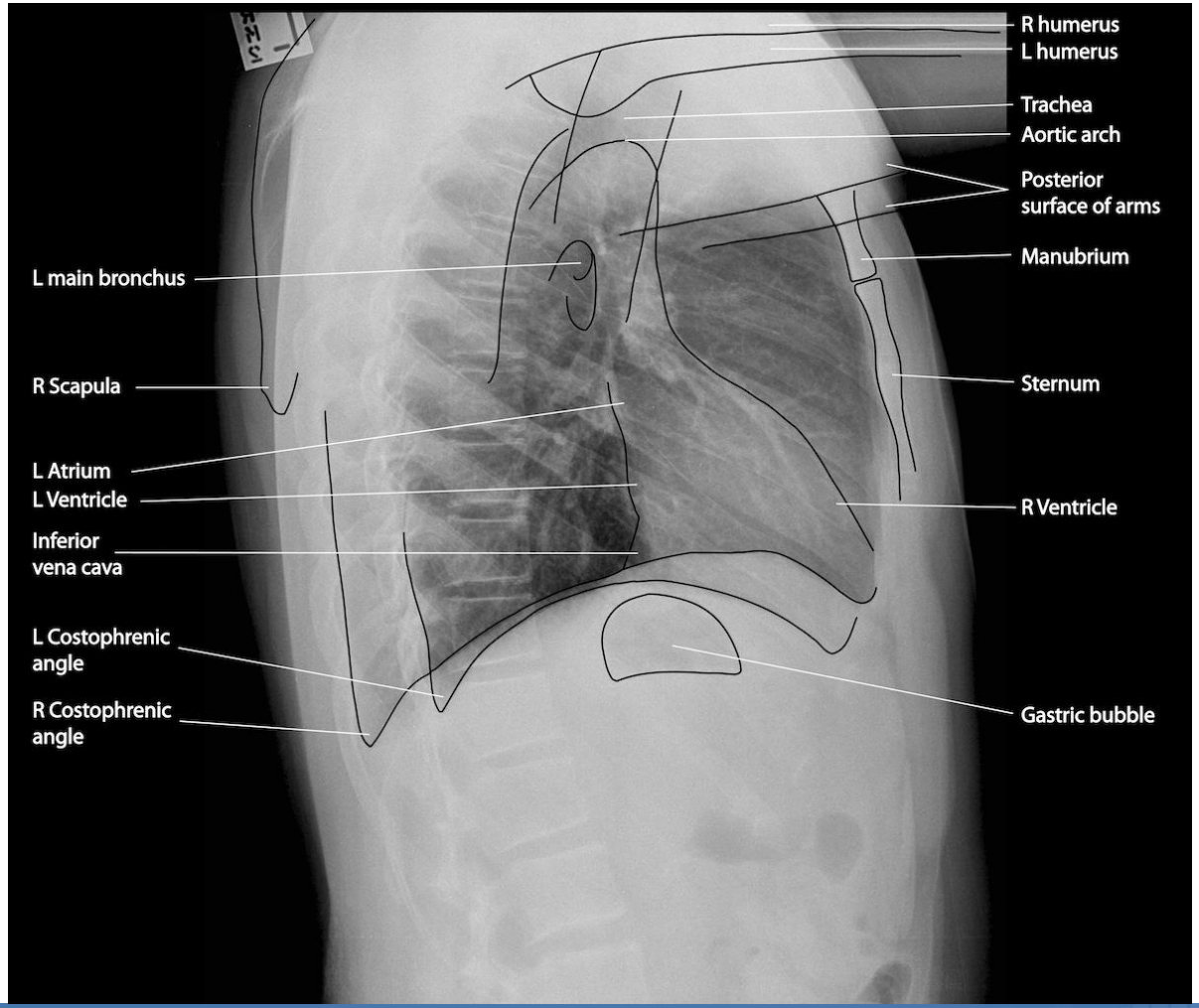
Normal Frontal Chest X-ray: Posterior Anterior



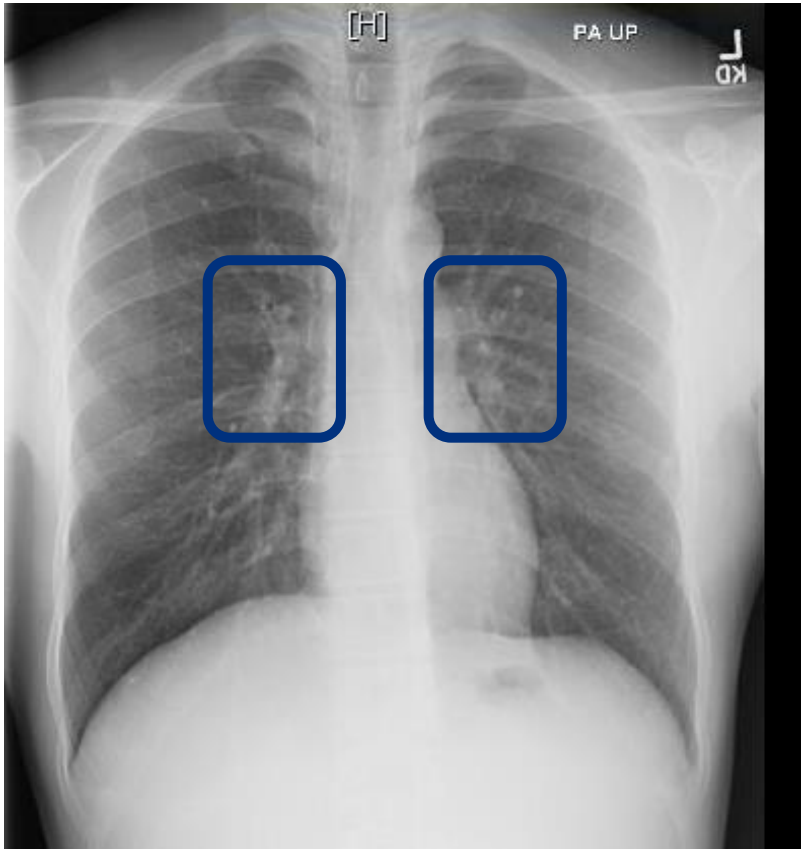
Note <u>silhouette</u> formed by
- lung adjacent to heart
- lung adjacent to diaphragm

Silhouette Sign

Normal Lateral Chest X-ray

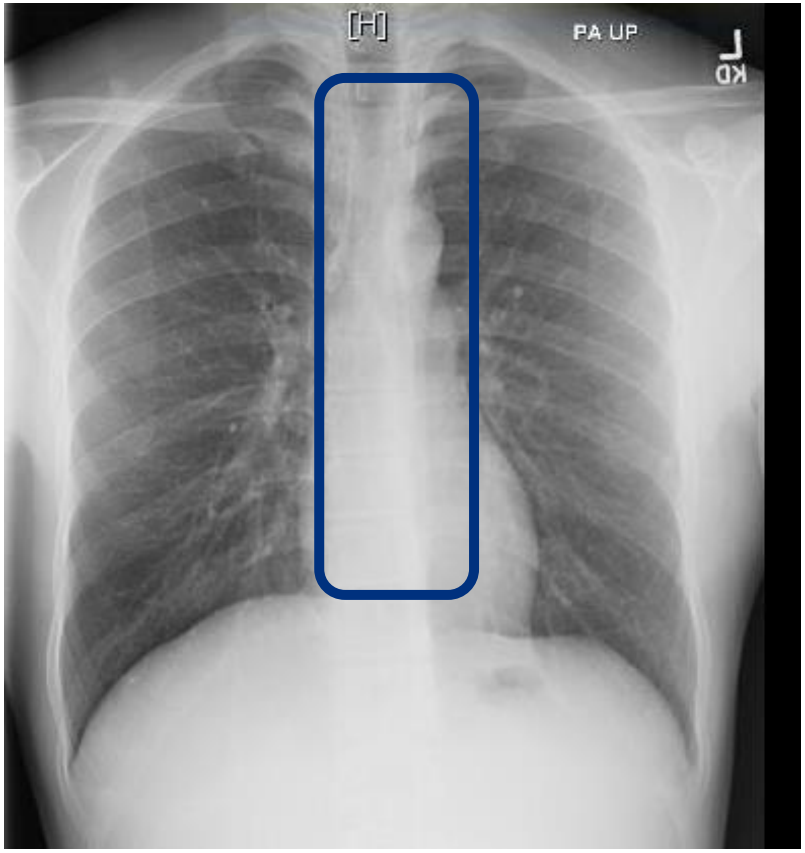


Normal PA & Lateral X-ray: Hilum



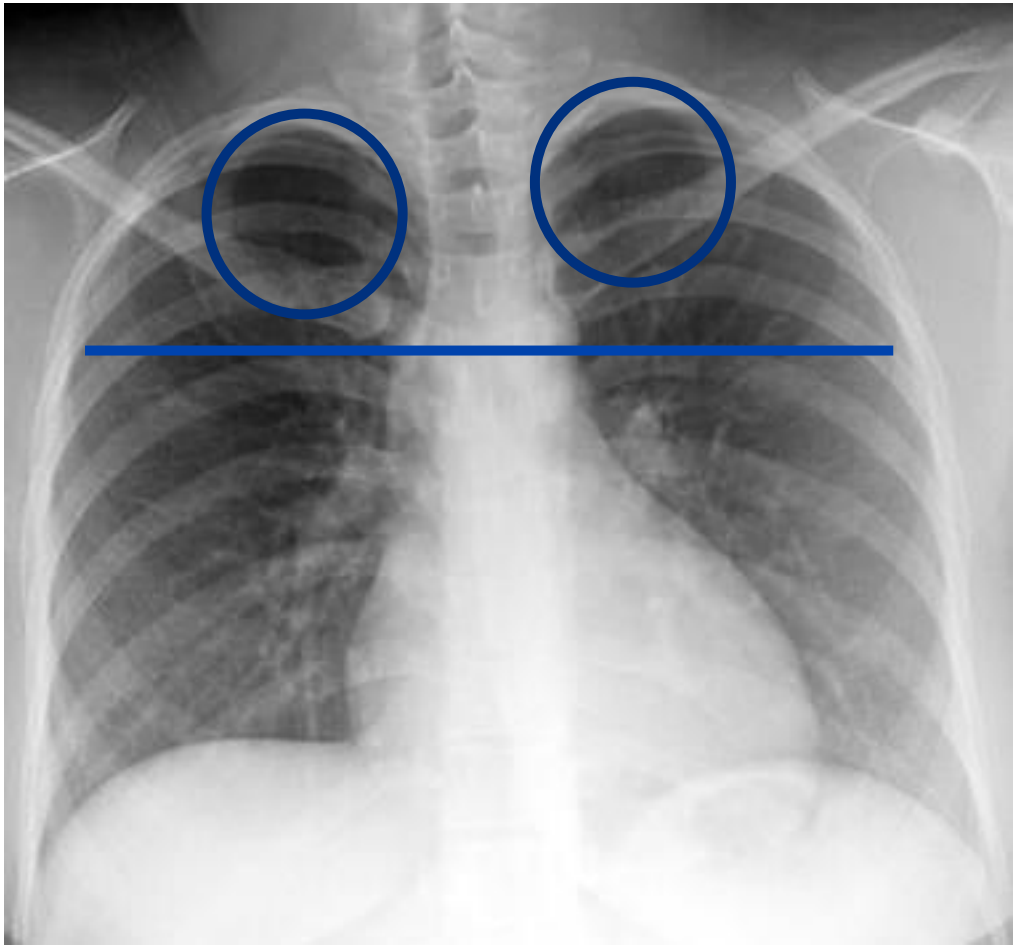
<u>Hilum</u> – Major bronchi, Pulmonary veins & arteries, Lymph nodes at the root of the lung)

Normal PA & Lateral X-ray: Mediastinum

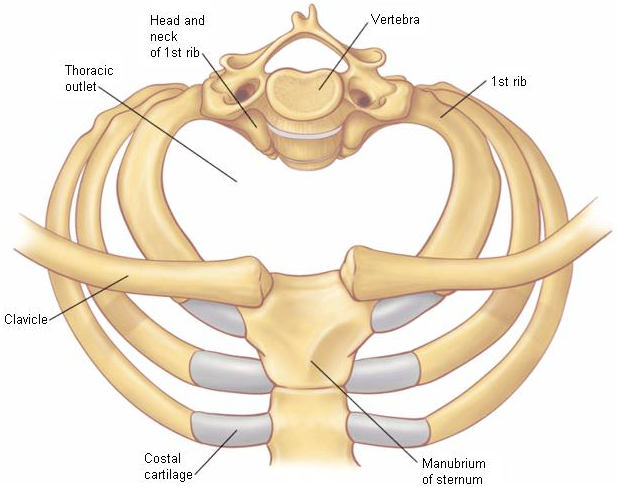


<u>Mediastinum</u> – Central chest organs (not lungs) – Heart, Aorta, Trachea, Thymus, Esophagus, Lymph nodes, Nerves (between 2 pleuras or lining of the lungs)

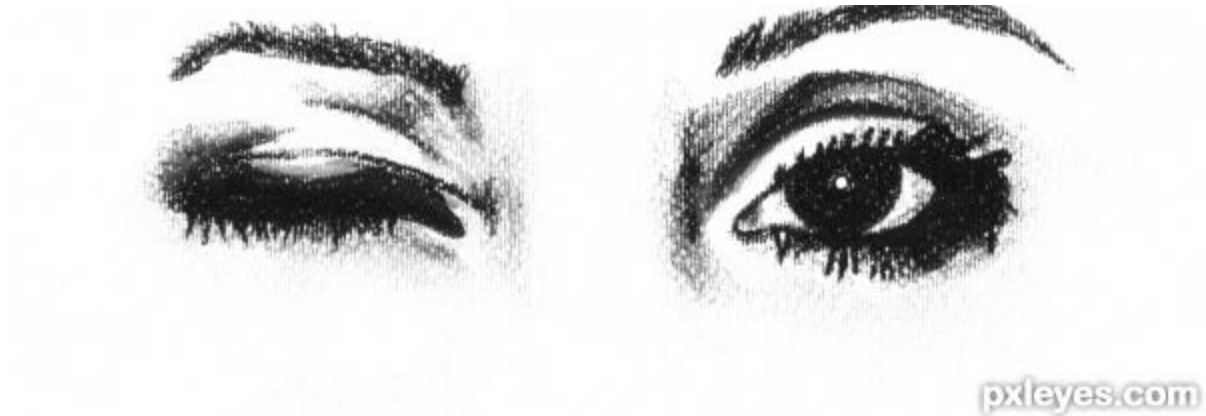
Normal PA & Lateral X-ray: Apex

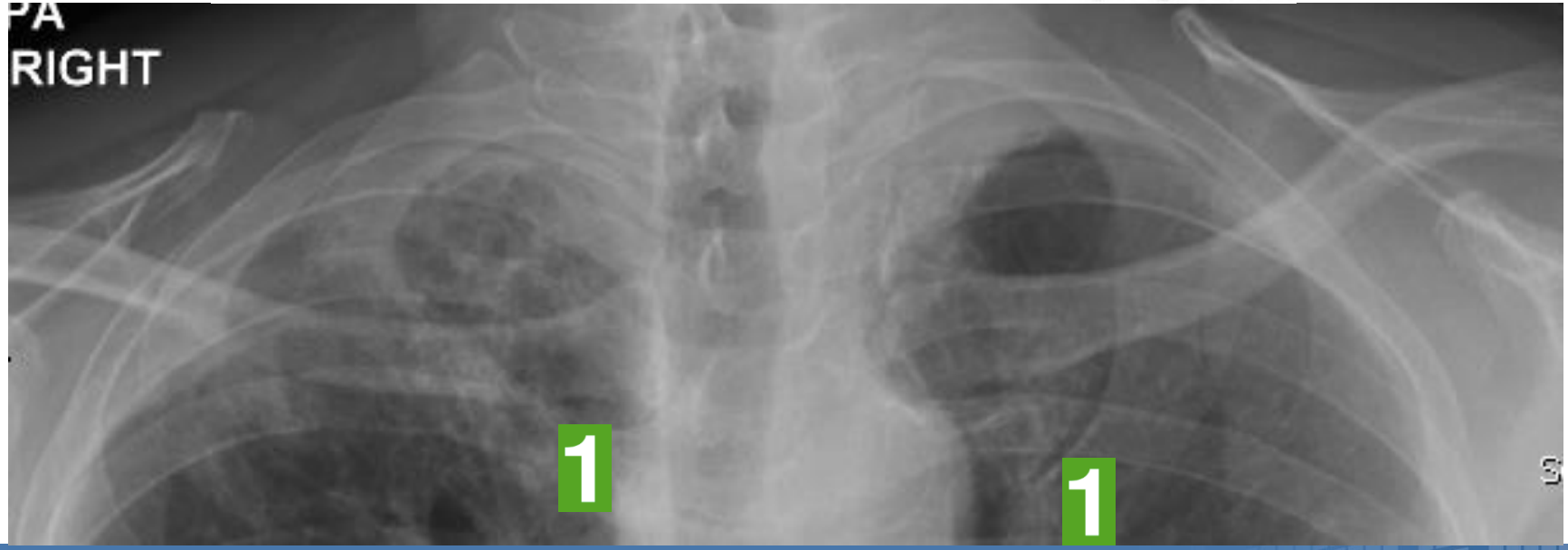


- Apex of lung
  - Area of lung above the level of the anterior end of the 1st rib

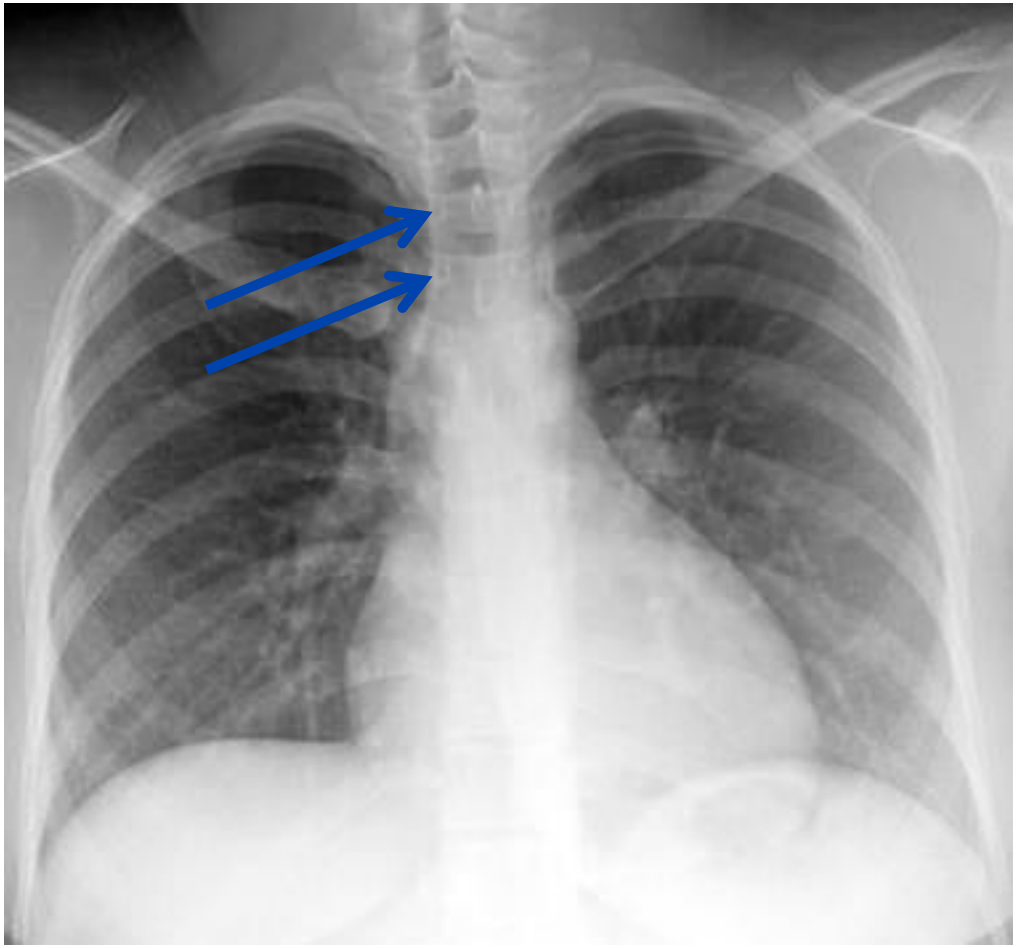


Wink Sign: Apex





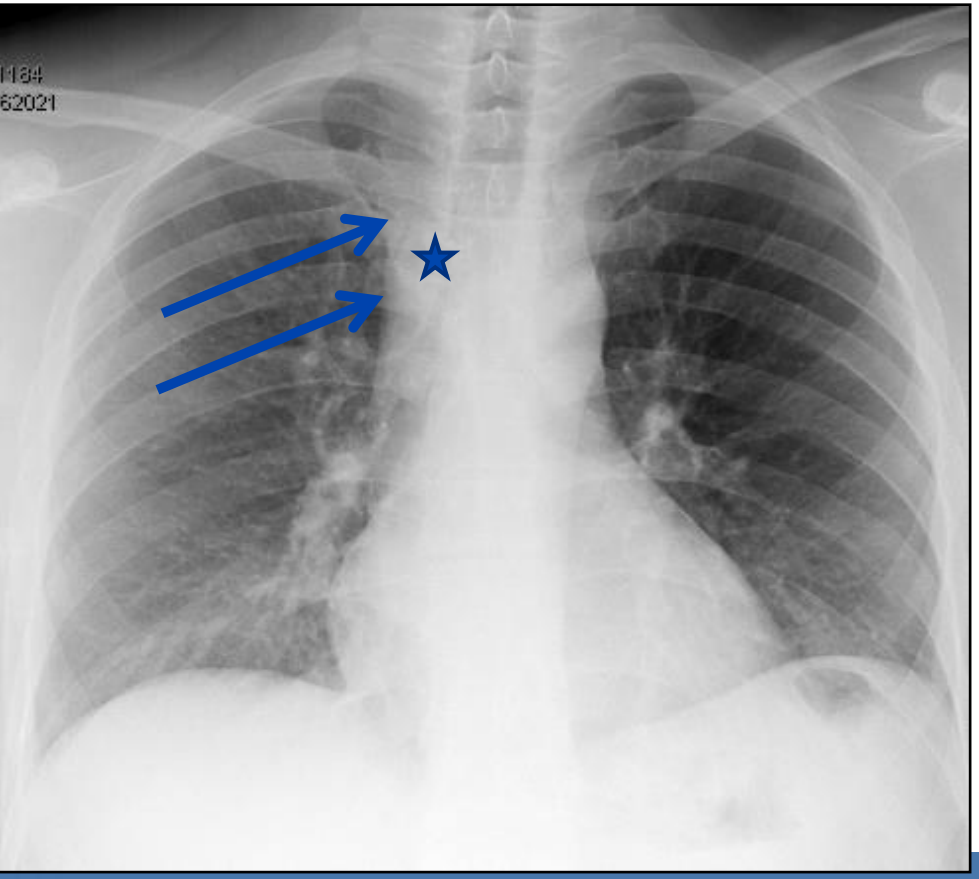
Normal PA & Lateral X-ray: Right Paratracheal Stripe

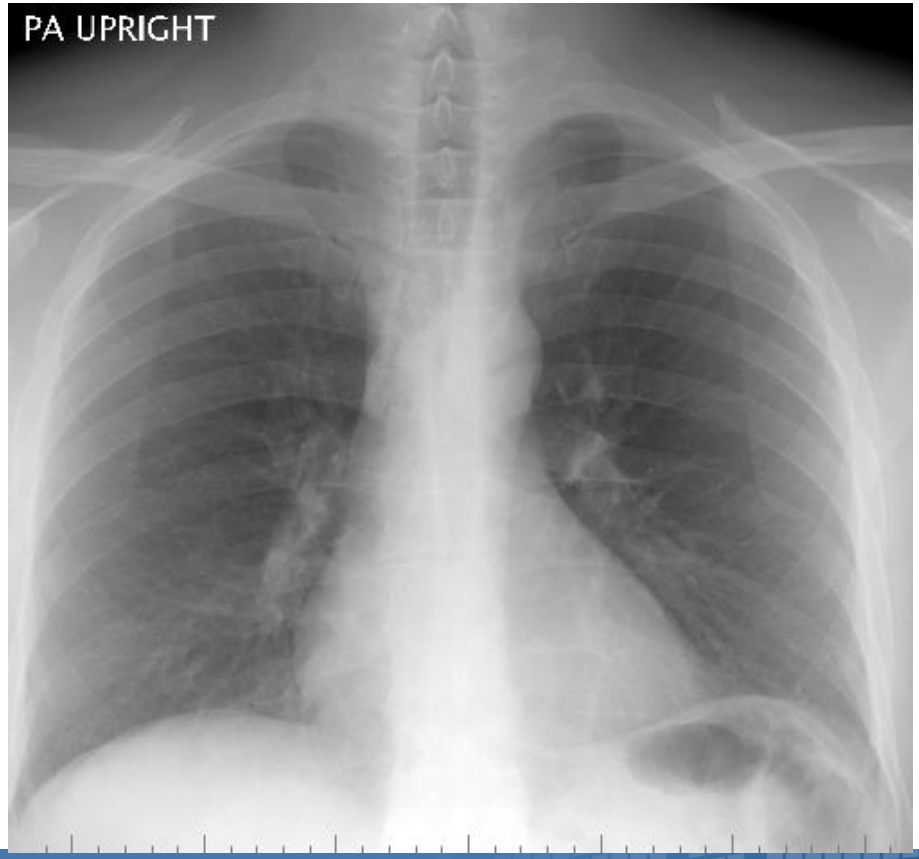


- Paratracheal stripe
  - Seen between the air in the trachea & air in the lung

50 Year Old Iraqi, Fevers

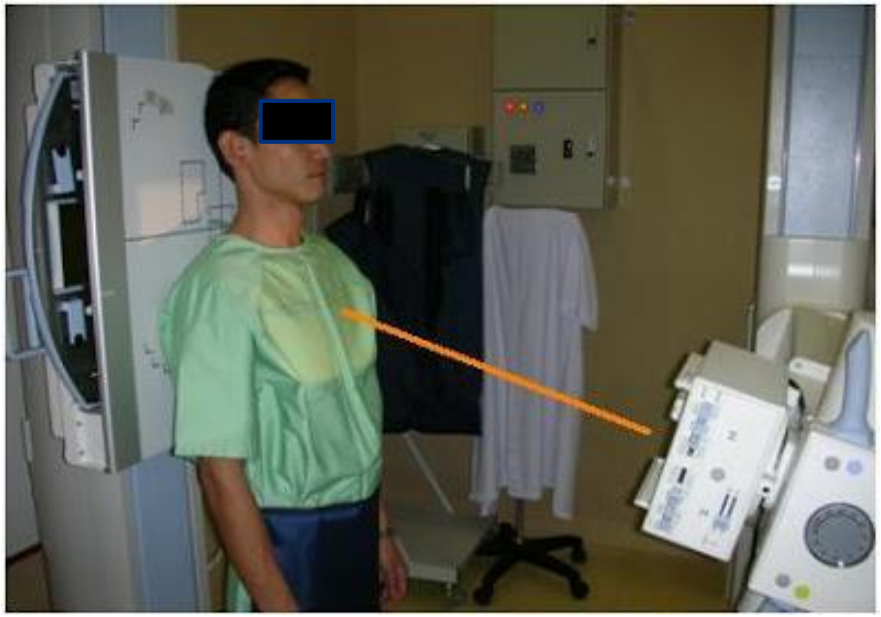
- At Diagnosis
- At End of Treatment





Special Methods of Detection for Apical Lesions

- AP Lordotic (AKA “Apical Lordotic”)
  - Lift ribs & clavicle off lung lesions

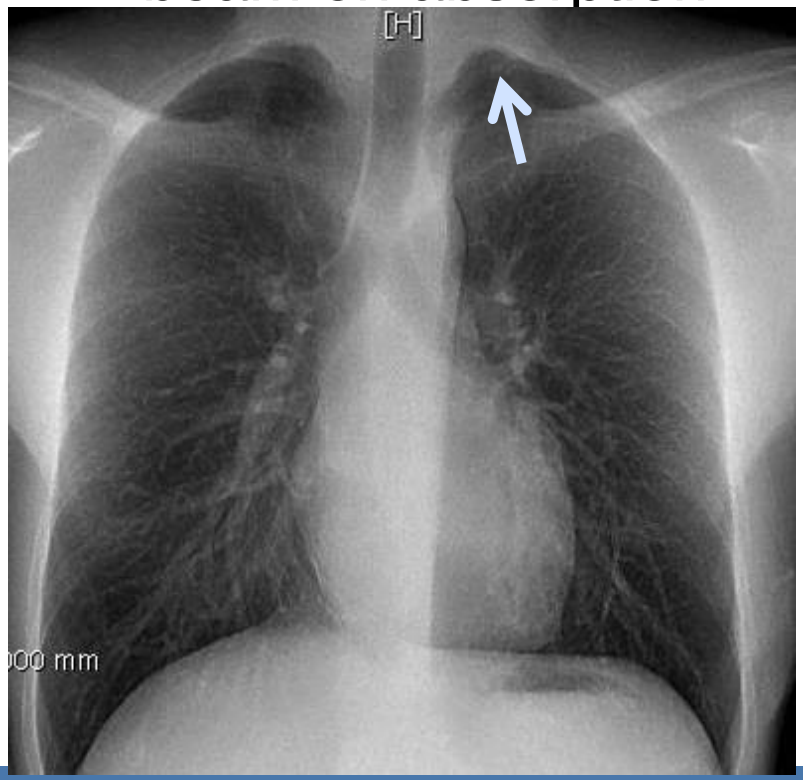


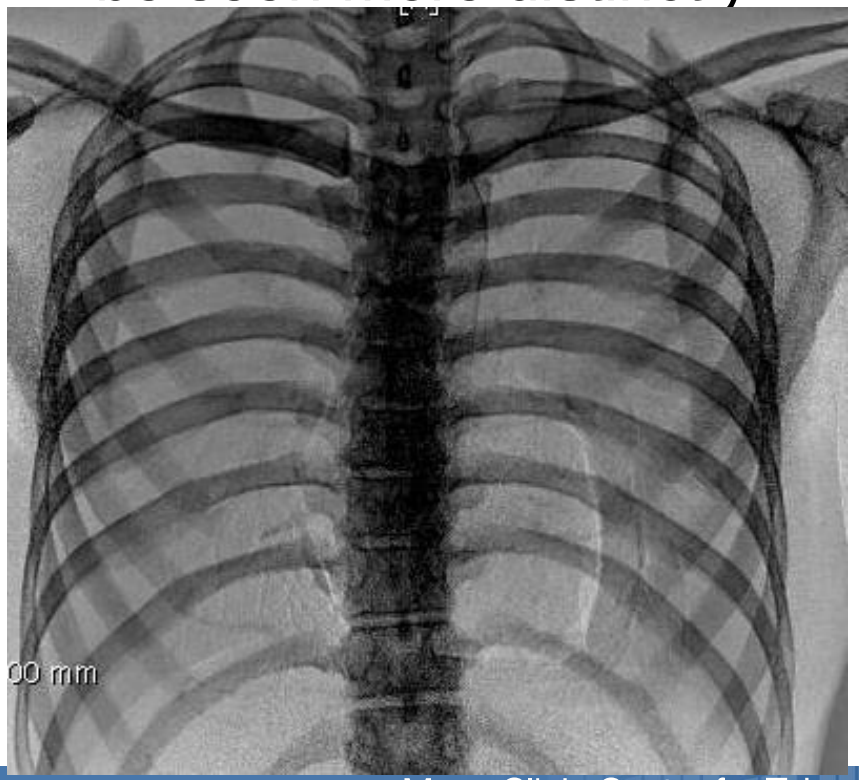
AP Lordotic for Clarifying Apical Lesions

- Standard PA Chest X-ray
- AP Lordotic Chest X-ray

Dual Energy Digital Subtraction Techniques: Useful for nodules

- Takes advantage of the effect of energy of x-ray beam on absorption.
- Dual Energy Technique can make bones fade or be seen more distinctly





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TB Radiology Image Library

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The TB Image Library is a joint project of the Curry International TB Center and Firland Northwest TB Center as an educational resource to share radiographic images related to tuberculosis.

- Individuals may use this site to gain an appreciation for the broad spectrum of presentation TB may have using various imaging modalities.
- The library images are free to download for non-commercial educational purposes only. All images should be credited in the format: CITC/Firland TB Image Library; contributor.
- To contribute images or offer comments/feedback/questions, please email: CurryTBcenter@ucsf.edu

Basic TB Chest abnormalities and patterns of disease

Consolidation/Opacities	**Cavitations/Cysts**	**Linear opacities/Fibrosis**
Nodules/Masses	**Miliary pattern**	**Lymphadenopathy**
Pleural abnormalities	**Trancheobronchial abnormalities**	

currytbcenter.ucsf.edu/sites/default/files/product_tools/tbradlibrary/category6.html

Consolidation

- Appears as a relatively homogeneous white area on chest x-ray
- Although the terms opacity and density are sometimes used, areas of consolidation are usually translucent; structures such as ribs are visible through the consolidation
- Is caused by filling of airspace with fluid, cells, pus, blood
- Without significant volume loss

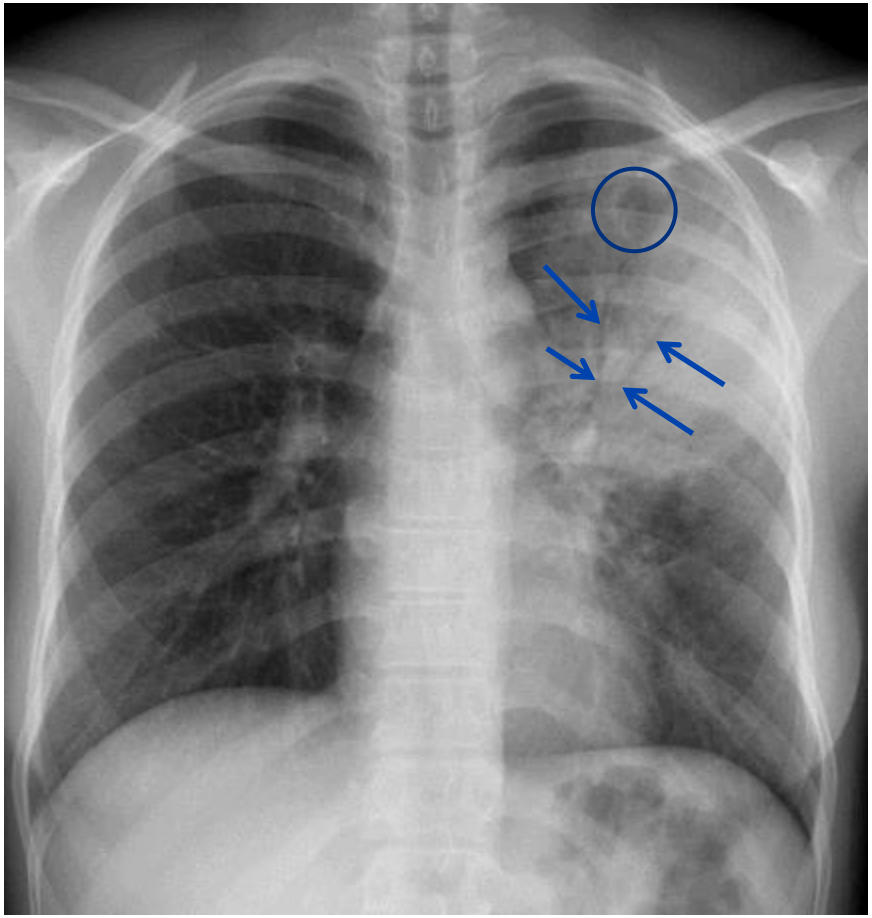
Consolidation

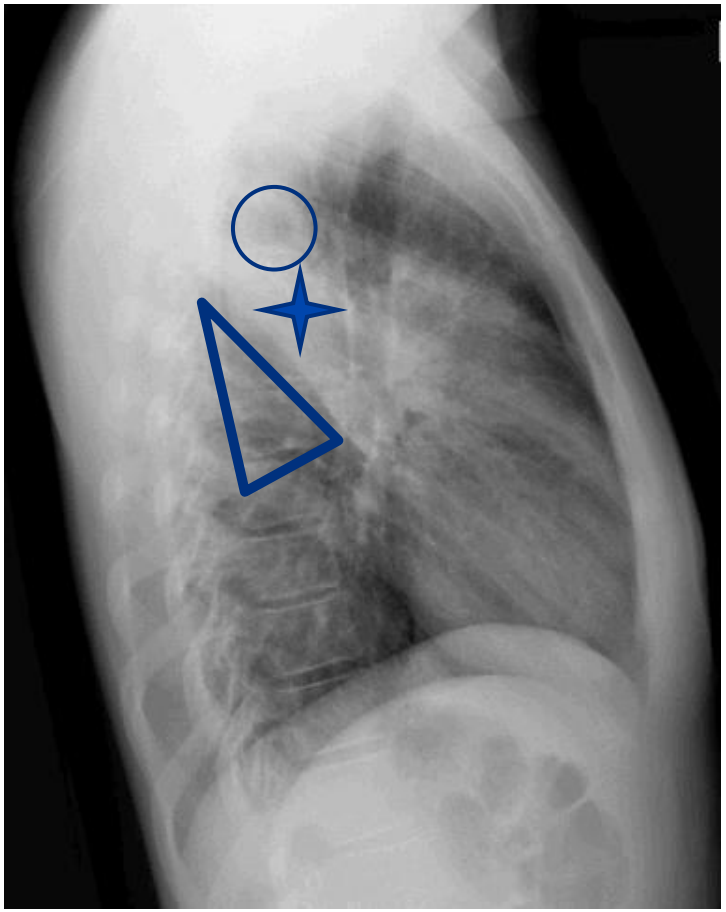
- Air bronchogram may be visible because air in the bronchus forms a silhouette with fluid in airspace (characteristic of consolidation; not always present).
- Silhouette sign occurs when opacity is contiguous with heart or diaphragm, causing loss of normal silhouette

Consolidation / Opacity / Density

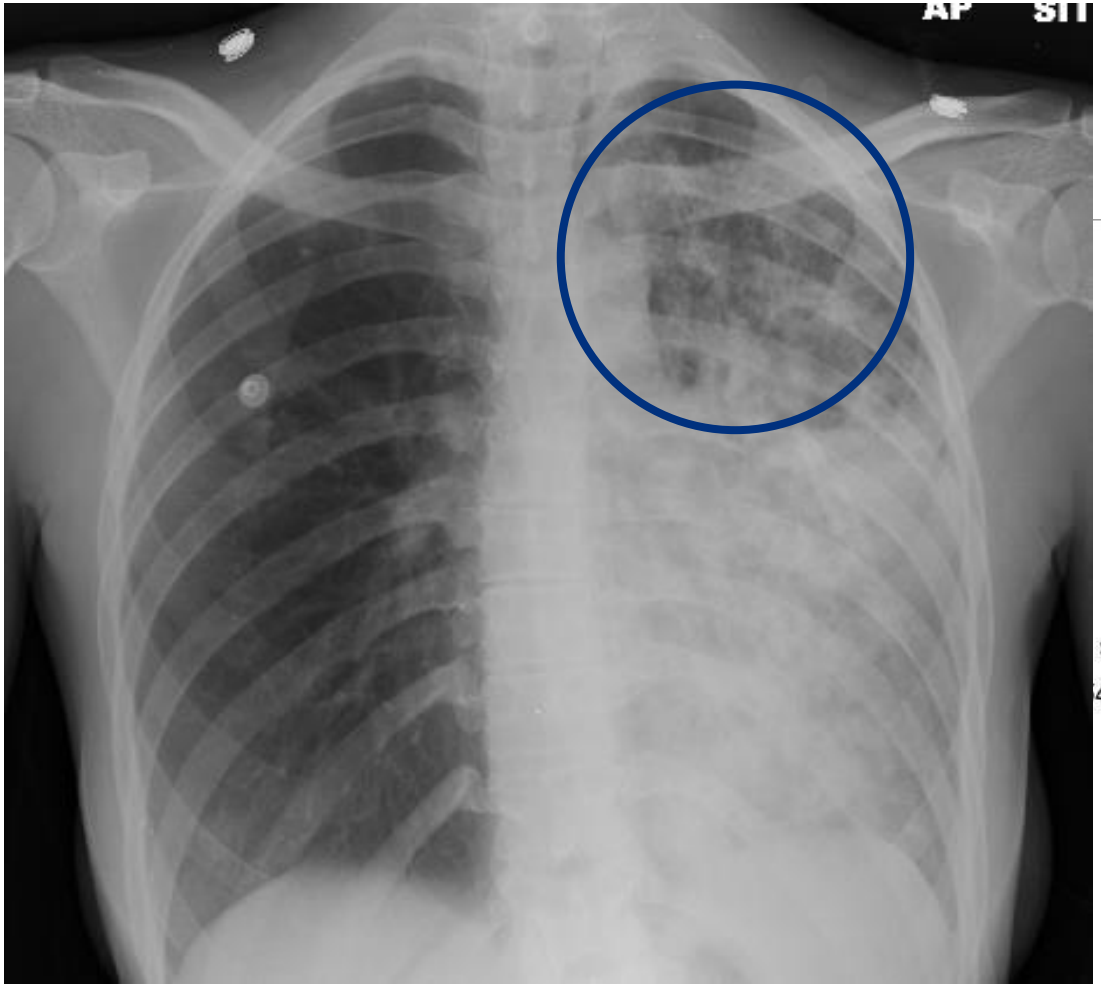
- The initial lesion in primary TB can be in any location in the lung
- In later (“reactivation”) TB, location is most frequently in the upper and posterior portions of the lung
  - Apical and posterior segments of the right upper lobe
  - Apical-posterior segment of the left upper lobe
  - Superior segments of the lower lobes

Consolidation, Air Bronchogram
Left upper lobe apical-posterior segment

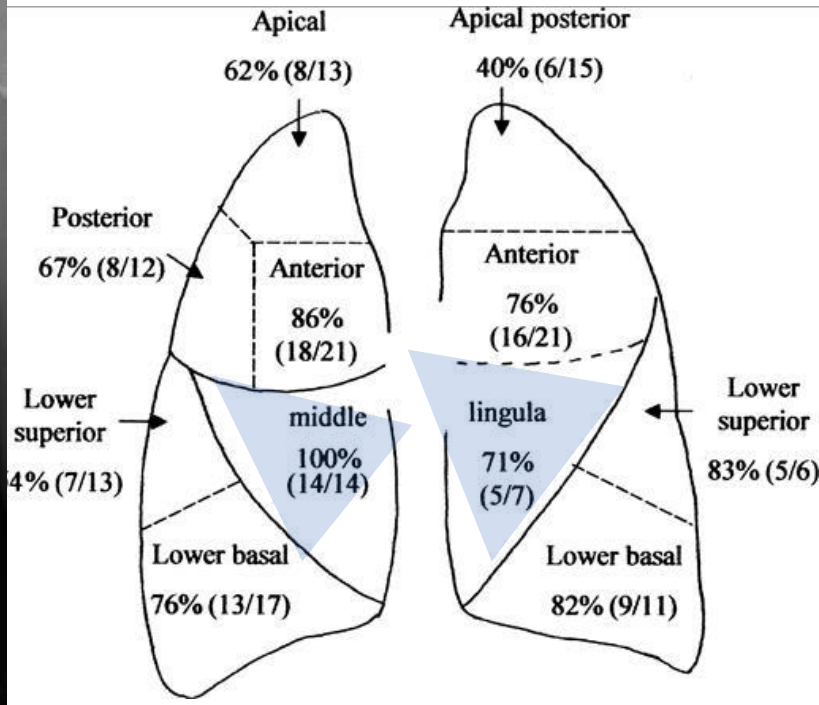




Silhouette Sign (no heart) & More
21 year old, severe agoraphobia



Lingula



Nodules / Masses

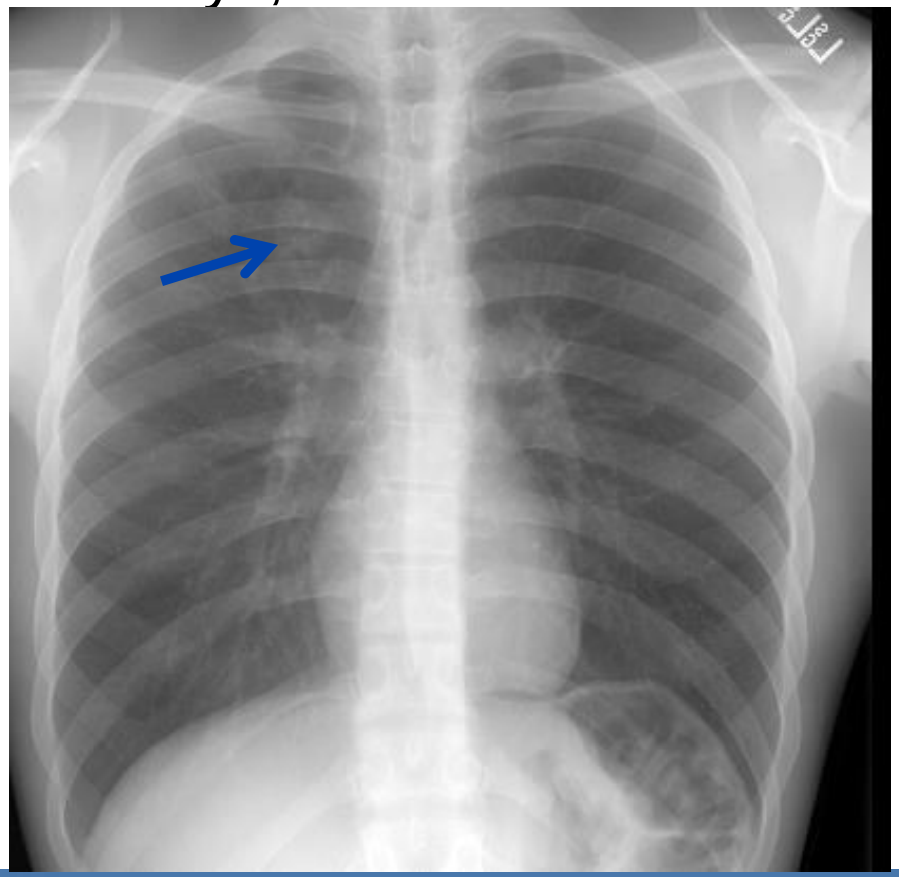
- Nodule - discrete opacity or density that is 2-30 mm in diameter
- TB nodules can be
  - Solitary
  - Multiple
  - Associated with other chest x-ray abnormalities due to TB
- A common pattern for primary TB is a nodule (the primary focus of infection) plus ipslateral enlarged mediastinal or hilar lymph node(s)

Nodules / Masses

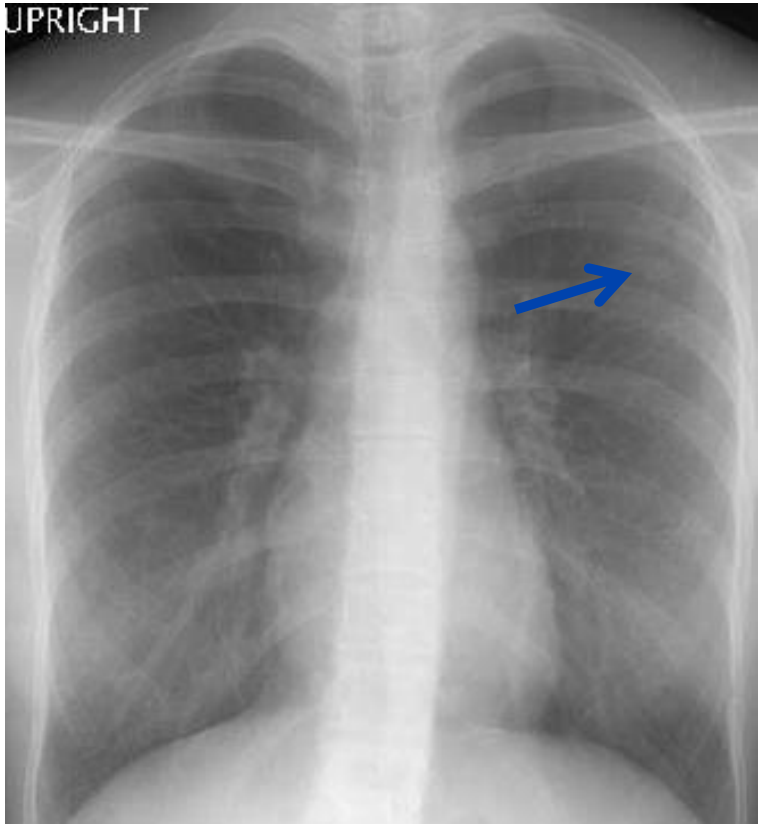
- TB nodules
  - Can cavitate (form cavities)
  - Calcify when they heal
- A mass is larger than a nodule and is not typical of TB

Screening for TB in High Risk Individuals

- 22 year old, cough for 4 days, contact of case



- Health Care Worker with + TB skin test 1 year earlier

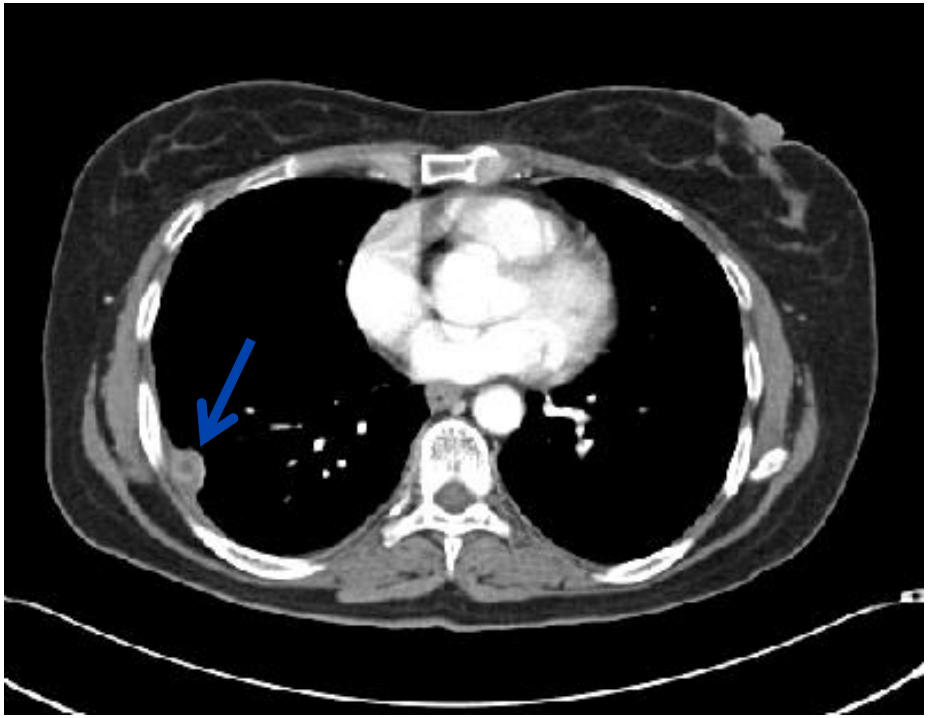


TB and Solitary Nodule

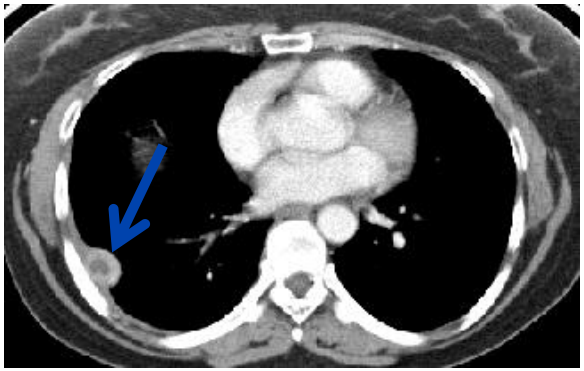
- Patient with metastatic colon cancer. Wife treated for TB. Patient had + TST; never treated

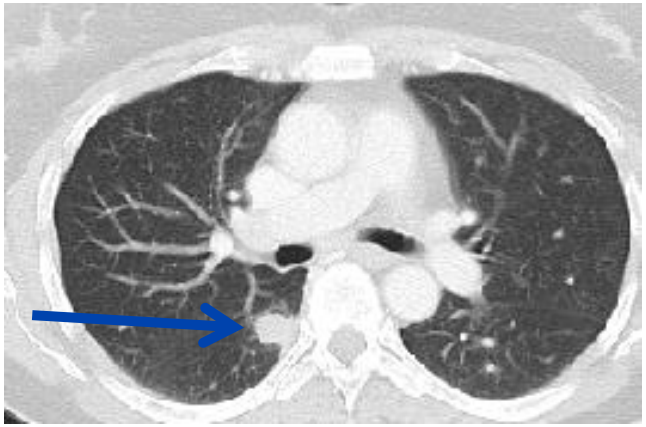
46 Year Old Bangladeshi Woman with: Poorly Controlled Diabetes – "Tuberculoma"

- 1st CT Scan – note rim enhancement, central low attenuation

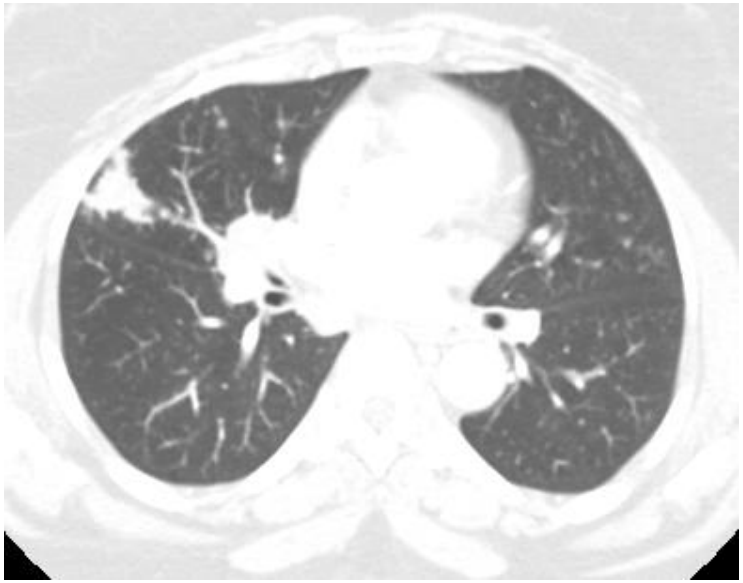


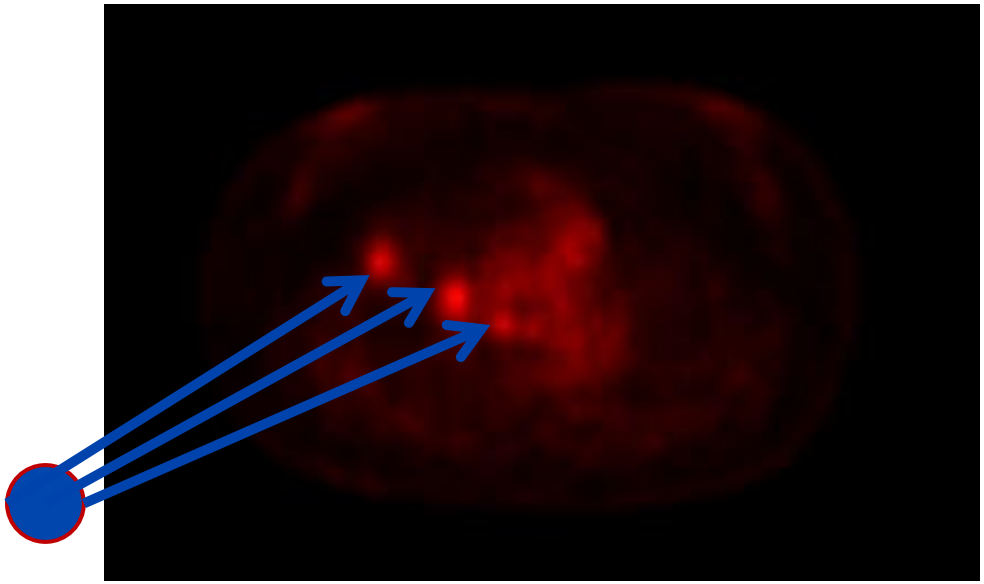
- 6 Weeks Later





PET Scans do NOT Differentiate TB from Cancer: This Patient had TB





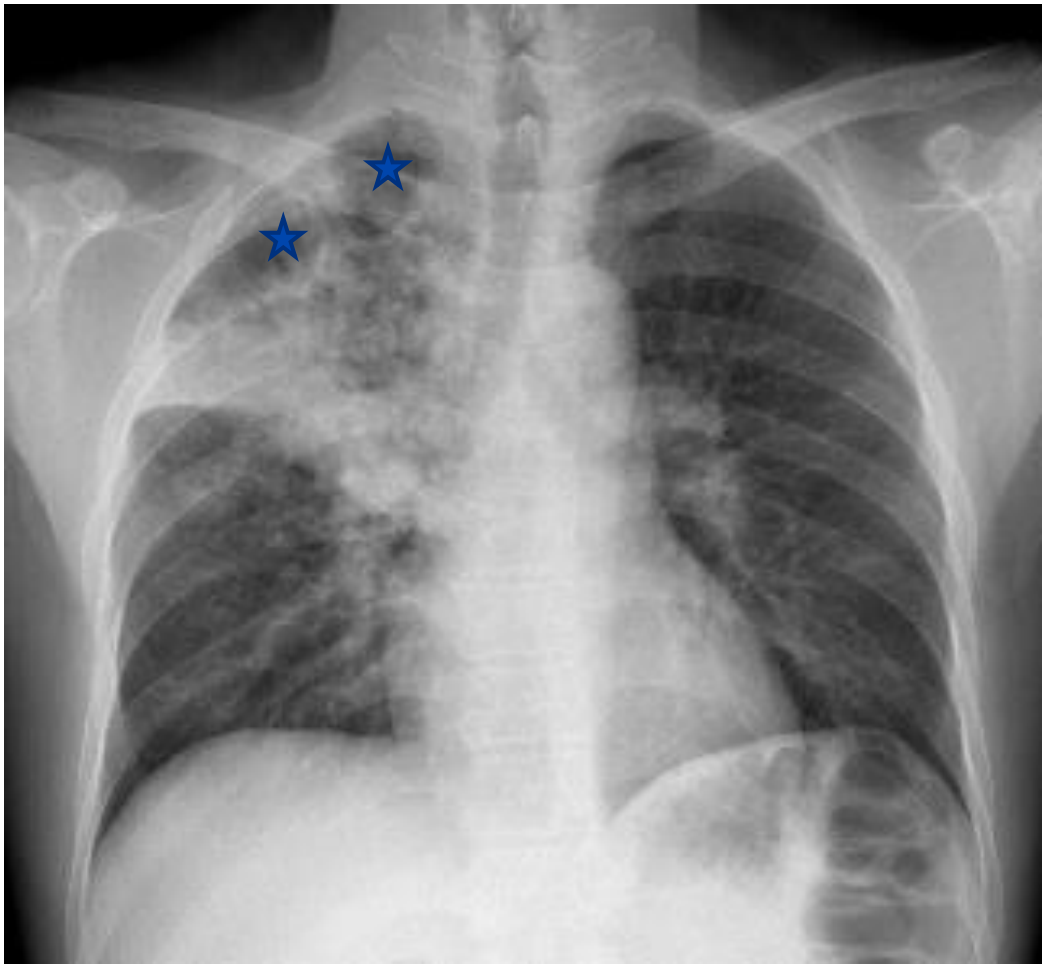
"FDG avid pulmonary nodule in the right middle lobe, along with two FDG avid lymph nodes involving the right hilum and subcarinal region. Findings suspicious for malignancy."

Cavities

- Most common in advanced disease (reactivation TB)
- Highly contagious, contain many actively multiplying organisms
- Endobronchial spread to other areas of lung
- Higher risk of developing drug resistance
- May take longer to treat
- Wall thickness thin to medium
- Significant air / fluid levels are rare

Cavities: Think Swiss Cheese

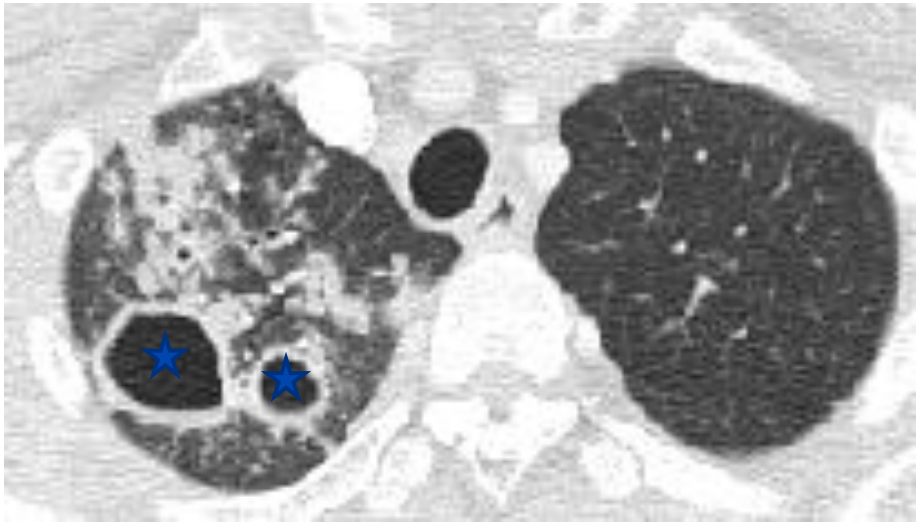
Young Man from Vietnam: Negative TB skin test, T-Spot, and QFT

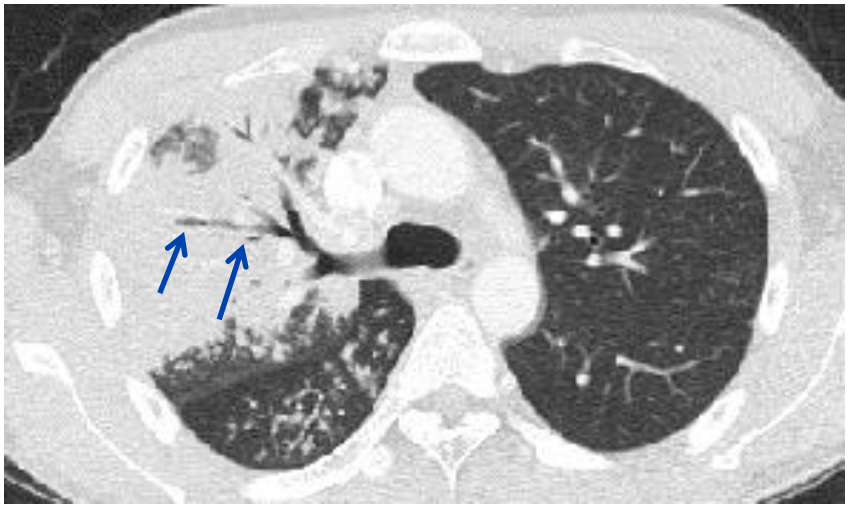


Young Man from Vietnam: Negative TB skin test, T-Spot, and QFT

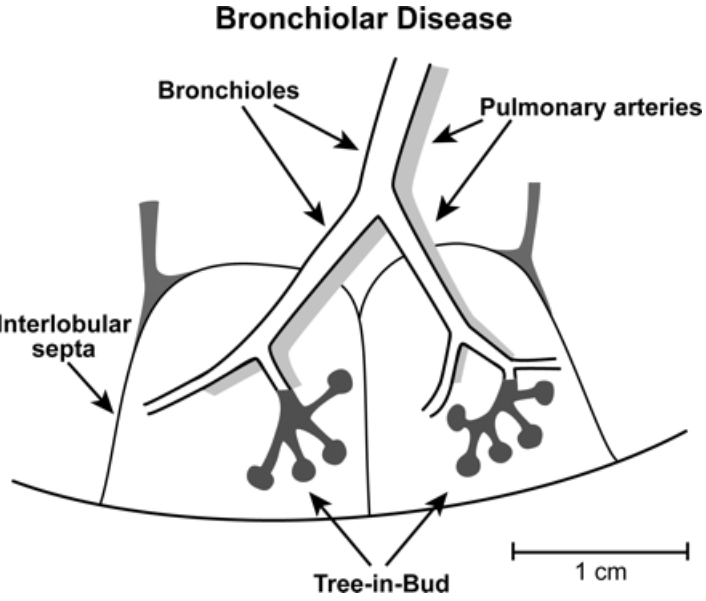
Multiple Findings on CT Scan

- Cavities, consolidation with air bronchograms, nodules, “tree-in-bud” densities

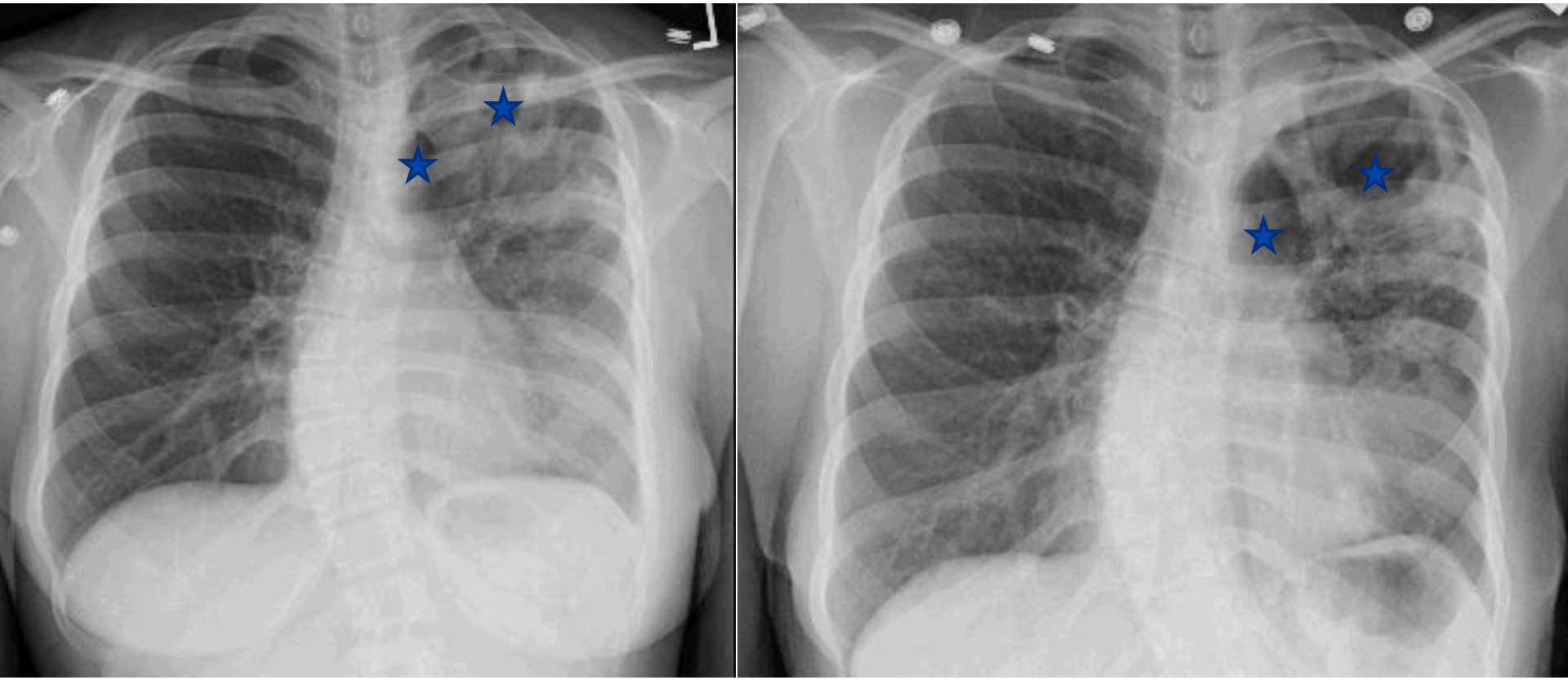




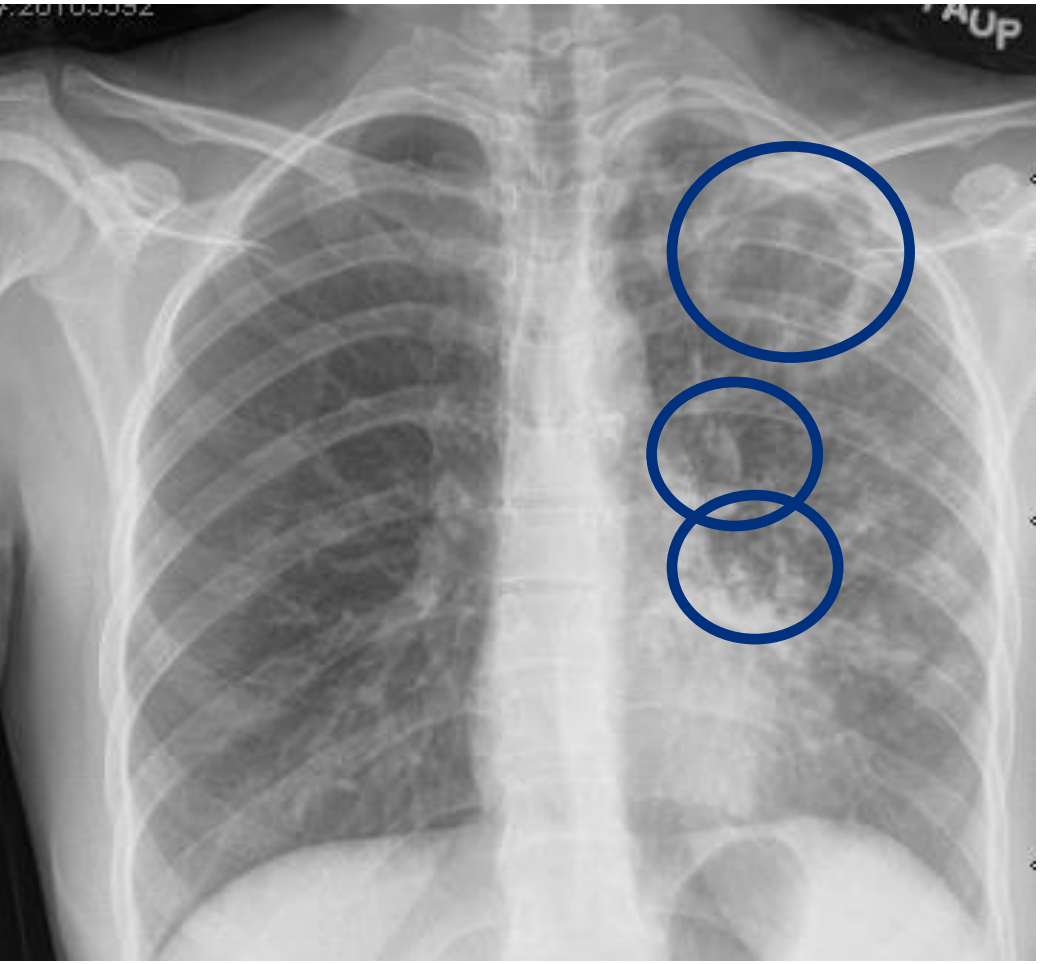
Tree-in-Bud



Young Woman Treated for Pneumonia And 6 Months Later



26 Year Old Woman from Yemen
Hemoptysis, Fever, Weight Loss



26 Year Old Woman from Yemen
Hemoptysis, Fever, Weight Loss

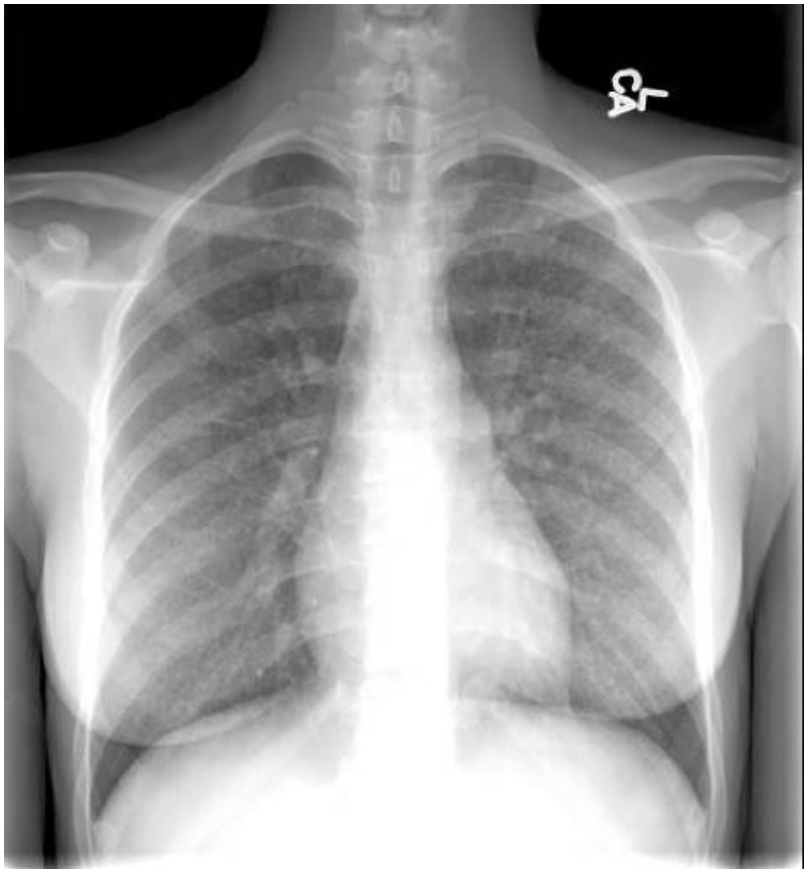
Miliary TB

- Disseminated disease
- *Usually* occurs during initial (primary) infection with hematogenous spread of MTB
- Uniformly distributed nodules ~ 2 mm. in size
- May progress to septic shock and acute respiratory failure
- After infection, miliary TB &/or meningitis occur in ~ 10-20% of babies < 1 year old

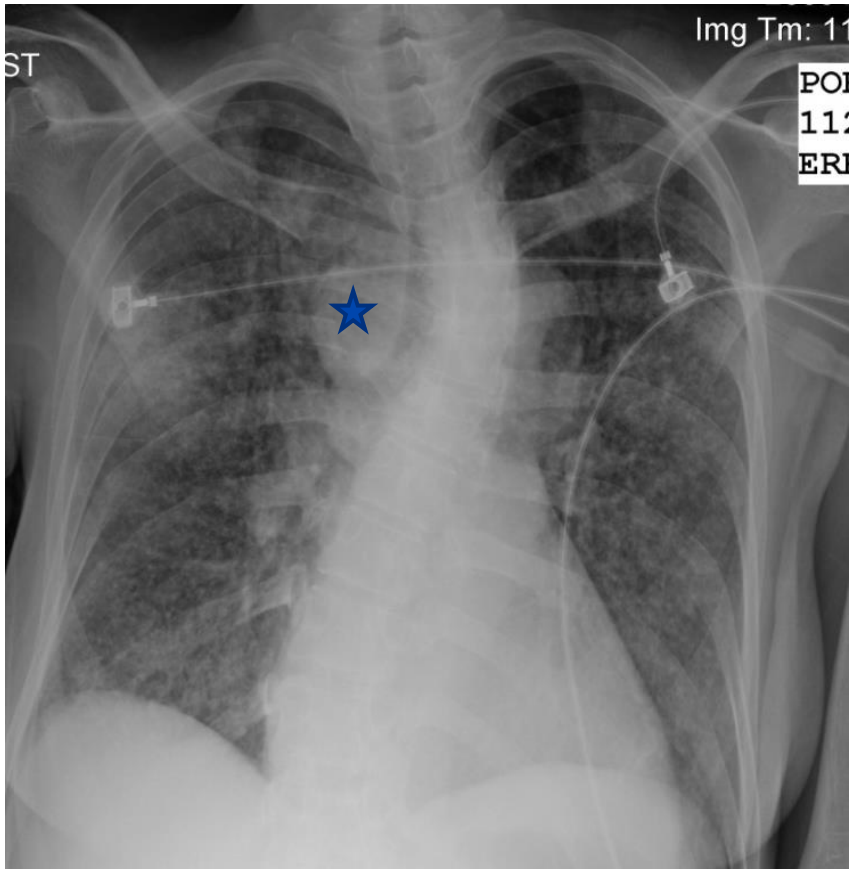
NEJM – New@NEJM.org Oct, 2013

Miliary Pattern

- 15 year old with disseminated MDR TB

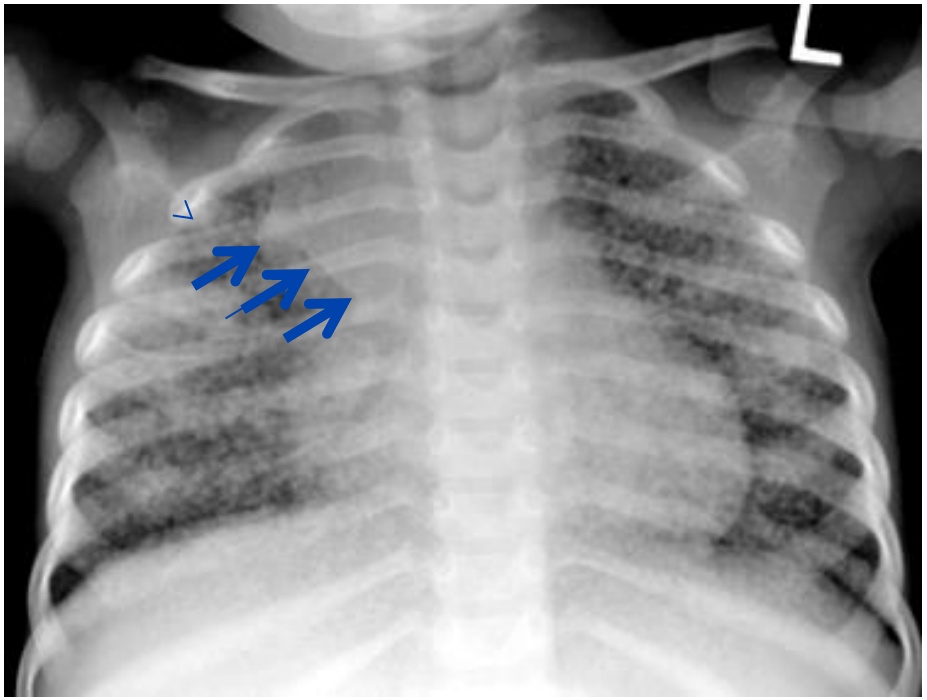


- Substance abuser, treated with prednisone for misdiagnosis of sarcoidosis



Miliary TB

- Courtesy of George D. McSherry, MD



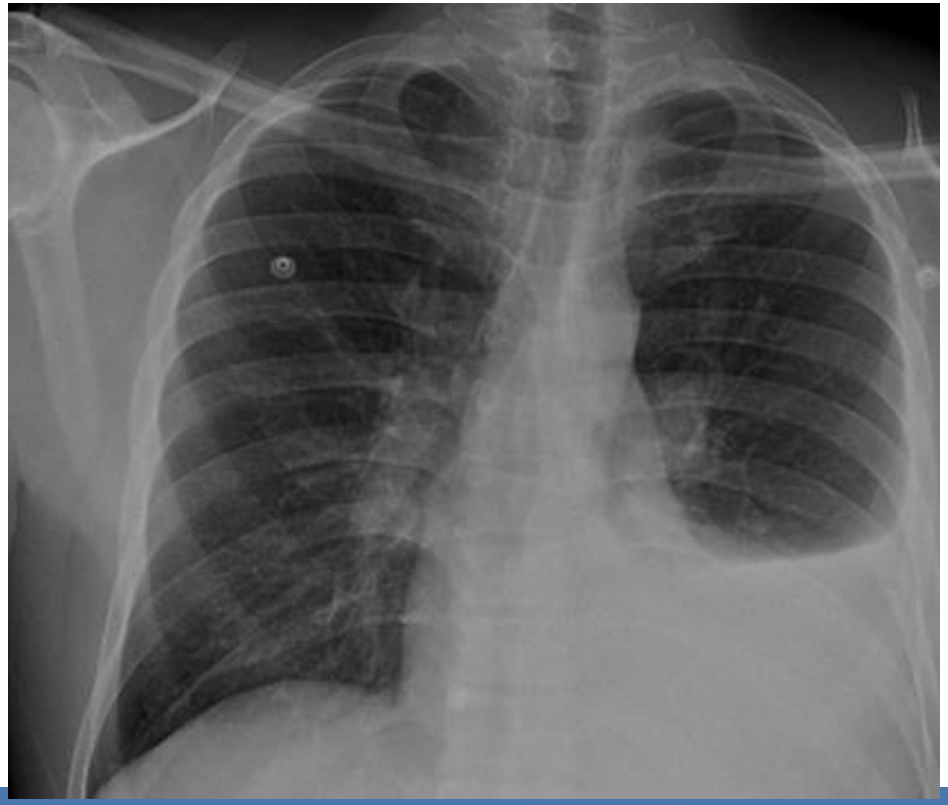
- Courtesy of Ted Standiford, MD

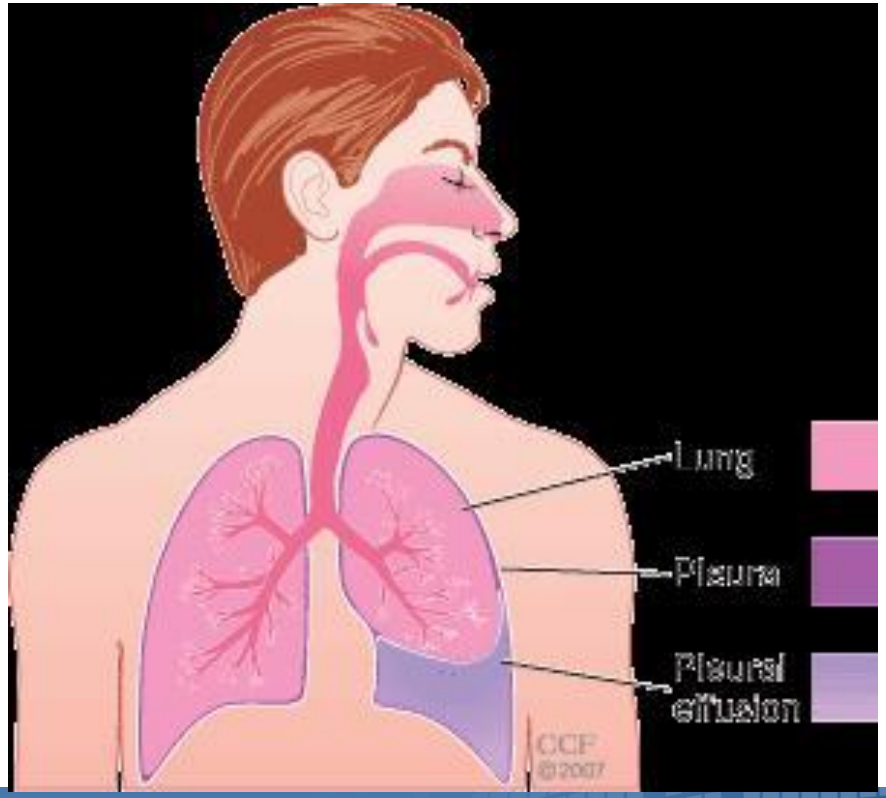
TB Pleural Effusions and Other Abnormalities

- Small to very large, can loculate
- Usually unilateral
- Primary (or post primary disease)
- Fluid can be serous, thick & congealing, or bloody – not frank pus unless complicated
- Exudate – high protein and LDH, white cells predominantly lymphocytes
- ↑ Adenosine deaminase and IFN-γ levels
- Bronchopleural fistulas can occur

44 Year Old Man: Homeless Shelter Outbreak

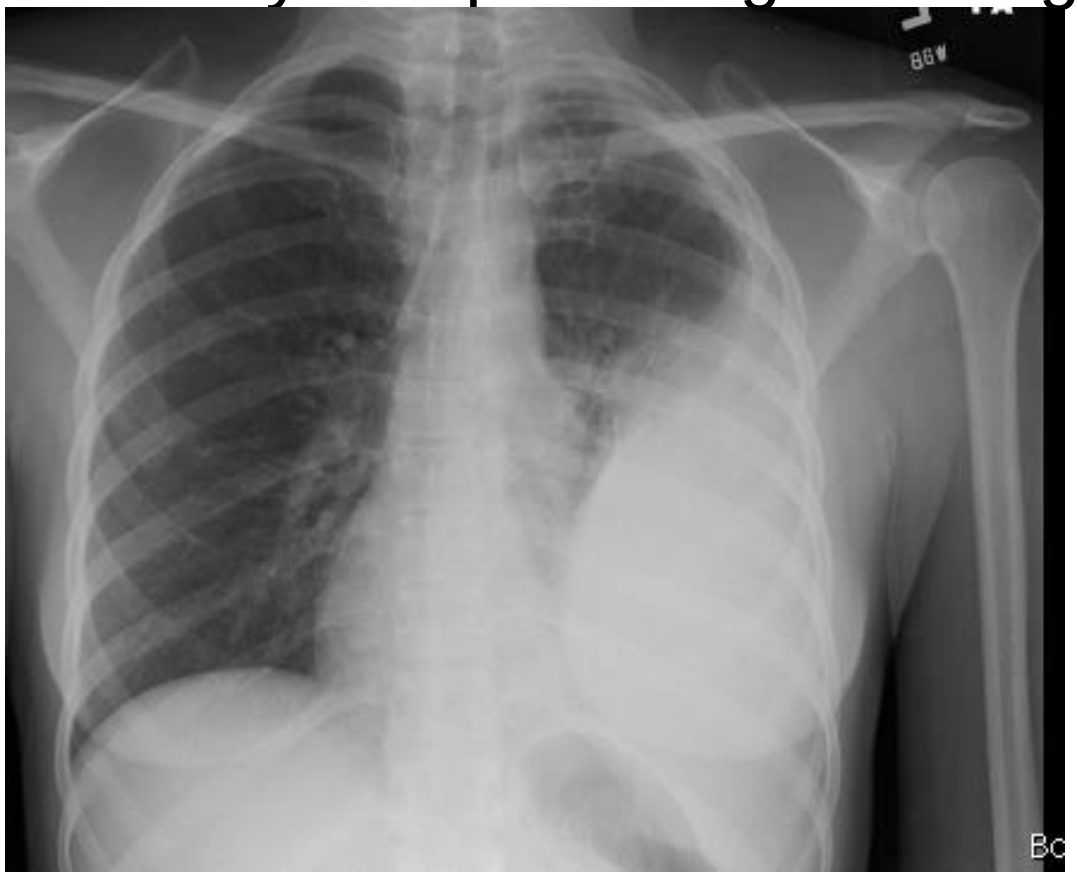
- Note meniscus sign, silhouette sign, less translucency than consolidation

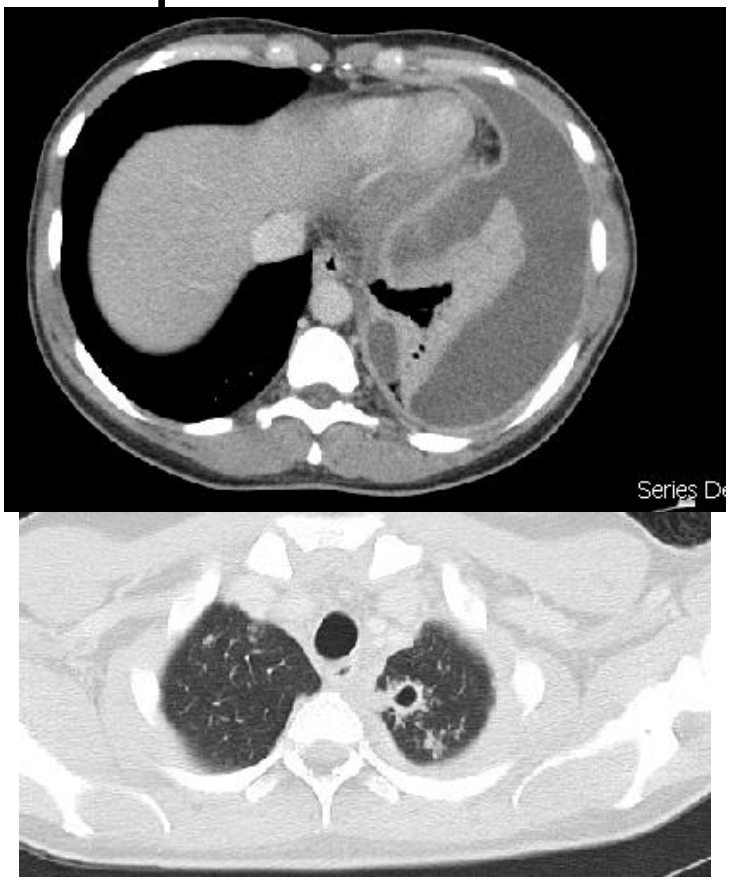




40 Year Old with Known Exposure to Contagious Case 1-2 Months Ago

- IV dye helps distinguish lung from pleural fluid

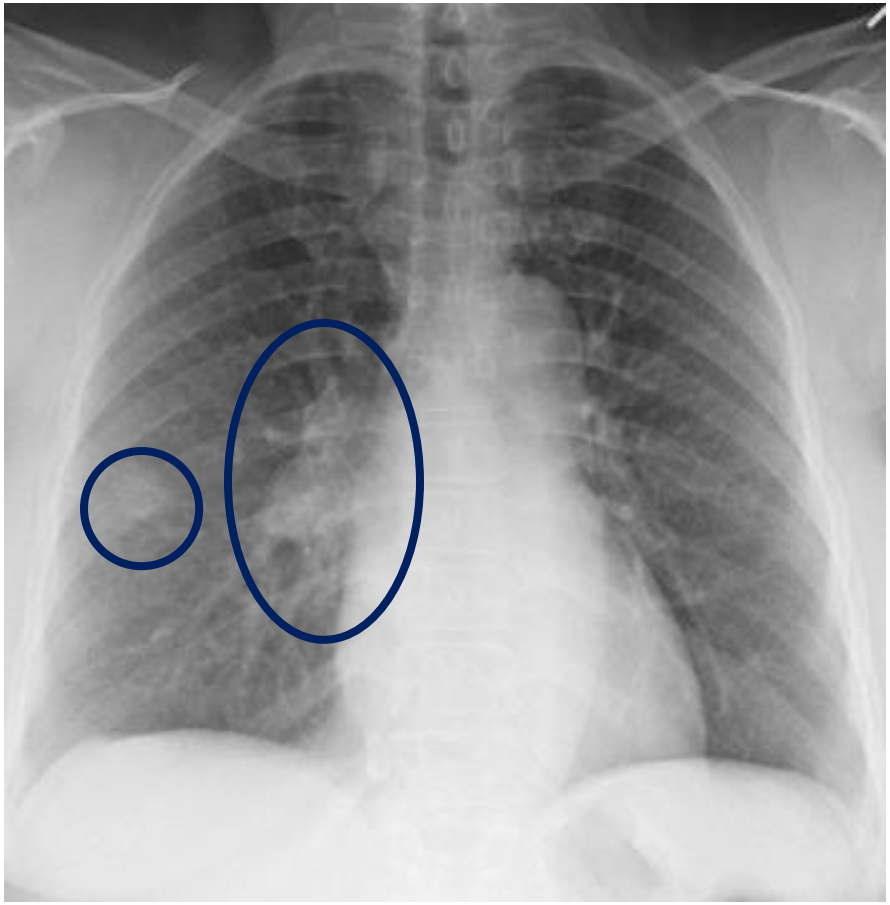


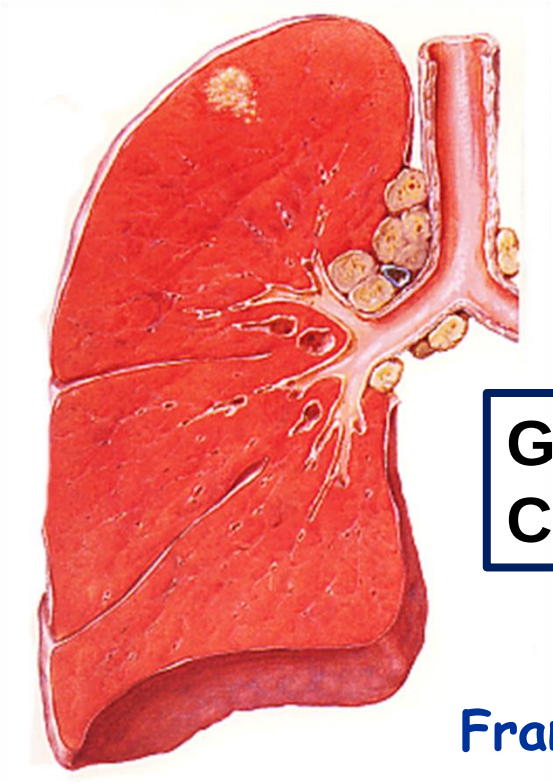


Lymphadenopathy

- Frequent in primary disease
- In children can be massive and compress airways
- Rim enhancement with dye and low attenuation centrally suggests TB

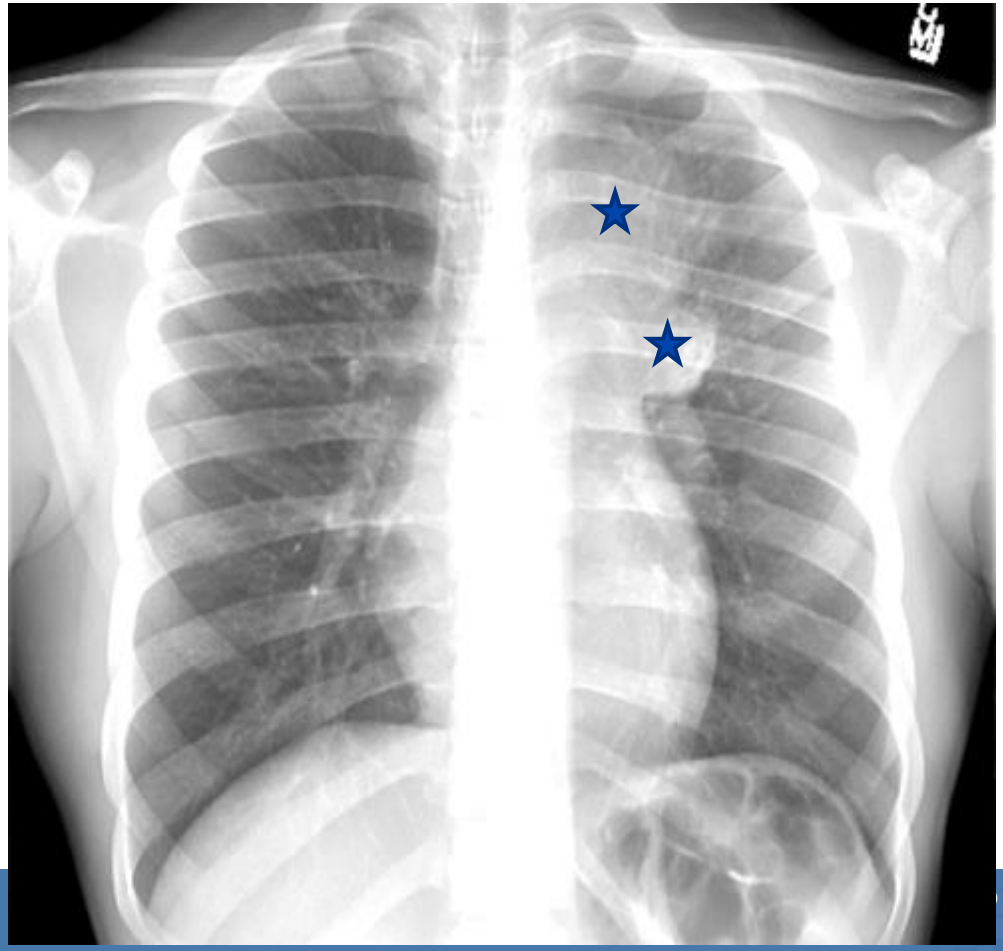
Recent Contact with TB Case: PET Scan Shown Before



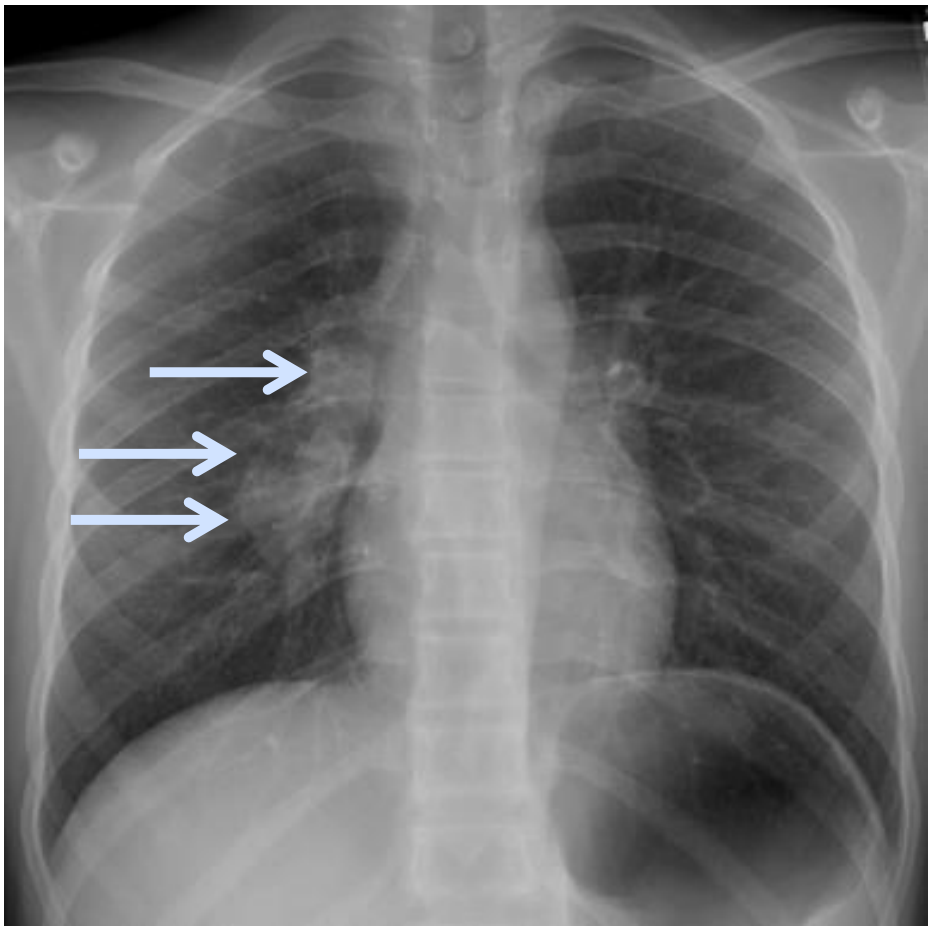


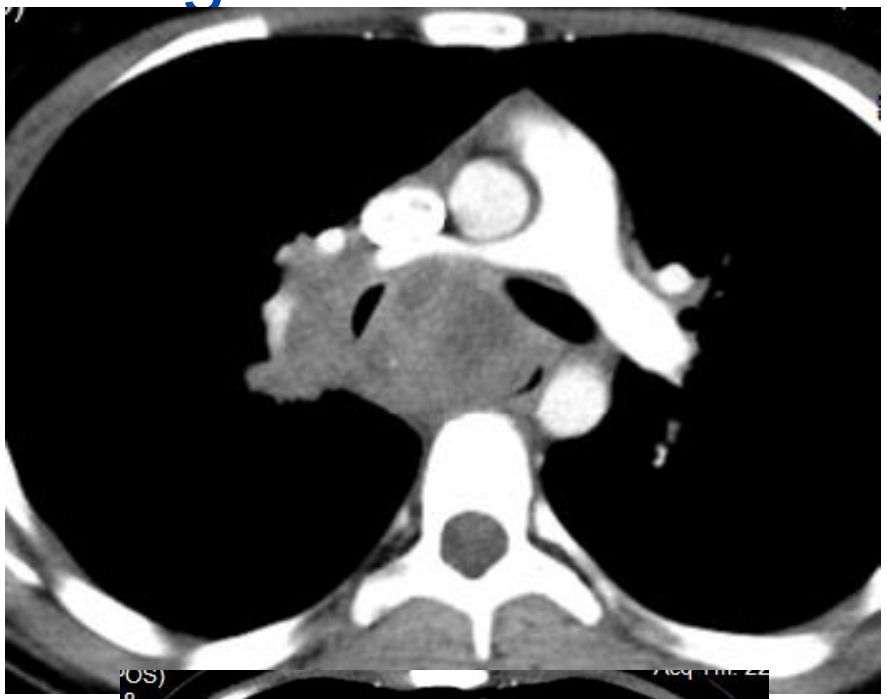
15 Year Old Boy with Cough Contact to Aunt with MDR TB

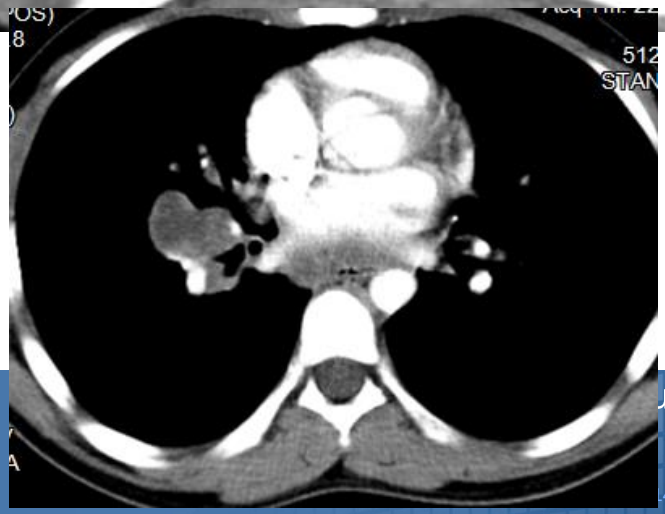
- Sputum culture + for MDR TB



15 Year Old Somali Boy.
Chest pain, Difficulty Eating

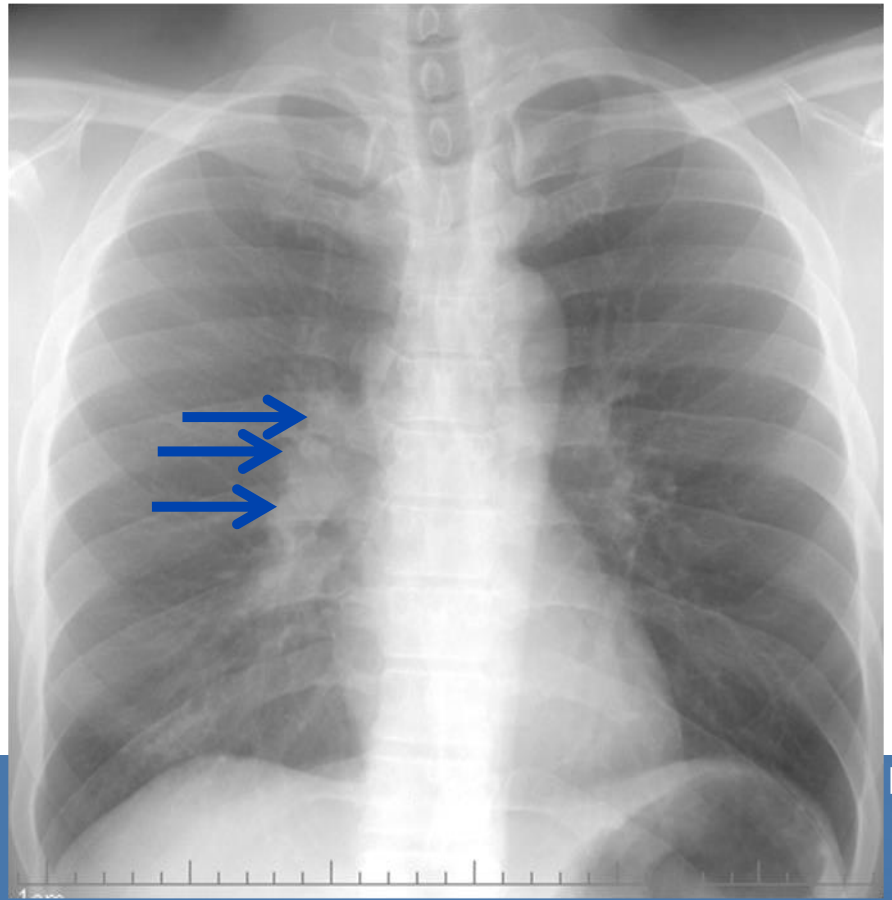






Recent Contact to Active Case: Large Day Care Center Outbreak

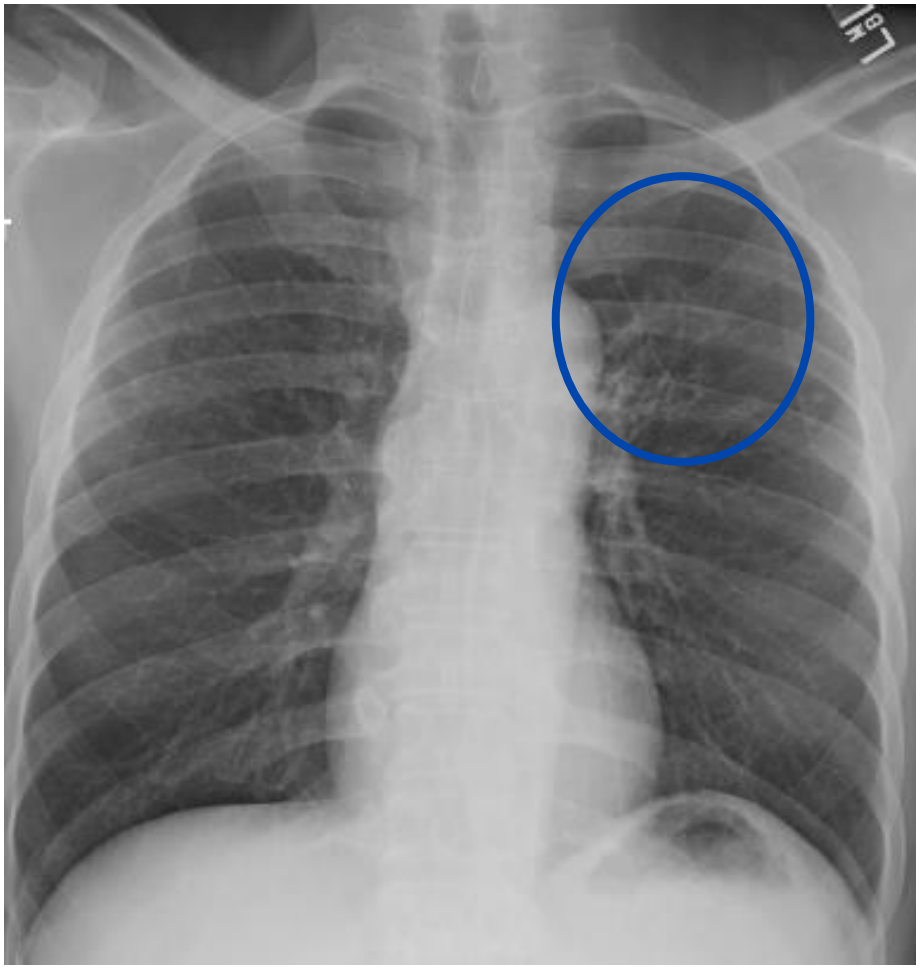
- Sputum culture + for MTB
- Note right hilum compared to left

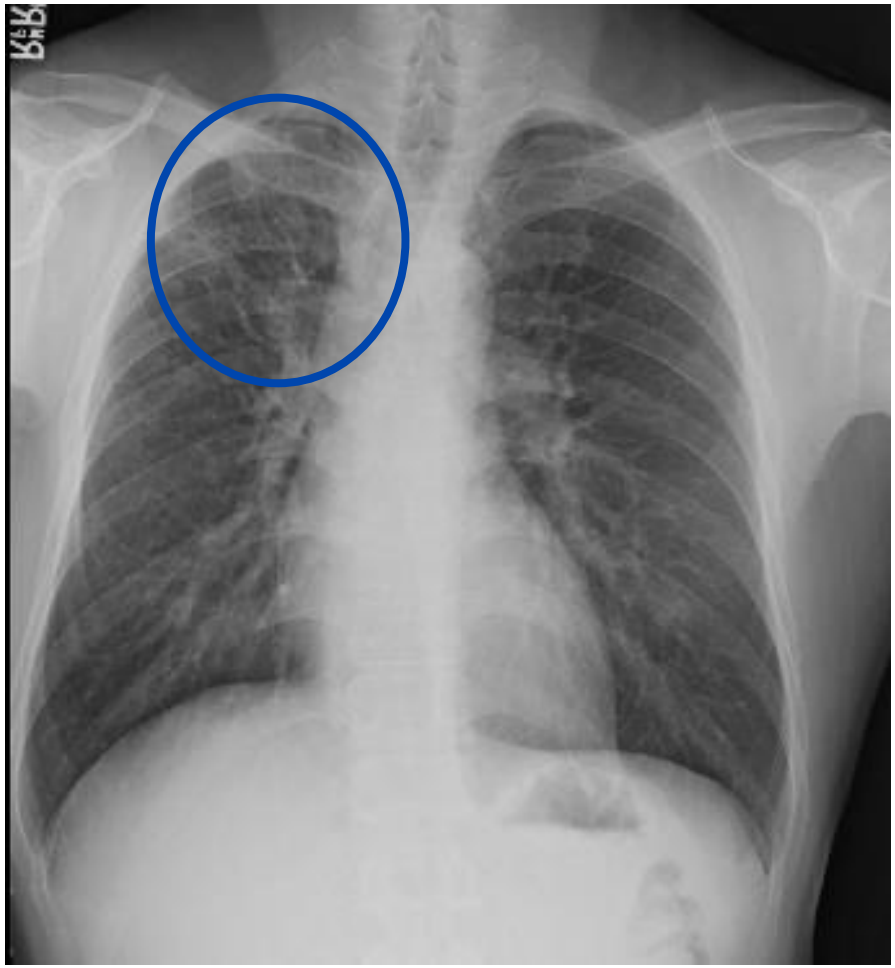


Linear Shadows / Fibrosis

- Can be old healed TB or active chronic TB
- Often seen with immigrants labeled B1
- Can be associated with volume loss

Treated TB:
Note Volume Loss



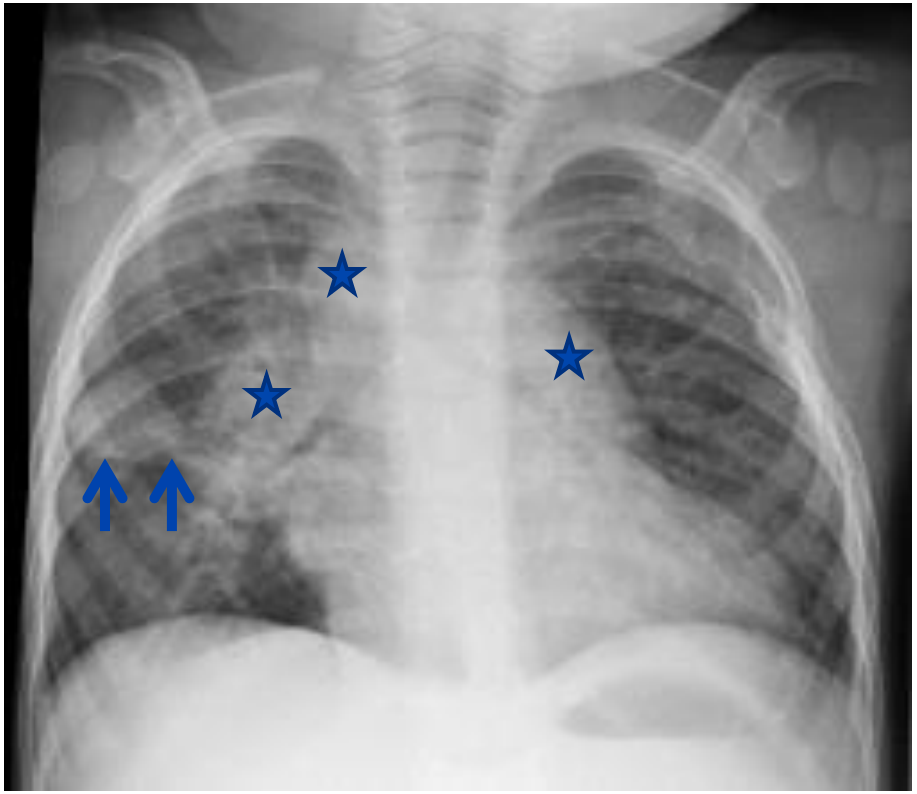


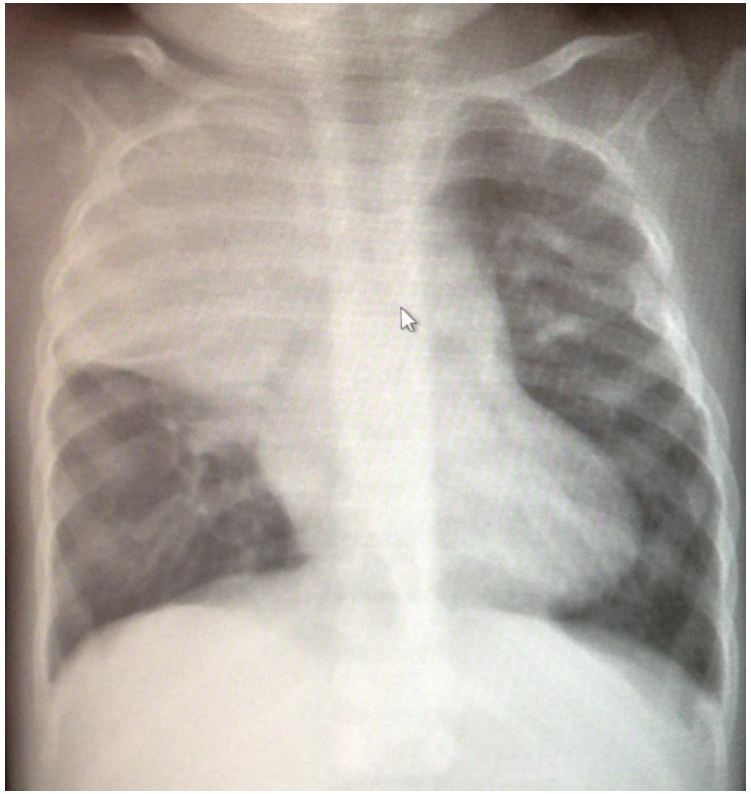
Tracheobronchial TB

- Airways can be compressed by large lymph nodes
- TB can be endobronchial
- Bronchiectasis and bronchostenosis are common sequelae
- Atelectasis or collapse of the lung beyond an obstructing lesion can occur (similar to lung cancer)

10 Month Old from Ghana with Fever: Baseline & 1 month into treatment

- Courtesy of Pamela Hackert, MD

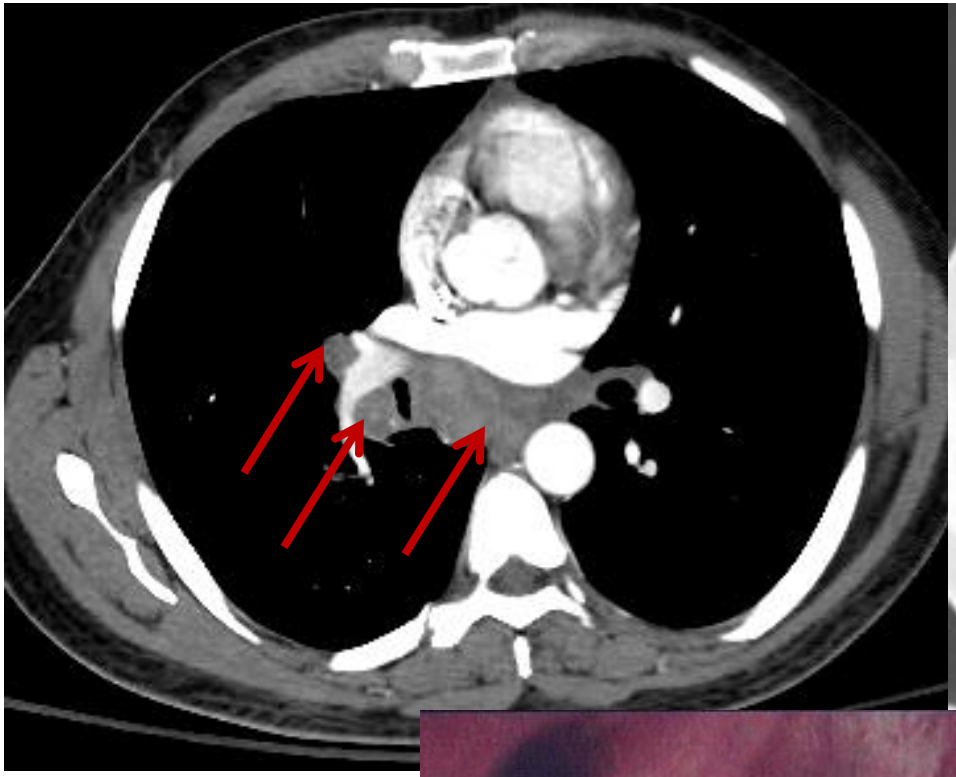


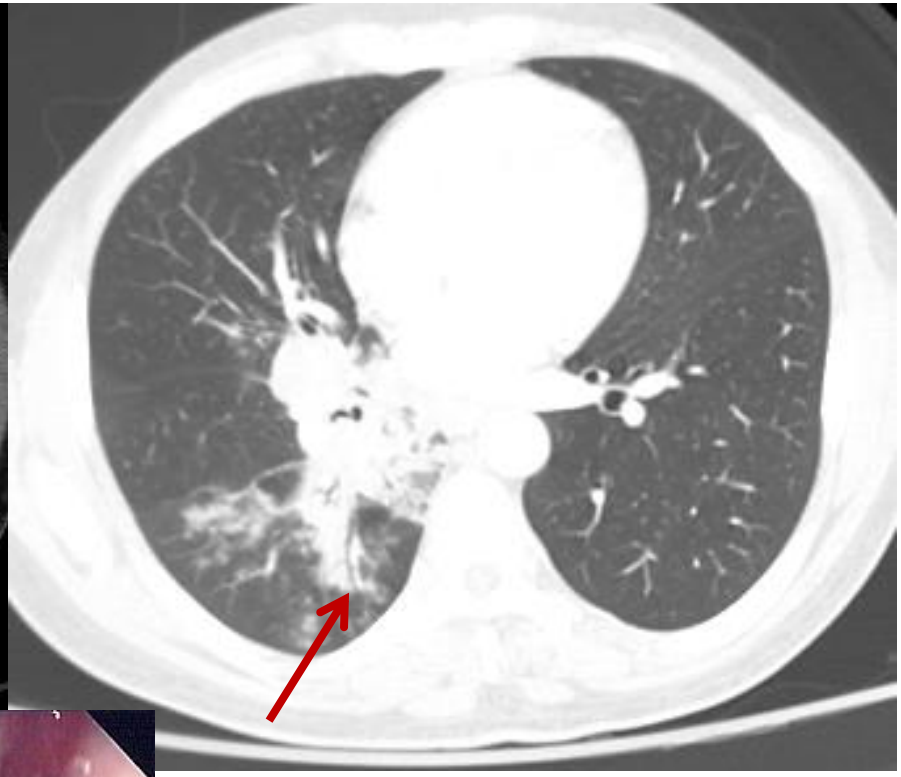


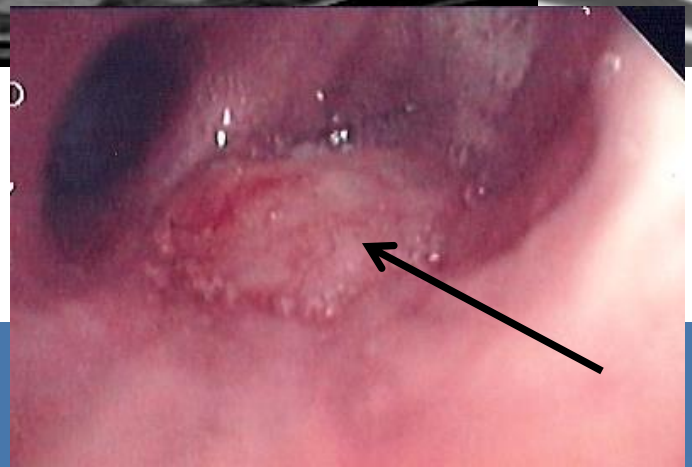
- After 2 weeks more of treatment

- Source Case

Homeless Man



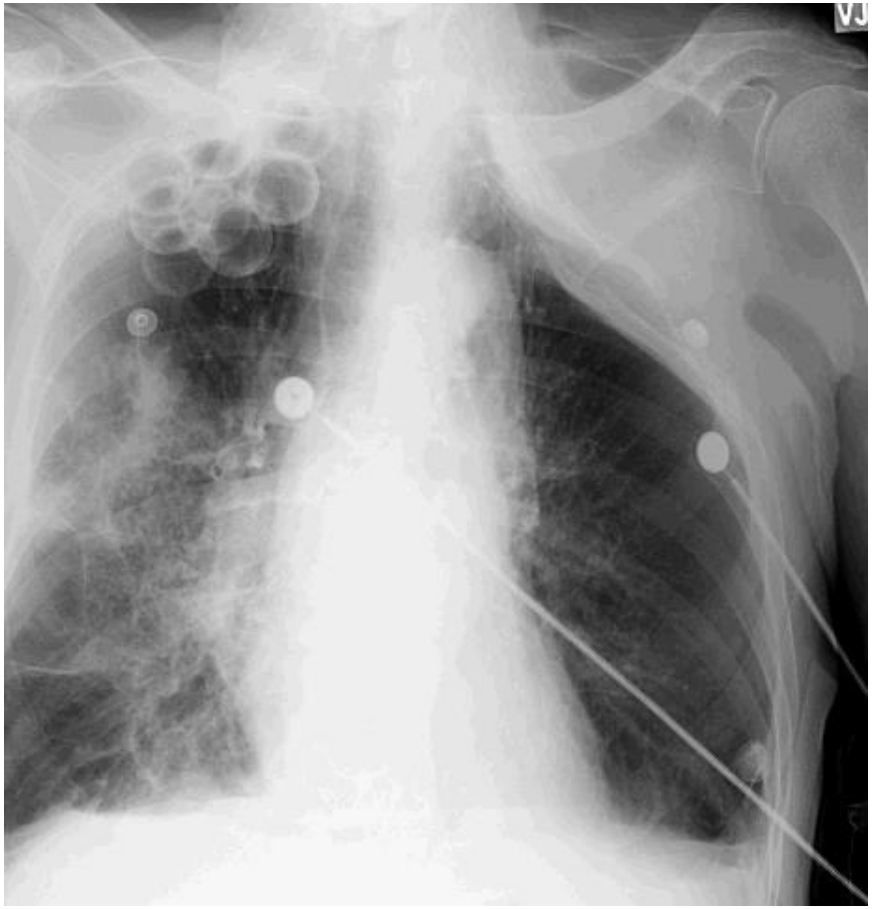




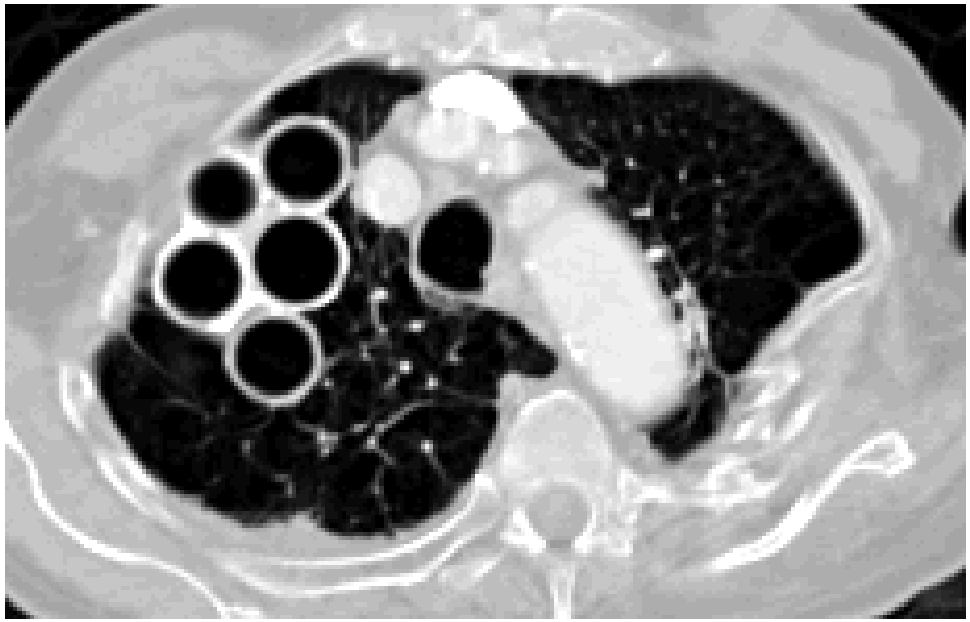
Who can name the 2 surgical procedures performed on this patient?

Alice Neel (1900-1984) TB Harlem

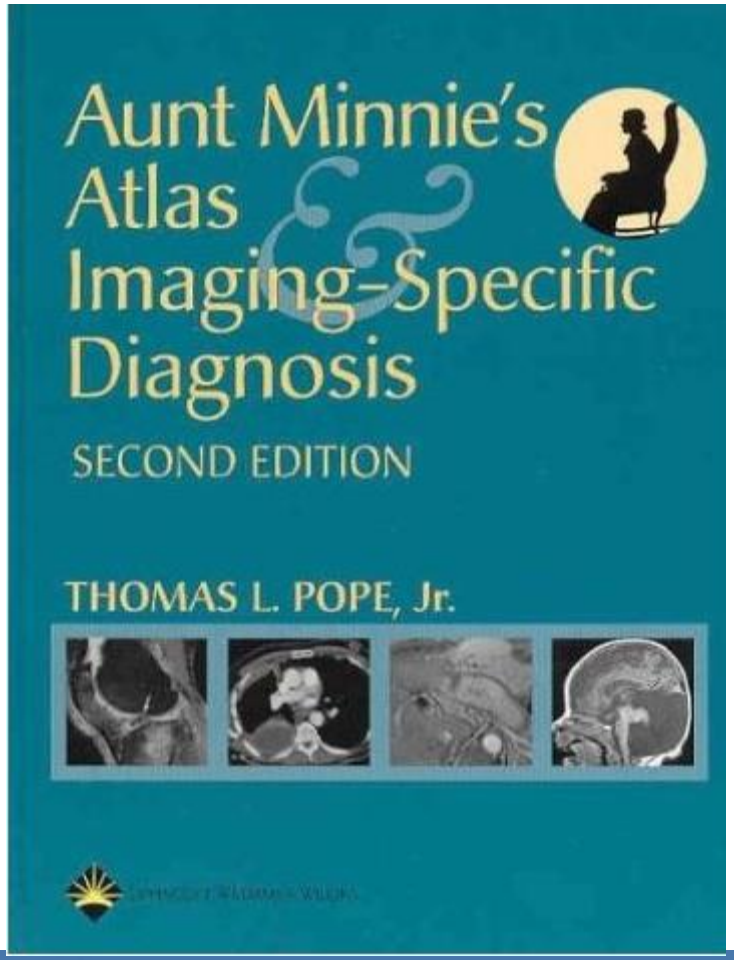
And The Names Are:



- Right plombage
- Left thoracoplasty



Conclusion: You can Learn to Recognize TB When You See It!



Ed Neuhauser and Ben Felson