Disclosures

• None financial

• I am **NOT** a radiologist or pulmonologist!!
  • An Inf Dis doc talking about radiology is always a “risky” proposition!!

• To cover a large topic in 30 min – we’re going to *go FAST!!*
Objectives

• You will
  • Identify the **major structures** on a normal chest x-ray
  • Identify **major chest x-ray abnormalities** commonly seen in TB
CXR Basics: PA (posterioranterior) film

Direction of X-ray beam

https://www.med-ed.virginia.edu/courses/rad/cxr/anatomy4chest.html
CXR Basics: lateral film

https://www.med-ed.virginia.edu/courses/rad/cxr/anatomy4chest.html
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 silhouette formed by
• lung adjacent to heart
• lung adjacent to diaphragm

Silhouette Sign
Normal Frontal Chest X-ray:
Corresponding lung lobes with Silhouette structures

https://www.med-ed.virginia.edu/courses/rad/cxr/anatomy4chest.html
Normal Lateral Chest X-ray
Normal PA & Lateral X-ray: Hilum

Hilum – Major bronchi, Pulmonary veins & arteries, Lymph nodes at the root of the lung)
Normal PA & Lateral X-ray: Mediastinum

**Mediastinum** – 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
CXR: 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
Adult: Reactivation Pulmonary TB

More common presentation in immunocompetent, HIV-neg. adults

Predilection for upper lung zones – via (considerations):

- Higher oxygen tension in upper lung zones (MTB is an obligate aerobe)
- Possible diminished lymph generation and impaired tissue clearance
- Possible decreased macrophage inhibition in intracellular MTB replication in oxygen rich environments

CXR of Pulmonary TB Disease – Reactivation
Typically in *Immunocompetent Adult*

- **Location:** “*Classic*”- apical and/or posterior segment of RUL; apicoposterior segment of LUL or superior segment of either lower lobe
- **Infiltrate:** fibronodular, irregular with variable coalescence and cavitation
- **Cavities:** thick, moderately irregular walls
- **Volume loss:** progressive, can be rapid

***PLEASE NOTE:***
- “Atypical” lung findings in approx. 1/3 patients
- Infiltrates can **appear anywhere!!**
Pulmonary TB with immunosuppression → *more variable; more challenging to interpret*

- CXR findings - advanced HIV/AIDS (↑variable):
  - Confluent pneumonia
  - Lower zone infiltrates
  - Hilar / paratracheal adenopathy
  - Risk for Miliary spread / pattern

- “Primary Complex pattern” common with HIV/AIDS
  - Hilar adenopathy
  - Lower / mid lung infiltrates, unilateral
  - Pleural effusions
Manifestations of Primary Pulmonary TB in children

- Hilar or mediastinal adenopathy
- Paucity of SSx relative to CXR
- Usually no cavities
TB Radiology Image Library

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

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CXR: 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

• Caused by filling of airspace with fluid, cells, pus, blood

• Without significant volume loss
Consolidation from TB

Left perihilar consolidation

Right upper and lower lung consolidations, left lung patchy and nodular opacities (TB)
CXR: 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, Air Bronchogram
Left upper lobe apical-posterior segment
CXR: 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 ipsilateral enlarged mediastinal or hilar lymph node(s)
CXR: 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
**CXR: Cavities**

- Most common in advanced disease (reactivation TB)
- Higher MTB organism burden
  - More contagious to others
  - 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
Multiple Findings on CT Scan

- Cavities, consolidation with air bronchograms, nodules, “tree-in-bud” densities
20 Year Old Woman from US City: Rx for LTBI as child when father had TB
Tree-in-Bud
CXR: 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
Pleural, lymphatic and extrapulmonary radiologic presentations of TB
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
Pleural TB
Pleural TB – Advanced, chronic, calcified
Miliary TB

• Disseminated disease

• *Usually* occurs during initial (primary) infection and/or with immunosuppression
  • Lack of immunologic containment: hematogenous spread of MTB

• Uniformly distributed nodules ~ 2 mm. in size

• After infection, miliary TB &/or meningitis occur in ~ 10-20% of babies < 1 year old
Miliary Tuberculosis

Granulomas from Mycobacterium tuberculosis

Millet seeds - small grains (average diameter <2 mm)

Mayo Clinic Center for Tuberculosis
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
Lymphadenopathy

- Frequent in primary disease
- In children can be massive and compress airways
- Rim enhancement with dye and low attenuation centrally suggests TB
CXR with hilar adenopathy and peripheral nodule
PET Scan (same pt):
- Do NOT Differentiate TB from Cancer:
- This Patient had TB

**PET report:** “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.”
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
Genitourinary TB

- Ureteral scarring
- Ureteral stenosis
- Ureteral obstruction
- Hydronephrosis
Vertebral TB (“Potts Disease”)

- Classically more destruction of ventral portion of vertebral body
  - Results in anterior wedging & collapse; Hunchback (“Gibbus”) deformity
- Typical location:
  - Childhood-adolescence: Thoracic spine
  - Adults: Lumbar spine; thoracic
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Pericardial TB
The End

• Questions?