Radiology of TB

Seth H. Iverson, MD
Clinical Instructor University of Wyoming
Casper Medical Imaging
TB Clinical Intensive, Casper, WY March 2, 2017
Disclosures

• None
Objectives

• You will
  • Identify the **major structures** on a normal chest x-ray
  • Identify major **chest x-ray abnormalities** commonly seen in TB
Basic Physics of the Radiographic Image

• Chest x-rays are produced by creating radiation in the specific form of x-rays which are directed toward a detector.

• The patient is placed between the x-ray source and the detector which will cause different interactions.
  • X-rays may be **unabsorbed** – pass through the patient unchanged
  • X-rays may be **completely absorbed** – totally deposited in the patient
  • X-rays may be **scattered** – deflected, but still hit the detector.
Factors Contributing to X-Ray Absorption

• Energy of the x-ray beam
  • Difference between standard PA and Lateral view performed in the Radiology Department and a portable x-ray.
  • Most TB suspected cases come to the Radiology Department for standard imaging.

• Density of the tissues
Factors Contributing to X-Ray Absorption

- Energy of the x-ray beam
- Density of the tissues
Descending Aorta – you can see it because the left lateral border contacts the aerated lung.
Left Pulmonary Artery
Left Upper Lobe Pulmonary Artery
Aorto-pulmonary window
Left Main Bronchus – air filled in soft tissue mediastinum
Left Atrial Appendage
Left Ventricle – aerated Lingula
Superior Vena Cava – aerated right upper lobe
Right paratracheal stripe
Right Pulmonary artery
Right atrial border – aerated medial segment of the right lower lobe
Diaphragms – aerated lower lobes
Costophrenic angles
Radiology of Primary TB

- Primary focus may not be visible - NORMAL chest radiograph
- Random location – nondescript focus of airspace disease
- Hilar or mediastinal adenopathy.
- Pleural effusion
Radiology of reactivation TB

• Calcified primary complex
• Unilateral or bilateral disease
• Patchy foci of airspace disease
• Single or multiple cavities
• Pneumothorax
• Lobar consolidation
• Tree-in-bud

• Has predilection for upper lobes or superior segment of lower lobes
• Scattered calcifications and/or fibrous contractions leading to hilar elevation and volume loss
• Hematogenous spread – miliary
• Pleural thickening, effusions, bronchopleural fistula, calcified pleura
• Endobrochial ulcers, strictures, obstruction leading to collapse or hyperinflation
• NORMAL
Differential considerations for TB findings

- Bacterial pneumonia
- Sarcoidosis
- Thyroid metastatic disease
- Mucous plug
- Lymphoma
- Empyema
- Progressive Massive Fibrosis

- Prior infection
- Radiation fibrosis
- Fungal infection
- Other granulomatous disease
- Pneumoconiosis
- Cancer
TB Radiology Image Library

The TB Image Library is a joint project of the Curry International TB Center and Finland 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/Finland 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

<table>
<thead>
<tr>
<th>Consolidation/Opacities</th>
<th>Cavitations/Cysts</th>
<th>Linear opacities/Fibrosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nodules/Masses</td>
<td>Miliary pattern</td>
<td>Lymphadenopathy</td>
</tr>
<tr>
<td>Pleural abnormalities</td>
<td>Tracheobronchial abnormalities</td>
<td></td>
</tr>
</tbody>
</table>

### TB Sub-categories

| TB/HIV | Pediatric TB | Extra-pulmonary TB |

http://www.currytbcenter.ucsf.edu/sites/default/files/product_tools/tbradlibrary/index.html
X-ray Terms

• Parenchyma – within the lung
• Extraparenchymal – anything outside the lungs (eg chest wall or pleura)
• Mediastinal
• Outside the patient
Silhouette Sign

• The opacity obscures the right heart border.
• What part of the lungs normally touches the right heart border?
  • The right middle lobe.
  • Right middle lobe pneumonia.
Silhouette Sign

• X-rays “see” density differences to create an interface.
• No density difference?
• No interface.

• Another example? The heart.
• Blood, myocardium, pericardium.

https://images.radiopaedia.org/images/2981903/2264f643b18b1010ec10a850f17550_jumbo.jpeg

Mayo Clinic - Center for Tuberculosis - TB Clinical Intensive - Casper, Wyoming March 2017
Basic Patterns of Disease

• Consolidation (airspace filling)
• Interstitial – includes linear and reticular opacities, small nodules, miliary nodules, and peribronchovascular thickening.
• Solitary nodule
• Mass
• Lymphadenopathy
• Cyst/Cavity
• Pleural abnormalities
Consolidation

• Confluent ill-defined opacity effacing normal shadows.

• Air is replaced by blood, pus, water, or cells.

Courtesy Thienkhai Vu, MD

Consolidation

• Right LLL consolidation

• Right hilar and paratracheal adenopathy

• HIV and TB

Courtesy Christine Ho, MD

http://www.currytbcenter.ucsf.edu/sites/default/files/product_tools/tbradlibrary/detail29.html
Air Bronchograms

• Normally the bronchi are not seen because air in bronchi surrounded by air in lungs.

• BUT when air in bronchi surrounded by airless aveoli – Voila!

• Opacity IN the lungs

http://www.svuhradiology.ie/wp-content/uploads/2015/05/AirBronchoCombo-1024x599.jpg
Consolidation

Febrile heroin addict shows right upper lobe consolidation with air bronchograms.

The patient did not respond to antimicrobial therapy, and active TB was diagnosed on bronchoscopy.
Consolidation

PA chest radiograph obtained 2 years after initial diagnosis.

There is persistent left upper lobe nodular lesions and cavitation.

Noncompliant on antituberculous drug treatment and developed drug-resistant tuberculosis.
Tree-in-bud opacities

22-year-old woman with active TB

Right upper lobe centrilobular and tree-in-bud opacities and upper lobe bronchiectasis.

Tree-in-bud is due to endobronchial dissemination
Tree-in-bud opacities

Same patient with active TB

Right upper lobe cavity with nodular walls and surrounding bronchiolitis and tree-in-bud opacities.

Bacterial, viral, and fungal infections may produce bronchiolitis, but associated cavitation is highly suggestive of TB.
Linear opacities/fibrosis

• After consolidation heals, scarring and fibrosis can result.

• This is actually M. avium in a patient with non-small cell lung cancer

Courtesy Masa Narita, MD

Linear opacities/fibrosis

• Subtle right apical linear opacities and clustered micronodules.

• Positive TB Culture


Courtesy Thienkhai Vu, MD
Linear opacities/fibrosis

Asymptomatic man with prior tuberculous empyema complicated by fibrothorax.

Asymmetric lung volume loss and dense pleural calcification.

Stable findings, sputum negative, and the patient had presumed inactive disease.
Linear opacities/fibrosis

Sequela of prior TB (Sputum neg)

Bilateral upper lobe volume loss
Intrinsic bronchiectasis
Architectural distortion
Nodules and Masses

Superior segment left lower lobe mass with bilateral apical micronodules.

Culture positive TB

Note:
Mass is arbitrary size of 3cm or greater.
Nodule is anything less than 3cm.


Courtesy Masa Narita, MD
Nodules and Masses

Necrotic noncavitary left upper lobe mass.

PET/CT avid metabolic activity

Tissue sample is positive for TB

http://www.currytbcenter.ucsf.edu/sites/default/files/product_tools/tbradlibrary/detail34.html

Courtesy Thienkhai Vu, MD
Nodules and Masses

Axial CECT after reinstitution of antituberculous drug therapy shows persistent left apical nodules.

Activity of disease cannot be determined on size change.
Nodules and Masses

Asymptomatic 42-year-old woman with known prior tuberculosis.

Stable multifocal right apical calcified lung nodules, consistent with healed tuberculomas.
Miliary pattern

Diffuse micronodules typically 2-3mm

Positive TB

Courtesy Masa Narita, MD

Miliary pattern

Courtesy Thienkhai Vu, MD

http://www.currytbcenter.ucsf.edu/sites/default/files/product_tools/tbradlibrary/detail15.html
Miliary pattern

49-year-old man with active TB

Left upper lobe cavities
Bilateral micronodules due to hematogeneous dissemination.

Patient is infectious and should be placed on respiratory isolation until therapy is instituted and sputum Gram stain becomes negative.
Miliary pattern

Metastatic Thyroid Cancer

Courtesy of Ted Lee, MD

Lymphadenopathy

TB and HIV

Courtesy Masa Narita, MD

http://www.currytbcenter.ucsf.edu/sites/default/files/product_tools/tbradlibrary/detail8.html
Lymphadenopathy

Right hilar adenopathy

Left apical consolidation

TB and HIV

Courtesy Masa Narita, MD

Lymphadenopathy

Bilateral hilar and paratracheal adenopathy

Bilateral lower lung patchy and left upper lung nodular opacities

TB and HIV

Courtesy Masa Narita, MD

http://www.currytbcenter.ucsf.edu/sites/default/files/product_tools/tbradlibrary/detail7.html
Lymphadenopathy

LUL consolidation

Left hilar and mediastinal enlarged lymph nodes with central low attenuation and peripheral rim enhancement, consistent with necrosis.
Cysts and Cavities

Superior-segment left lower lobe large cavity with air-fluid level

Bilateral mid to lower lung micronodules (TB)

Courtesy Masa Narita, MD

http://www.currytbcenter.ucsf.edu/sites/default/files/product_tools/tbradlibrary/detail5.html
Cysts and Cavities

Bilateral upper lobe cavities
Centrilobular micronodules (TB)


Courtesy Thienkhai Vu, MD
Cysts and Cavities

Bilateral upper lobe cavities
Micronodules (TB)

http://www.currytbcenter.ucsf.edu/sites/default/files/product_tools/tbradlibrary/detail2.html

Courtesy Masa Narita, MD
Cysts and Cavities

Posterior right upper lobe thin walled cavity with air-fluid level (TB)

Courtesy Masa Narita, MD

Cysts and Cavities

Posterior right upper lobe thin walled Cavity with air-fluid level (TB)

Courtesy Thienkhai Vu, MD

http://www.currytbcenter.ucsf.edu/sites/default/files/product_tools/tbradlibrary/detail33.html
Pleural Disease

Bronchopleural fistula
Bilateral micronodules
Right upper lobe scarring

HIV & TB

Courtesy Masa Narita, MD

Pleural Disease

Moderate right pleural effusion

Pleural thickening

Right upper lobe 1.5 cm nodular opacity and bilateral diffuse micronodules

TB


Courtesy Thienkhai Vu, MD
Pleural Disease

Young man who presented with fever and left chest pain.

Loculated left pleural effusion or pleural thickening and asymmetric thickening of the adjacent left chest wall soft tissues.
Pleural Disease

Same patient with loculated left basilar pleural effusion with intrinsic calcification

Thickening and enhancement of the pleural surfaces.

Left paravertebral abscess with destruction of an adjacent rib.
Pleural Disease

Small loculated pleural effusion with coarse pleural calcification and thickening (TB)

Courtesy Thienkhai Vu, MD

Right upper lobe airway occlusion with post-obstructive consolidation (TB)

Left apical bronchiectasis, nodules and linear densities (TB)

Courtesy Masa Narita, MD

Courtesy Thienkhai Vu, MD

Question #1

• What is not a characteristic finding of primary tuberculosis?

A. Pleural effusion
B. Bronchopleural fistula
C. Lymphadenopathy
D. Airspace Disease
Question #2

Where in the lungs is reactivation TB predeisposed to occur?

A. Superior segments of the lower lobes as well as the apical and posterior segments of the upper lobes
B. Posterior segment of the lower lobes
C. Hilar regions
D. Random distribution
We can learn to recognize Tuberculosis when we see it.