The Radiology of Tuberculosis

David Ashkin, M.D., F.C.C.P.
Medical Director, Southeastern National Tuberculosis Center
Medical Director, Florida Bureau of TB and Refugee Health
Clinical Assistant Professor, Department of Medicine, University of Florida College of Medicine
Assistant Professor, Div. of Pulmonary and Critical Medicine, University of Miami

Transmission and Pathogenesis of TB

Pulmonary TB
  ↓
  Cough
  ↓
  Droplet Nuclei
  ↓
  Primary Lung Infection (Lower Lobe Distribution)
  ↓
  Lymphohematogenous Spread
  ↓
  Cellular Immunity and Positive Tuberculin Skin Test at Six Weeks
  ↓
  90% No TB
  ↓
  10% TB
  ↓
  85% 15%
  Pulmonary Extrapulmonary
The Pathogenesis of TB is a Two-Stage Process

<table>
<thead>
<tr>
<th>STAGE</th>
<th>DESCRIPTION</th>
<th>RISK FACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Acquisition of infection</td>
<td>• High concentration of <em>M. tuberculosis</em> in the air</td>
</tr>
</tbody>
</table>
| 2     | Development of disease after infection | • Poor immune status  
                      |                                                   | • Recent Infection  
                      |                                                   | • Fibrotic lesions (old TB) on chest x-ray         |

Diagnosis of Active TB Disease

Key: THINK TB
GENERAL INDICATIONS FOR A CHEST X-RAY TO DETECT POSSIBLE TB

1. Unexplained cough (more than three weeks)
2. Unexplained cough with fever (more than three days)
3. Unexplained pleuritic chest pain, hemoptysis and/or dyspnea (promptly)
4. Unexplained fever, night sweats, weight loss
   - Positive tuberculin skin test and/or
   - Diagnosis of HIV infection

What to Include on a Chest X-Ray Request

- Type of exam requested
  - E.g. PA, Lateral, Lordotic or Decubitus views; Tomogram, CAT Scan
- Specific reasons for request
  - Symptoms of TB
  - Screening test for TB
  - As a follow-up
- History of pulmonary disease or abnormal chest x-ray
  - Describe
- Please compare with old films
How to Read a Chest X-Ray

- Technique ("RIP")
- Diaphragms
- Heart
- Trachea
- Hila
- Lung fields
  - Vasculature
  - Parenchyma
- Minor fissure
- Bones
  - Clavicles
  - Scapula
  - Ribs
  - Sternum
  - Spine
- Soft tissue
- Compare with old films

PA Film
Expiration & Inspiration

PA Film

Scapulae
Soft Tissues
Pleura
Diaphragms

Compare Apices
Mediastinum
Hilum
Heart
Bases
Costophrenic Angles
Lateral CXR

- Apices
- Anterior
- Scapulae
- Spine
- Mediastinum
- Hilum
- Heart
- Posterior
- Diaphragm
- Costophrenic Angles
- Base
Pathogenesis of Tuberculosis

“Classic” Chest X-Ray Findings in TB

- Hilar and/or mediastinal lymphadenopathy with or without a noncavitary infiltrate anywhere in the lung
  - Primary TB
- Upper lung field infiltrate with or without cavitation
  - Reactivation TB
- Large unilateral pleural effusion*
- Pericardial effusion*
- Miliary pattern*

* Primary or reactivation TB
Primary TB

Hilar Adenopathy
Primary TB

Hilar Adenopathy

Infiltrate

Pleural Effusion
Primary Tuberculosis

- **Findings:** (CXR)- widened right paratracheal stripe. (CECT)- Low attenuation lymphnodes, some w/ peripheral enhancement.
- **Dx:** primary Tb
- **DDx:** Primary Tb or fungal, mets, lymphoma.

Immunocompetant patients: 90% have radiographic visible dz. Right paratracheal nodes most commonly effected.

Case 1. Young male patient with fever and cough has a focal opacity in the left lower lobe that looks like a pneumonia. This is a case of primary tuberculosis in an adult.
A chest x-ray from a young child with primary pulmonary tuberculosis.

Figure 1. Consolidation in primary tuberculosis.

Harisinghani M G et al. Radiographics 2000;20:449-470

©2000 by Radiological Society of North America
Summary – Sequelae of Primary TB

- Ghon lesion, Ghon complex
- Manifest primary TB
- Pleural effusion
- Compression/invasion of bronchi by hilar nodes
- Lymphohematogenous dissemination
  - Miliary TB
  - TB Meningitis
- Progressive primary TB
Left apical hidden by clavicle/ribs

Lordotic
Fibrocavitary later
Figure 12. Lung destruction in postprimary tuberculosis.

Harisinghani M G et al. Radiographics 2000;20:449-470

©2000 by Radiological Society of North America

Figure 13. Bronchiectasis in postprimary tuberculosis.

Harisinghani M G et al. Radiographics 2000;20:449-470

©2000 by Radiological Society of North America
Terminology of TB Radiology

Infiltrate
Figure 6. Miliary tuberculosis.
Terminology of TB Radiology

Endobronchial

Figure 11.

Harisinghani M G et al. Radiographics 2000;20:449-470

©2000 by Radiological Society of North America
Figure 14. Endobronchial spread of tuberculosis.

Lymphadenopathy
Chest radiograph reveals calcified hilar tuberculous lymphadenitis.
Primary TB with adenopathy with clear lungs
6 month Follow up

Figure 4. Mediastinal tuberculous adenopathy.
Tuberculous broncholithiasis

Tuberculous bronchostenosis.

RadioGraphics
Harisinghani M G et al. Radiographics 2000;20:449-470

Effusion
Case 2.
Posteroanterior chest radiograph in a young patient shows a right upper lobe and right lower lobe consolidation and a small pleural effusion on the right side.

Case 2. CT scan obtained with the pulmonary window setting demonstrates consolidation in the right upper lobe, ground-glass opacities in the right lower lobe, and a pleural effusion on the right side. This patient has extensive tuberculous pneumonia and is immunocompromised.
Figure 5. Pleural effusion.

Harisinghani M G et al. Radiographics 2000;20:449-470

©2000 by Radiological Society of North America
Case 3. A middle-aged man presents with a cough and fever lasting several weeks. Posteroanterior chest radiograph shows a prominent paratracheal area on the right, lymphadenopathy, a cavitary opacity in the right upper lobe, and a focal consolidation in the middle lung zone on the right.
Case 3. CT scan obtained with the pulmonary window setting in the right upper lobe shows an irregular, thick-walled cavity with some increased markings around it. A nearby nodule is also shown.

Figure 8. Cavitary postprimary tuberculosis.

Harisinghani M G et al. Radiographics 2000;20:449-470

©2000 by Radiological Society of North America
**Figure 9.** Cavitary postprimary tuberculosis.

Harisinghani MG et al. Radiographics 2000;20:449-470
Non-Classic (atypical) Chest X-Ray Findings in TB

- Lower lobe infiltrates
- Single or multiple nodules with or without cavitation
- Diffuse non-miliary interstitial or alveolar infiltrates
Differential Diagnosis
“mimics”

Nontuberculous Mycobacteria NTMB
1. MAI: Mycobacterium Avium Intracellulare
   (or MAC: Mycobacterium avium intracellulare Complex)
2. M. fortuitum-cheloneae (complex)
3. M. Kansasii – common rural skin test +
histoplasmosis

Wegeners Granulomatosis
Active tuberculoma misdiagnosed as Cancer

Figure 18. Tuberculous involvement of the left sternoclavicular joint.

Harisinghani M G et al. Radiographics 2000;20:449-470
Pericardial Effusion
Summary

Consider the possibility of TB* when the chest x-ray reveals any unexplained . . .

- Focus or diffuse infiltrate anywhere in the lung
- Intrathoracic lymphadenopathy
- Pericardial or pleural effusion

* Especially in high-risk groups for TB.
If a Chest X-Ray Suggests TB . . .

- Isolate the patient
- Promptly notify the hospital infection control nurse
- Promptly notify the county health department
- Obtain at least three sputum specimens on three separate days for smear and culture
- Start the anti-TB drug regimen at the first positive AFB smear
- If all three sputa are AFB-negative and TB is still suspected, start **empiric** TB treatment pending culture results