


# Imaging of Tuberculosis

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Thoracic Imaging



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# Disclosures

- Consultant
  - Parexel International
  - Arterys

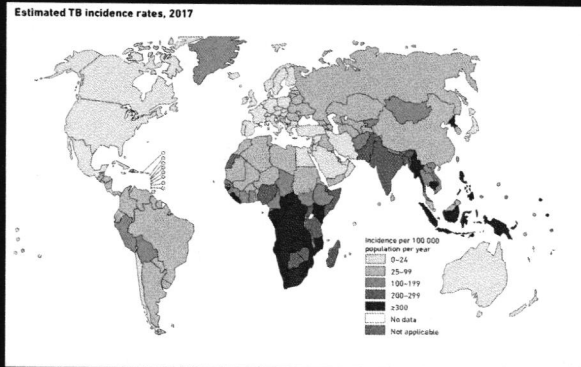
# Objectives

- Illustrate CT and radiographic findings of tuberculosis
- Describe complications of tuberculosis
- Provide an update on imaging of TB, particularly non-morphologic techniques

# Epidemiology

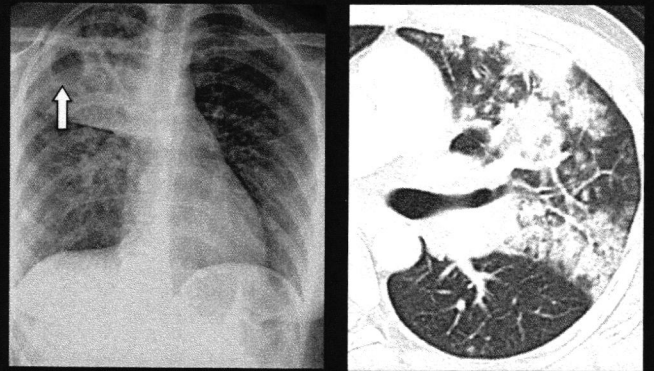
- Majority of cases in Asia
  - India and China have largest number of cases
- Largest number of active cases per capita
  - Sub-Saharan Africa: HIV epidemic
- U.S. and Western Europe
  - Foreign born residents
  - Recent immigrants from endemic regions

## Estimated Incidence 2017



World Health Organization 2018 Global Tuberculosis Report

## Imaging



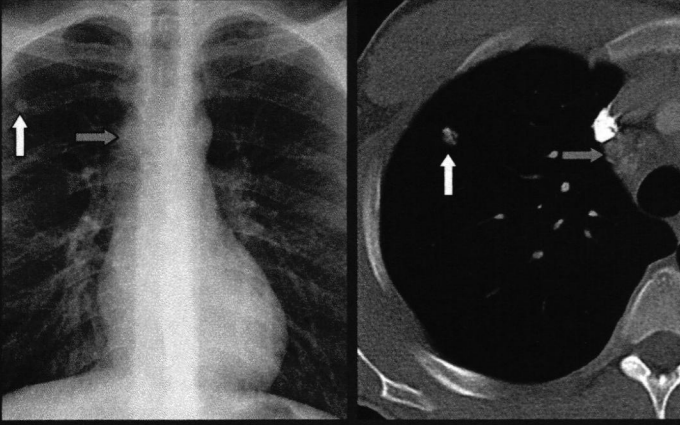
## Imaging

- CT more sensitive than radiography
  - Miliary nodules with normal radiograph
  - Mediastinal lymphadenopathy
  - Subtle cavitation
  - Endobronchial spread
- CT useful for evaluating pleural, mediastinal, and chest wall complications

## Primary Infection

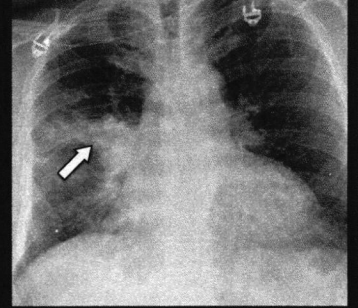
- Ghon focus: initial site of infection
  - Heals and forms calcified nodule
  - May expand to cause consolidation
- Ranke complex:
  - Ghon focus *and*
  - Regional lymphadenitis

## Ranke Complex



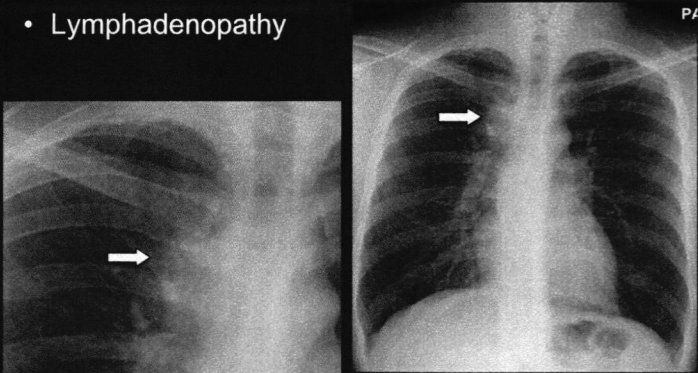
## Primary Tuberculosis

- Consolidation
- Occurs in most adults with primary infection
- Expansion of initial Ghon focus



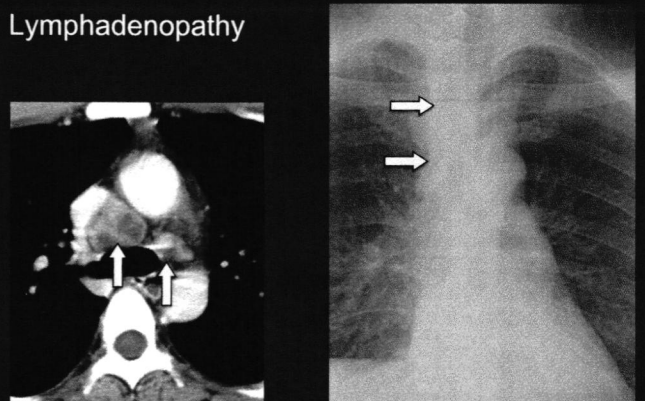
## Primary Tuberculosis

- Lymphadenopathy



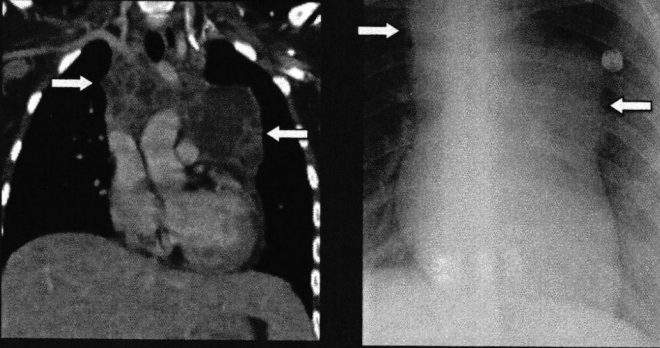
## Primary Tuberculosis

- Lymphadenopathy

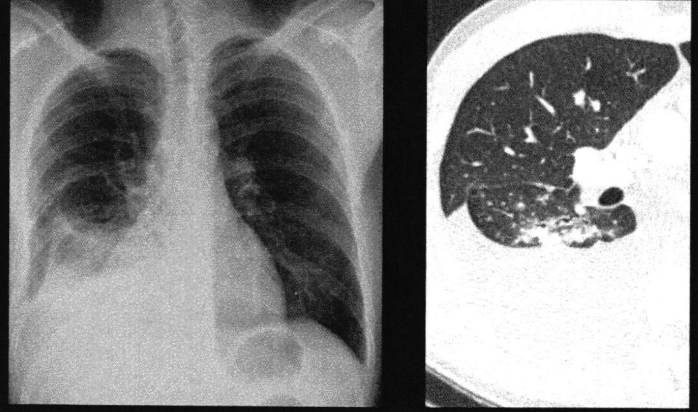


# Primary Tuberculosis

- Lymphadenopathy



# Primary Tuberculosis



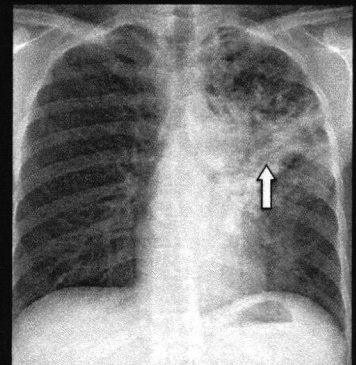
# Primary Tuberculosis

- Most commonly occurs in children
- Increasing number of cases in adults because of HIV infection

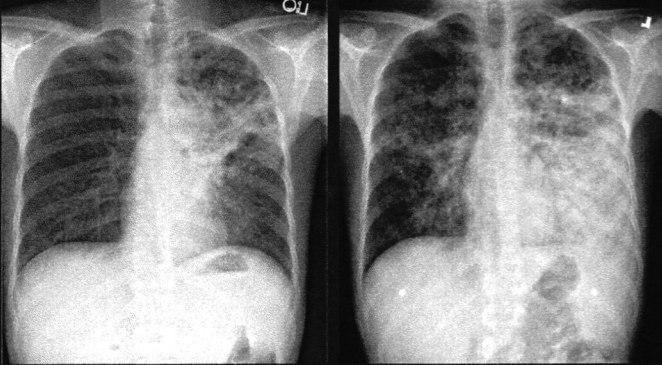
Radiographic Finding	Adults	Children
Lymphadenopathy	10%-30%	95%
Consolidation	90%	70%
Pleural effusion	30%-40%	5%-10%

# Post-Primary TB

- Consolidation in approximately 50%
- Posterior and apical segments of upper lobes
- Superior segments of lower lobes



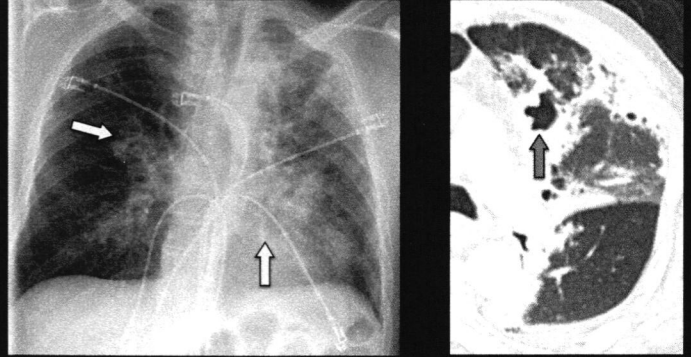
## Post-Primary TB



Initial radiograph

8 days later

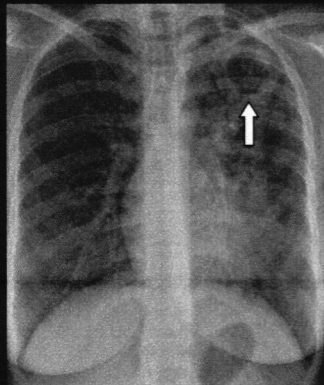
## Post-Primary TB



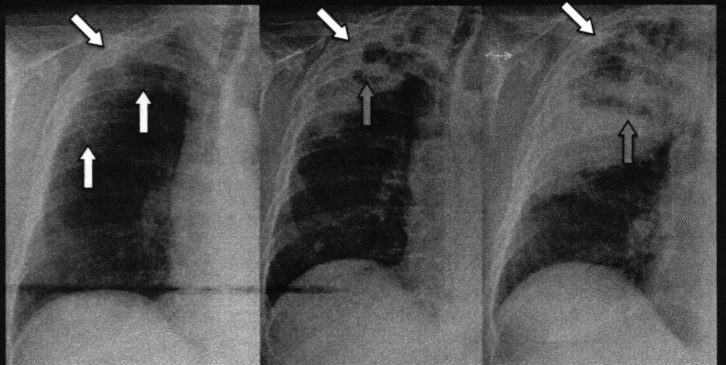
Courtesy of Travis Henry, M.D. (Atlanta, GA)

## Post-Primary TB

- Cavities
- 20%-40% of patients
- 10%-20% contain fluid levels
- Apical and poster segments of upper lobes
- Superior segments of lower lobes

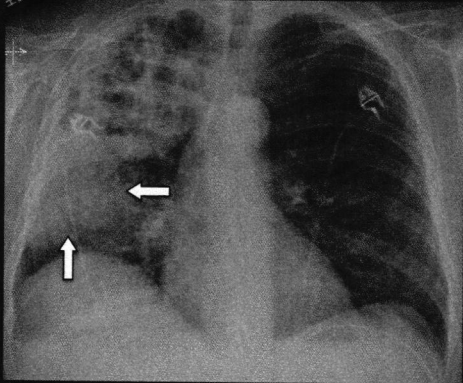


## Post-Primary TB



Courtesy of Julie Takasugi, M.D. (Seattle, WA)

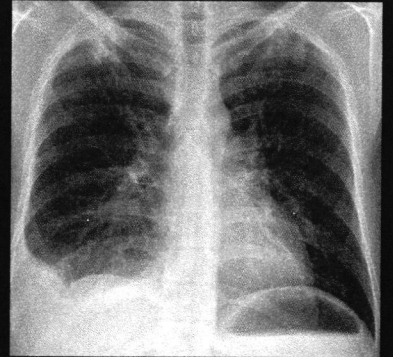
## Post-Primary TB



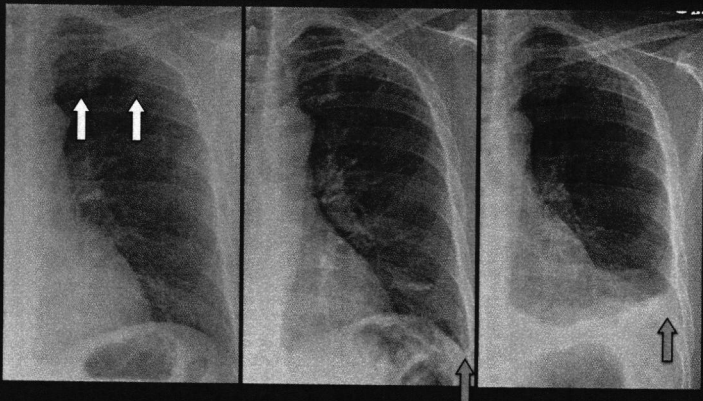
Courtesy of Julie Takasugi, M.D. (Seattle, WA)

## Post-Primary TB

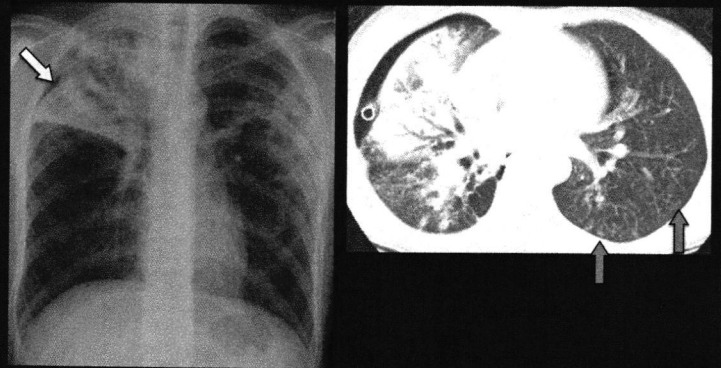
- Pleural disease
- Effusion
- Empyema
- Bronchopleural fistula



## Post-Primary TB



## Post-Primary TB



Courtesy of Sudhakar Pipavath, M.D. (Seattle, WA)

## Post-Primary TB

Finding	Frequency
Consolidation	55%
Cavitation (Fluid levels)	20%-45% (10%-20%)
Small nodules away from primary focus	20%-25%
Lymphadenopathy	5%-10%
Pleural effusion	15%-25%
Tuberculoma	5%

## TB with HIV Co-Infection

CD4+ > 200 cells/mm<sup>3</sup>

- Reinfection
- Reactivation

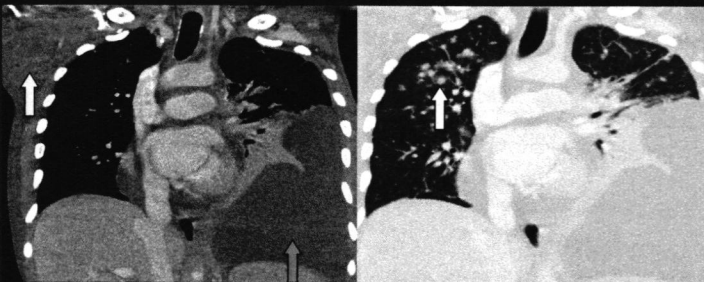
CD4+ > 50 cells/mm<sup>3</sup> and < 200 cells/mm<sup>3</sup>

- Primary

CD4+ < 50 cells/mm<sup>3</sup>

- Atypical manifestations
- Disseminated

## TB with HIV Co-Infection



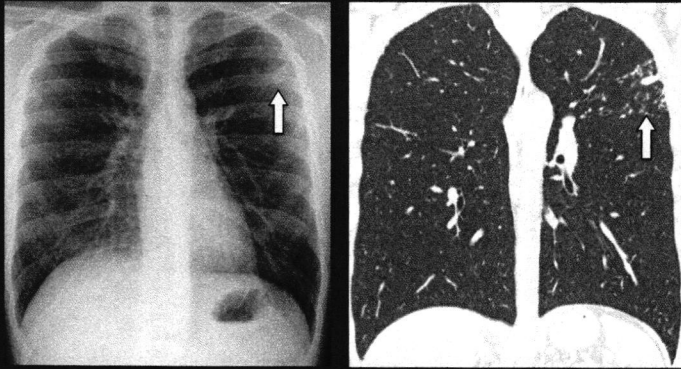
CD4+ T-cell count: 150 cells/mm<sup>3</sup>

Courtesy of Sudhakar Pipavath, M.D. (Seattle, WA)

## Active Tuberculosis or Not?

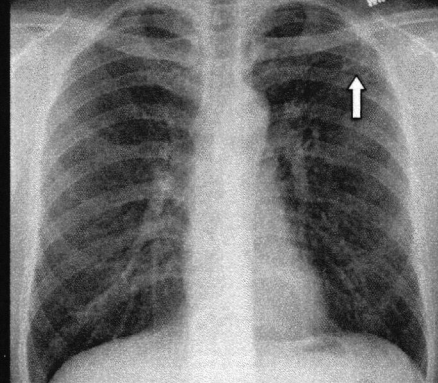
- Many imaging findings of tuberculosis reflect sequela of infection
- Small centrilobular nodules and tree-in-opacities on CT are strong predictors of active infection
- Progression of radiographic abnormalities also strongly favor active infection

## Active Tuberculosis or Not?



Sputum stains and cultures – *M. tuberculosis*

## Active Tuberculosis or Not?



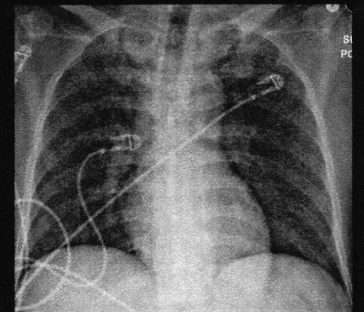
Sputum stains and cultures – no TB

## Disseminated TB

- Disseminated or “miliary” TB can occur as primary or post-primary infection
- Other findings of post-primary infection may be apparent
- Most immunocompromised

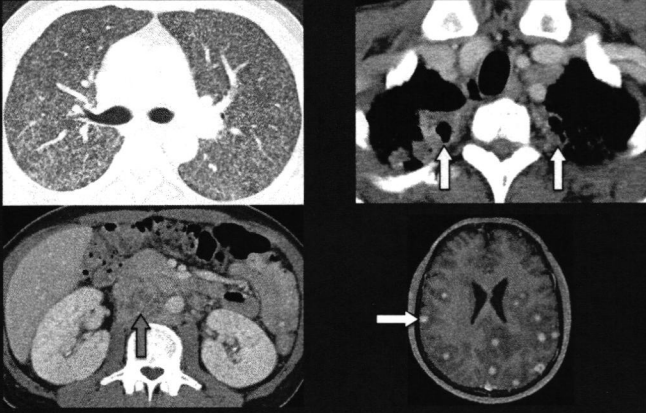
## Disseminated TB

- Diffuse tiny lung nodules
- Radiograph may be normal
- Patients typically very ill

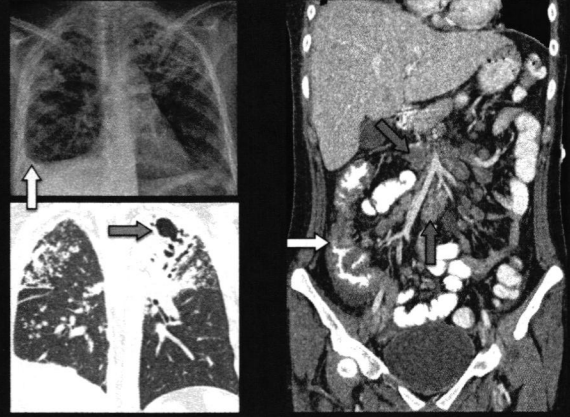




## Disseminated TB



## Disseminated TB



Courtesy of Howard Mann, MBBS (Salt Lake City, UT)

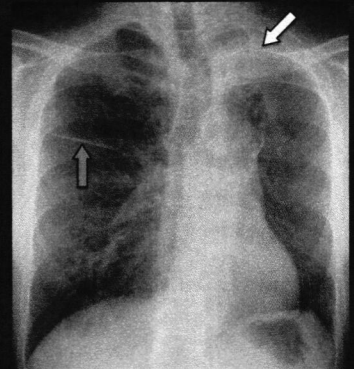
## Complications – Lungs

- Scar
- Lung destruction
- Bronchiectasis
- Cavities
- Acute respiratory distress syndrome
- Aspergilloma
- Tracheobronchial stenosis
- Broncholithiasis



## Complications - Lung

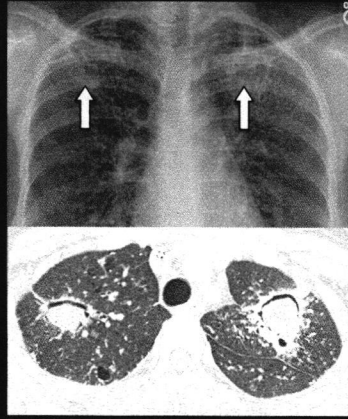
- Scar and destruction of lung
- Up to 40% of patients with post-primary TB
- Result of marked fibrotic response



Courtesy of Travis Henry, M.D.  
(San Francisco, CA)

## Complications - Lung

- Chronic cavity following treatment
- Aspergilloma in up to 11% of patients with TB
- Hemoptysis in over 50%



## Complications - Lung

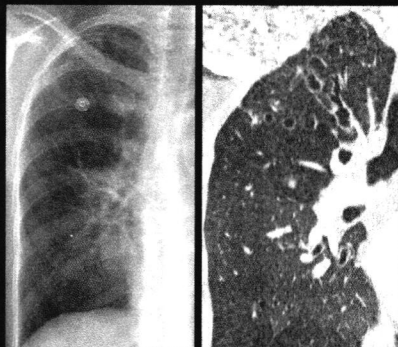
- Tuberculoma
- 5% of patients with TB
- 5 mm - 40 mm
- Satellite nodules
- Calcification in up to 30%



Kim HY et al. *Radiographics* 2001

## Complications - Lung

- Bronchiectasis
- 30% - 60% of patients with post-primary TB
- Up to 85% of patients on CT
- Favors apical and posterior segments of upper lobes



## Complications - Lung

- Tracheobronchial stenosis
  - Compression from lymph nodes
  - Primary airway wall infection
- Left main bronchus most common
- Irregular luminal narrowing

