Perspectives on Adult TB Radiology

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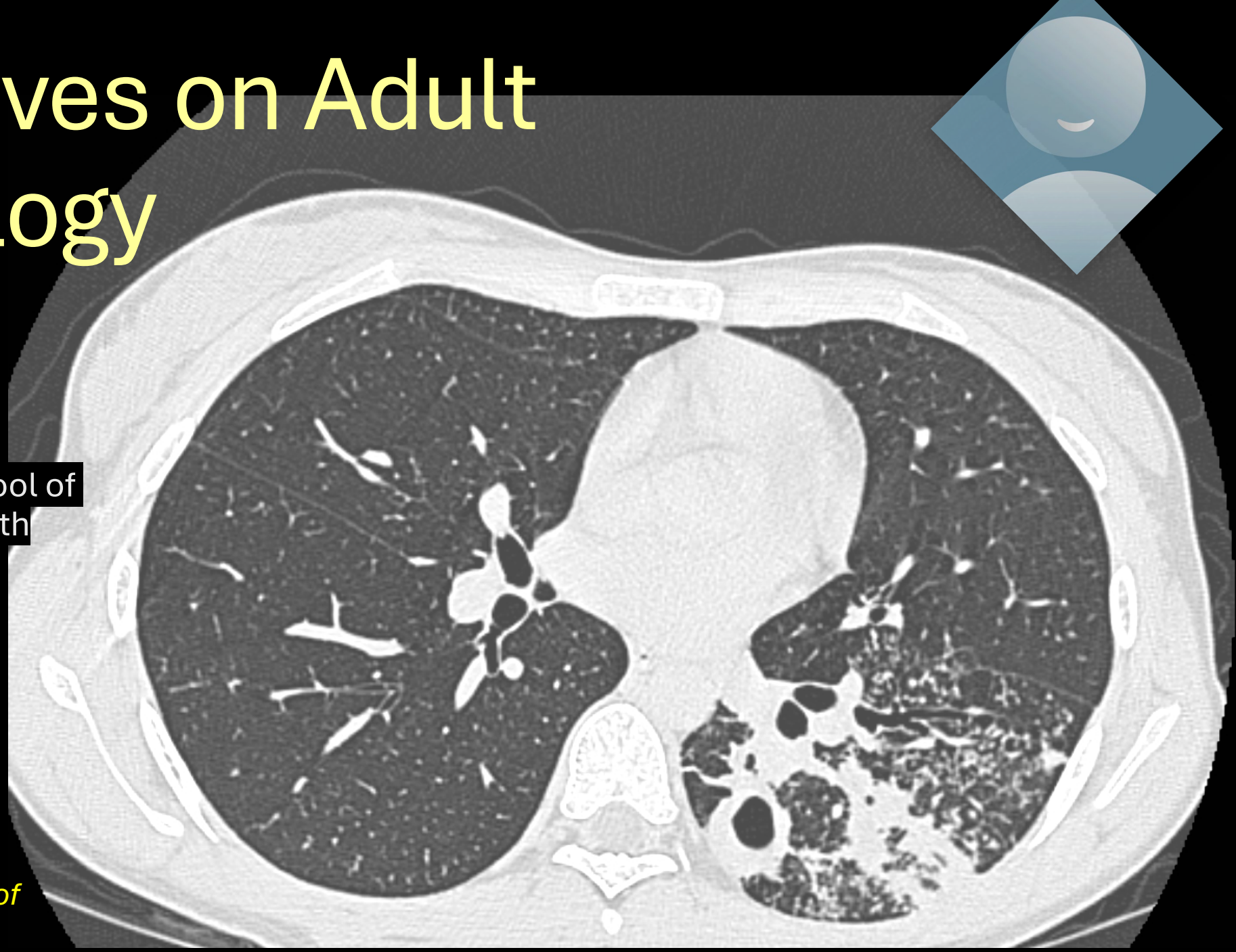
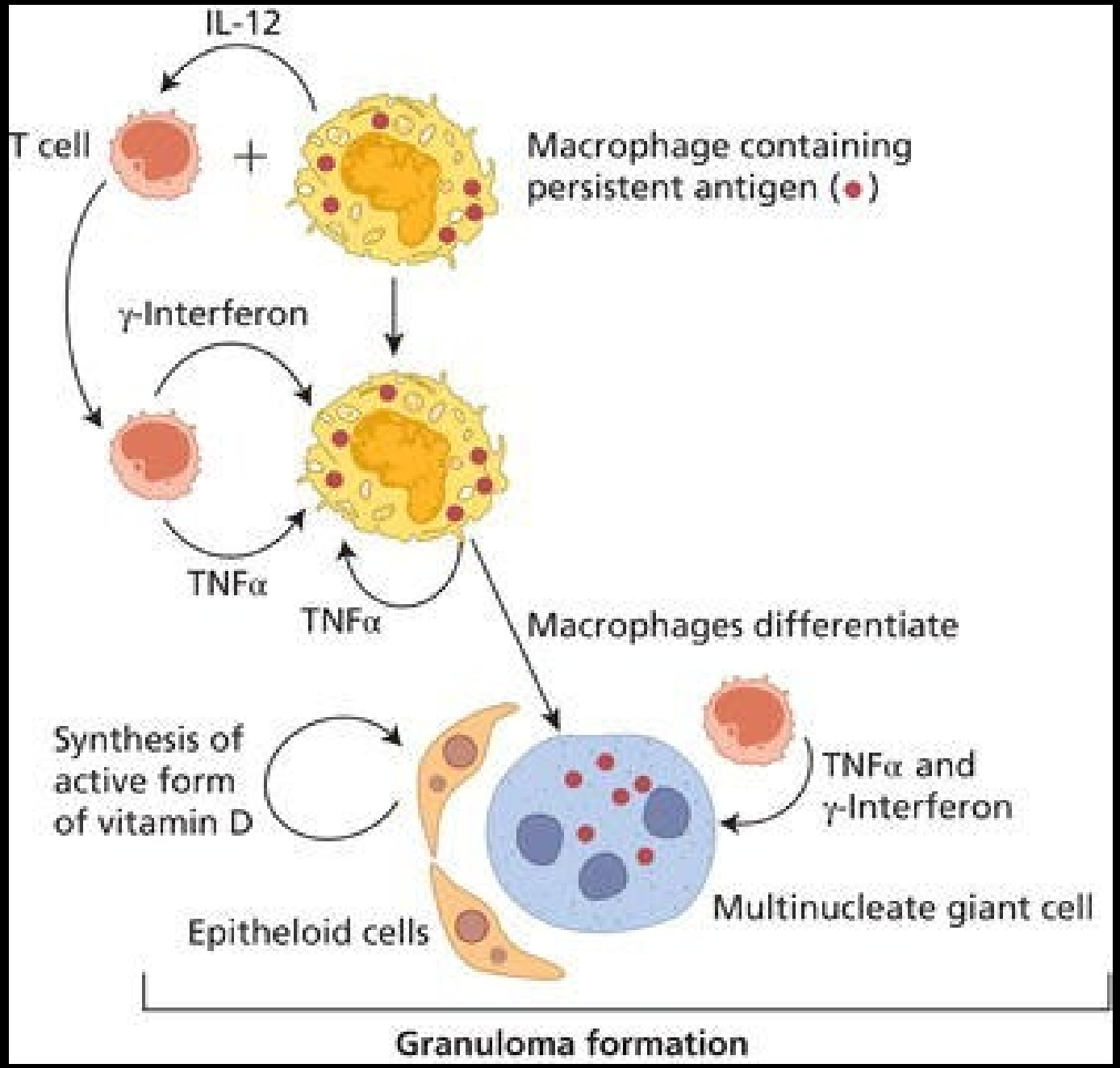


Thank you to Jeff Kanne, MD, FACR, FCCP!
Chief of Thoracic Imaging
Department of Radiology
University of Wisconsin School of Medicine and Public Health

Overview

- Pathology background
- Imaging review: Radiographs (x-ray) vs CT
- Clinical approach: Primary vs post-primary
  - Case examples
- Imaging approach: Active vs latent
  - Case examples
    - Active
    - In immunocompromised patients
    - Disseminated
    - Multi-drug resistant
- Complications

Pathology background



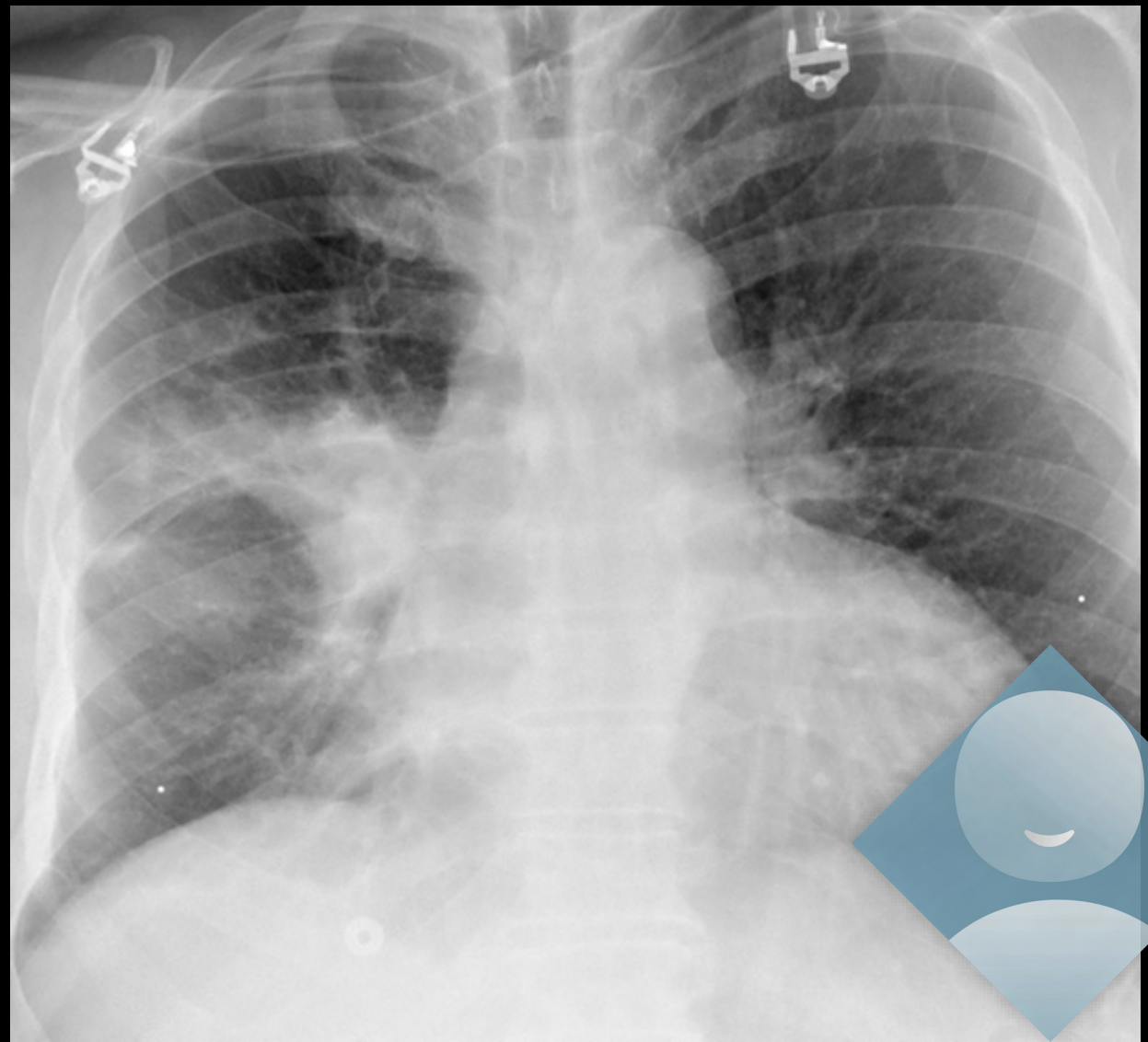
Chest Diseases. Chapel and Haeney's Essentials of Clinical Immunology, 7th Edition. December 31, 2021.

Pathology background

- Host response to TB dictates disease
- 4 possibilities:
  - Bacterial clearance
  - Latent infection
  - Active pulmonary TB
  - Disseminated/miliary TB

Background: Radiographs (x-ray)

- Opacities and densities
- Cardiomediastinal contours



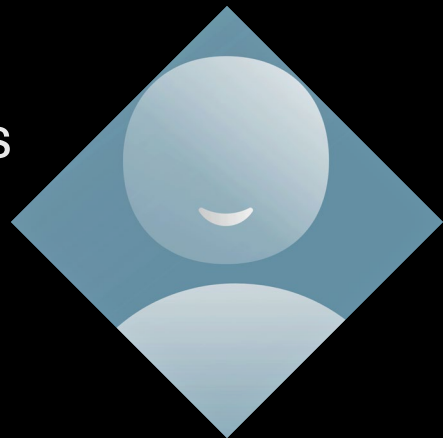
Background: Computed tomography (CT)

- Soft tissue window vs lung window
- Can see many more findings than x-ray

Radiographs vs. Computed Tomography (CT)

- Radiography (x-ray): less sensitive
  - Screening for active disease
  - Large nodules
  - Consolidation
  - Mediastinal lymphadenopathy
  - Subtle cavitation

- CT: more sensitive
  - Miliary nodules
  - Useful for evaluating pleural, mediastinal, and chest wall complications
  - Endobronchial spread

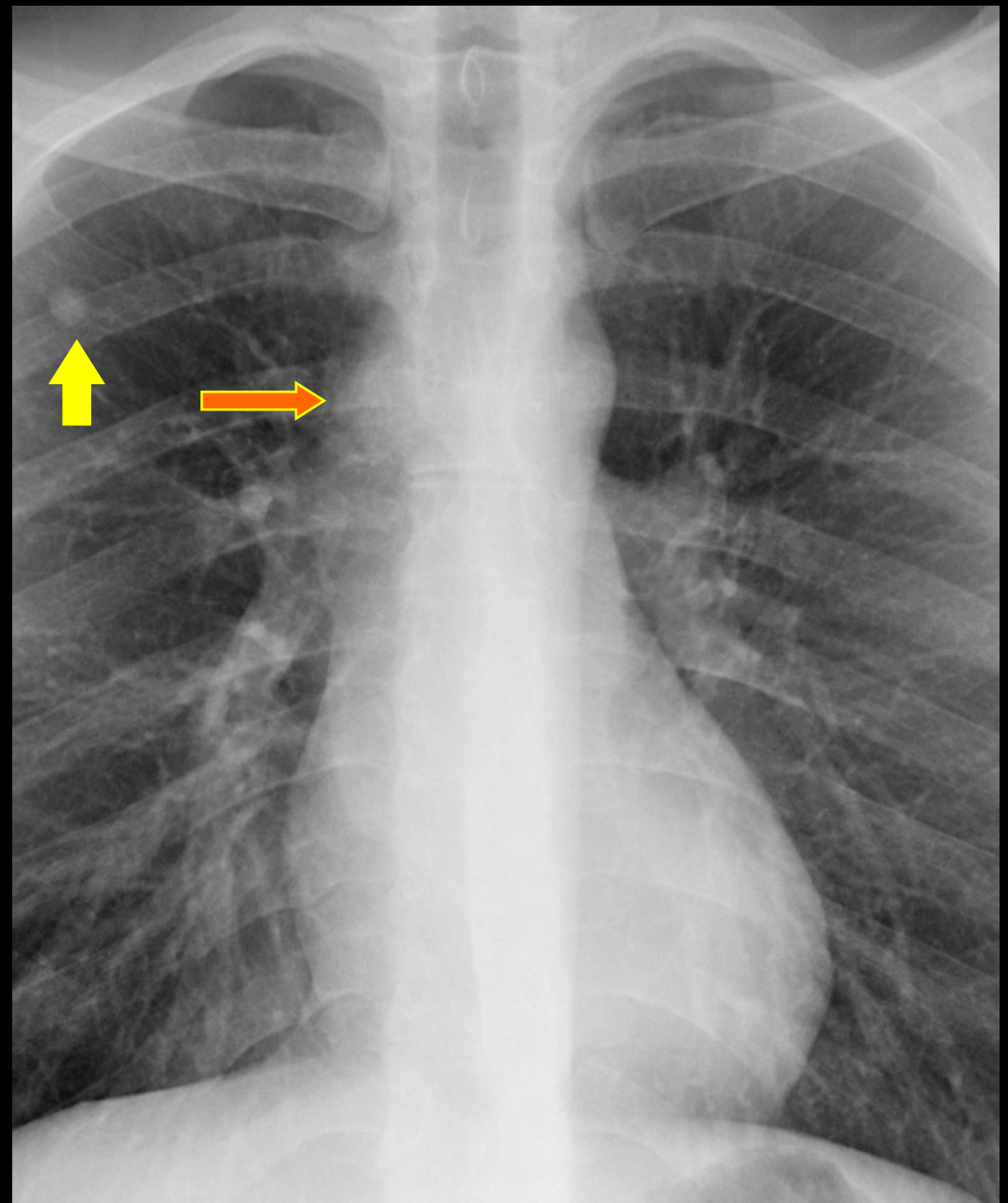


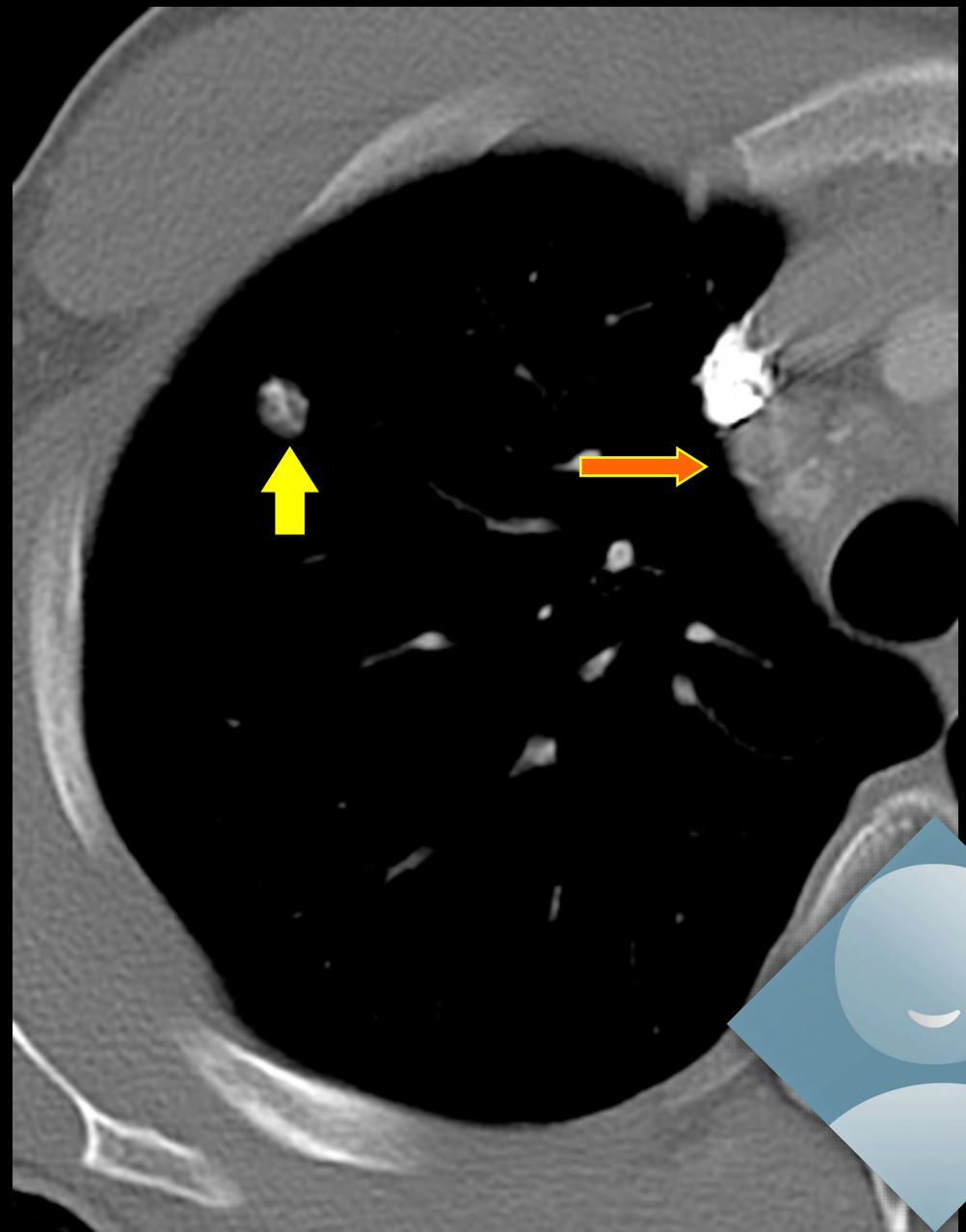
Primary TB

- Ghon focus: initial site of infection
  - Heals and forms calcified nodule
  - May expand to cause consolidation

- Ranke complex:
  - Ghon focus *and*
  - Regional lymphadenitis

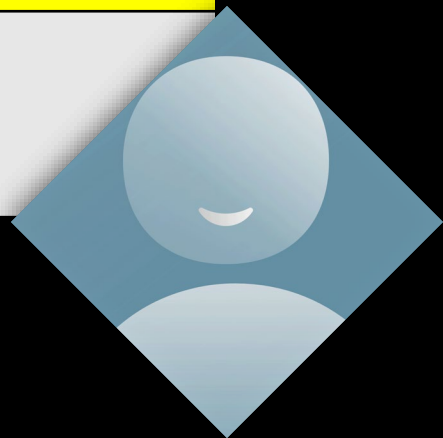
Ranke Complex



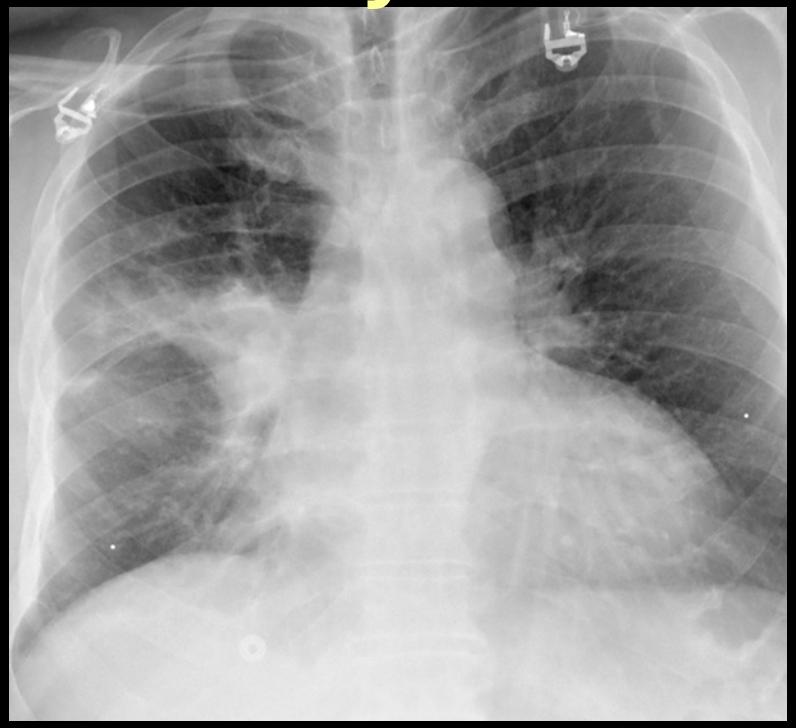


Primary TB

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

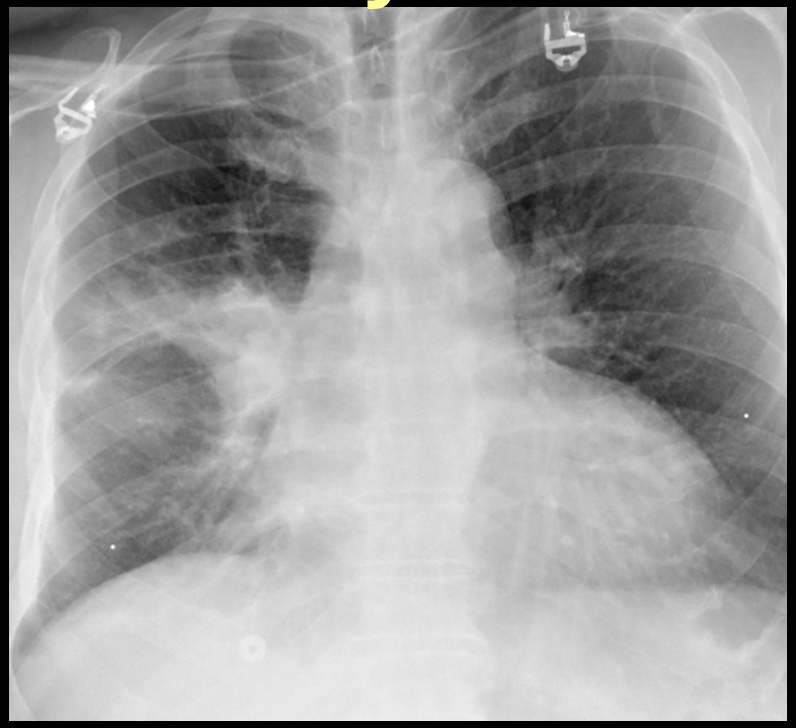


Primary TB Imaging Findings

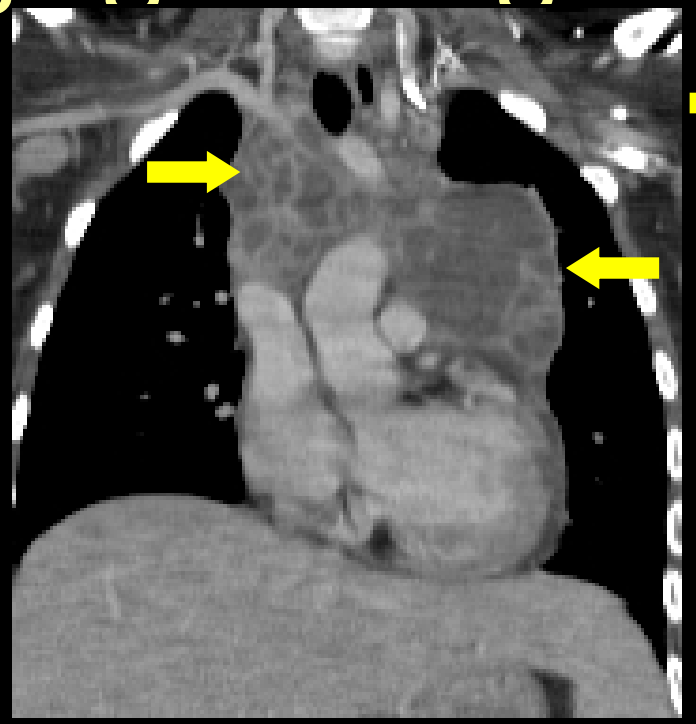


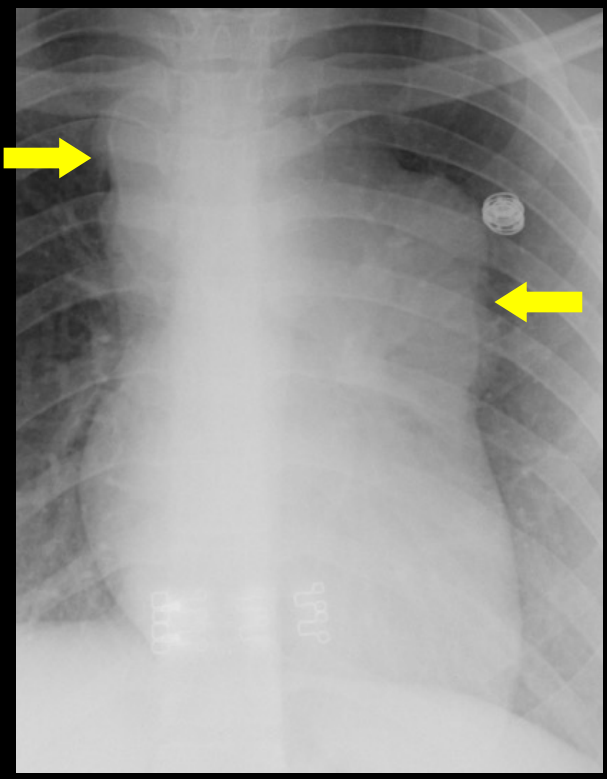
Consolidation

Primary TB Imaging Findings



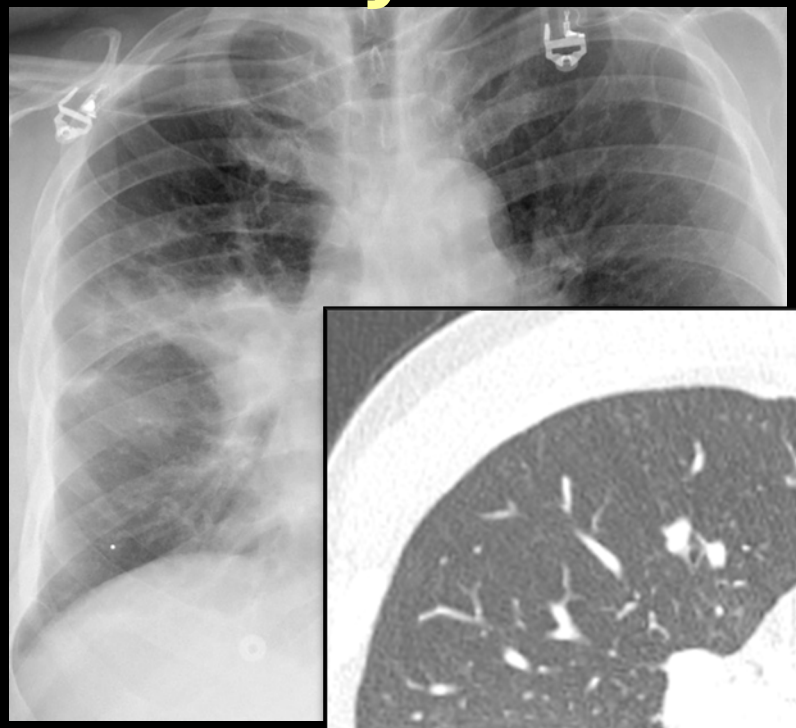
Consolidation





Lymphadenopathy

Primary TB Imaging Findings



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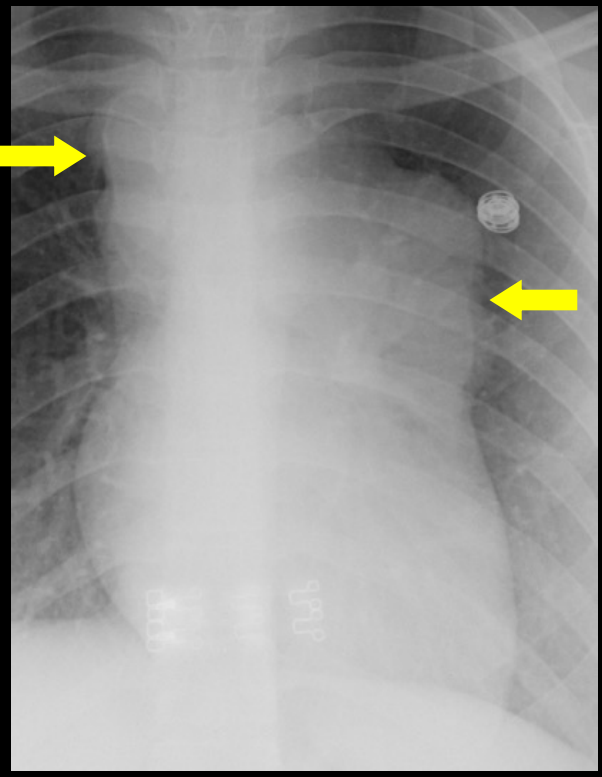
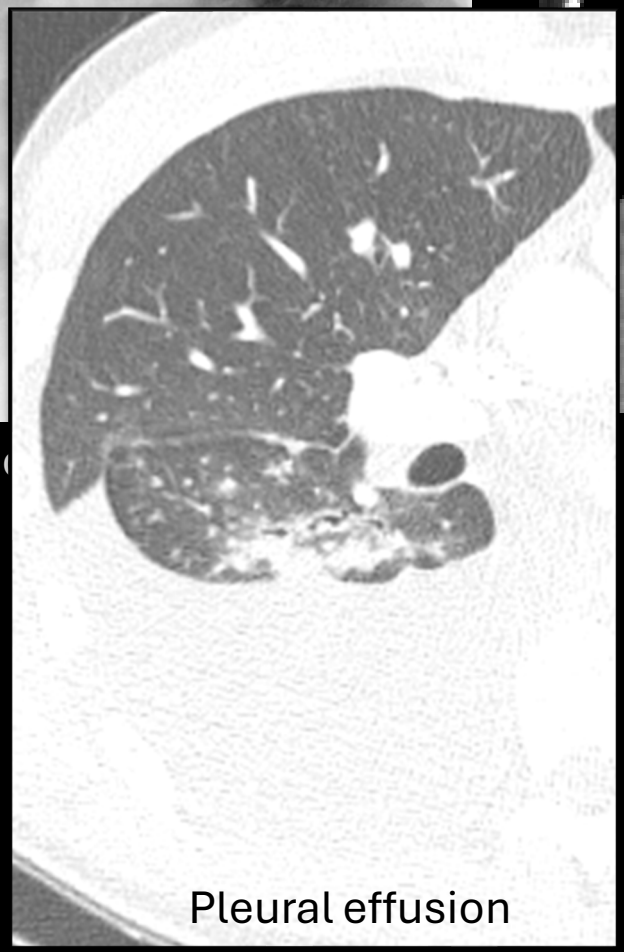
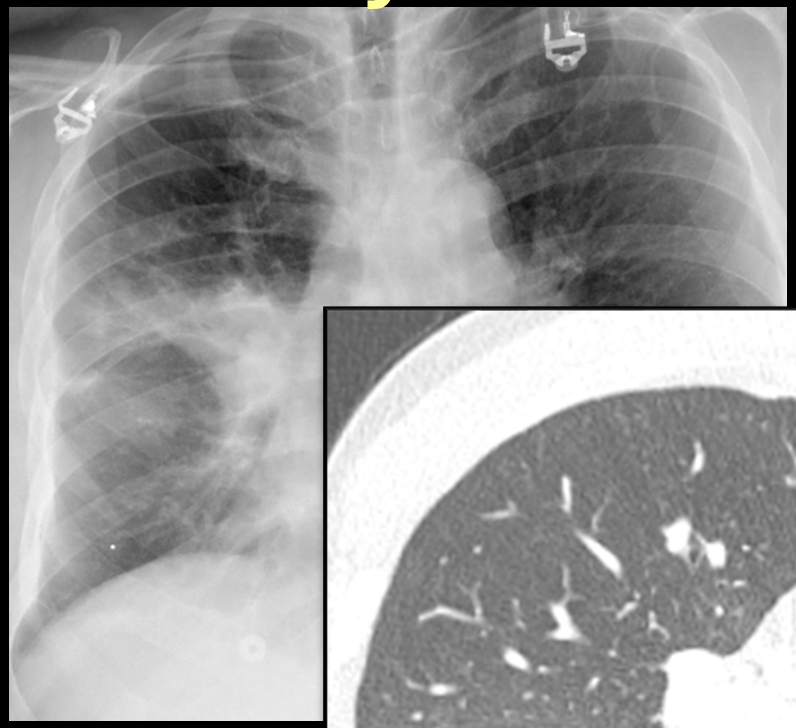


Lymphadenopathy



Pleural effusion

Primary TB Imaging Findings



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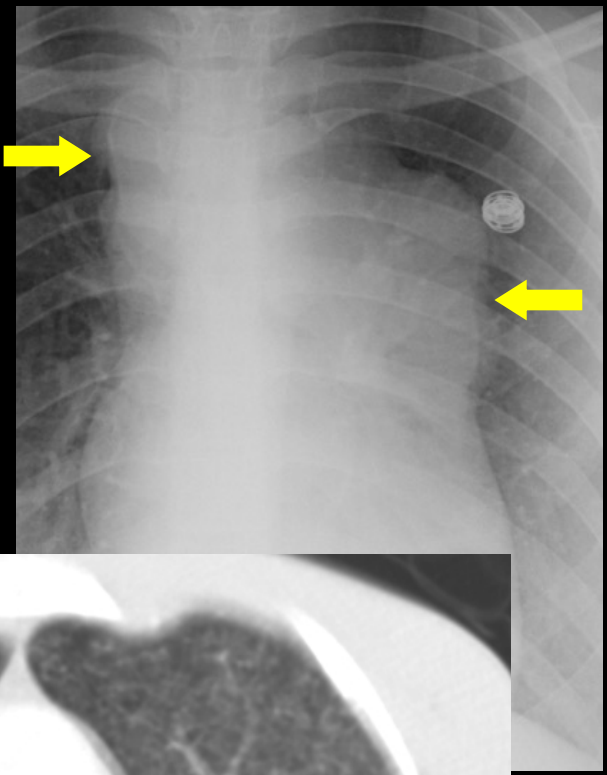
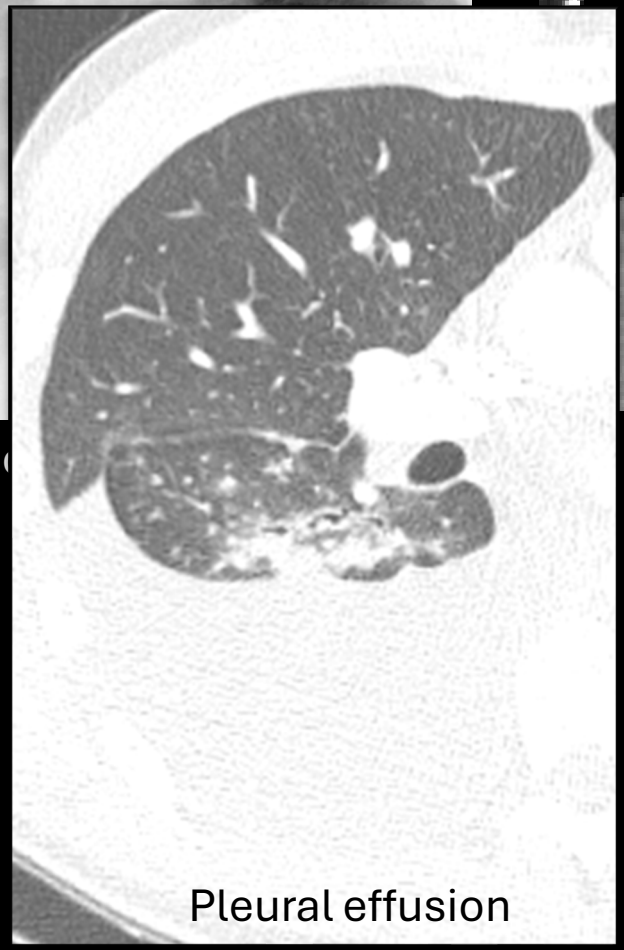
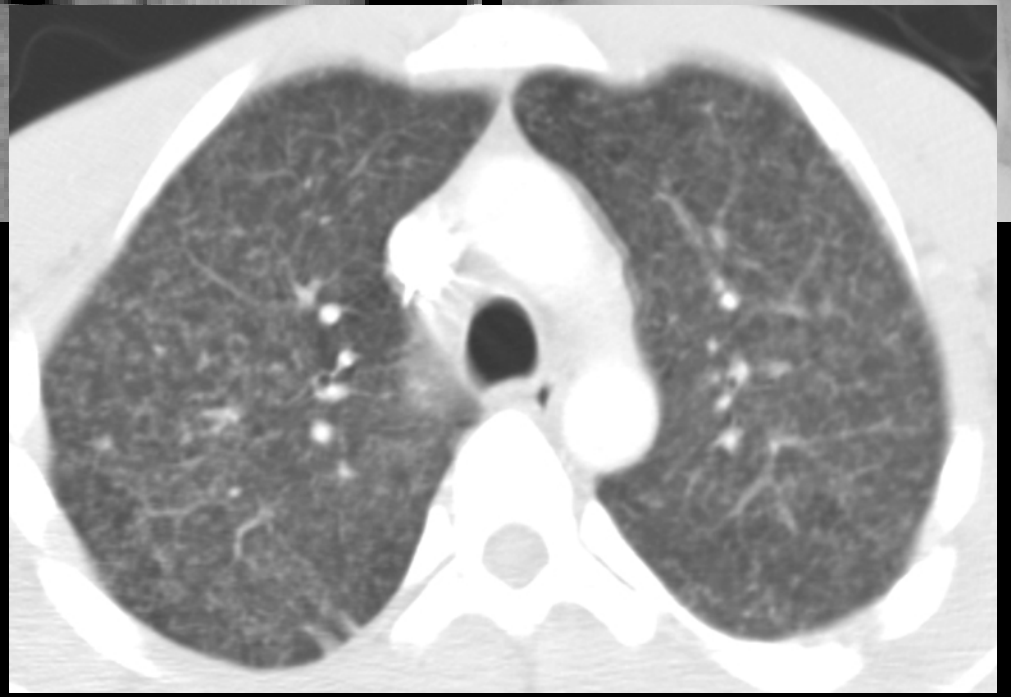


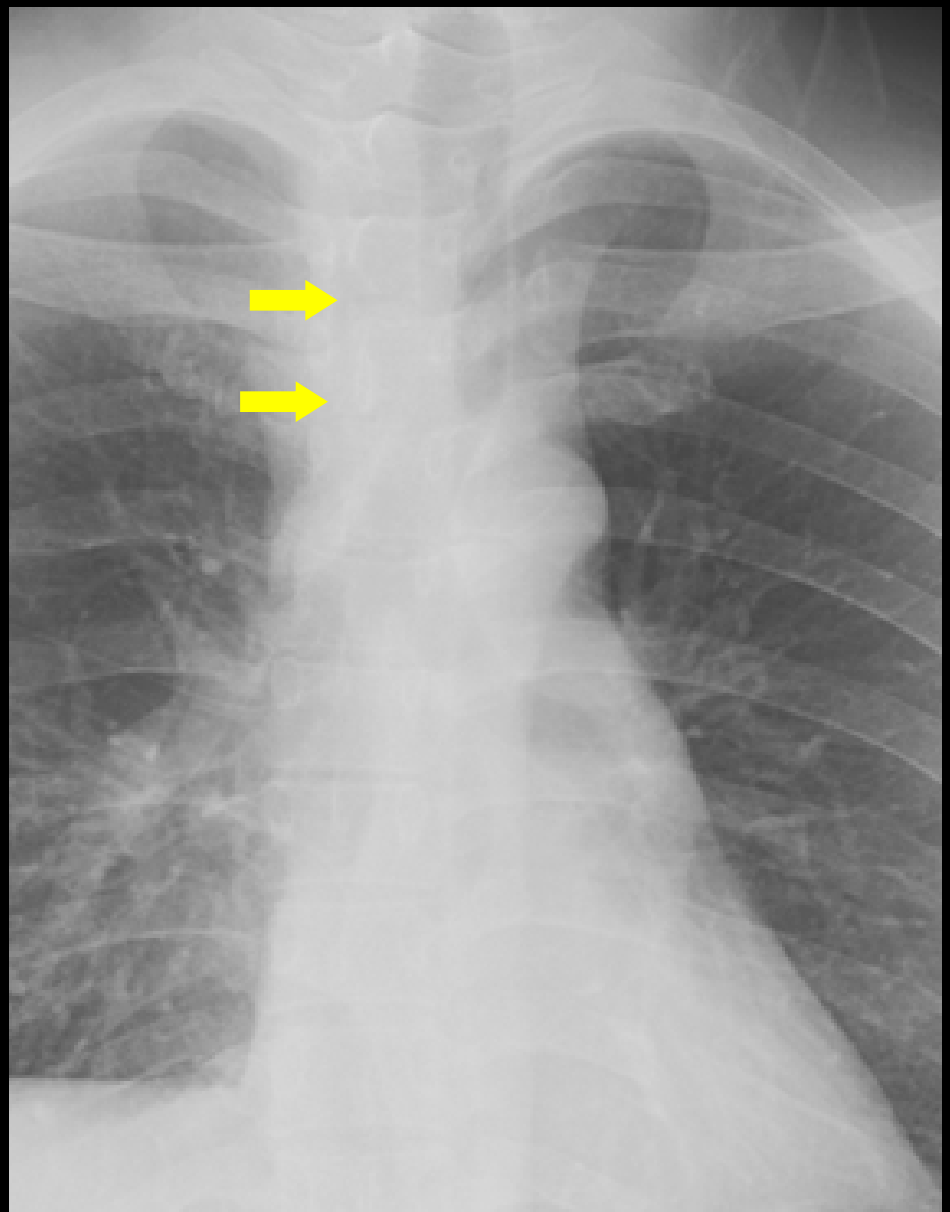


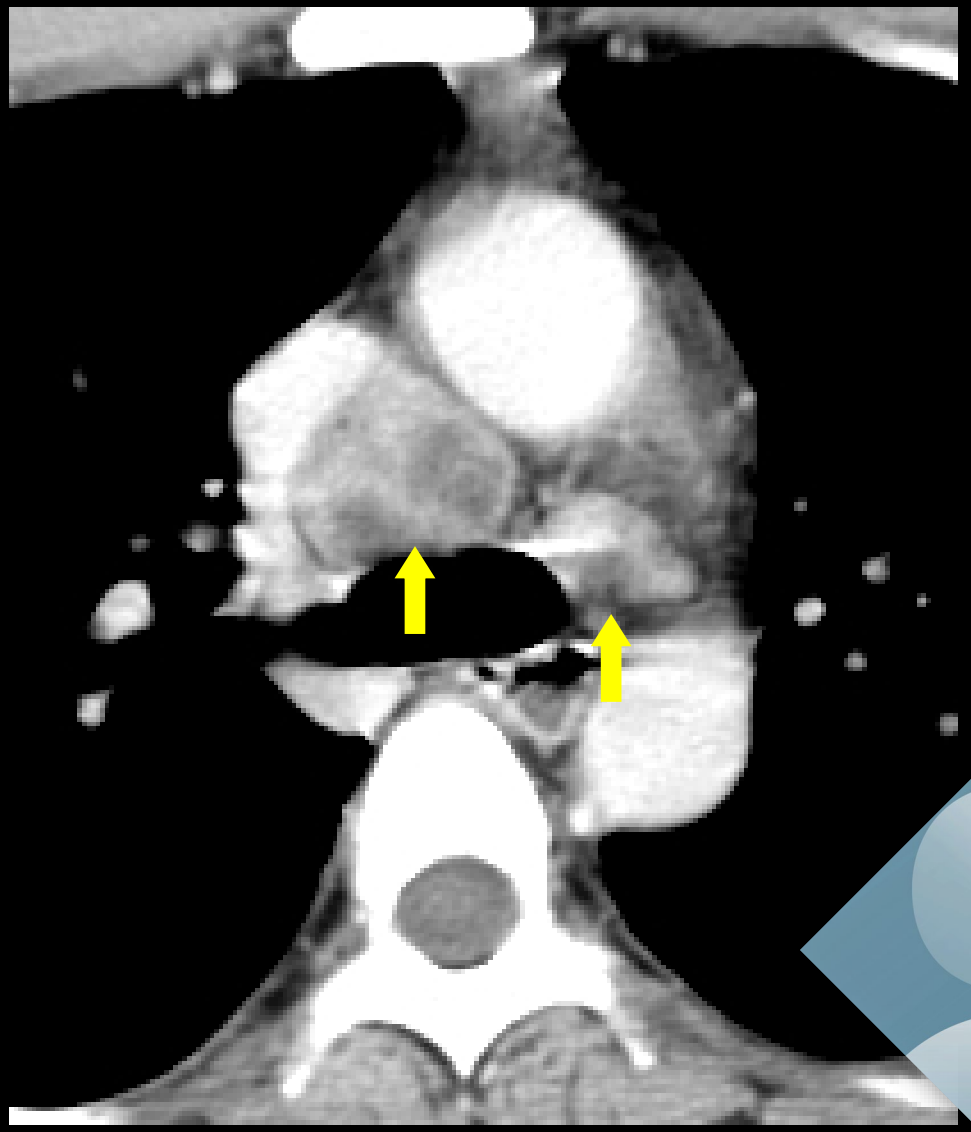
Pleural effusion



Miliary disease

Primary TB: Lymphadenopathy





Post-Primary TB Imaging Findings

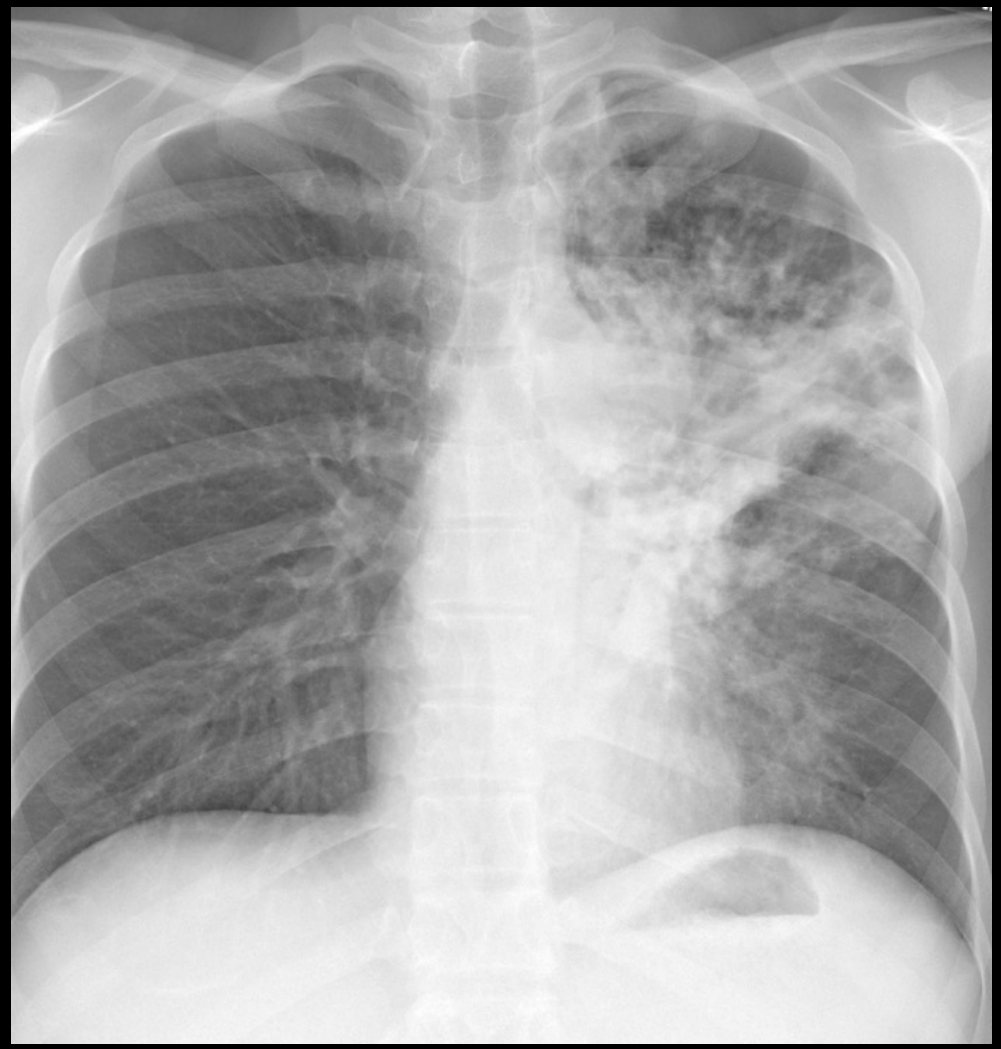
- Centrilobular nodules, “tree-in-bud” sign, consolidation, ground-glass opacities, cavitation, bronchial wall thickening, miliary nodules, an isolated pulmonary nodule, parenchymal bands, interlobular septal thickening

~~Post-Primary TB~~ Imaging Findings

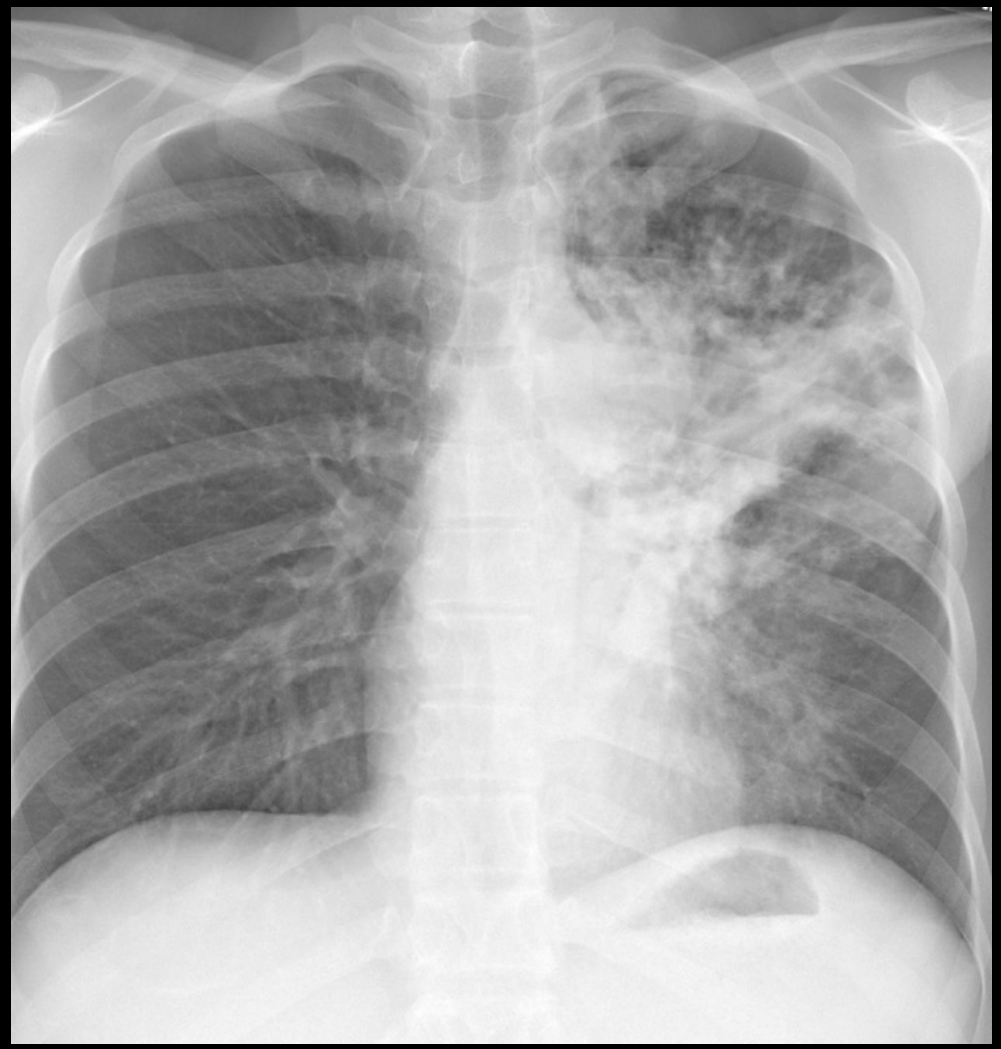
Active

- Centrilobular nodules, “tree-in-bud” sign, consolidation, ground-glass opacities, cavitation, bronchial wall thickening, miliary nodules, an isolated pulmonary nodule, parenchymal bands, interlobular septal thickening

Active TB: Consolidation



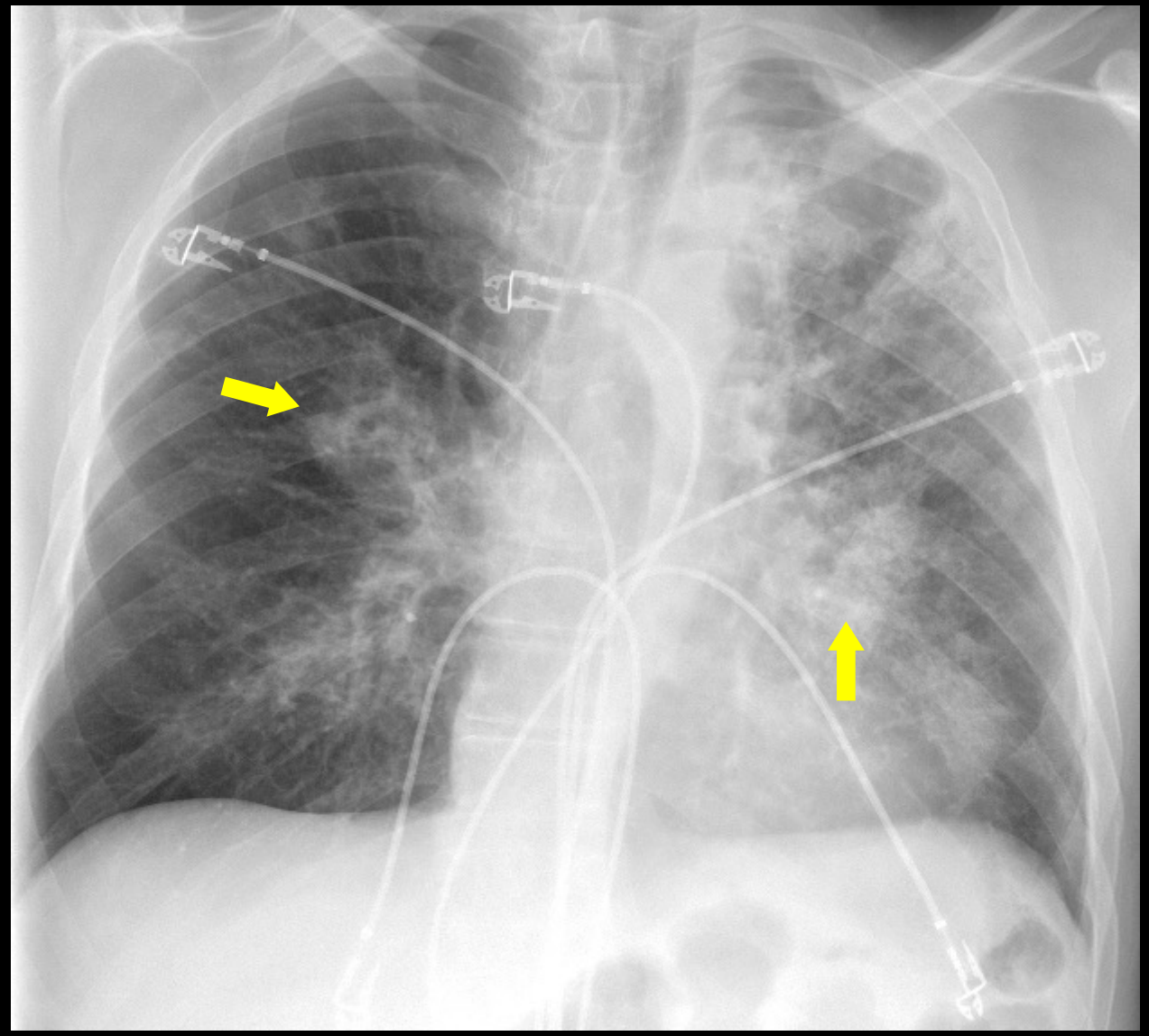
Active TB: Consolidation

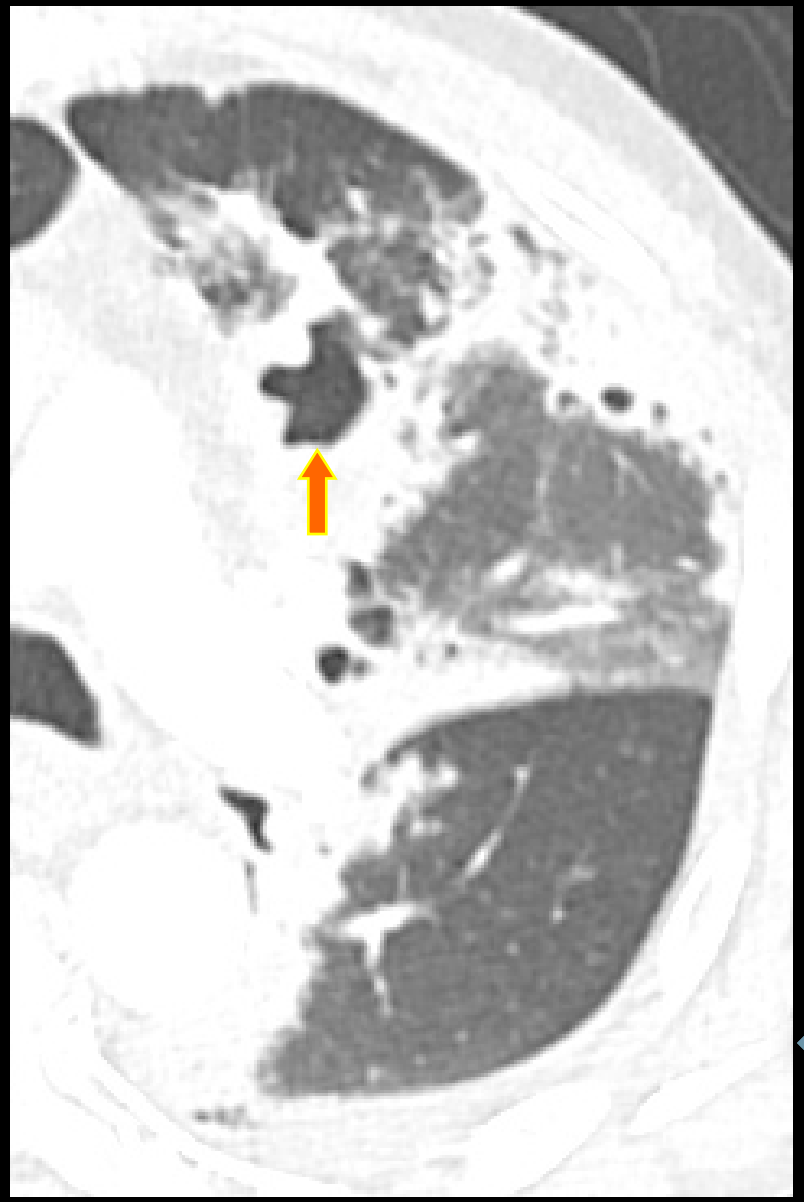


Initial radiograph

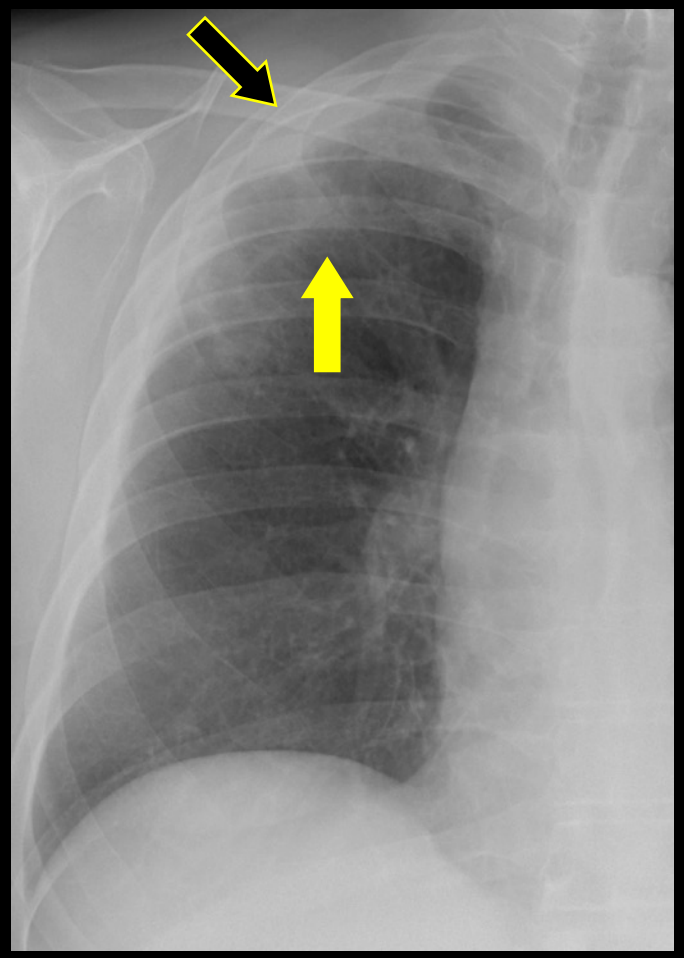
8 days later

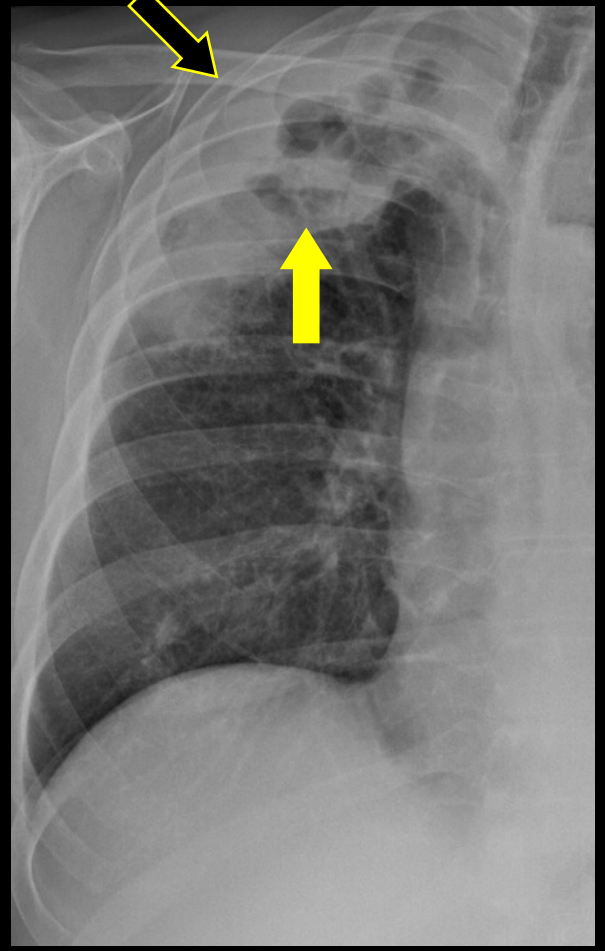
Active TB: Cavities

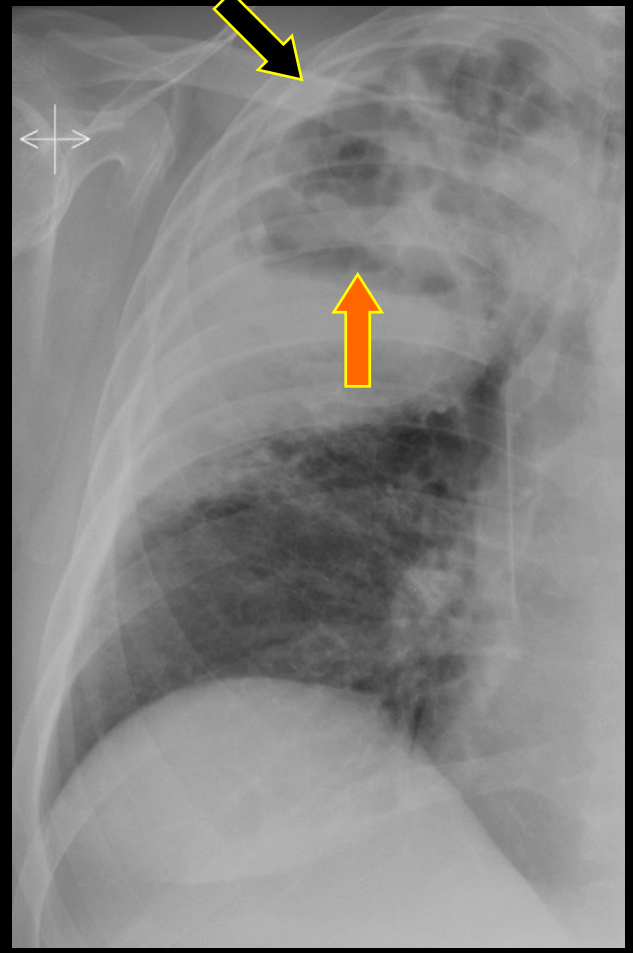


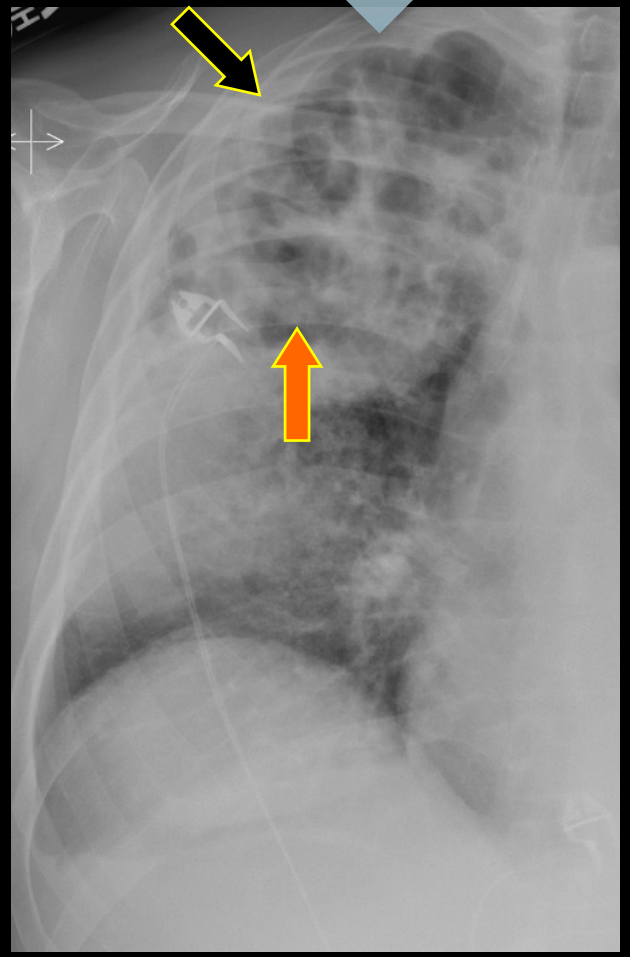


Active TB

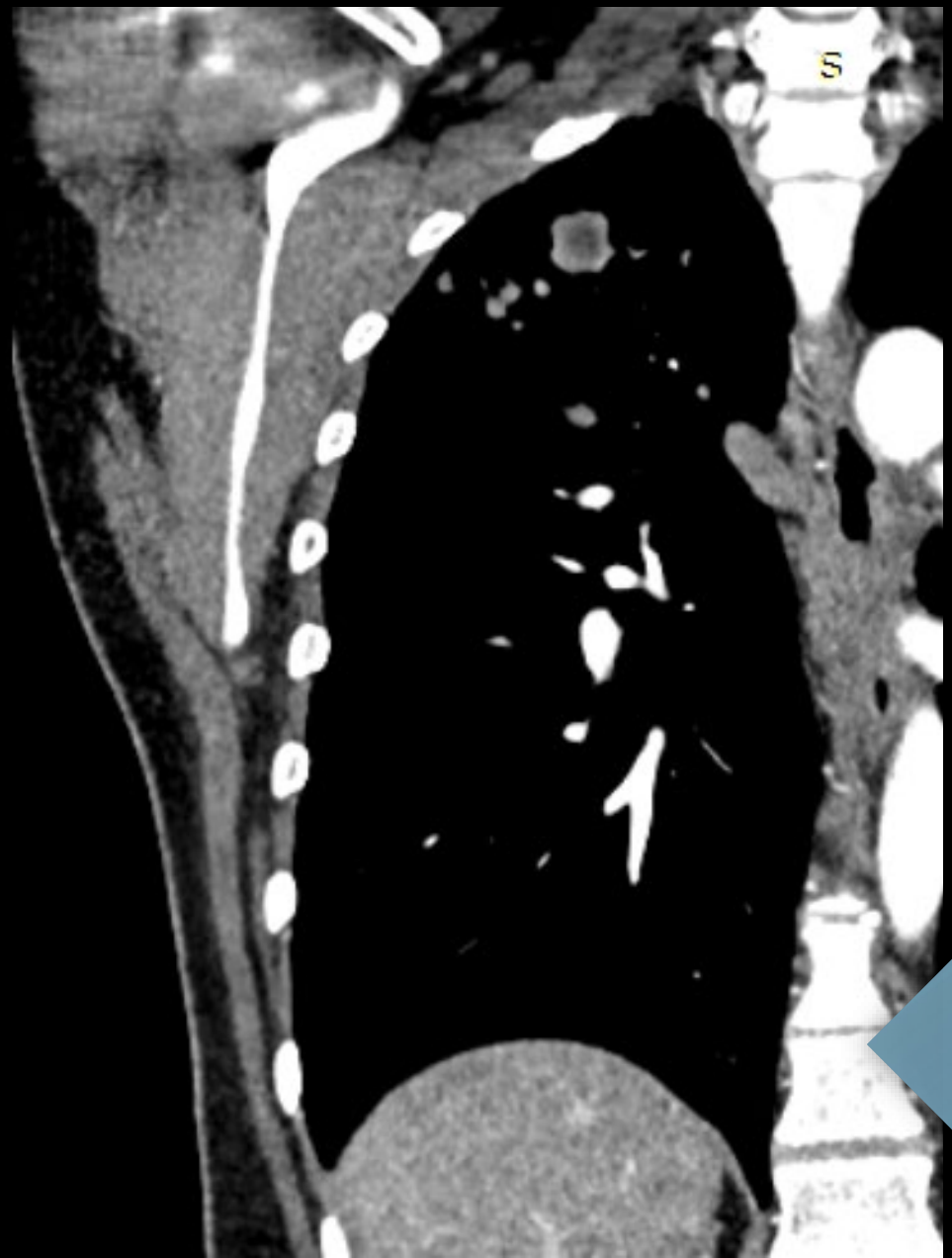




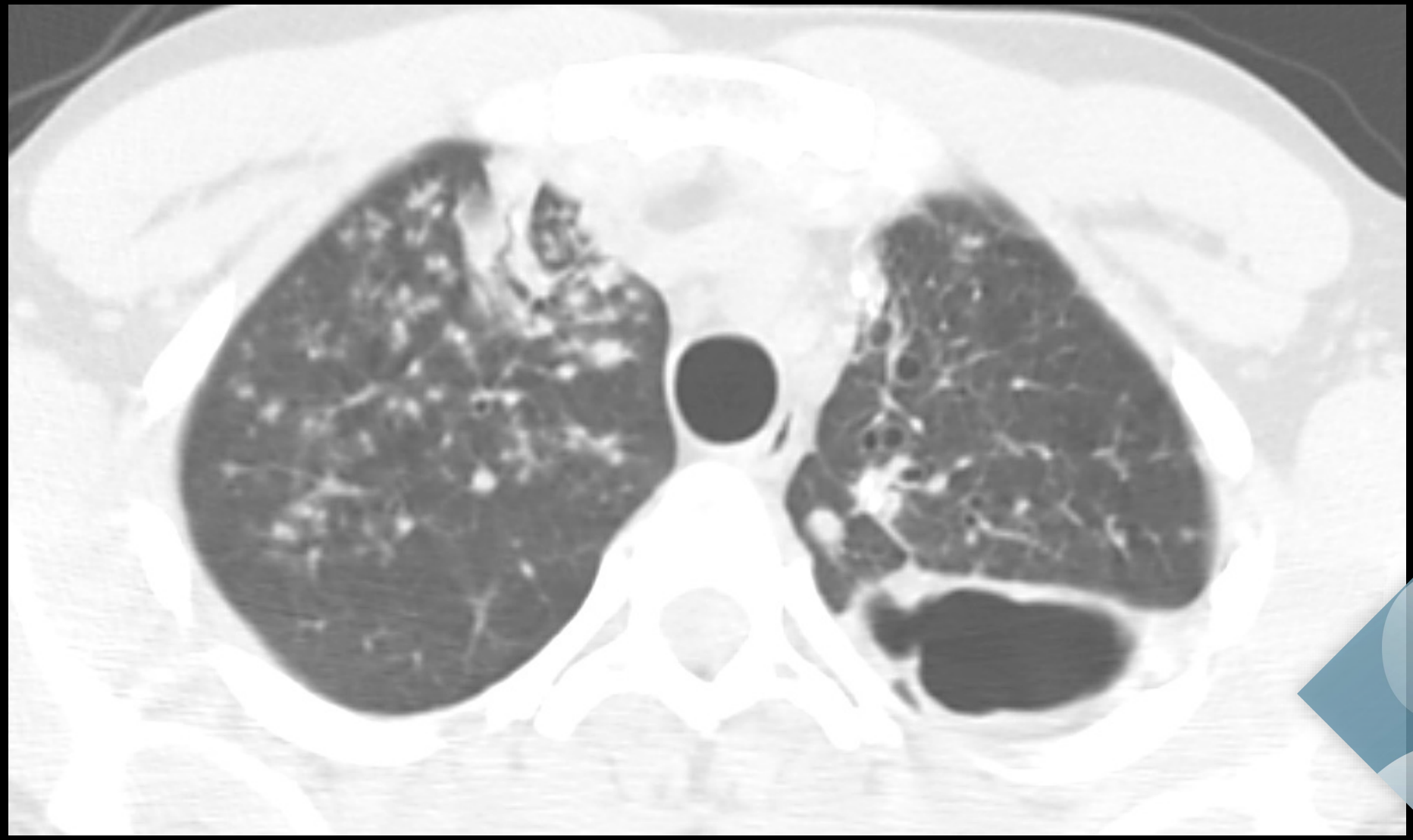




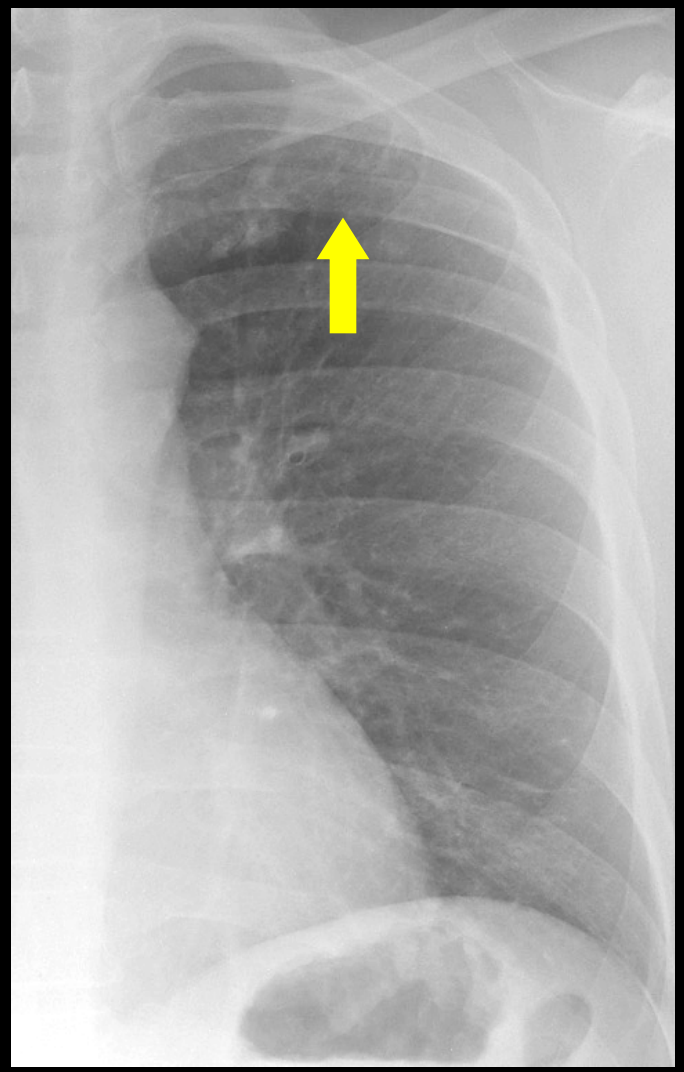
Active TB: Nodules

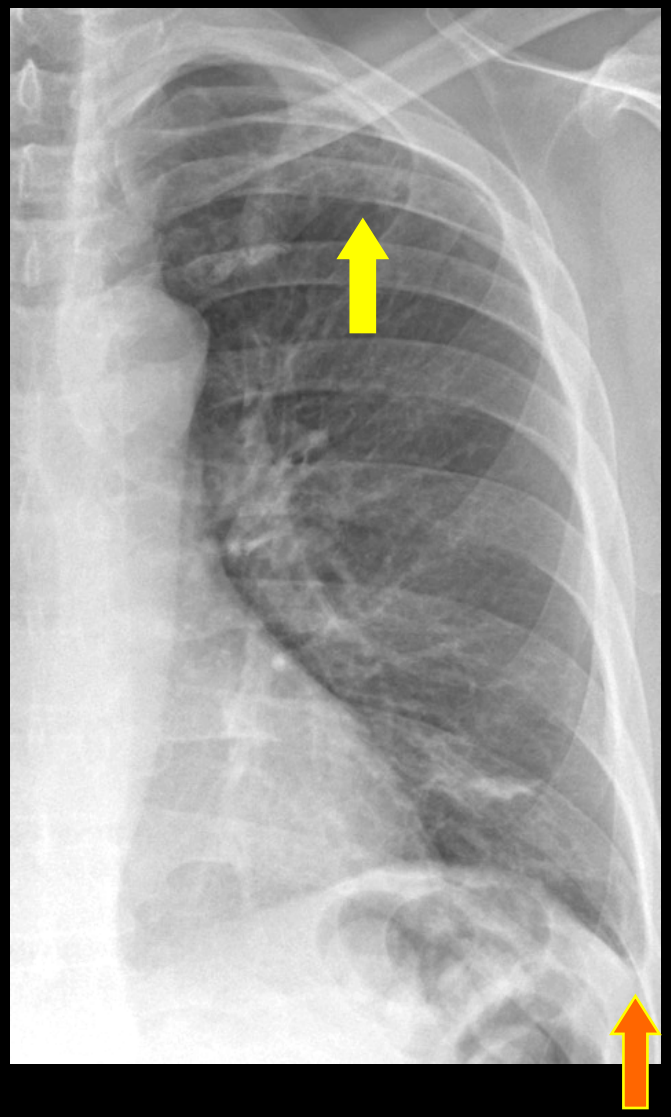


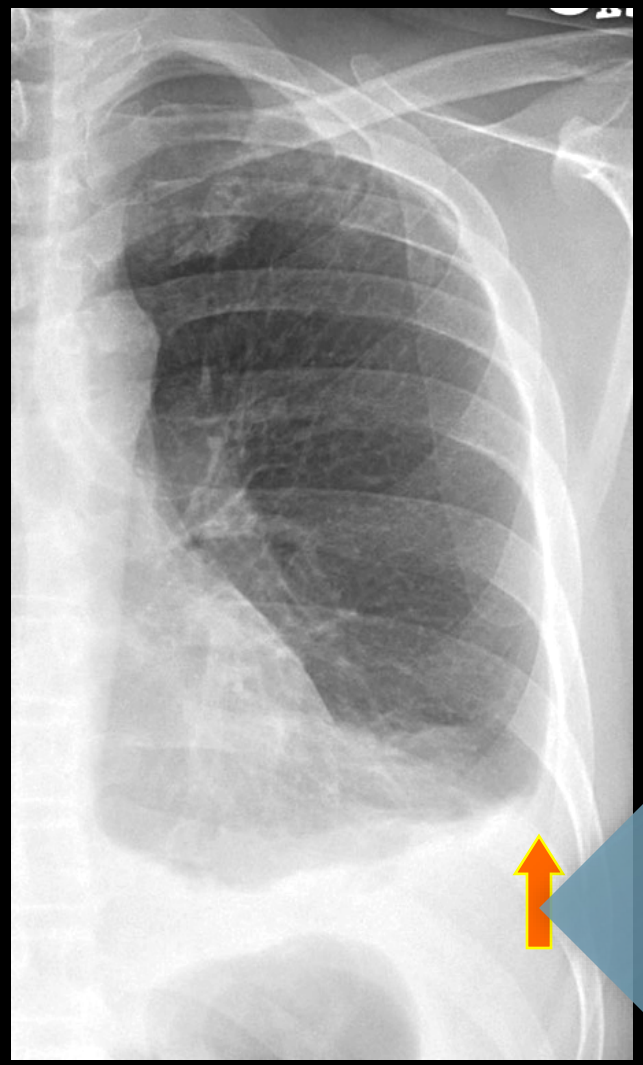
Active TB: Cavity and nodules



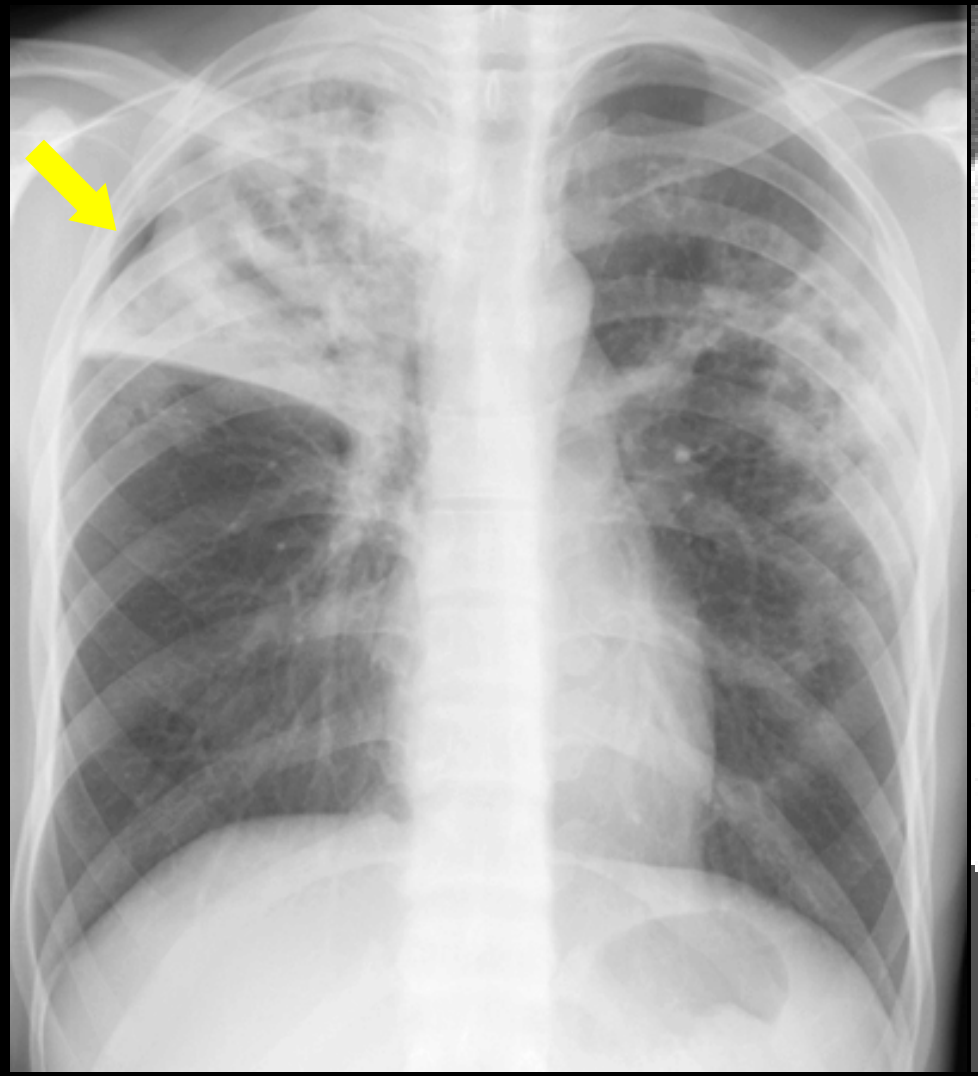
Active TB

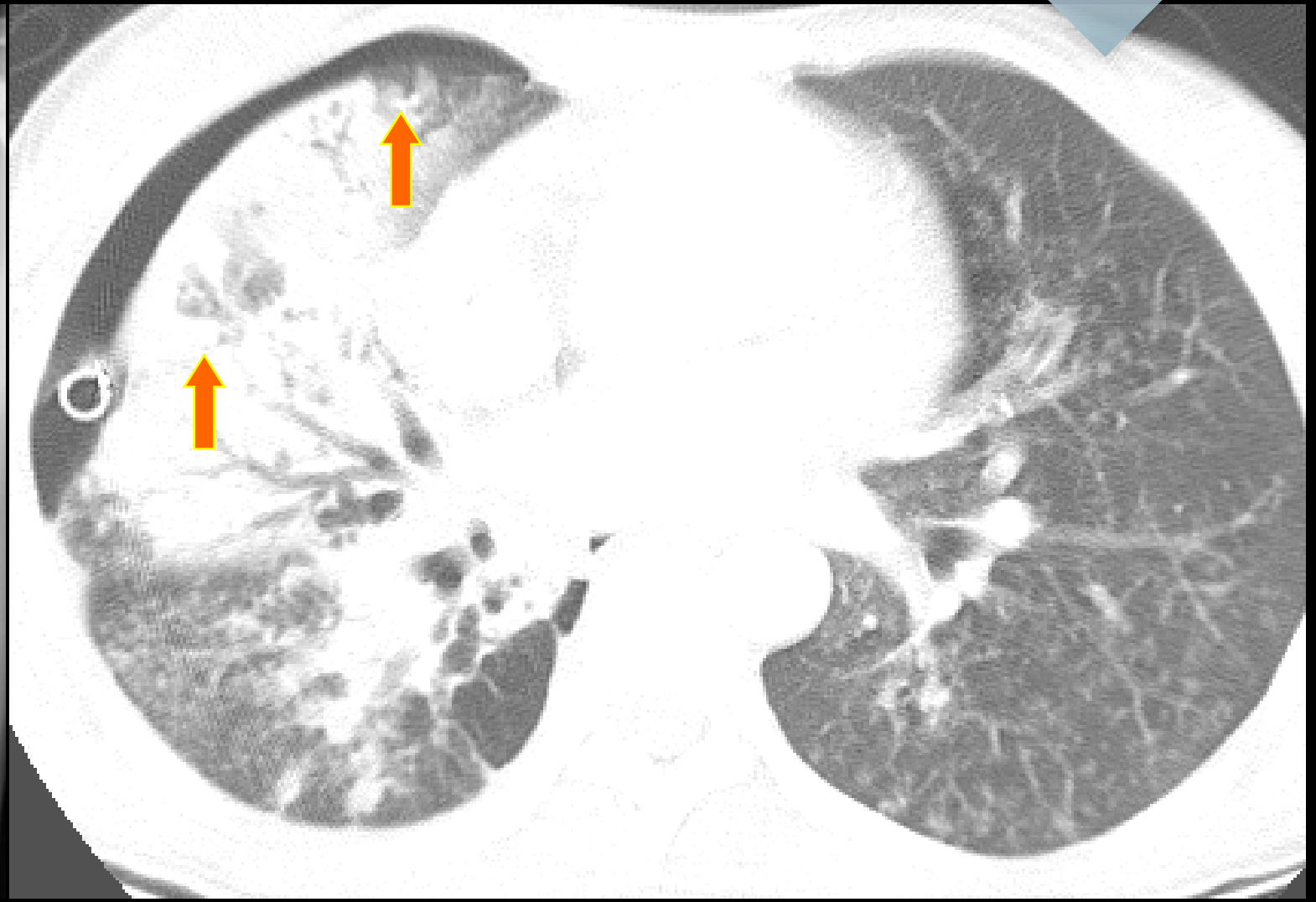




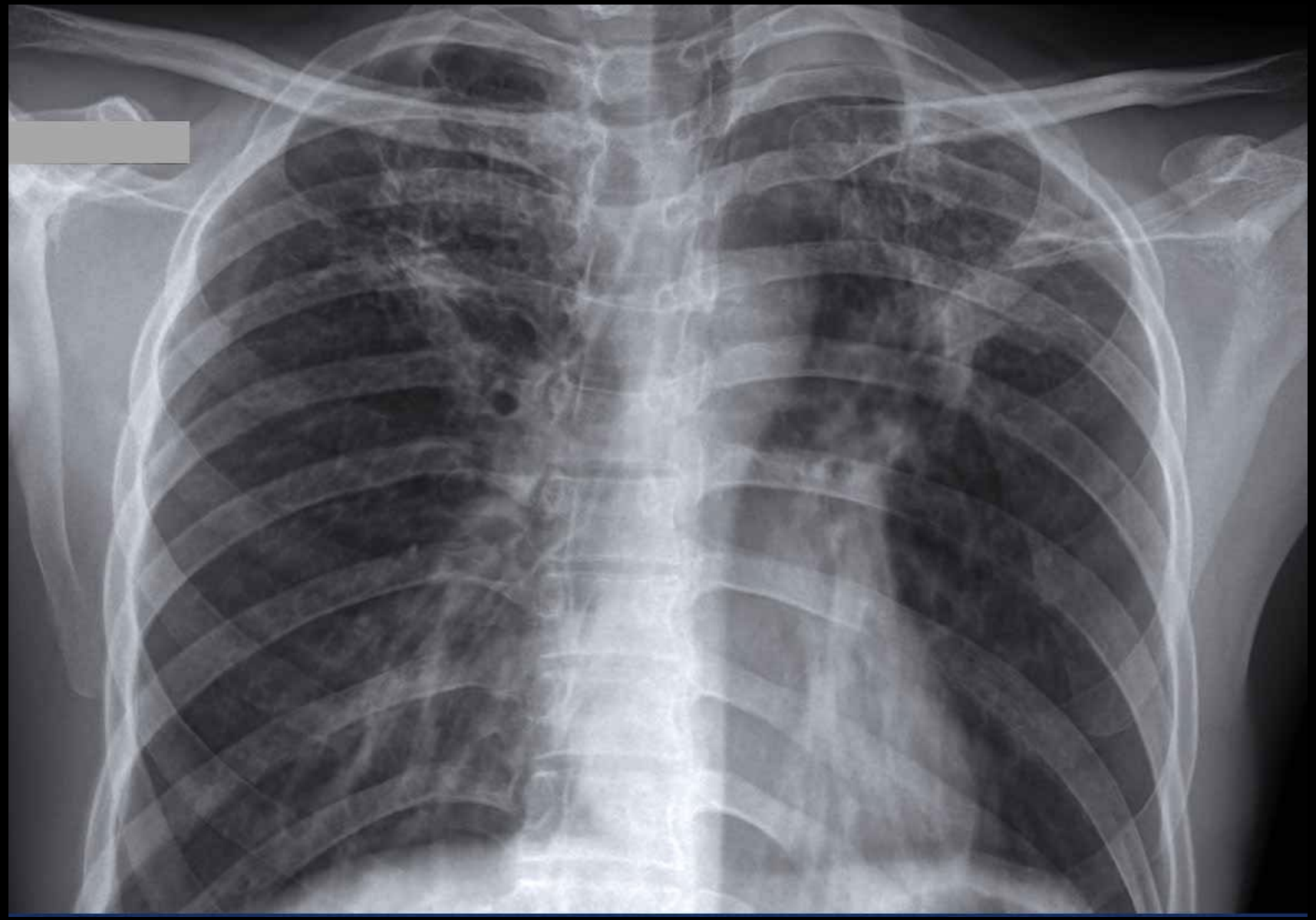


Active TB





Latent TB



Radiology Assistant

The Radiology Assistant : Imaging findings in TB

TB in Immuncompromised Patients

- Host's ability to mount a granulomatous immune response determines the imaging appearance
  - Preserved immunity → classic upper-lobe cavitary disease
  - Severe immunosuppression → atypical patterns

TB in Immuncompromised Patients

TB in HIV

- **Mild Immunosuppression (CD4 >200 cells/µL)**

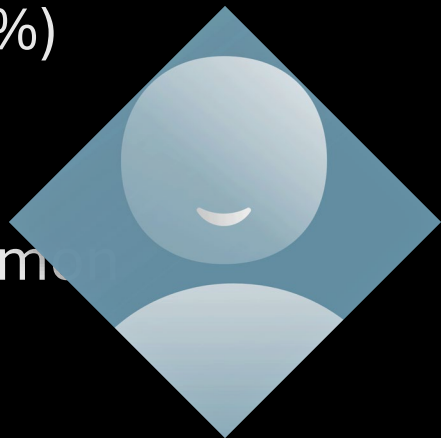
Radiographic Pattern Resembles immunocompetent disease

- Upper-lobe predominant
- Cavitation present in ~68% of cases
- Consolidation with air bronchograms
- Centrilobular tree-in-bud nodularity
- Pleural effusion less common

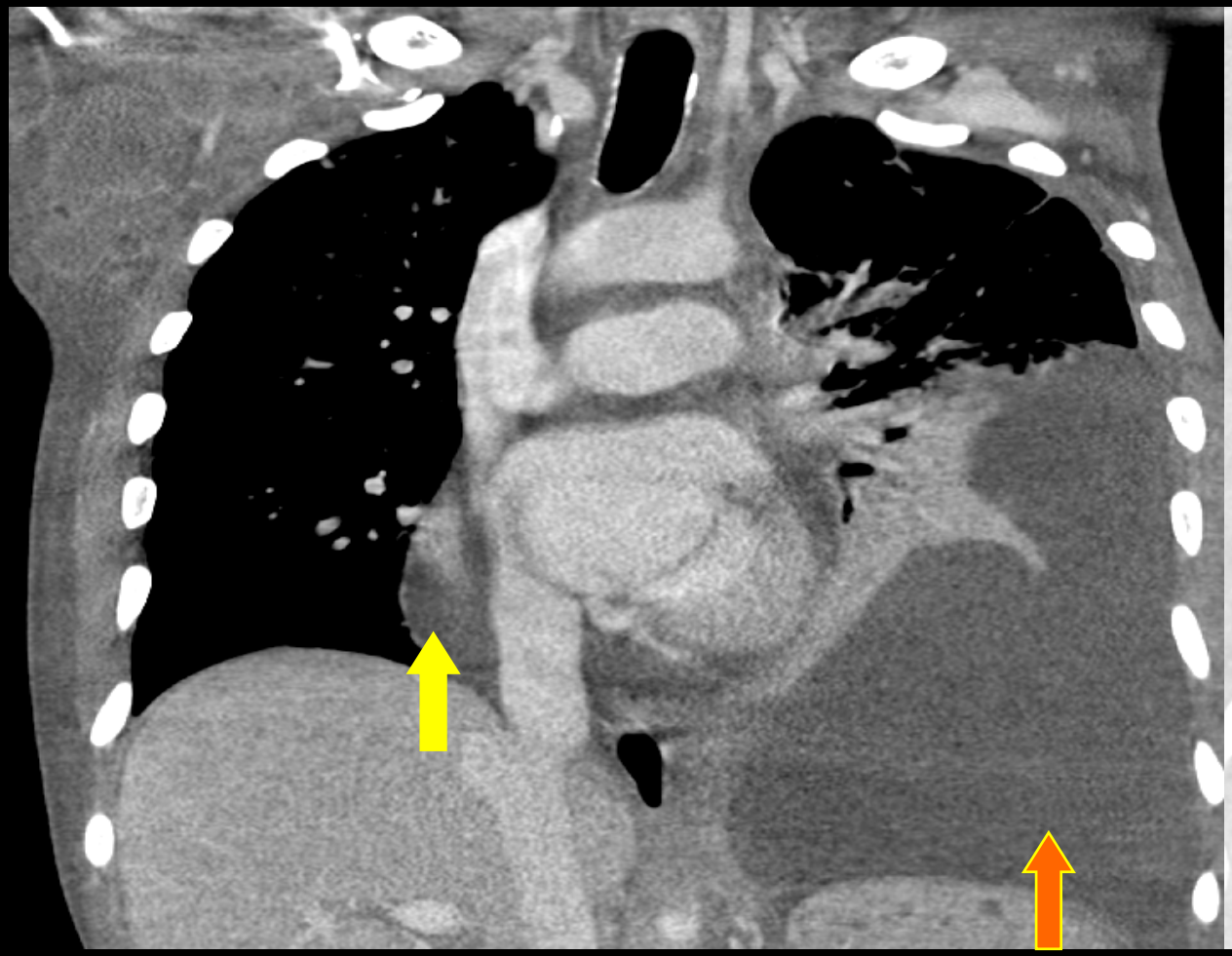
- **Severe Immunosuppression (CD4< 200 cells/µL)**

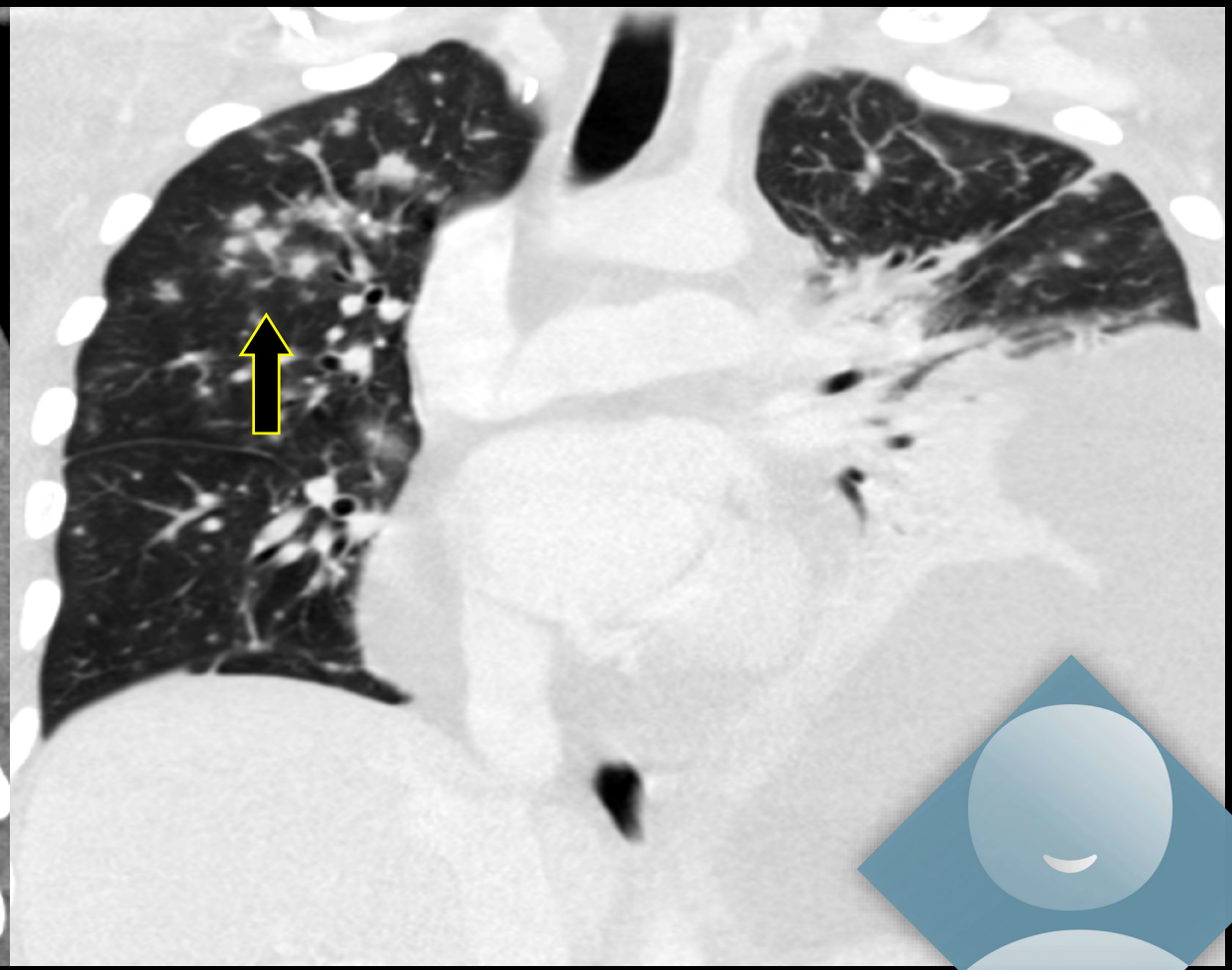
Radiographic Pattern: Atypical — reflects impaired granuloma formation

- Diffuse or lower-lobe predominant
- Cavitation infrequent (~32%)
- Lymphadenopathy
- Miliary pattern in ~64%
- Pleural effusion more comm



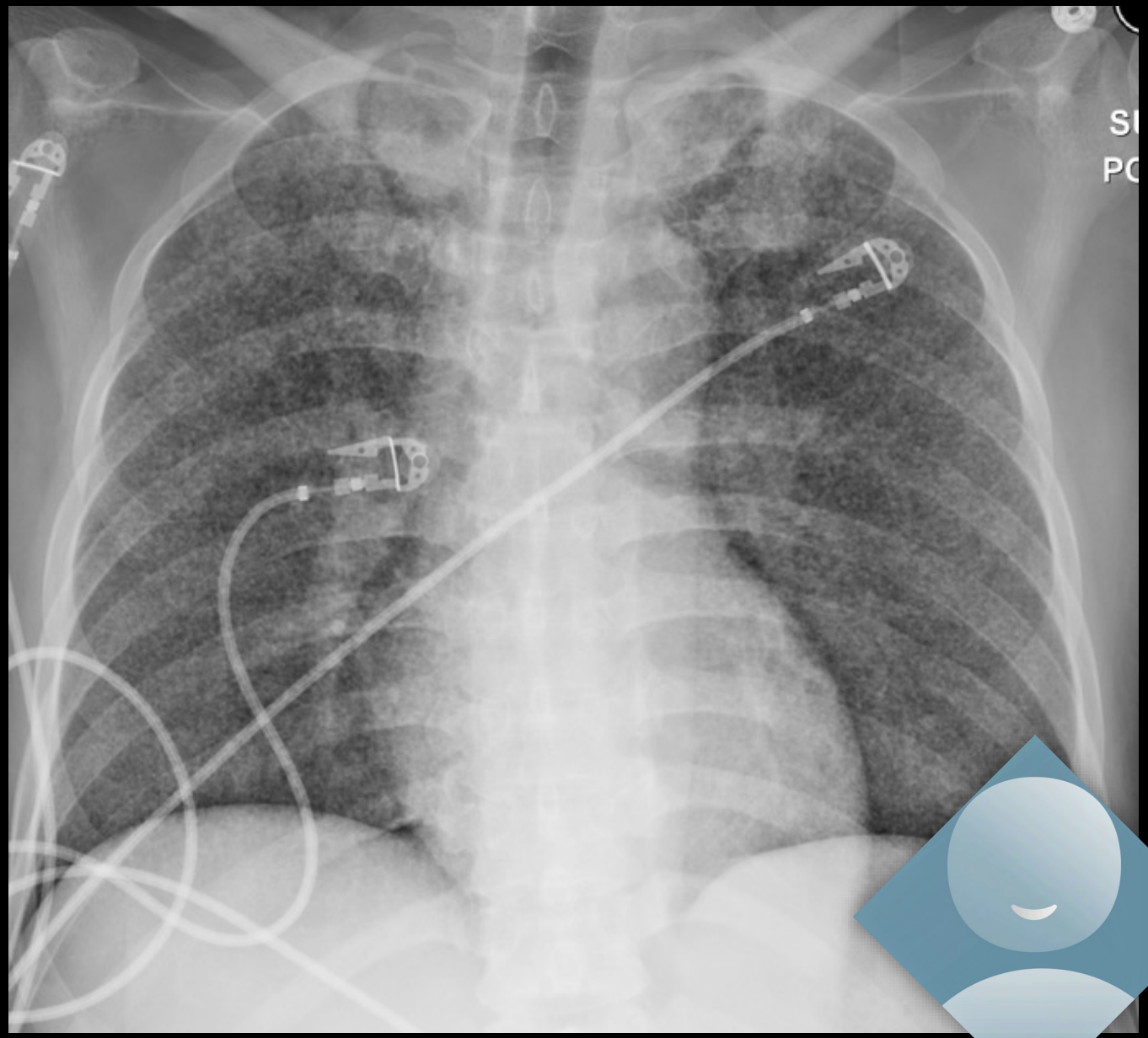
TB in HIV: CD4+ T-cell count: 150 cells/μL



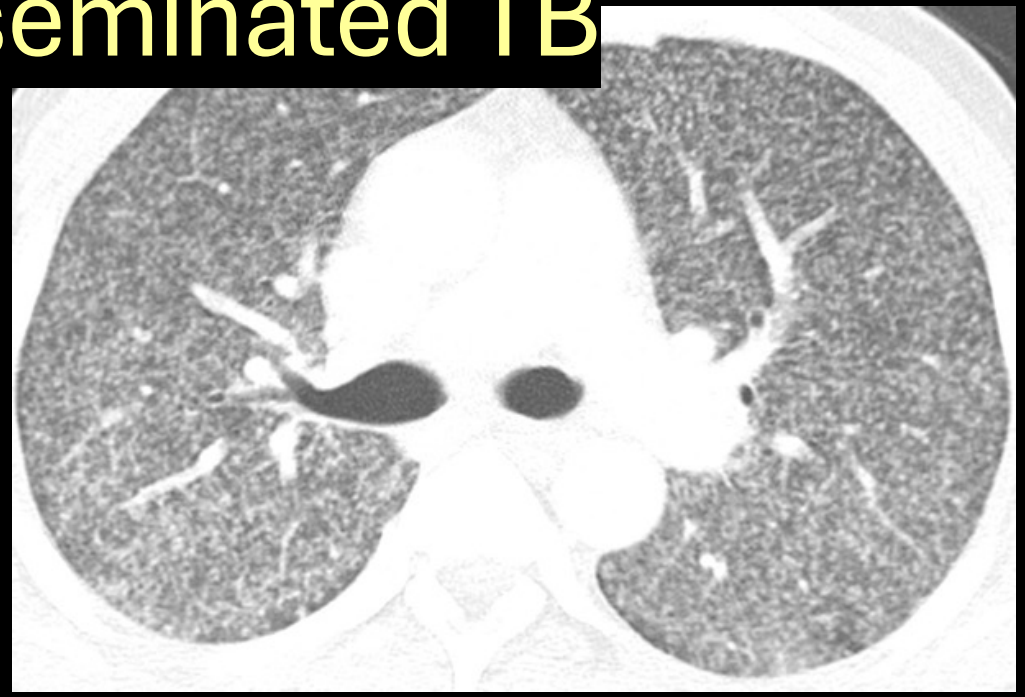


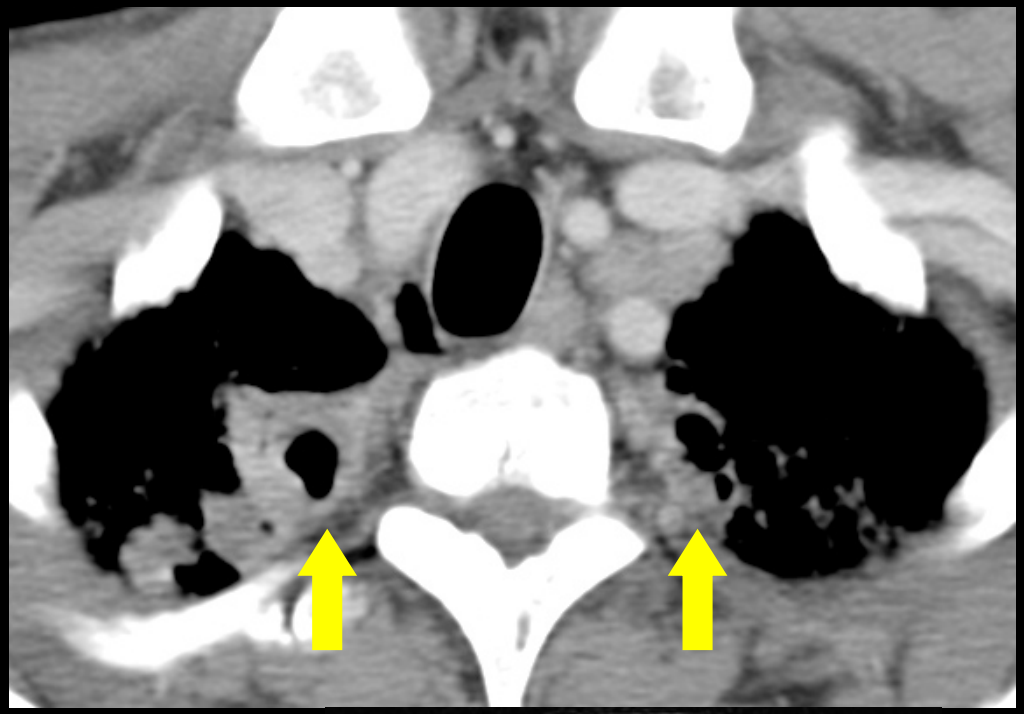
Disseminated TB

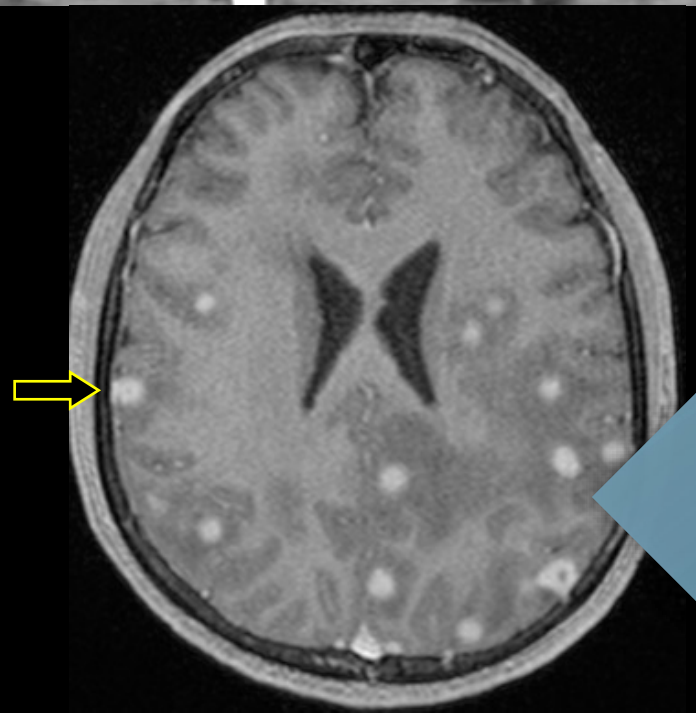
- Diffuse tiny lung nodules
- Radiograph may be normal
- Patients typically very ill



Disseminated TB





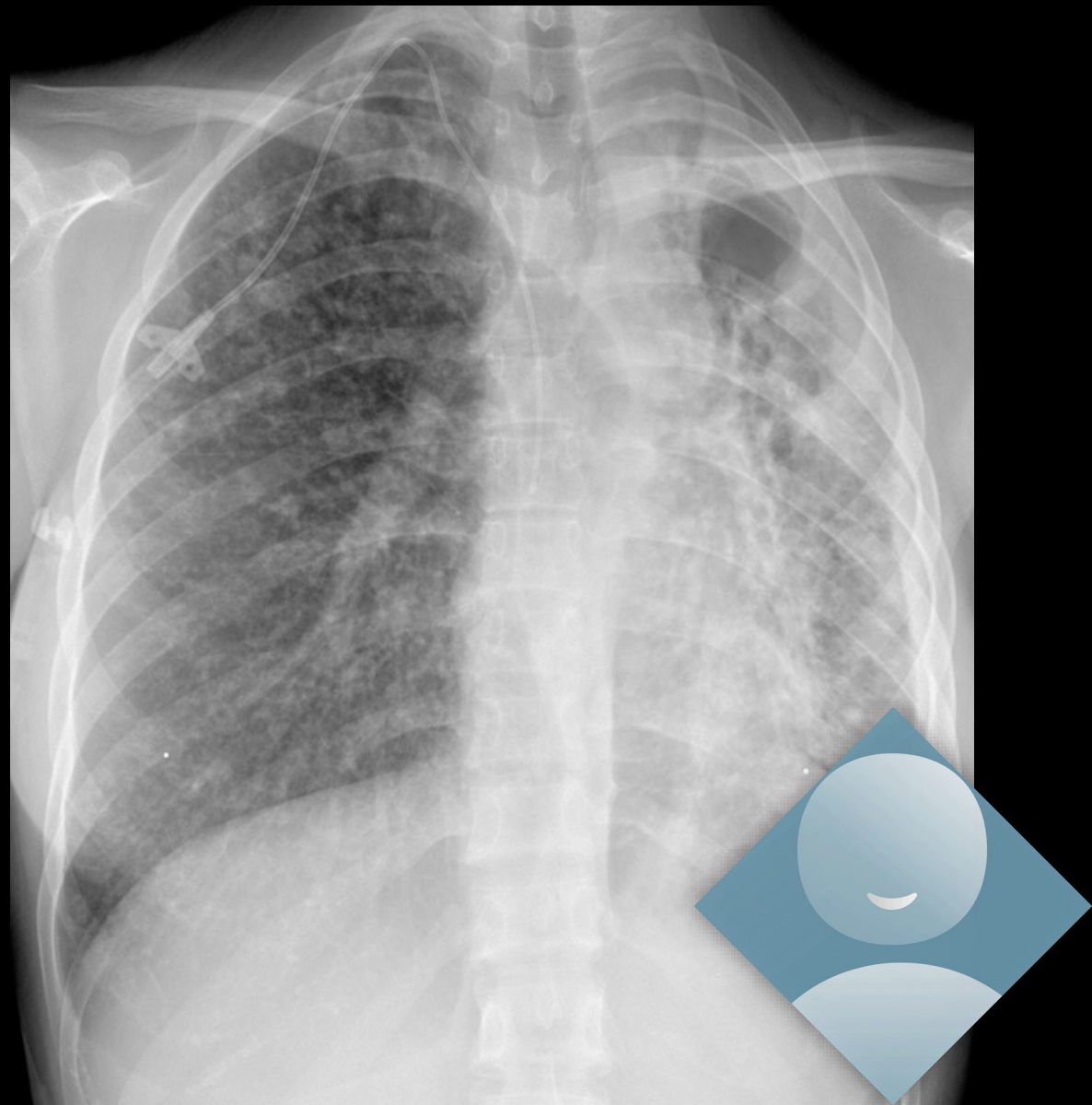


Complications

Lung, Pleura, Mediastinum, Vasculature

Complications – Lungs

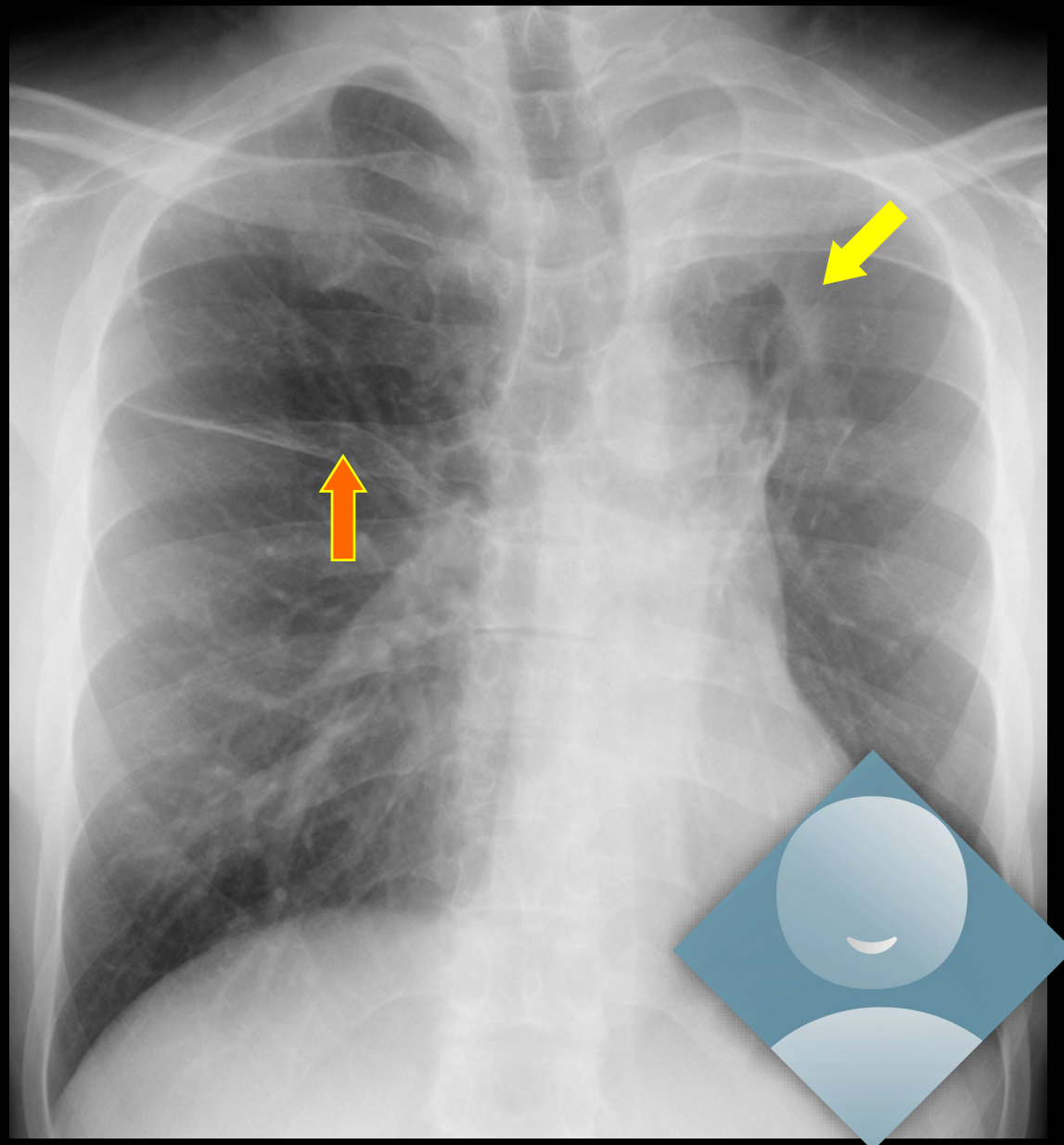
- Scar
- Lung destruction
- Bronchiectasis
- Cavities
- Acute respiratory distress syndrome
- Aspergilloma
- Central airway stenosis
- Broncholithiasis



Complications - Lung

Scar and destruction of lung

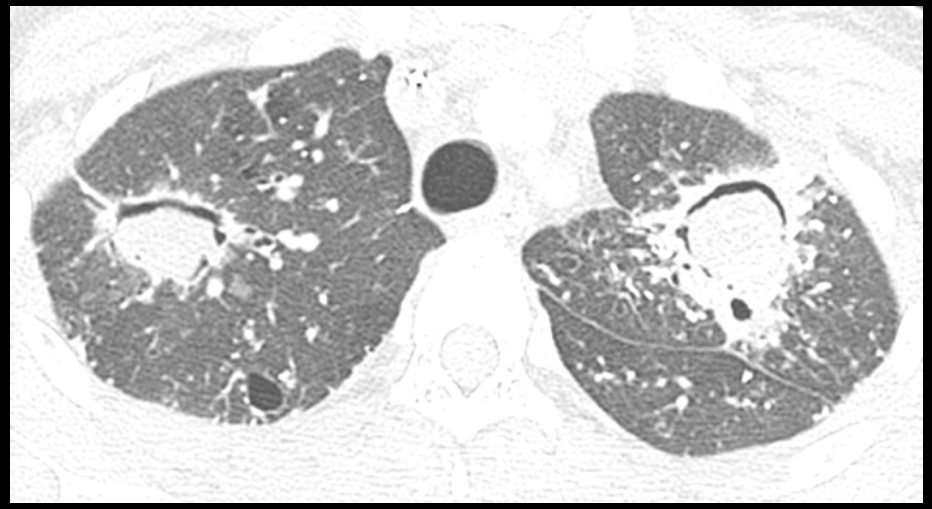
- Up to 40% of patients with post-primary TB
- Result of marked fibrotic response

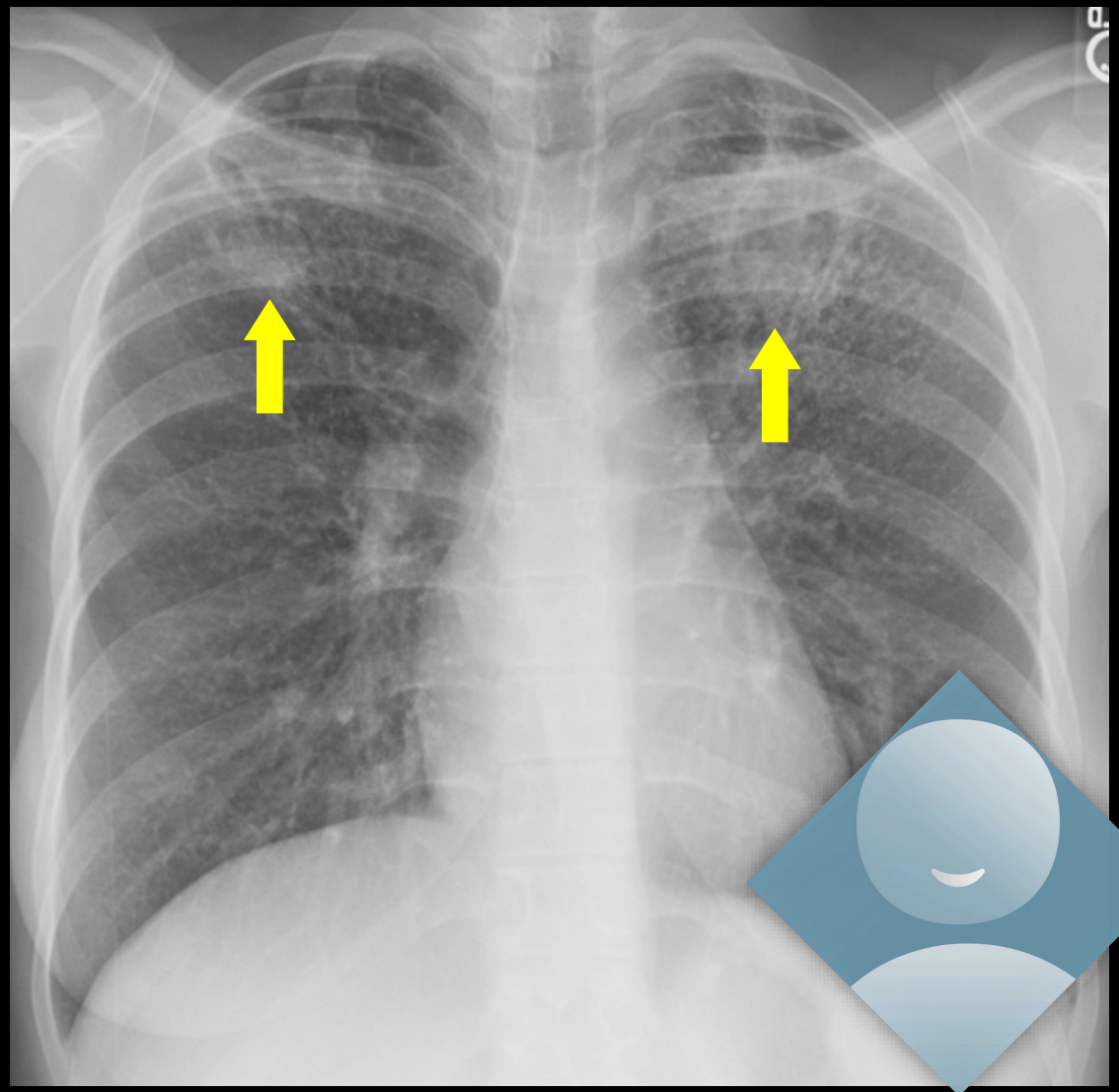


Complications - Lung

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%

Complications - Lung

Tuberculoma

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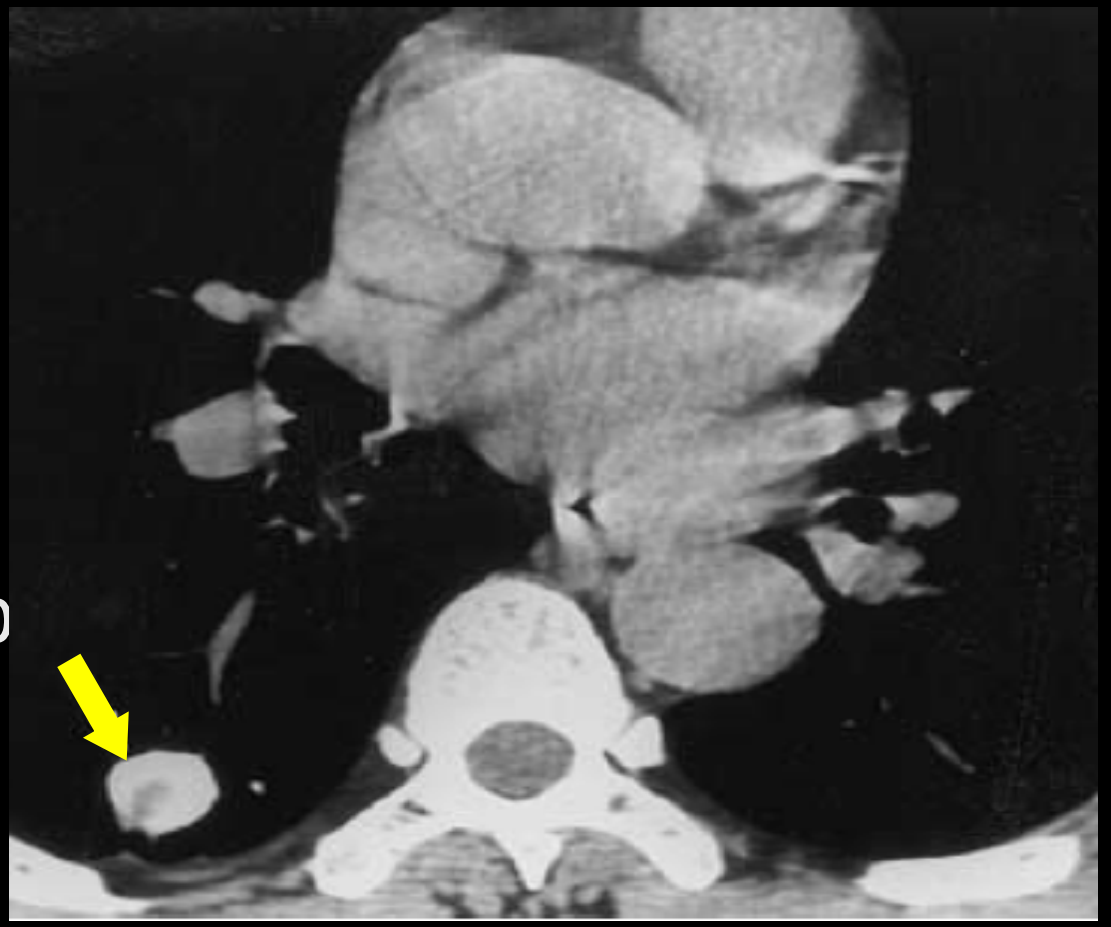
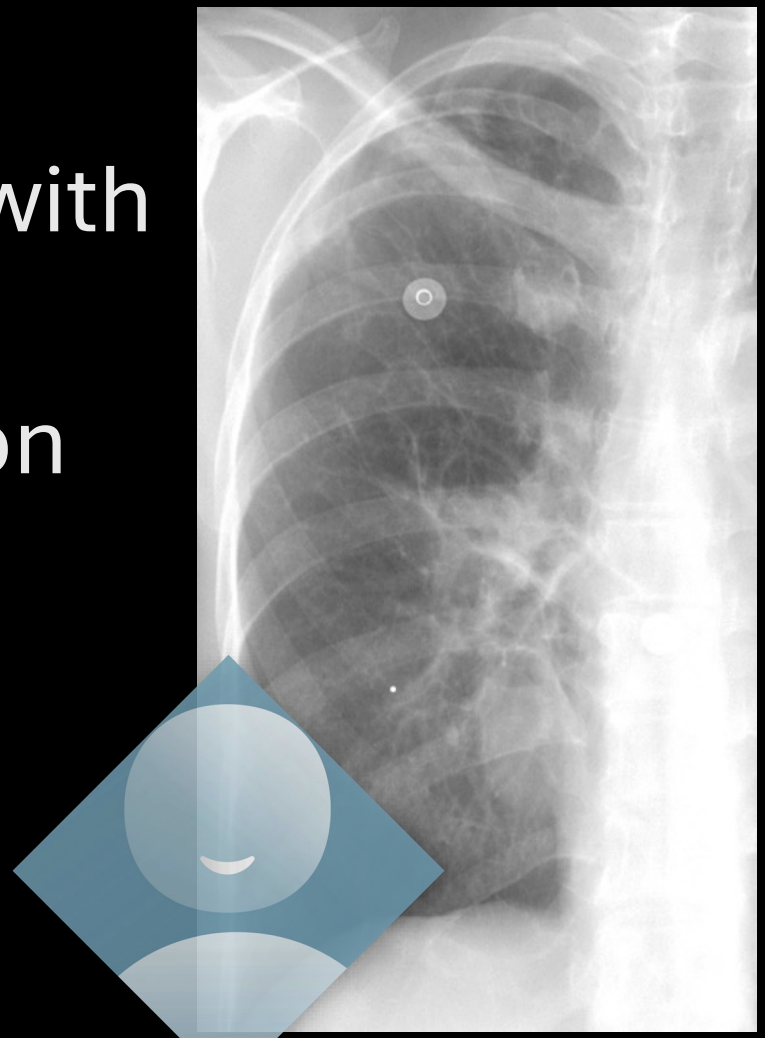


Complications - Lung

Bronchiectasis

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

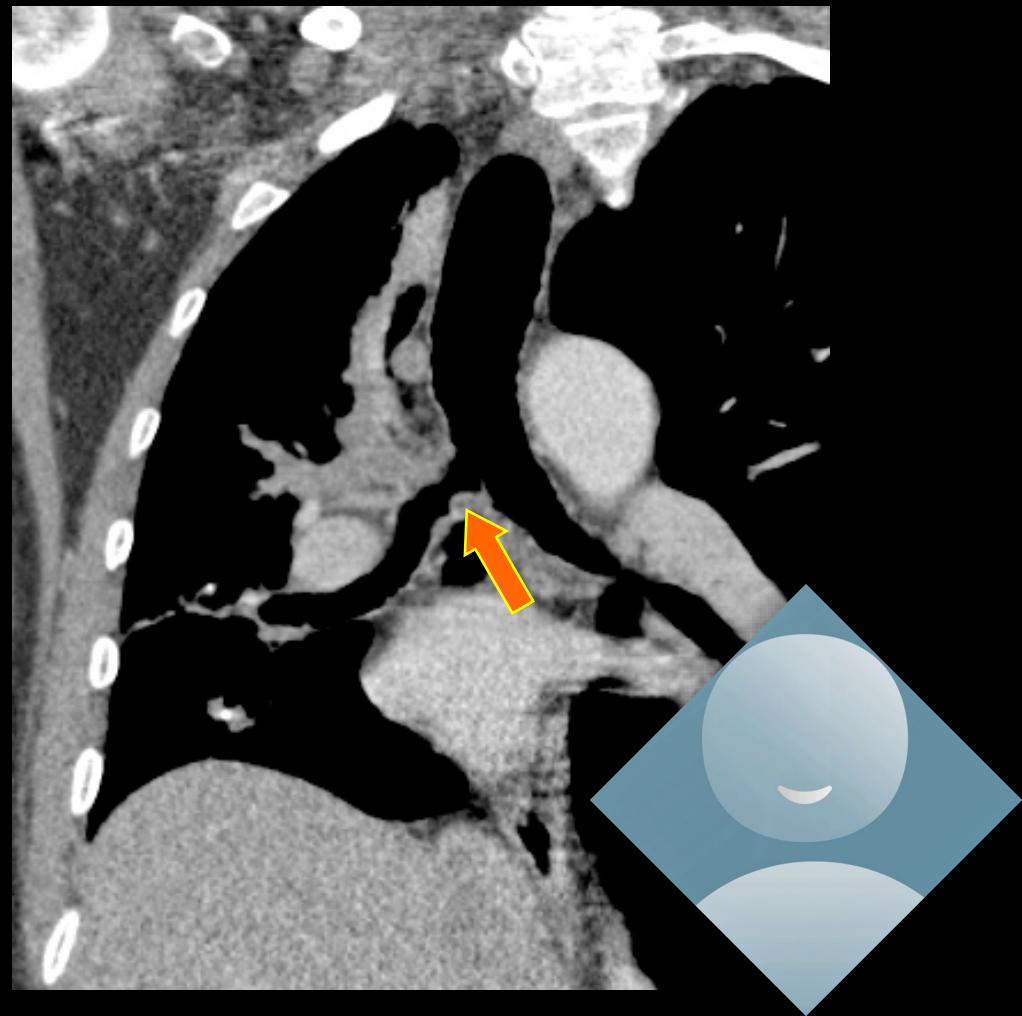


Complications - Lung

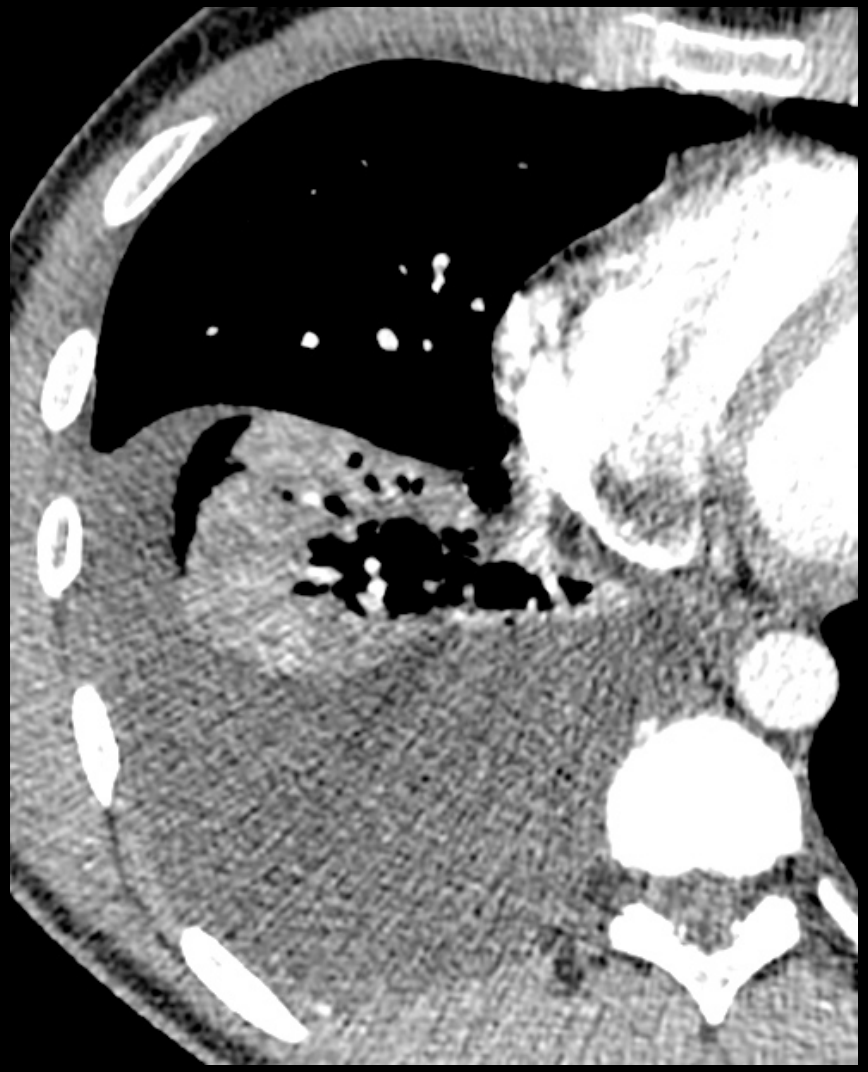
Tracheobronchial stenosis

- Compression from lymph nodes
- Primary airway wall infection

- Left main bronchus most common
- Irregular luminal narrowing



Complications - Pleura



- Pleurisy
- Empyema
- Empyema necessitans
- Fibrothorax
- Pneumothorax
- Bronchopleural fistula

Complications - Pleura

- Empyema
- Bronchopleural fistula

Complications - Pleura

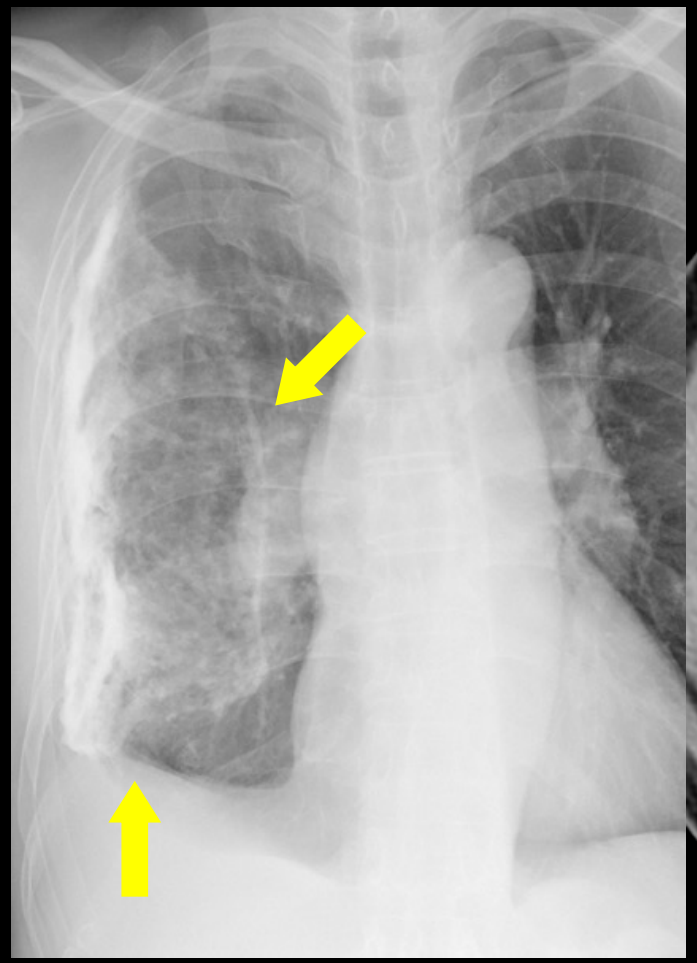
Empyema necessitans

- Direct extension of empyema into the chest wall

Complications - Pleura

Fibrothorax

- Sequela of TB empyema or effusion
- Absence of pleural fluid favors inactivity



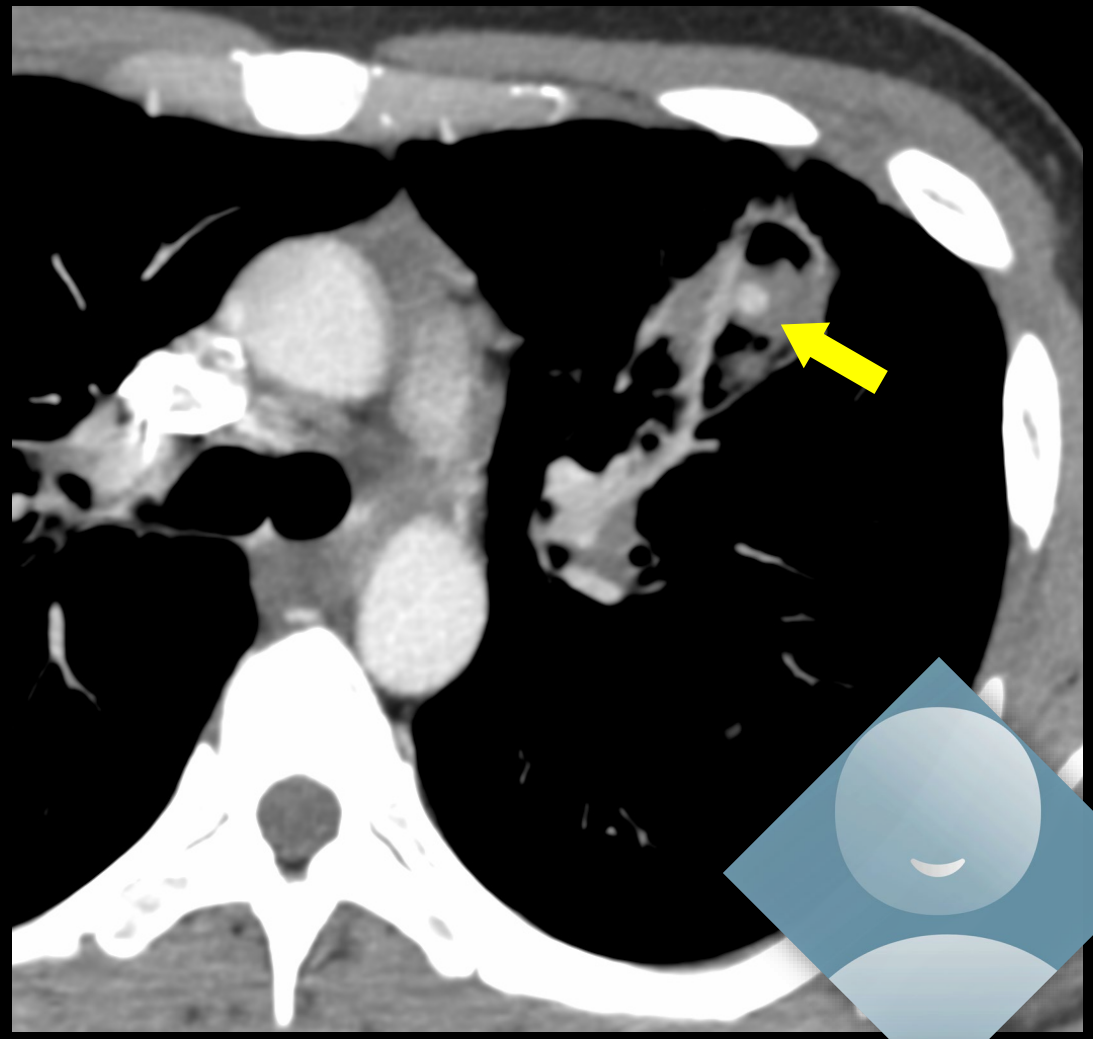
Complications - Vascular

- Pulmonary and bronchial arteritis
- Thrombosis
- Bronchial artery pseudoaneurysm
- Rasmussen aneurysm

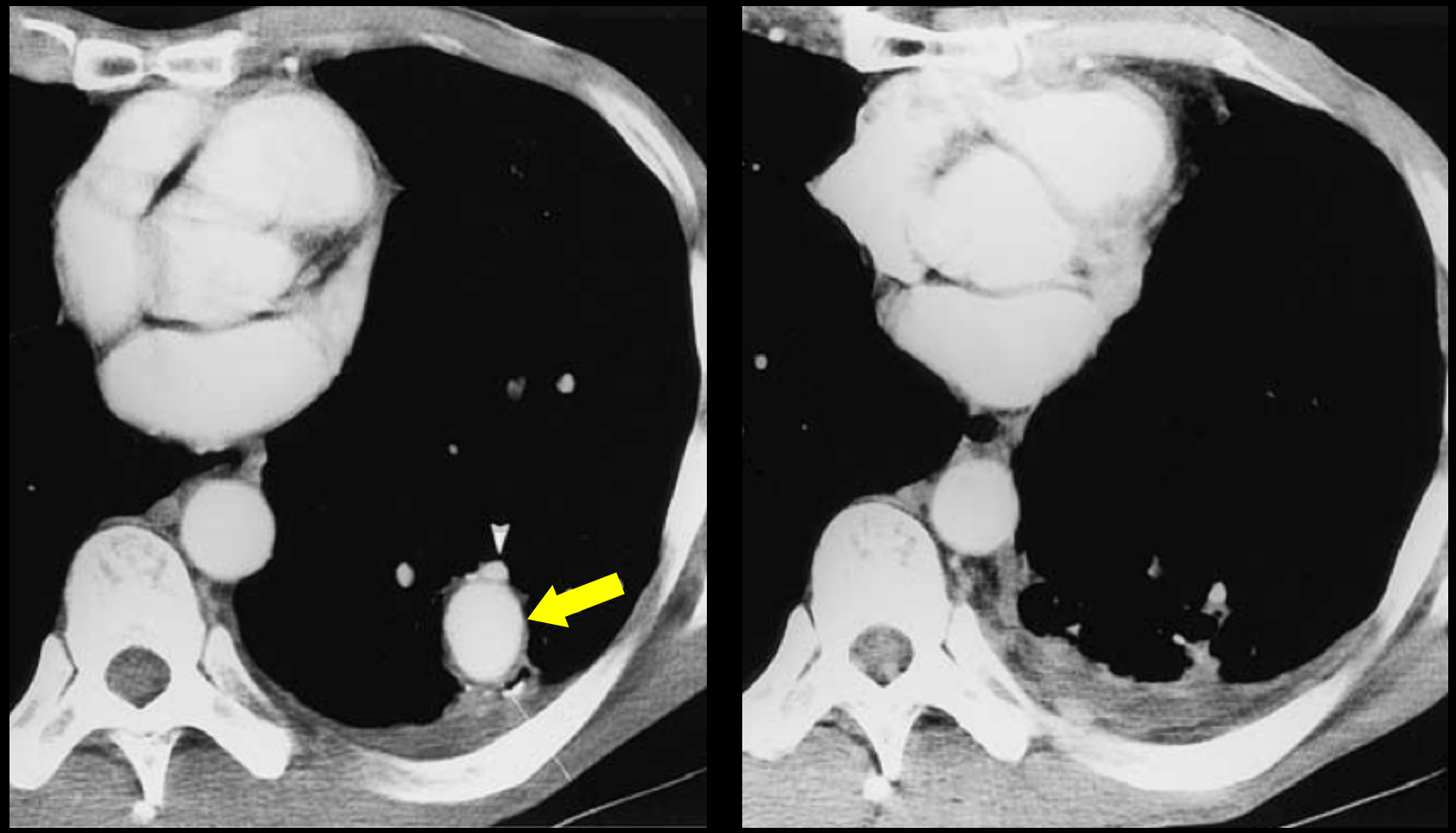
Complications - Vascular

Rasmussen aneurysm

- Pseudoaneurysm of pulmonary artery from tuberculosis
- 5% of patients with chronic cavitary TB (autopsy series)



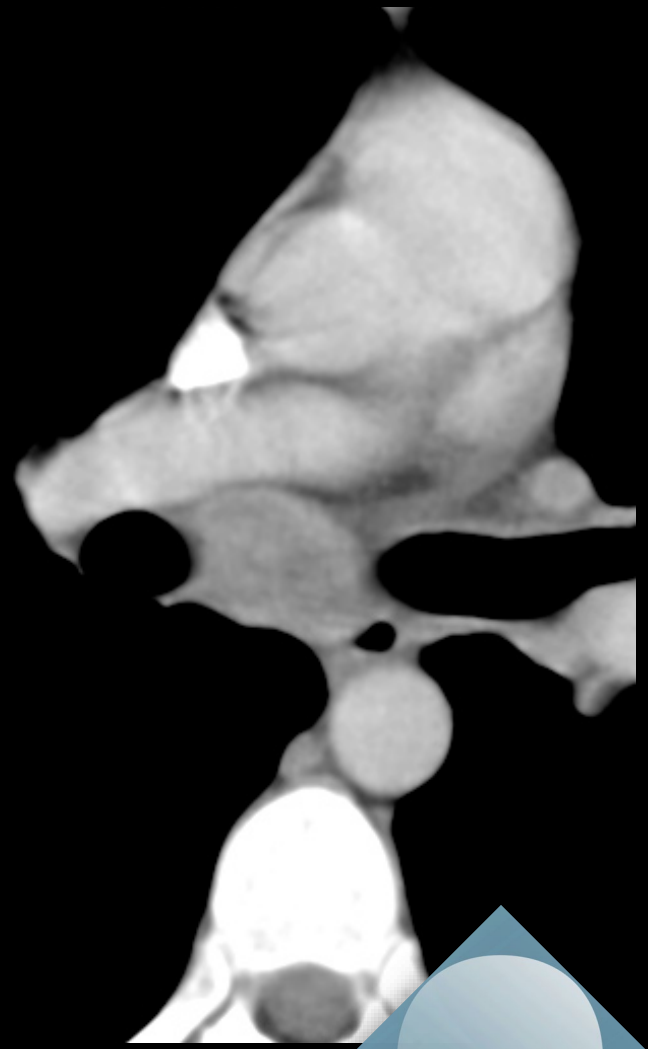
Complications - Vascular



Kim HY et al. *Radiographics* 2001

Complications - Mediastinum

- Esophagomediastinal fistula
- Esophagobronchial fistula
- Constrictive pericarditis
- Mediastinal fibrosis



Complications - Mediastinum

- Esophagomediastinal fistula
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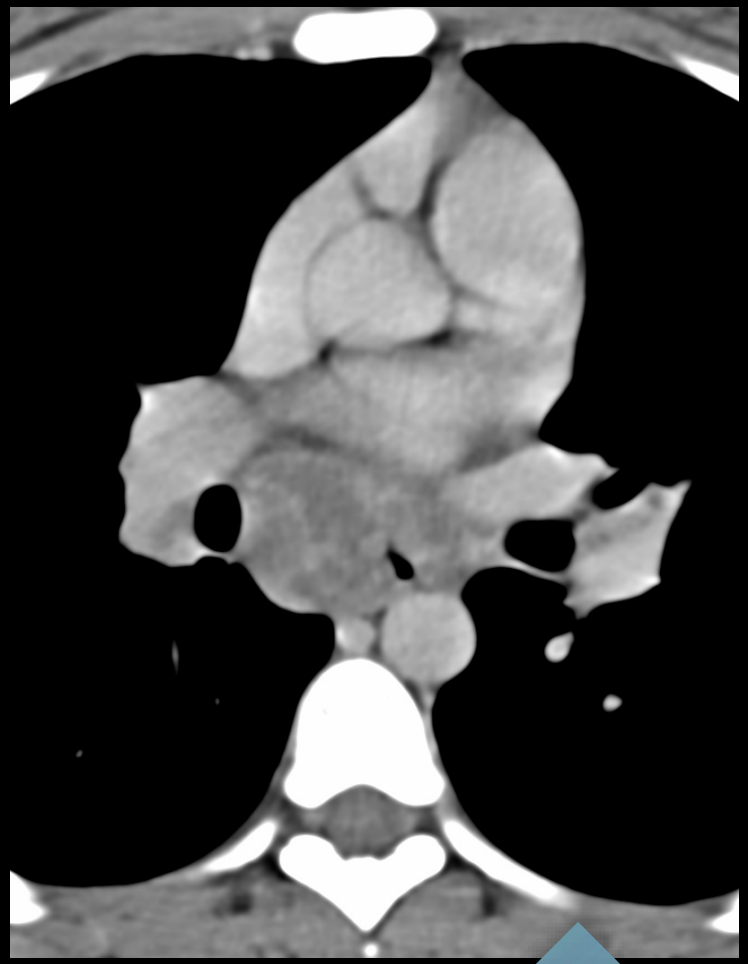
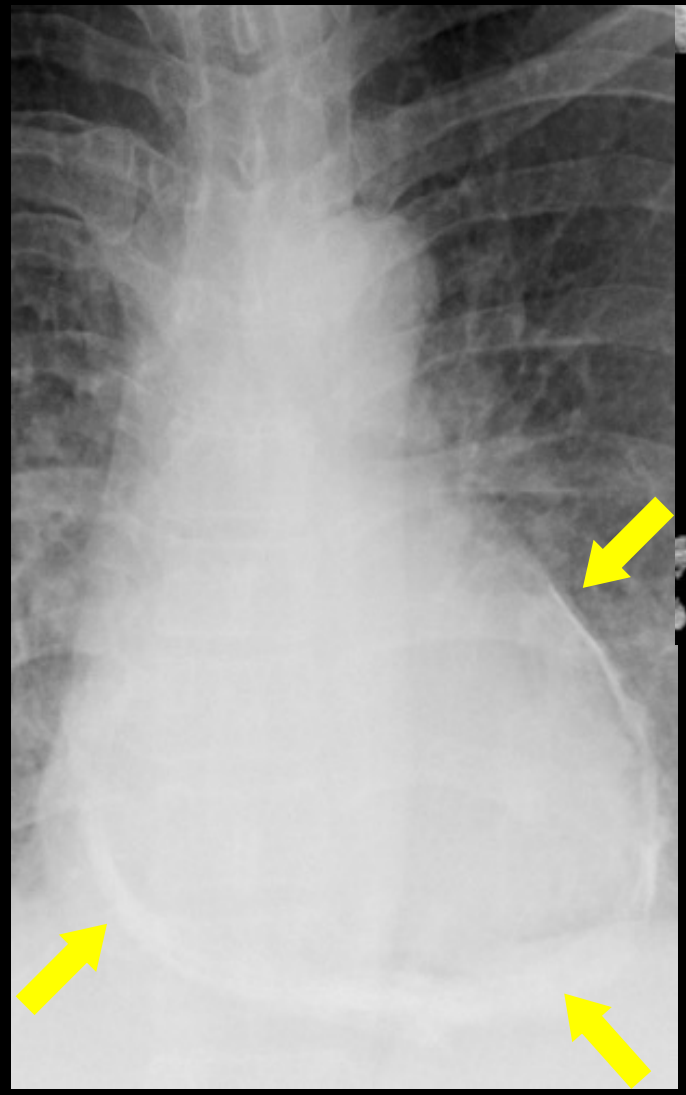
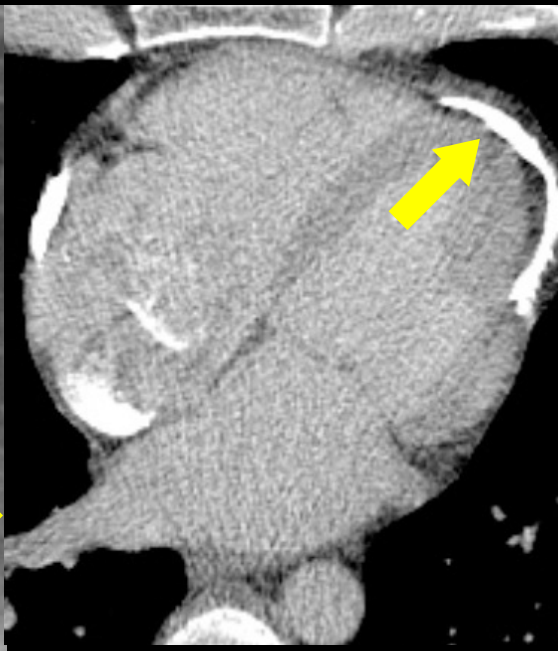


Complications - Mediastinum

Pericardial TB

- 1% of patients
- Direct extension or disseminated disease
- Constrictive pericarditis in 10% of patients with pericardial TB





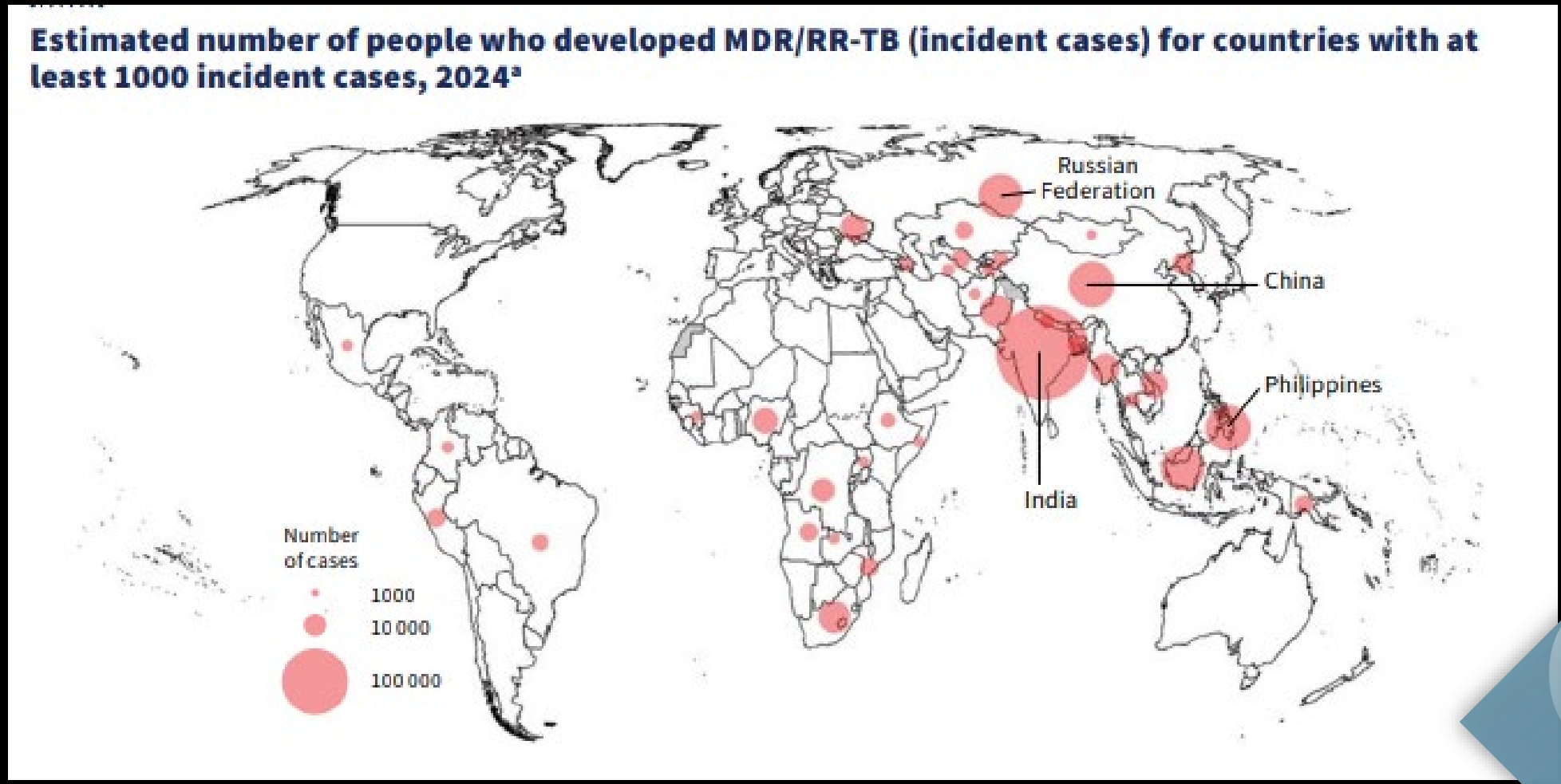
Multidrug Resistant TB

- Imaging findings are the same as drug-sensitive, but can have greater extent in MDR TB
- Infection is prolonged and more difficult to treat
- Resection may be required for advanced cavitary disease

Overview

- Pathology background
- Imaging review: Radiographs (x-ray) vs CT
- Clinical approach: Primary vs post-primary
  - Case examples
- Imaging approach: Active vs latent
  - Case examples
    - Active
    - In immunocompromised patients
    - Disseminated
    - Multi-drug resistant
- Complications

Multidrug Resistant TB



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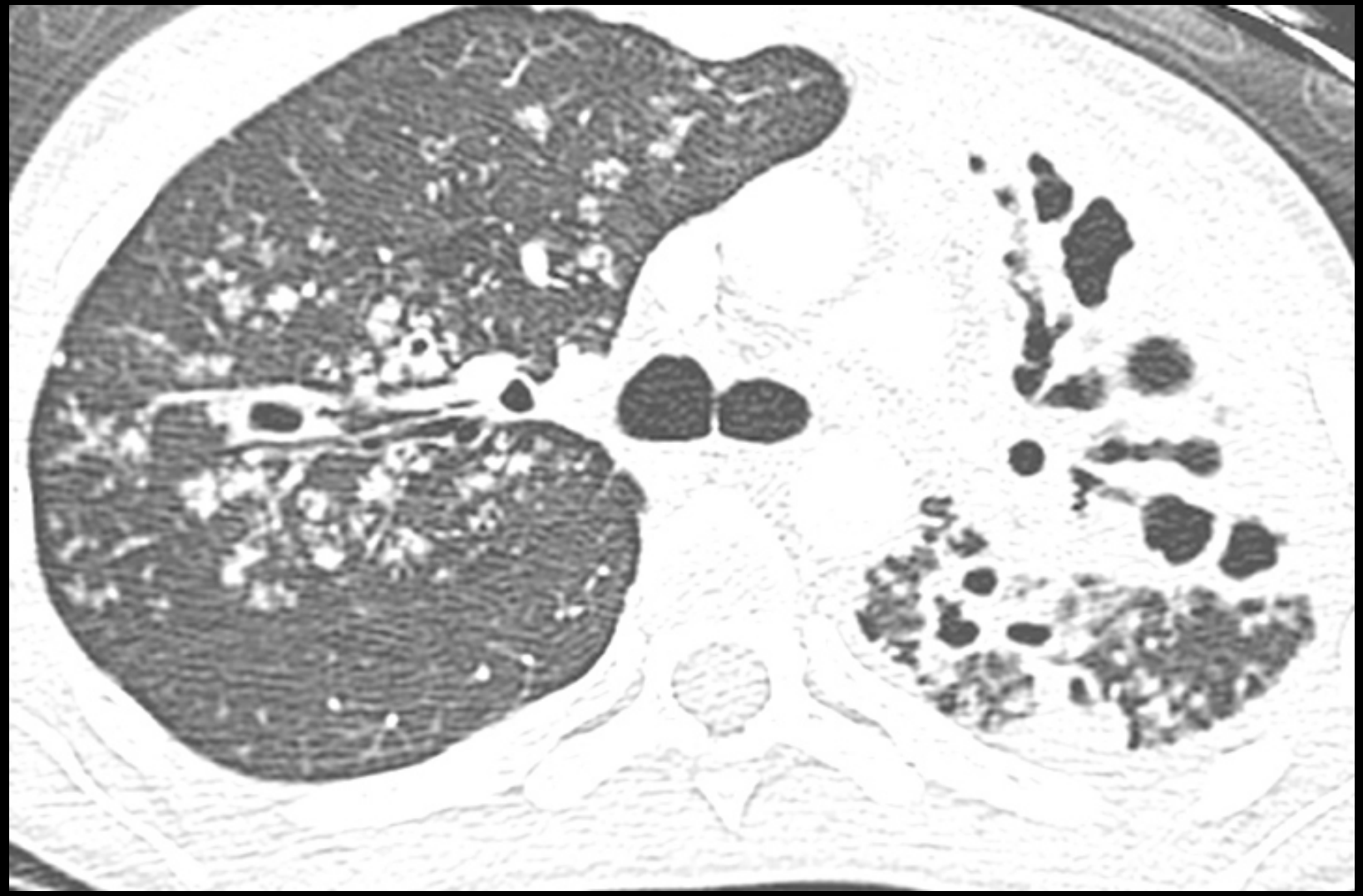
Multidrug Resistant TB



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Thank you!

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