61ST ANNUAL

Denver TB Course

(Hybrid Event)

APRIL 2-4, 2025

National Jewish Health®

Chest Radiograph Interpretation in Tuberculosis

Tilman Koelsch, MD

Disclosures

None

Goals

- Understand importance of adequate radiographic technique
- **Basics of CXR interpretation**
- Identify features of tuberculosis
  - Adults
  - Children
  - HIV
  - Healed/inactive
- Role of CT

Approach to Chest Radiograph

- Technical
  - Exposure
  - Inclusion
  - Rotation
  - Inspiration

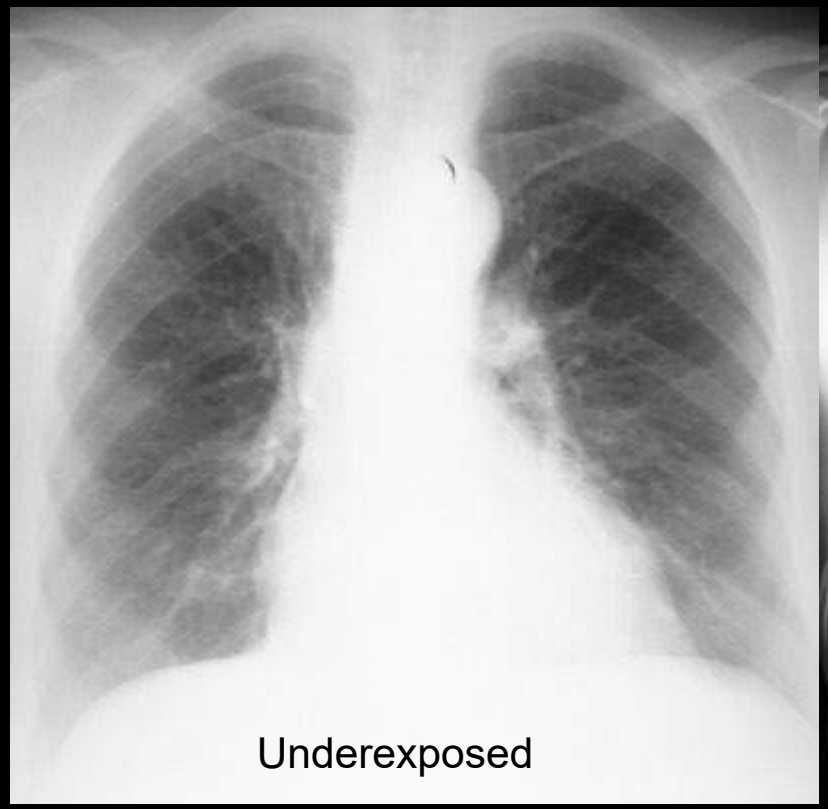
- Initial "Gestalt"

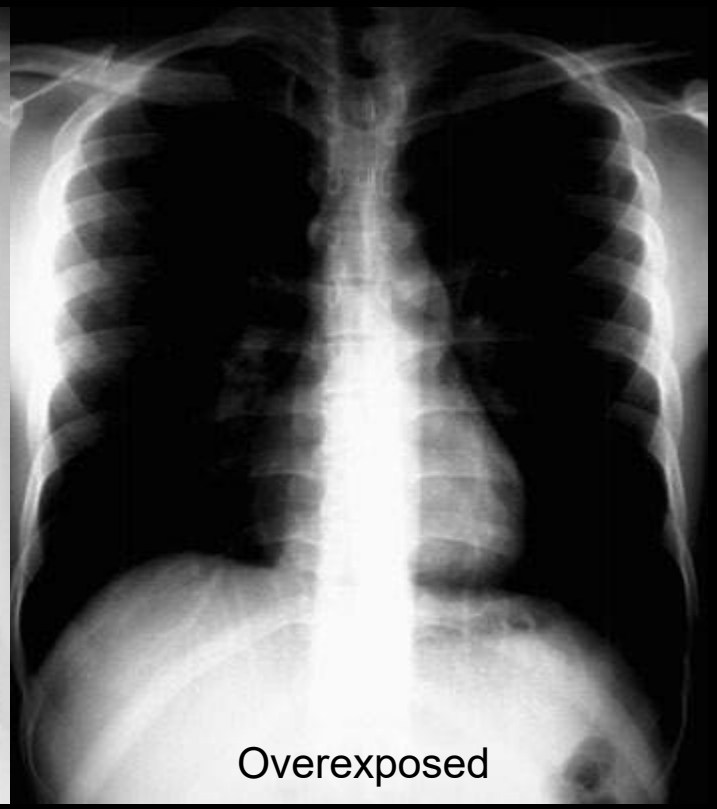
- Systematic Survey
  - Lungs/ribs - *Symmetry*
  - Mediastinum/heart
  - Soft tissues/abdomen

- Miss/ "Hidden" areas

Technical Adequacy of Chest X-ray

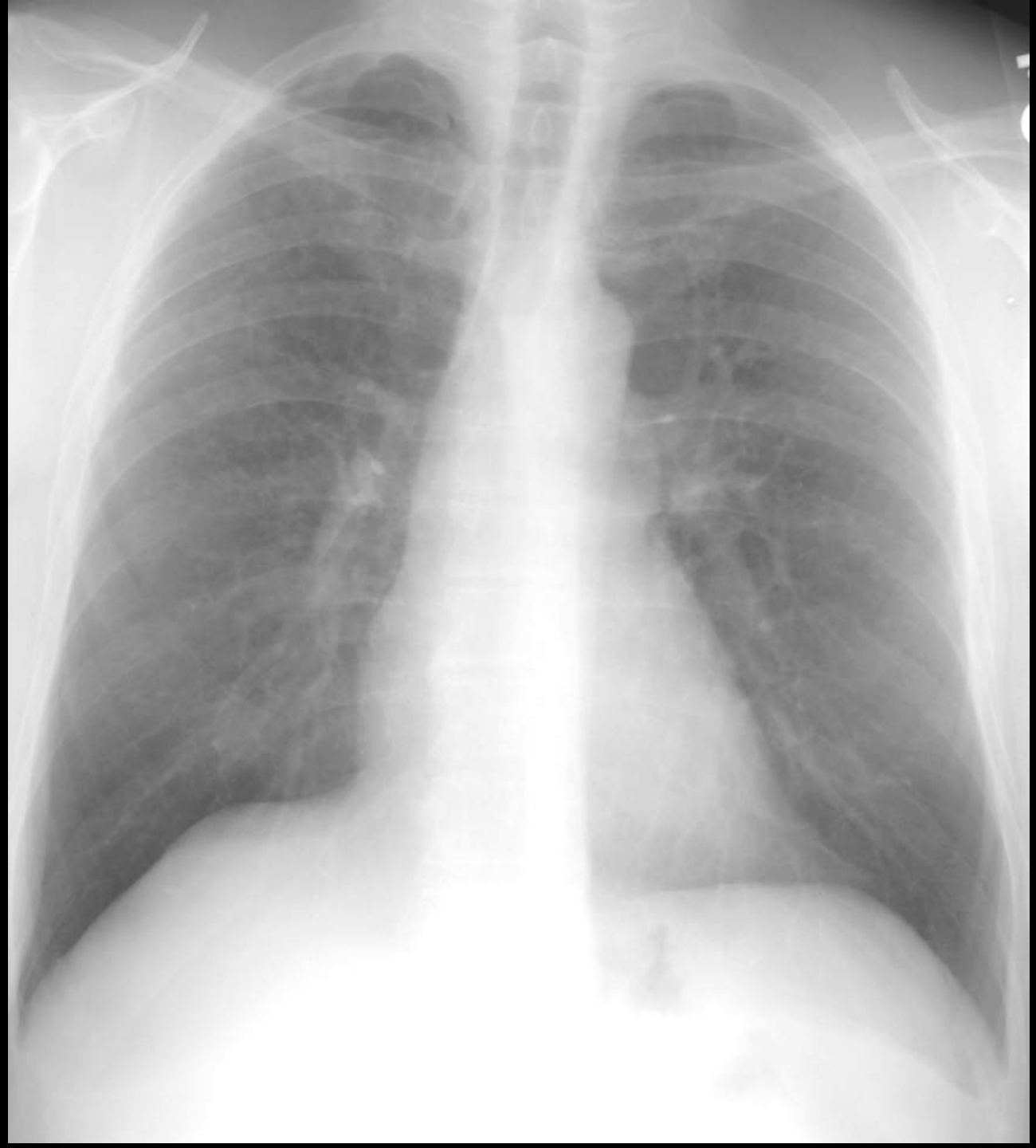
Exposure

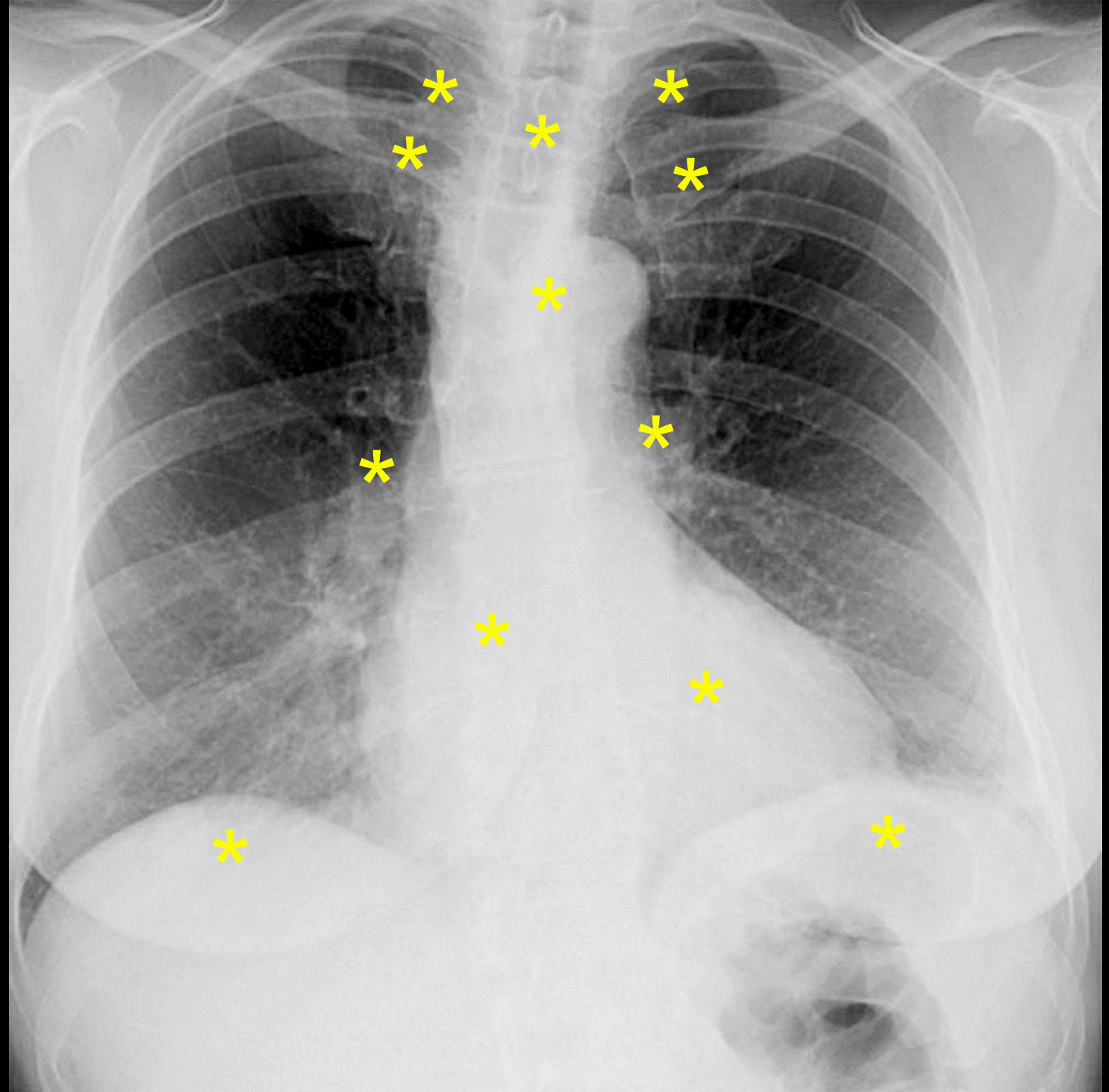




Patient positioning (not rotated, etc)
Inclusion (entire lungs)
Inspiration

Quality of this Chest X-ray?





- <u>Miss/"Hidden" areas</u>
  - Apices
  - Hila/suprahilar
  - Trachea/bronchi
  - Retrocardiac
  - Retrodiaphragmatic

Hidden Areas – Apices

Outline

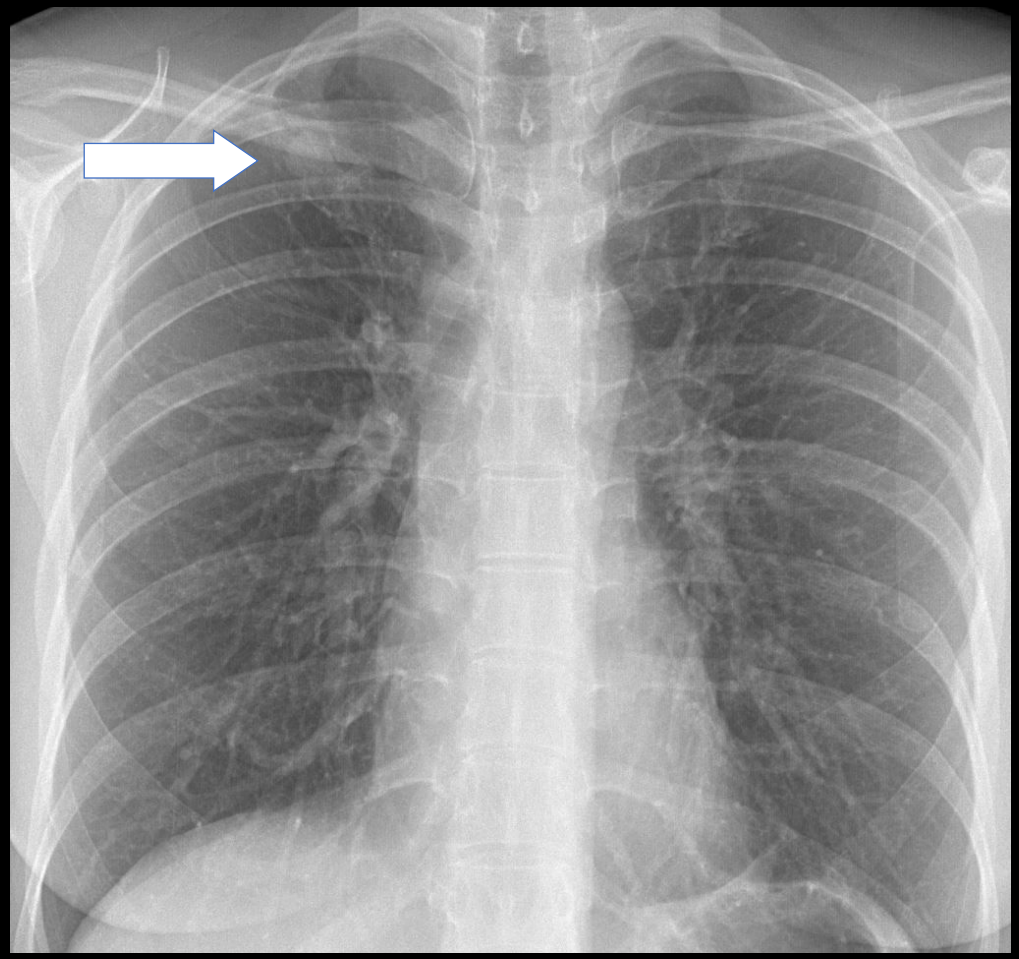
- Lung in TB
- Mediastinum
- Putting it Together – Typical and Atypical TB
  - Kids and HIV Pts.
- “Often Overlooked” – Pleura and Airways
- CT

Common **LUNG** X-ray Findings in Tuberculosis

- Opacity
  - Nodule
  - Nodular pattern
  - Consolidation
  - Atelectasis
  - Pleural effusion
- Lucency
  - Cavity
  - Bronchiectasis

Nodule

Rounded opacity, well or poorly defined, measuring up to 3 cm in diameter.



Nodular Pattern

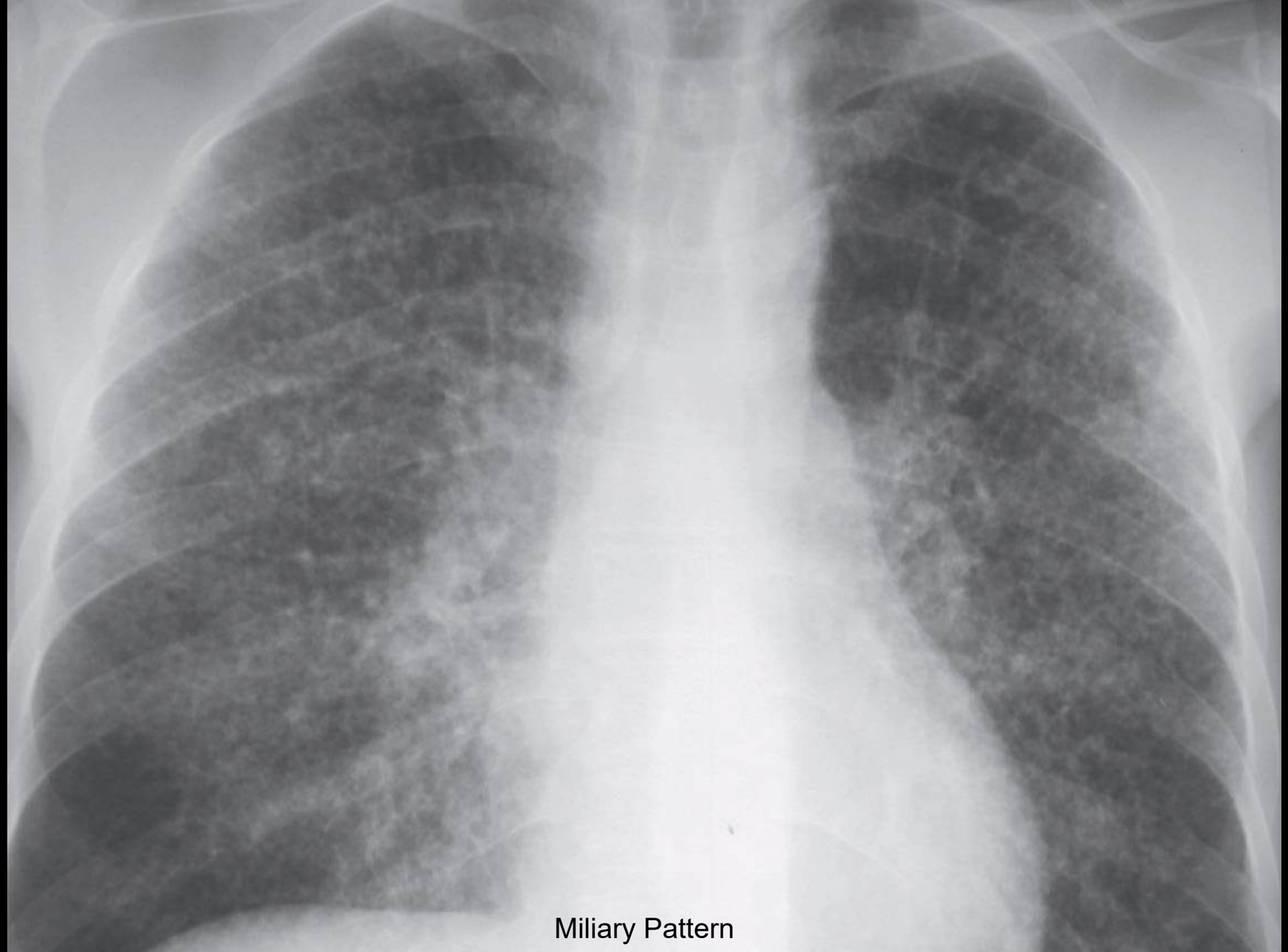
Innumerable small rounded opacities that are discrete and range in diameter from 2 to 10 mm

Miliary Pattern

Profuse, discrete, rounded pulmonary opacities 2-3 mm in diameter generally uniform in size diffusely distributed throughout the lungs- sometimes lower lung predominant

Millet Seeds

Miliary Pattern



Miliary Pattern

Consolidation

Homogenous increase in lung opacity

Often poorly defined and confluent

Atelectasis

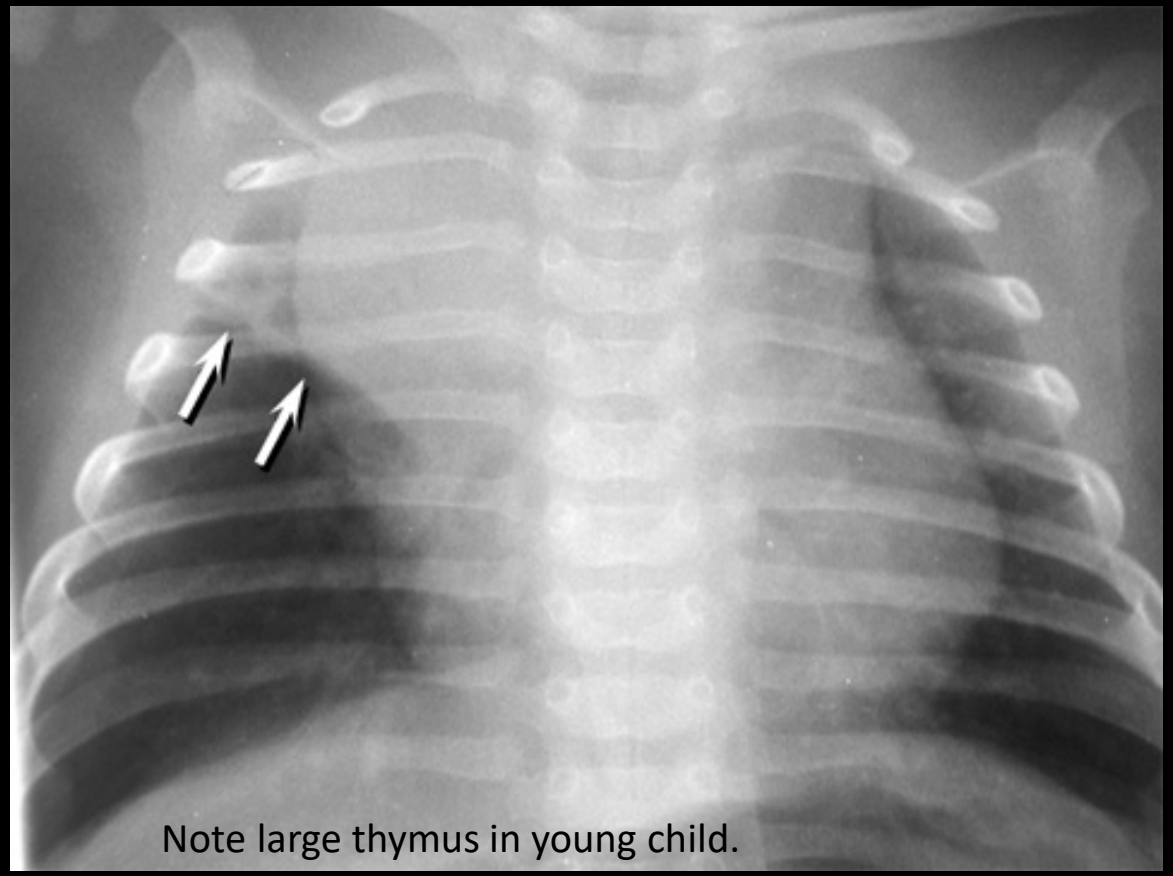
Reduced volume of a lobe or lung, with increased opacity

Displacement of mediastinum, hila, bronchi, or fissures

Not talking about mild atelectasis

2nd Signs helpful

Elevated Minor Fissure

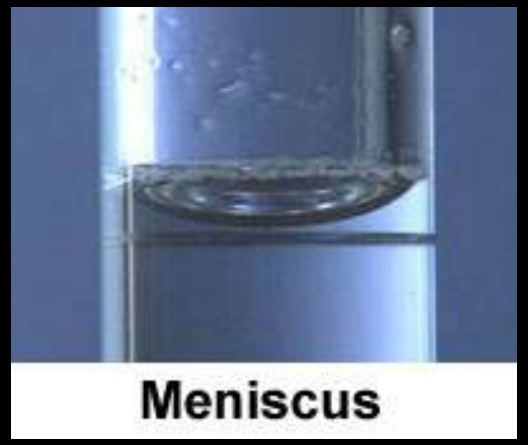


Note large thymus in young child.

Pleural Effusion

Fluid in the pleural space

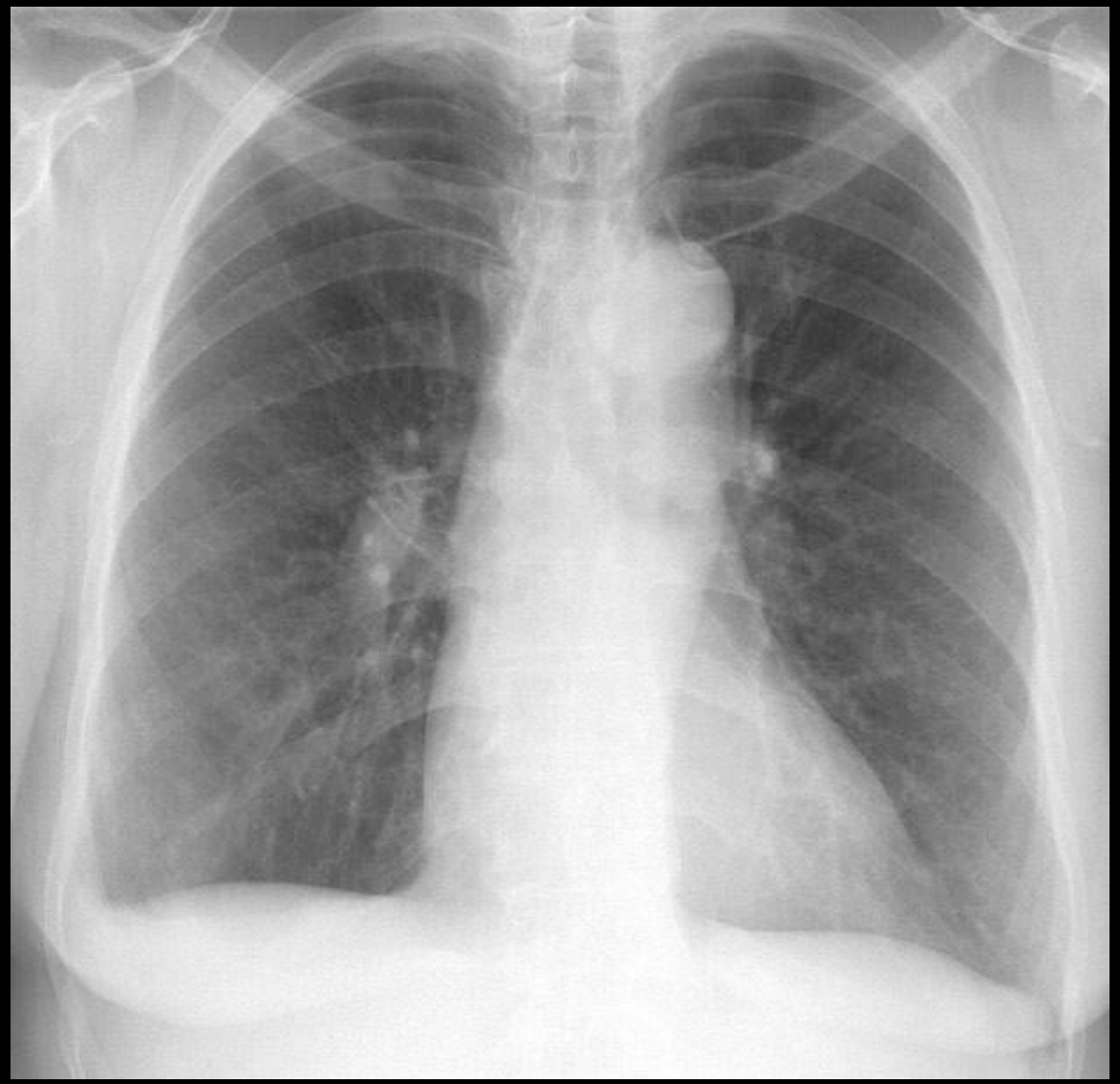
On erect chest radiograph, characterized by blunting of costophrenic angle and meniscus sign



Pleural Thickening (vs Effusion)

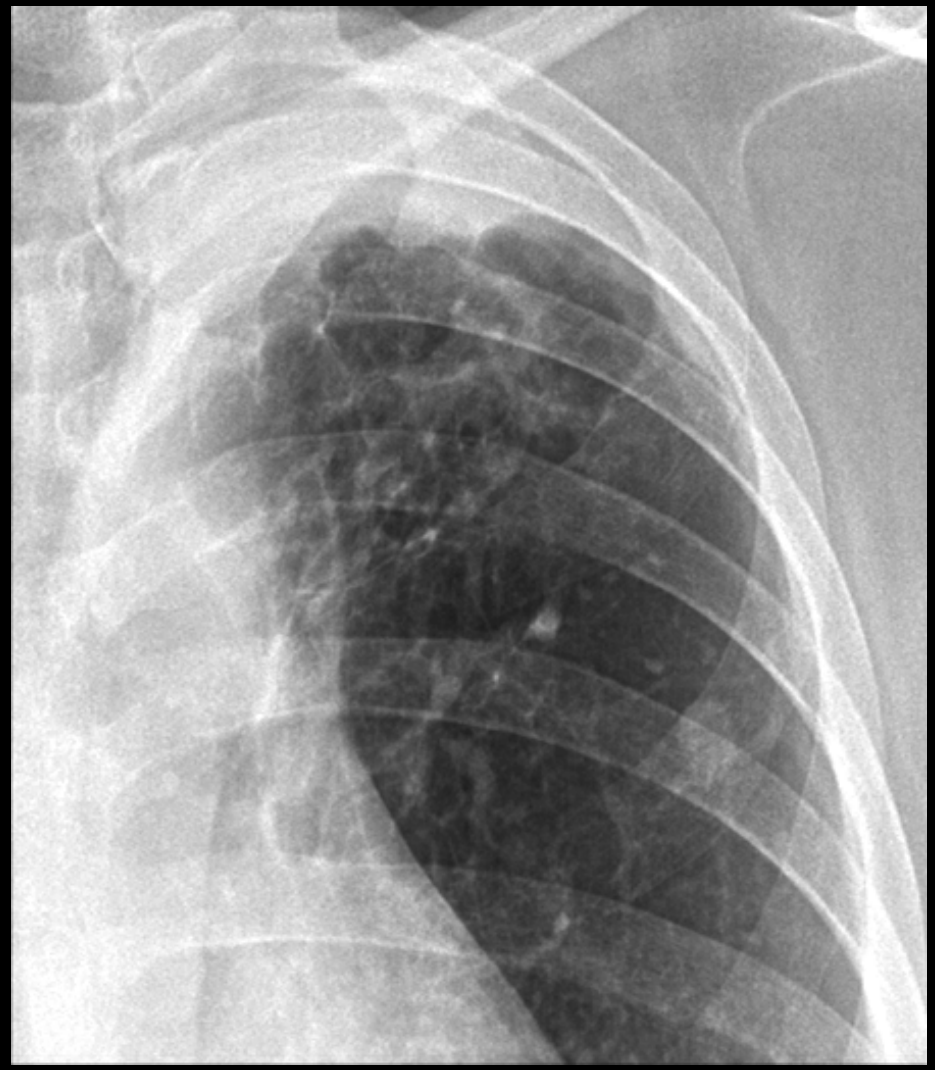
Blunted CP angle is not curved

Thickening usually extends up the chest wall



Cavity

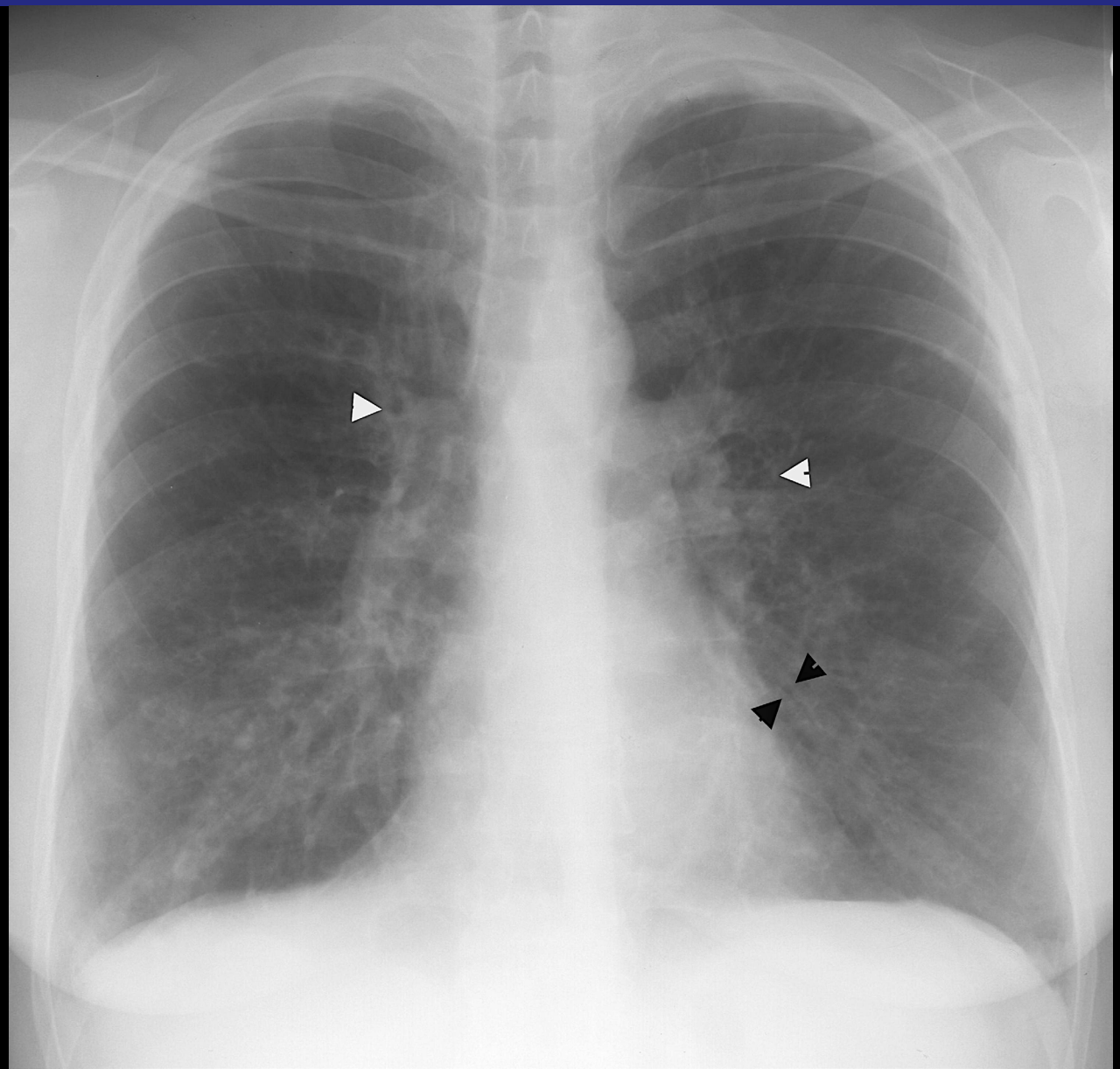
Gas-filled space within consolidation, mass, or nodule



Bronchiectasis

Ring shadows

Train tracks

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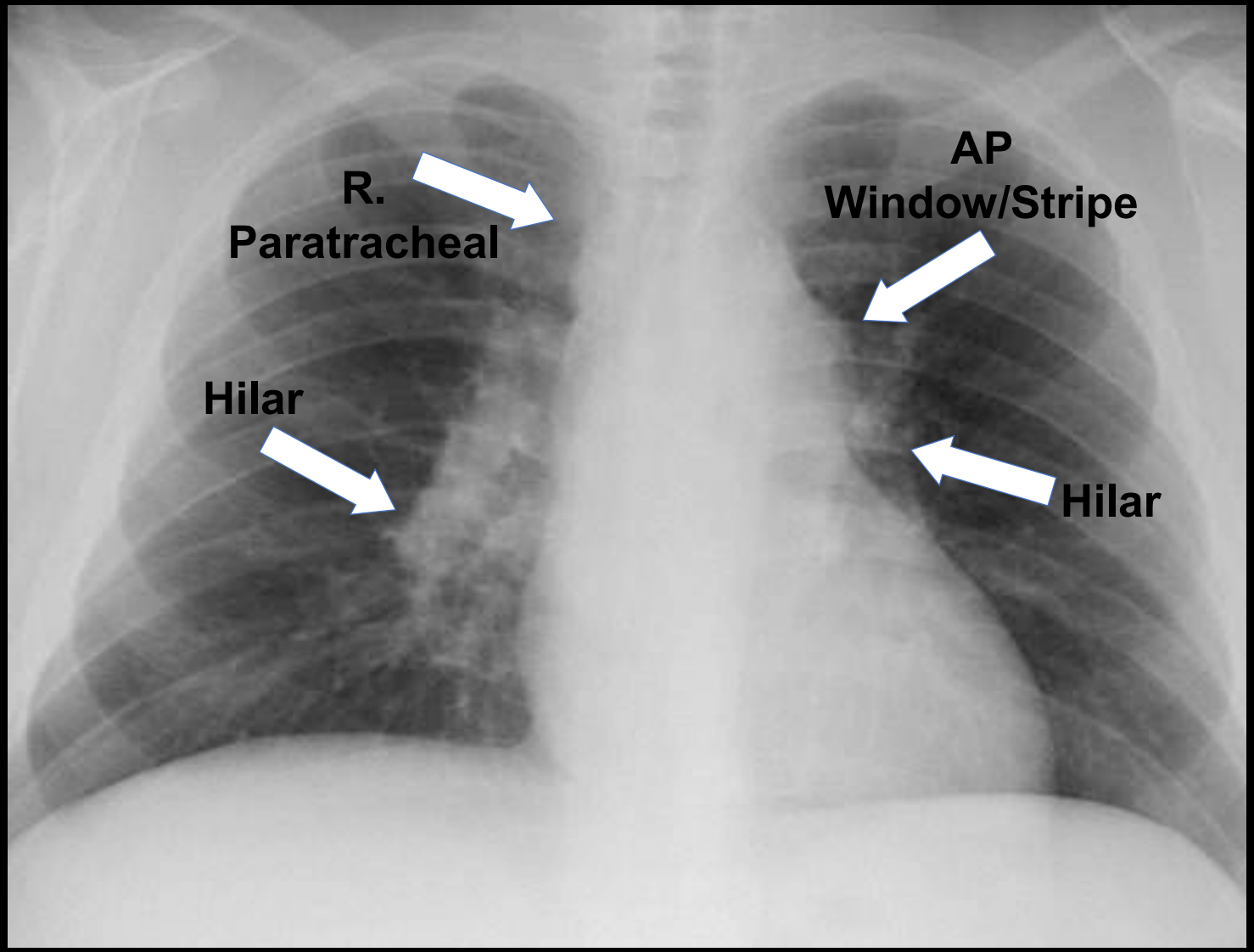
Adenopathy

Challenging to see on X-ray unless bulky

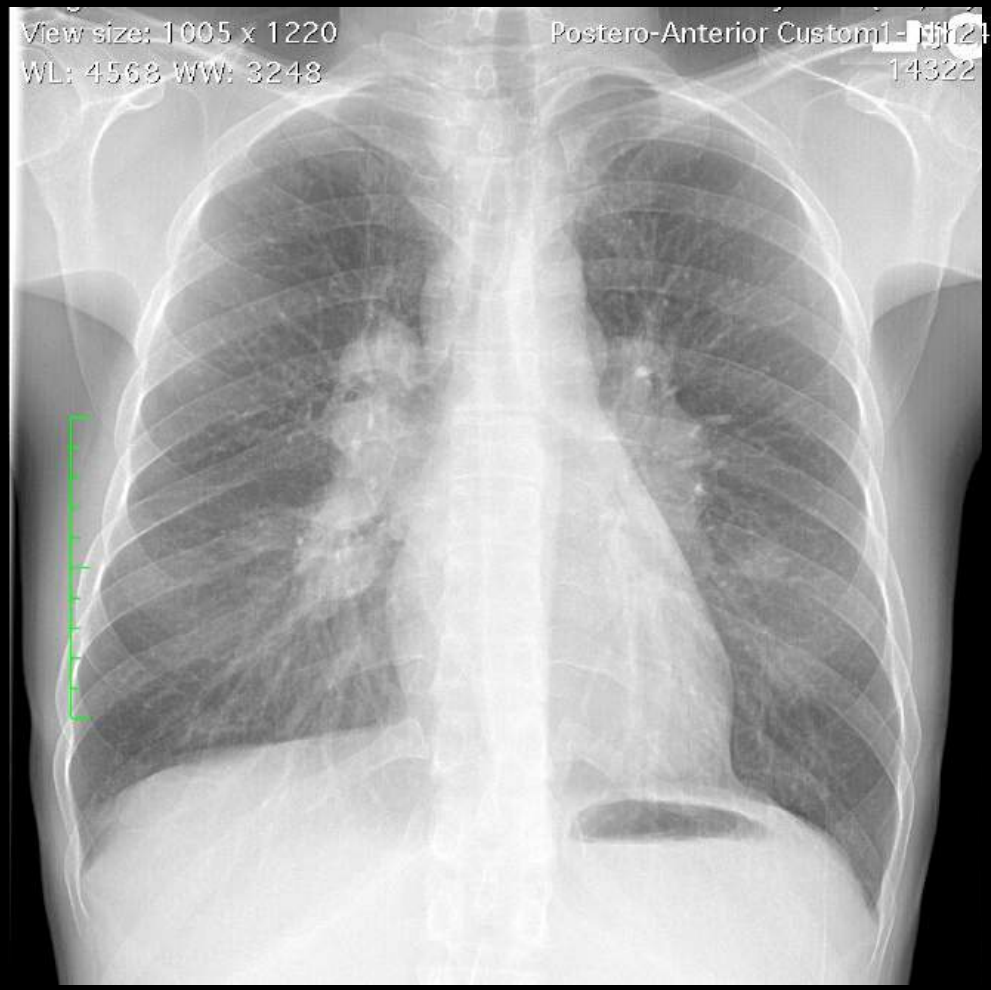
Luckily TB adenitis tends to be conspicuous
(**AND often important clue of TB**)

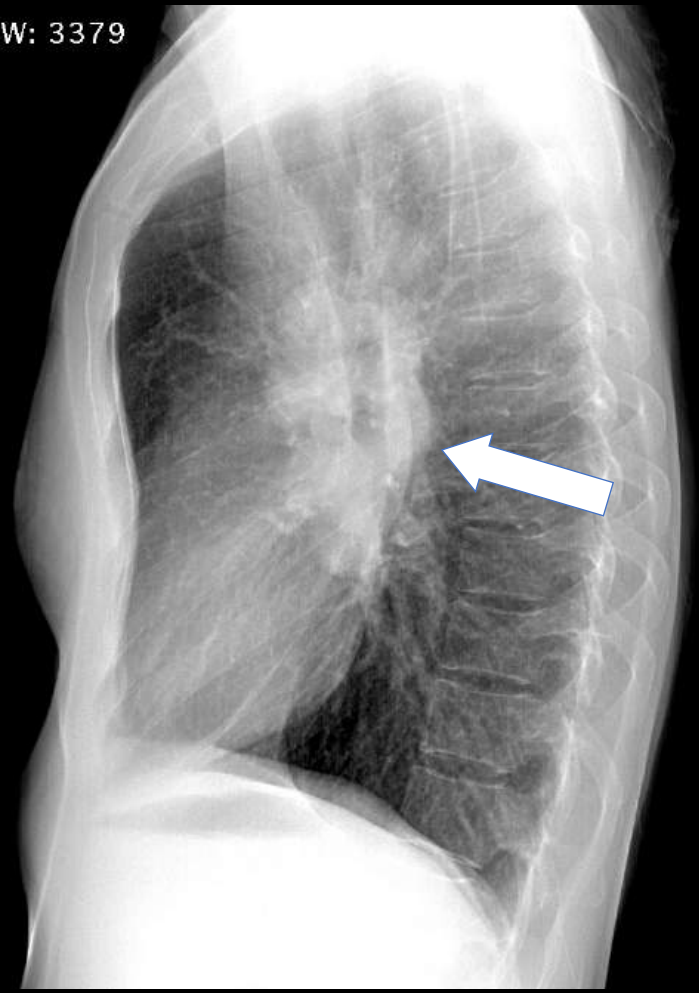
Hilar>Mediastinal

Mediastinal Adenopathy



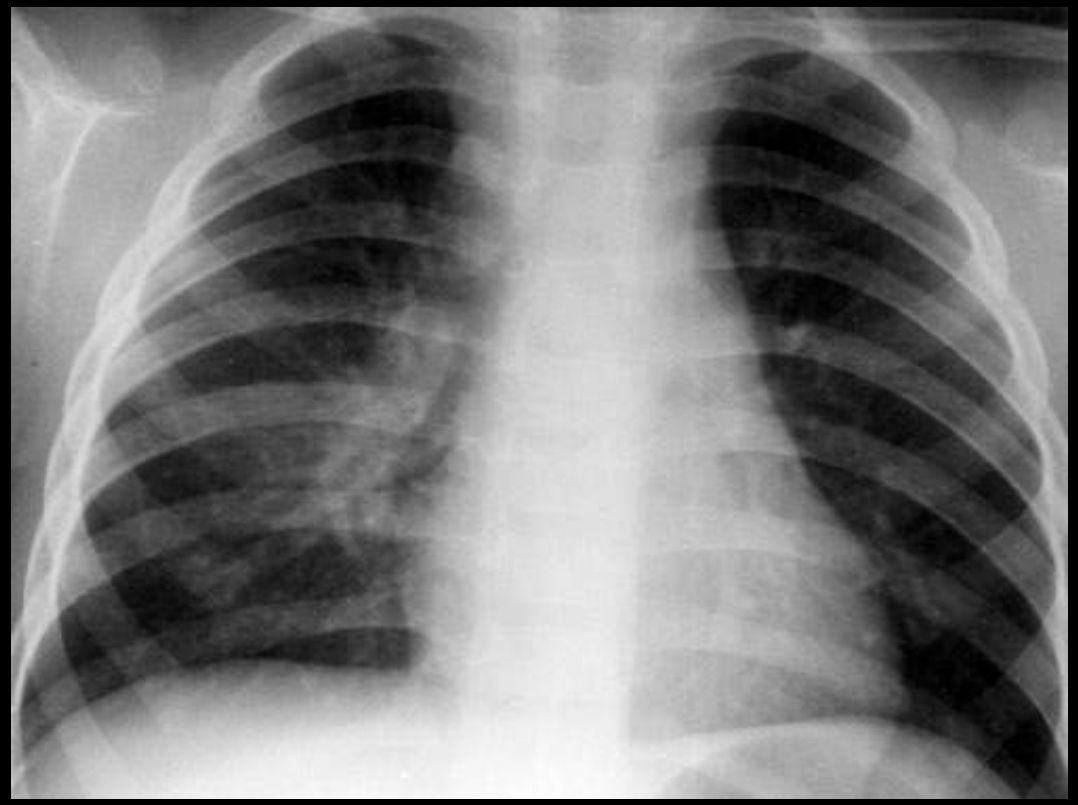
Hilar Adenopathy

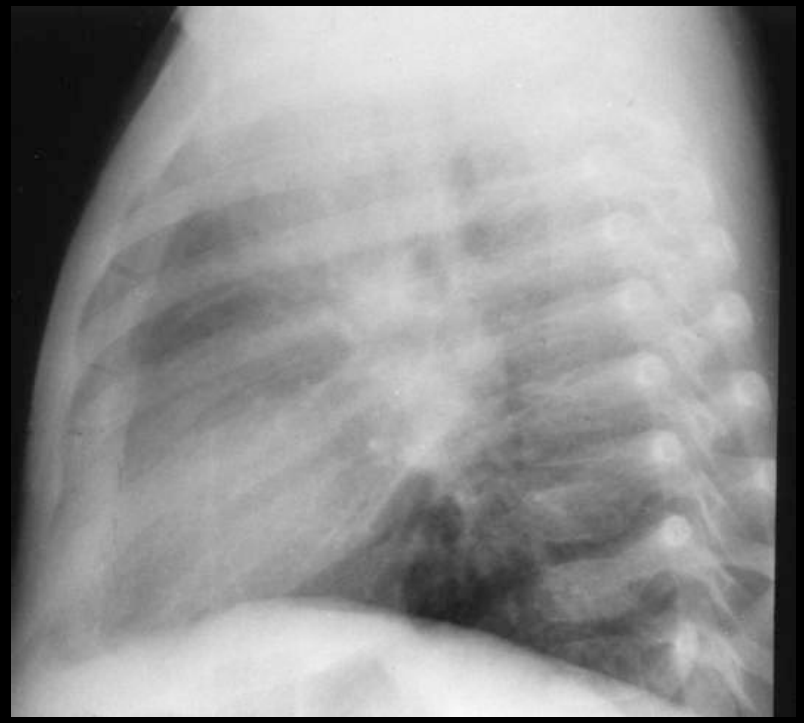




Vs. Normal
Lateral Hilum

Hilar Adenopathy





Vs. Normal
Lateral Hilum

AP “Window”

Left lung between aortic arch and the left PA

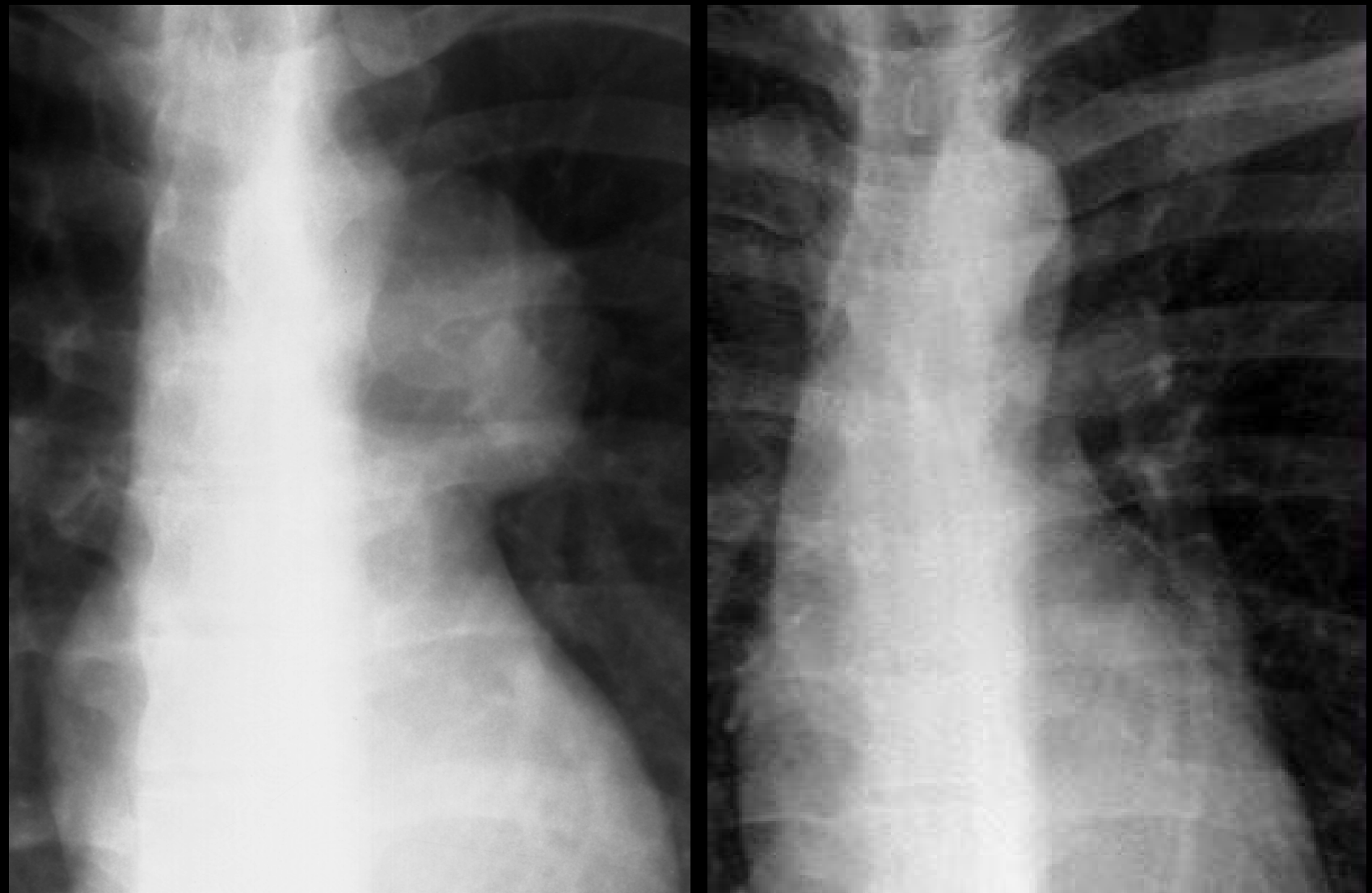
Almost always seen

Usually concave or straight

Abnormal convexity
- Lymph nodes
- Mediastinal mass
- Vascular abnormality

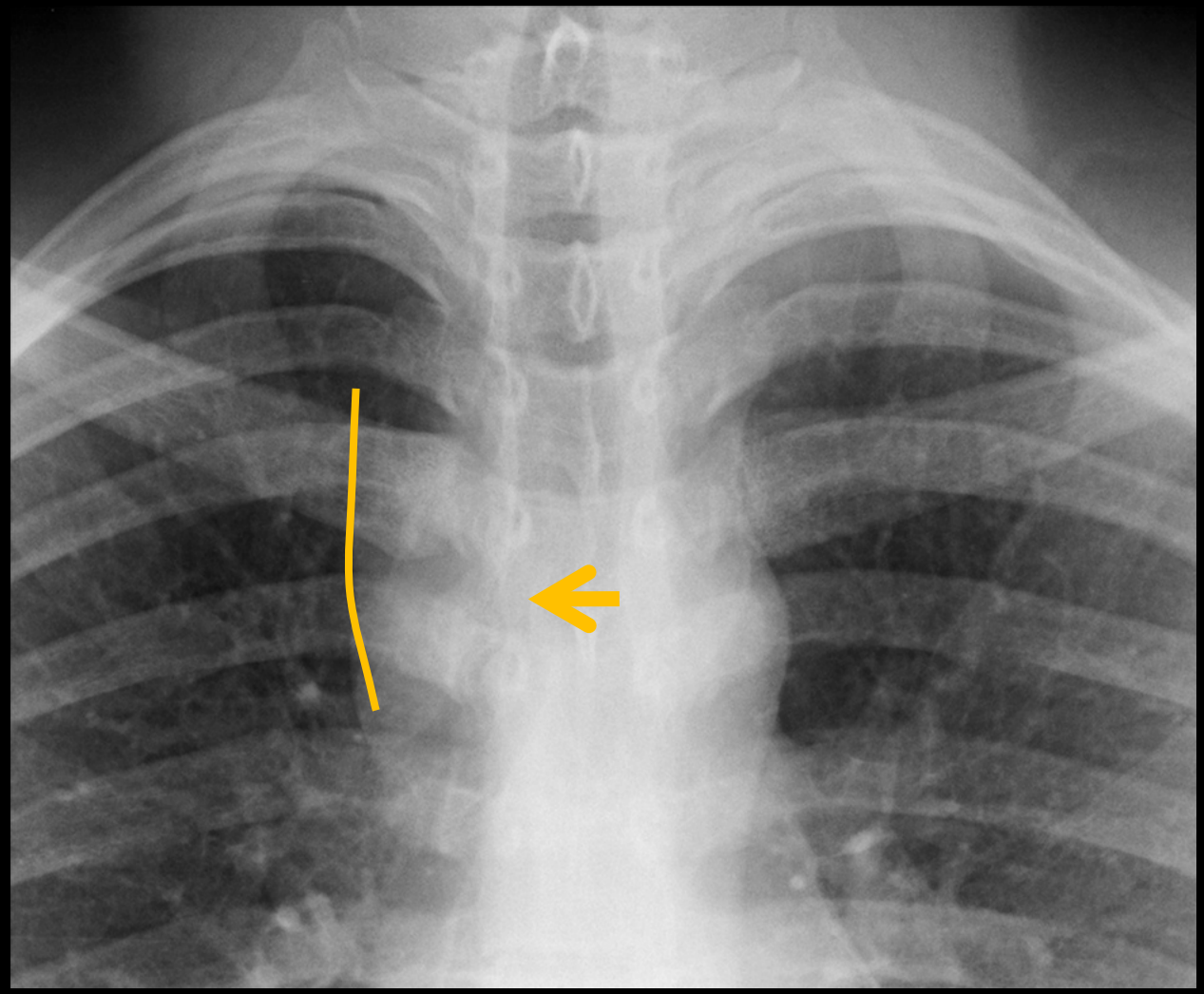
AP “Window” Adenopathy

Abnormal AP Window vs. Normal AP Window

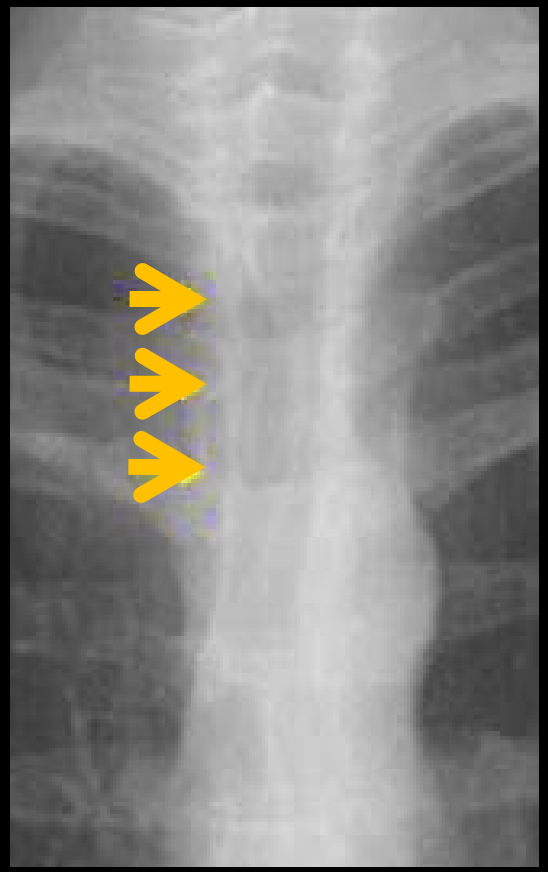


Right Paratracheal Adenopathy

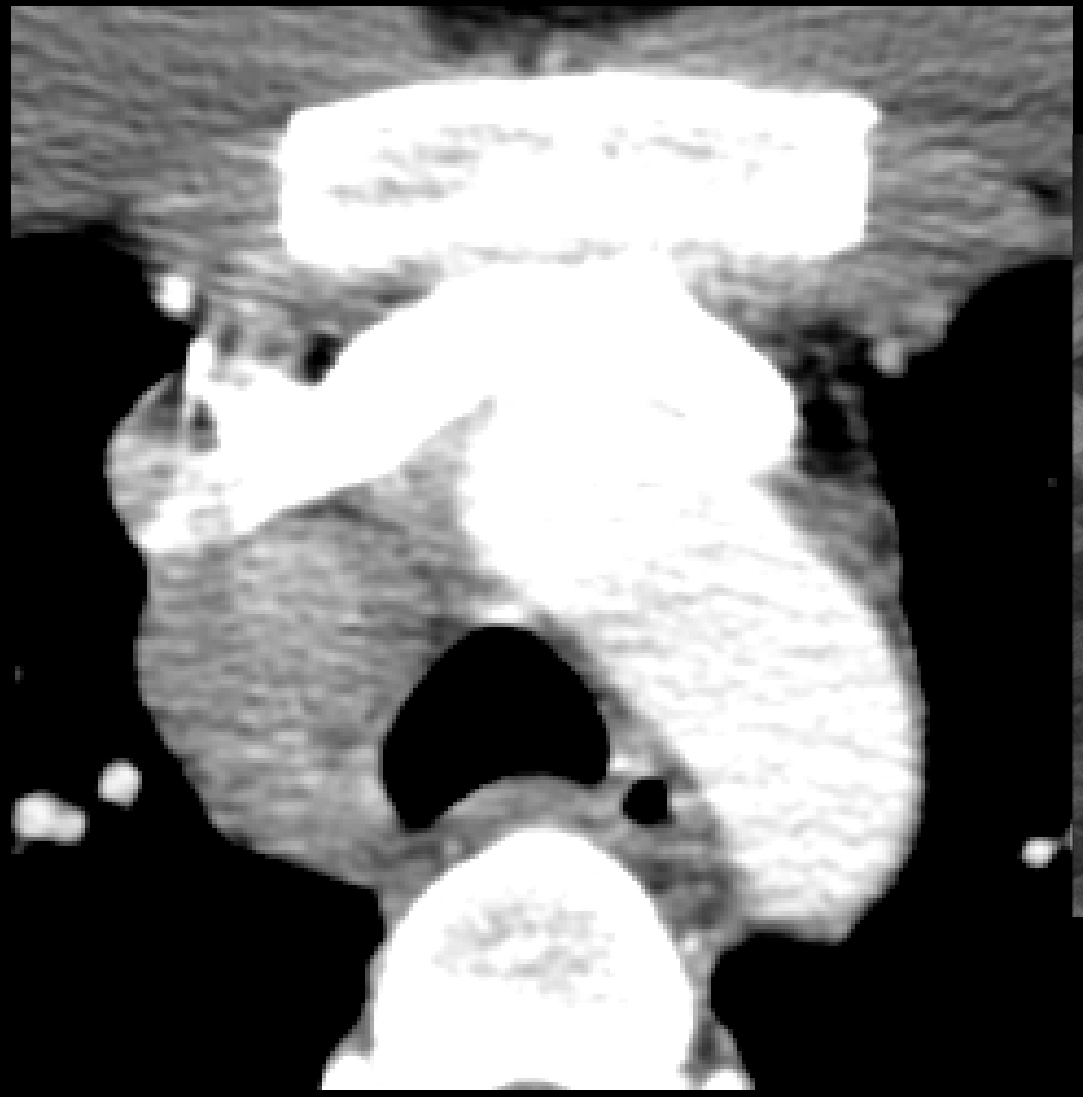
Adenopathy vs.

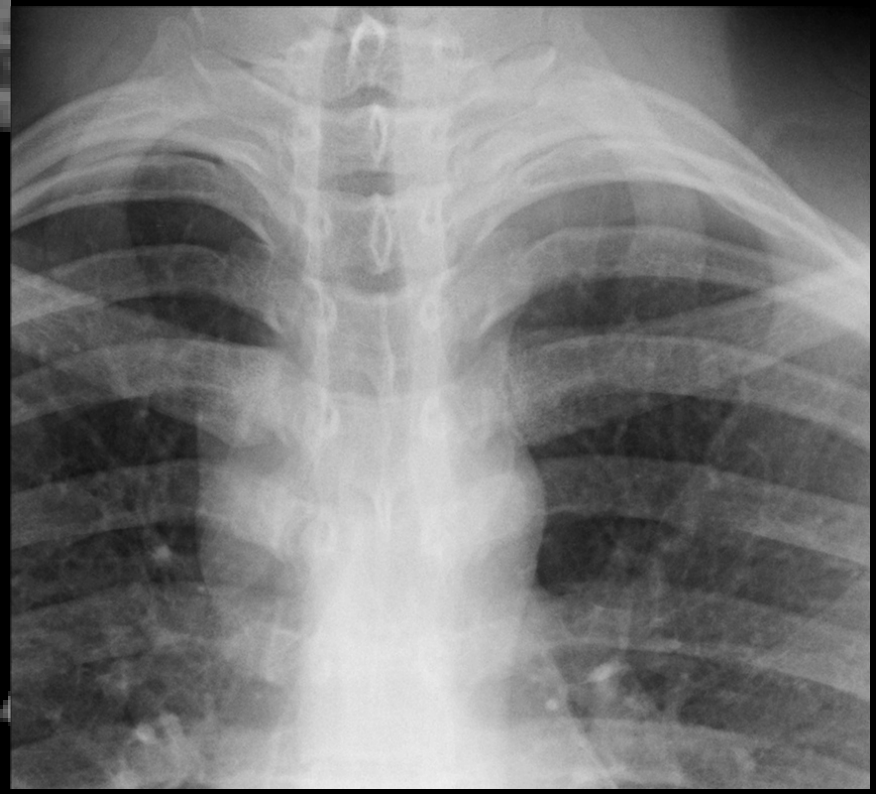


Normal R. Paratracheal Stripe



Right Paratracheal Adenopathy





Primary vs Post-primary Tuberculosis

In adults, there is no significant difference in radiographic features between recently and remotely acquired TB.

Therefore, “post-primary” and “primary” terms inaccurate

Better to use terms “typical” and “atypical”

Rozenshtein A, et al. AJR. 2015 May 204:974-978
Geng E, et al. JAMA. 2005 Jun 8;293(22):2740-5.
Jones BE, et al. AJRCCM. 1997 Oct;156(4 Pt 1):1270-3.

Typical Tuberculosis

- *Upper lobe* “infiltrate”
- *Upper lobe* cavities

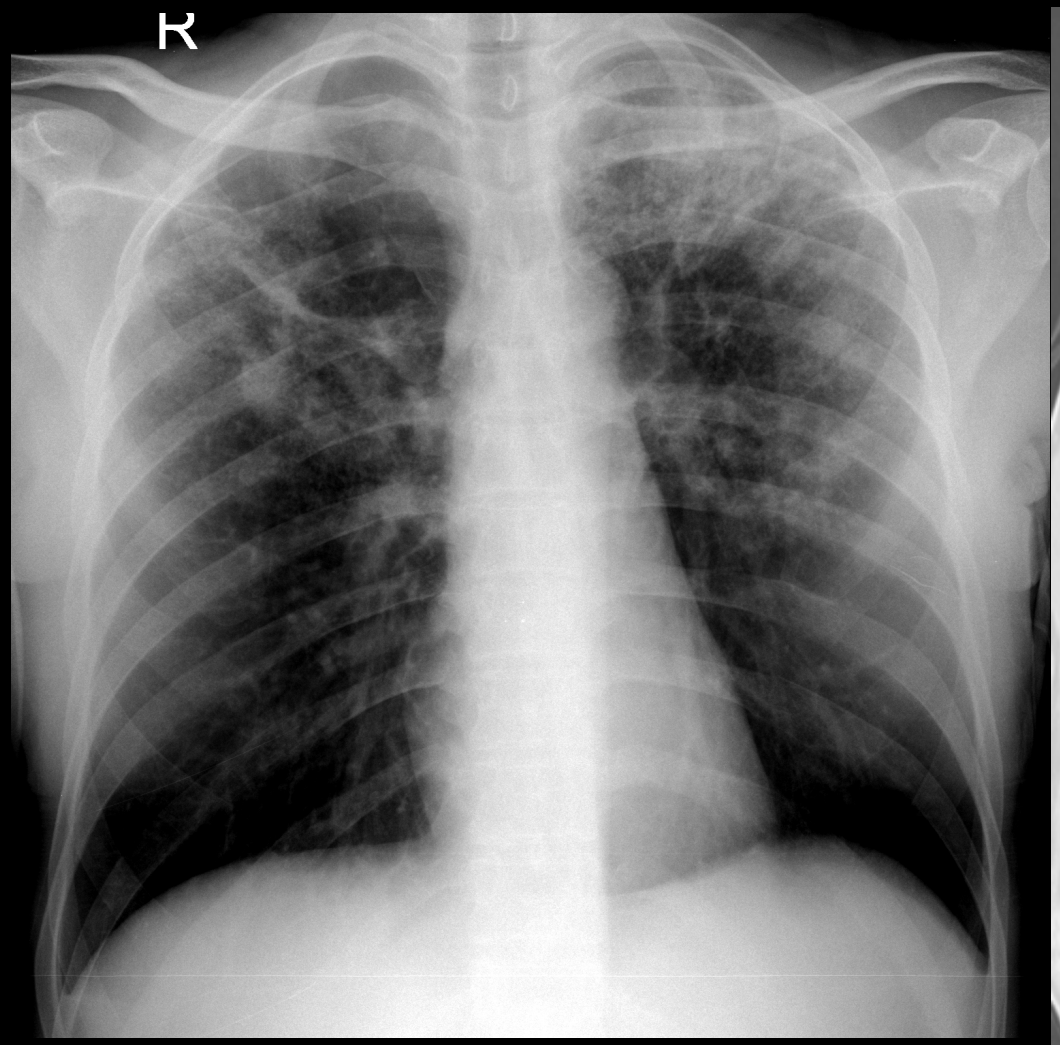
Geng E et al. JAMA. 2005 Jun 8;293(22):2740-5.

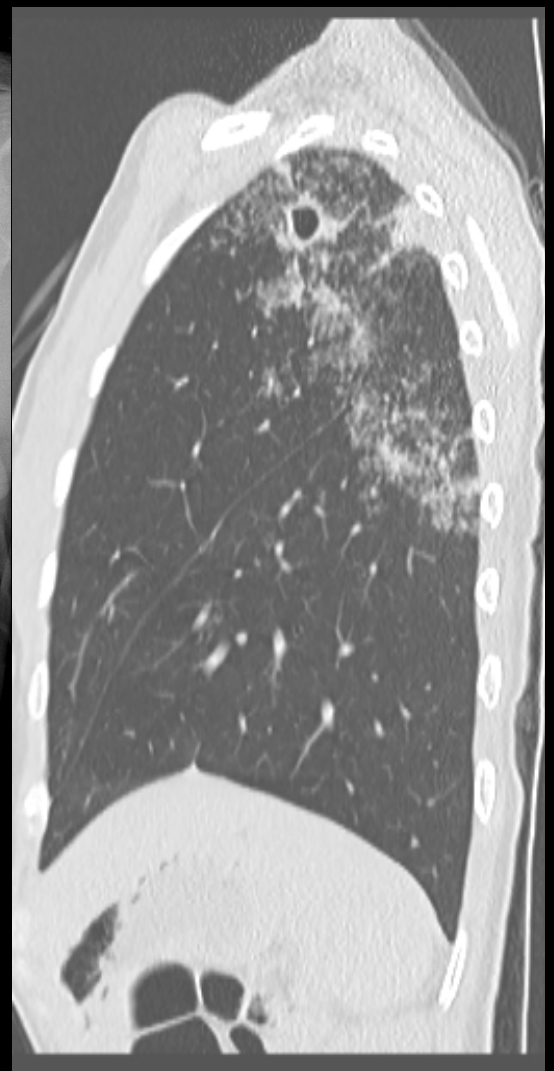
Typical Tuberculosis

- Apical/Posterior Segments Upper Lobe - & Superior Segment Lower Lobes

Typical Tuberculosis

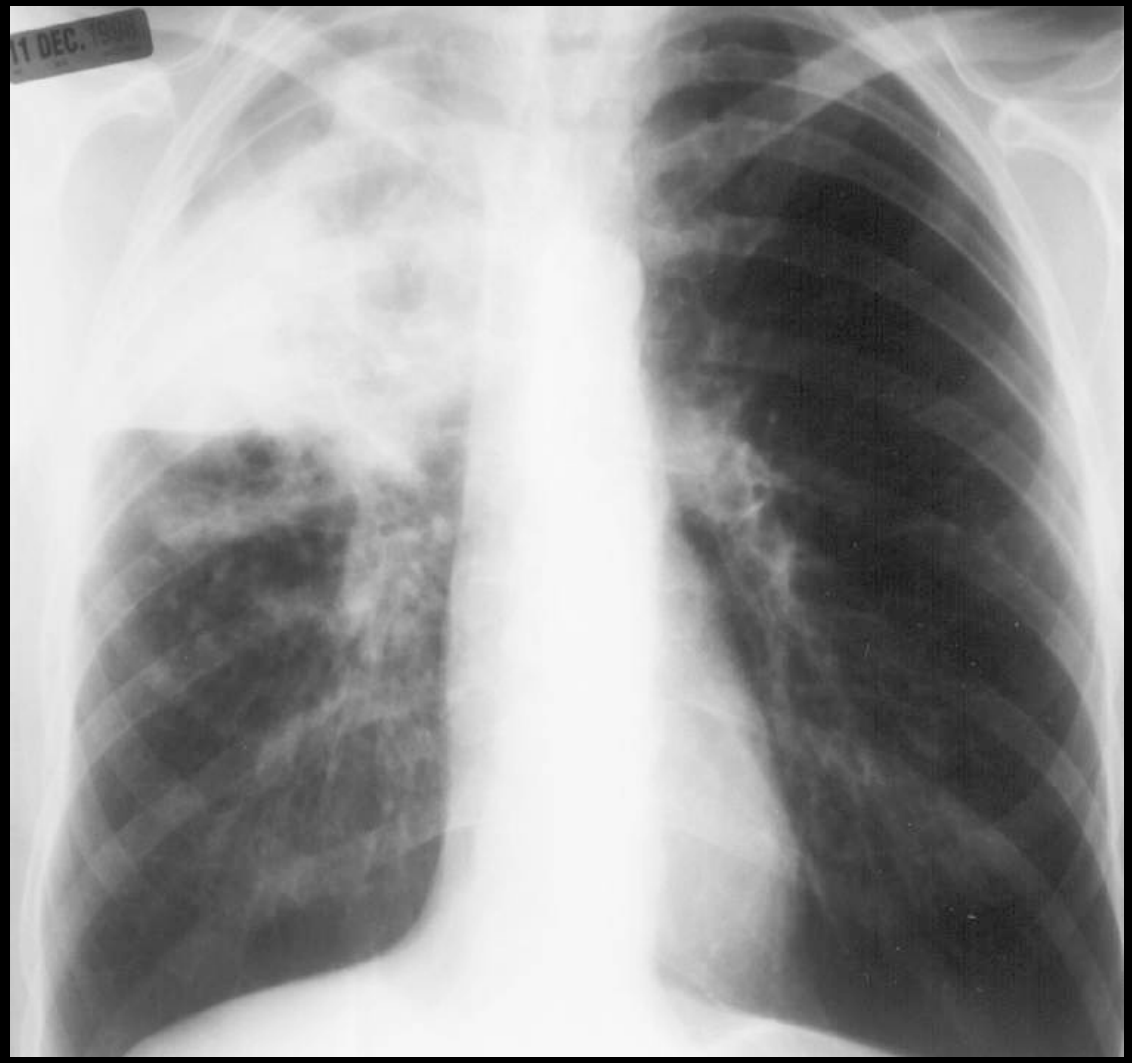
- Apical/Posterior Segments Upper Lobe - & Superior Segment Lower Lobes



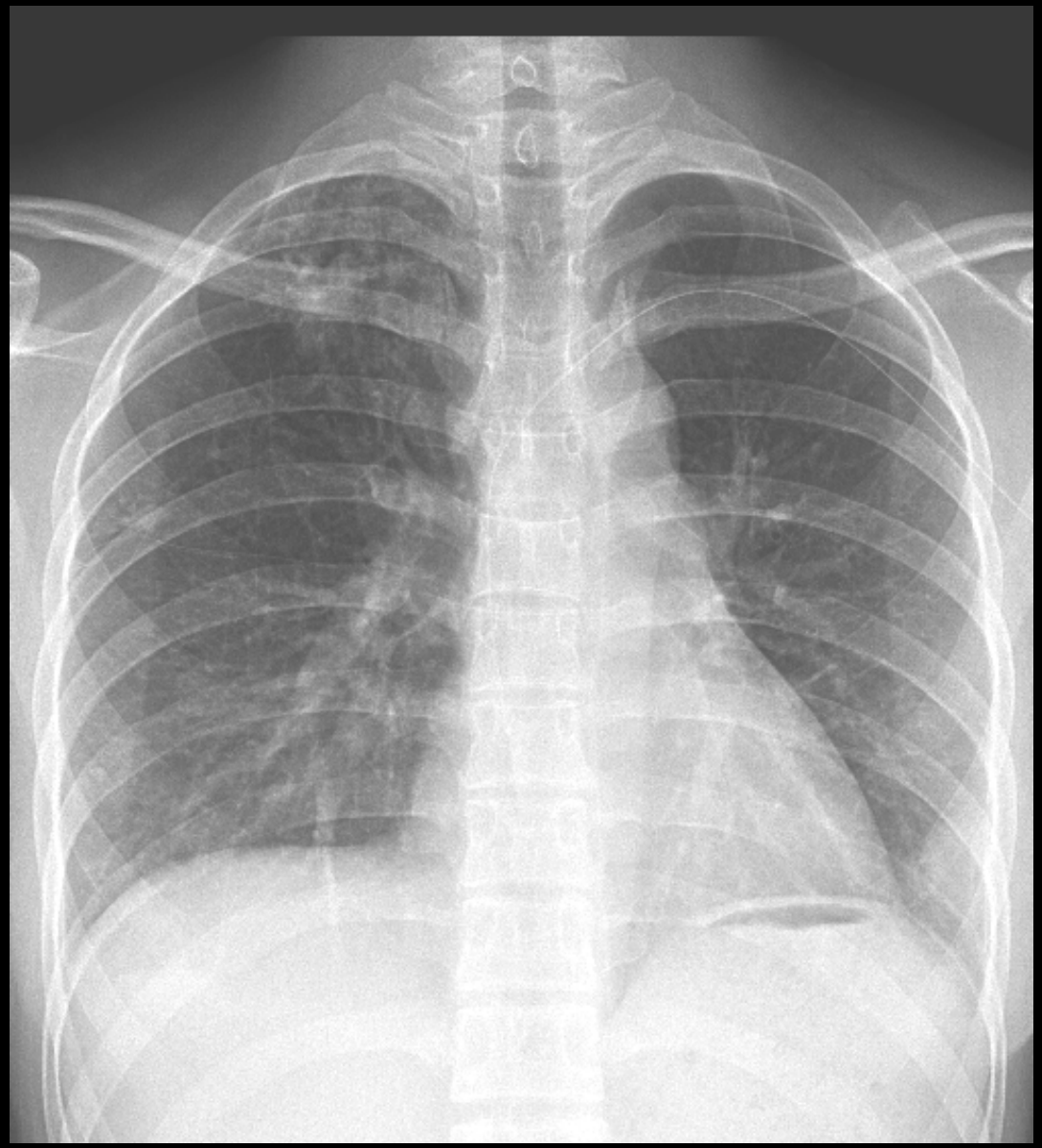


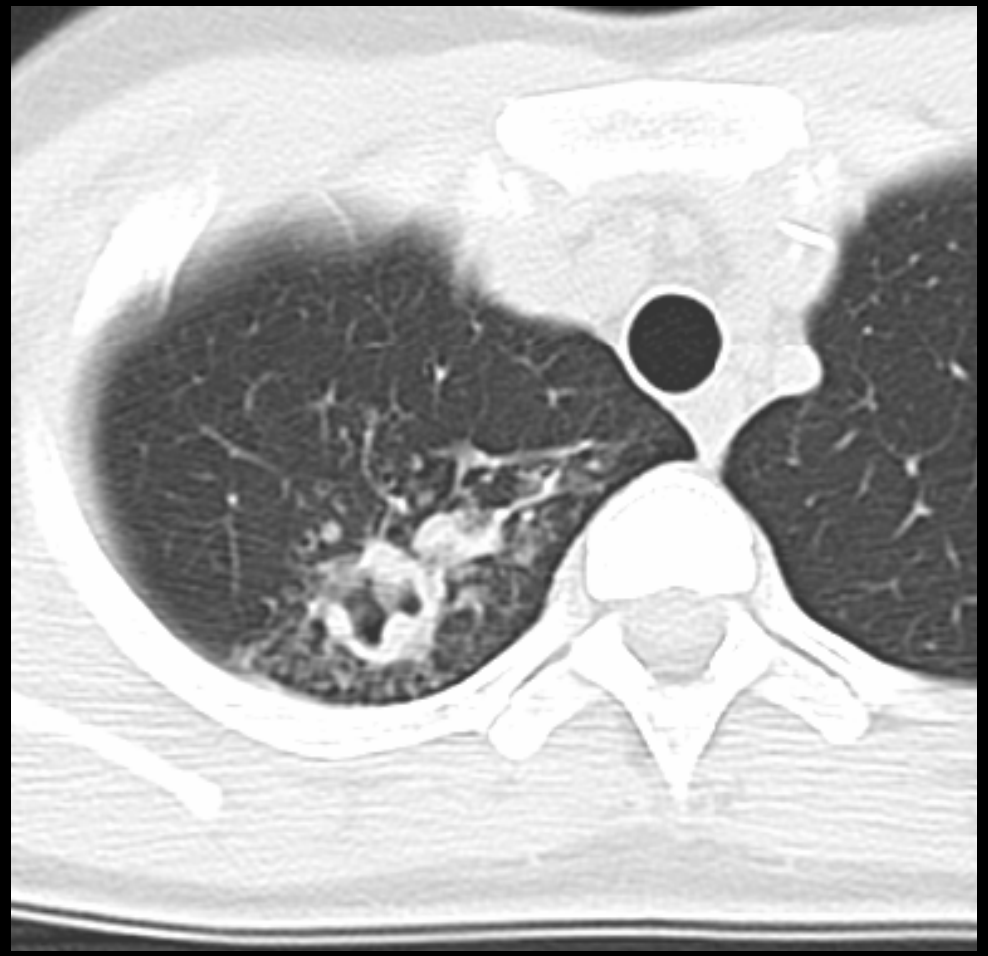
Typical Tuberculosis

- Consolidation with Cavitation

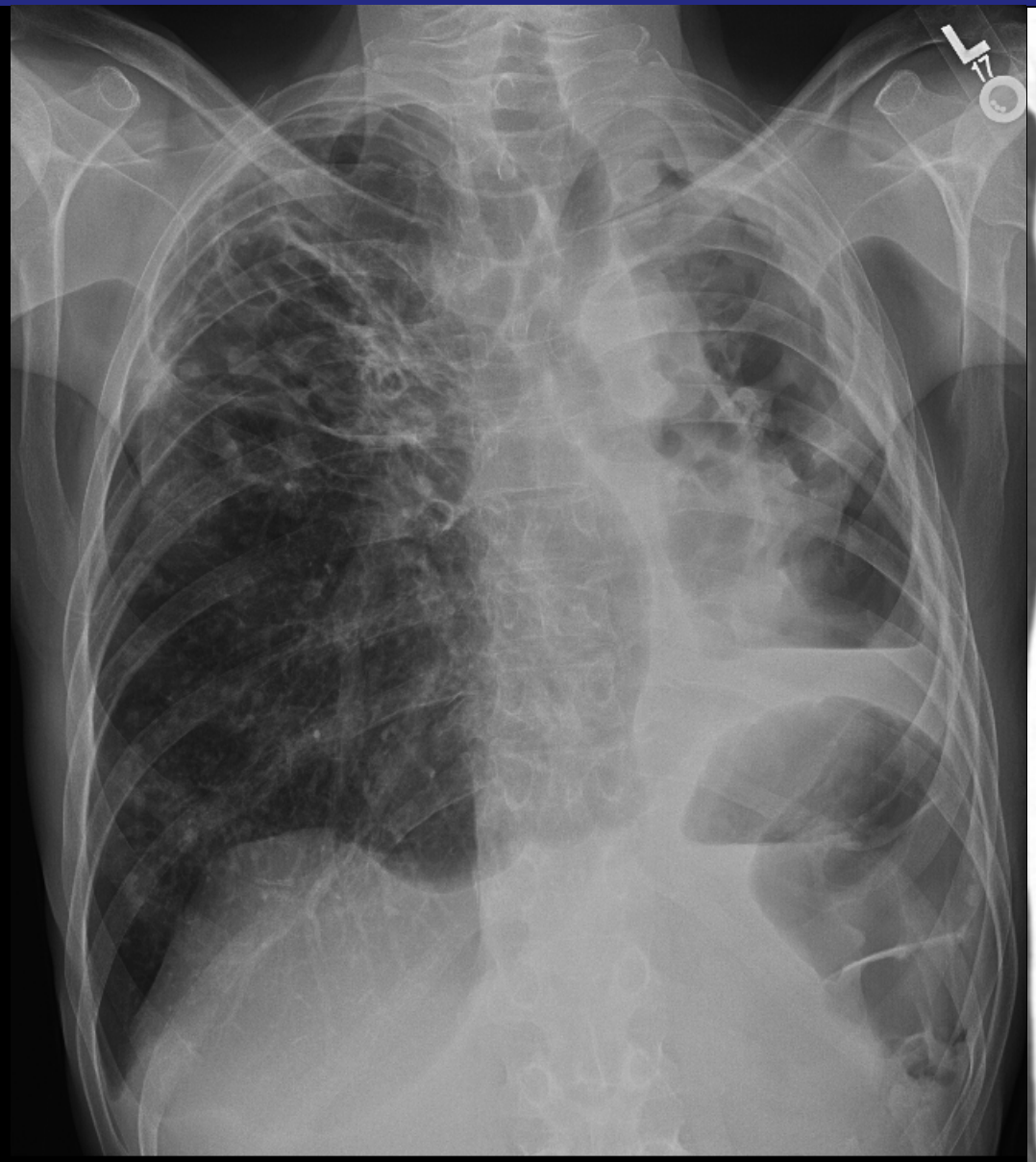


Typical Tuberculosis

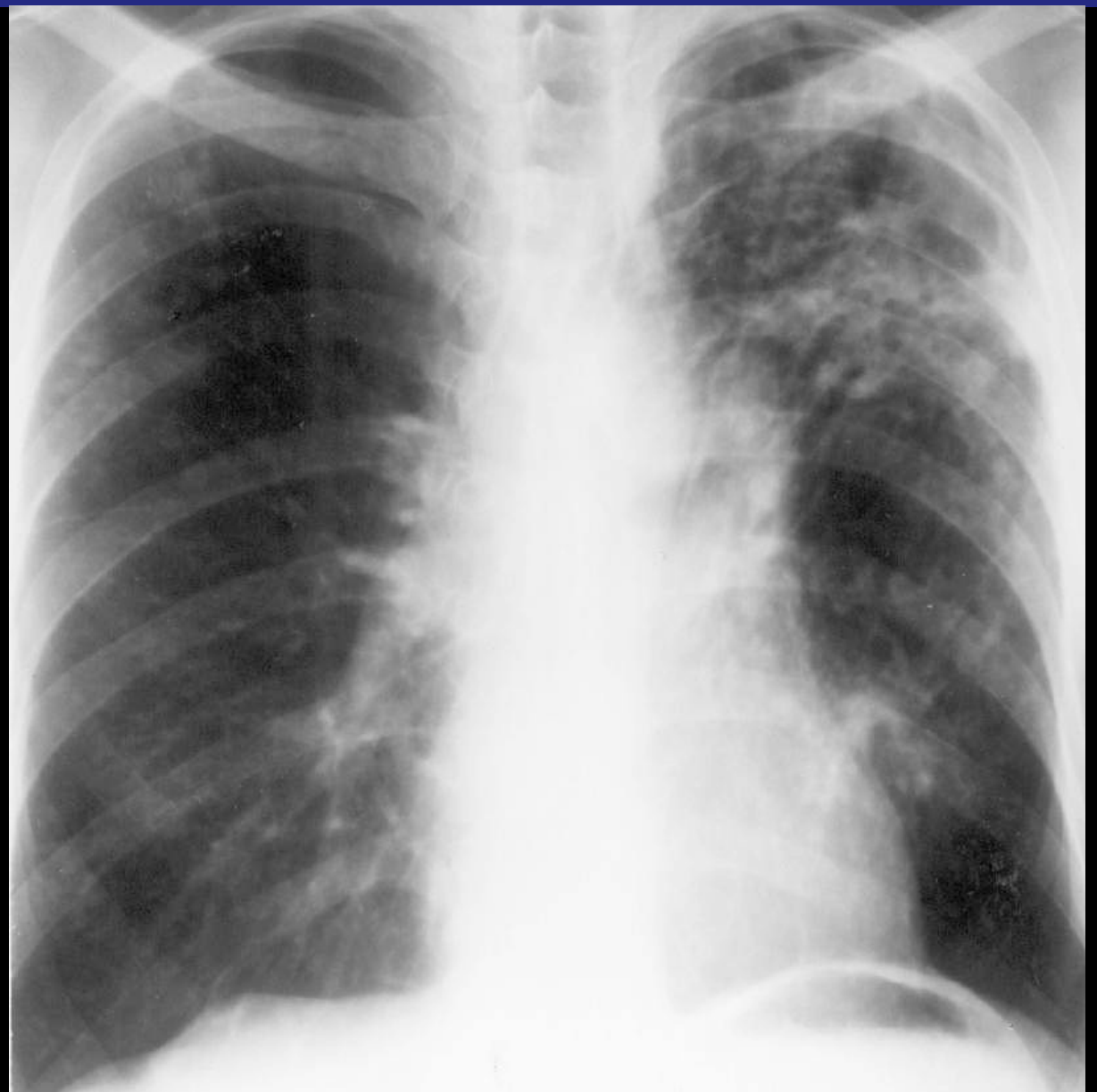




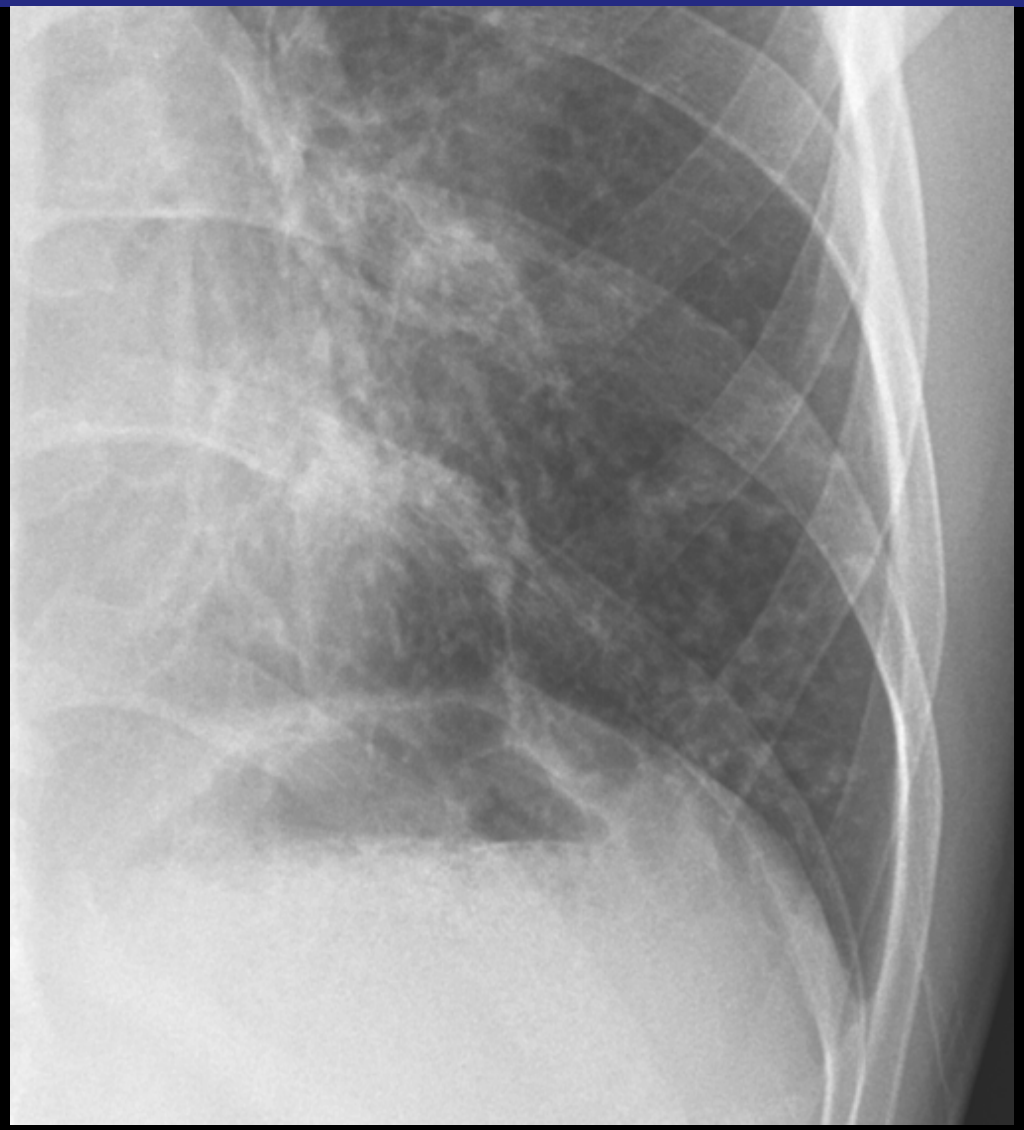
Typical Tuberculosis



Typical Tuberculosis - Endobronchial Spread



Typical Tuberculosis - Endobronchial Spread



Atypical Tuberculosis

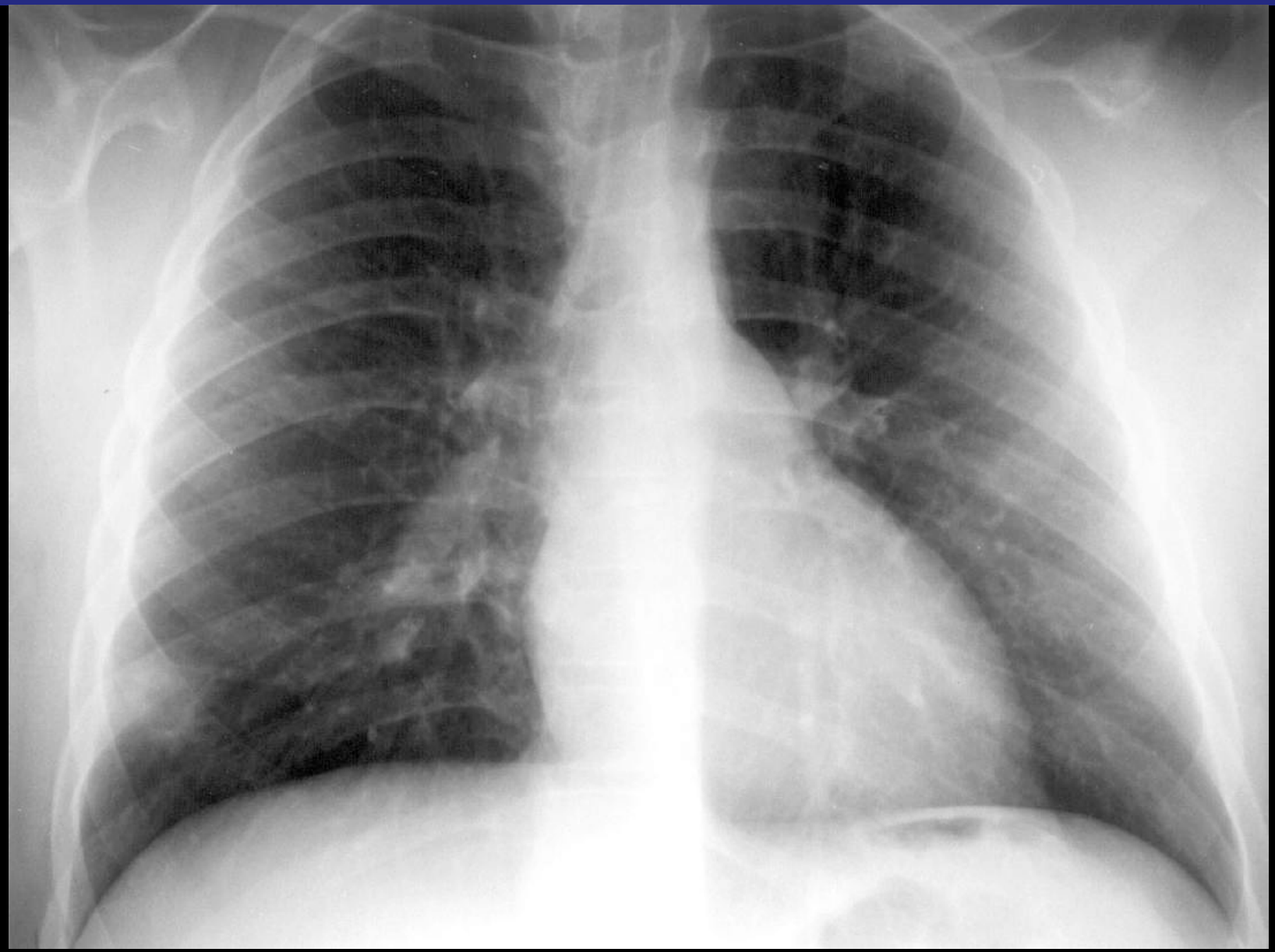
- *"Atypical" is more common in children & HIV*

- Lower or mid-lung opacity
- Lymphadenopathy *Only*

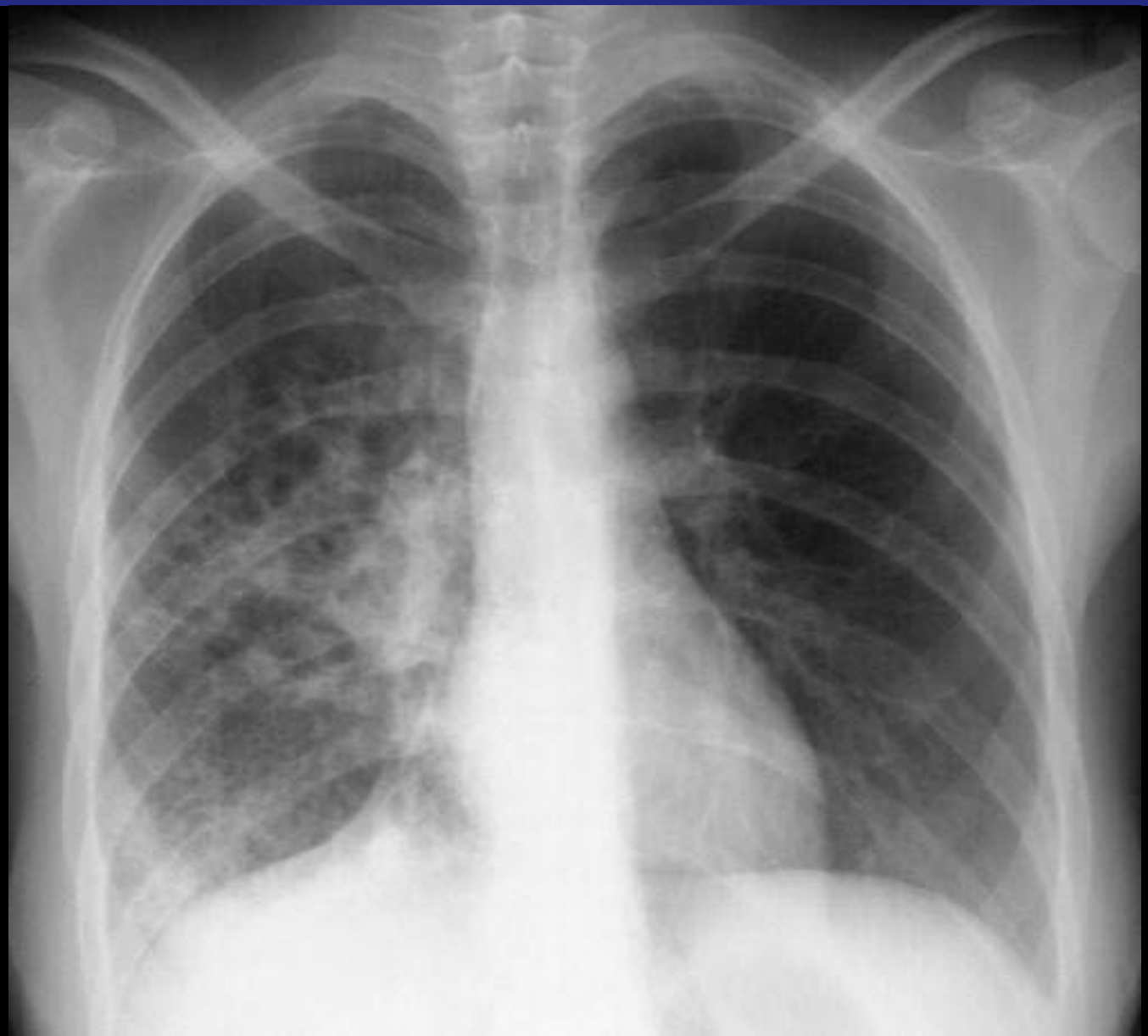
- Effusions, without cavity or upper lung opacity
  - In kids, simple effusions more common with older age, as "hypersensitivity reaction" to TB.

Geng E et al. JAMA. 2005 Jun 8;293(22):2740-5.

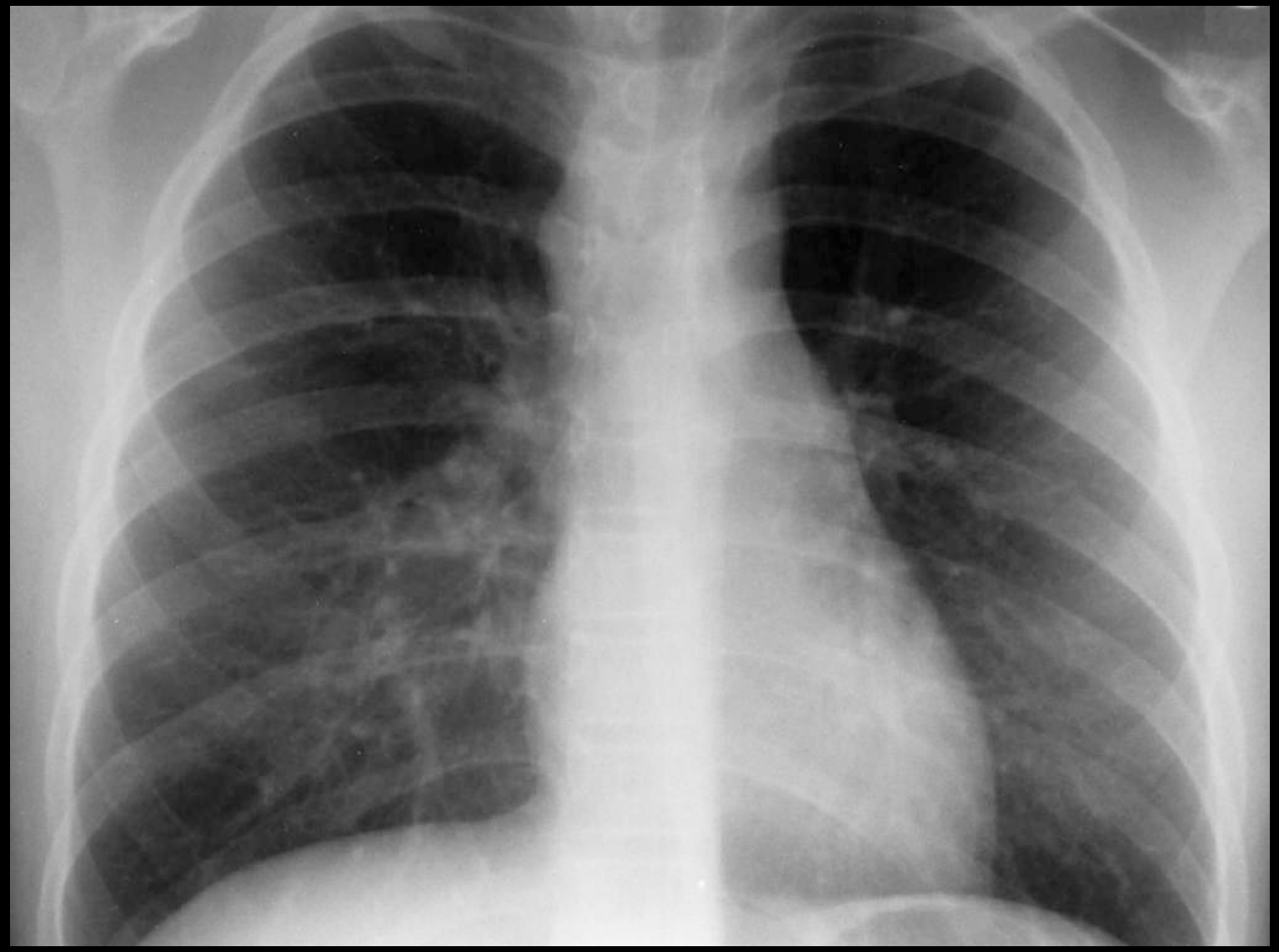
Atypical Tuberculosis- RLL cavity/hilar adenopathy

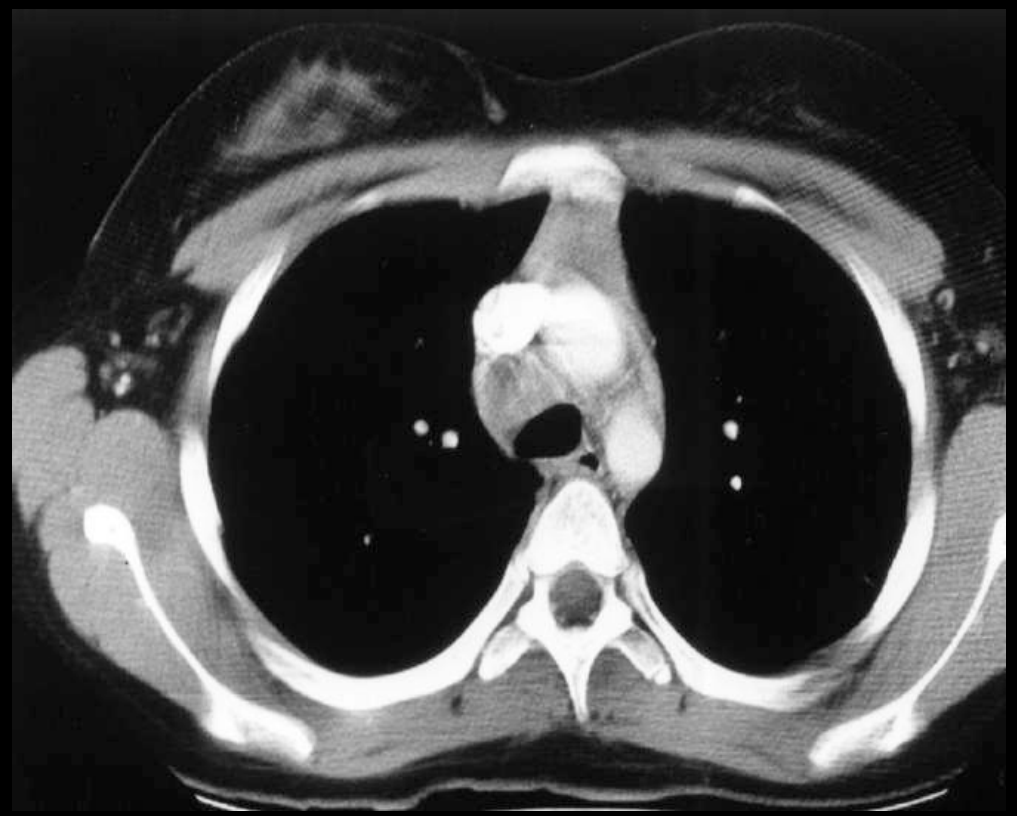


Atypical Tuberculosis

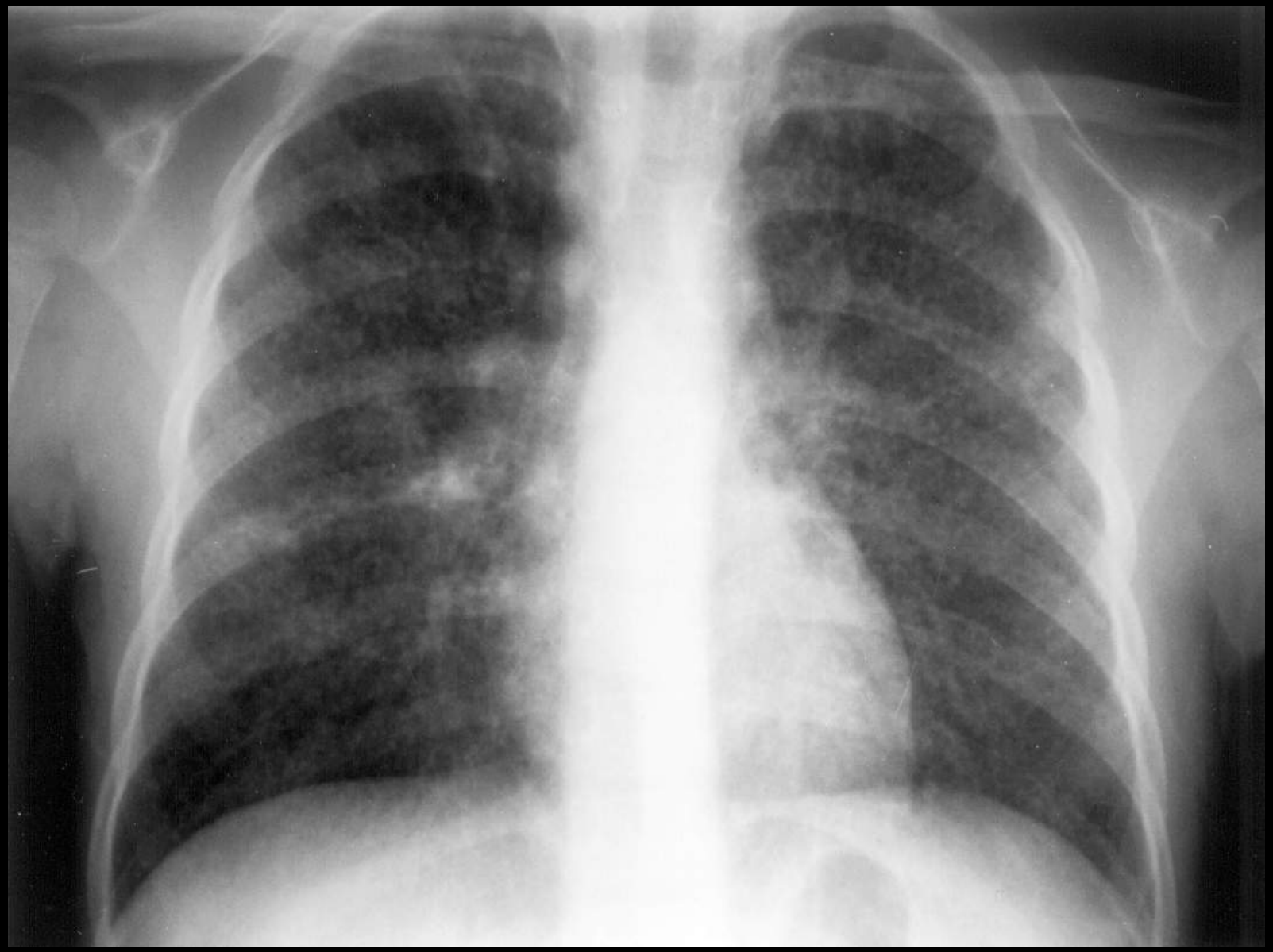


Atypical TB- Hilar/Mediastinal Lymphadenopathy





Atypical Tuberculosis - Miliary Pattern



Childhood Tuberculosis - Lymphadenopathy

Finding		
Any adenopathy	175	92%
Right hilar	83	43%
With mediastinal nodes	43	23%
Left hilar	37	19%
With mediastinal nodes	16	8%
Bilateral hilar	49	26%
With mediastinal nodes	44	23%
Mediastinal only	6	3%

(n=191)

Leung AN. Radiology. 1992 Jan;182(1):87-91.

Parenchymal Abnormality in Childhood TB

Finding		
Parenchymal abnormality with adenopathy	130	68%
Parenchymal abnormality without adenopathy	2	1%
Right lung consolidation	78	41%
Left lung consolidation	21	11%
Bilateral consolidation	33	17%
Lobar atelectasis	16	8%
Effusion	11	6%
Normal CXR	14	7%

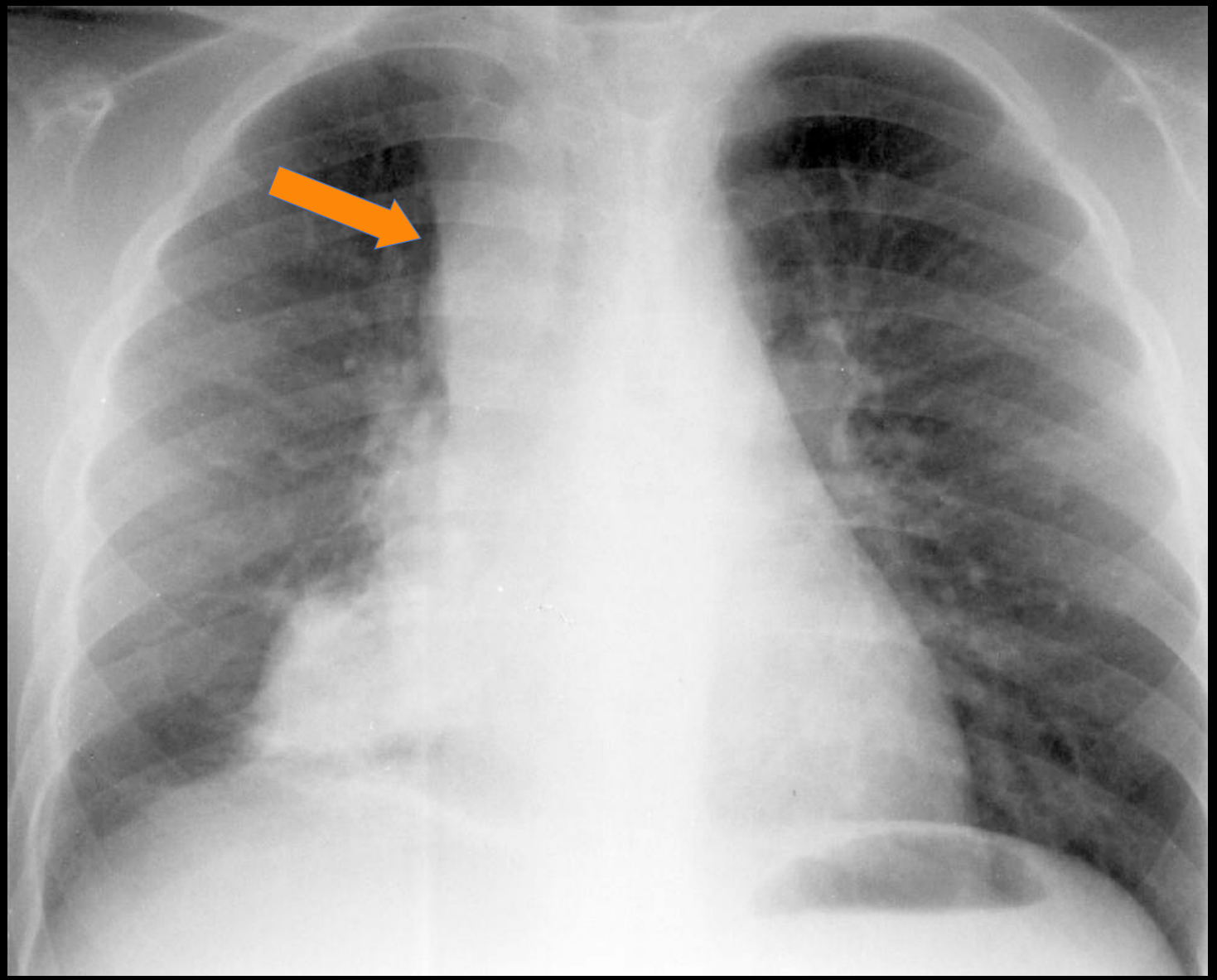
Leung AN. Radiology. 1992 Jan;182(1):87-91.

“Primary” Tuberculosis in Childhood: Pearls

- Parenchymal abnormality is more common in children older than 3 years
- Adolescents with recent infection usually have typical features of tuberculosis with upper lobe nodules or cavity

- *Leung AN, et al. Radiology. 1992 Jan;182(1):87-91.*
- *Koh WJ, et al. Korean J Radiol. 2010 Nov-Dec;11(6):612-7.*

Childhood TB - Hilar/Mediast. Lymphadenopathy

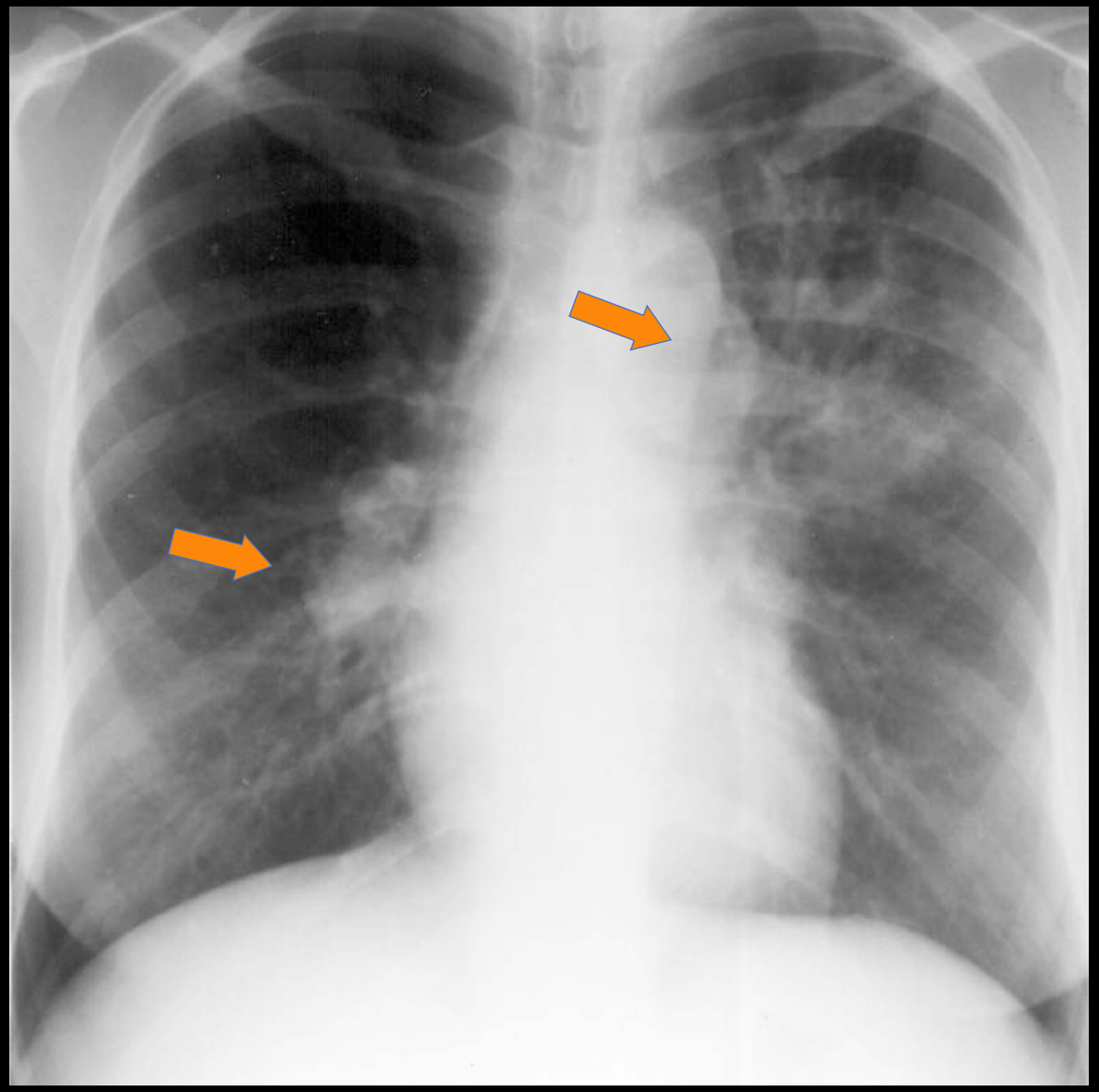


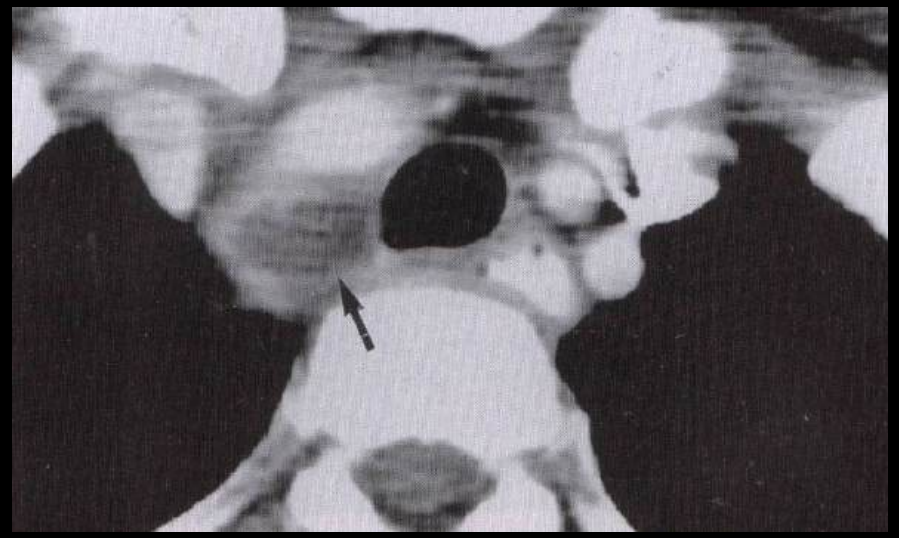
Chest Radiograph - TB and HIV

- Chest radiograph often looks like “atypical” (“primary”) disease – in more advanced TB
- Adenopathy is common and highly predictive of tuberculosis
- *Radiograph may be normal in up to 10% of cases*

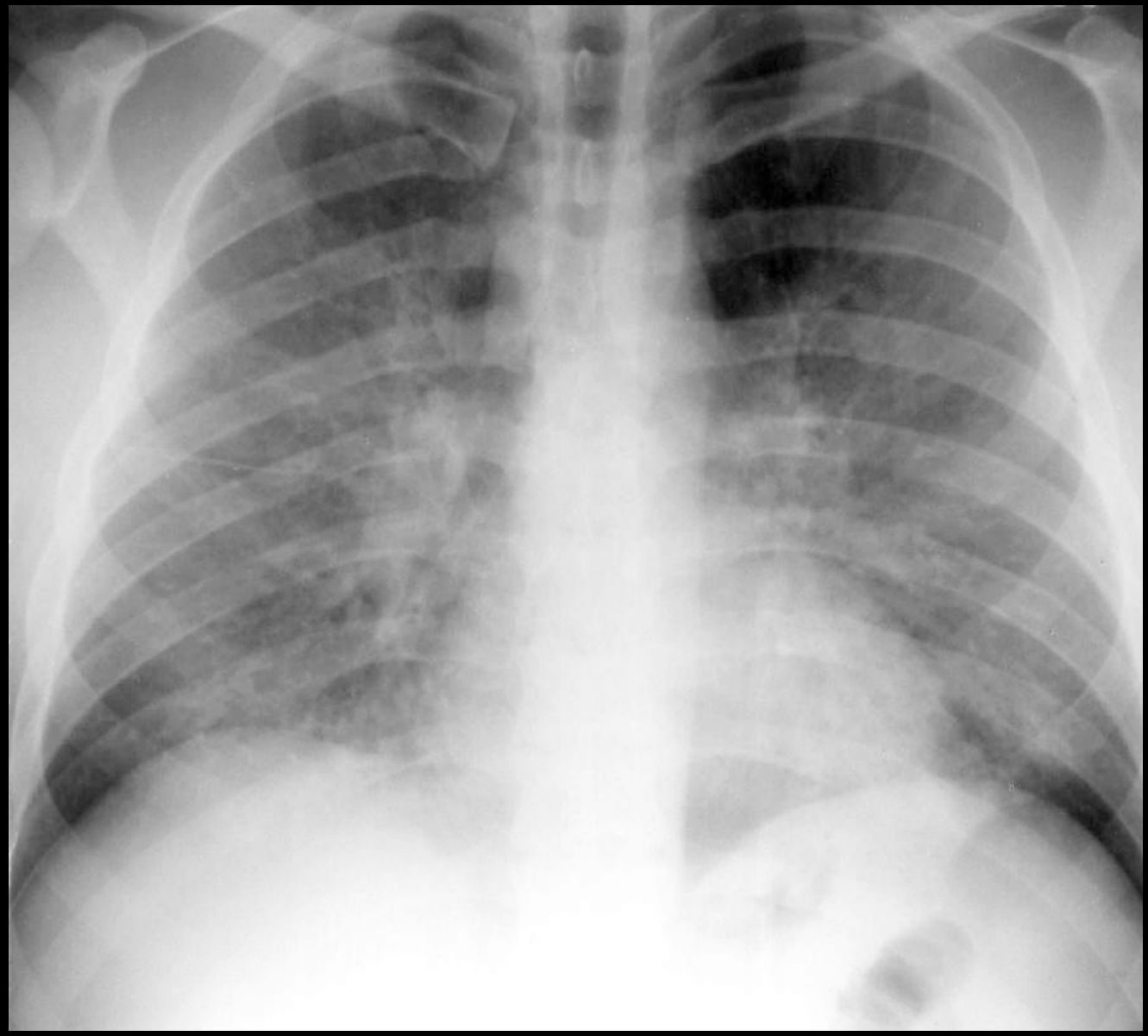
Geng E et al. JAMA. 2005 Jun 8;293(22):2740-5.

Chest Radiograph - TB and HIV





Chest Radiograph - TB and HIV



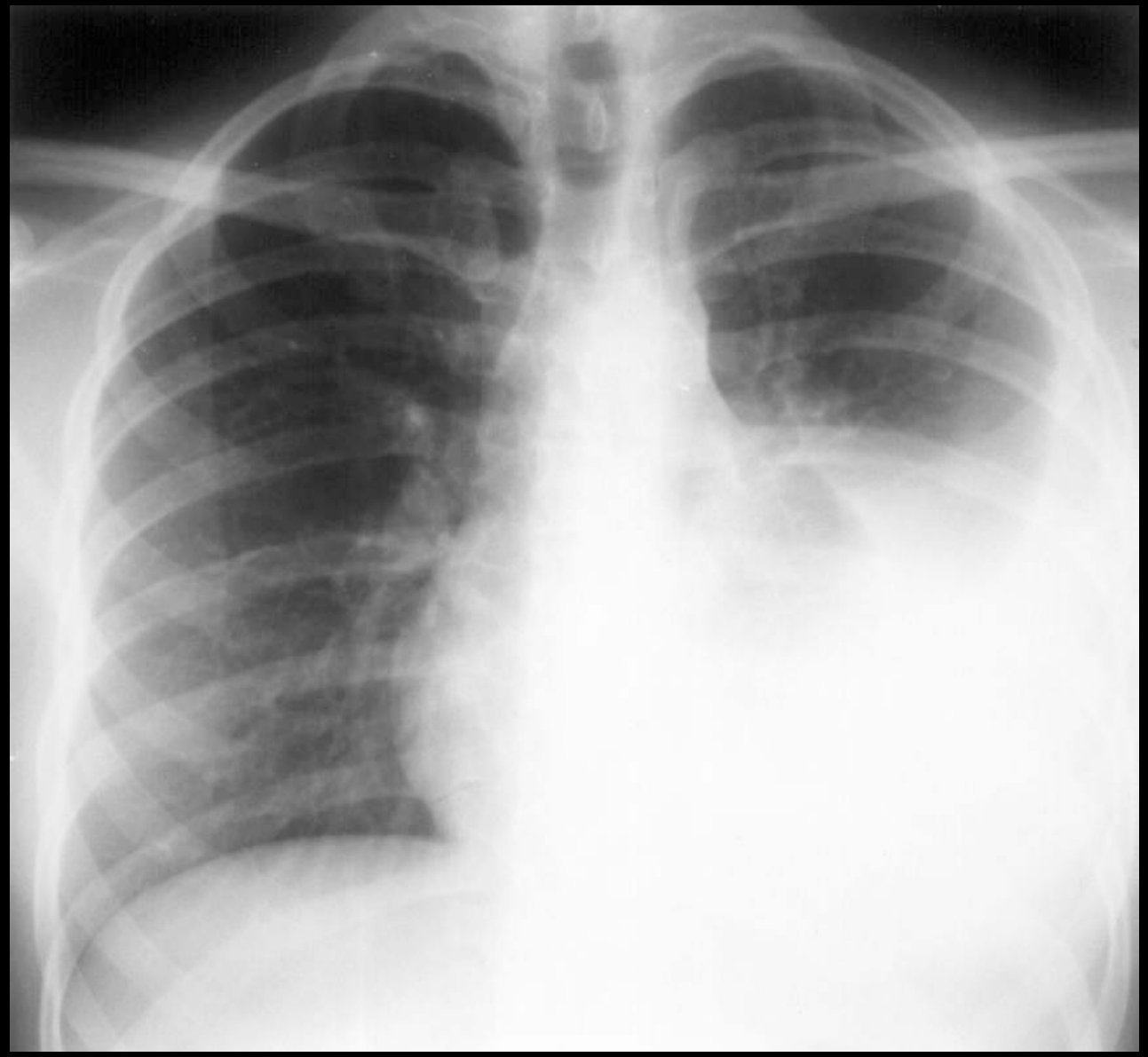
Pleural Tuberculosis

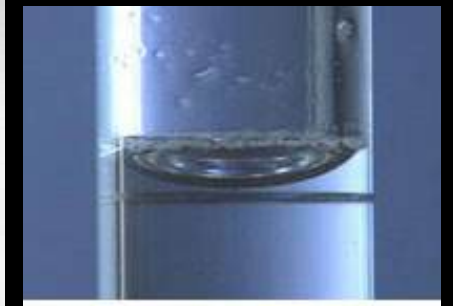
- Effusions common in adults (6-15%)

- Less common in children
- But, may be sole finding in kids

- Air fluid level may indicate bronchopleural fistula

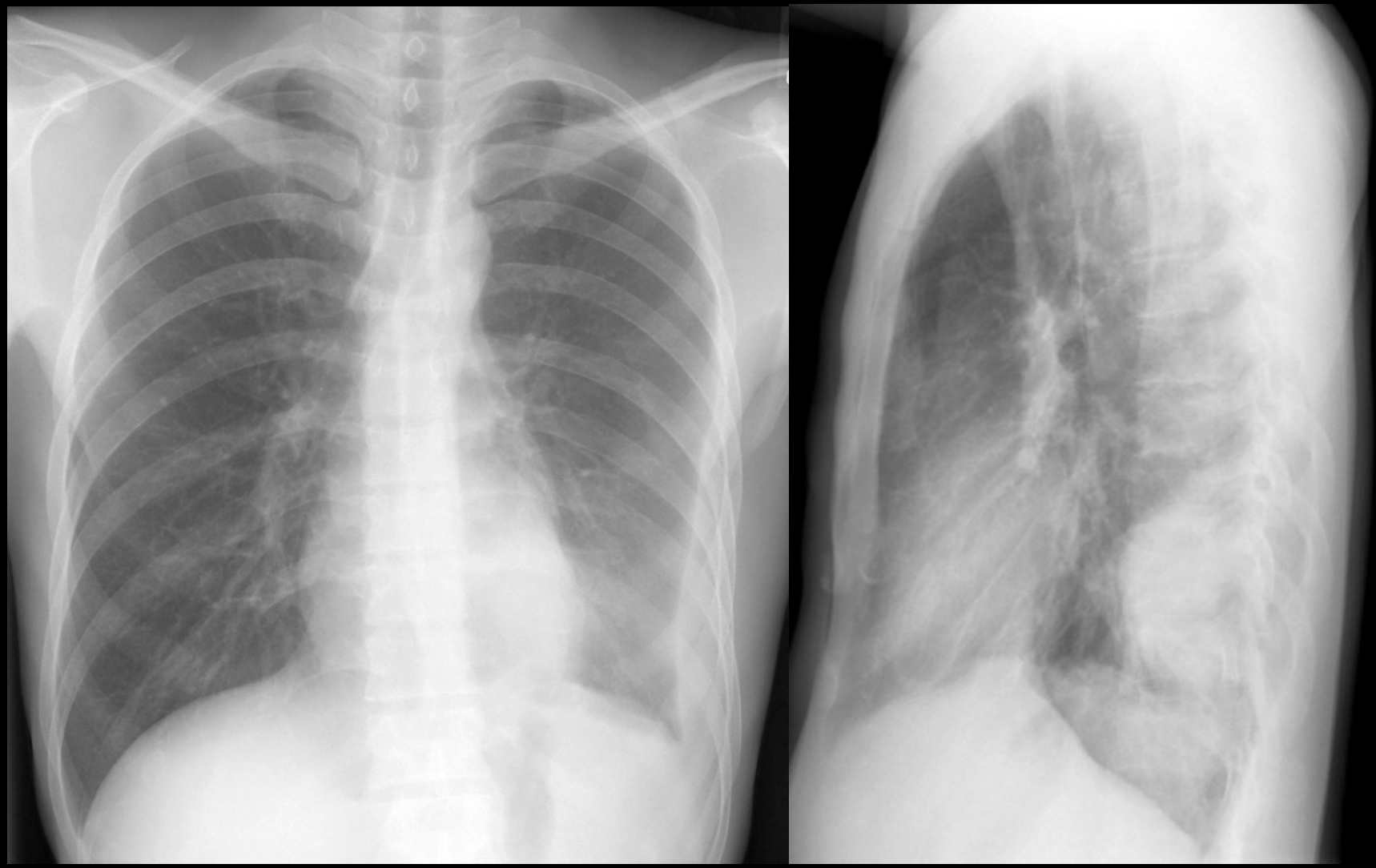
Pleural Effusion



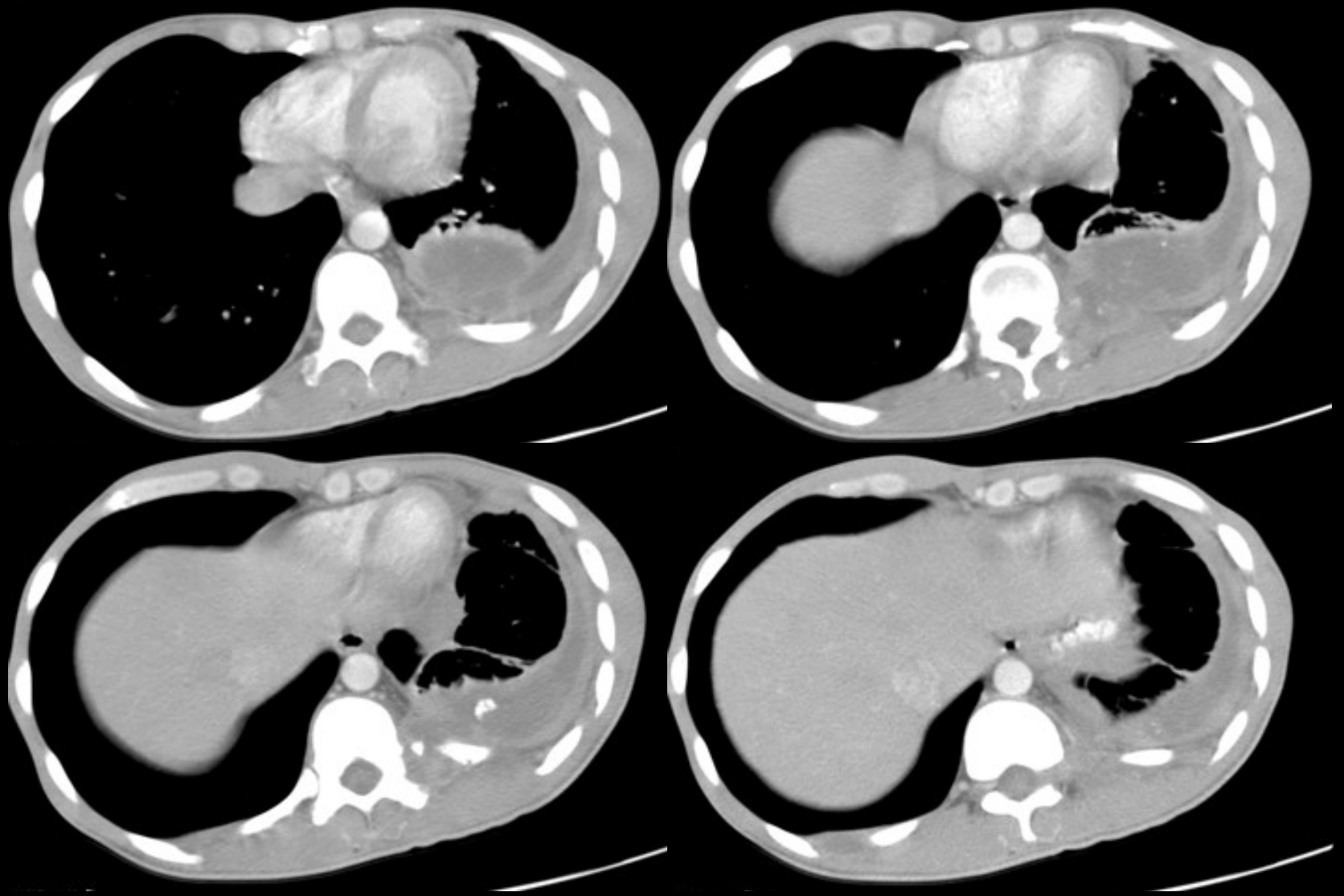


Meniscus

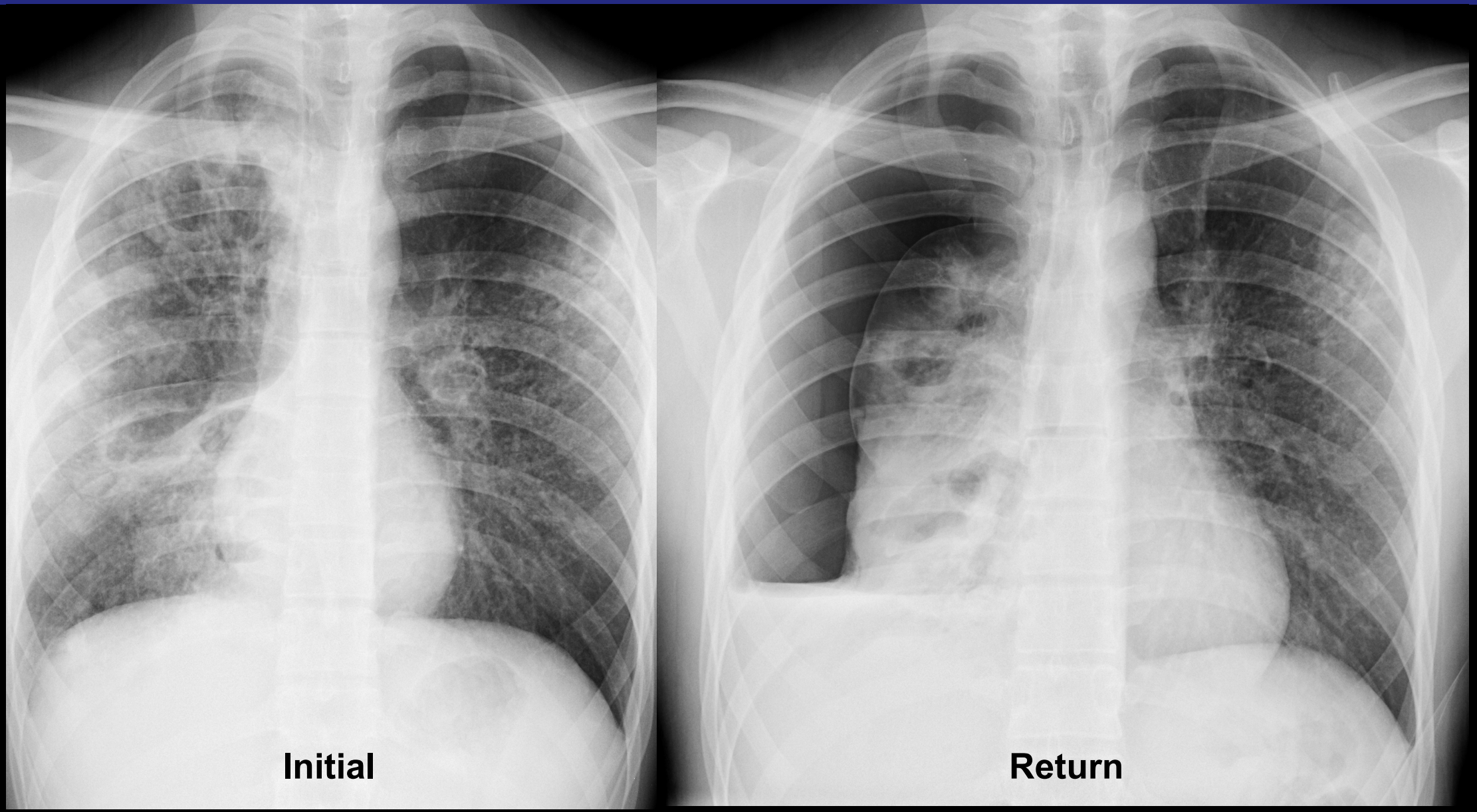
Tuberculosis - Empyema



Tuberculosis - Empyema



Bronchopleural Fistula



Empyema Necessitans

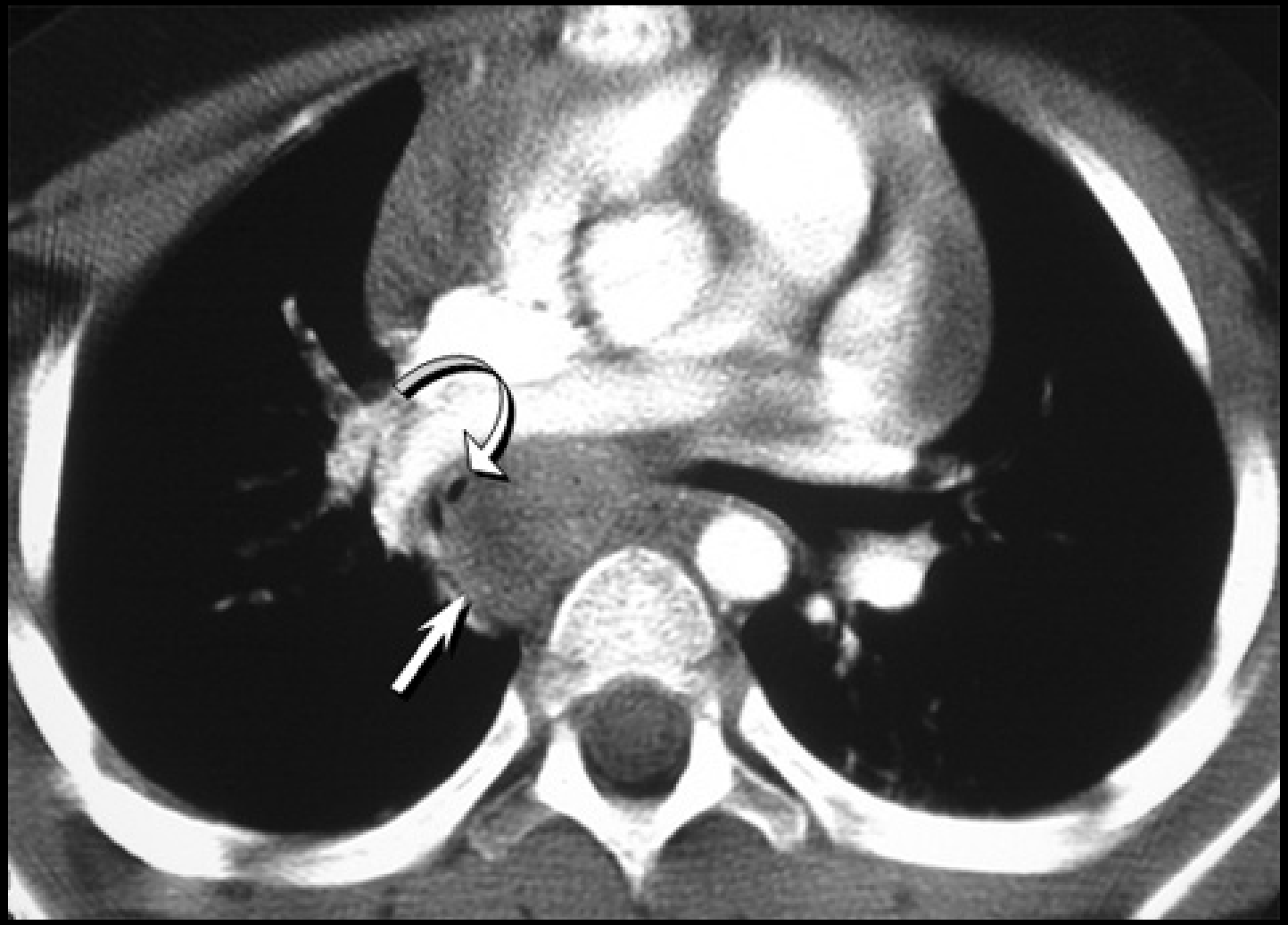
Tuberculosis and Airways

Atelectasis due to

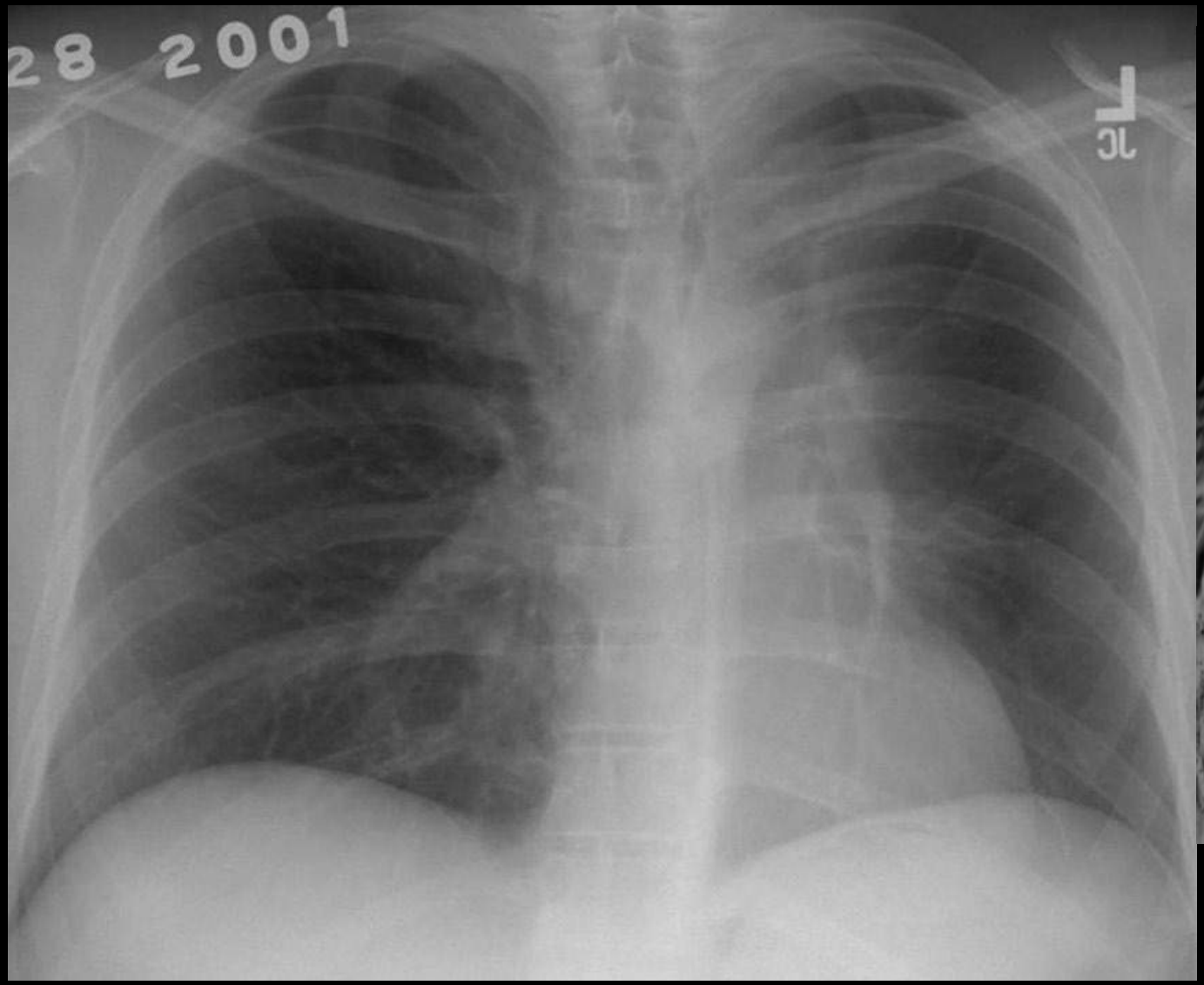
1) Nodal enlargement - compressing airway
2) Endobronchial abnormality - obstructing airway

May never resolve

Airway Narrowing due to Nodal Enlargement



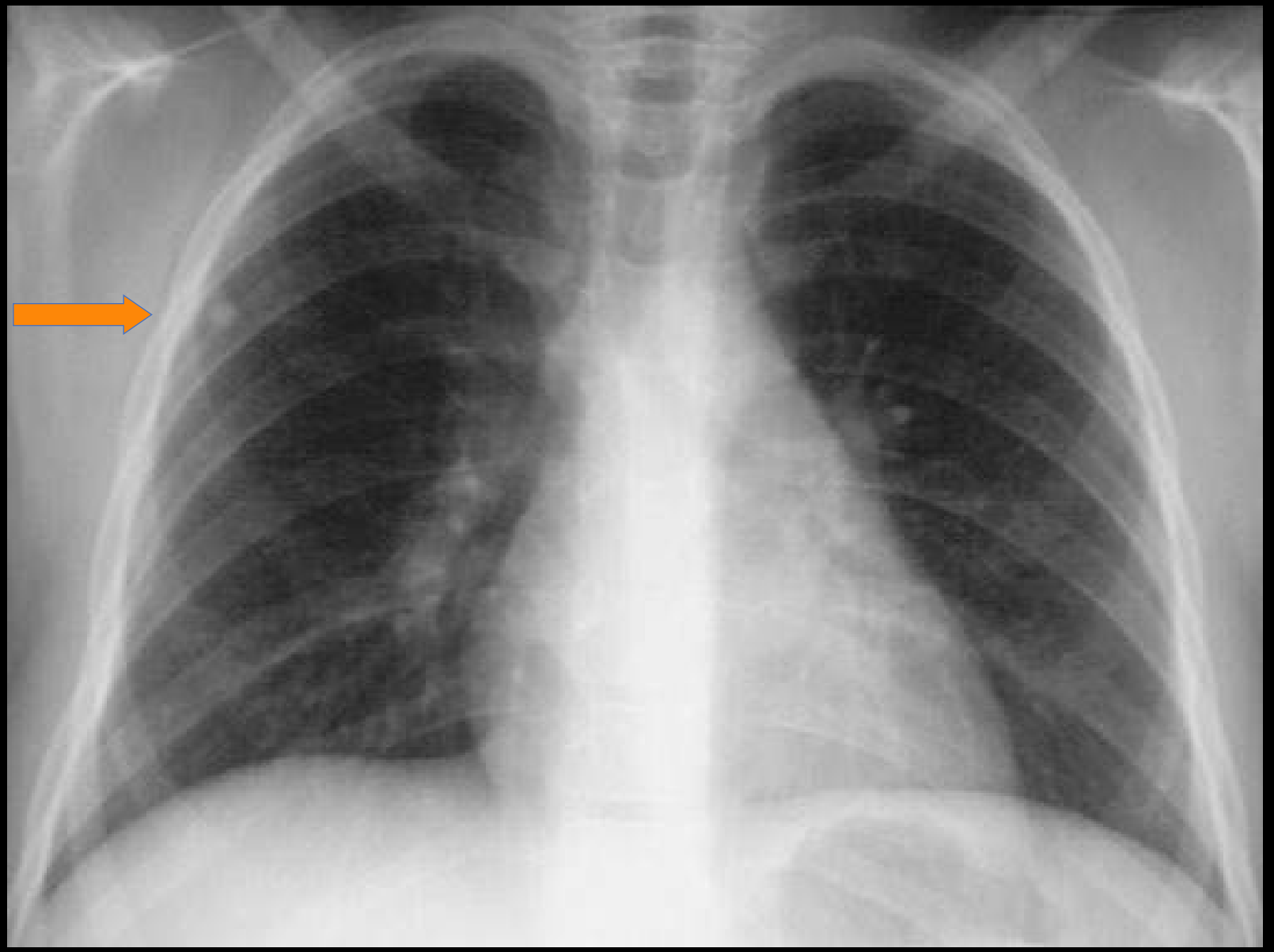
Bronchostenosis



The Chest Radiograph - Healed Tuberculosis

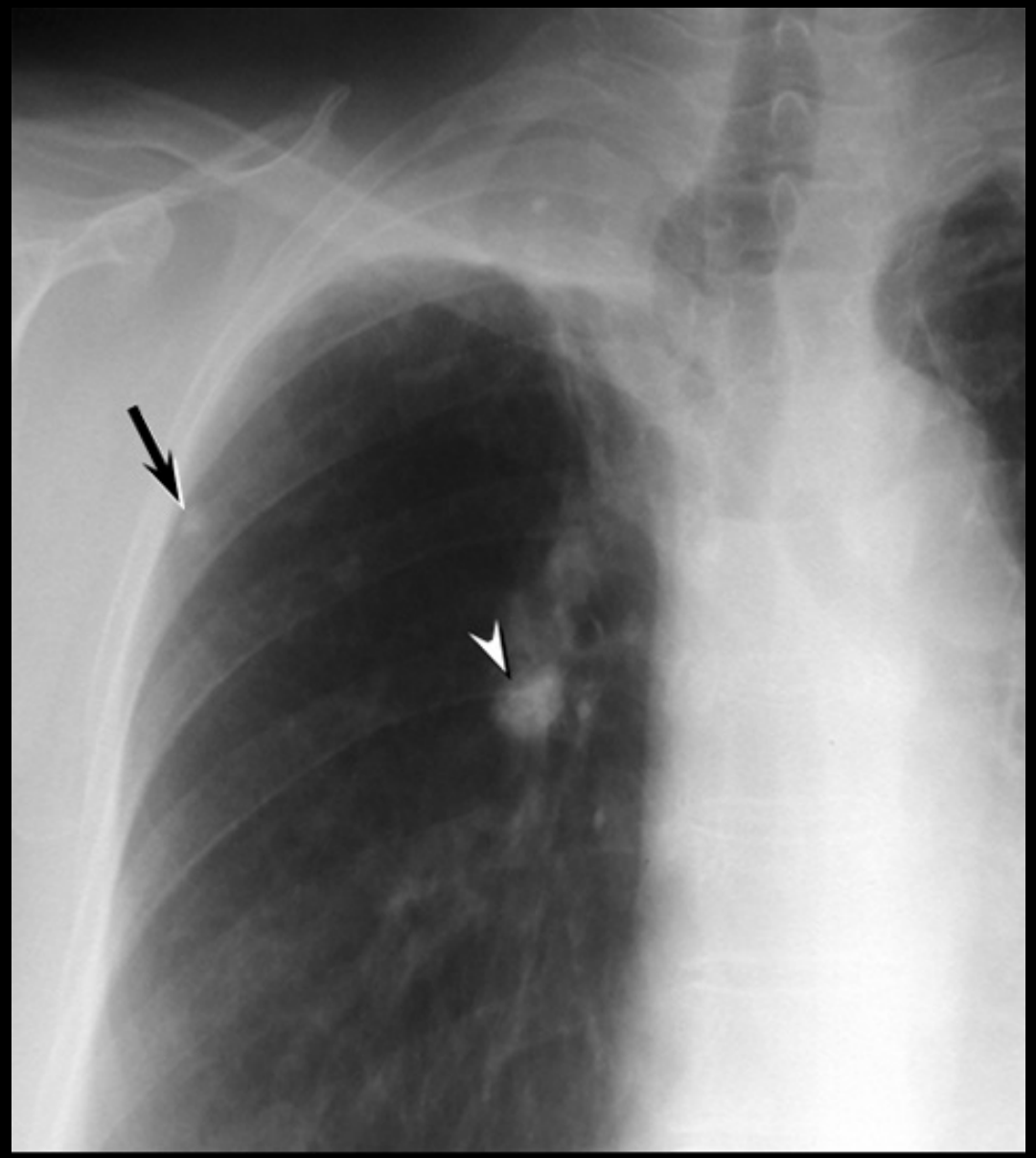
- Calcified granuloma - *Ghon lesion*
- Calcified granuloma & hilar calcification - *Ranke complex*
- Apical pleural thickening
- Fibrosis and volume loss

Healed Tuberculosis - Ghon Lesion

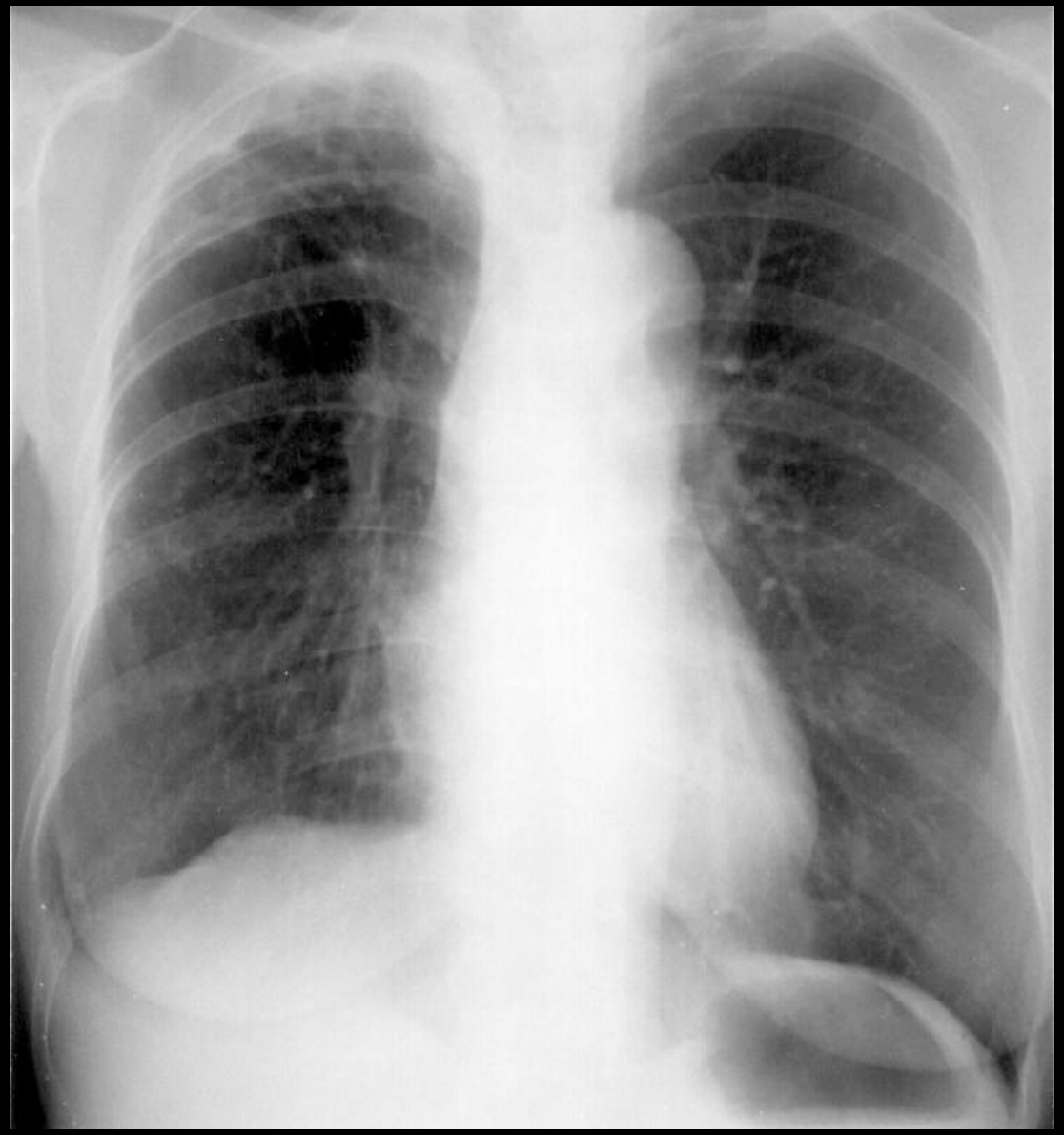


Note – Calcified nodule is more dense than rib.

Healed Tuberculosis - Ranke Complex



Healed Tuberculosis - Apical Fibrosis



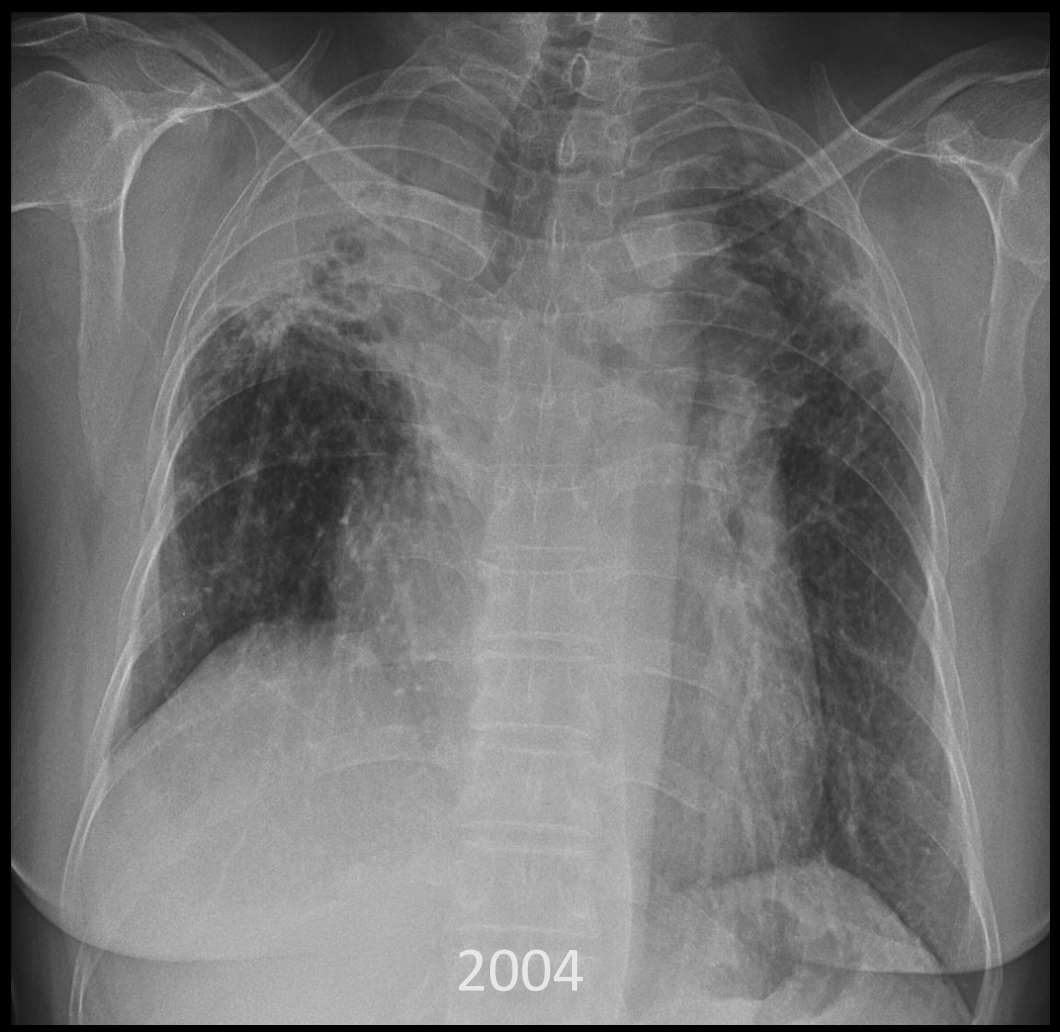
“Activity” of Tuberculosis

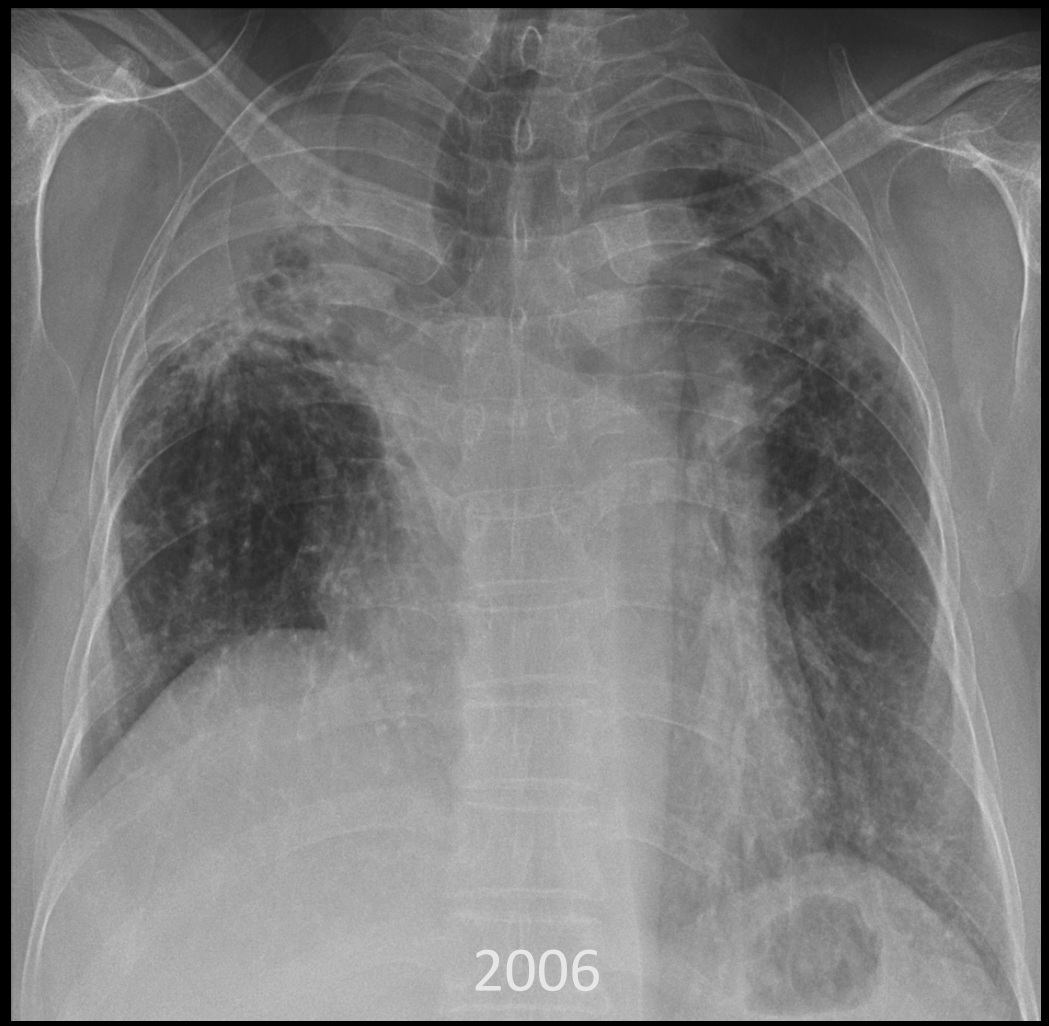
- ***Activity cannot be determined from single chest radiograph***

- *Progressive disease **indicates** activity*

- Cavitation and bronchogenic spread *suggest* activity

Stable Tuberculosis





Old X-rays often helpful (Want 6 months+ stability)

Latent Tuberculosis

- ~5% will get TB in 1-2 years - “Primary”
- ~5% will control TB but reactive later - “Reactivation”
- ~90% will never develop symptoms – “Latent”
  - Asymptomatic and “*Non-Contagious*”
    - Should have “Normal” CXR
    - Very small number can have subtle abnormalities
      - *Pleural Thickening, Calcified Nodules, Non-Calcified Nodules, Fibrotic Scarring*

Nachiappan A, et al. Radiographics. 2017 37:52-72
Uzorka JW, et al. Open Forum Infect Dis. 2019 Jul 1;6(7):ofz313

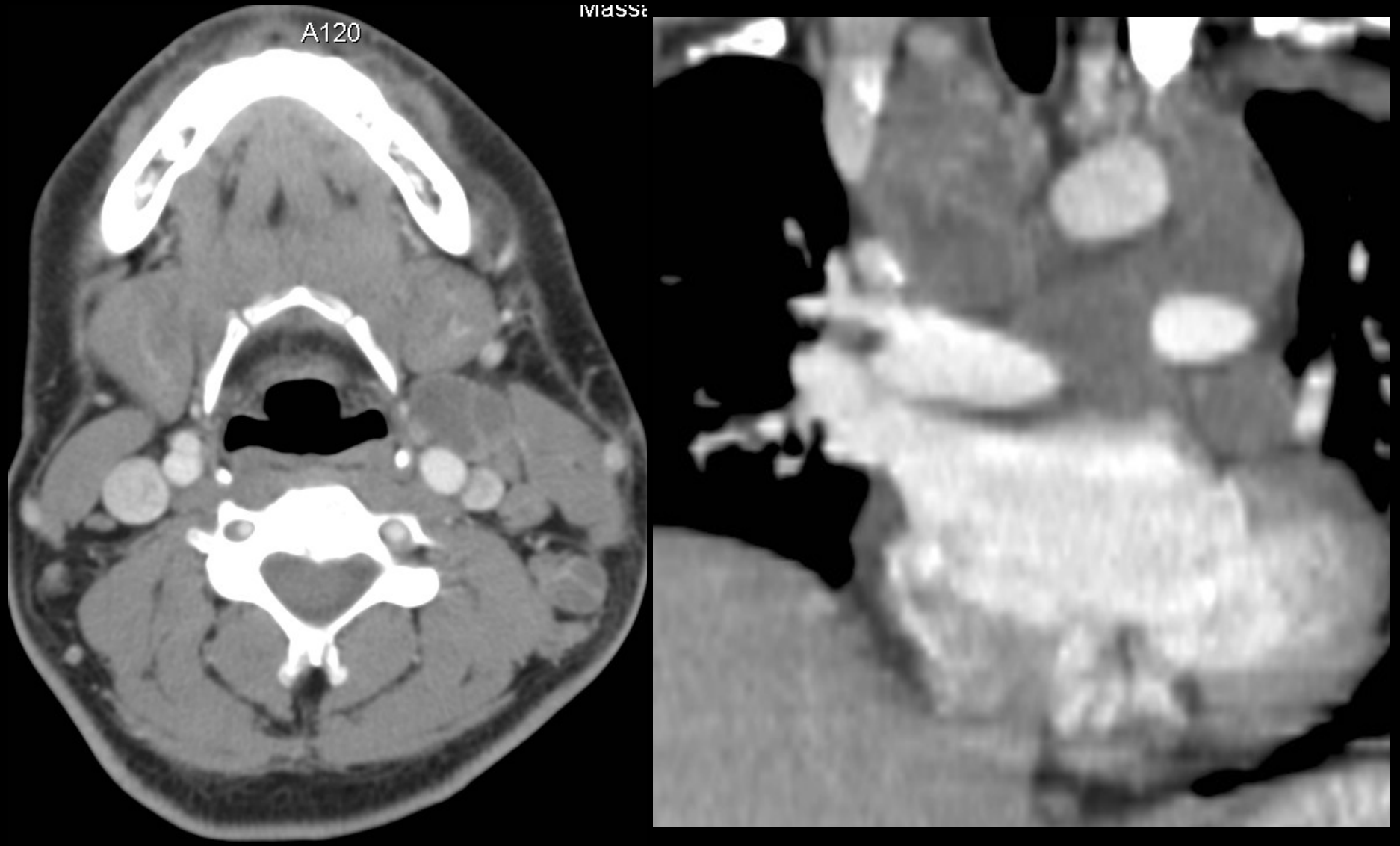
Role of CT in Tuberculosis

- Useful in “Equivocal” Chest X-ray
  - *CT increases the specificity of a TB diagnosis*

- Higher sensitivity
- Occult miliary disease and cavities
- Necrotizing adenopathy

- Roadmap for bronchoscopist
- Presurgical

CT in TB Adenopathy



CT in Airway TB

Summary

- Chest radiograph requires systematic approach
- Typical (Post-primary) TB: Upper lung fibrocavitary disease, “endobronchial spread” nodules
- Atypical (Primary) TB: Usually children, HIV, consolidation with adenopathy
- ***Serial radiographic evaluation important to determine activity***

References

- *Nachiappan A, et al.* **Pulmonary Tuberculosis: Role of Radiology in Diagnosis and Management.** *Radiographics 2017; 37:52-72.*

- *Jeong YJ, et al.* **Pulmonary Tuberculosis: Up-to-Date Imaging and Management.** *AJR 2008; 191:834-844*

- *Burrill J, et al.* **Tuberculosis: A Radiologic Review.** *Radiographics 2007;27:1255-1273.*

Thank You