



CURRY
INTERNATIONAL
TUBERCULOSIS
CENTER

Mayo Clinic Center for Tuberculosis



Chest X-Ray Interpretation for the TB Clinician

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Accreditation Statement



Accreditation Statement

In support of improving patient care, Mayo Clinic College of Medicine and Science is jointly accredited by the Accreditation Council for Continuing Medical Education (ACCME), the Accreditation Council for Pharmacy Education (ACPE), and the American Nurses Credentialing Center (ANCC) to provide continuing education for the healthcare team.

Credit Statement(s):

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UAN Number: UAN JA0000238-0000-26-089-L99-P.

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This activity was planned by and for the healthcare team, and learners will receive 18.25 Interprofessional Continuing Education (IPCE) credit for learning and change.

IPCE CREDIT™

Other Healthcare Professionals:

A record of attendance will be provided to all registrants for requesting credits in accordance with state nursing boards, specialty societies or other professional associations.

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Available Credit

- 18.25 ACPE,
- 18.25 *AMA PRA Category 1 Credit™*
- 18.25 ANCC
- 18.25 Attendance
- 18.25 IPCE

Disclosures

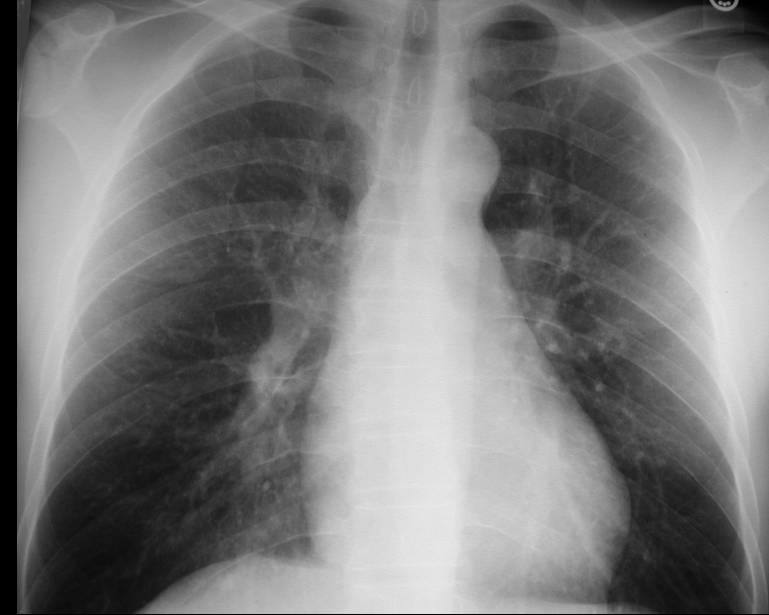
No relevant financial disclosures to report and no mention of off-label use of any medications or products

Learning Objectives

1. Understand how X-rays produce images
2. Assess chest X-ray (CXR) technical quality
3. Identify normal CXR anatomy
4. Recognize abnormal CXR findings in patients with TB

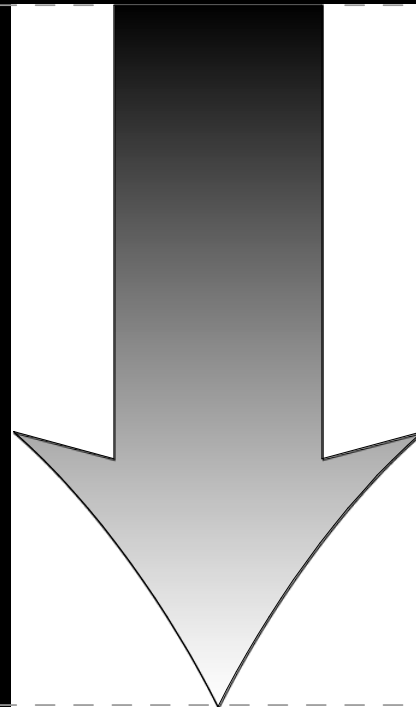
How X-Rays Produce Images

- X-ray photons:
 - Transmitted: Blacker image
 - Absorbed: Whiter image
- X-ray absorption depends on:
 - Beam energy
 - Tissue density



**Maximum
Transmission**
(least dense tissue)

**Maximum
Absorption**
(densest tissue)



Blackest

Air

Fat

Soft tissue

Calcium

Bone

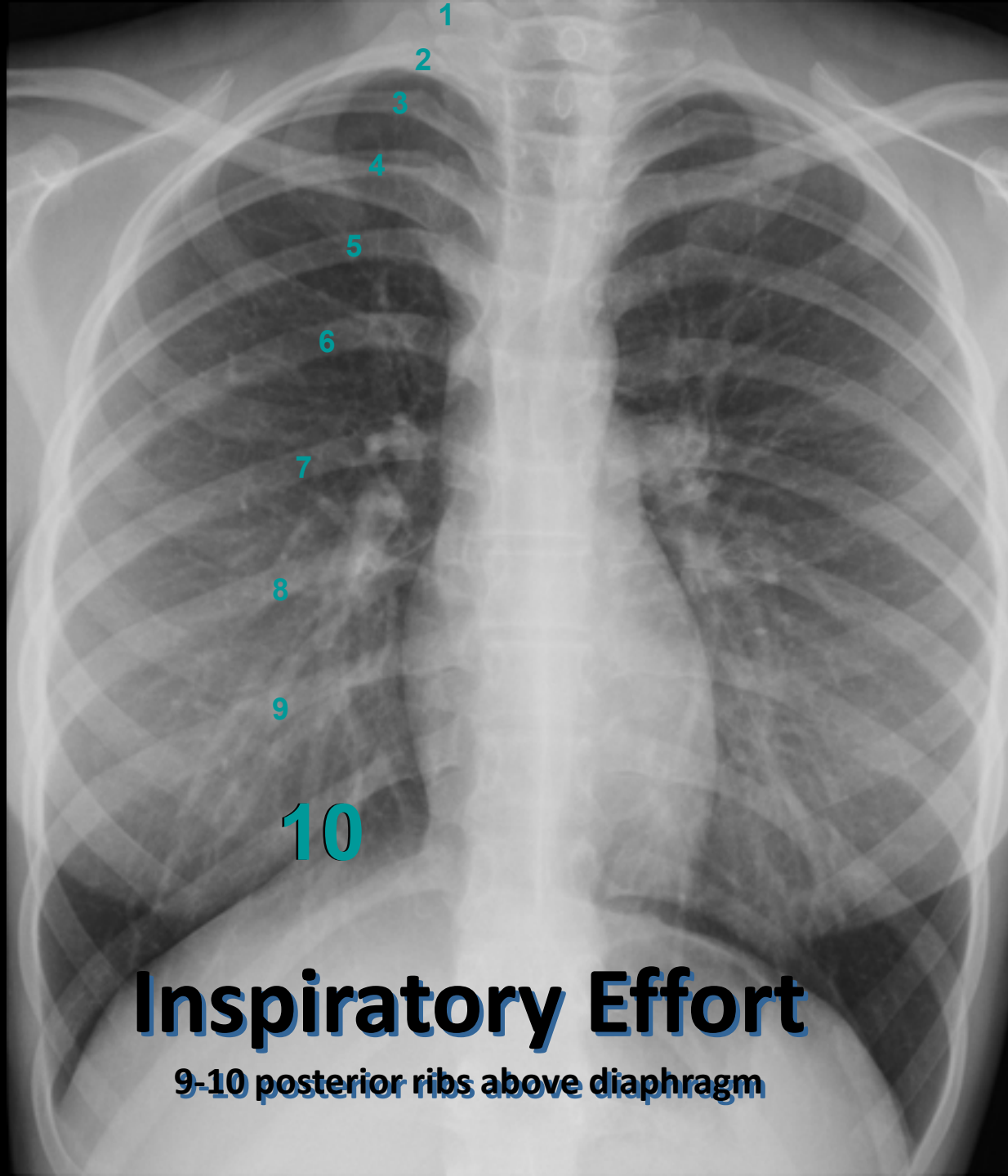
X-ray contrast

Metal

Whitest

Assess CXR Technical Quality

1. Inspiratory effort
2. X-Ray Exposure
3. Positioning / rotation



Inspiratory Effort

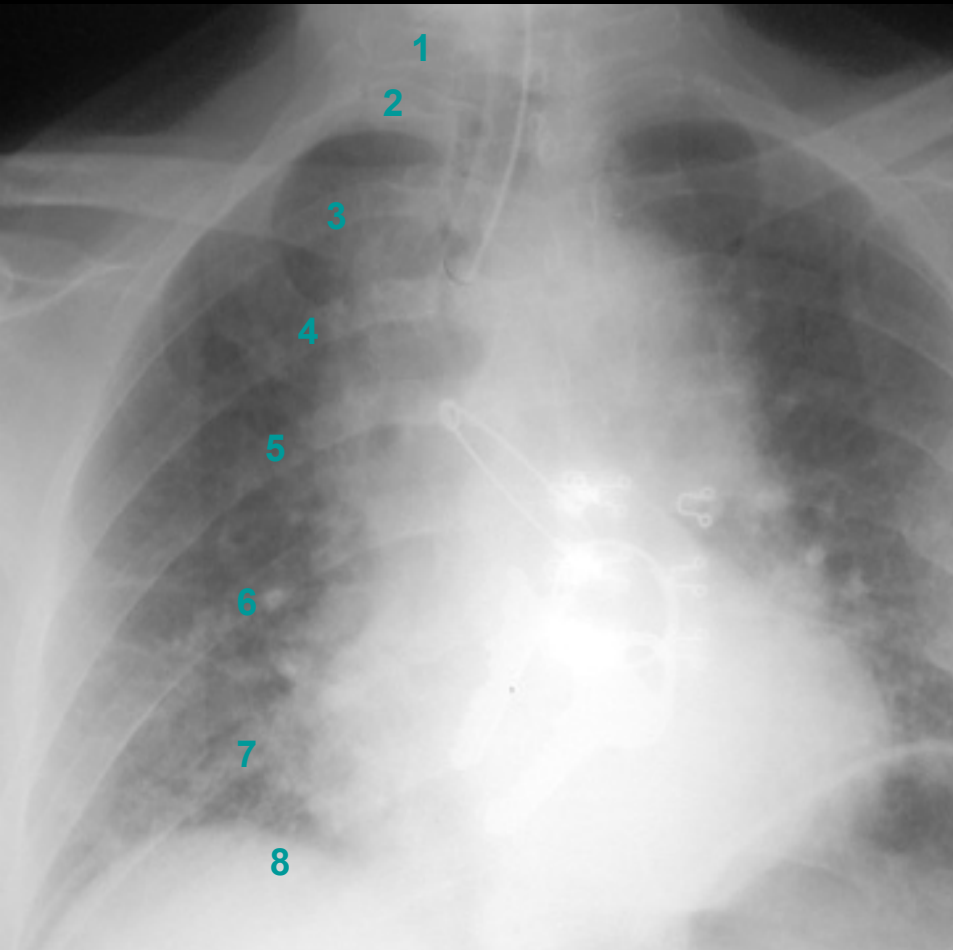
9-10 posterior ribs above diaphragm

Inspiratory Effort

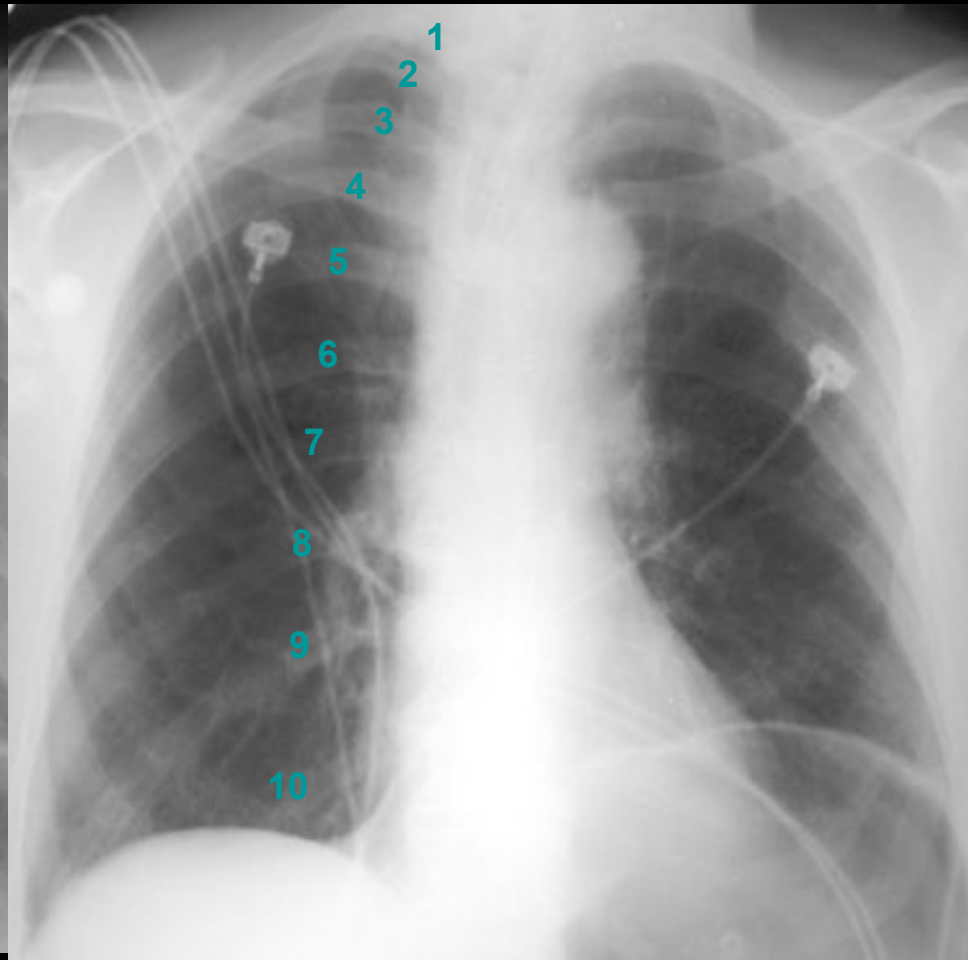


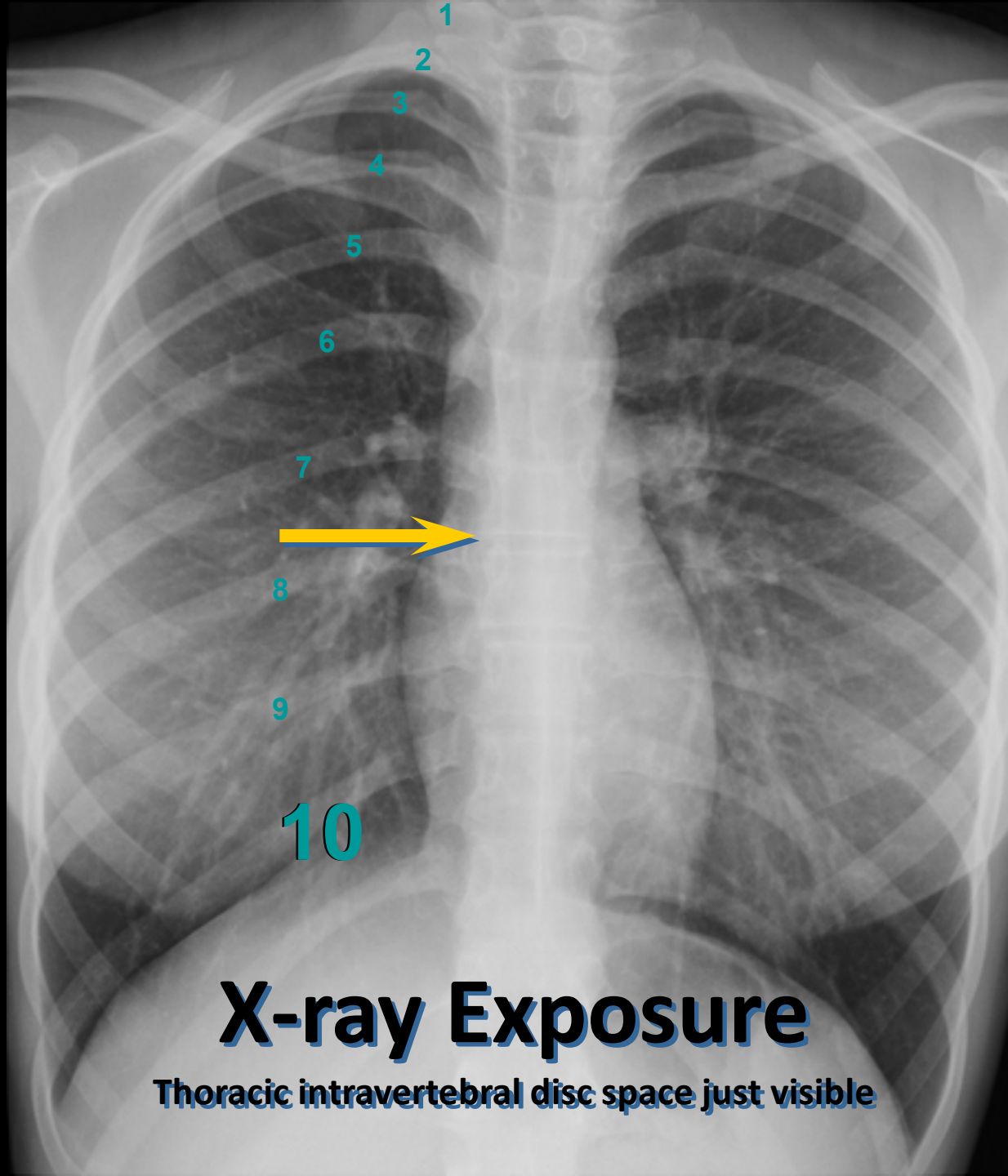
Inspiratory Effort

Low Lung Volumes



Full Inspiration

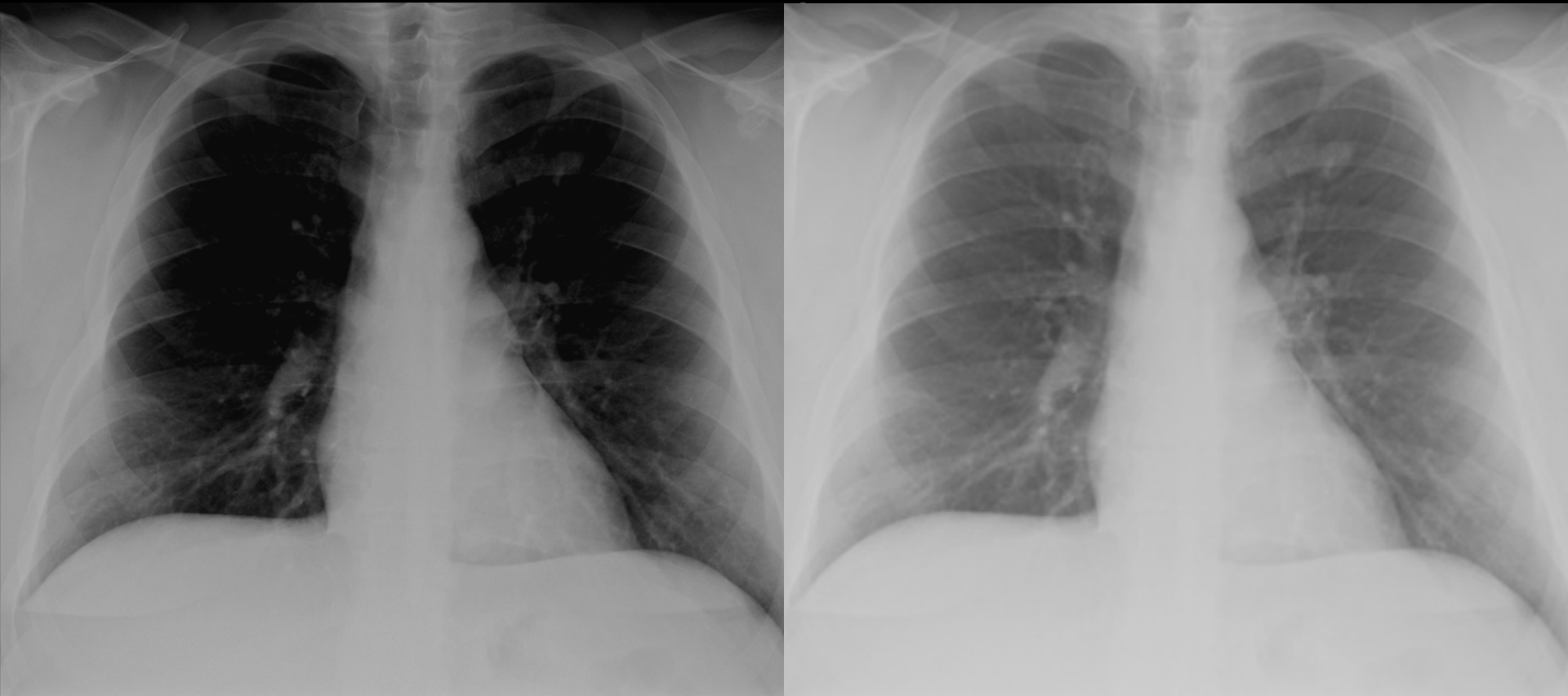




X-ray Exposure

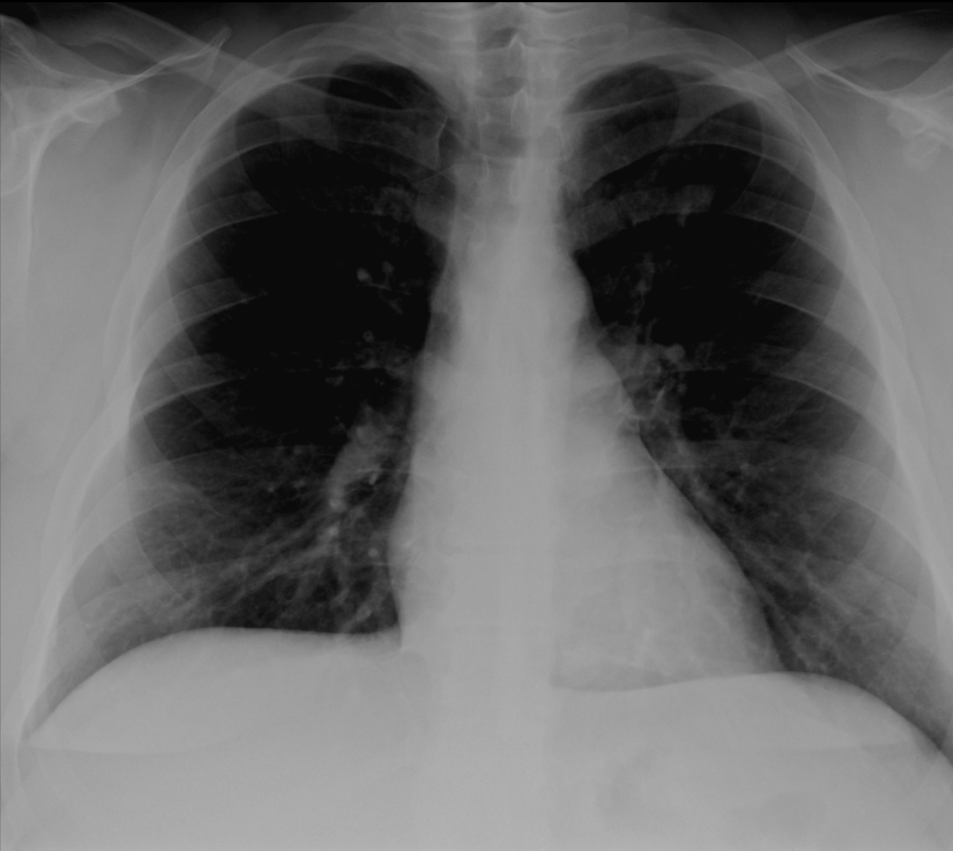
Thoracic intravertebral disc space just visible

X-Ray Exposure



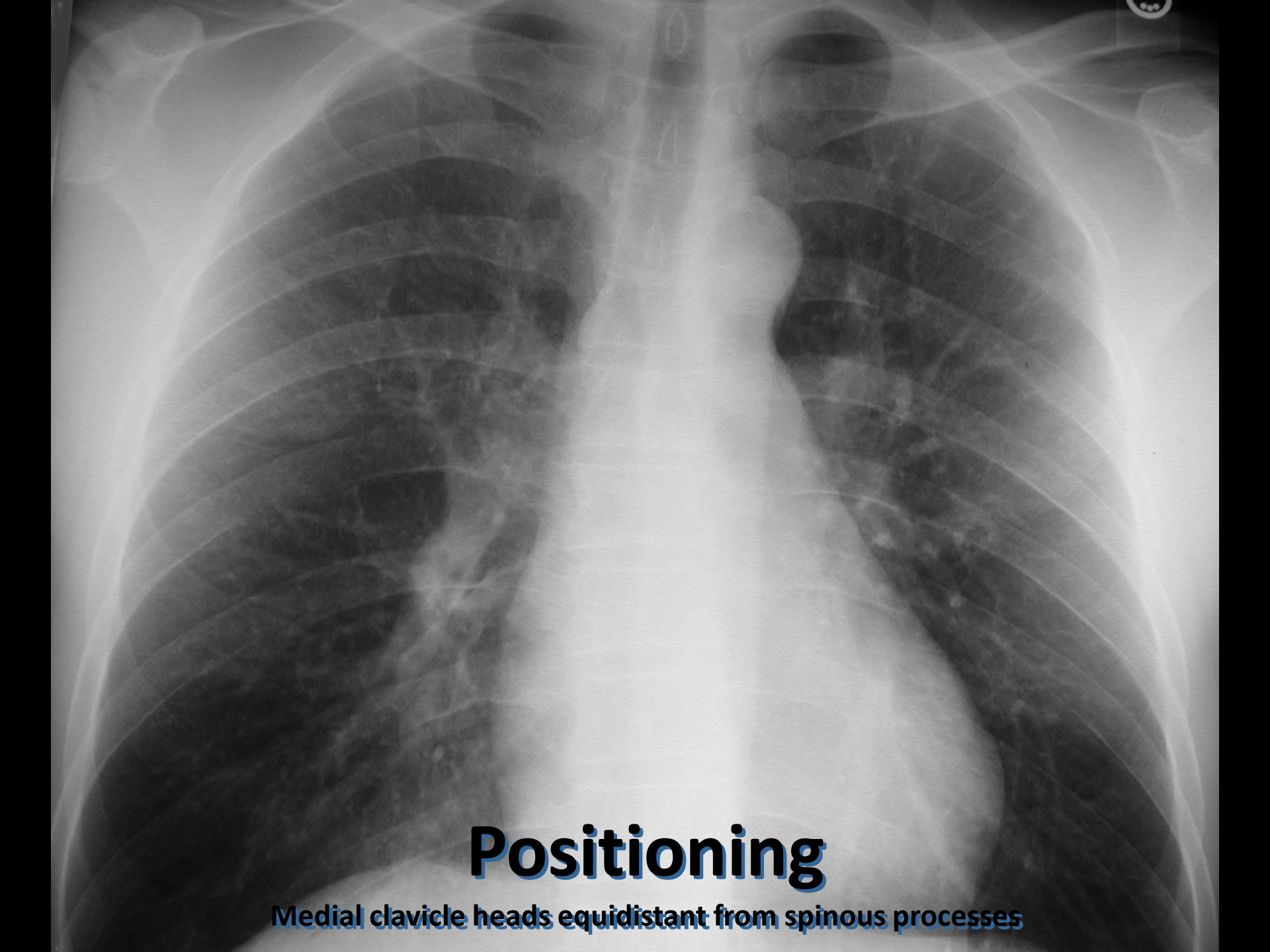
X-Ray Exposure

Overexposure



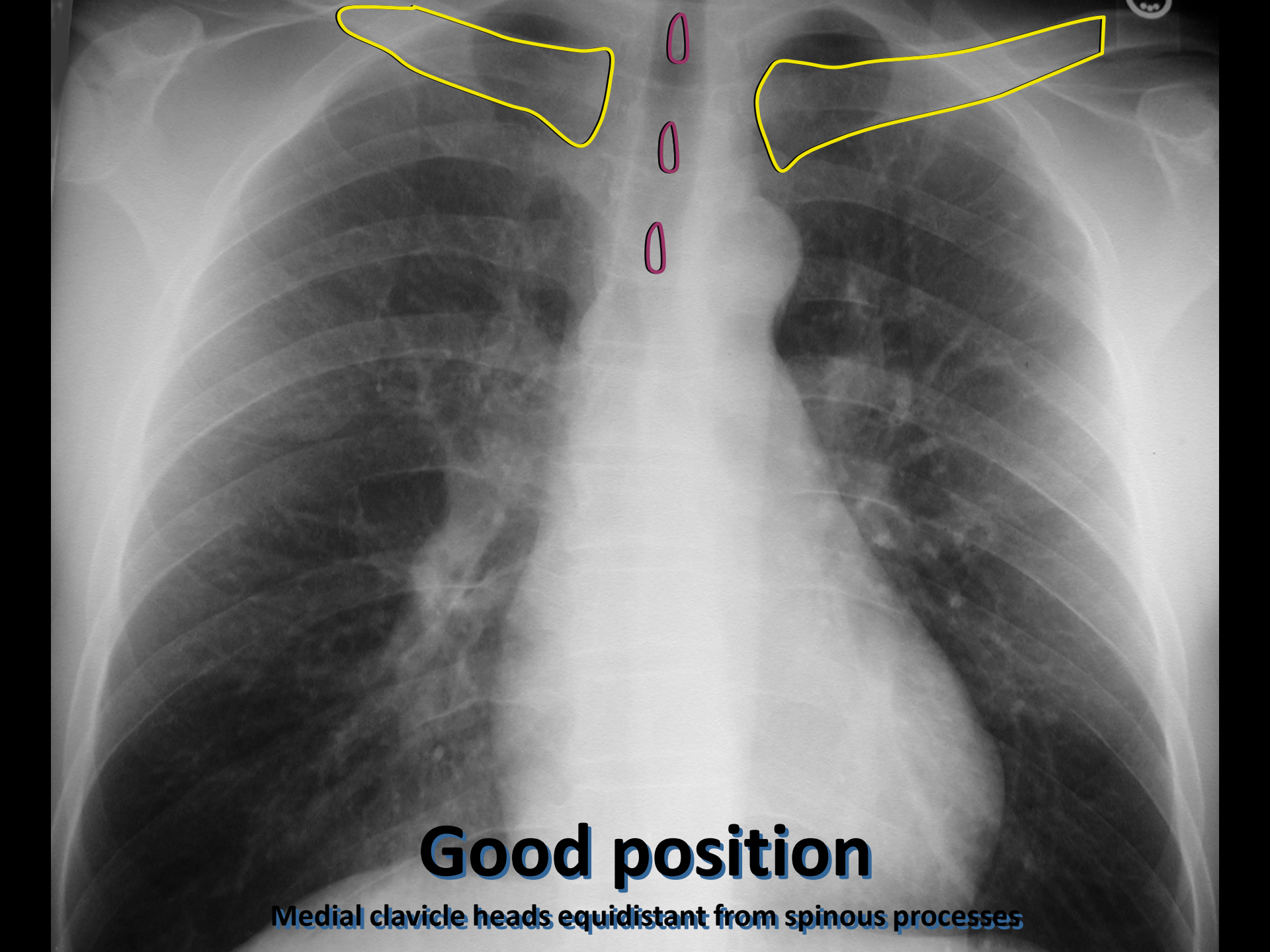
Proper Exposure





Positioning

Medial clavicle heads equidistant from spinous processes

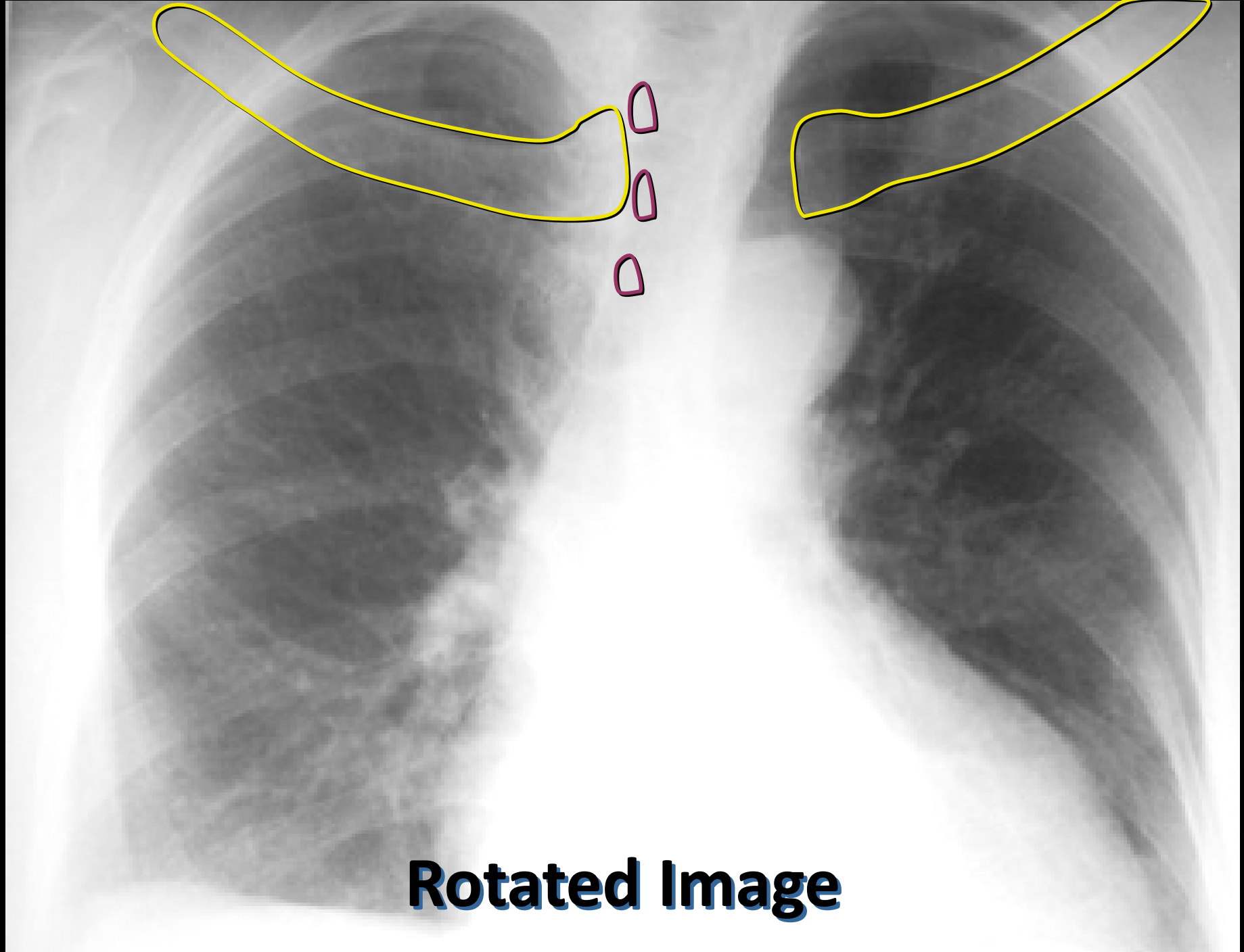


This is an anteroposterior (AP) chest radiograph. The image shows the thoracic cavity with the lungs, heart, and bony structures. Two yellow hand-drawn outlines are positioned at the top of the image, one on each side, highlighting the medial ends of the clavicles. Three pink hand-drawn ovals are placed vertically along the midline, corresponding to the T1, T2, and T3 vertebral levels. The text 'Good position' is written in large, bold, blue letters at the bottom, and a smaller line of text below it states 'Medial clavicle heads equidistant from spinous processes'.

Good position

Medial clavicle heads equidistant from spinous processes



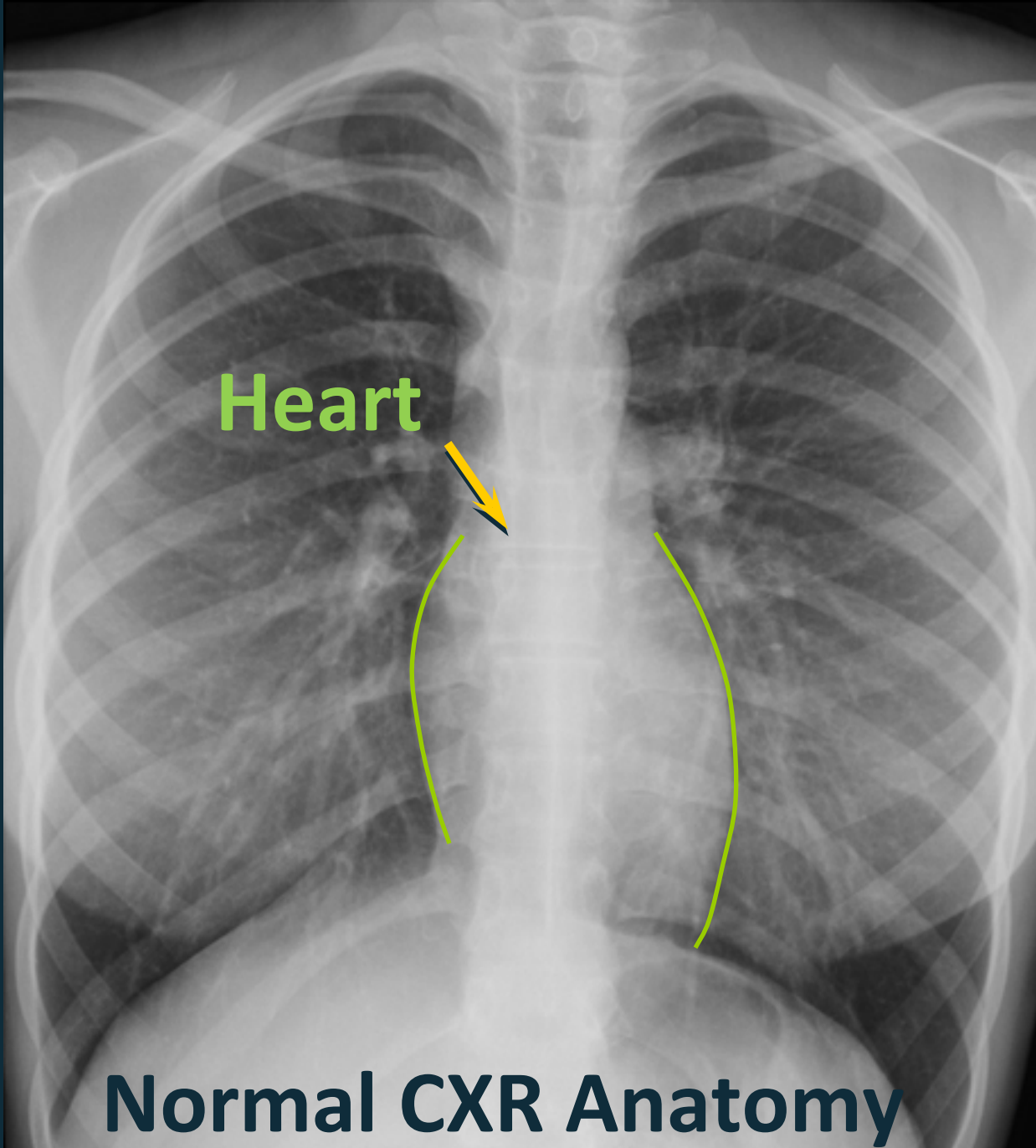


Rotated Image



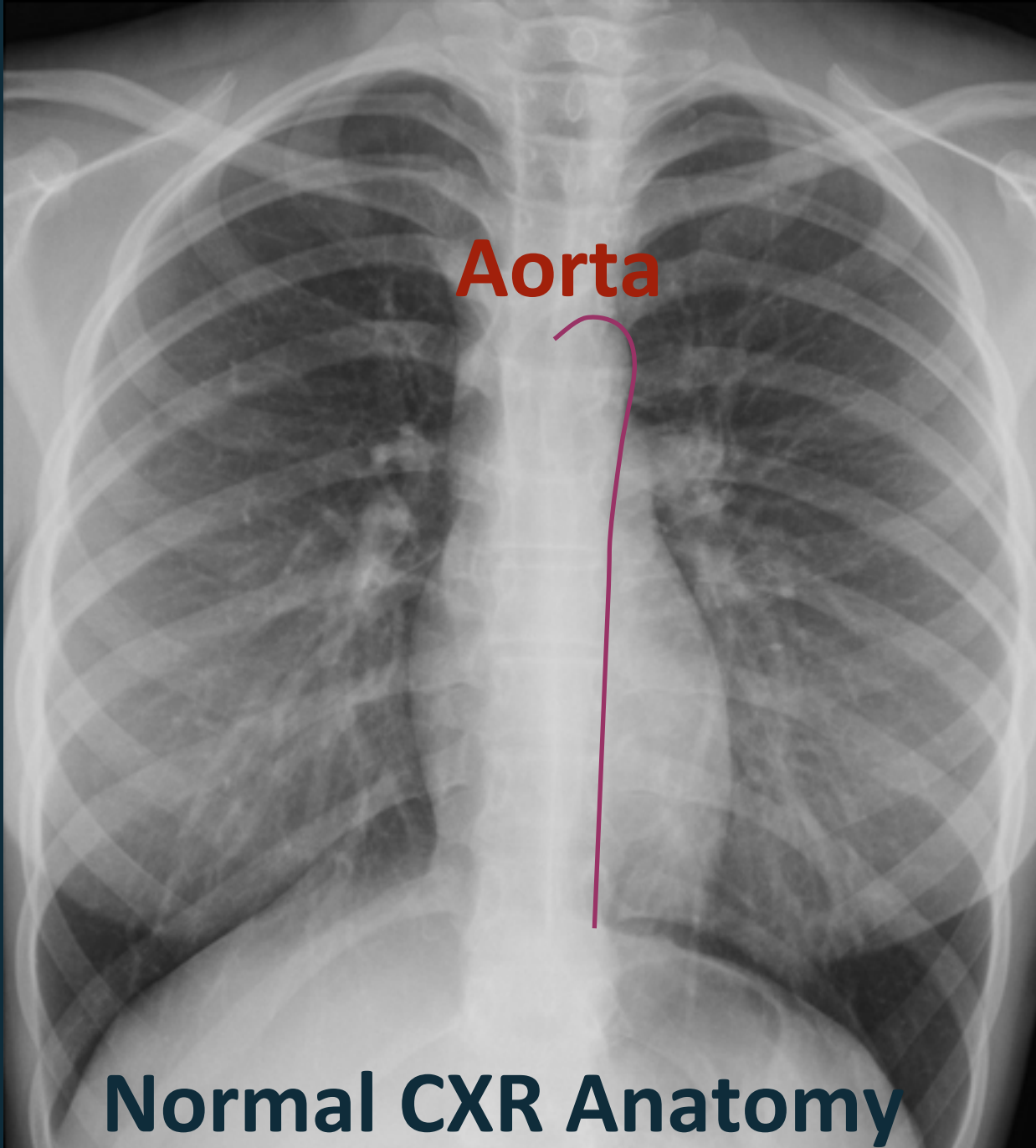
Normal CXR Anatomy

Image credit: Curry International Tuberculosis Center, University of California, San Francisco

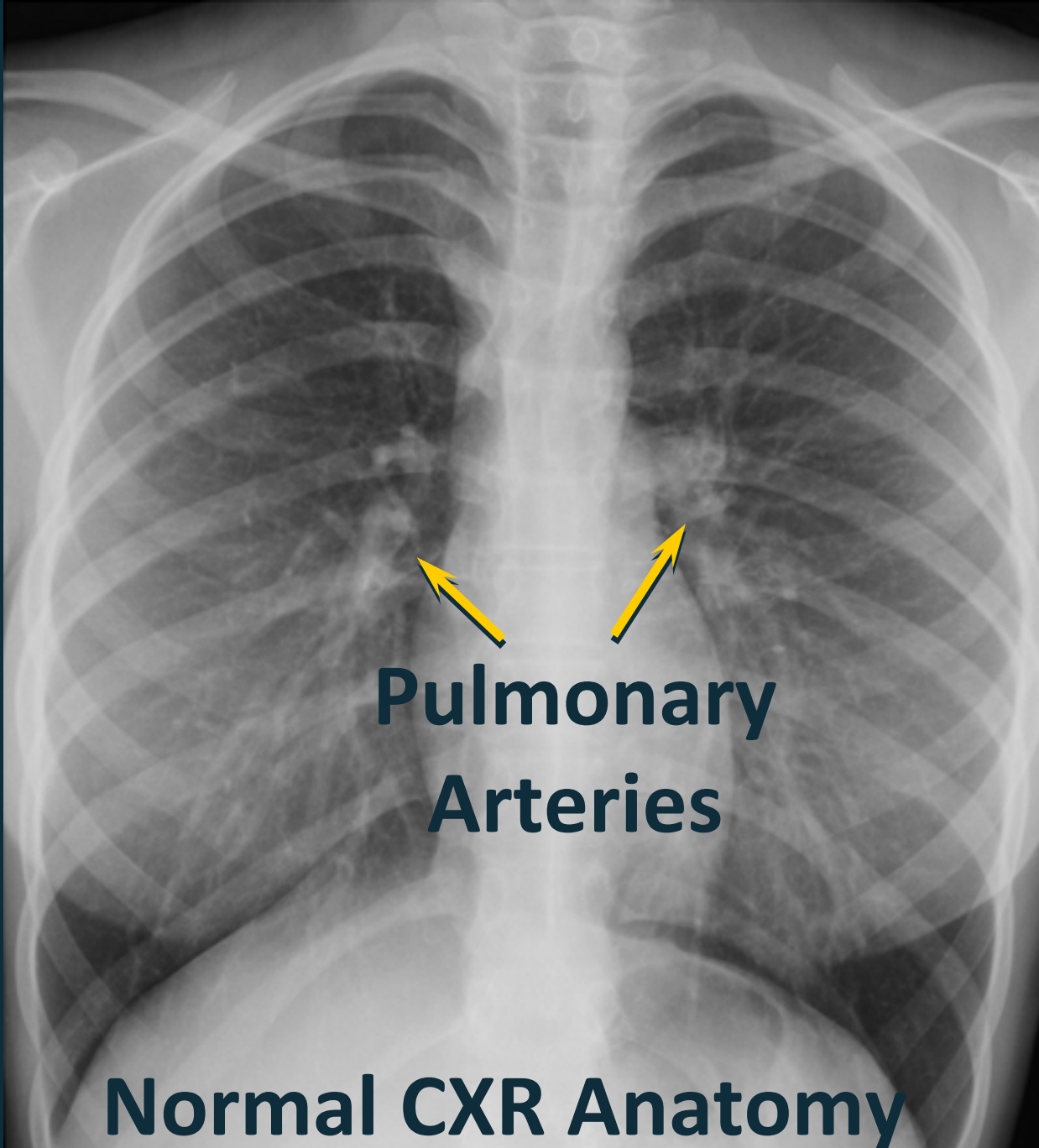


Heart

Normal CXR Anatomy

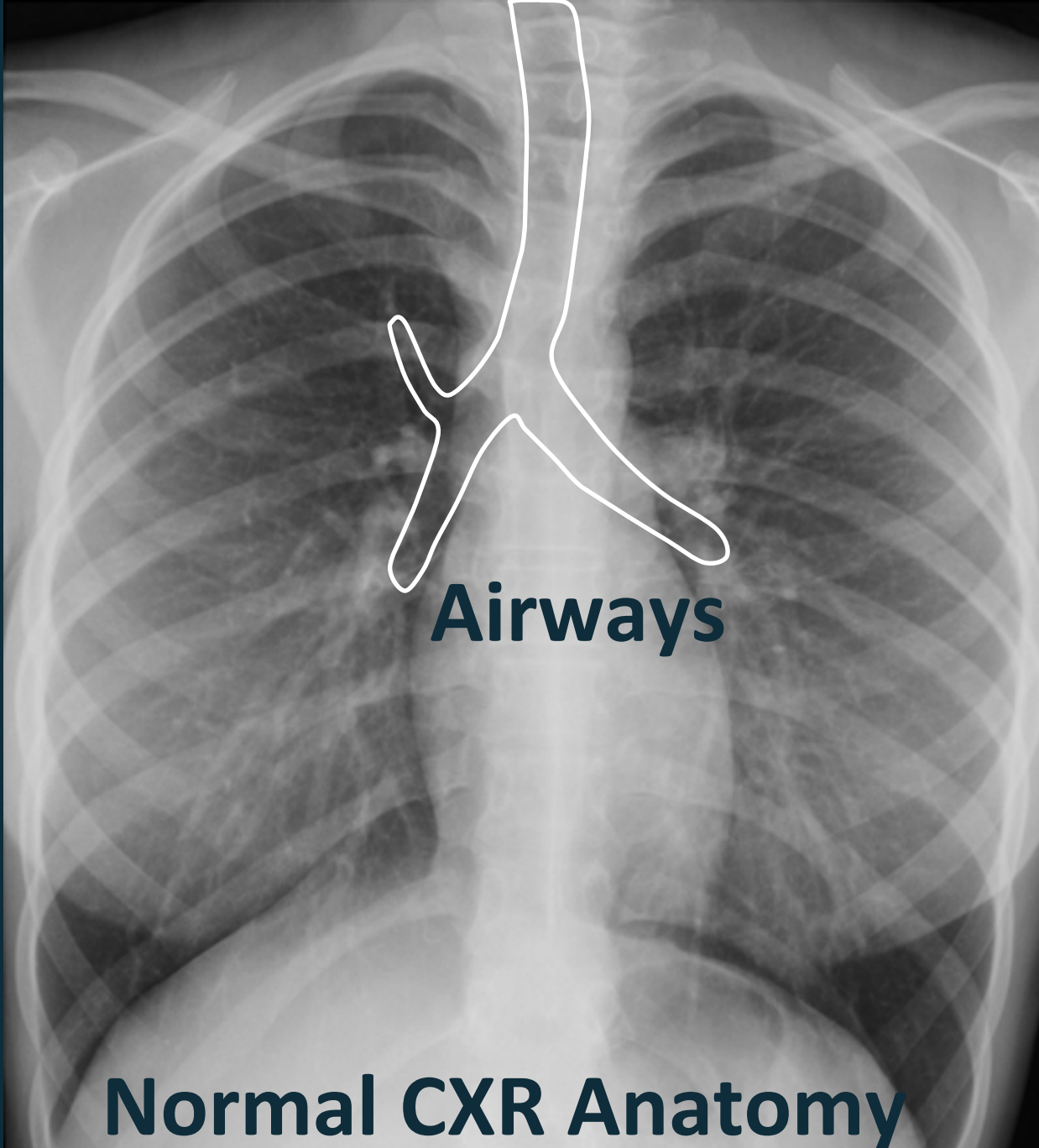


Normal CXR Anatomy



**Pulmonary
Arteries**

Normal CXR Anatomy

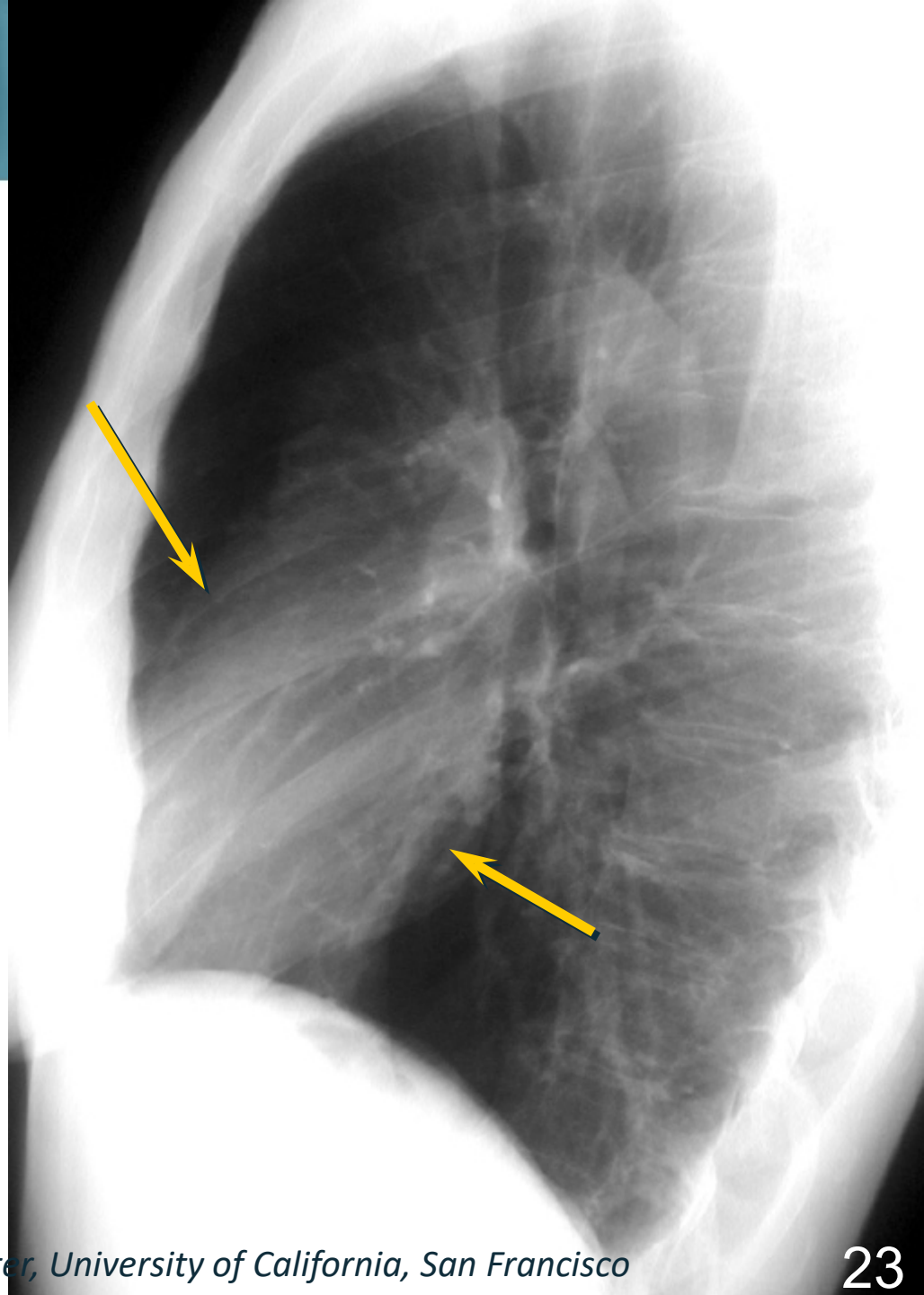


Airways

Normal CXR Anatomy

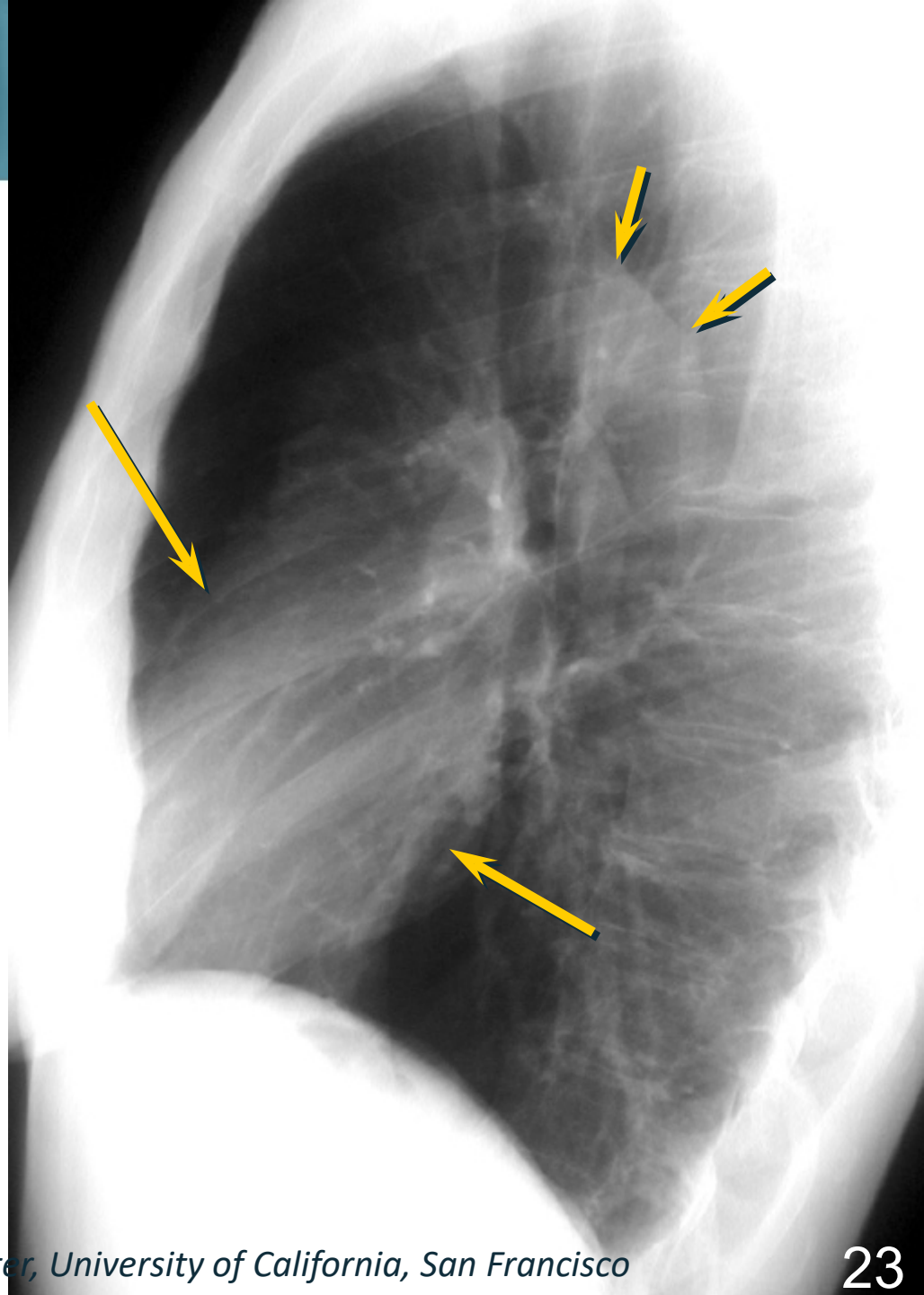
Lateral CXR Anatomy

- Heart



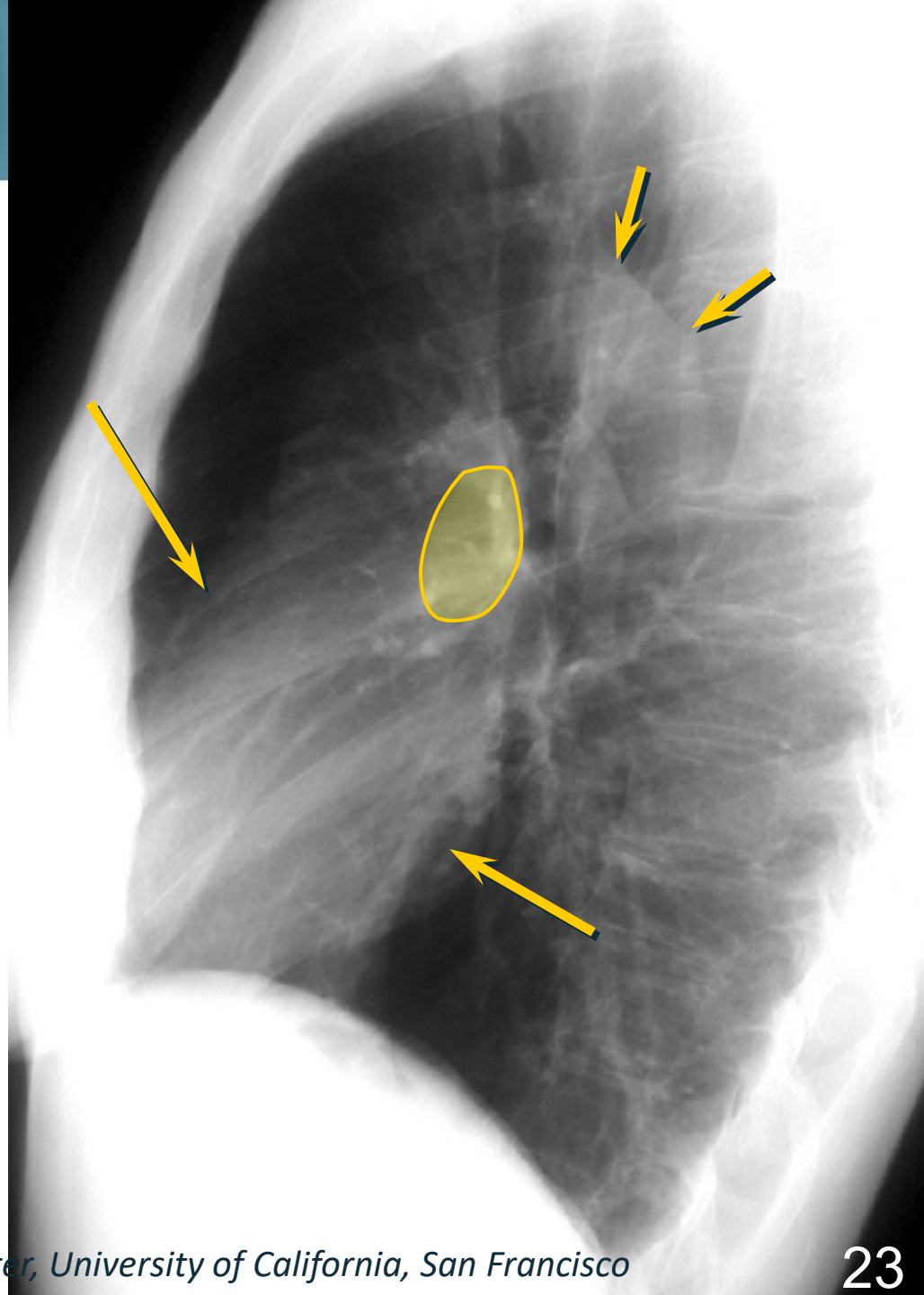
Lateral CXR Anatomy

- Heart
- Aortic arch



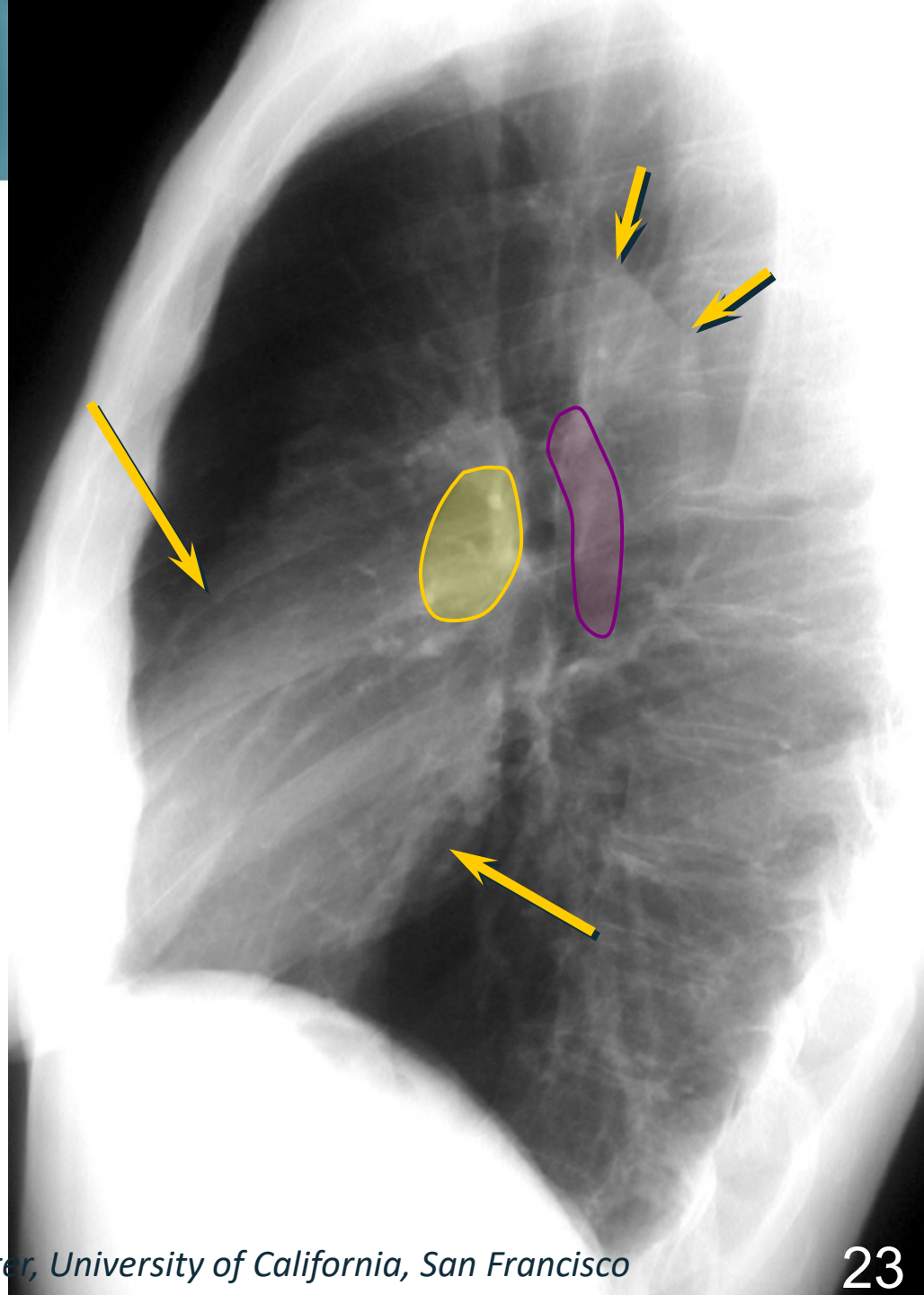
Lateral CXR Anatomy

- Heart
- Aortic arch
- Right pulmonary artery



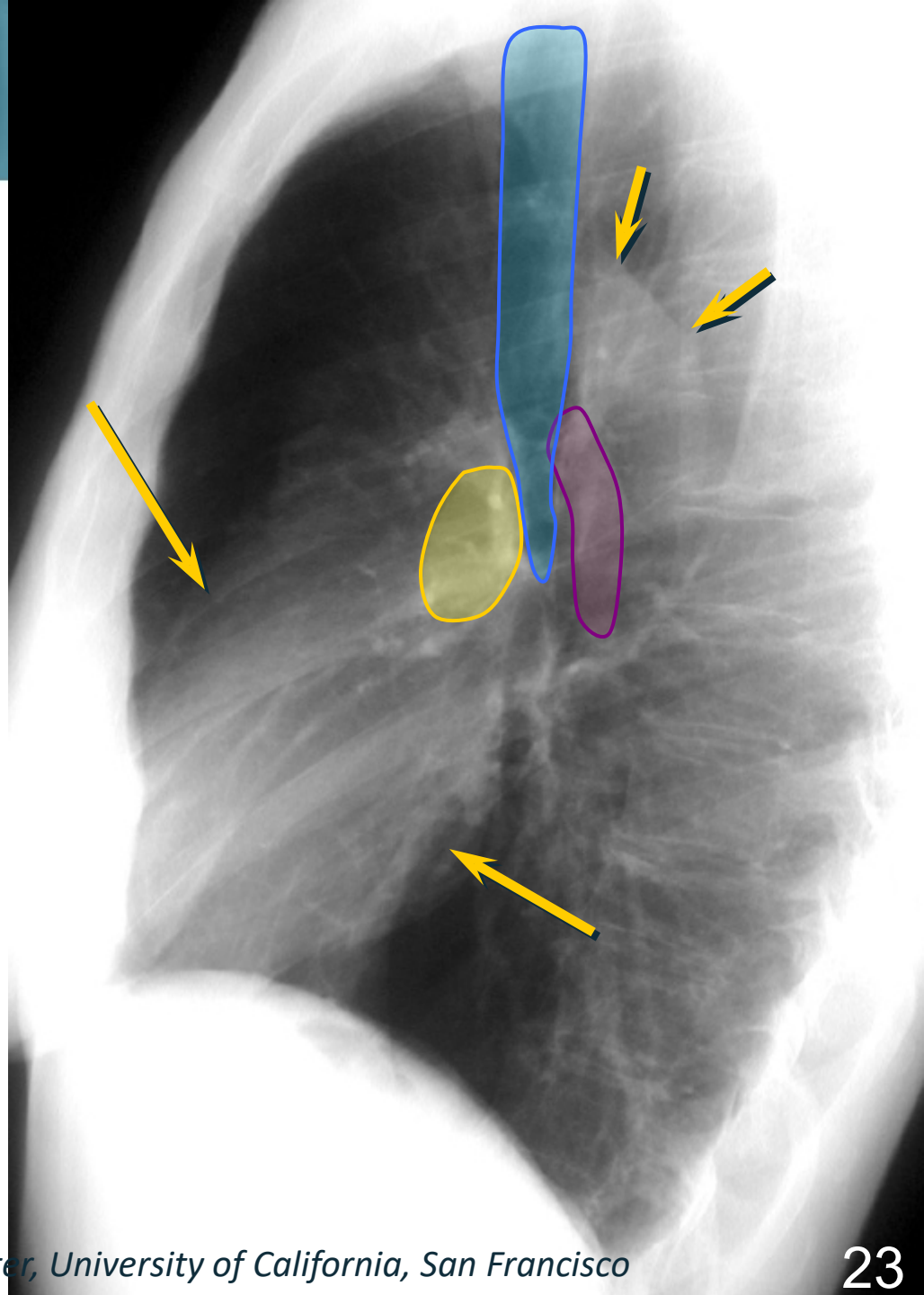
Lateral CXR Anatomy

- Heart
- Aortic arch
- Right pulmonary artery
- Left pulmonary artery



Lateral CXR Anatomy

- Heart
- Aortic arch
- Right pulmonary artery
- Left pulmonary artery
- Trachea & bronchi



Approach to Reading a CXR

➔ **Be Systematic (ABC's)**

Airways

Bone and Soft Tissue

Cardiomediastinal
Contours

Diaphragm

Everything else (lung
fields, pleural surface,
abdomen)



Worth a Second Look

- Apices
 - Hilar regions
 - Retrocardiac
 - Below diaphragm
- } Particularly for TB

Abnormal CXR findings

- Consolidation / air-space opacity
- Interstitial opacity
- Nodules and masses
- Lymphadenopathy
- Cysts and cavities
- Pleural abnormalities

Consolidation: Bacterial Pneumonia



Air

bronchograms

Consolidation: Reactivation TB

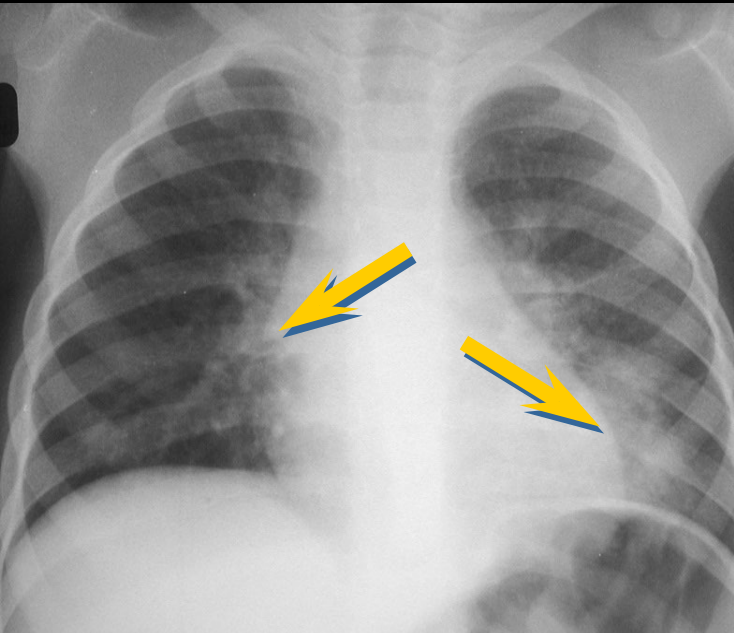
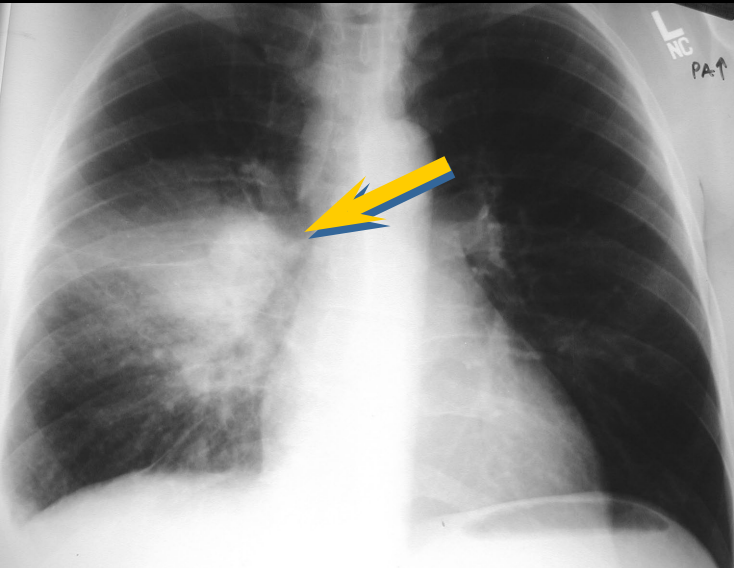


“Typical Pattern” of Active TB (Post-primary or Reactivation)

- Patchy consolidation
Apical/posterior segments of
upper lobes & superior segments
of lower lobes



Consolidation: Primary TB

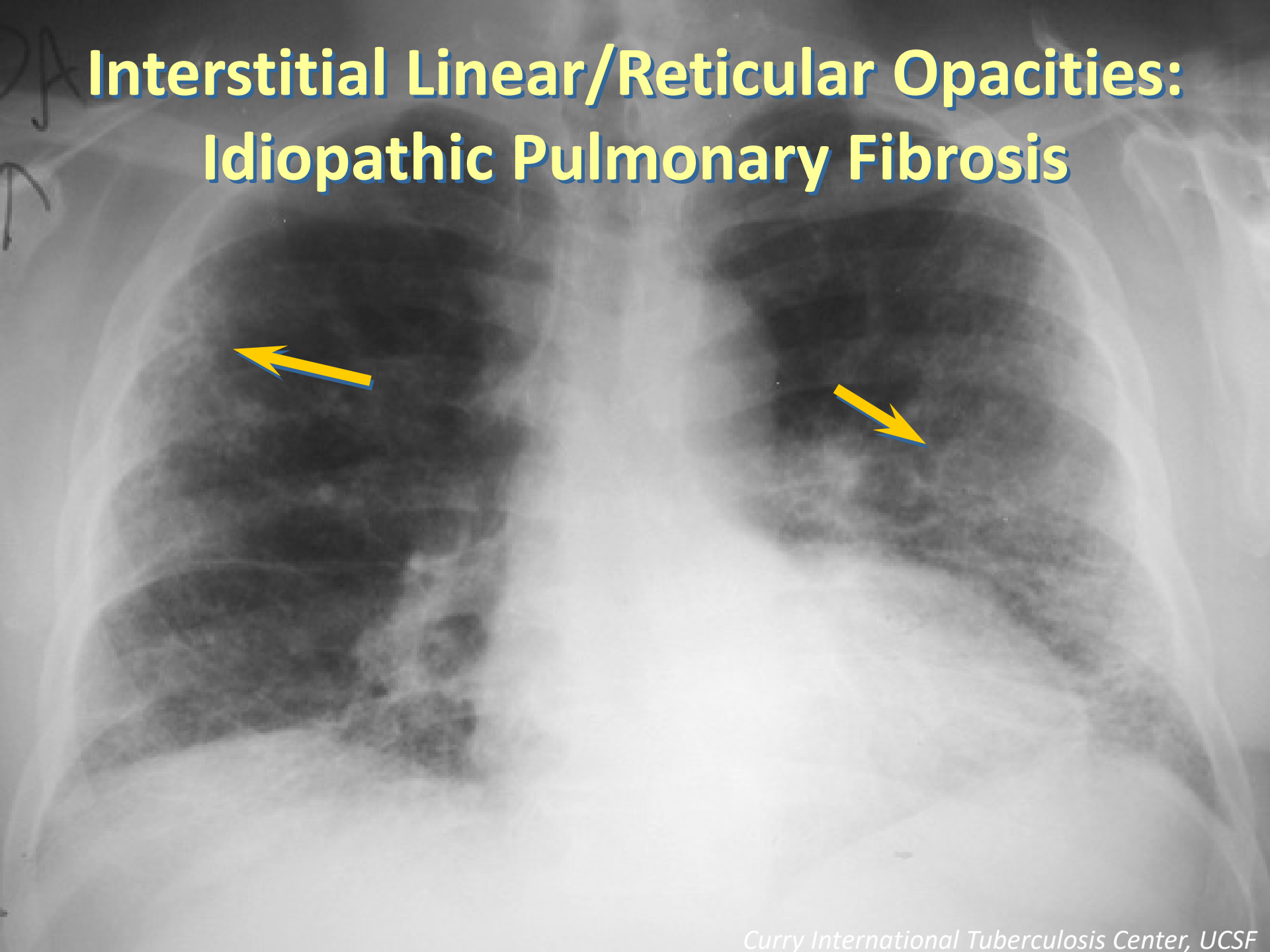


- “Atypical Pattern”: Primary TB (Children, HIV)
- Air-space consolidation, any lobe (slight lower lobe predominance)
- Other CXR findings in Primary TB
 - Cavitation is uncommon
 - Adenopathy
 - Miliary pattern
 - Pleural effusions

Interstitial Opacities

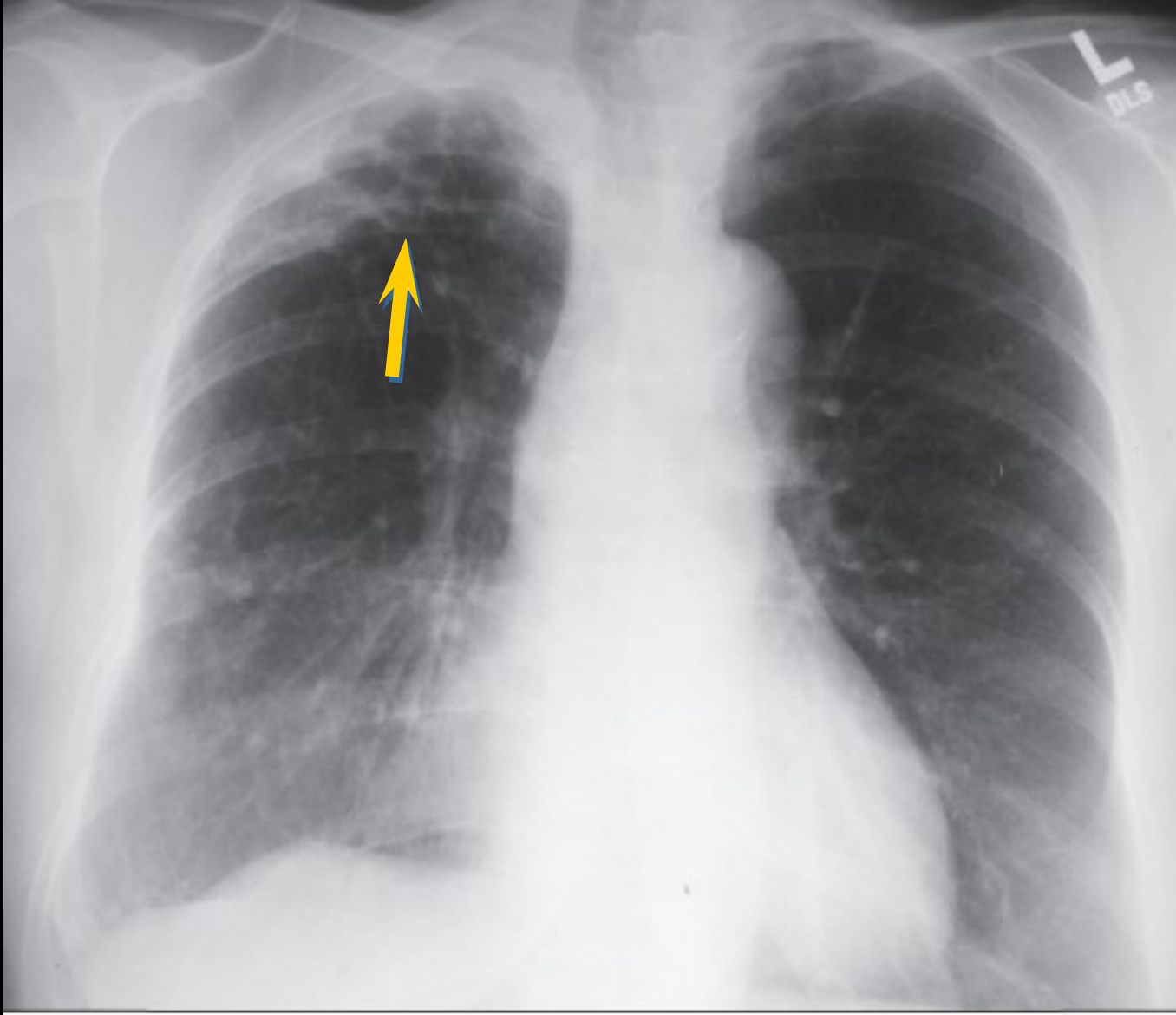
- Disease localized to pulmonary interstitium, i.e., alveolar septae & connective tissues that support alveoli
- Hallmarks:
 - Lines and/or reticulation
 - Small, well-defined nodules (eg, Miliary pattern)
- Pulmonary edema, interstitial lung diseases, sarcoidosis, infection, tumor (lymphangitic spread)

Interstitial Linear/Reticular Opacities: Idiopathic Pulmonary Fibrosis

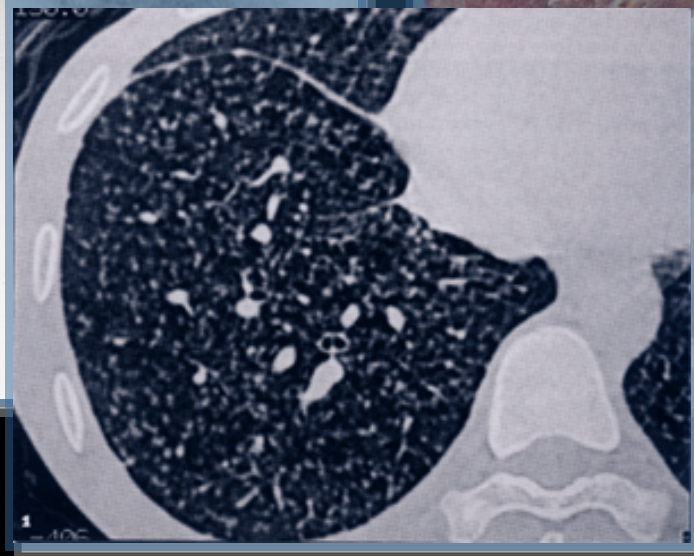
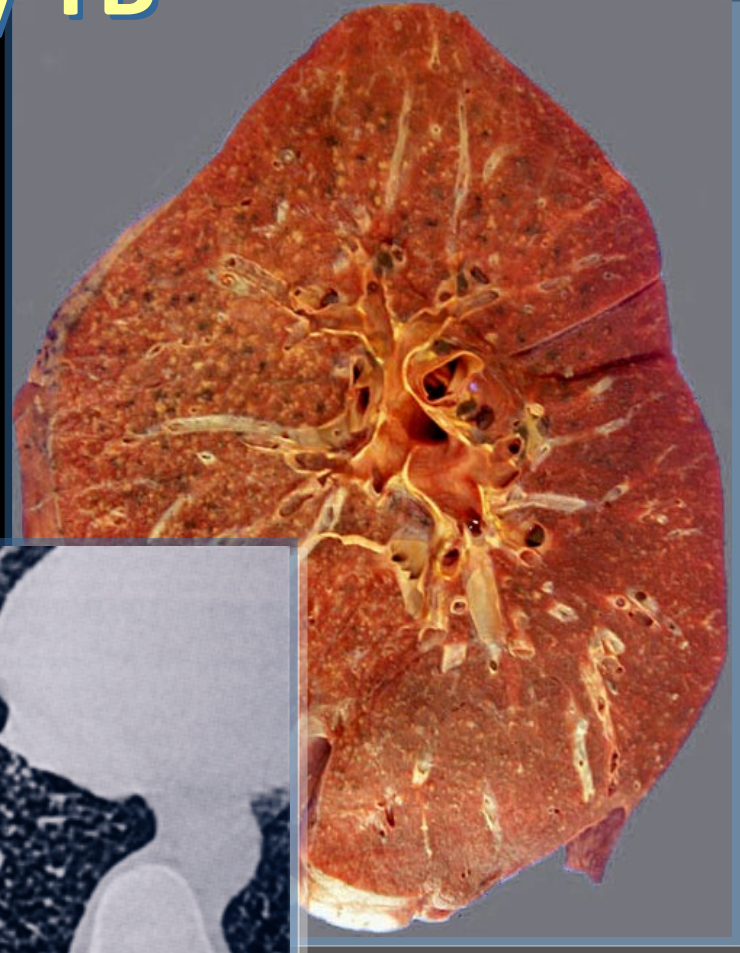
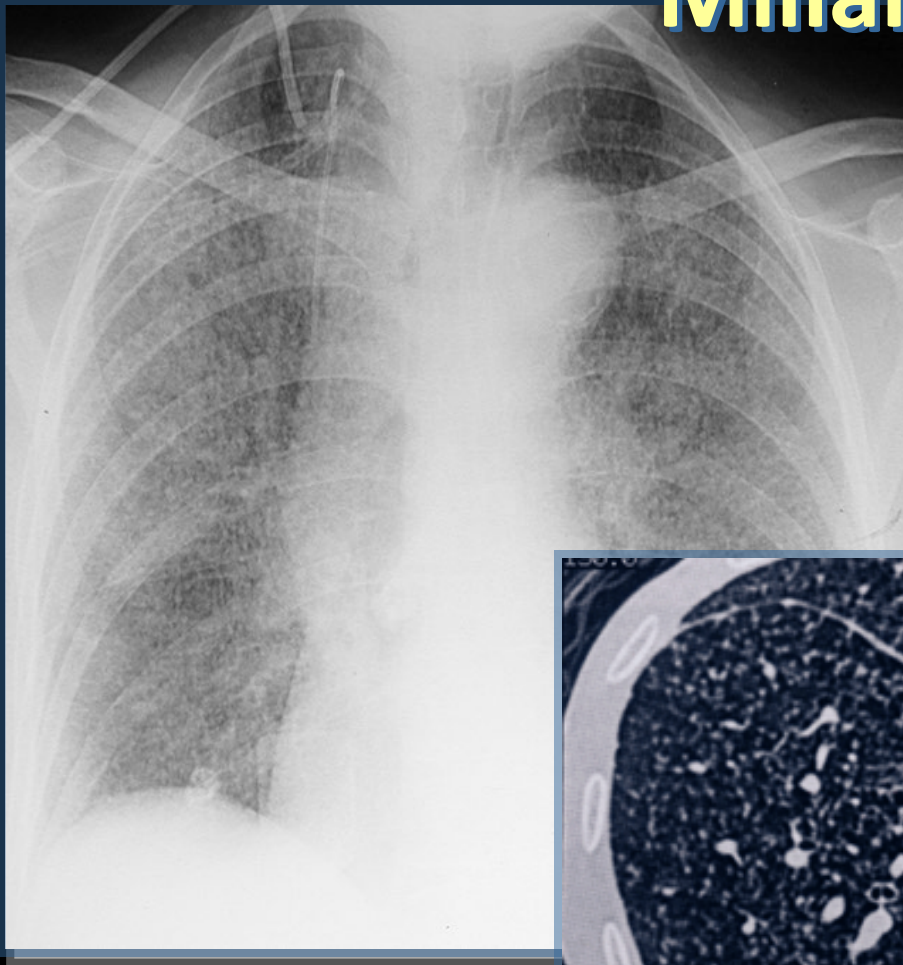


Interstitial Linear Opacities

Post-TB Fibrotic Scarring

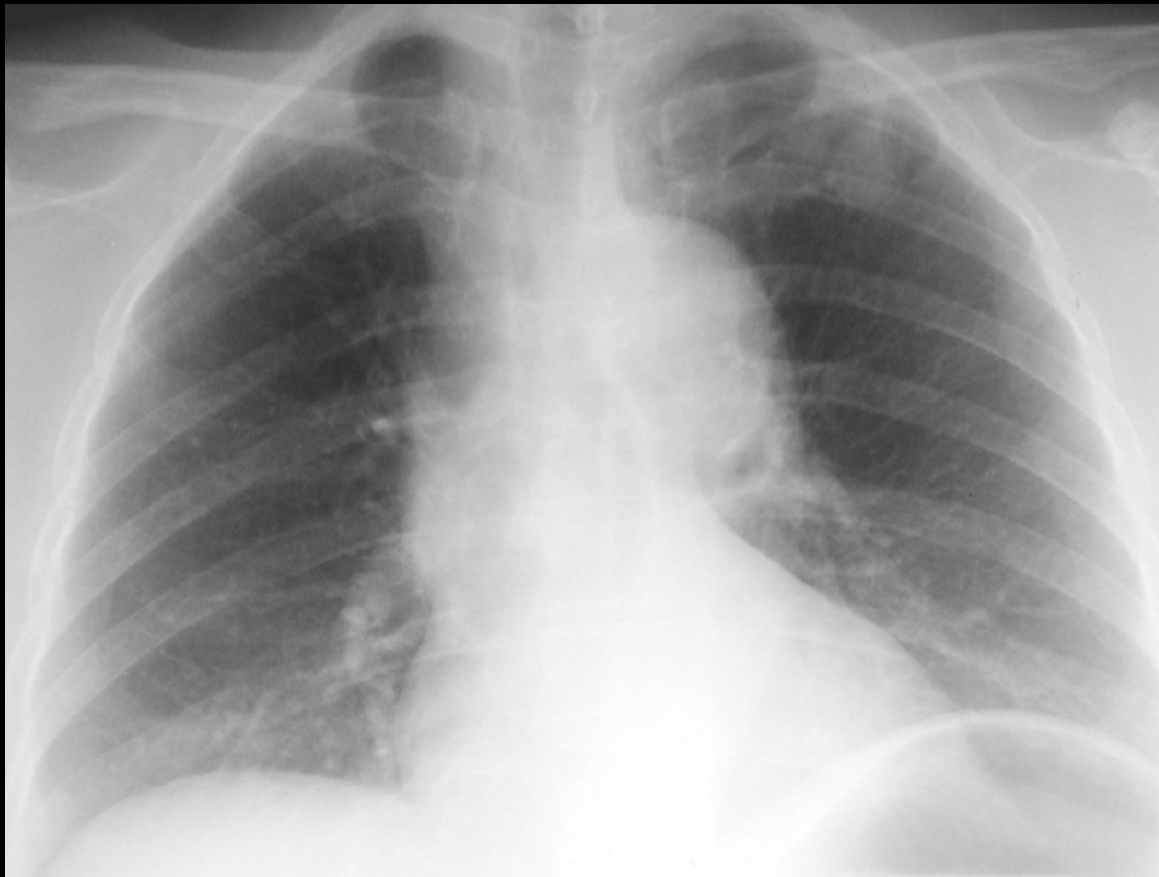


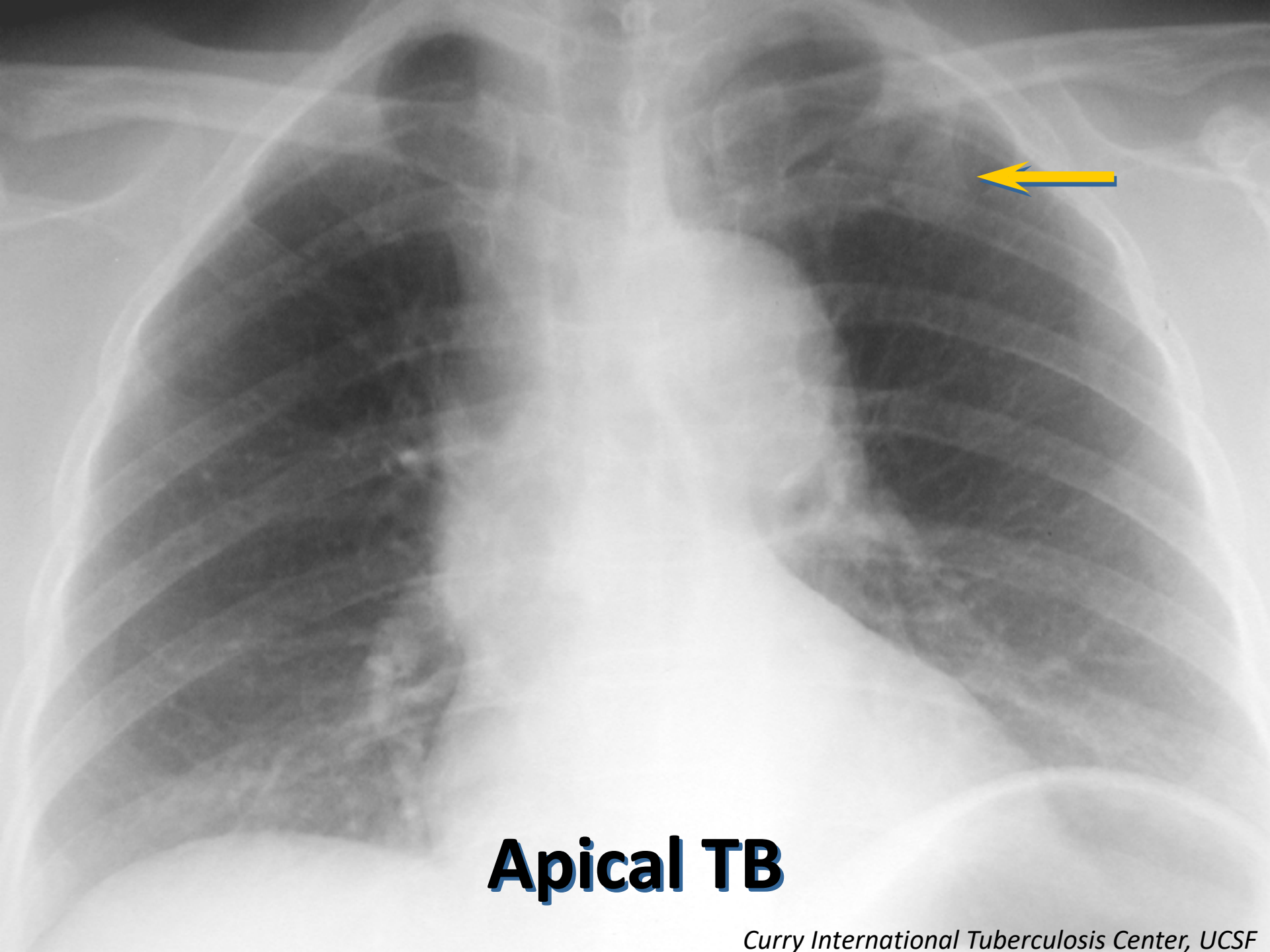
Interstitial Nodular Opacities: Miliary TB



Nodules & Masses

- Discrete lesion, sharp border, circular shape
- Size: nodule $\leq 3\text{cm}$ < mass



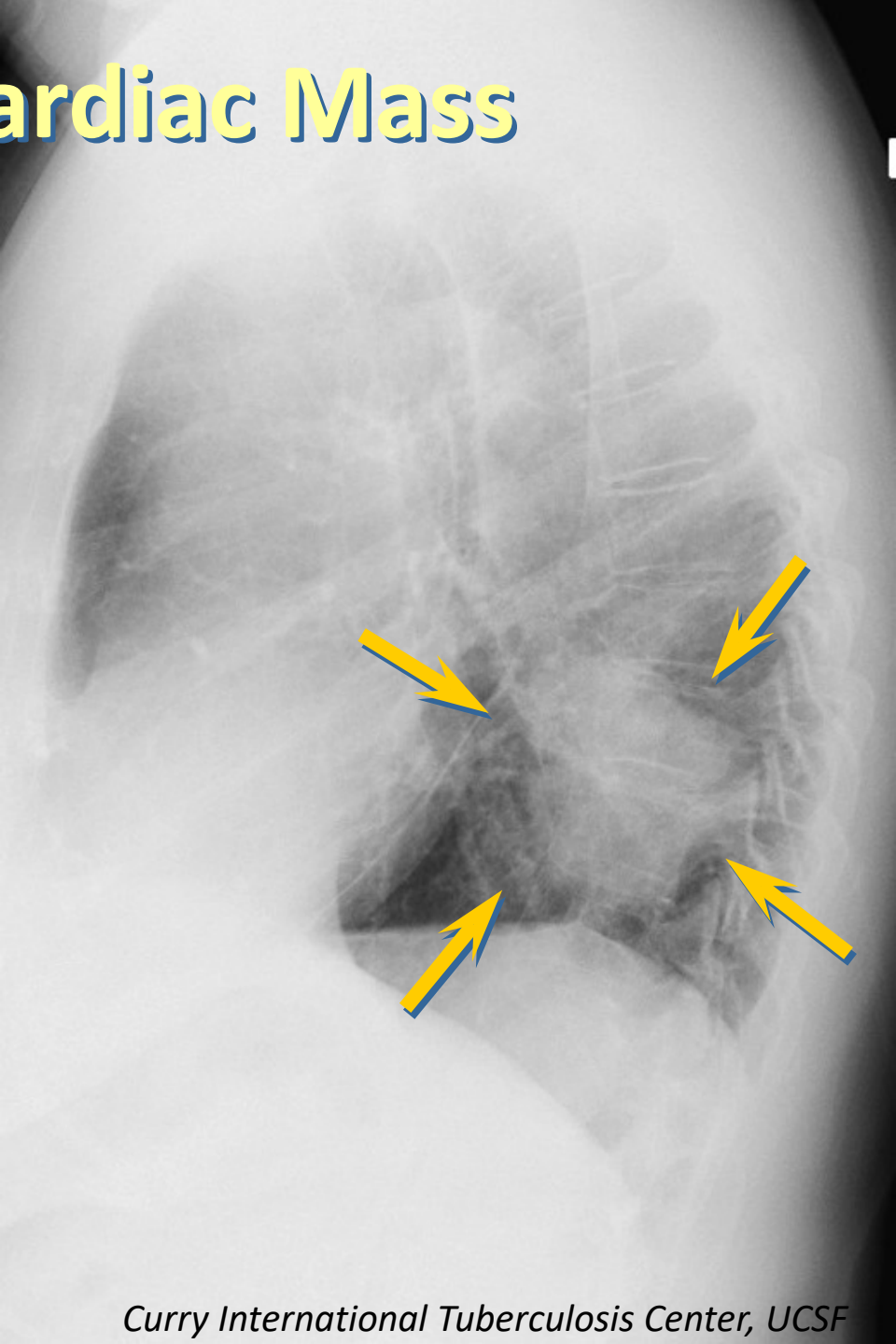
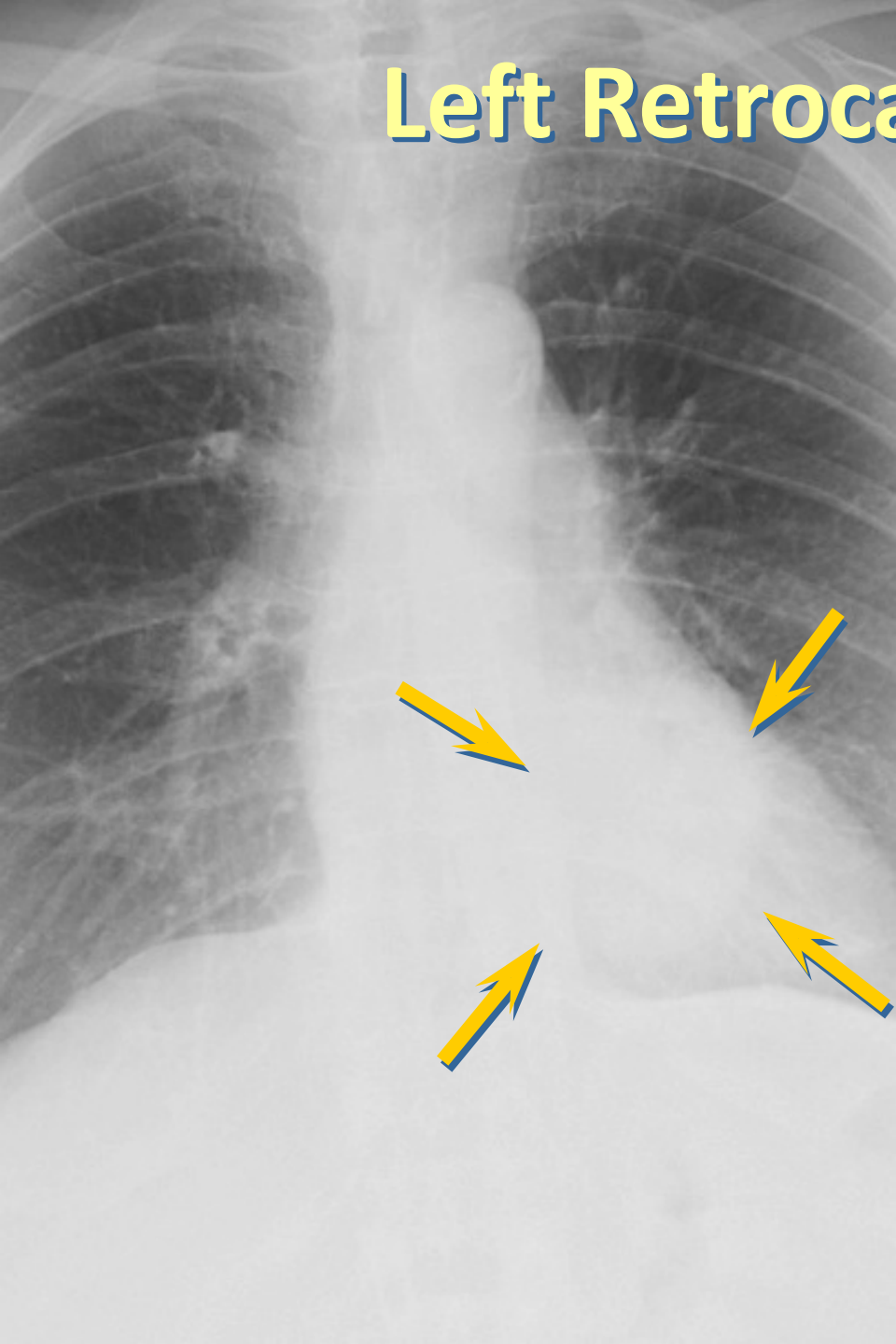


Apical TB



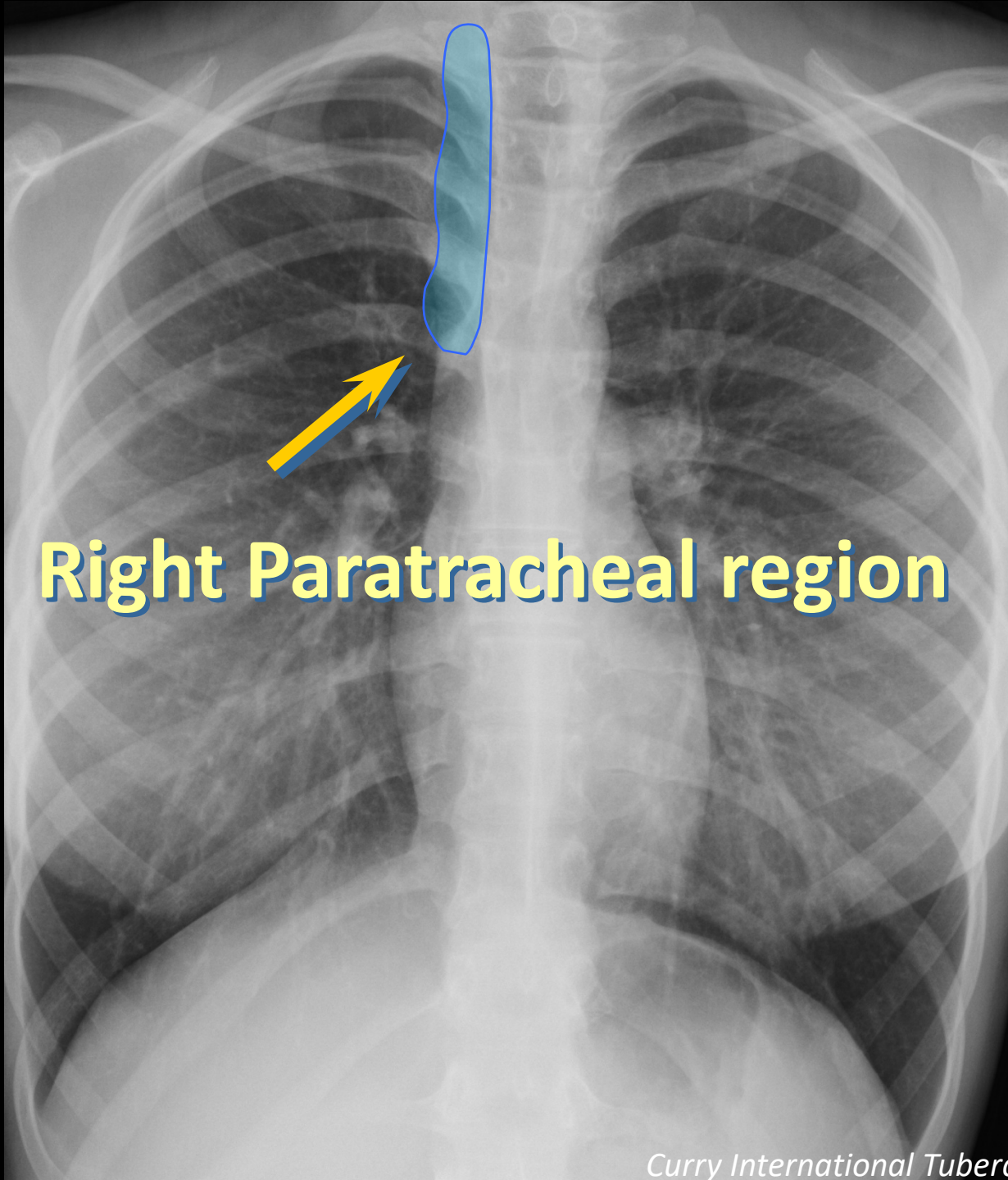


Left Retrocardiac Mass

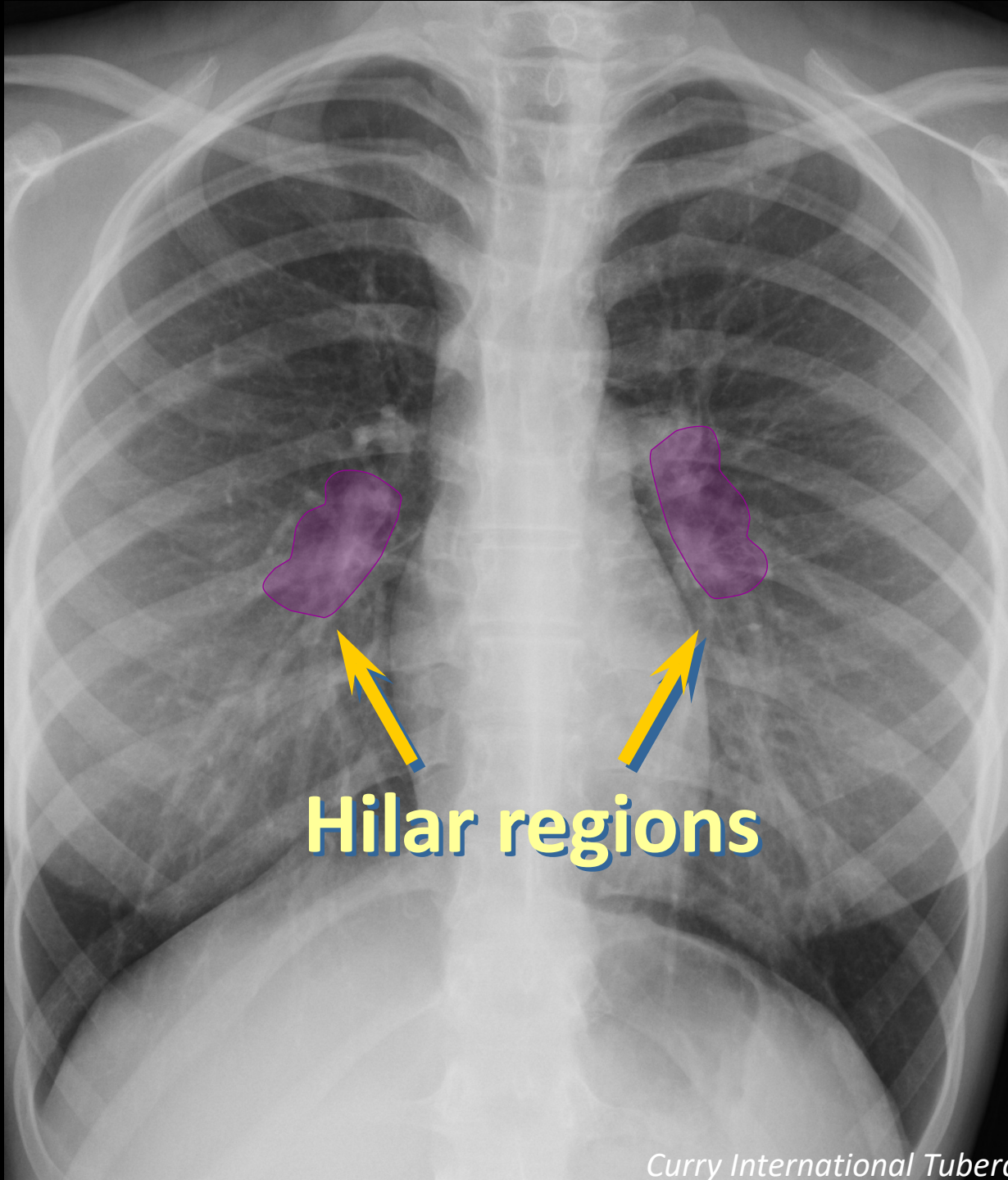


Lymphadenopathy on CXR

- Some specific locations for TB lymphadenopathy
 - Right paratracheal
 - Hilar
 - Aorto-pulmonary window

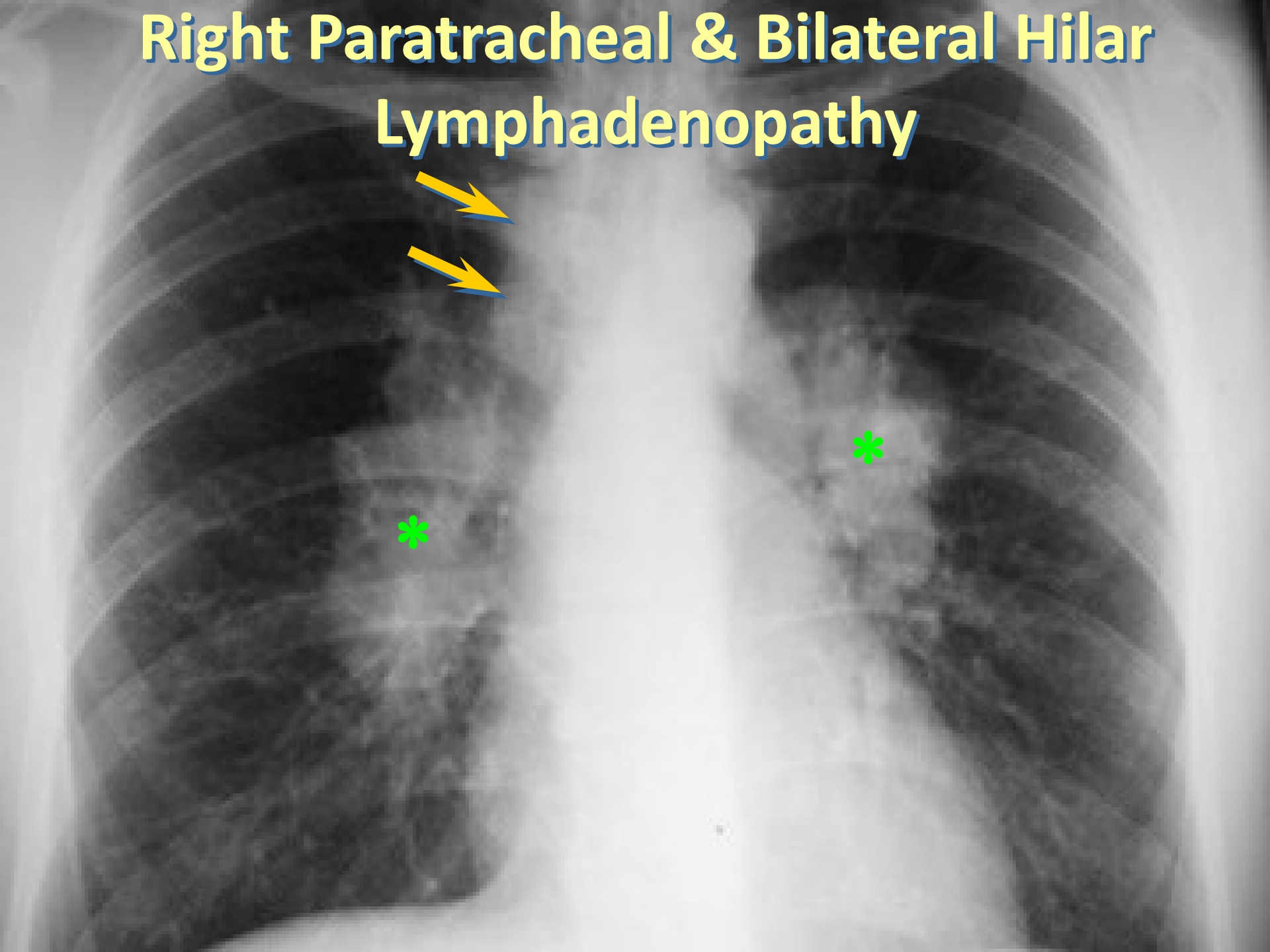


Right Paratracheal region



Hilar regions

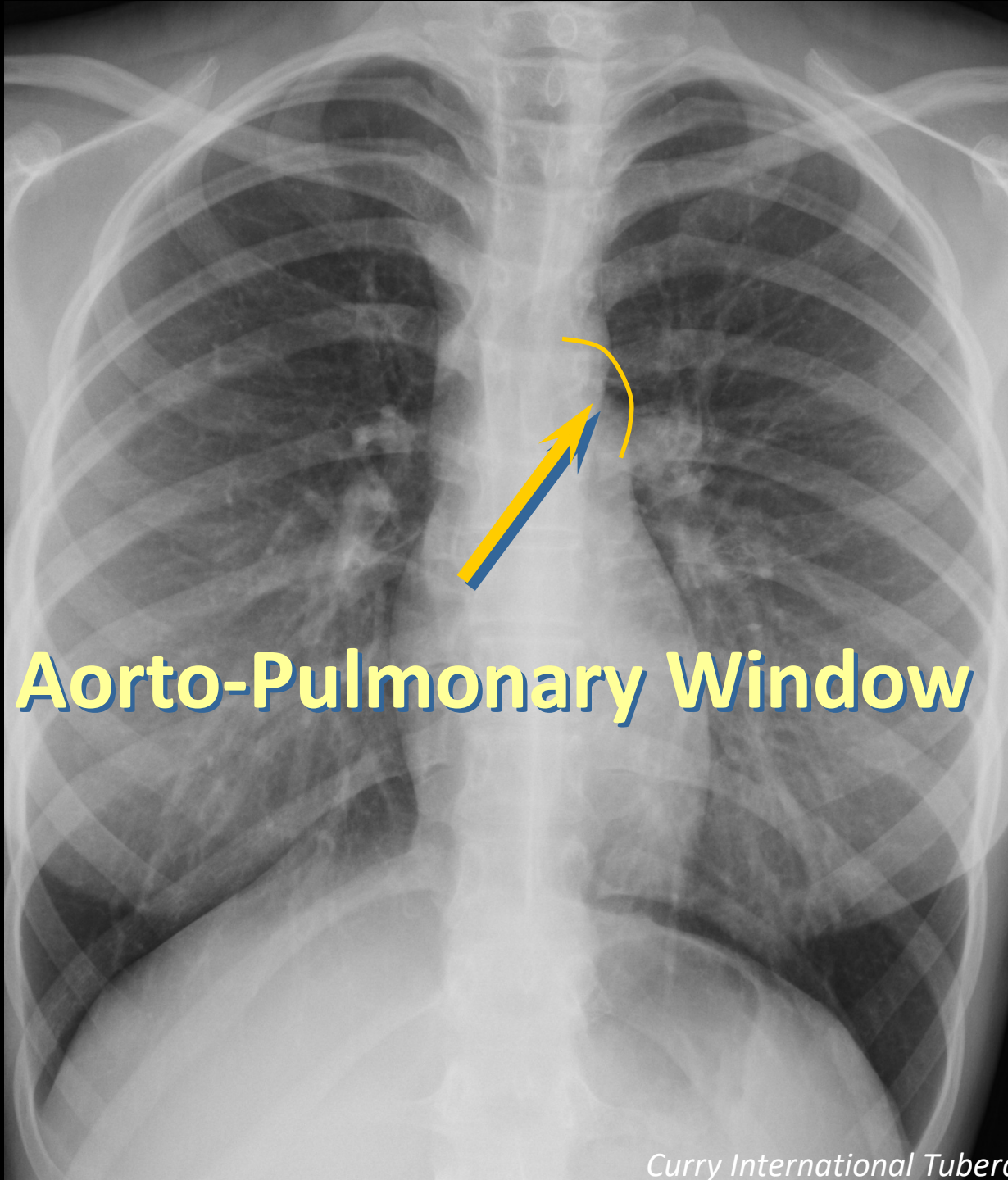
Right Paratracheal & Bilateral Hilar Lymphadenopathy



Normal

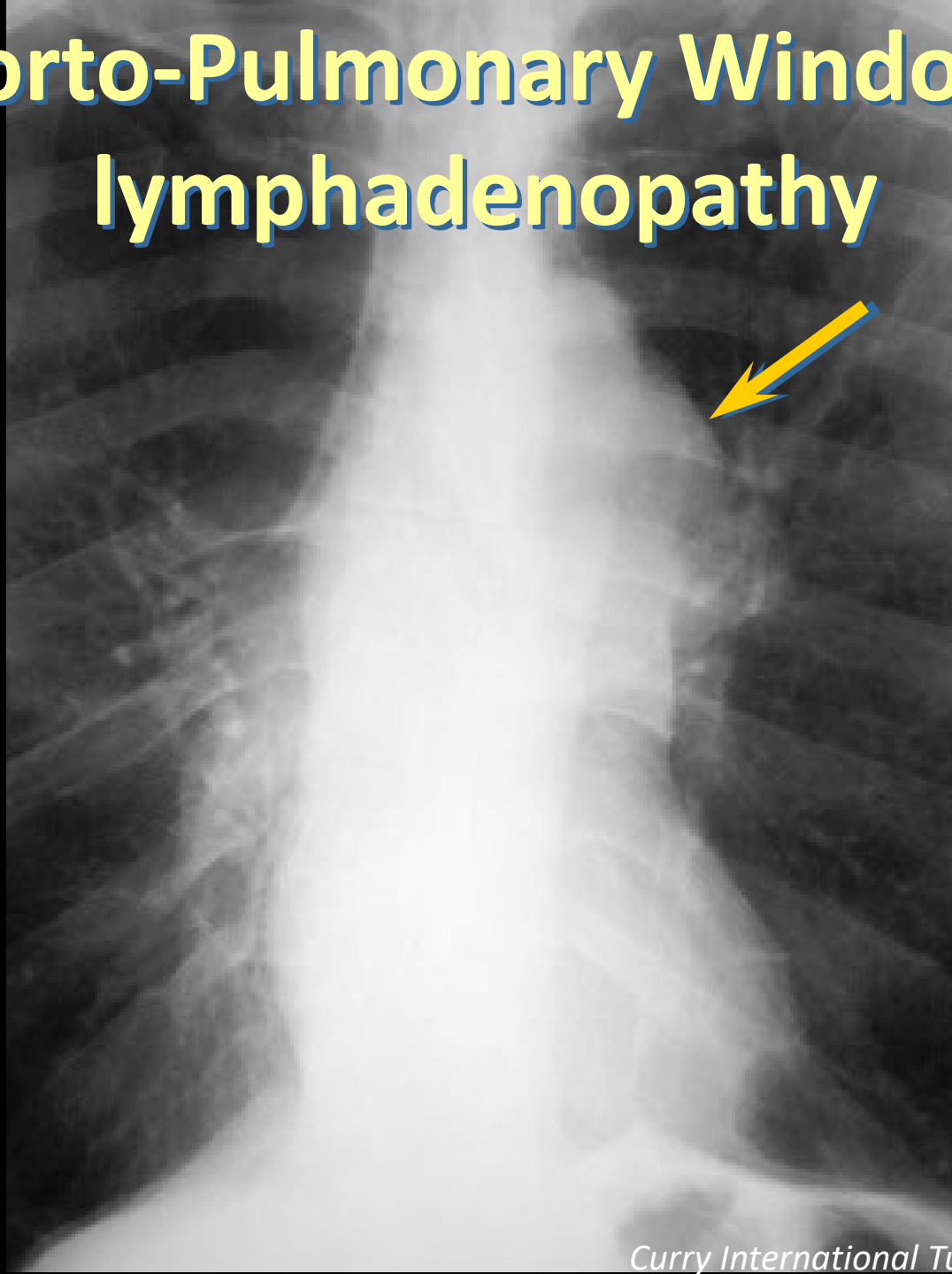
**Right Hilar
Lymphadenopathy**





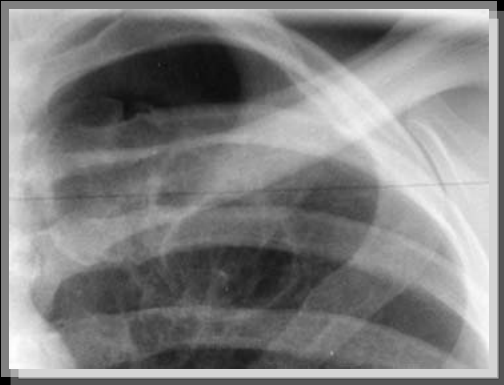
Aorto-Pulmonary Window

Aorto-Pulmonary Window lymphadenopathy



Cysts & Cavities

- Circular lung parenchyma “holes” with definable wall, filled with air and/or fluid
- Thin wall = Cyst; Thick wall = Cavity
- Cavities: TB, bacterial or fungal pneumonia, malignancy, autoimmune disease



Pneumocystis
pneumonia



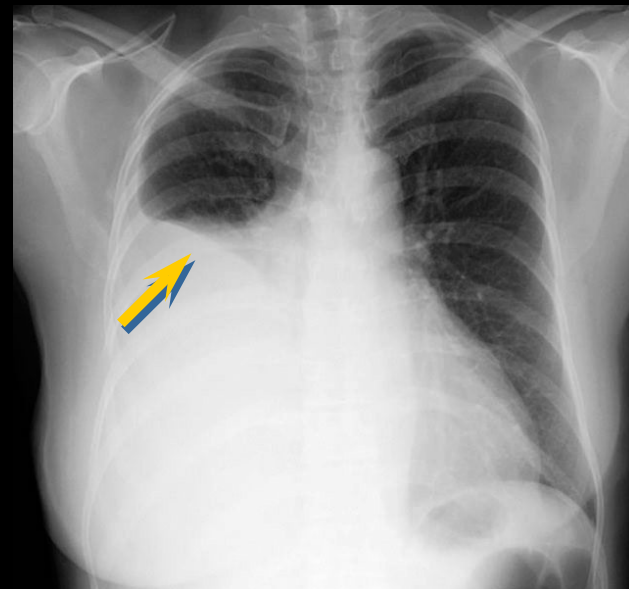
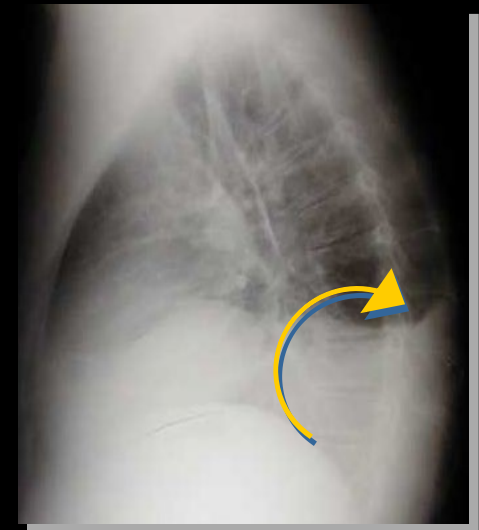
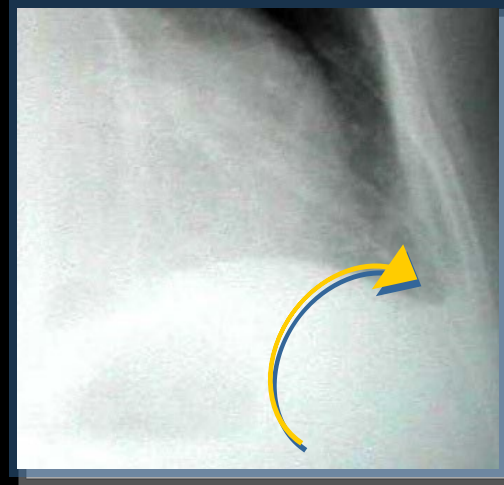
Cavitary TB



Lung cancer

Pleural Effusions

- Smooth opacification, dependent portion of lung
- Common in TB
 - Small effusions: costophrenic angle blunting
 - Large effusions: more obvious



Radiographic Patterns: Pulmonary TB

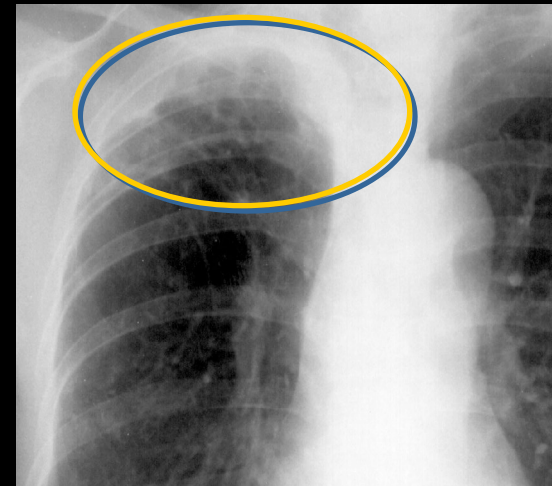
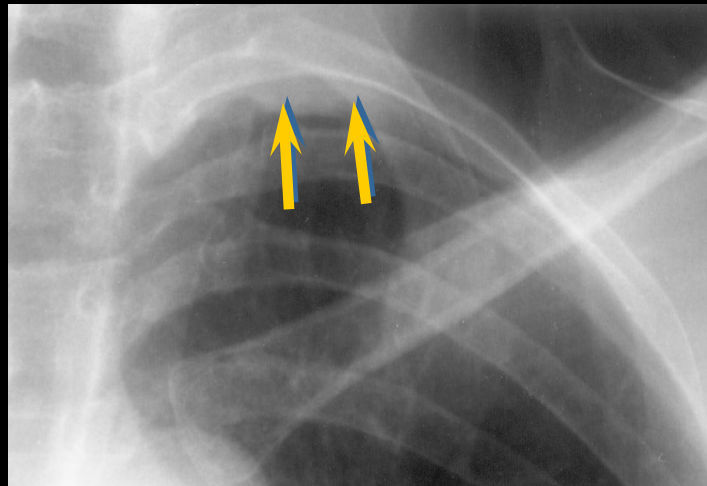
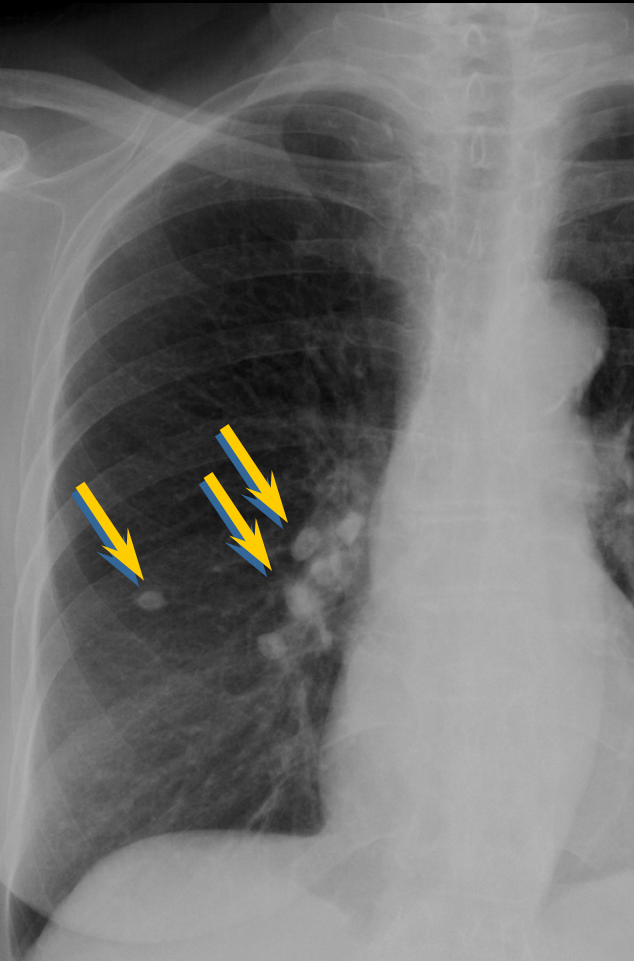
TB Pattern	"Typical" (Post-Primary)	"Atypical" (Primary)
Infiltrate	90% upper	Can be anywhere
Cavitation	Common	Uncommon
Adenopathy (Only)	Uncommon	Common, especially in children Unilateral > bilateral
Effusion	May be present	May be present

CXR Pattern: Early vs. Advanced HIV

	Early HIV (CD4>200)	Advanced HIV (CD4<200)
Pattern	“Typical” (Post-primary)	“Atypical” (Primary)
Infiltrate	Upper lobes	Lower lobes, multiple sites, or miliary
Cavitation	Common	Uncommon
Adenopathy	Uncommon	Common
Effusion	Uncommon	More common

Old/Healed TB

- Ca^{++} granuloma–Ghon lesion
- Ca^{++} granuloma and hilar node calcification–Ranke complex
- Apical pleural thickening
- Fibrosis and volume loss



Conclusions: Basic TB Radiology

- Poor quality CXR is hard to interpret
- Use a systematic approach (eg, ABC's)
- Practice normal CXR anatomy
- Practice characterizing & describing lesions: enhances confident communication with other clinicians
- Chest CT often adds little to CXR for typical TB

