胸壁、肋膜及縱隔腔病變

三軍總醫院
胸腔內科
張山岳醫師

病灶的定位與辨別

先判斷胸腔內或胸腔外 → lateral view、 PE

胸腔外 (**extrathoracic)**

- Skin
- Foreign body

胸腔內 (**intrathoracic)**

- 肺內**(intrapulmonary)** : 肺實質病灶
- 肺外**(extrapulmonary)** **: Pleura, Chest wall (bone, soft tissue)**

Intrapulmonary vs. Extrapulmonary

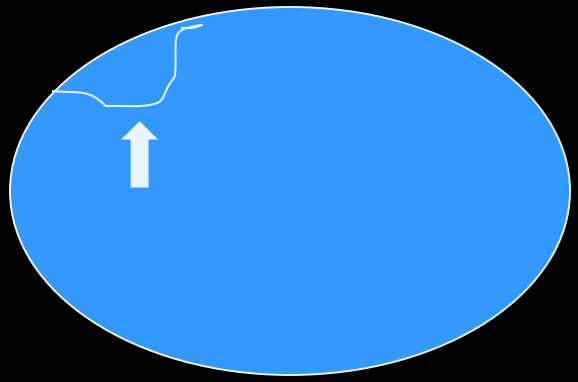
Incomplete border sign

Tapered margin sign

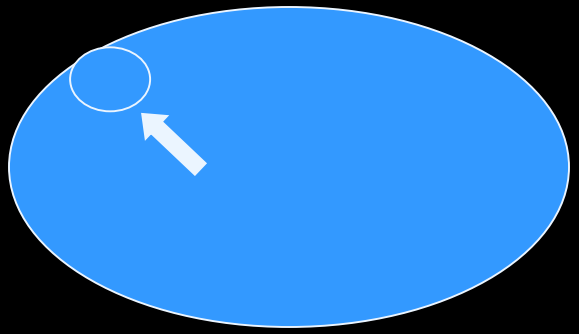
Center outside the lung

Bilateral lesion

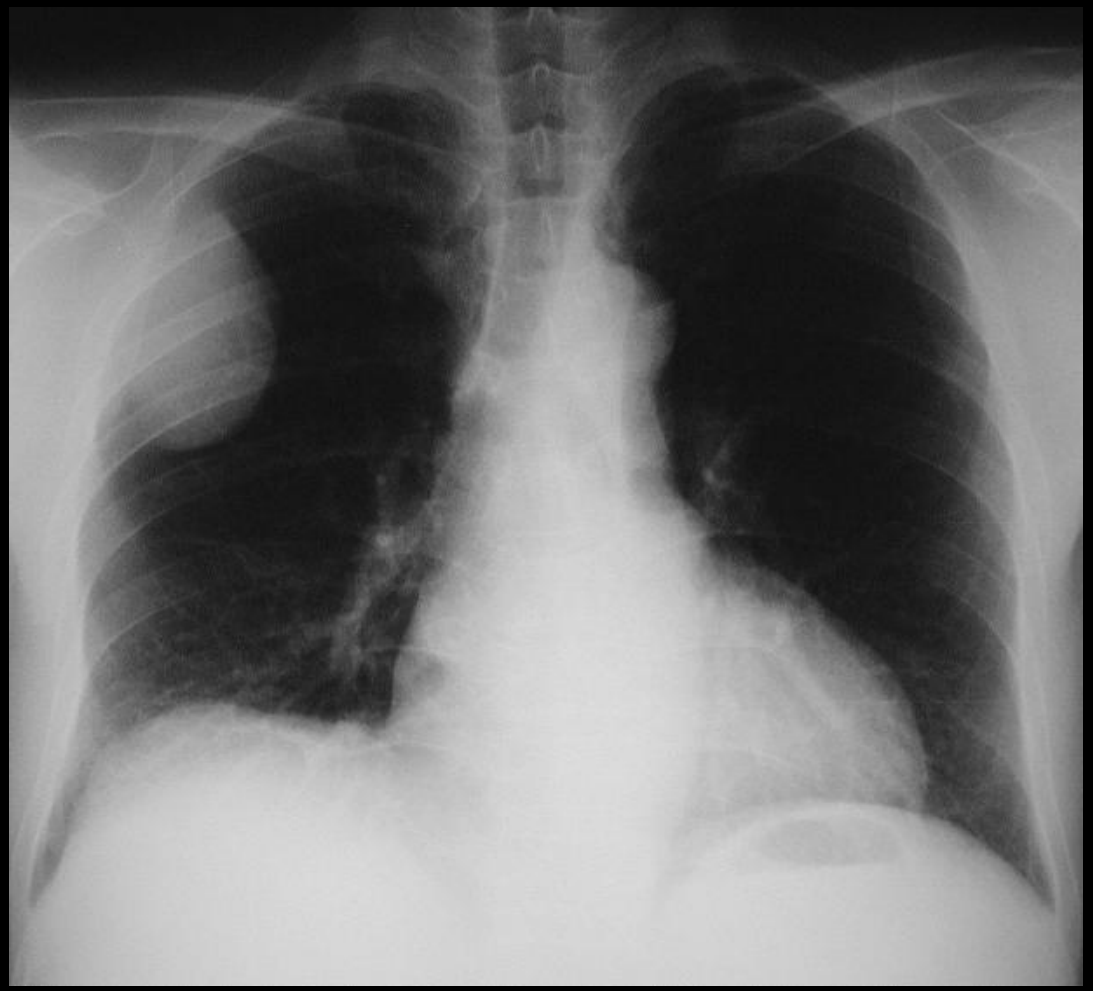
Extra-pulmonary sign

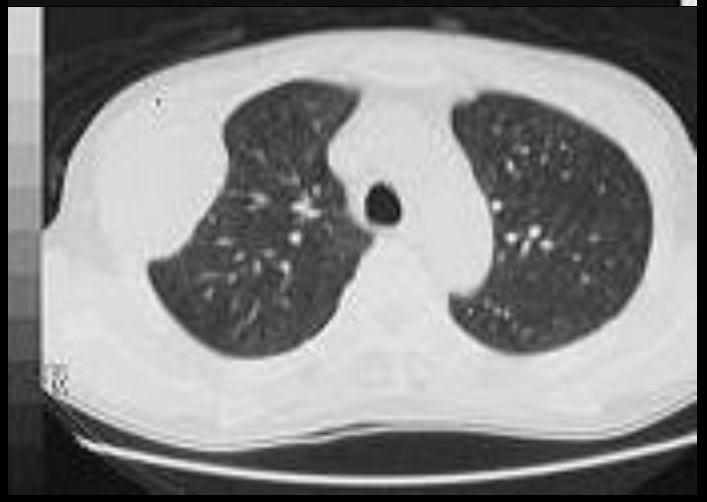


Intra-pulmonary lesion



Incomplete border sign（邊緣）





Distinguish from chest wall from pulmonary lesions

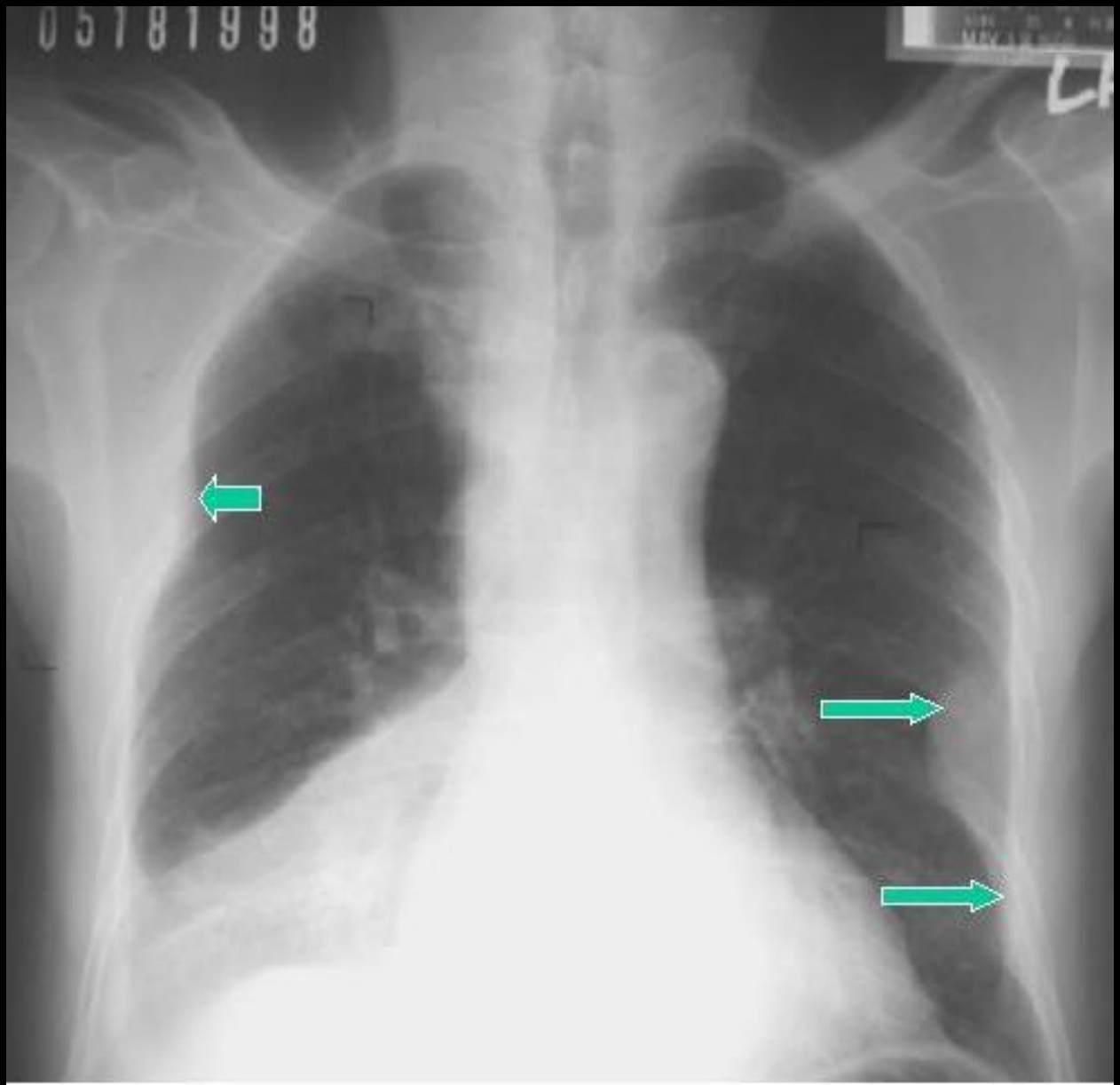
內緣清楚而外緣模糊，指向肺外的病灶

Tapered border sign（角度）

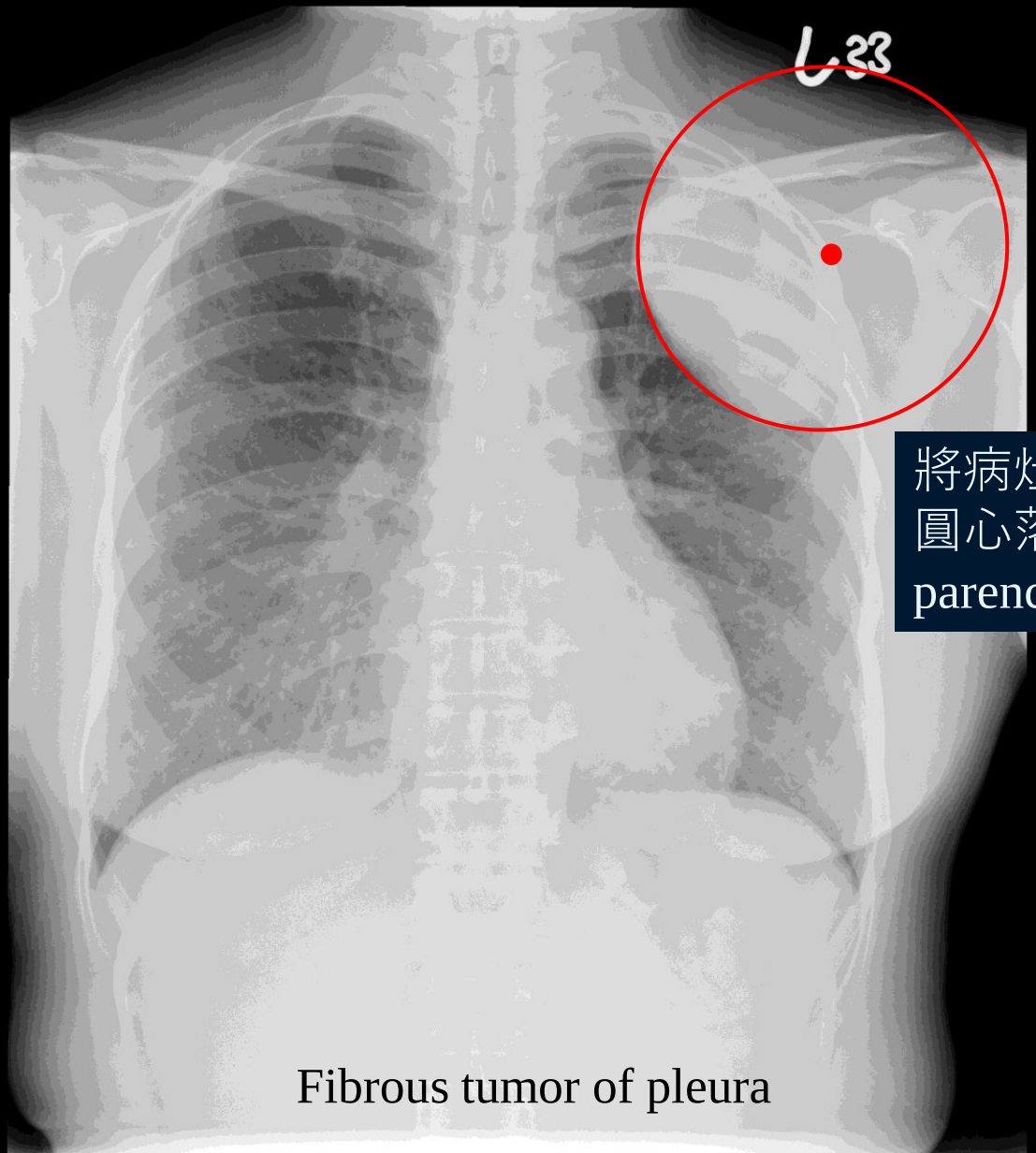
分辨lesion在肺內或肺外

肺外的lesion與chest wall間會呈鈍角(將pleura向內推)

肺內的lesion與chest wall則呈銳角



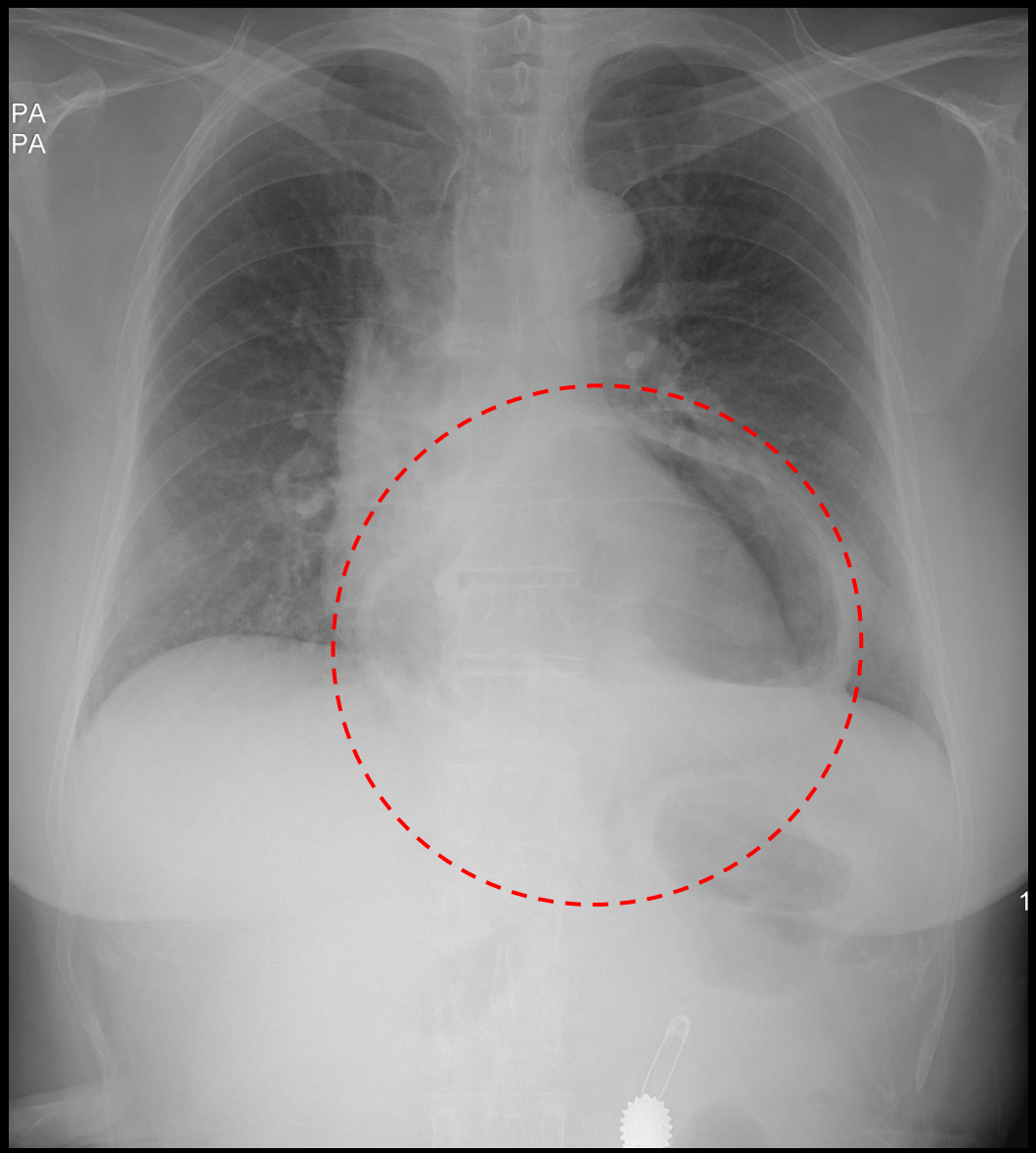
Center outside the lung

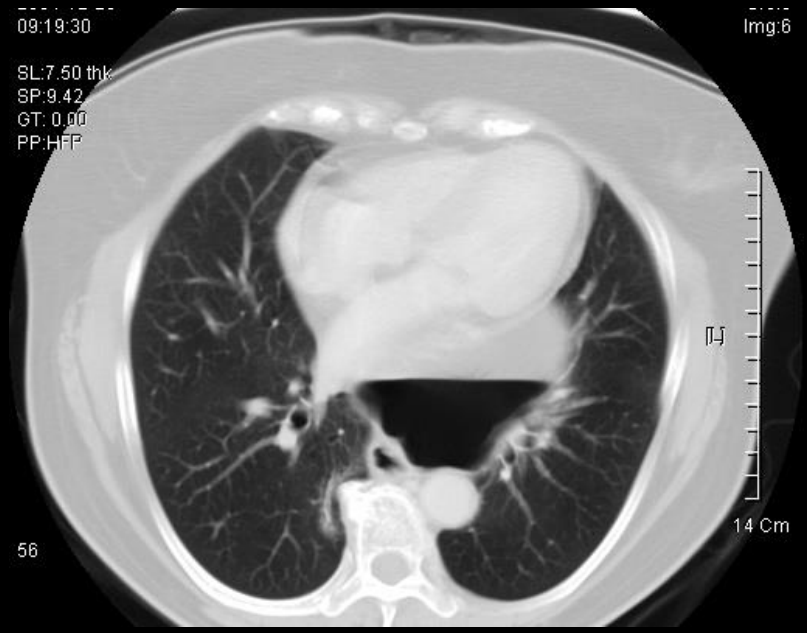


將病灶畫成一個圓
圓心落在lung parenchyma之外

Fibrous tumor of pleura

Bilateral lesion





Hiatal Hernia

Lesion橫跨縱膈腔

Imaging of Chest Wall Lesion

Imaging of Pleura Lesion

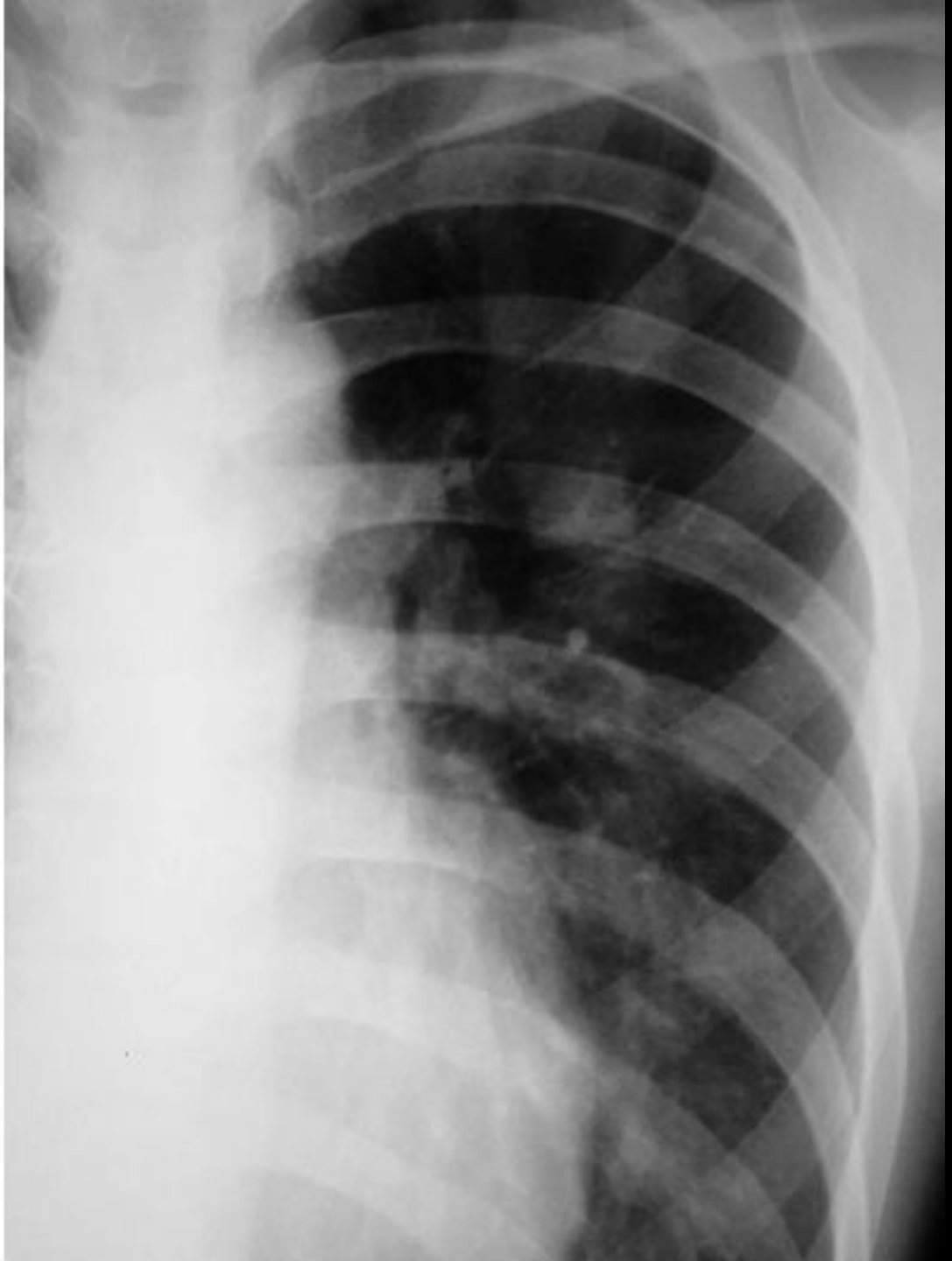
Imaging of Diaphragm Lesion

Imaging of Mediastinum Lesion

Imaging of Chest Wall Lesion

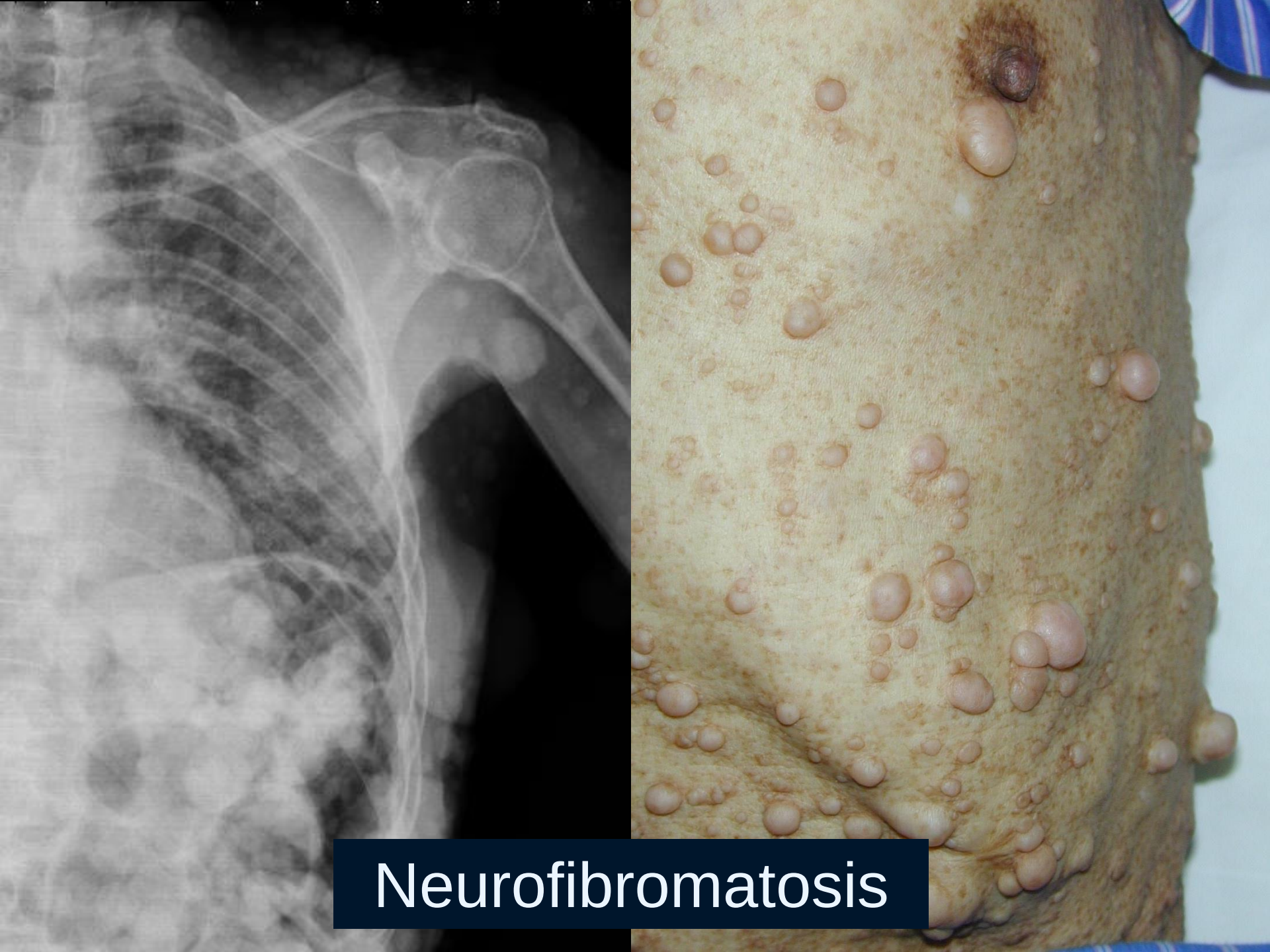
Chest Wall Lesions- Soft Tissue

- Foreign body
  - buttons, electrodes, wires, tubes, dressings and hair braids (髮辮)
- Skin tumor
  - Neurofibromatosis, moles / melanoma, Kaposi's sarcoma
- Soft tissue tumor
  - Fibroma, lipoma, hemangioma, muscle tumor
- Calcification
  - Parasite calcification (Filaria cysticerosis)
  - Granulomatous LAP
- Subcutaneous emphysema
  - Pneumothorax: trauma, post-procedure….
  - Deep neck infection
- Breasts / nipples
  - s/p mastectomy
  - Breast tumor
  - Mammoplasty



Extra-thoracic foreign body

髮辮 (hair braid), left side



Neurofibromatosis

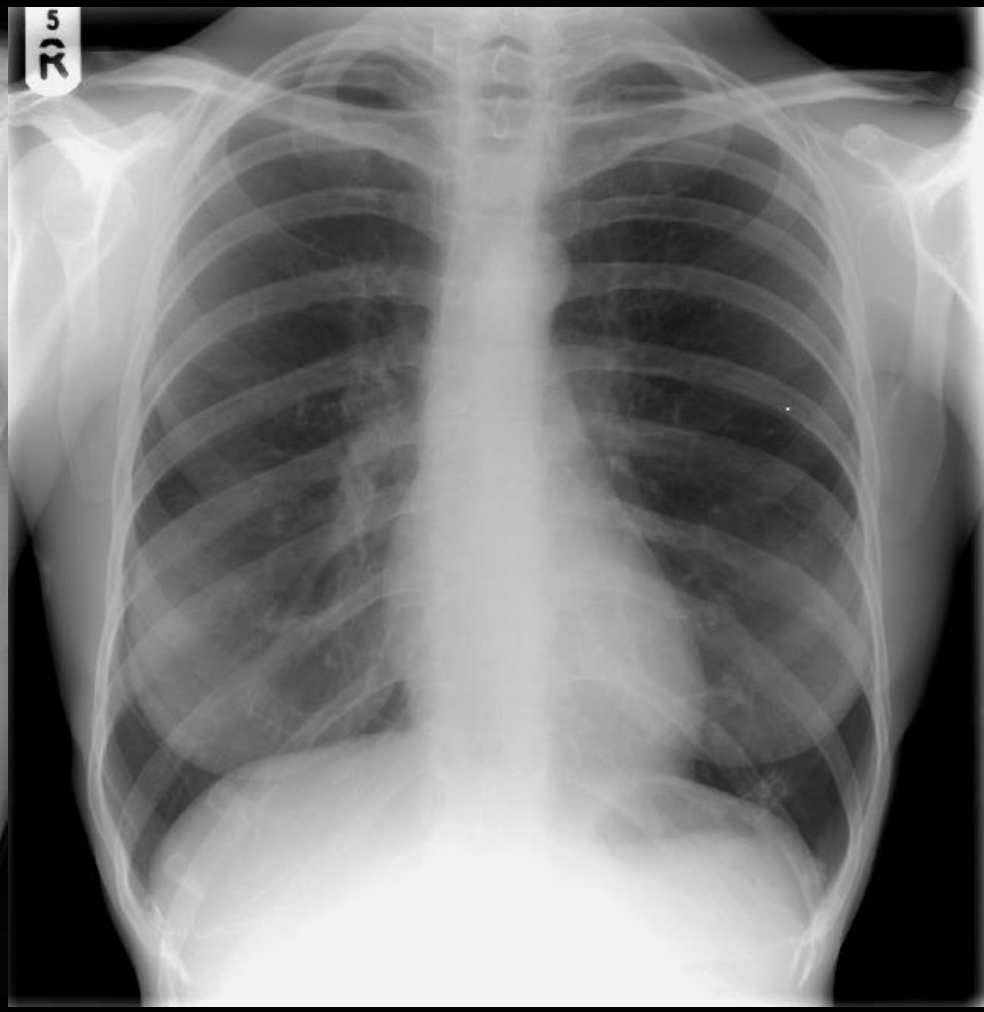
Subcutaneous emphysema

Breast

- 正常的乳房影像：
  - 為一均質的陰影，由上而下直到橫膈，由內而外直到胸壁，其濃度會逐漸增加。如果這個陰影沒有造成lung marking的減少或遮蔽，則可以判定是來自乳房造成的陰影，而不是肺內病變。
- 異常的乳房影像：
  - Mammoplasty：沒有正常乳房的濃度漸增現象
  - 單側乳房異常：s/p mastectomy, breast tumor

Comparison

s/p mammoplasty, bil.

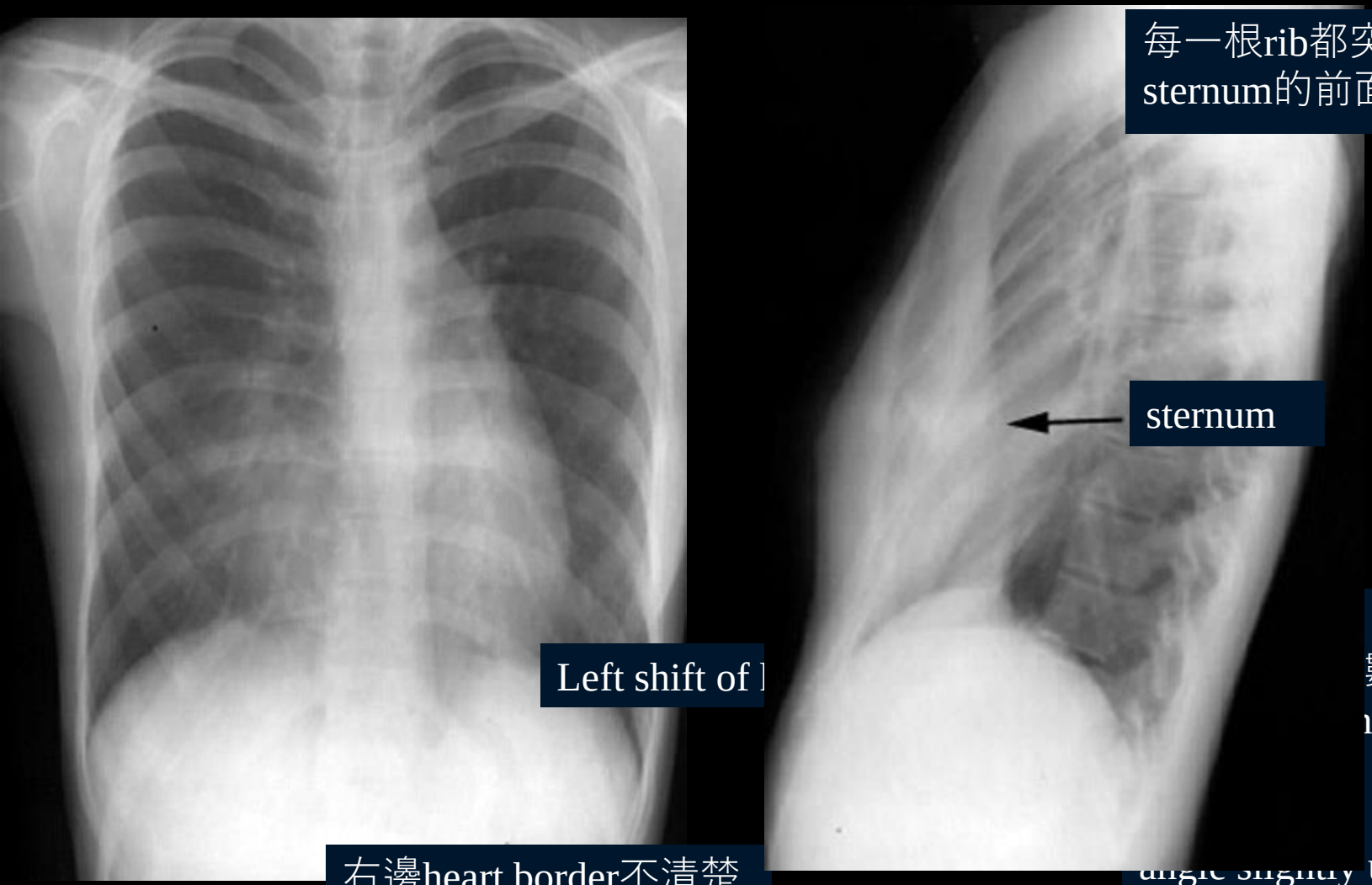


Normal breast shadow

Chest Wall Lesions – **Bone**

- **Sternum:**
  - Funnel chest (pectus excavatum, 漏斗胸)
  - Pigeon chest (pectus carinatum, 鴿胸)
- **Spine:**
  - Kyphoscoliosis
  - Neurogenic lesions
  - Compression fracture
  - Osteopenic / osteogenic lesion of metastasis
  - Paraspinal abscess

Pectus Excavatum (漏斗胸)



每一根rib都突出在sternum的前面

sternum

Left shift of

右邊heart border不清楚

downward

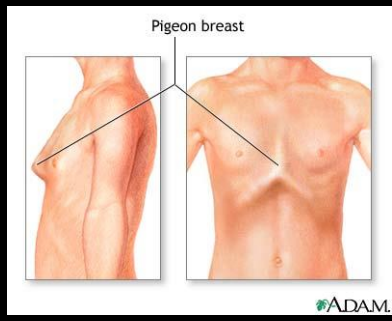
數字”7”),

ost parallel to

sometimes

upward.

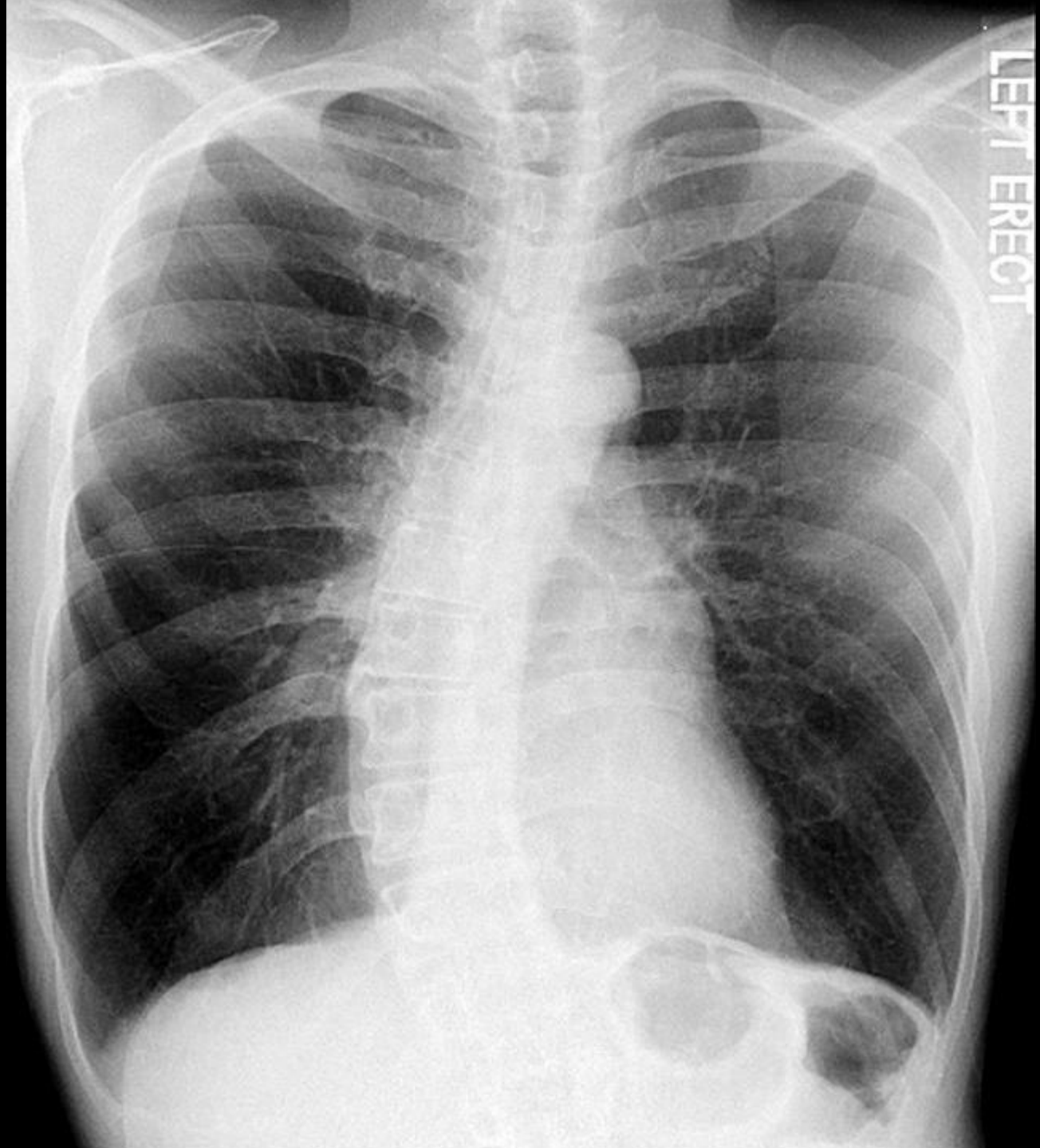
Pectus carinatum (鴿胸, pigeon chest)

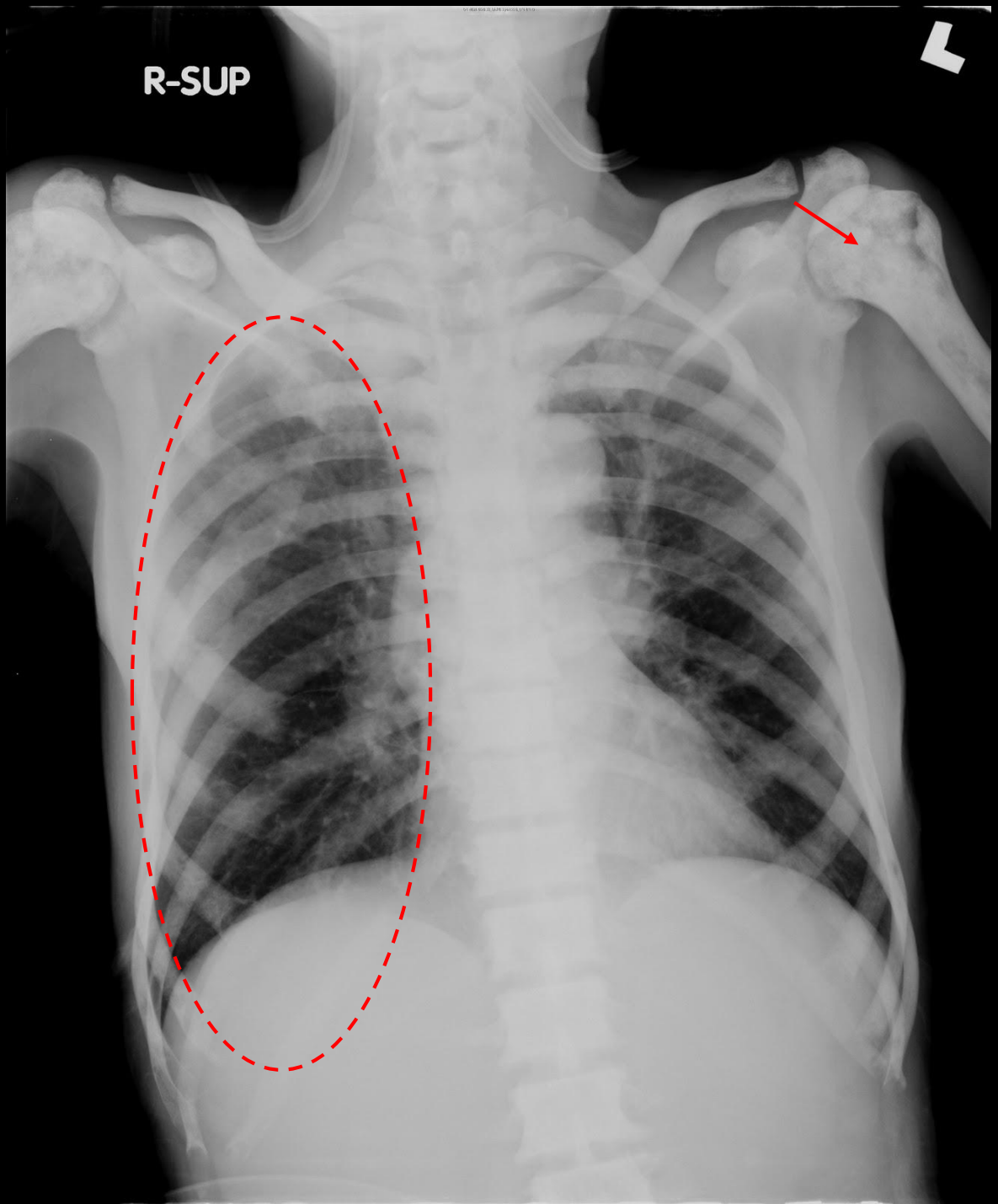


RadioGraphics 2007; 27:989–1004

Anterior protrusion of the upper portion of the sternum and the costal cartilages, with bilateral flattening of the sides of the chest

Scoliosis





Prostate cancer

Osteoblastic change

Chest Wall Lesions – Bone

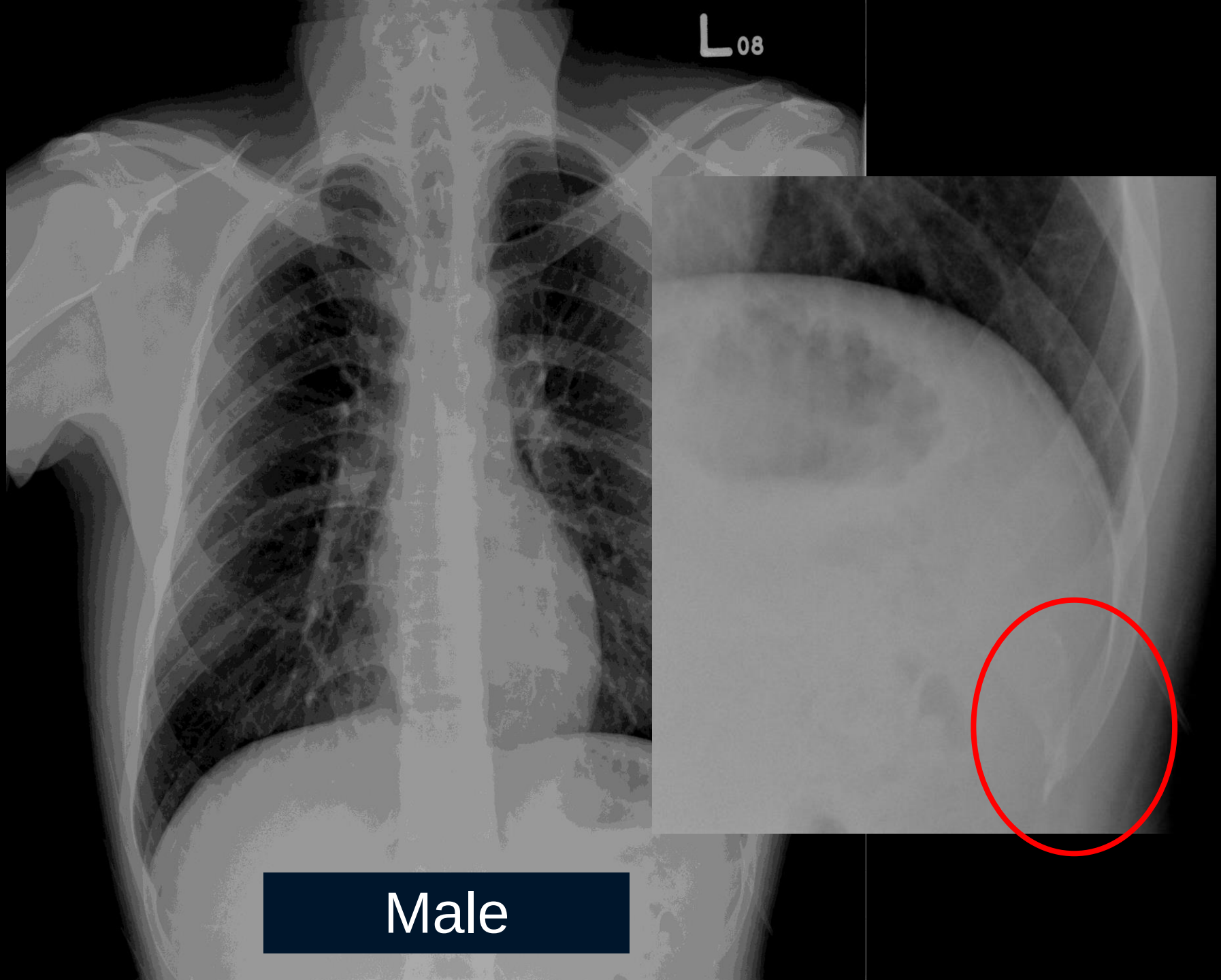
- Rib:
  - Costal cartilage : 分辨性別、年齡
  - 先天發育異常: forked rib, fusion rib, cervical rib
  - Contour異常：rib fracture ; funnel chest, barrel chest
  - Rib notching (下緣)：CoA, neurogenic tumor (benign)
  - Rib變寬/size變大：thalassemia, bone tumor

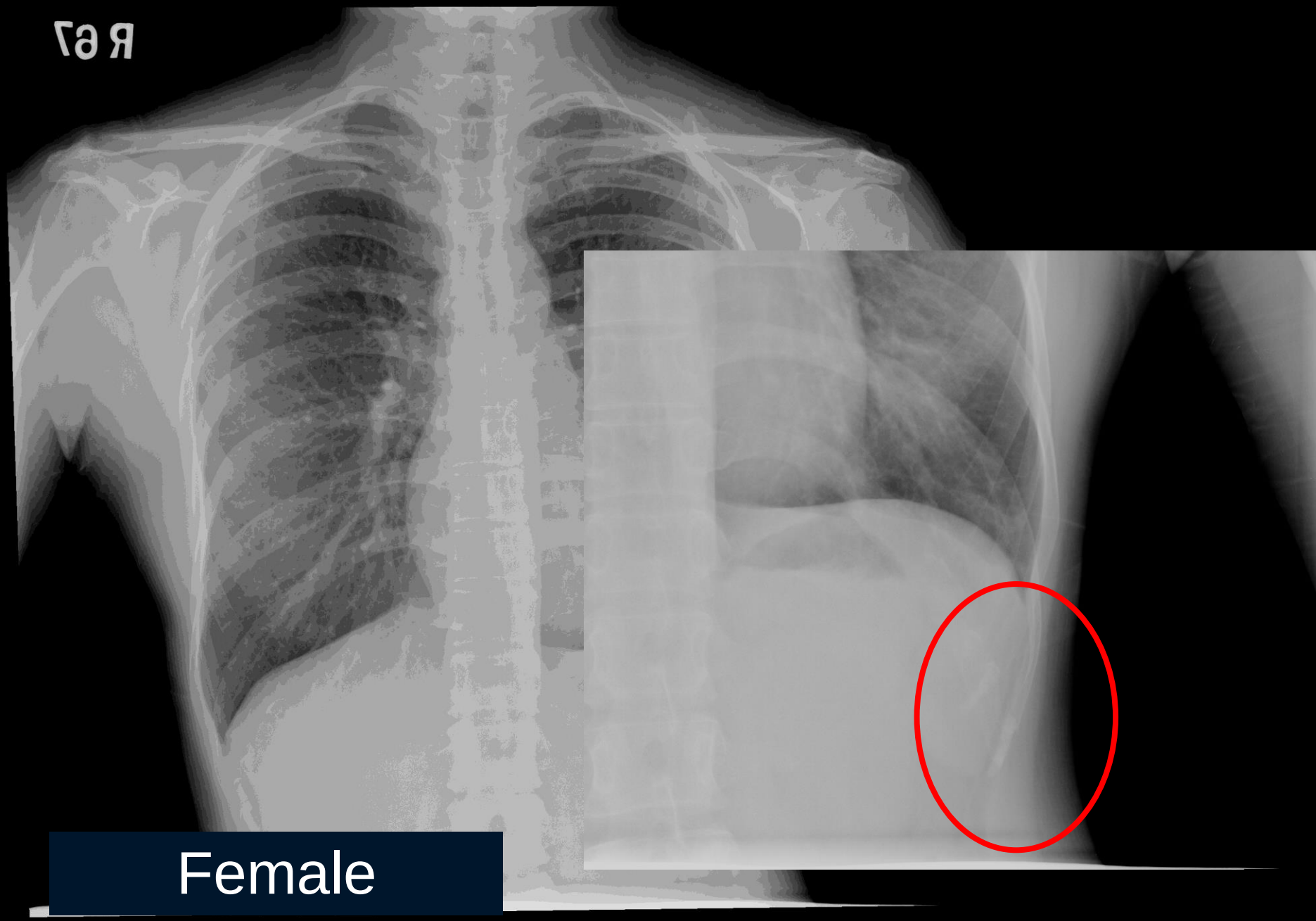
Chest Wall Lesions – Bone

- Rib:
  - Density改變：
    - ↑(變白)：diffuse - 2M (metastasis, myelofibrosis), 2O (osteopetrosis, osteodystrophy); 鈣化 - Osteochondroma, chondrosarcoma, osteosarcoma
    - ↓(變黑)：osteolytic, osteoporosis
  - Chest wall mass + rib destruction：
    - 成人：Multiple myeloma (plasmacytoma), metastasis, Pancoast tumor
    - 小孩：Ewing's sarcoma, neuroblastoma
    - 感染：TB, aspergillosis, actinomycosis, nocardiosis , blastomycosis

用Rib來判斷病患的性別和年齡

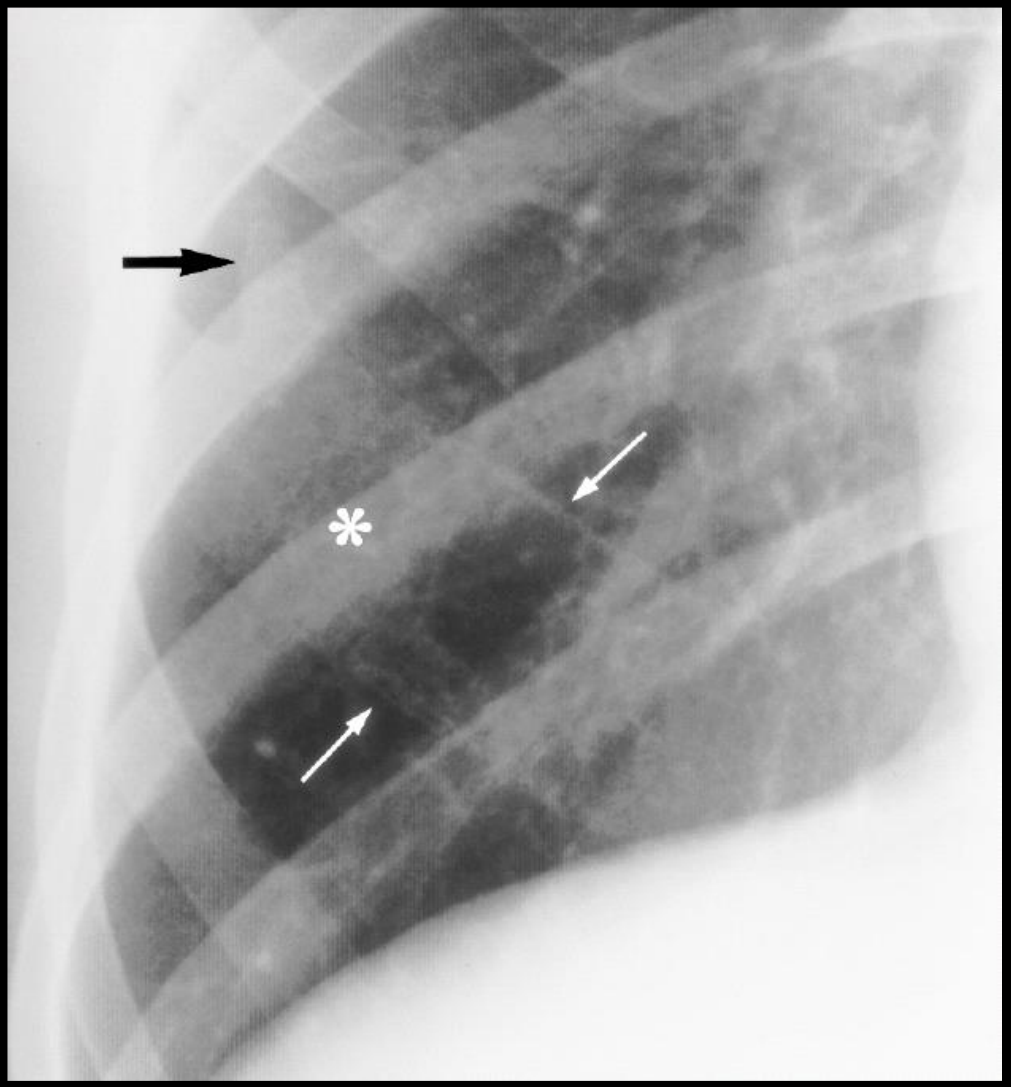
- 性別: calcification of costal cartilage的形態
  - M: peripheral (vaginal type)
  - F : central (penial type)
- 年齡：
  - 第一根肋軟骨鈣化: 30-40 y/o


L 08
Male


Female

先天發育異常

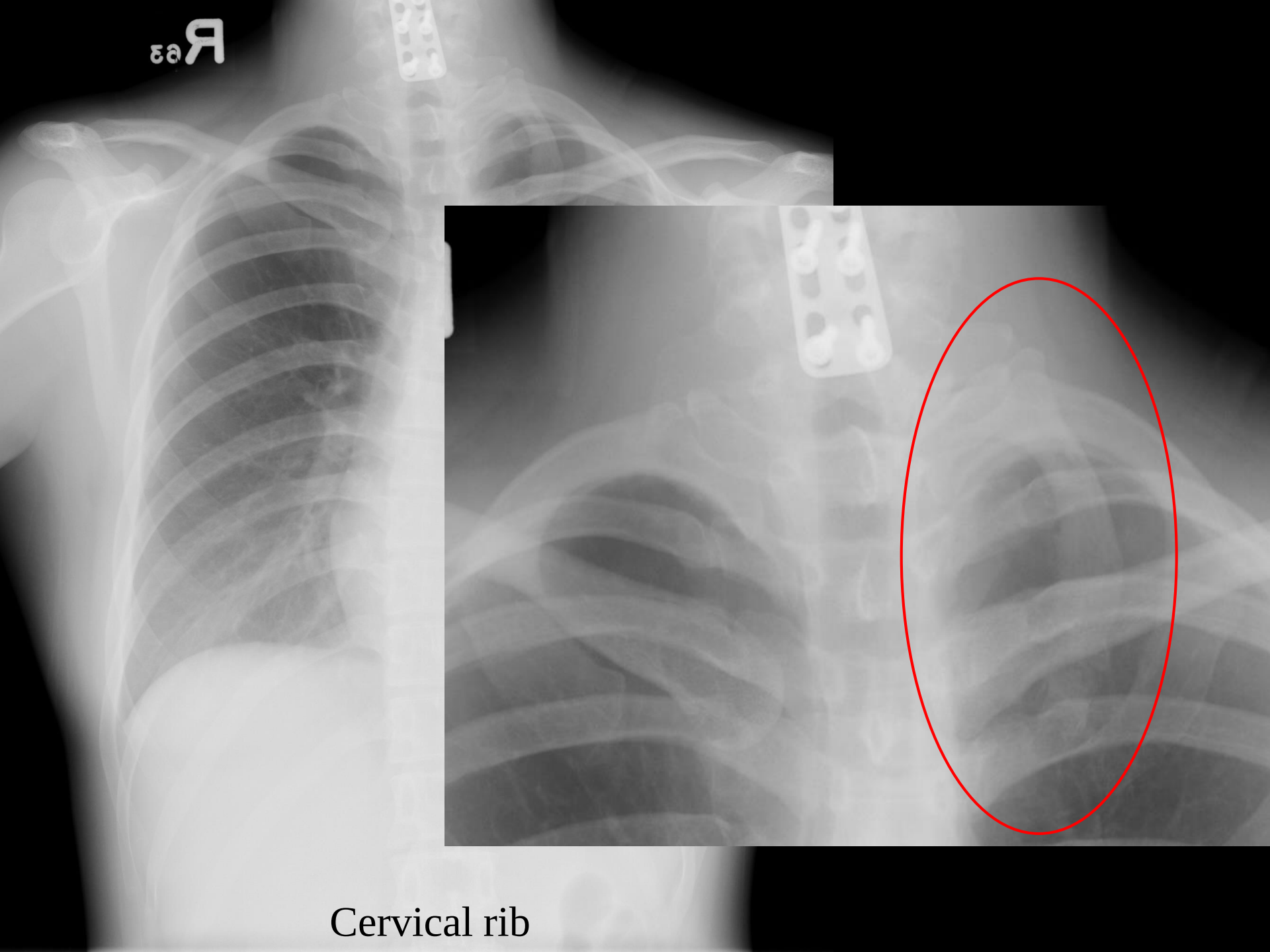
- **Bifid or forked rib**
  - 最常發生於4th rib
  - The anterior portion of rib is duplicated



RadioGraphics 1999; 19:105–119

先天發育異常

- **Cervical rib:**
  - A supernumerary or accessory rib arising from the C7 vertebra.
  - About 0.5% of the population and is more common in females than in males.
  - Usually asymptomatic
  - May thoracic outlet syndrome by compression of the brachial plexus or subclavian vessels.
    - Pain in the hand when the arm is elevated
    - Difference in pulse intensity between the two arms when the affected extremity is in a certain position

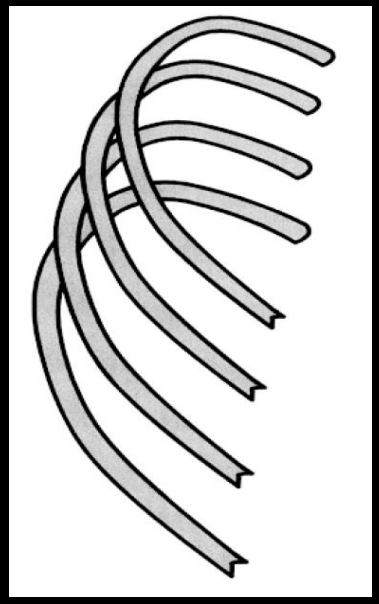


Cervical rib

Costal Shape and Contour

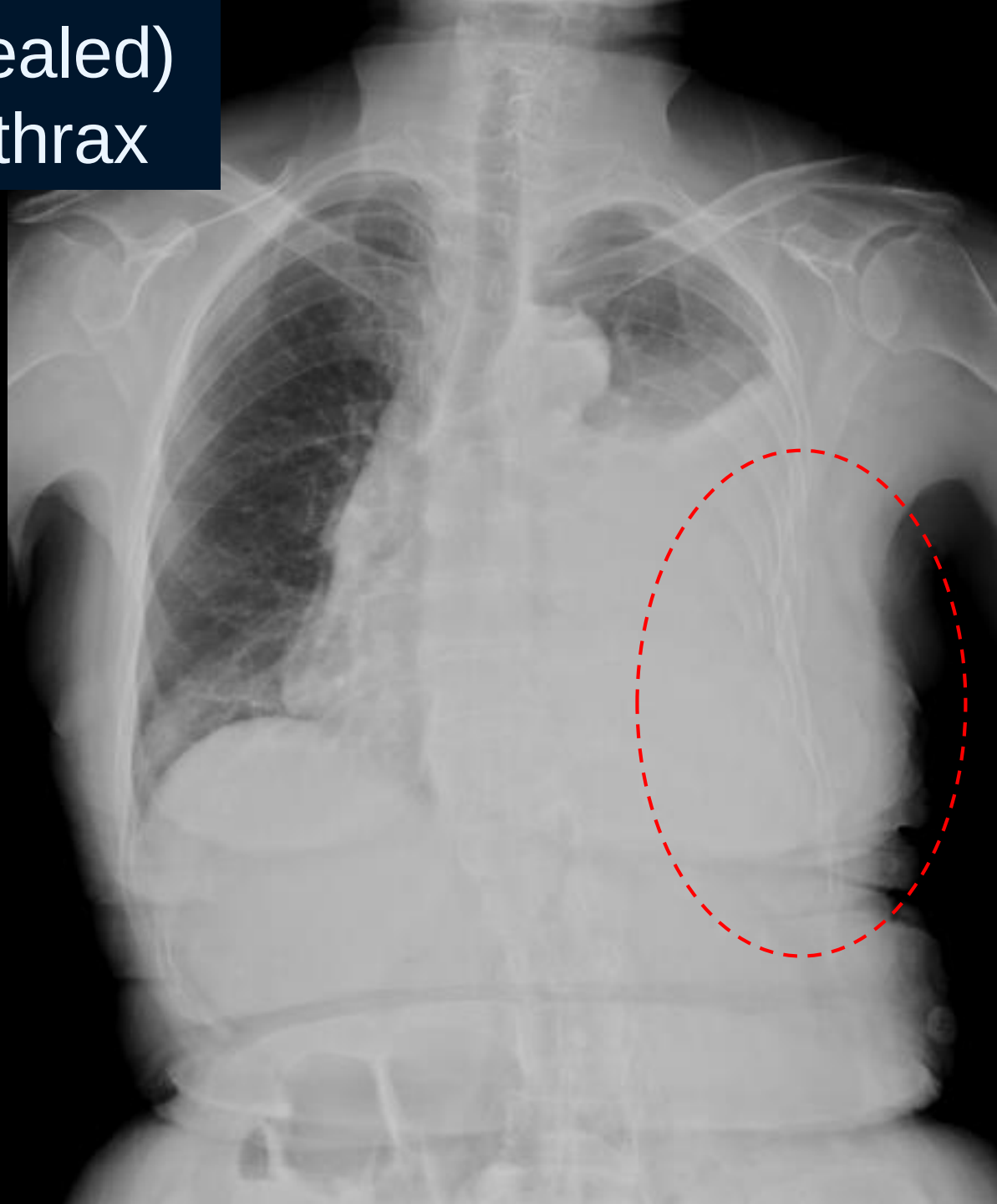
- Funnel Chest

- Accentuated downward angulation of the anterior portions of the ribs, which run almost parallel to each other
- Posterior portions of the ribs sometimes angle slightly upward

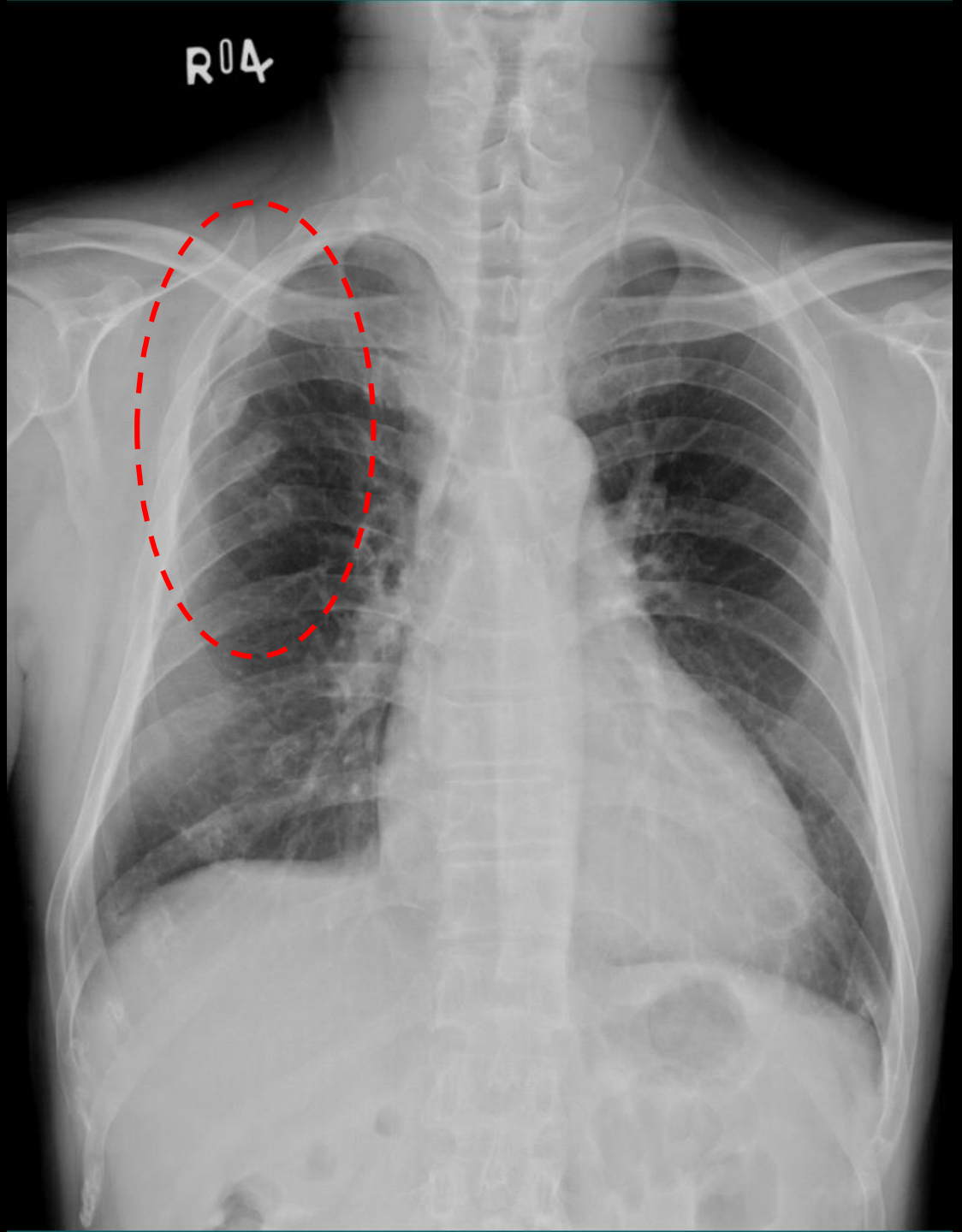


RadioGraphics 1999; 19:105–119

Rib fracture (not healed) with hemopneumothrax



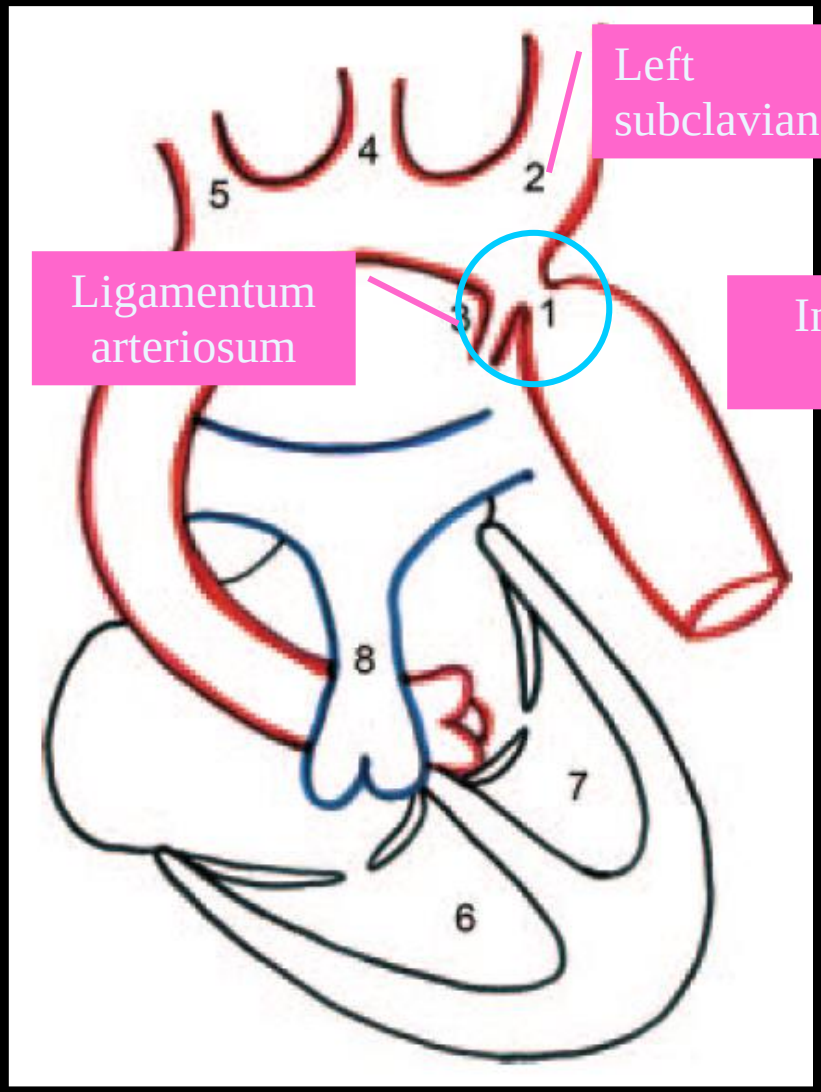
Rib Fracture, healing with calus formation



Rib Notching (下緣)
Coarctation of Aorta-主動脈狹窄

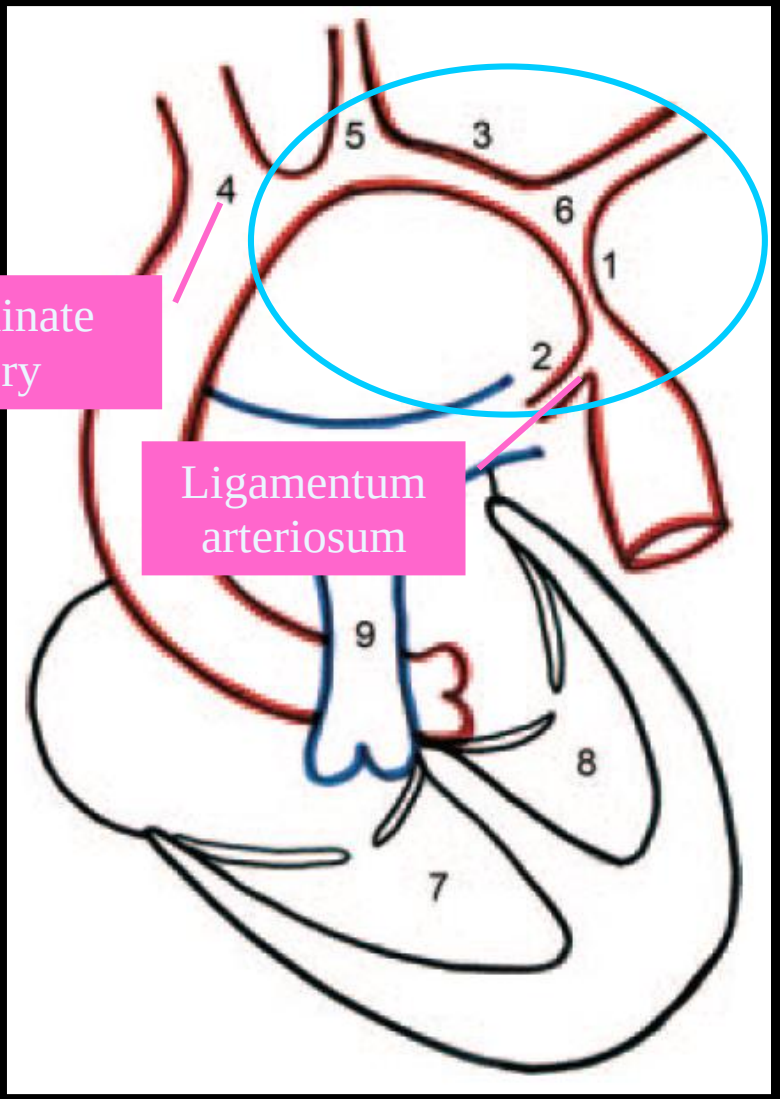
- Deformity of the aortic media and intima → prominent posterior infolding of the aortic lumen.
- Characteristically occurs at or near the junction of the aortic arch and the descending thoracic aorta.
- Two main types:
  - **Localized (postductal or adult-type)**: most common
    - a focal narrowing of the aorta, just beyond the origin of the left subclavian artery or the ligamentum arteriosum
    - accompanied by dilatation of the left subclavian artery
  - **Tubular hypoplasia (preductal or infantile-type)**
    - The 2nd common cause of heart failure in newborn
    - A long narrowed segment beyond origin of innominate artery
    - Associated with intracardiac defect, esp. a deformed or bicuspid aortic valve

RadioGraphics 2007; 27:1323–1334



Adult type

Narrowing distal to ductus arteriosus



Infantile type

Narrowing proximal to ductus arteriosus

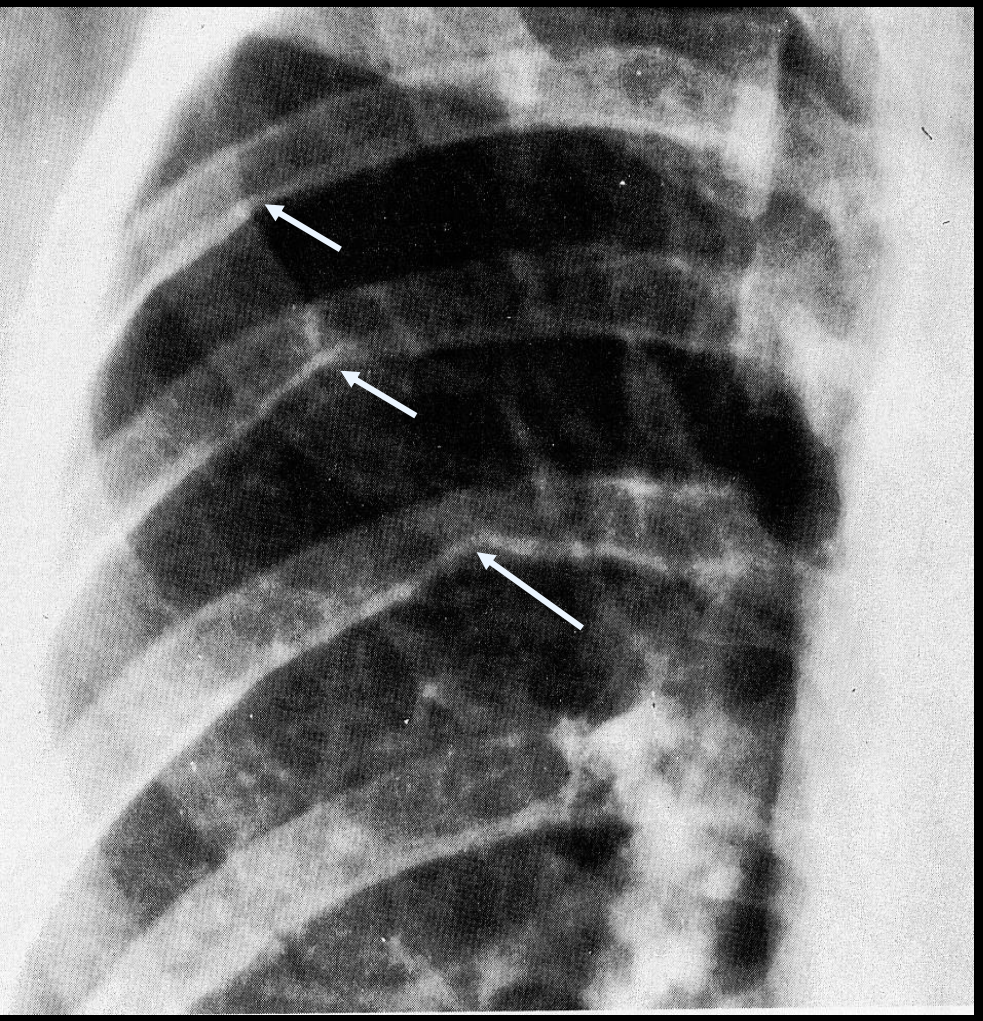
RadioGraphics 2007; 27:1323–1334

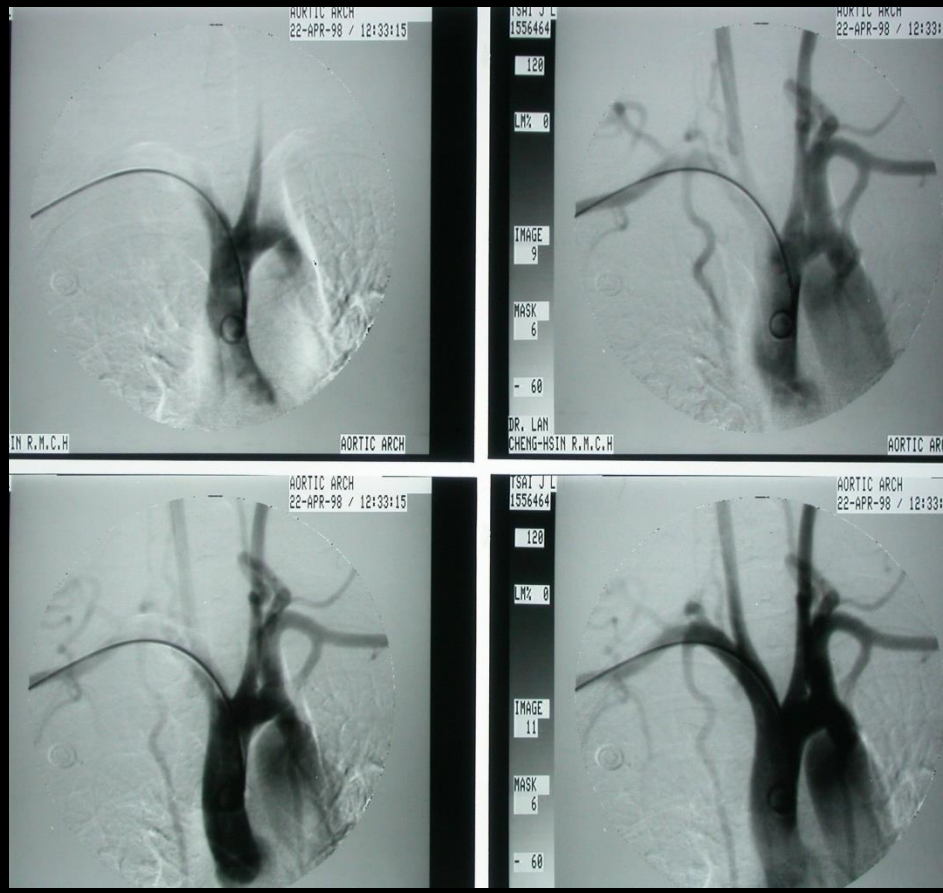
Rib Notching (下緣)
Coarctation of Aorta-主動脈狹窄

- Imaging
  - Inferior rib notching
    - Best diagnostic clue
    - An elaborate system of collateral vessels (including collateral internal mammary, intercostal, and superior epigastric arteries) forms to bypass the coarctation.
    - The dilated and tortuous intercostal vessels form deep grooves on the undersurfaces of the ribs
    - Usually 3rd ~8th ribs
    - 1st and 2nd ribs supplied from costocervical trunk, not from D-aorta, so both not served as collateral vessels

RadioGraphics 2007; 27:1323–1334

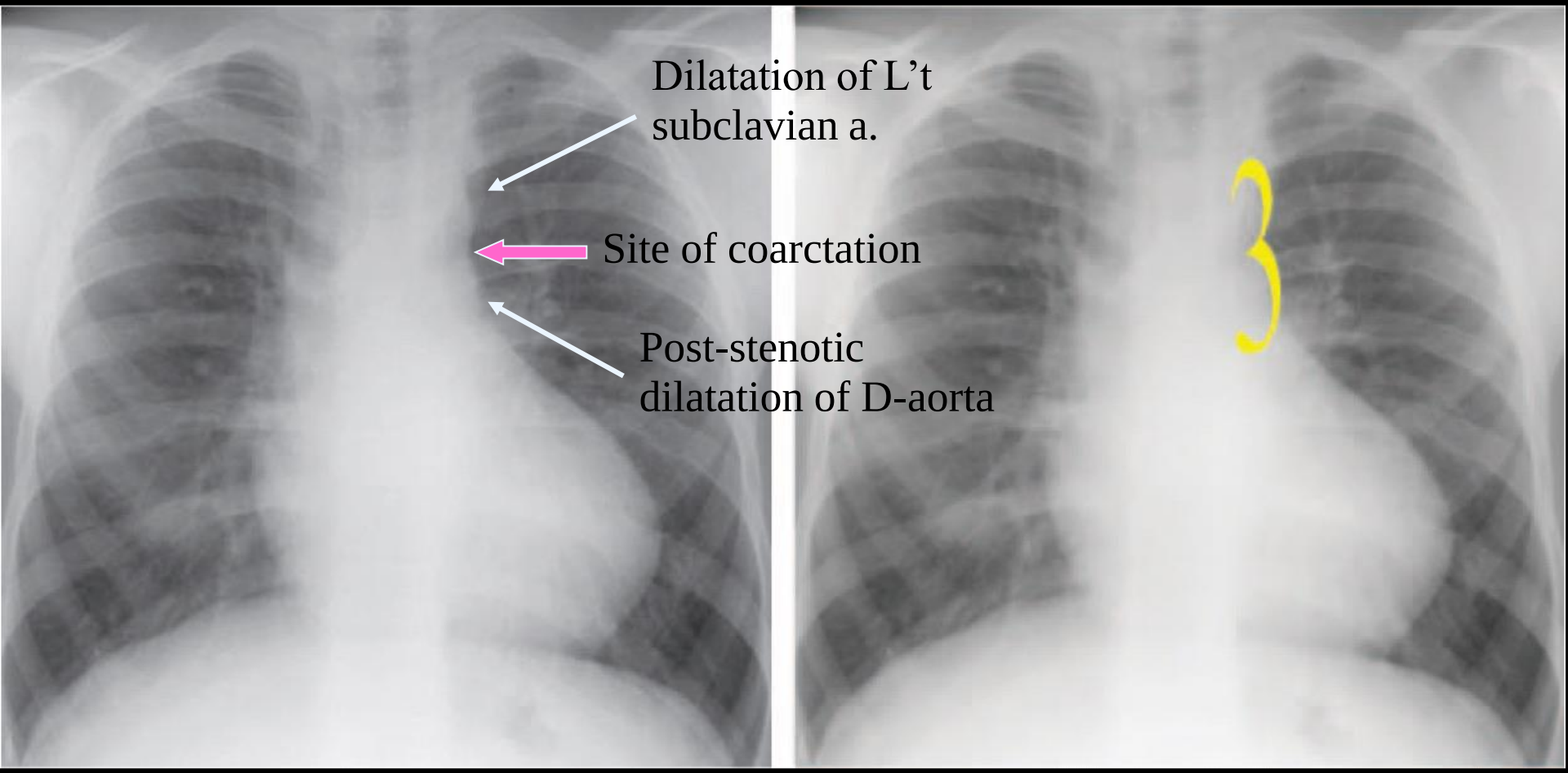
Coarctation of the aorta





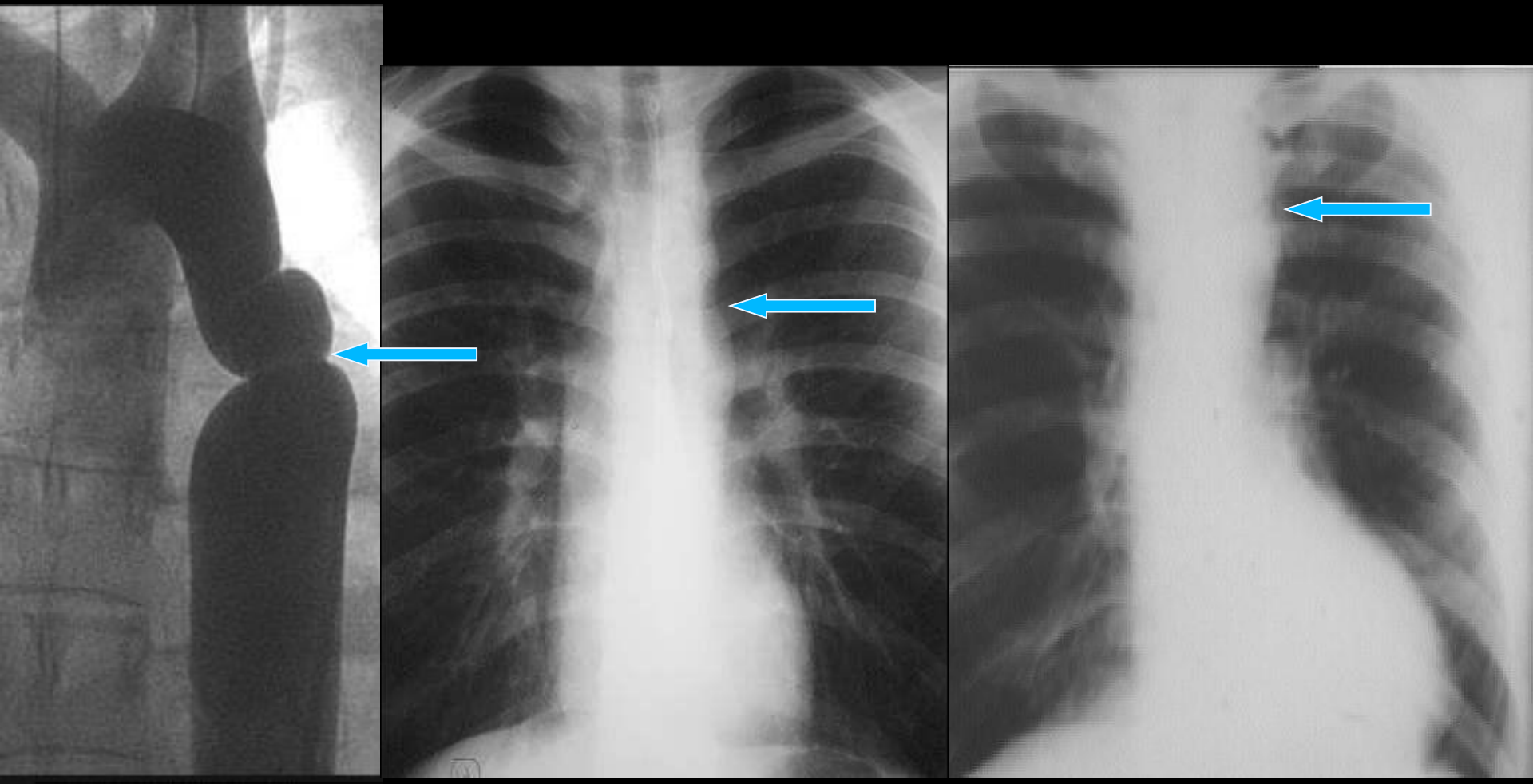
Coarctation of the aorta

Figure-of-3 sign: 50%–66% of adults

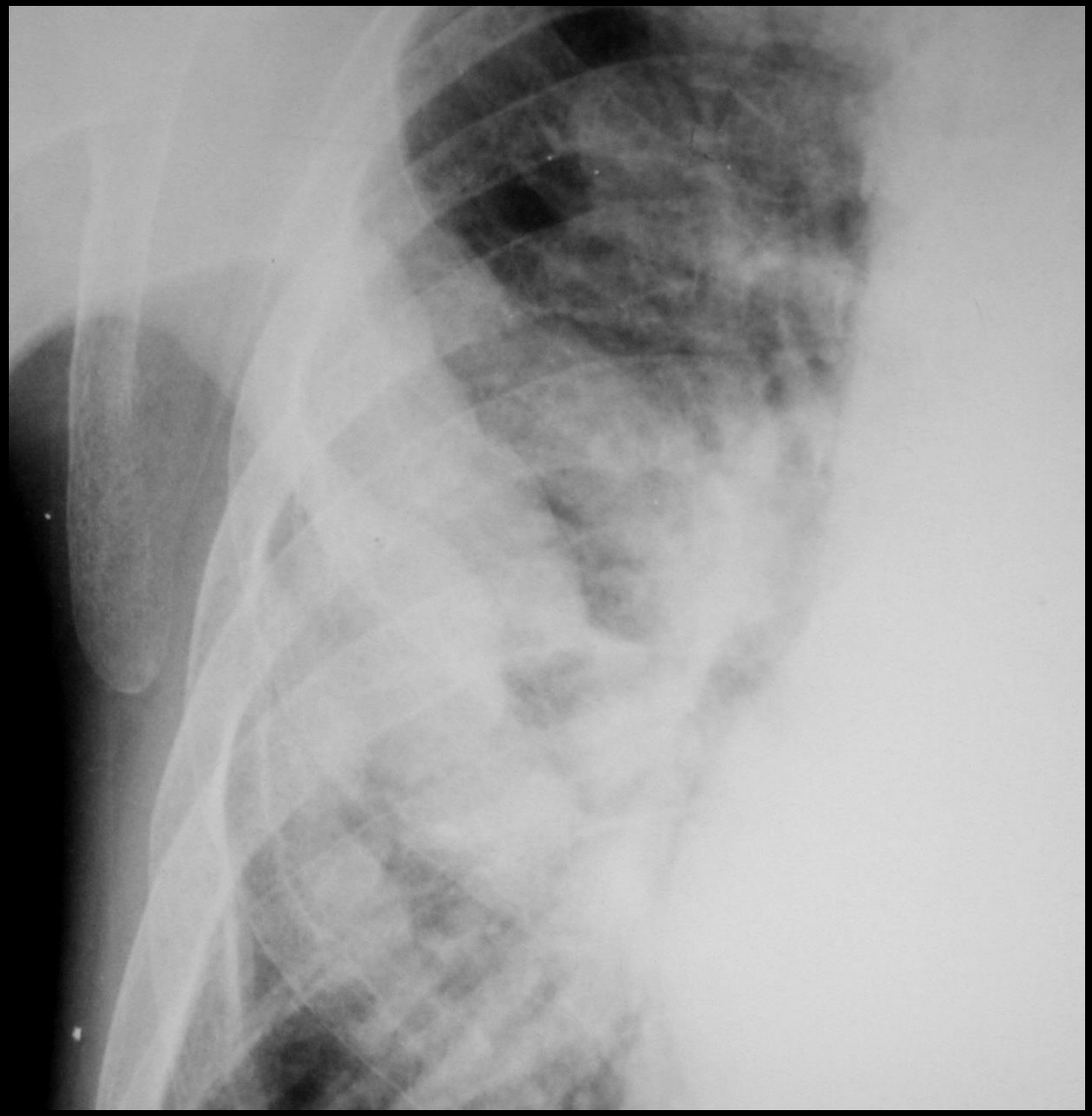


RadioGraphics 2007; 27:1323–1334

Figure-of-3 sign
(Coarctation of Aorta)



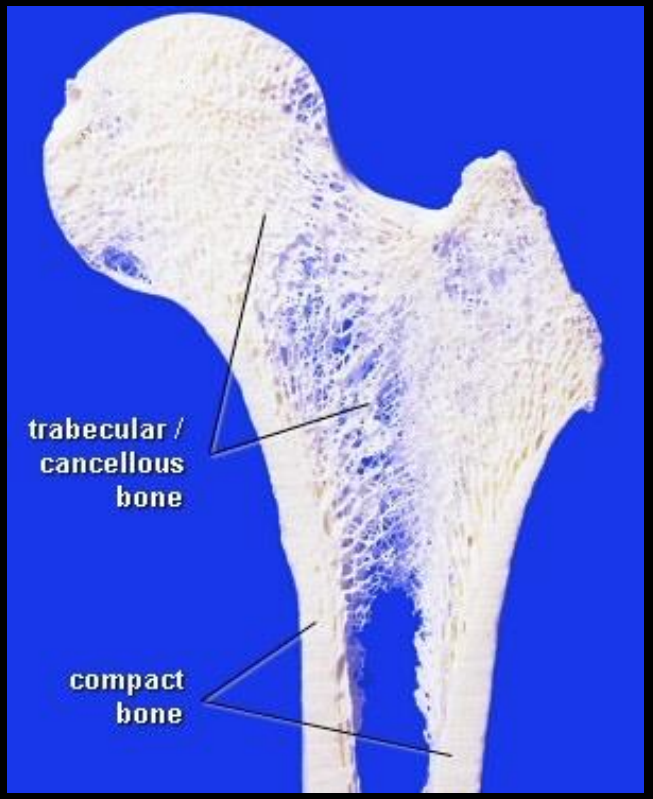
Thalassemia

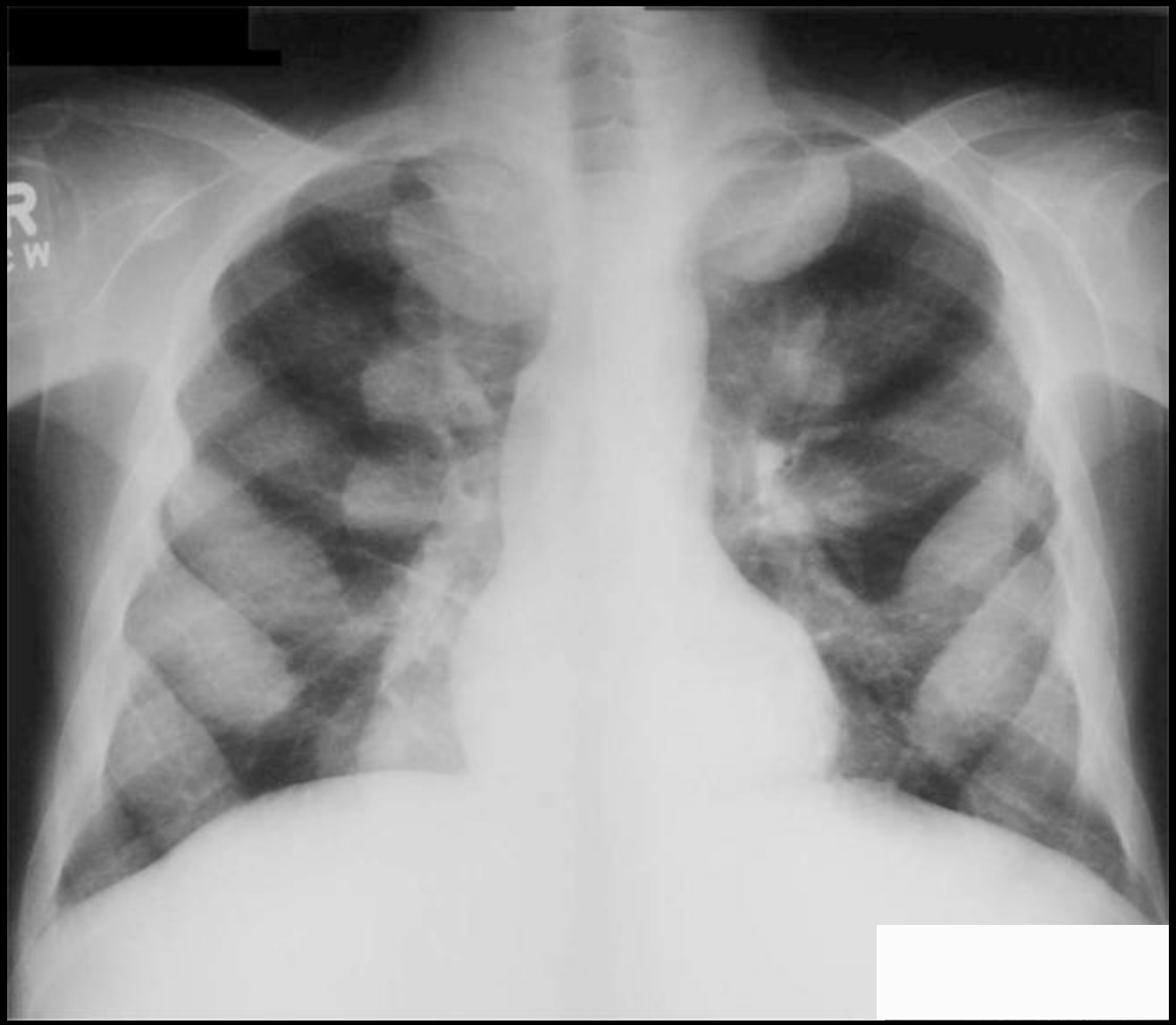


Rib變寬

Cortex變薄

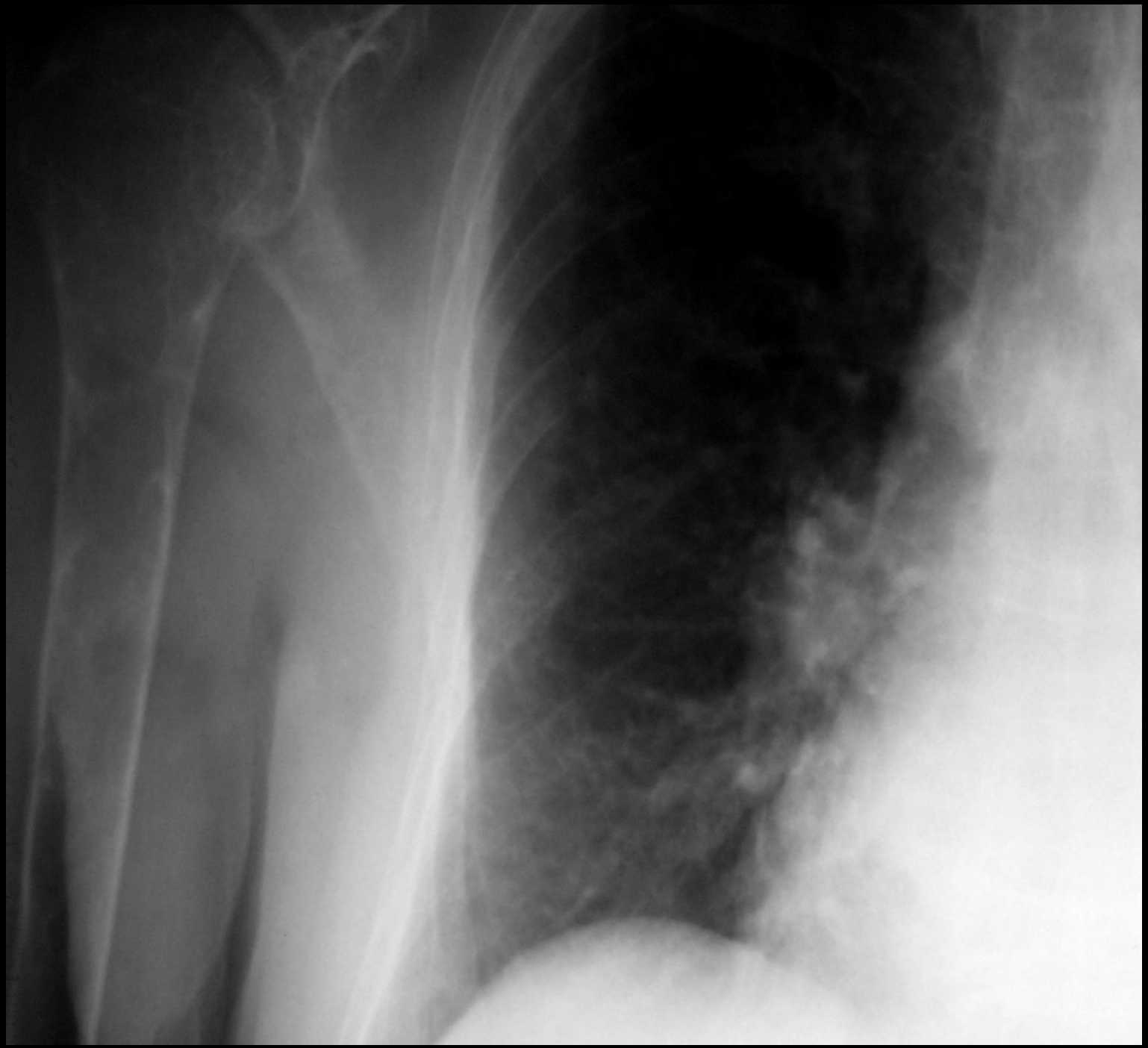
Bone trabeculae消失不見





Multiple Myeloma

Osteolytic Lesions



Imaging of Chest Wall Lesion

Imaging of Pleura Lesion

Imaging of Diaphragm Lesion

Imaging of Mediastinum Lesion

Imaging of Pleural Lesion

Pleural Lesions

Pleural effusion

Pleural mass

Pleural thickening / calcification

Pneumothorax

Pleural Effusion

Free pleural effusion

Subpulmonic effusion

Encapsulated pleural effusion

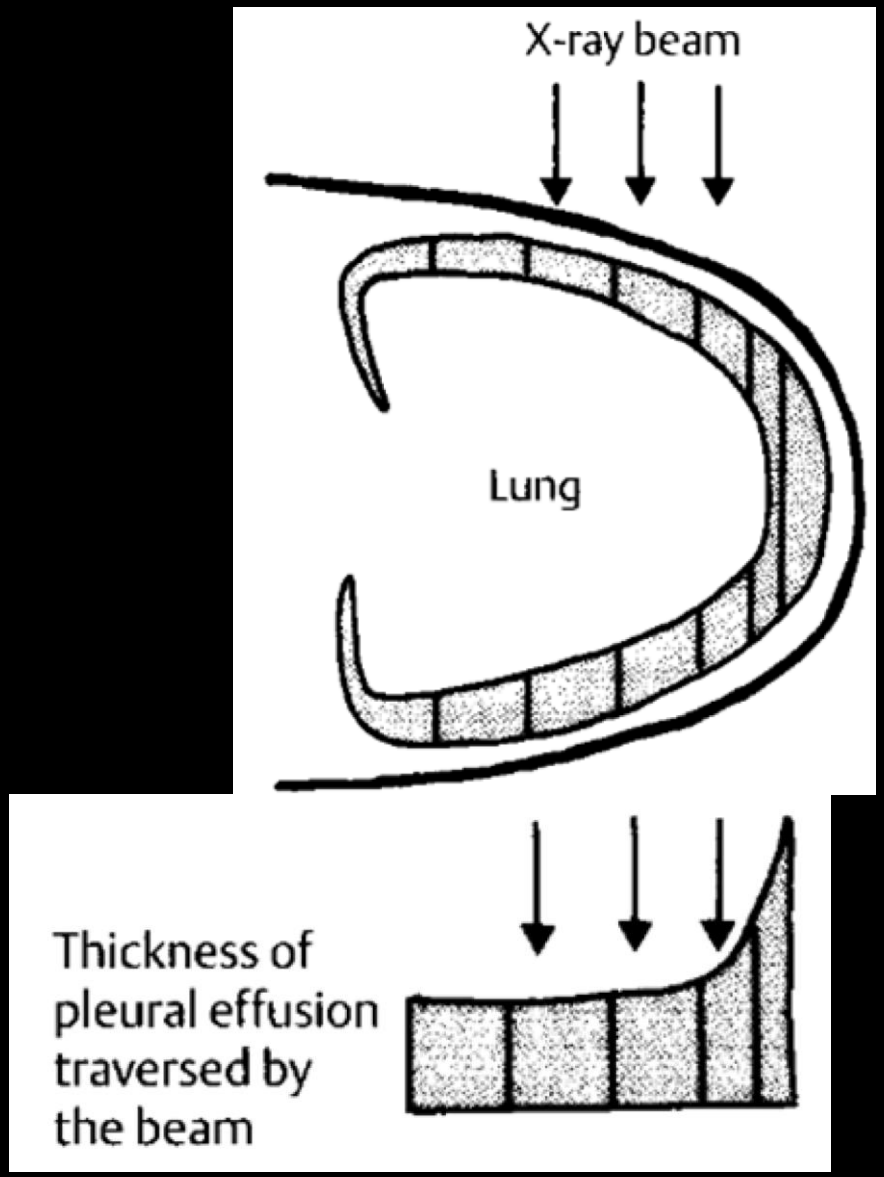
Interlobar pleural effusion

Free Pleural Effusion

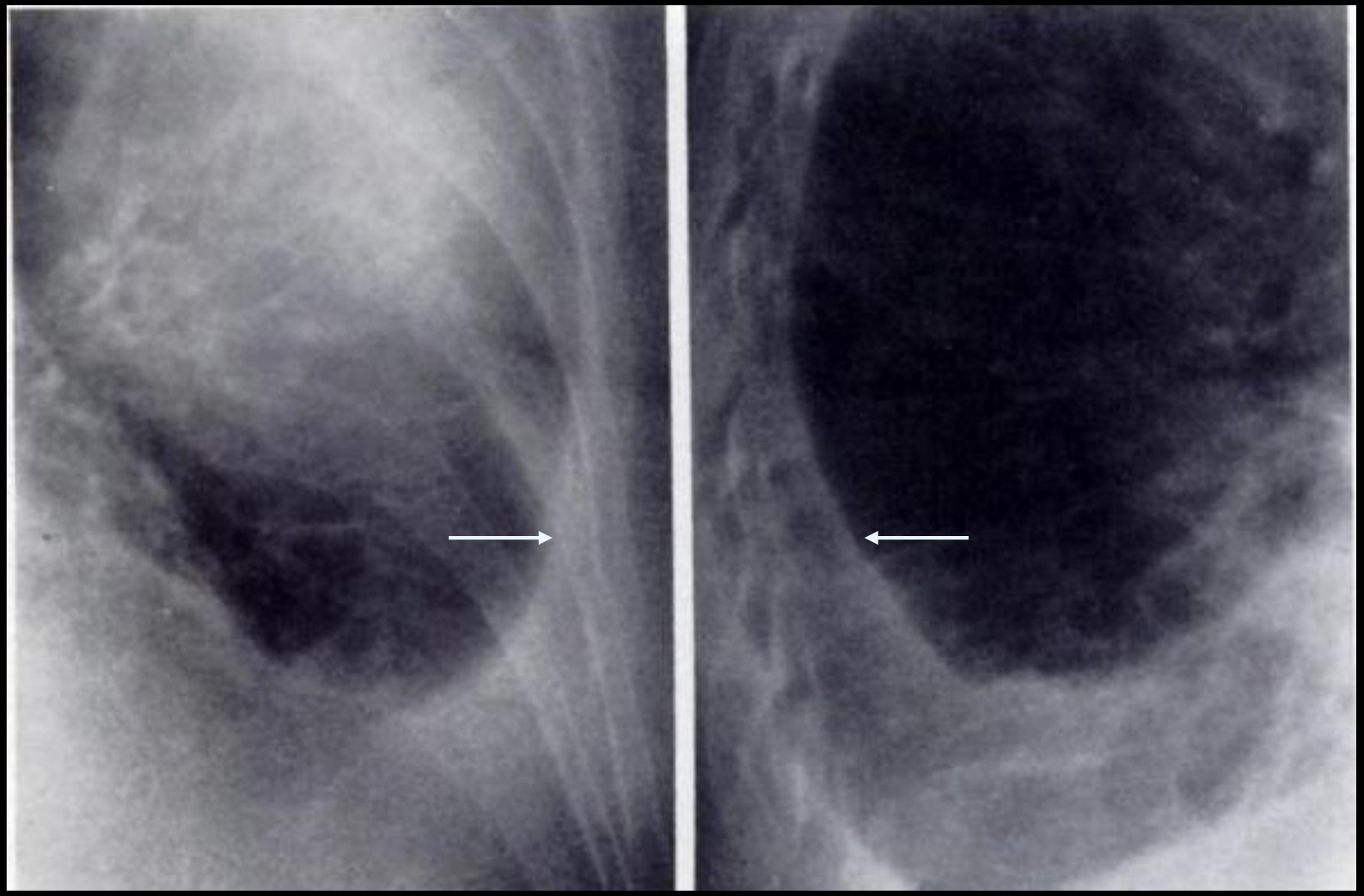
- Normally, 10-15cc in one pleural space
- 隨姿勢改變形狀
- PA view:
  - Lateral C-P angle or medial phrenicovertebral sulcus
  - Meniscus sign or angle blunting
  - 通常積水量 > 300cc
- Lat view:
  - Posterior CP angle blunting, 積水量 > 100cc
  - More sensitive than PA view
- Supine view:
  - 由横膈至肺尖呈現homogenous GGO (略有漸層)
  - 當lateral CP angle blunting時, 積水量約500~1000cc
- Decubitus view:
  - Can detect PE less than 100cc

Meniscus sign

- Pleural effusion為底盤寬大、上方窄細的形狀
  - 與重力有關
- Meniscus sign的形成
  - 外側的lung厚度較薄，趨近中央時肺的厚度逐漸增加 – Density titration by air
  - 在平行X-ray beam的方向上，在periphery處X-ray beam需要穿過greater depth of effusion (e > a-a')，所以愈內側的superior margin of pleural effusion在CXR上愈不容易看出來



Typical Meniscus Sign

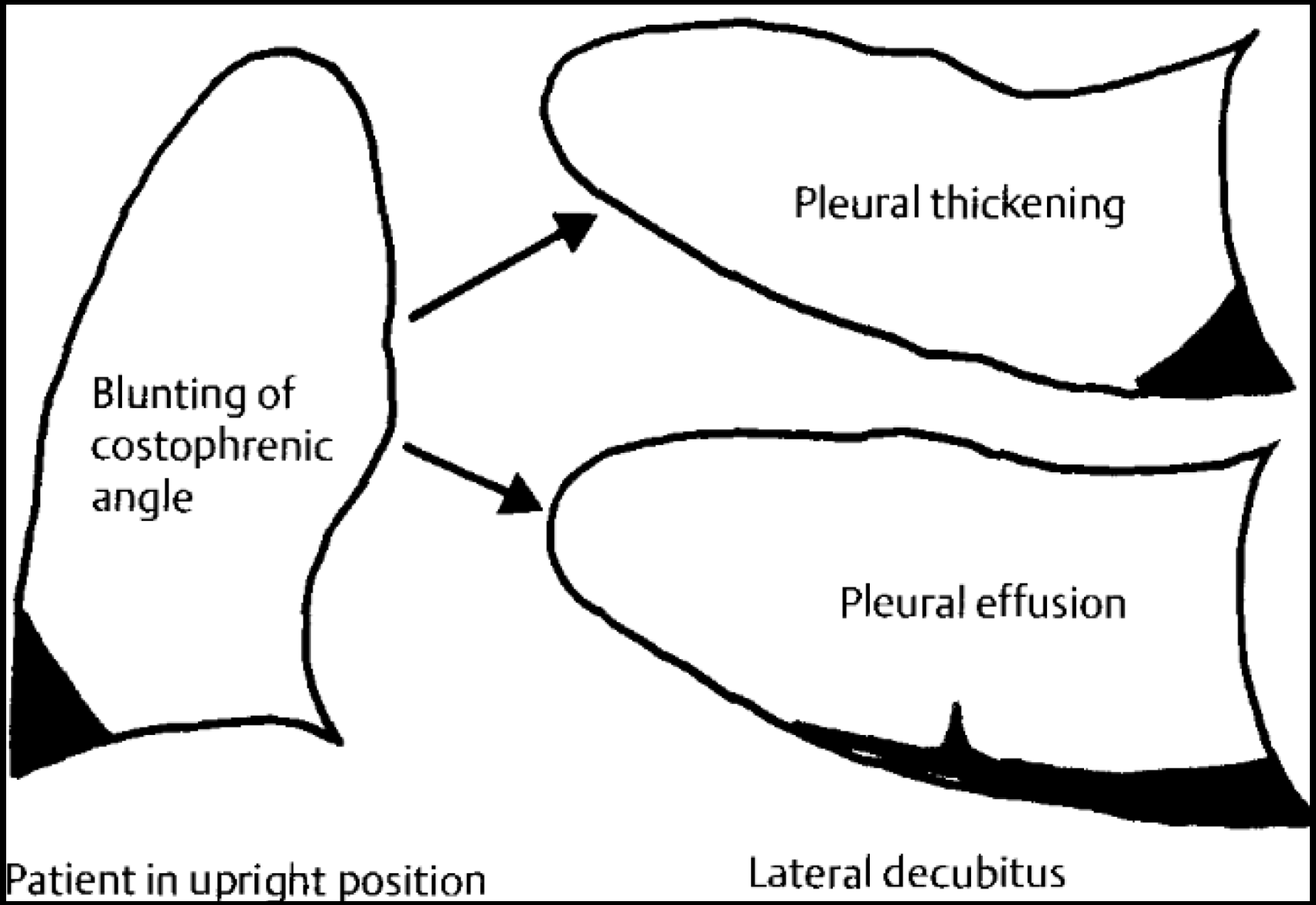


PA view

Lateral view

AJR 139:899-904, November 1982

Decubitus position for D/D of pleural effusion or thickening

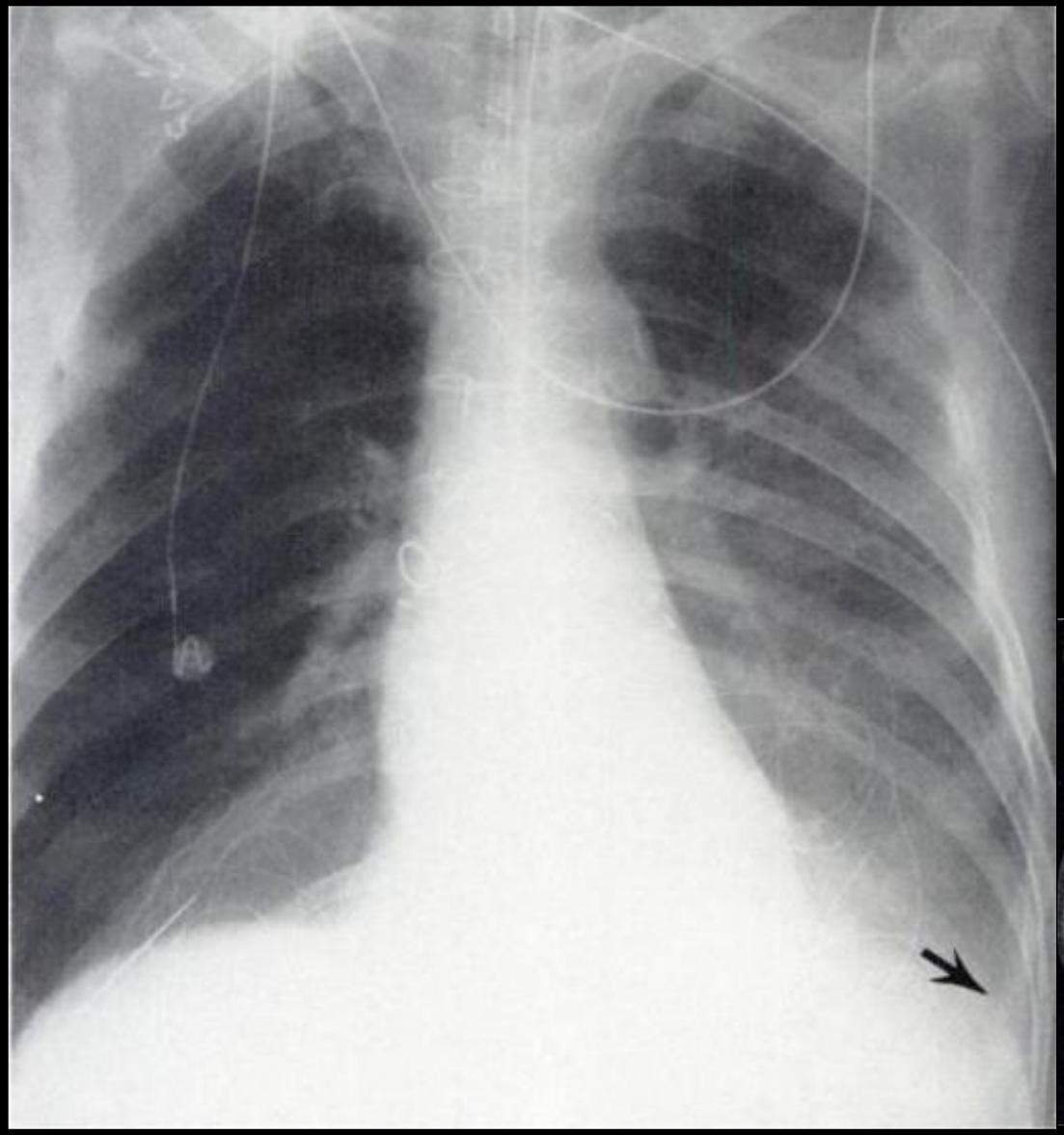


Pleural Effusion in Supine Patient

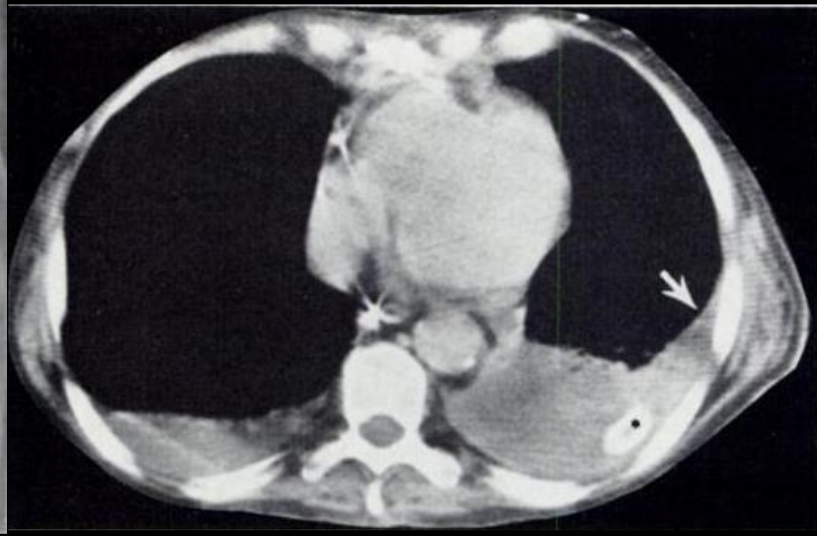
TABLE 1: **Correlation of Radiographic Abnormalities on Supine Films with 64 Pleural Effusions in 40 Patients**

Effusion Size	No. (%) of Pleural Effusions					
	Totals	Detected on Supine Films	(1) With Increased Opacity of Hemithorax	(2) With Loss of Diaphragm	(3) With CP Angle Meniscus	(4) With Apical Cap
Very small (<175 ml) . . .	3	0	0	0	0	0
Small (175–525 ml)	11	10 (91)	10 (91)	5 (45)	0	0
Moderate (>525 ml)	28	28 (100)	28 (100)	20 (71)	7 (25)	0
Large	22	22 (100)	22 (100)	15 (68)	9 (41)	12 (54)

AJR 142:59-64, January 1984

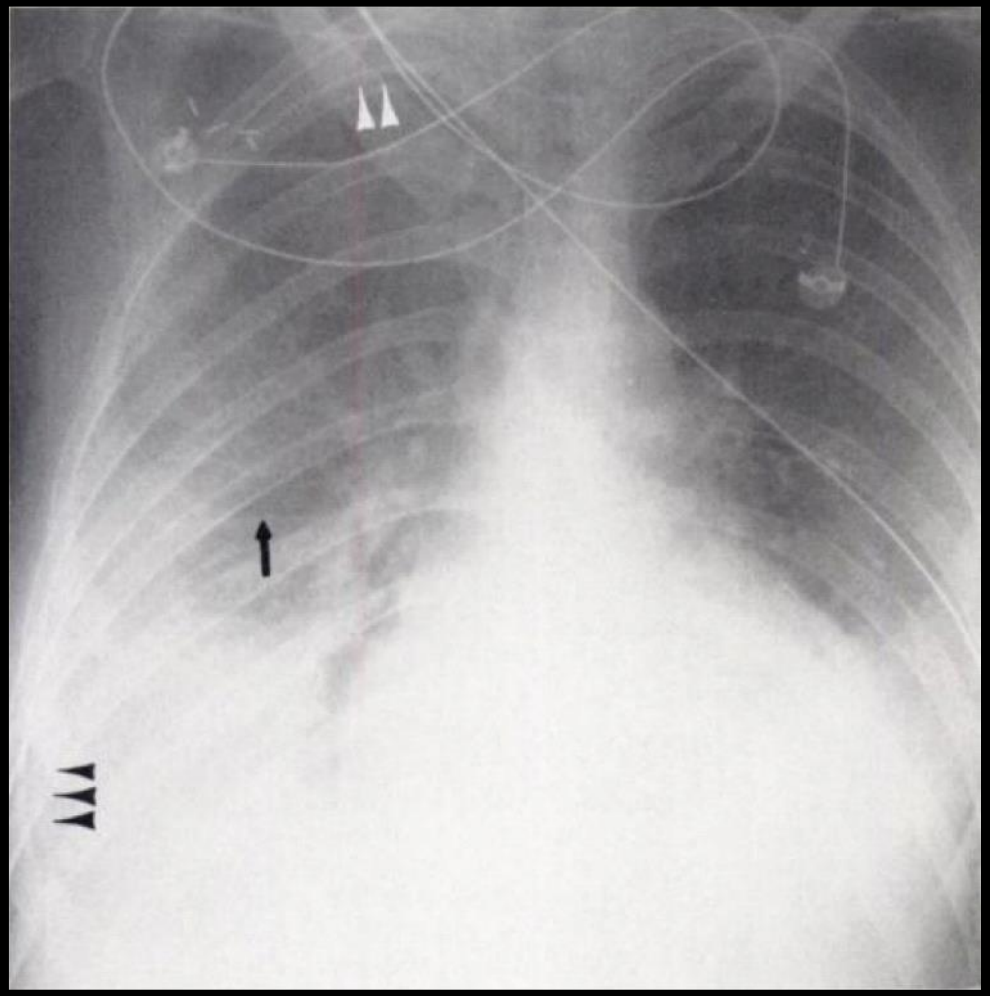


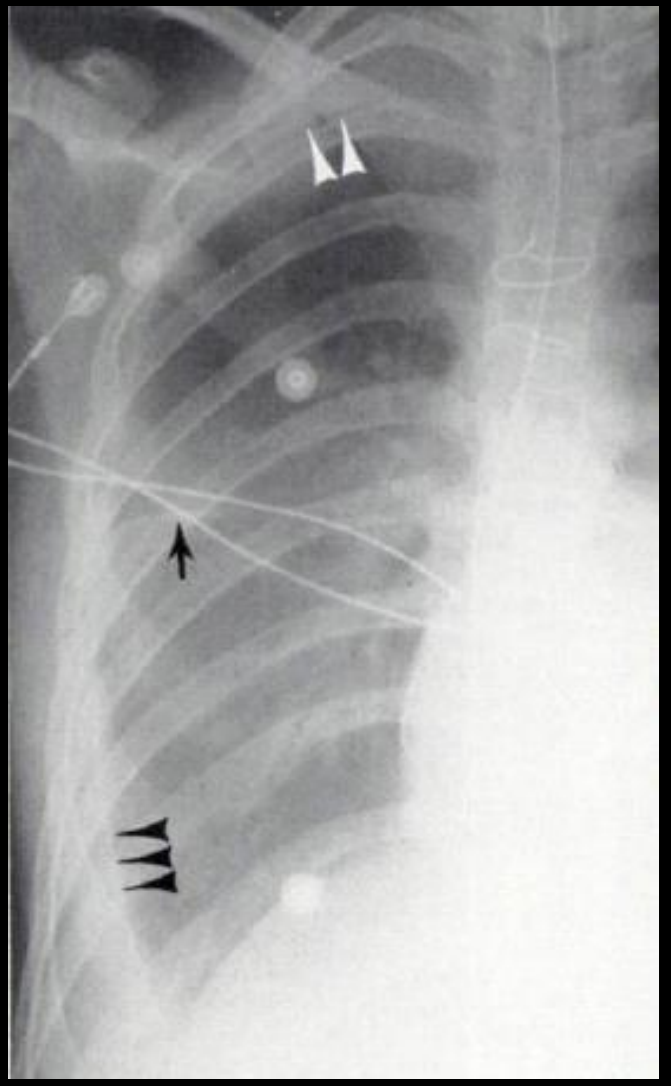
- R’t : Small amount PE
  - Increased opacity
- L’t : Moderate amount PE
  - Increased opacity
  - Obliteration of hemidiaphragm
  - Meniscus sign



AJR 142:59-64, January 1984

Large amount pleural effusion





- Increased density over entire hemithorax
- Accentuation of right minor fissure

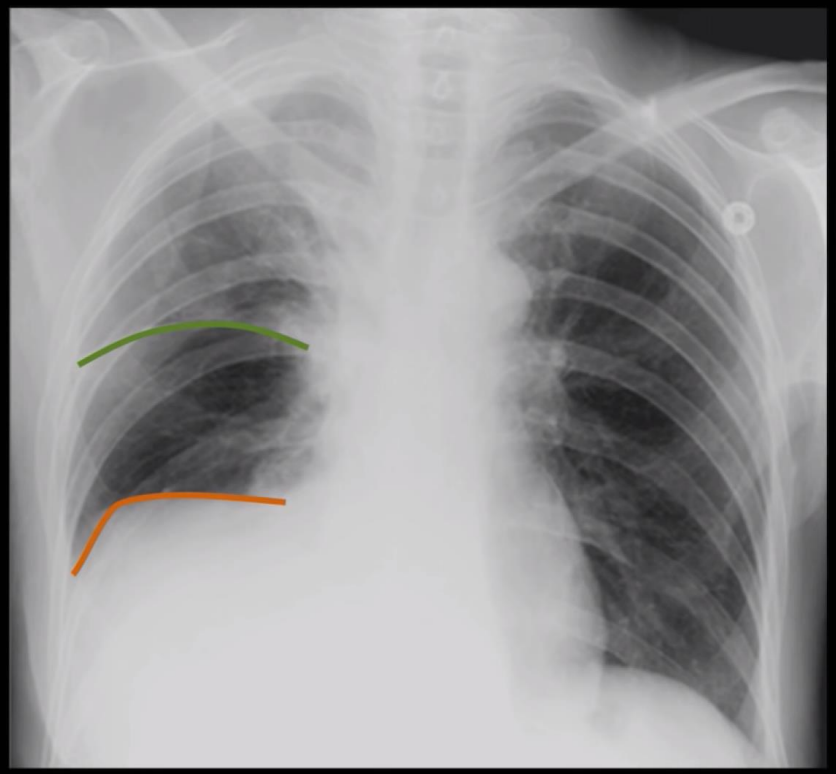
- Apical cap
- Meniscus sign

AJR 142:59-64, January 1984

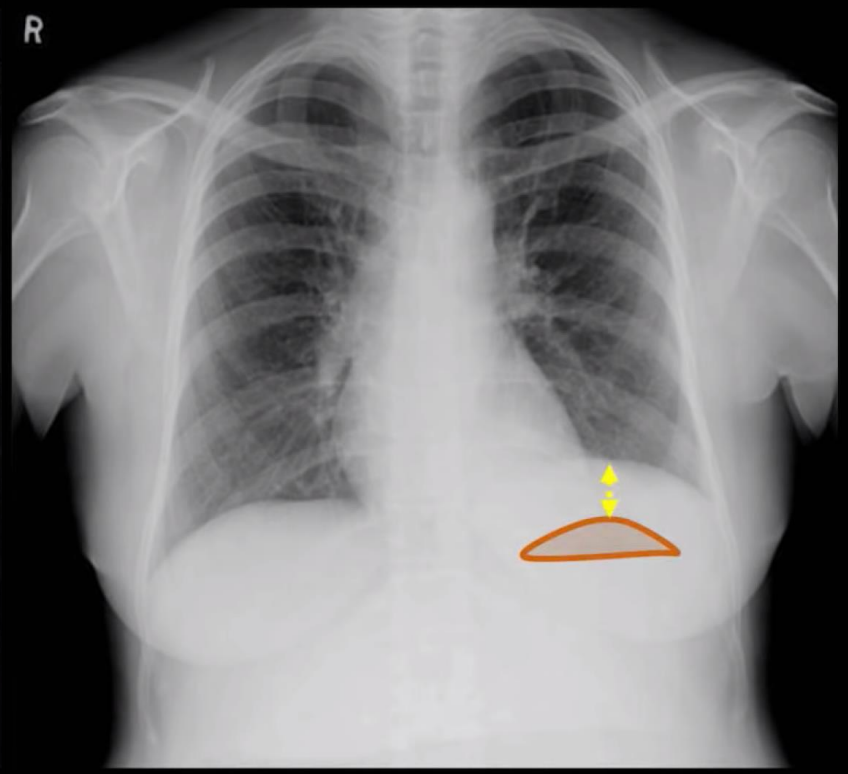
Subpulmonic Effusion

- 定義
  - Pleural effusion積在下肺葉和橫膈之間。
  - 積液積存於橫膈和visceral pleural of lower lobe之間，積液量愈多，則lower lobe愈往上推移，稱為”pseudodiaphragm”。
- **PA view**
  - Diaphragm 的最高點向外移至外 1/3 (正常的在內1/2~1/3)
  - C-P angle變鈍、變淺
  - Diaphragm以下的lung markings 消失
  - L’t side: diaphragm 和 gastric bubble 相隔>2cm

Subpulmonic Effusion

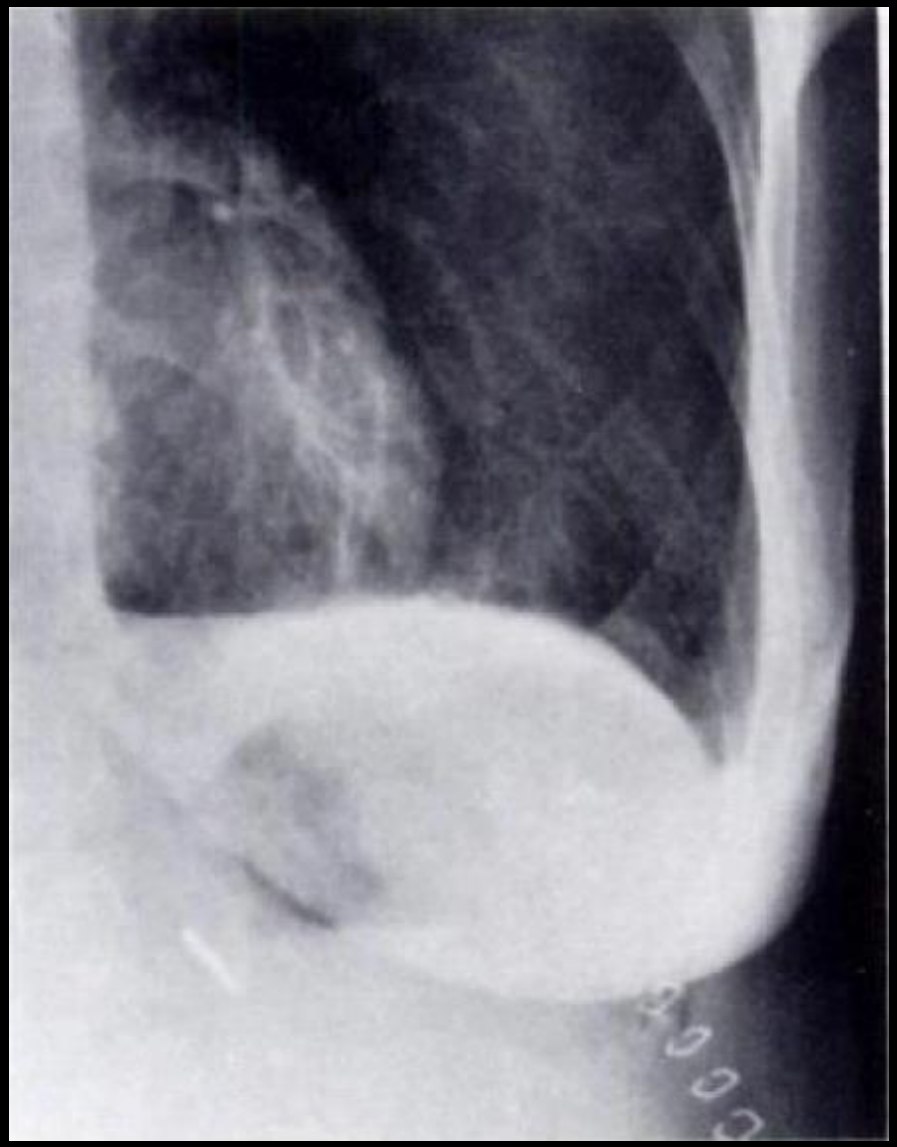


Right subpulmonic effusion



Left subpulmonic effusion

Subpulmonic Effusion

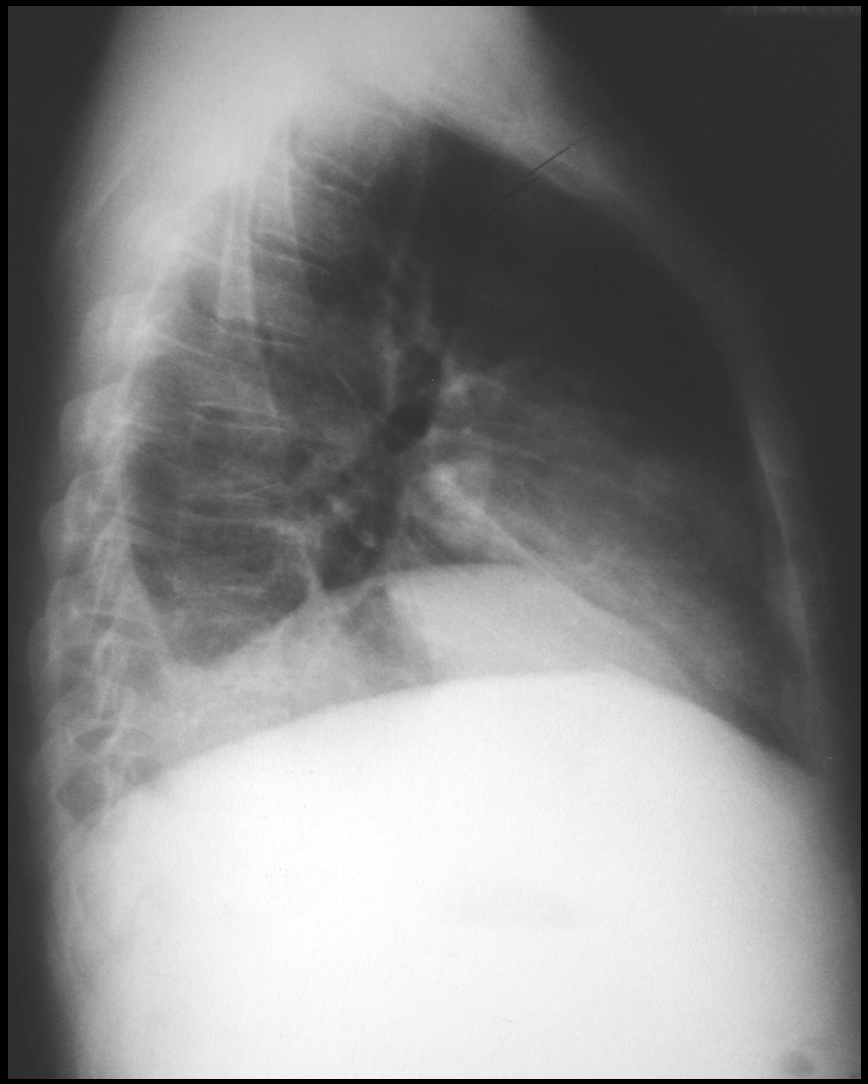


Diaphragm以下的lung markings消失

L’t side: diaphragm 和gastric bubble相隔>2cm

AJR 139:899-904, November 1982

Subpulmonic Effusion

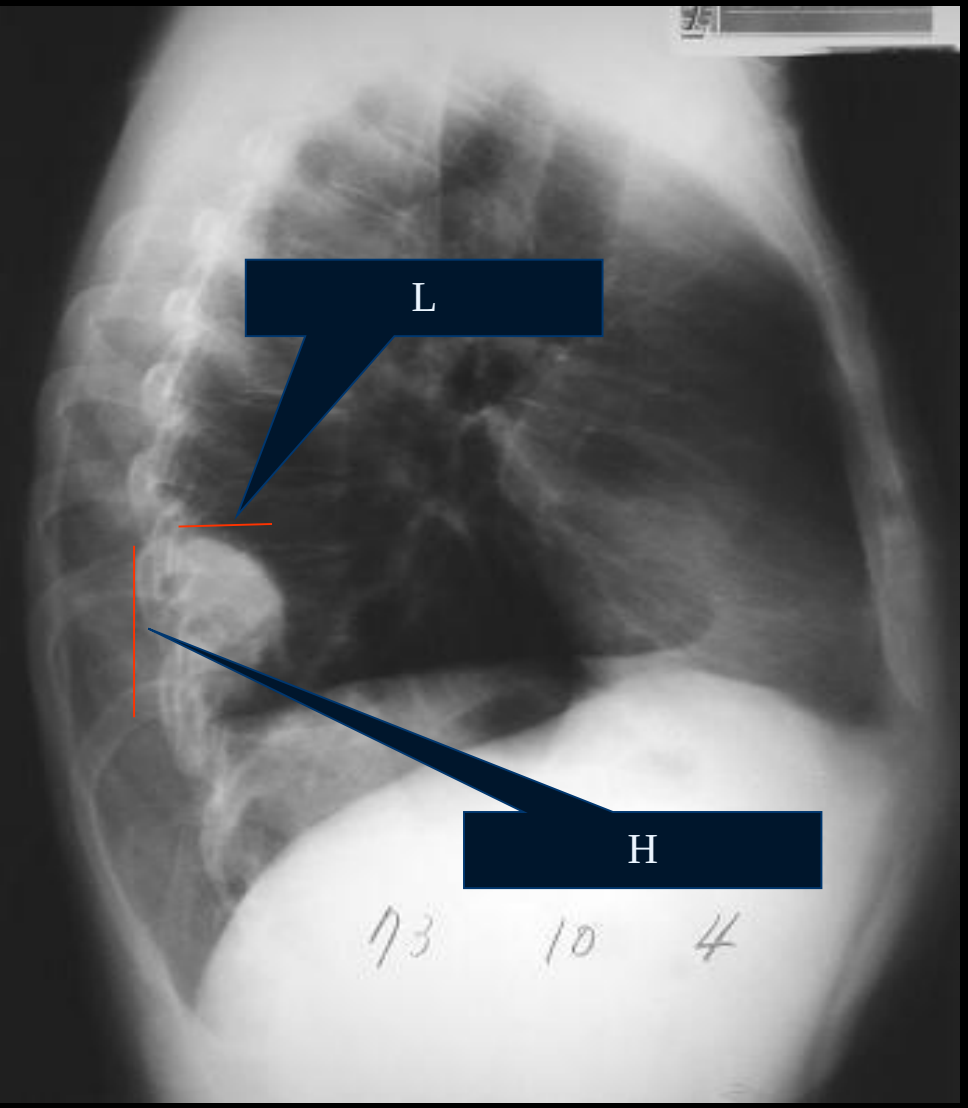


Lateral view

後段diaphragm變平 (curve消失), 並且會中止在major fissure處

Meniscus in posterior C-P angle

Encapsulated Effusion



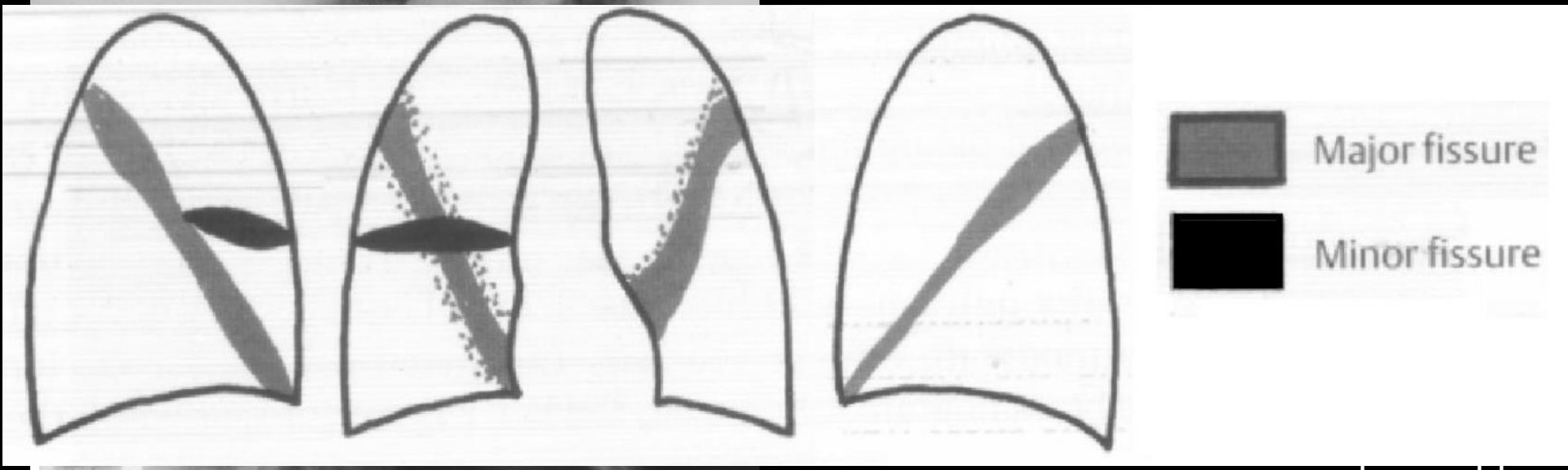
Not free (loculated)

Dome-shaped

Causes: empyema, neoplasm, hemothorax

(因重力關係, L<H : more fluid like)

Interlobar Effusion



border

- 形狀：
  - PA view : round or oval
  - Lat. View : lenticular shape
- "Phantom tumor" improved after diuretics

D.D. of Pleural Effusion (1)

- **With cardiomegaly:**
  - H (hemodynamic)
    - Cardiovascular:
      - CHF
      - Post-cardiotomy syndrome
    - Collagen-vascular disease
      - SLE, RA
    - Pulmonary embolism with R't side heart enlargement
  - I (infection): myocarditis or pericarditis with pleurisy
    - TB, virus, rheumatic fever
  - N (neoplasm): malignant pericardial effusion and pleural effusion
    - Metastasis, mesothelioma
- **With subsegmental atelectasis:**
  - Post-operative
  - Pulmonary embolism
  - Rib fractures
  - Abdominal mass / abscess / ascites

D.D. of Pleural Effusion (2)

- **With lobar opacities:**
  - Pneumonia with PPE/ empyema
  - Chronic infection :
    - TB (common)
    - Fungus (rare)
  - Pulmonary embolism
  - Neoplasm:
    - Lung ca
    - Lymphoma
    - Metastasis
- **With hilar enlargment:**
  - Vascular shadow
    - Pulmonary embolism
  - Lymphadenopathy
    - Neoplasm
      - Lung ca.
      - Metastasis
      - Lymphoma
    - Infectious :
      - TB
      - Fungus infection (rare)
    - Inflammatory:
      - Sarcoidosis

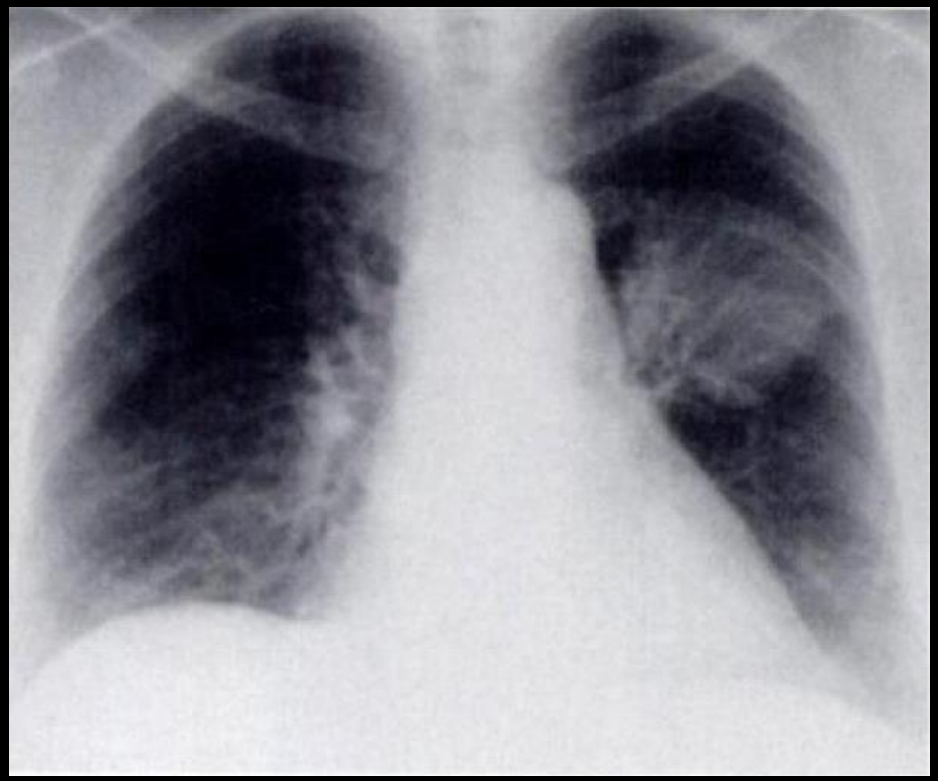
Pleural Masses

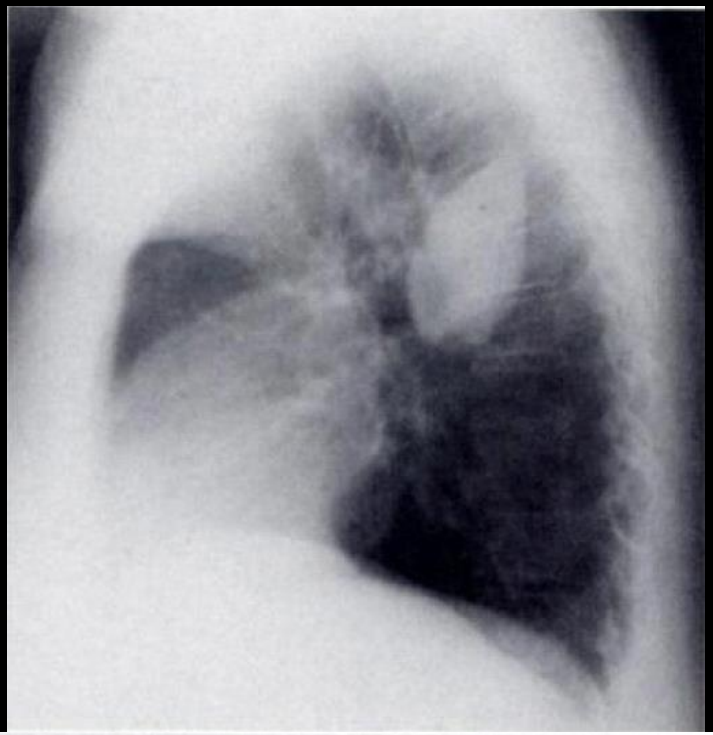
- **Solitary**
  - Loculated fluid
    - 水 (pleural effusion)
    - 血 (hemothorax)
    - 膿 (empyema)
  - Neoplasms
    - Mesothelioma
    - Metastasis
    - Fibrous tumor of pleura
  - Mesothelial cyst
- **Multiple**
  - Loculated pleural effusion
  - Neoplasms (3M)
    - Metastases (Adenoca)
    - Malignant mesothelioma
    - Malignant thymoma
  - Pleural plaque

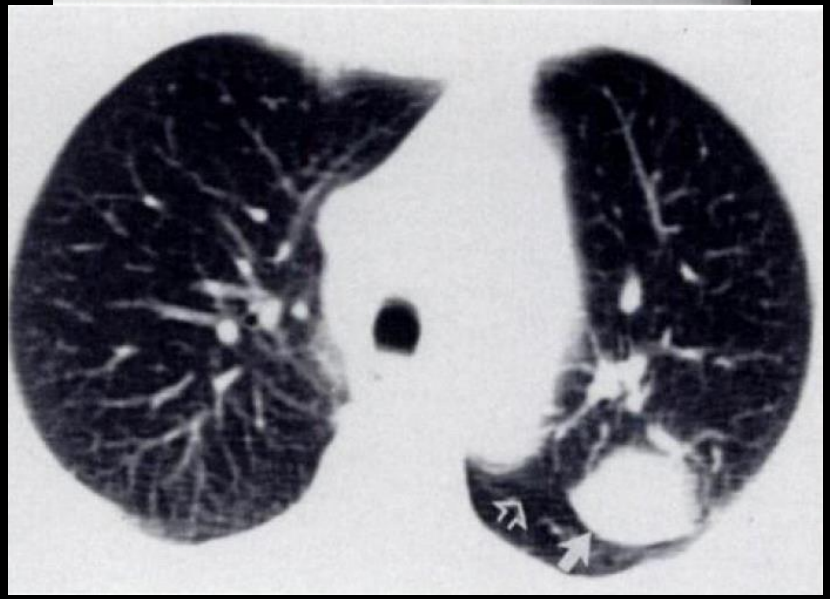
Pleural Metastasis

- Origin:
  - 40% from lung carcinoma
  - 20% from breast carcinoma
  - 10% from lymphoma
  - Remaining 30% from other primary sites
- Image:
  - May mimic malignant mesothelioma
  - Malignant effusion is the most frequent manifestation of metastatic pleural disease and is often accompanied by solid tumor deposits of variable size

Pleural Metastasis

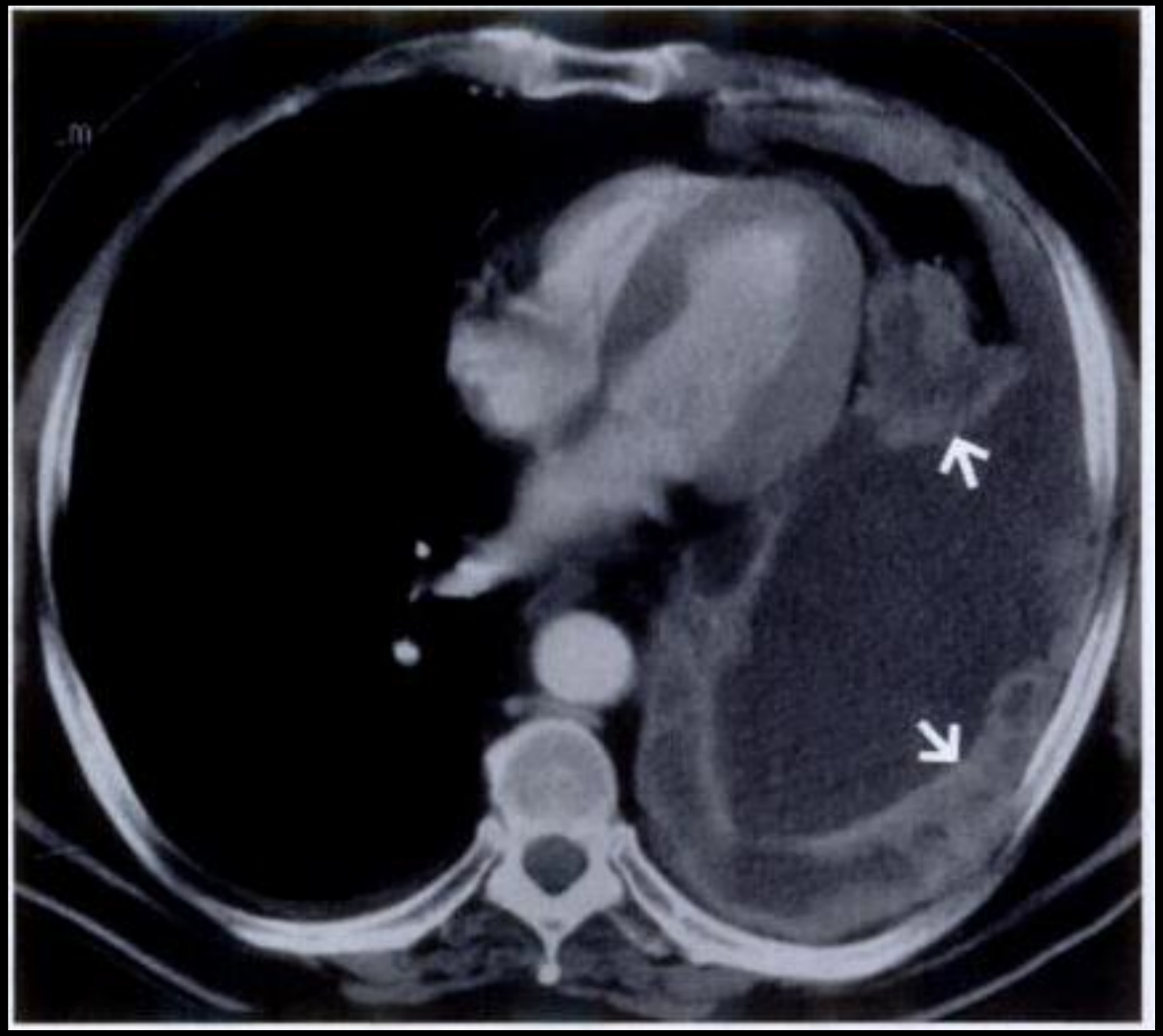






Pleural metastasis to the major fissure on the left side from a primary lower extremity fibrosarcoma

RadloGraphics 1992; 12:1191-1201



Pleural implants due to metastatic lung adenocarcinoma. CT scan shows pleural effusion, enhancing pleural nodules and masses (arrows), and involvement of the mediastinal pleural surfaces. This case would be indistinguishable from mesothelioma on the basis of only the CT findings.

RadioGraphics 1997; l7:63-79

Mesothelioma

- 又叫做Localized fibrous tumor of pleura
- Usually benign; 37% malignant change
- Mesothelioma
  - Benign (non-cancerous) mesothelioma
    - Solitary fibrous tumor
    - 與asbestos無關
    - 主要在肺的周邊或是位於fissure
  - Malignant mesothelioma
    - Solitary or multiple
    - 與asbestos有關
    - Invasive and destructive

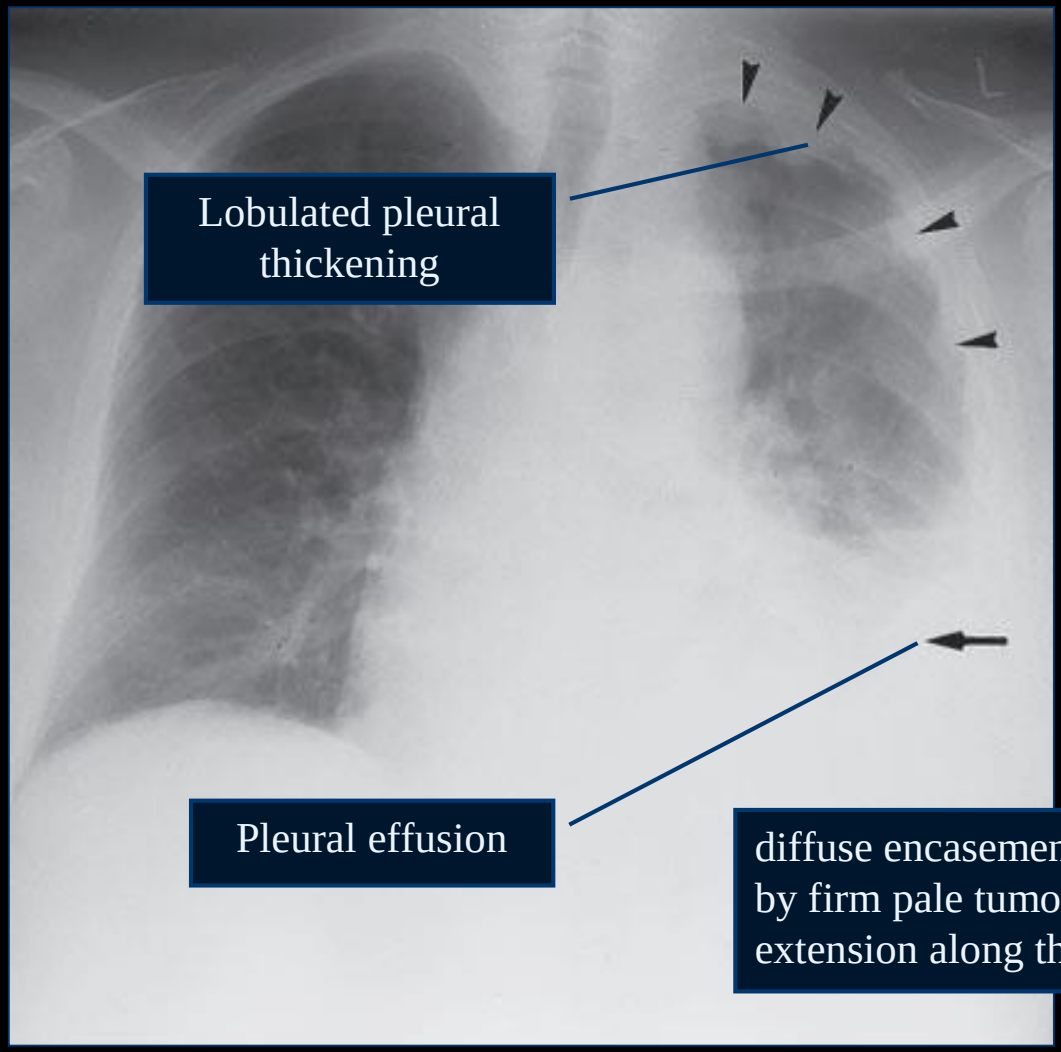
Malignant Mesothelioma

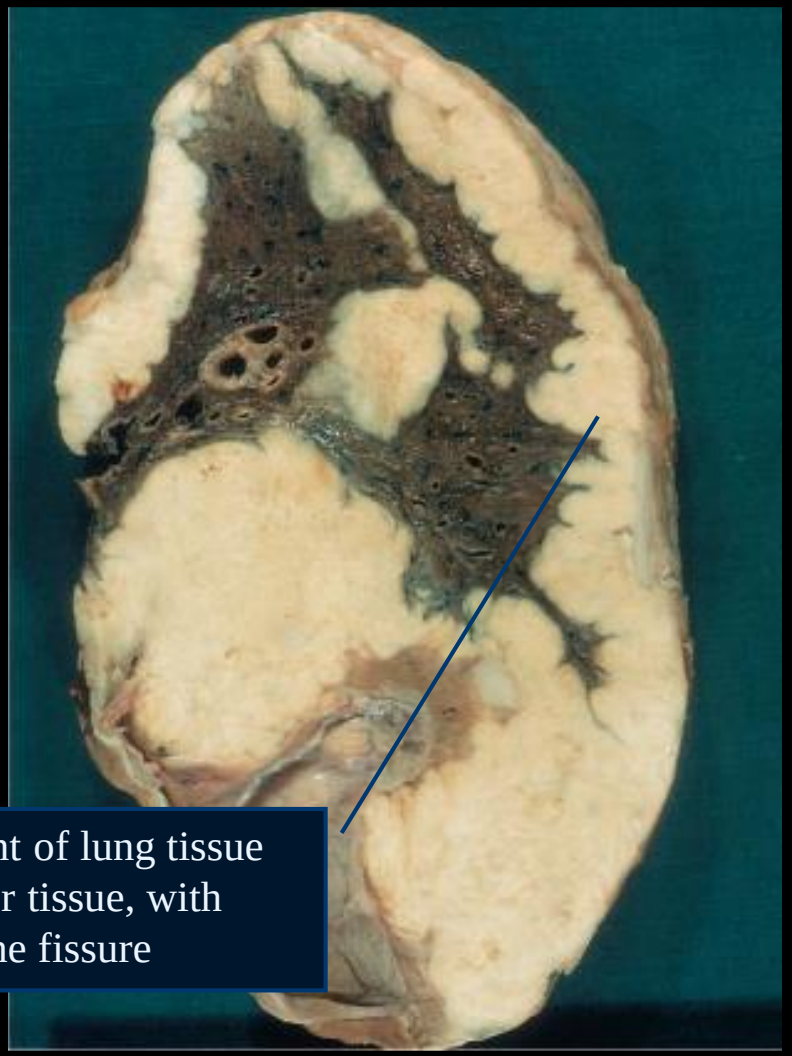
- The most common primary neoplasm of the pleura
- Risk factors:
  - Asbestos, radiation, chronic pleural disease
  - Not related to cigarette smoking
- Asbestos pleural plaque is not the precursor of mesothelioma
- Latency from the first exposure to asbestos: 35~40 yrs
  - Peak in 60~70 y/o
  - Rare in childhood
- Male predominant (4x)
- Poor prognosis, most p't dying within 1 yr

Malignant Mesothelioma

- Image:
  - Extensive, lobulated nodular pleural thickening
    - CT scan: tumor thicker at base
    - The most common findings on CT scan
  - Pleural effusion
    - Unilateral, rarely bilateral (10%)
    - Moderate to large amount (1/3高度: 50%, 2/3高度: 40%, > 2/3高度: 10%)
  - Small hemithorax (contracted)
    - 有時會因為pleural effusion而造成volume expansion (15%), 但是很少造成明顯的mediastinal shift
  - Other findings of CT scan
    - Mediastinal organ invasion: 可能包圍mediastinal structure > 50%
    - Pleural plaque over contralateral lung
    - Transdiaphragmatic extension

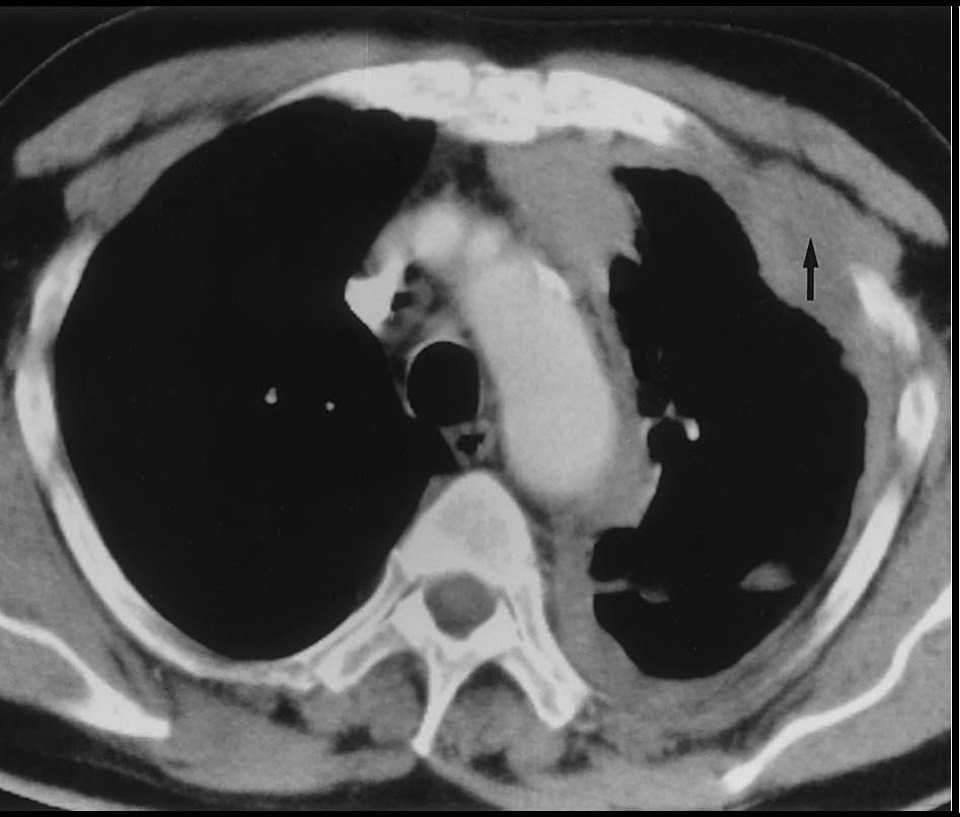
Malignant Mesothelioma



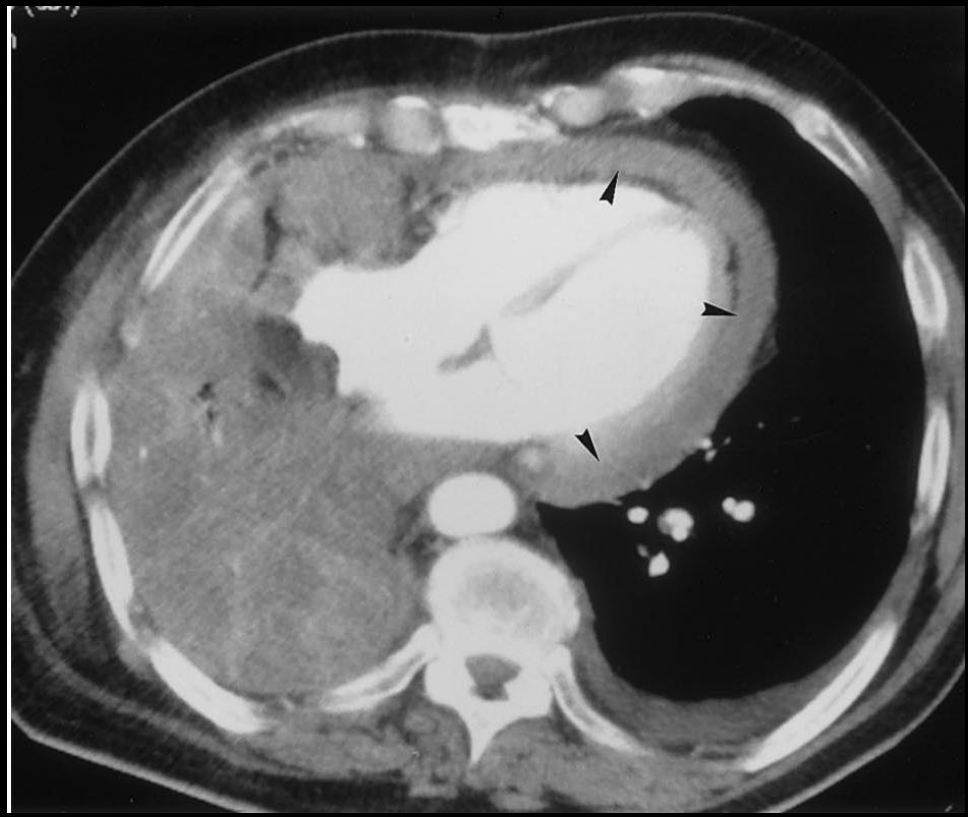


RadioGraphics 2002; 22:S167–S184

Malignant Mesothelioma



left-sided malignant mesothelioma shows contraction of the hemithorax and chest wall invasion (arrow).



a right-sided mesothelioma shows invasion and encasement of the pericardium (arrowheads)

RadioGraphics 2002; 22:S167–S184

Differential Diagnosis of Benign and Malignant Pleural Disease

Favor malignant pleural disease

- Circumferential involvement
- Nodular thickening
- Parietal pleura > 1cm
- Mediastinal pleural involvement

Differential Diagnosis of 3”M”

Malignant mesothelioma

- Pleural effusion (90%)
- Extensive lobulated pleural thickening
- Often contracted hemithorax

Malignant (invasive) thymoma

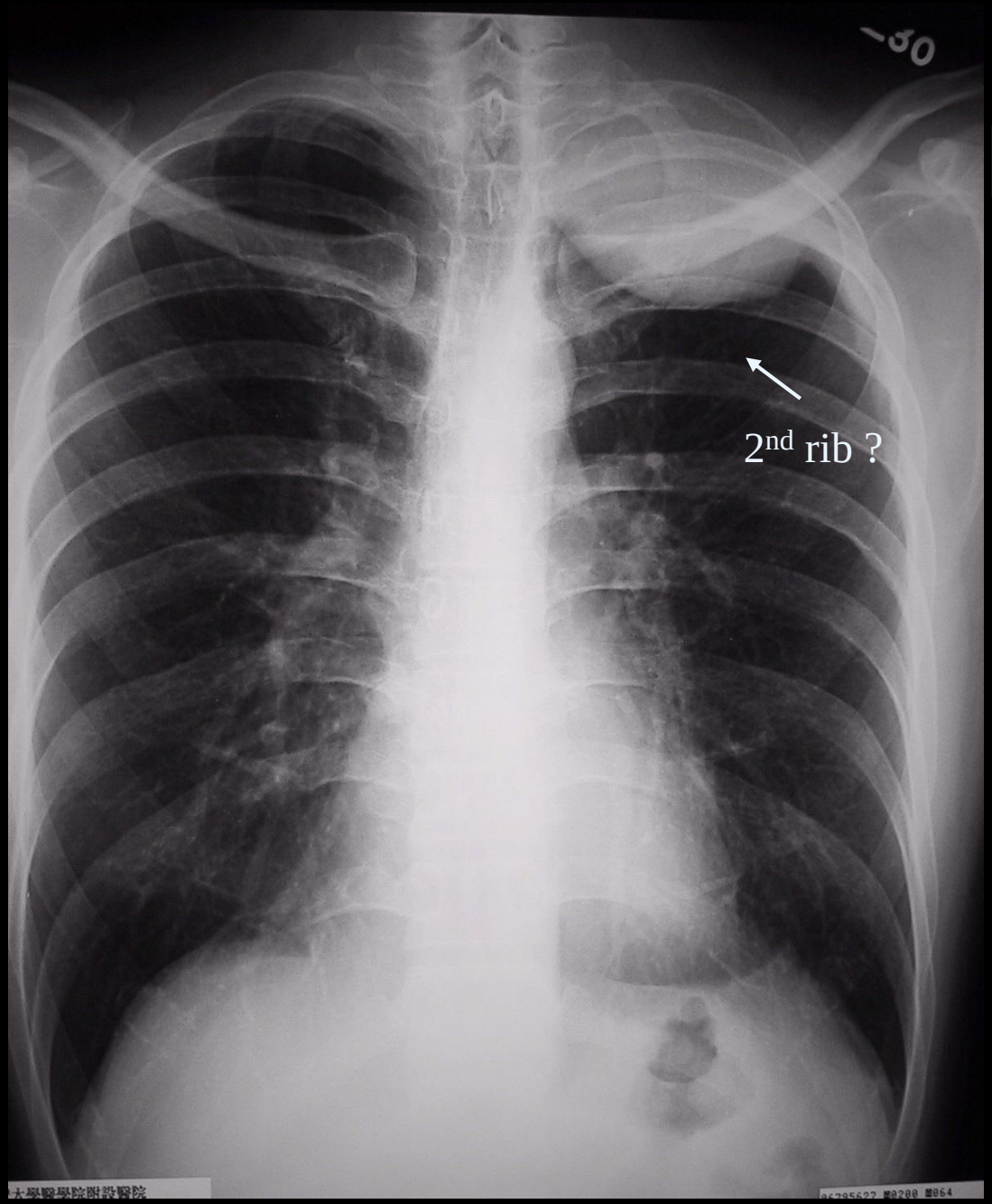
- Anterior mediastinal mass

Metastasis of pleura (esp. adenocarcinoma)

- Less often contracted hemithorax

Pleural Thickening

- **H (hemodynamic)**
  - Healed (organized) hemothorax
  - Collagen-vascular disease: 因反覆pleural effusion
- **I (infectious)**
  - Organized empyema related to pyogenic or TB infection: 最常見
- **I (inhalational)**
  - Asbestosis, talcosis
- **N (neoplasm)**
  - Diffuse nodular pleural thickening:
    - 3M + primary lung cancer (adenocarcinoma)
  - Pancoast's tumor:
    - Apical pleural thickening + bony destruction



Left shoulder pain for 3 months

Miosis
Anhydrosis
Ptosis

Pancoast tumor with left 2nd rib destruction and Horner syndrome

Pleural Calcification

原因：

Fibrocalcified visceral pleura:

- Pyothorax, TB
- Hemothorax

Fibrocalcified parietal pleura:

- Asbestos
- Talc

兩側橫膈和 lateral chest wall 的pleural calcification: asbestosis or talcosis

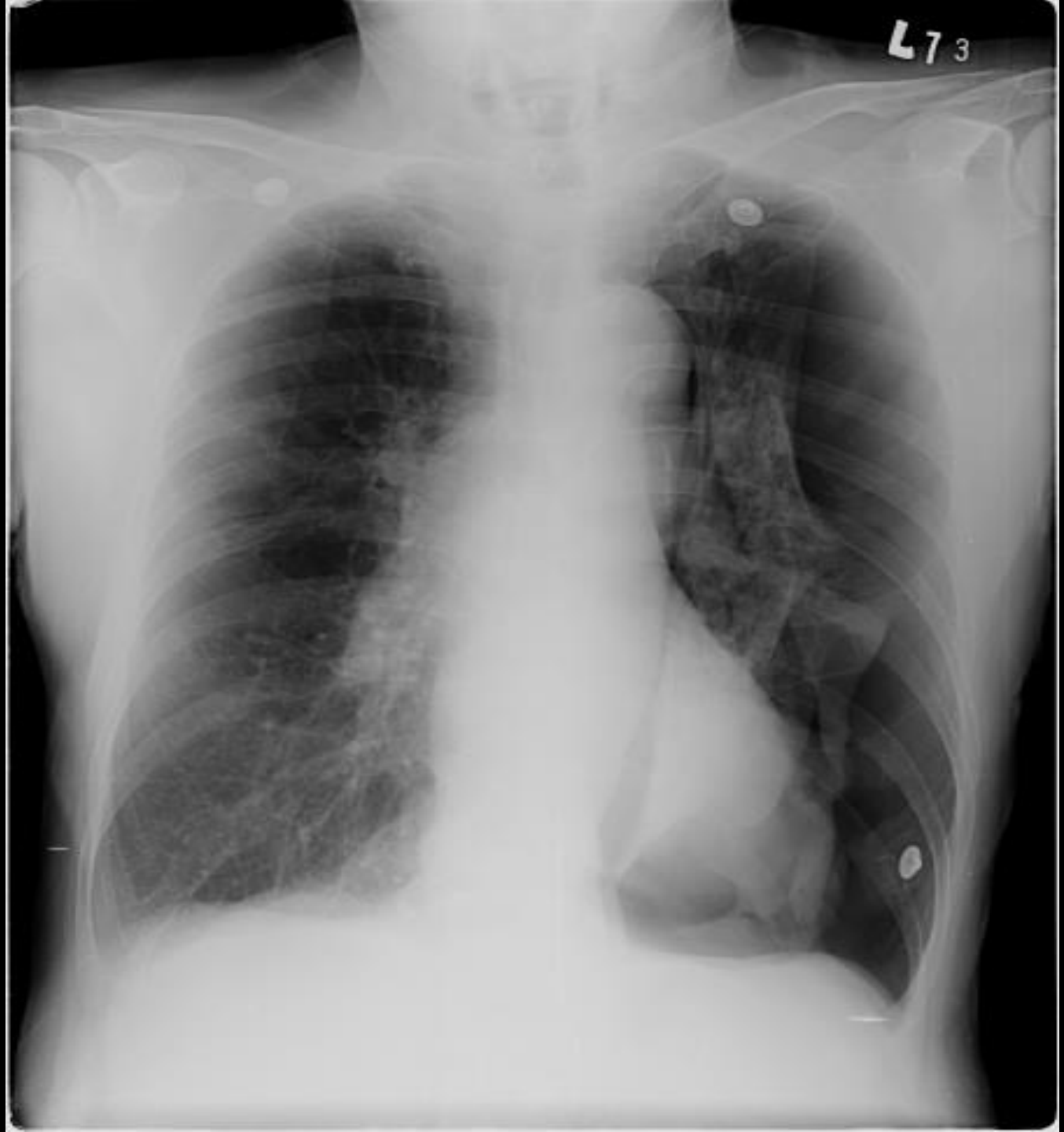
Pneumothorax

Upright patient:

- Identify the pleural line
- Most often near the apex

Supine patient:

- 在supine position， 胸腔最高處為anterior C-P sulcus， 其次為lateral CP sulcus。所以發生氣胸時， air最先填充至anterior CP sulcus， 量更多時， lateral CP sulcus亦被填滿。
- **Deep sulcus sign**: anterior和lateral CP sulcus顯得非常深, 橫膈被襯托得很清晰
- Sharper than normal appearance of hemidiaphragm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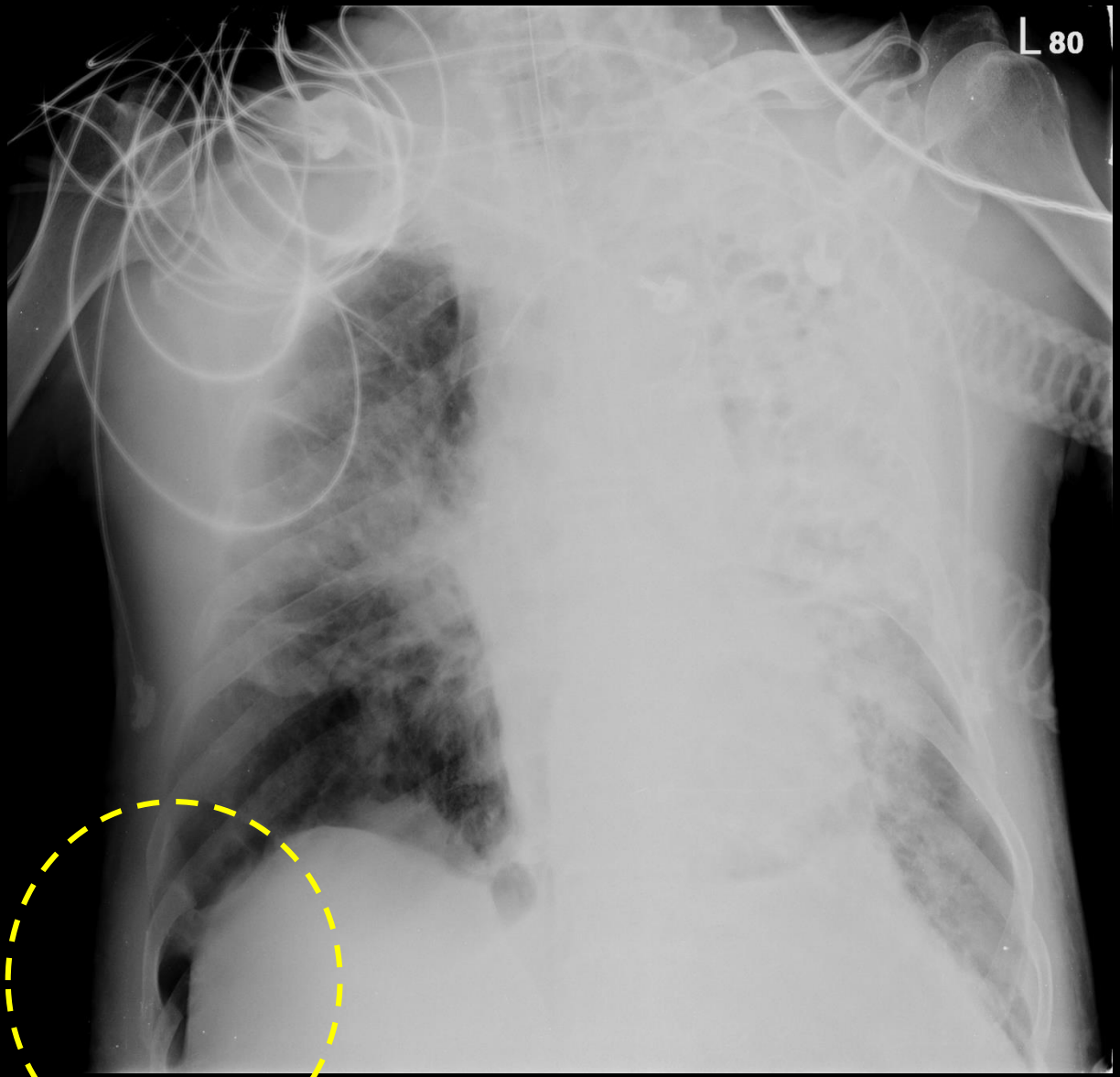
Pneumothorax- Deep Sulcus Sign



Pneumothorax with Subcutaneous Emphysema

Imaging of Chest Wall Lesion

Imaging of Pleura Lesion

Imaging of Diaphragm Lesion

Imaging of Mediastinum Lesion

Imaging of Diaphragm & Sub-diaphragmatic Lesions

Diaphragm Depression

- **Bilateral**
  - Emphysema
  - Bilateral pneumothorax
  - 瘦長體格
- **Unilateral**
  - Tension pneumothorax
  - 下肺野有大的bullae
  - 單側lung hyperexpansion (ex: 吸入異物)

Diaphragm Elevation

- **Bilateral**
  - 肺部因素
    - 吸氣不足 or 吐氣照相
    - Bilateral atelectasis
    - Restrictive lung disease
  - 腹部因素
    - 油：obesity
    - 水：ascites
    - 小孩：懷孕
    - 器官：肝脾腫大
- **Unilateral**
  - 肺部病灶
    - Subpulmonic effusion
    - Decreased lung volume
  - 腹部病灶
    - Abdomen mass: liver, distended stomach, colon interposition
    - Subphrenic abscess
  - 橫膈本身病灶
    - Eventration
    - Diaphragmatic hernia
    - Traumatic rupture of diaphragm
    - Diaphragmatic tumor
    - Phrenic nerve paralysis

Subpulmonic Effusion

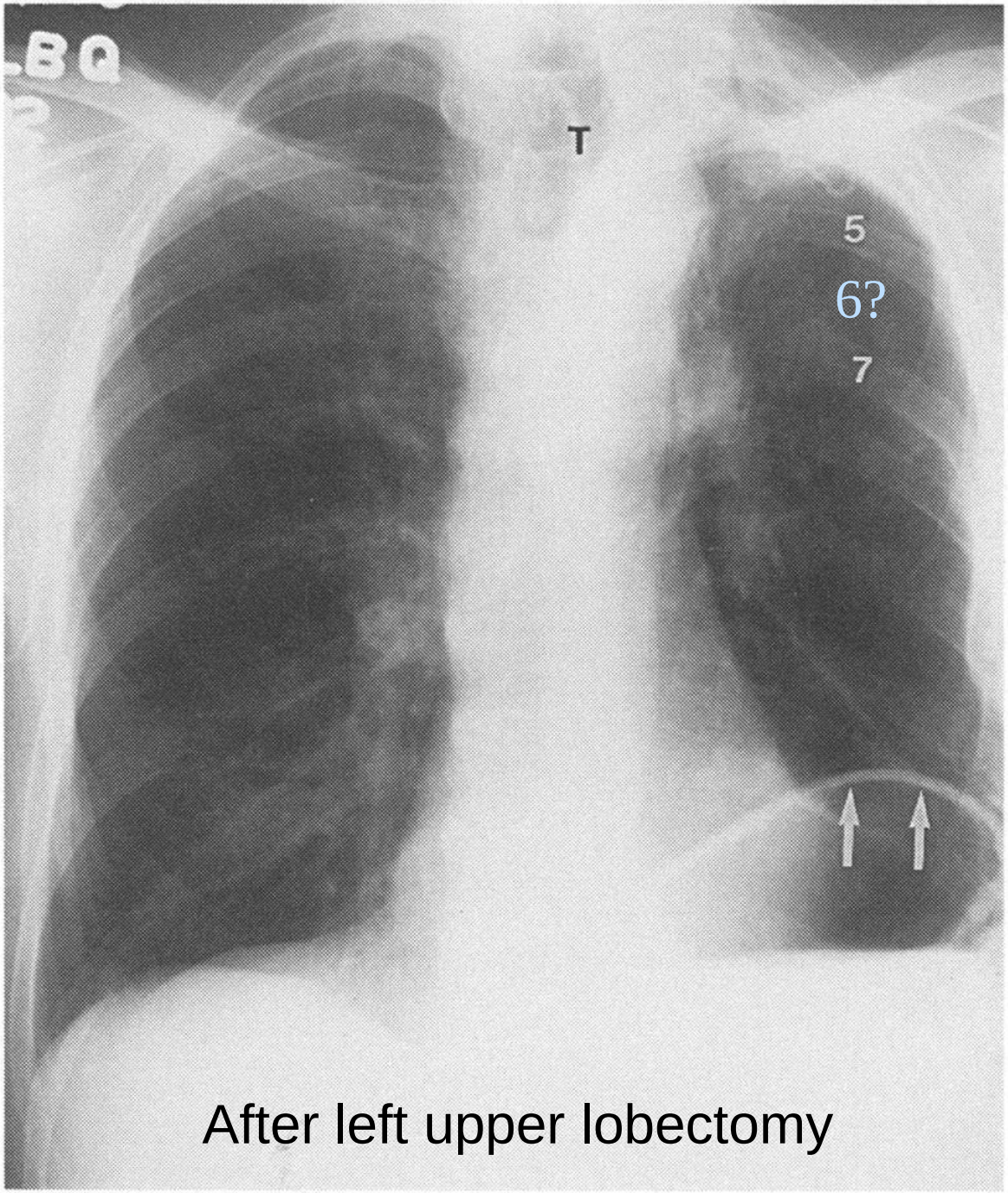
- 定義
  - Pleural effusion 只會積在下肺葉和橫膈之間，而不會溢出至同側的C-P sulcus。
  - 由於積液積存於橫膈和visceral pleural of lower lobe之間，積液量愈多，則lower lobe愈往上推移，所以CXR上有如橫膈一般，稱為”pseudodiaphragm”。
- **PA view**
  - Diaphragm 的最高點向外移至外 1/3 而正常的內1/2~1/3
  - C-P angle變鈍、變淺
  - Diaphragm以下的lung markings 消失
  - L’t side: diaphragm 和 gastric bubble 相隔>2cm

Decreased Lung Volume

Atelectasis / collapse

Lobectomy / pneumonectomy

Hypoplastic lung

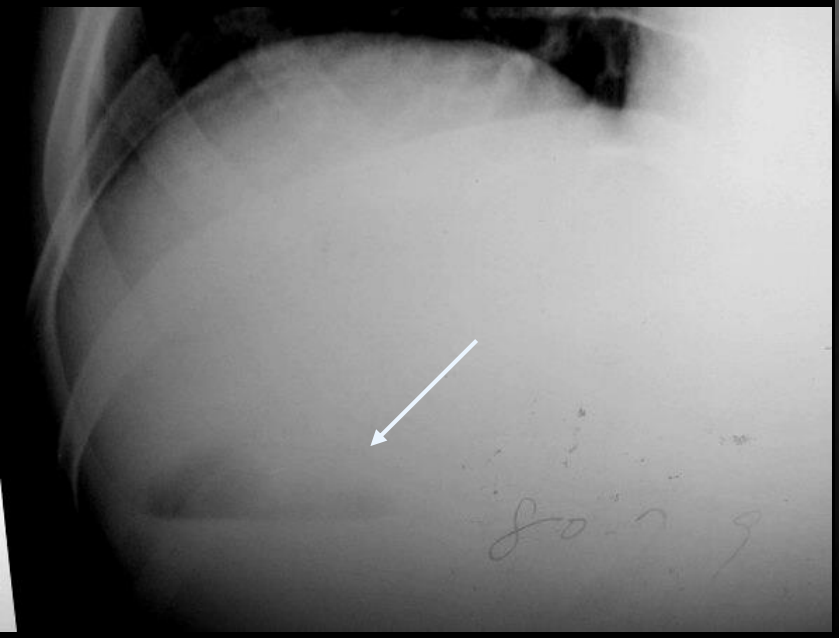


After left upper lobectomy

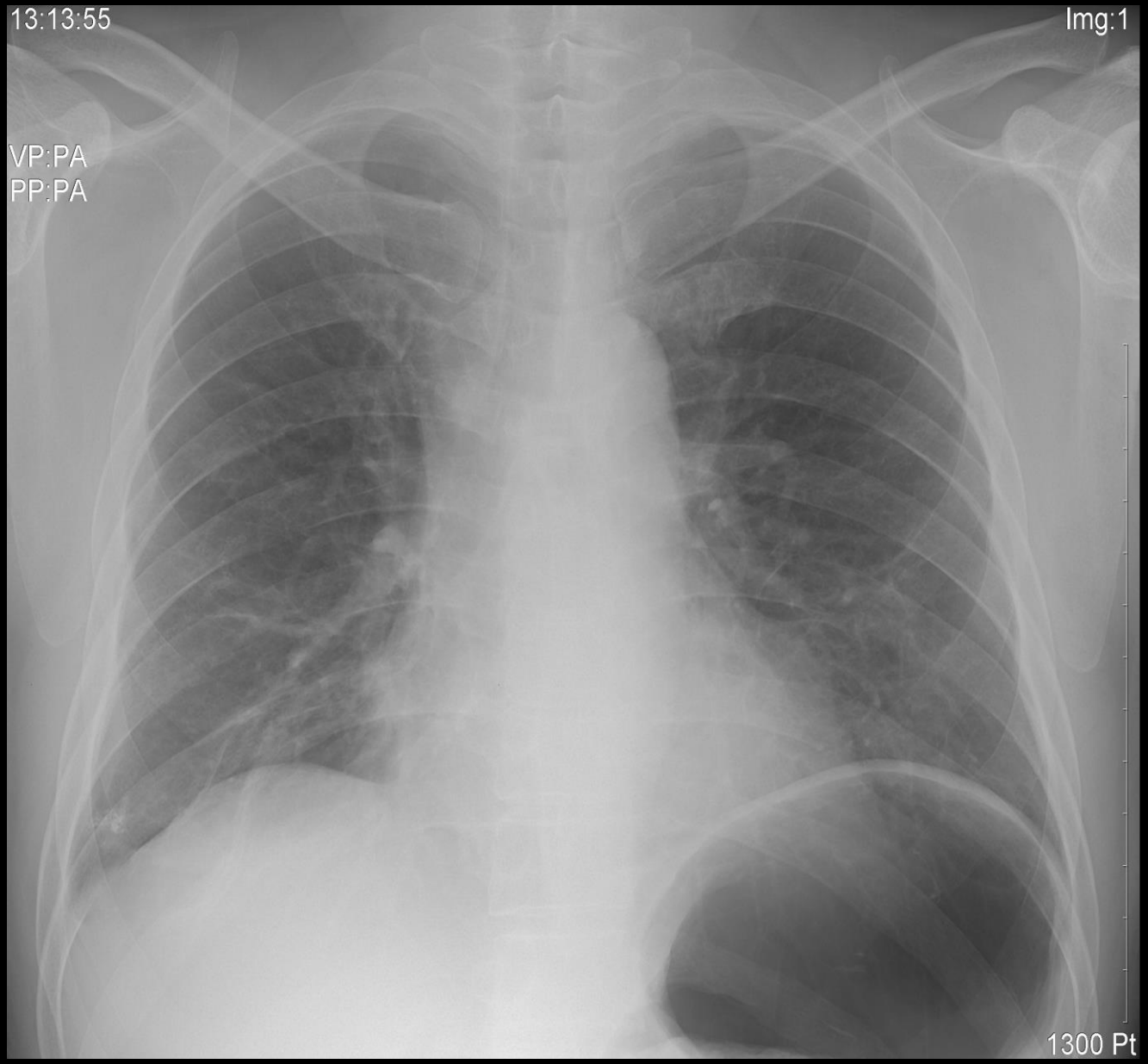
Abdominal Diseases

- Subphrenic abscess
  - Elevated diaphragm + pleural effusion 最常見
  - Localized extraluminal air below the diaphragm
  - Basilar platelike subsegmental atelectasis
- Liver:
  - HCC
  - Liver abscess: air-fluid level within liver shadow
- Distended stomach
- Interposition of colon

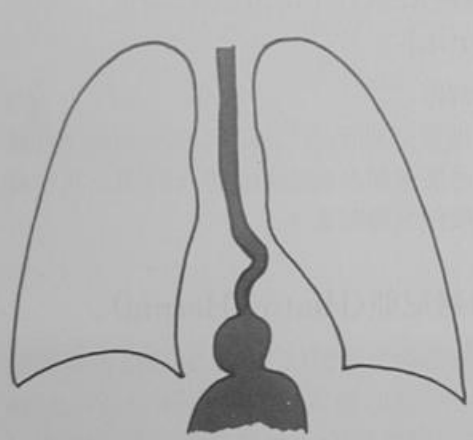
Liver abscess with Septic embolism



Distended Stomach

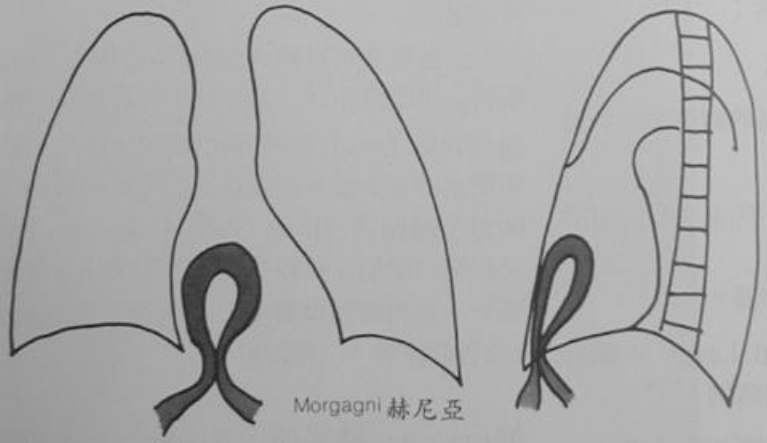


赫尼亞
Bochdalek's hernia



Axial hiatal hernia
軸狀裂口赫尼亞

食道赫尼亞
Paraesophageal herni

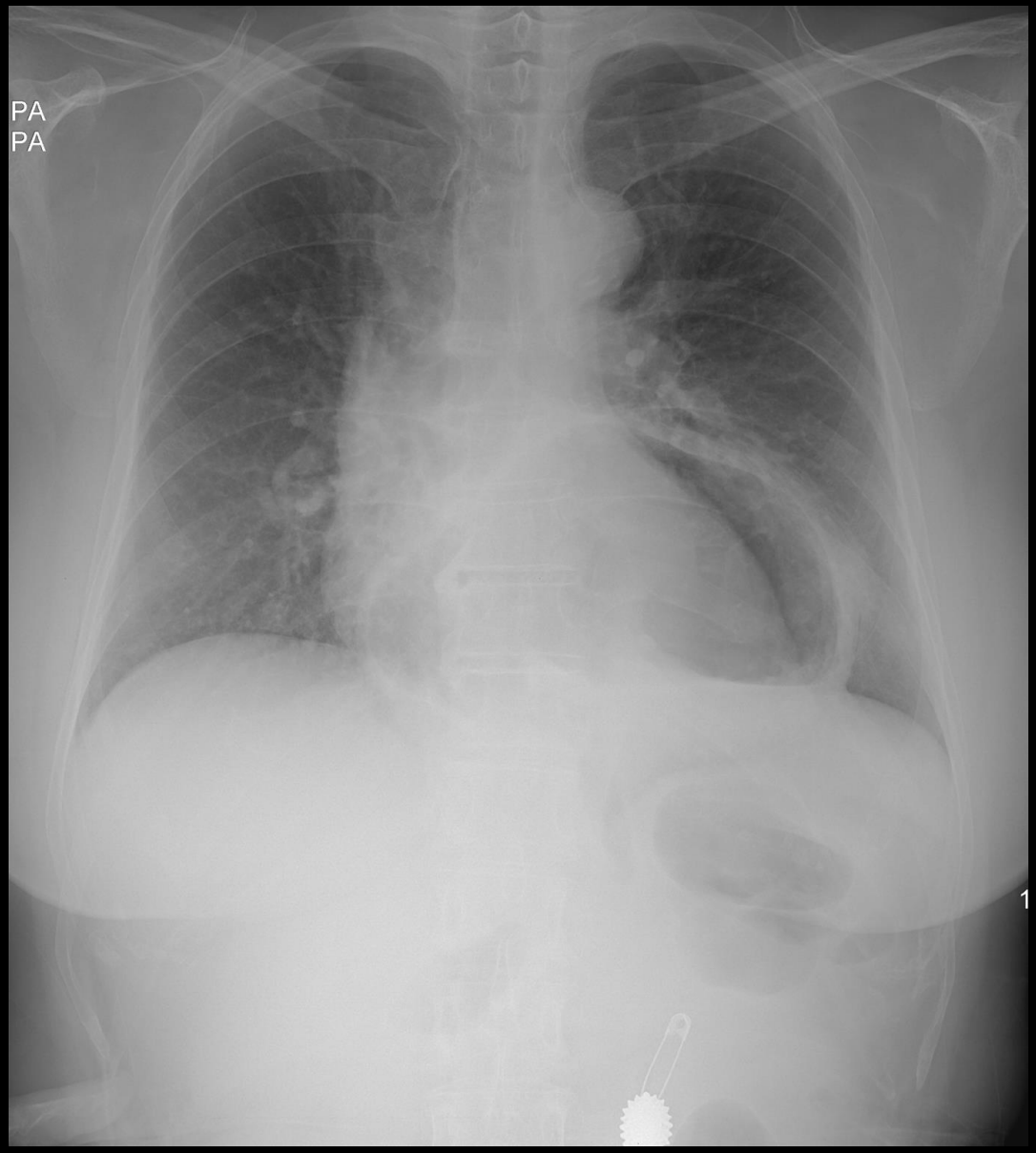


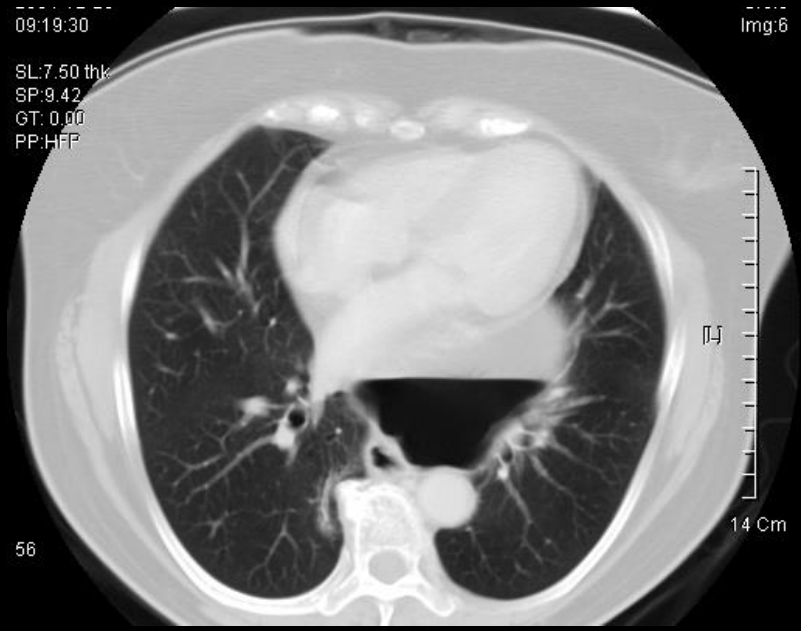
Morgagni 赫尼亞

Diaphragm Hernia (1)

- Hiatal hernia
  - The most common non-traumatic hernia
  - Risk factors: obesity, pregnancy
  - A retrocardiac mass, usually with air or air-fluid level
  - Near the midline or cross it
  - Occasionally on one side and may mimic lung abscess

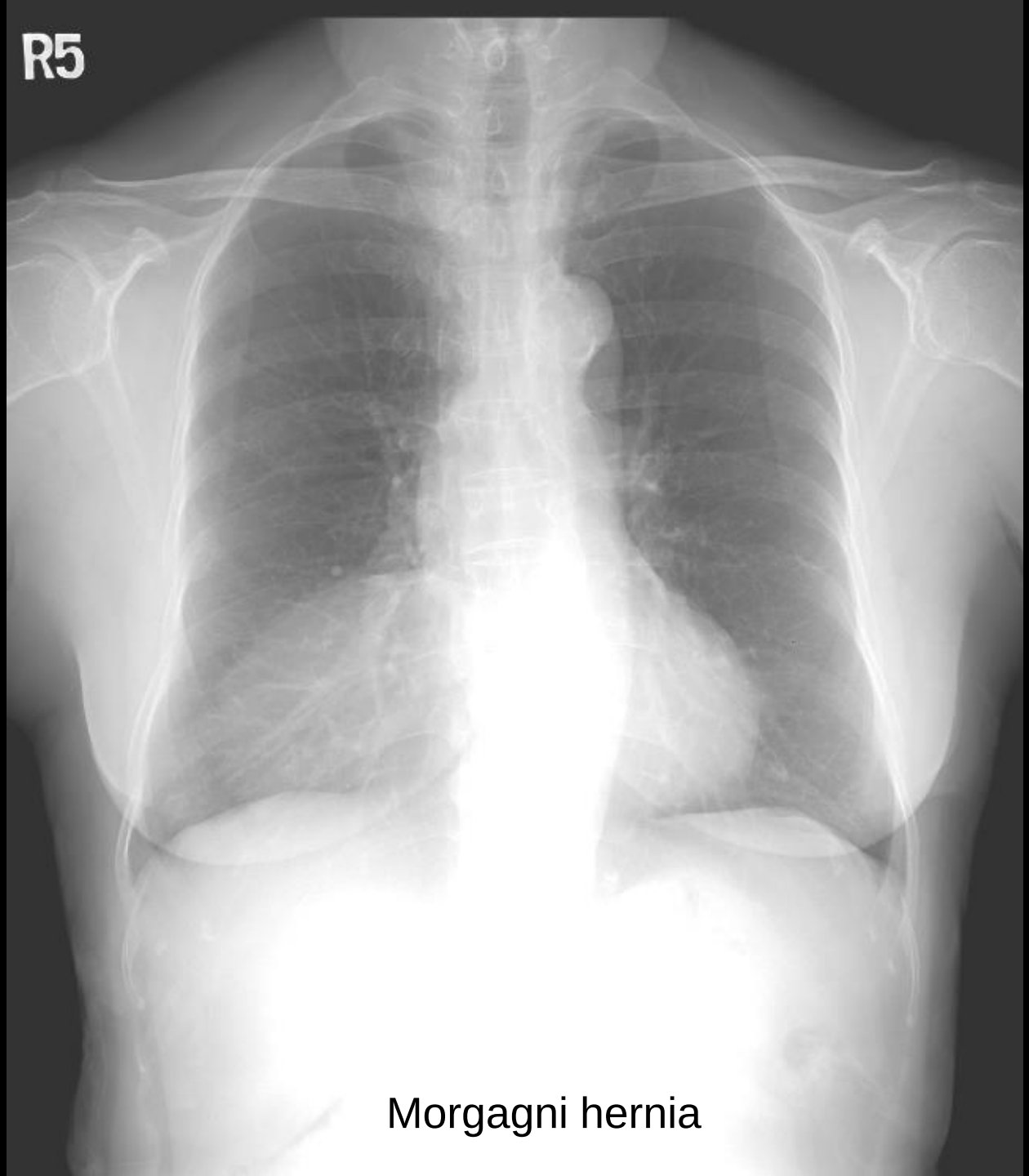
Hiatal Hernia





Diaphragm Hernia (2)

- Morgagni's hernia
  - 右前、內
  - More common in adult than in infant
  - Risk factors: obesity, effort, increased abdominal pressure
  - Herniated abdominal contents (in order of decreased frequency): omentum, colon, stomach, liver, and small intestine
  - CXR: a smooth, well-defined opacity in right cardiophrenic angle, may obscure the right heart border.

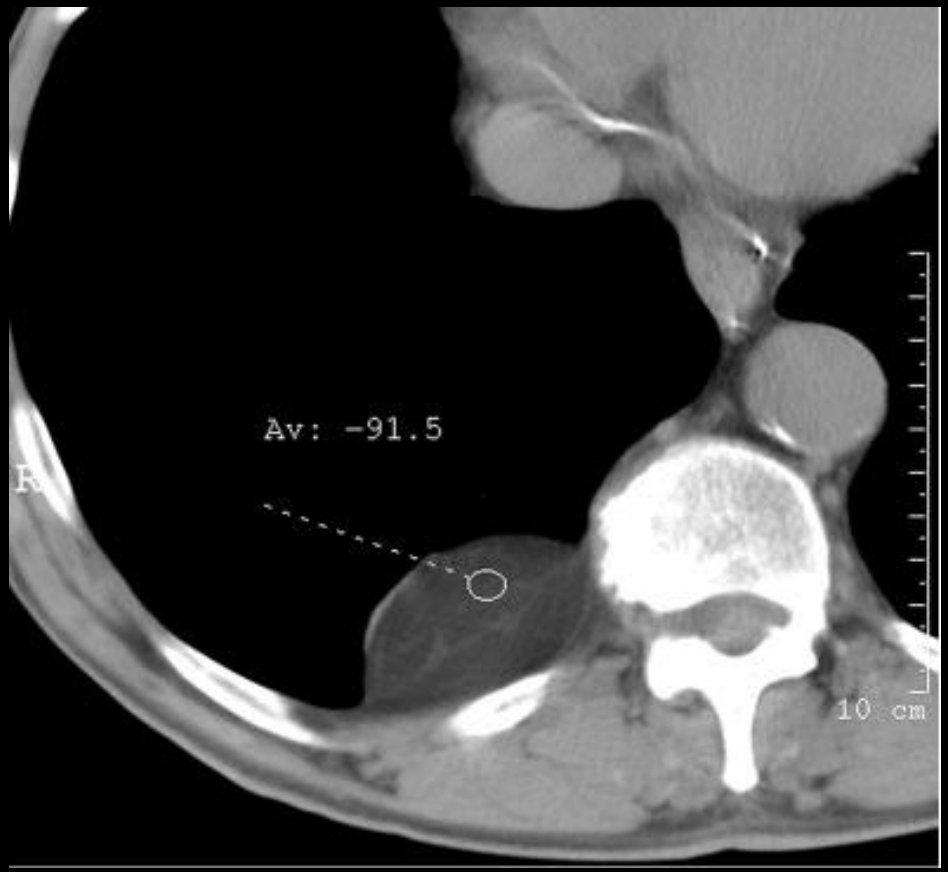


Morgagni hernia

Diaphragm Hernia (3)

- Bochdalek's hernia
  - Usually diagnosed in infants who present with clinical symptoms of pulmonary insufficiency.
  - A lung-based soft-tissue-opacity lesion; left (70%–90%, presumably owing to the protective effects of the liver), posterior (左後)
  - Must be considered when the mass is continuous with the diaphragm.
  - The herniated contents mostly contain fat and omental tissue.

Bochdalek’s hernia



RadioGraphics 2002; 22:S61–S78

Imaging of Chest Wall Lesion

Imaging of Pleura Lesion

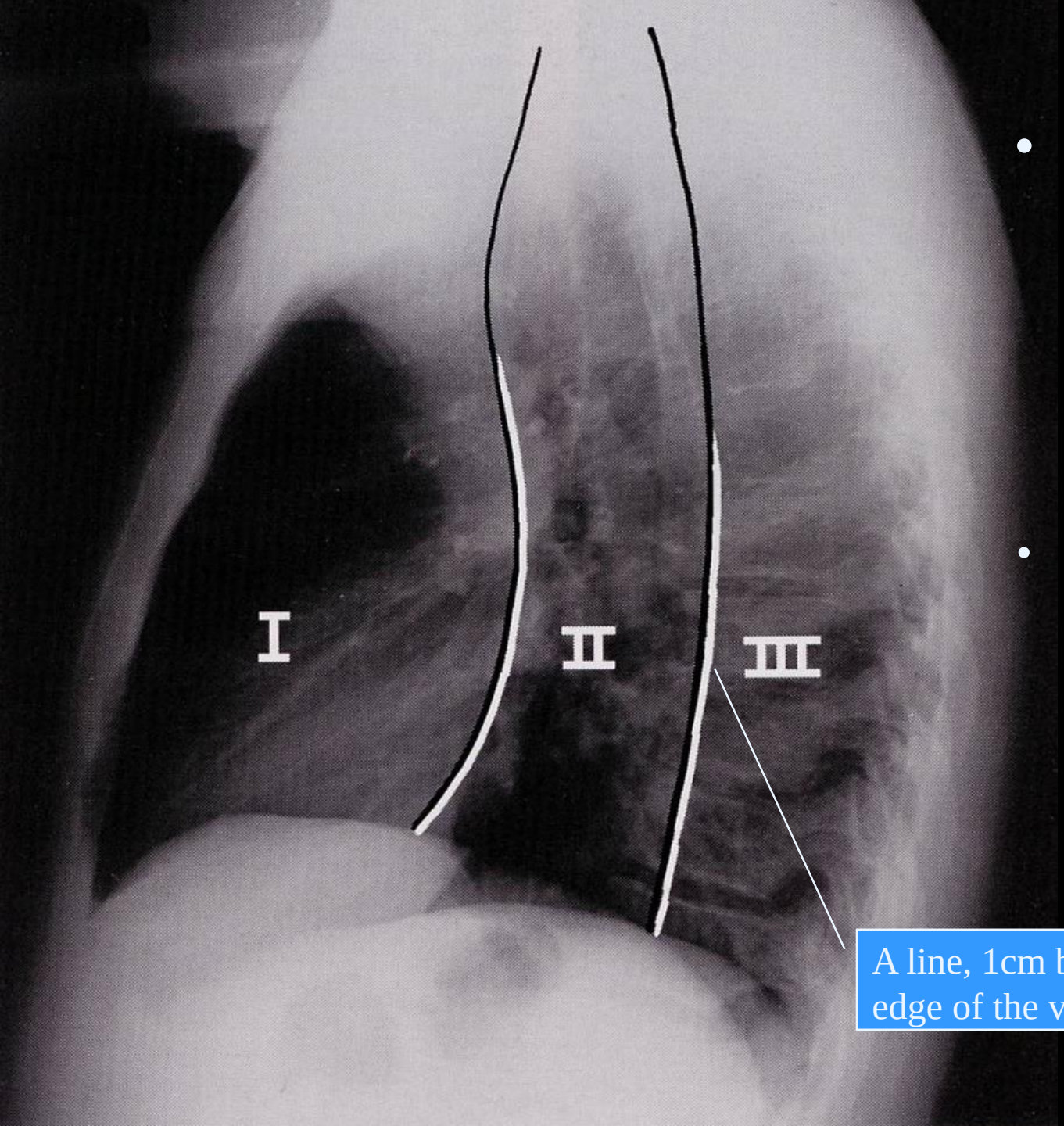
Imaging of Diaphragm Lesion

Imaging of Mediastinum Lesion

Mediastinum Lesions

Anatomy Landmarks

- Identify the location to narrow D/D
  - PA view: Silhouette sign
  - Lat. View: better
- Divide anterior and middle mediastinum:
  - Anterior border of the trachea – posterior border of the heart – posterior border of IVC
- Divide middle and posterior mediastinum:
  - A line 1cm posterior to the anterior border of the vertebral bodies



- Anatomy Landmarks
  - 氣管前緣、心臟後緣、IVC
  - 椎體前緣向後1 cm畫線
- 分為前、中、後縱隔

A line, 1cm back from the anterior edge of the vertebral bodies

List of Mediastinum Lesions

- Shift
- Widening
  - Aortic aneurysm / dissection
  - Mediastinitis (± air-fluid level)
  - Lipomatosis
- Soft tissue density
  - Mass, Neoplasm
- Air or air-fluid level
  - Pneumomediastinum
  - 食道：
    - Esophagus reconstruction
    - Achalasia
  - Hiatal hernia

Mediastinal Shift

- Mechanism: Pressure imbalance
- Determine which side is diseased by
  - Associated findings
  - Expiratory film: air-trapping
  - Lateral decubitus film
- Causes
  - Lung volume:
    - Decrease (ex: atelectasis, post-OP),
    - Increase (ex: check valve; air 進得去，但出不來)
  - Huge lung mass
  - Pleural disease (effusion, air, mass)

List of Mediastinum Lesions

- Shift
- Widening
  - Aortic aneurysm / dissection
  - Mediastinitis (± air-fluid level)
  - Lipomatosis
- Soft tissue density
  - Mass, Neoplasm
- Air or air-fluid level
  - Pneumomediastinum
  - 食道：
    - Esophagus reconstruction
    - Achalasia
  - Hiatal hernia

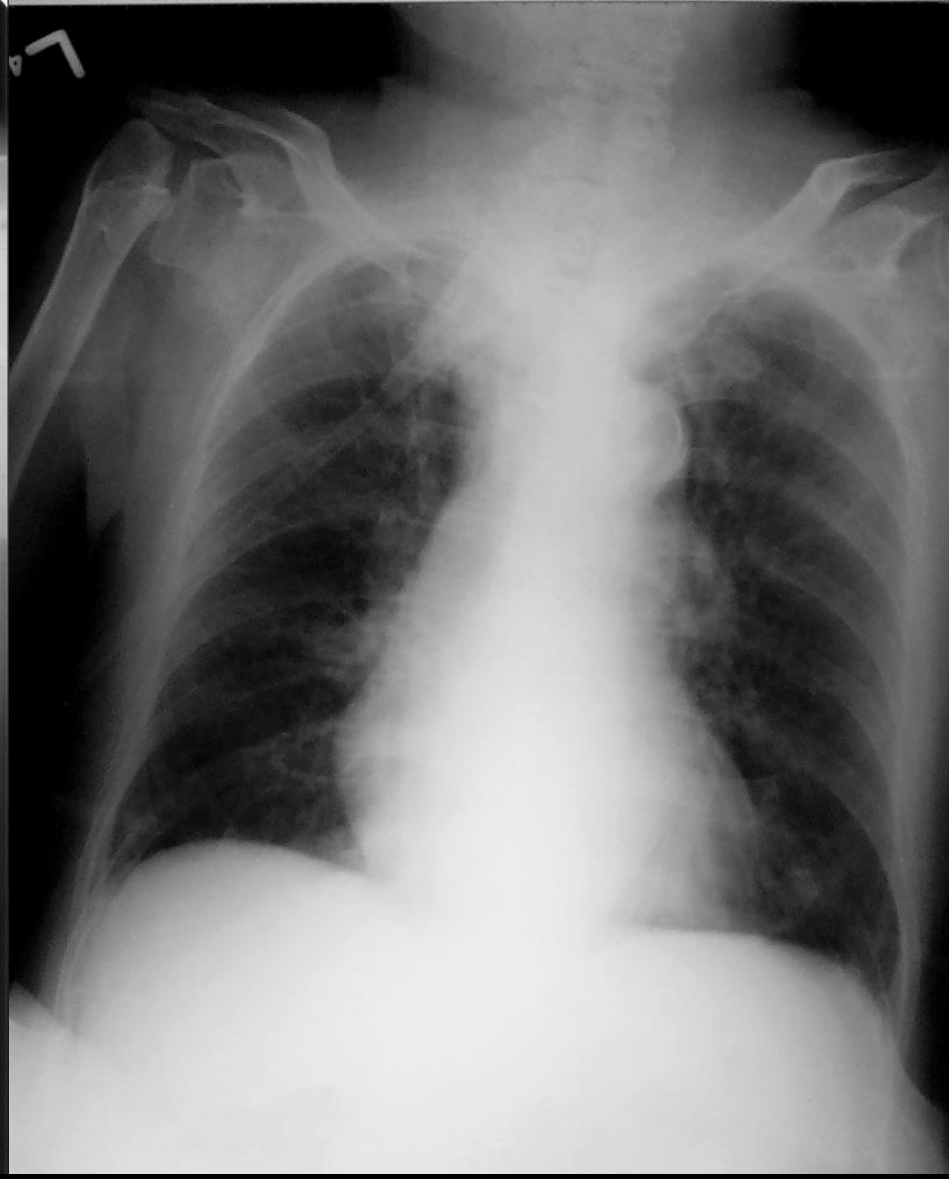
Mediastinal Widening

- **First, exclude below conditions**
  - Supine AP film
  - Lordotic film
  - Inadequate inspiration

Mediastinal Widening

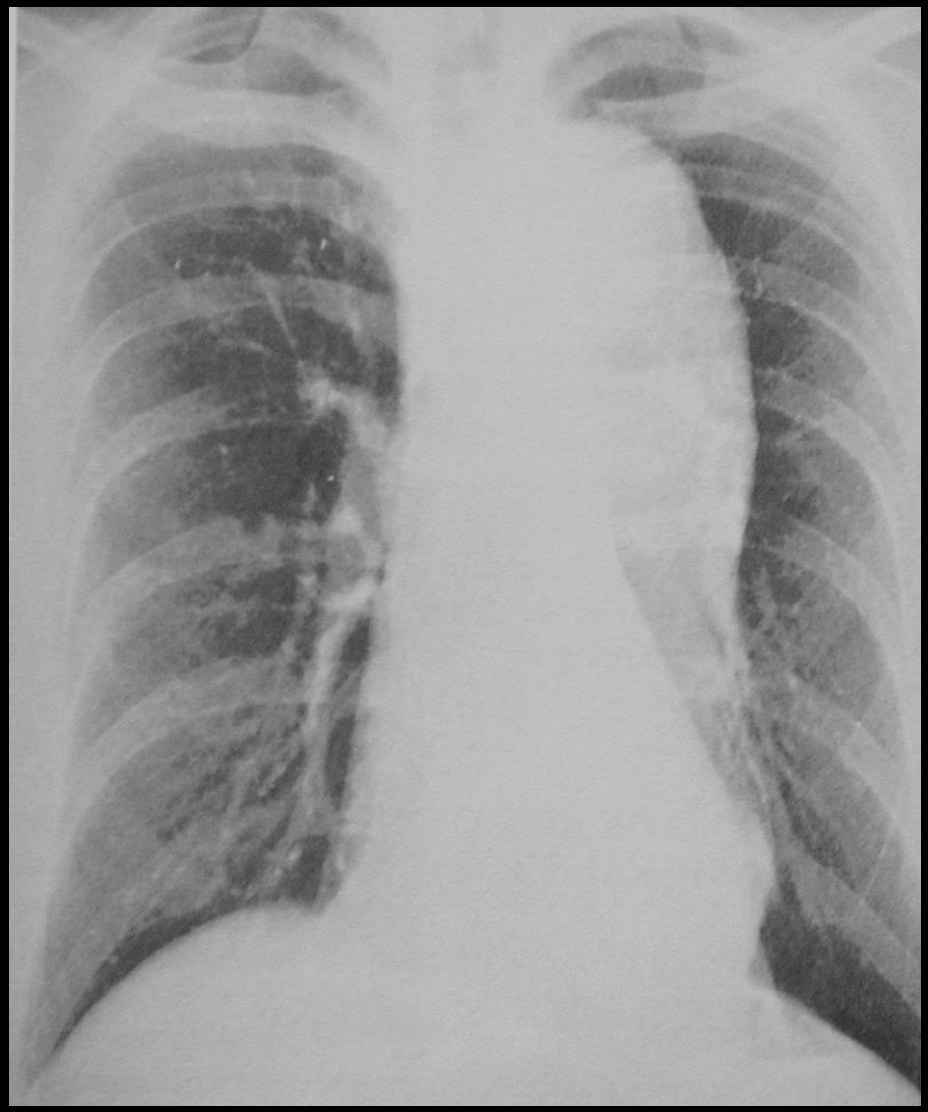
- Hemodynamic (Vascular)
  - Tortuous aorta, aortic aneurysm, aortic dissection
  - Hematoma: trauma, post-operation, catheters
- Mediastinitis
  - Acute mediastinitis
  - Fibrosing mediastinitis
- Neoplasm / Mass
  - Lymphoma, lung ca, LAP
- Lipomatosis
  - Steroid use, Cushing's syndrome, obesity

PA view



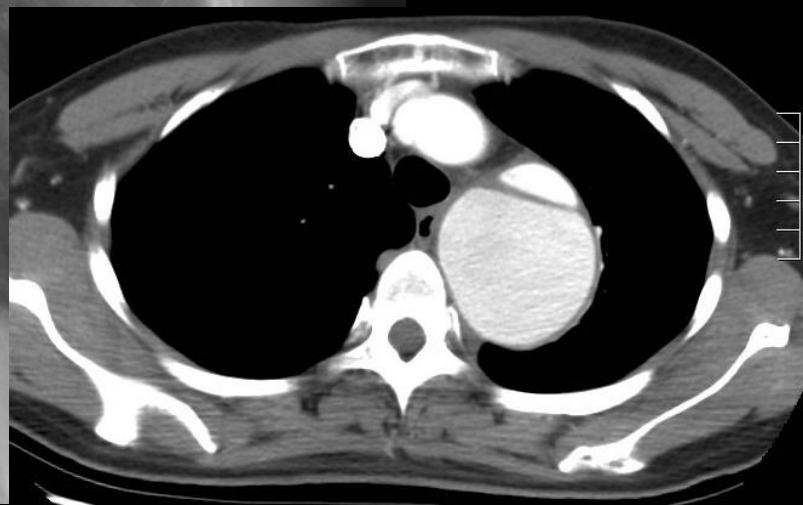
AP view

Aortic Dissection



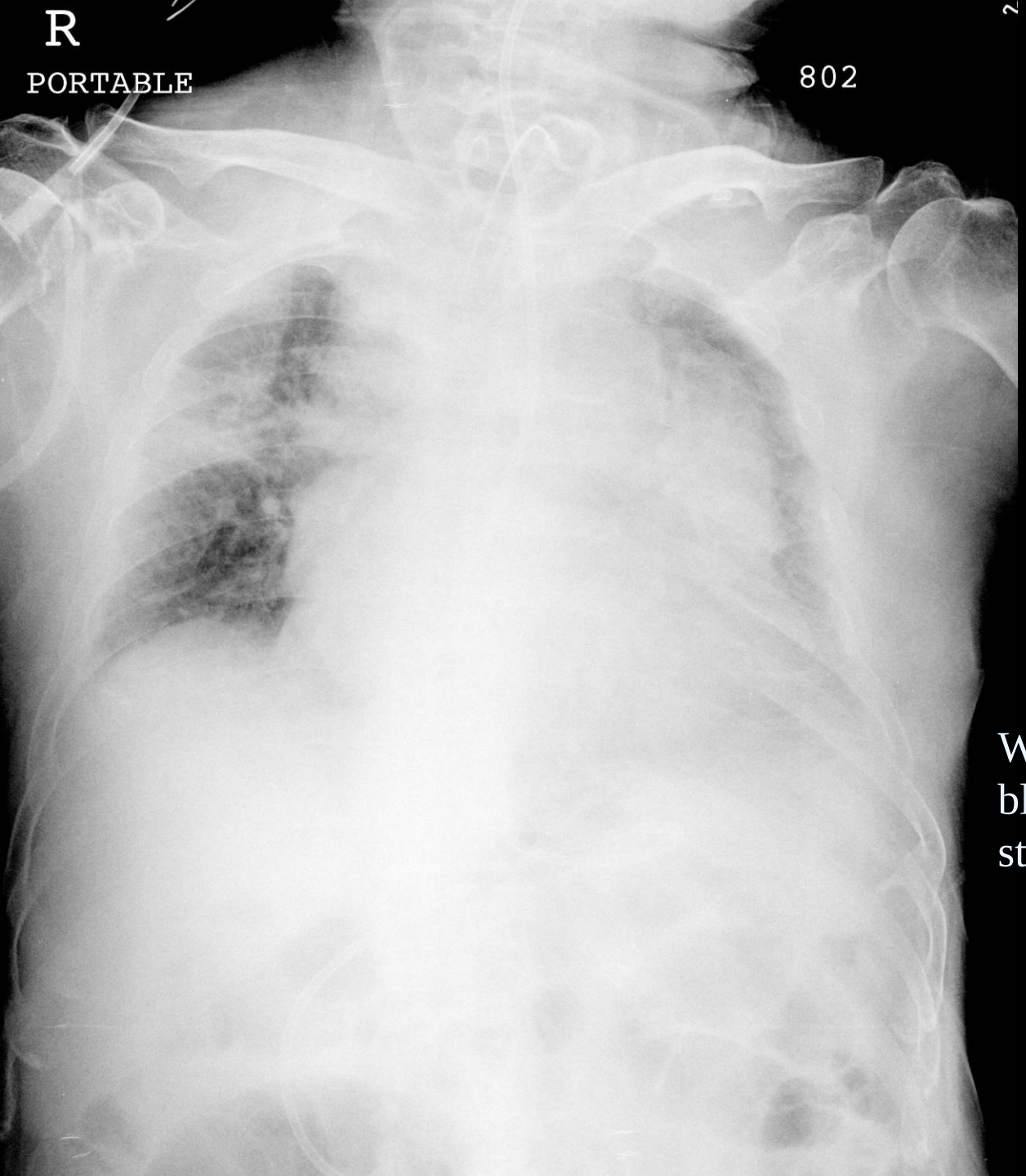
Aortic Aneurysm

Aortic dissection



Acute Mediastinitis

- **Causes:**
  - Esophageal perforation: the most common cause (Boehaave's syndrome, TE fistula)
  - Esophageal/cardiac surgery
  - Direct extension of infection from adjacent structures (e.g. retropharyngeal abscess)
  - Hematogenous spread of infection
- **CXR:**
  - Widening of mediastinum, typically with blurred ill-defined mediastinal margin
  - Pneumomediastinum may be evident
- **Diagnosis:**
  - By extravasation of ingested contrast into the mediastinum or pleural space



- 73 y/o man, laryngeal SCC s/p R/T
- dyspnea, dysphagia for days
- Acute mediastinal abscess due to self withdrawal of metallic tracheostomy

Widening of mediastinum, blurring of mediastinal structures

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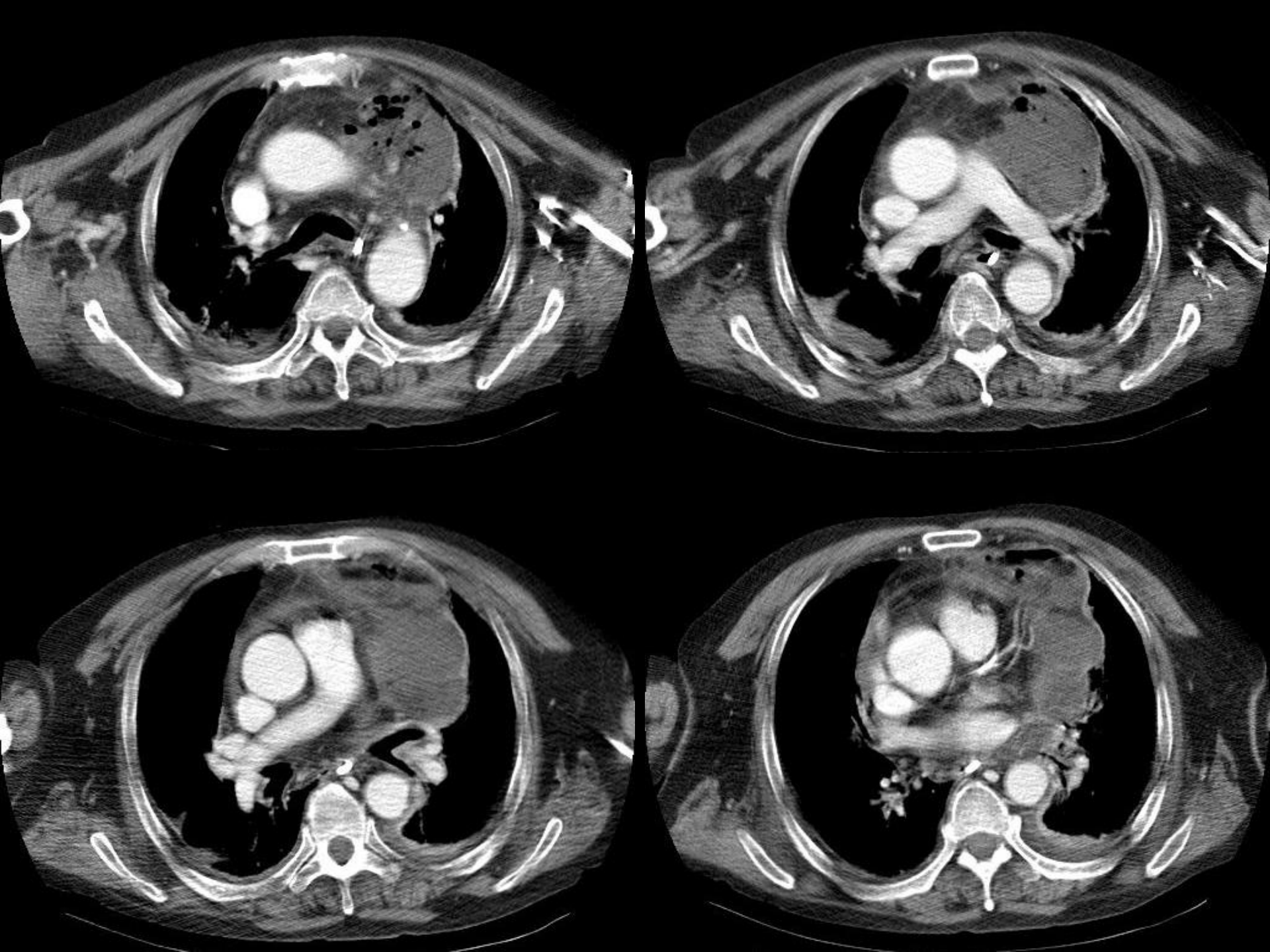


Pneumomediastinum

- Gas within the mediastinum can result from 5 sites:
  - Lung (most common), mediastinal airway, neck, esophagus, and abdominal cavity.
- CXR:
  - Lucent streaks of gas outlining the mediastinal structures
  - Continuous diaphragm sign: when gas interposed between the heart and diaphragm, it permits identification of the central portion of diaphragm.

Pneumomediastinum

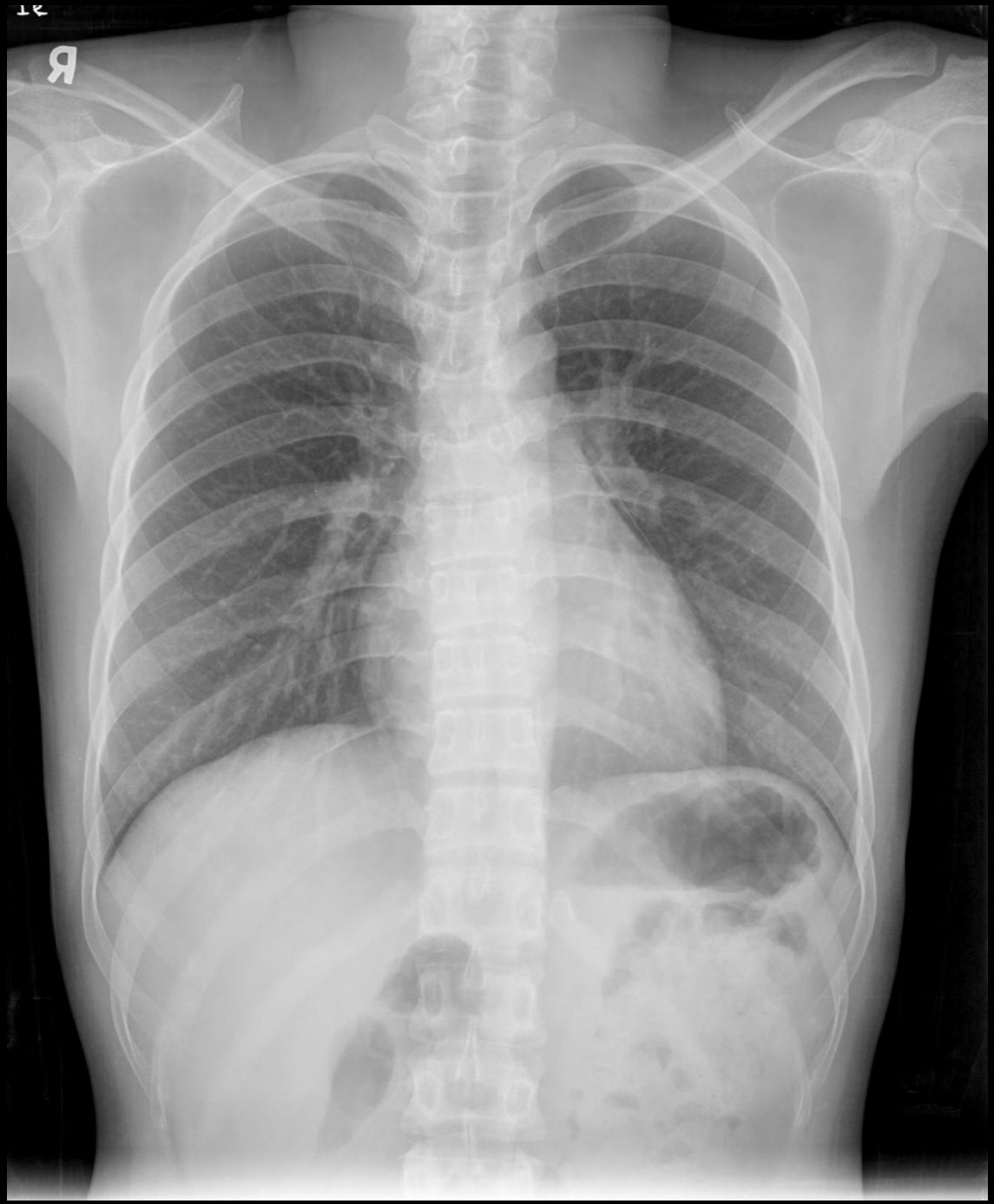
- The terminal air spaces of the lung are the most common source of pneumomediastinum.
- In the presence of a pressure gradient between an alveolus and the interstitium, air ruptures from the alveolus into the perivascular and peribronchial fascial sheath (interstitial emphysema)
- Continued insufflation caused an overflow of air into the retroperitoneum, anterior mediastinum, and subcutaneous tissues of the neck and axilla

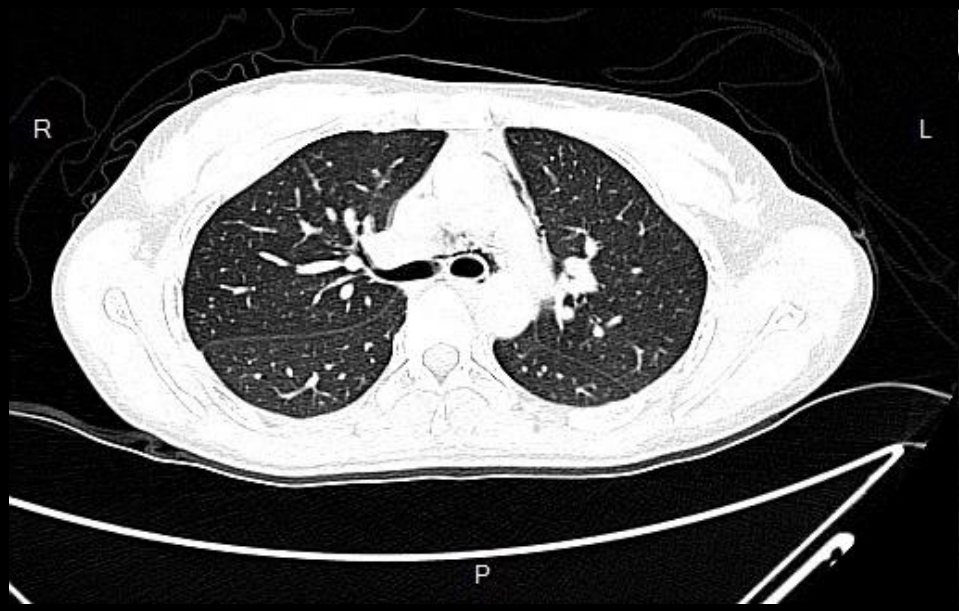
Table 2
Radiographic Signs of Pneumomediastinum

Subcutaneous emphysema
Thymic sail sign
Pneumoprecardium
Ring around the artery sign
Tubular artery sign
Double bronchial wall sign
Continuous diaphragm sign
Extrapleural sign
Air in the pulmonary ligament

The most reliable sign

RadioGraphics 2000; 20:1043–1057


R


R
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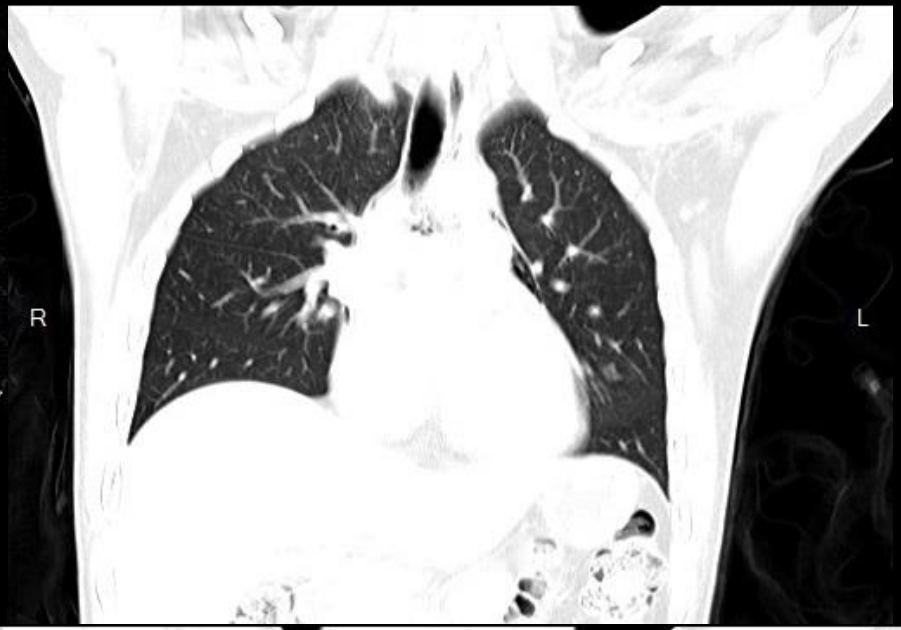
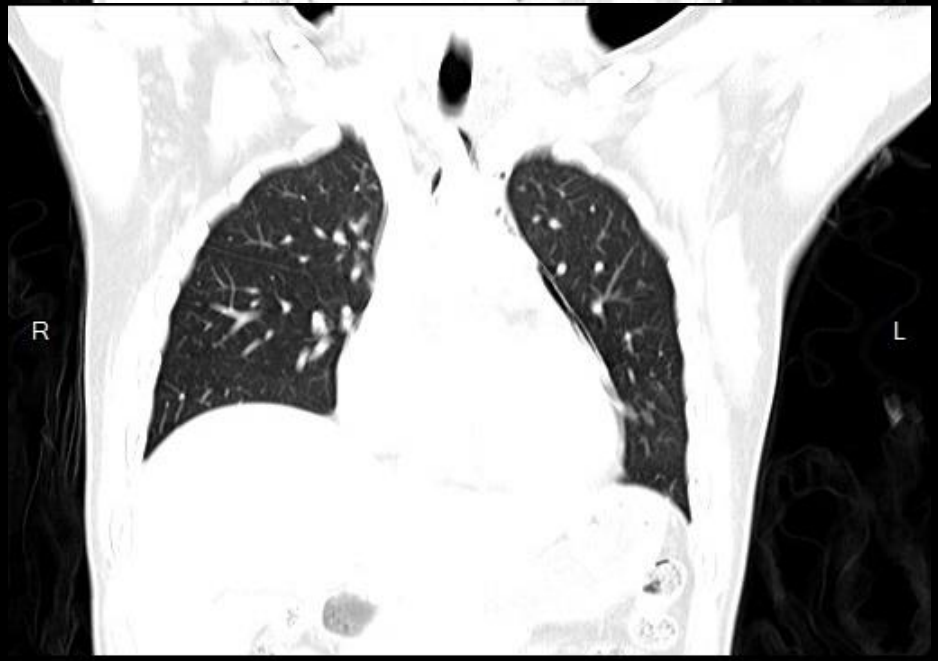
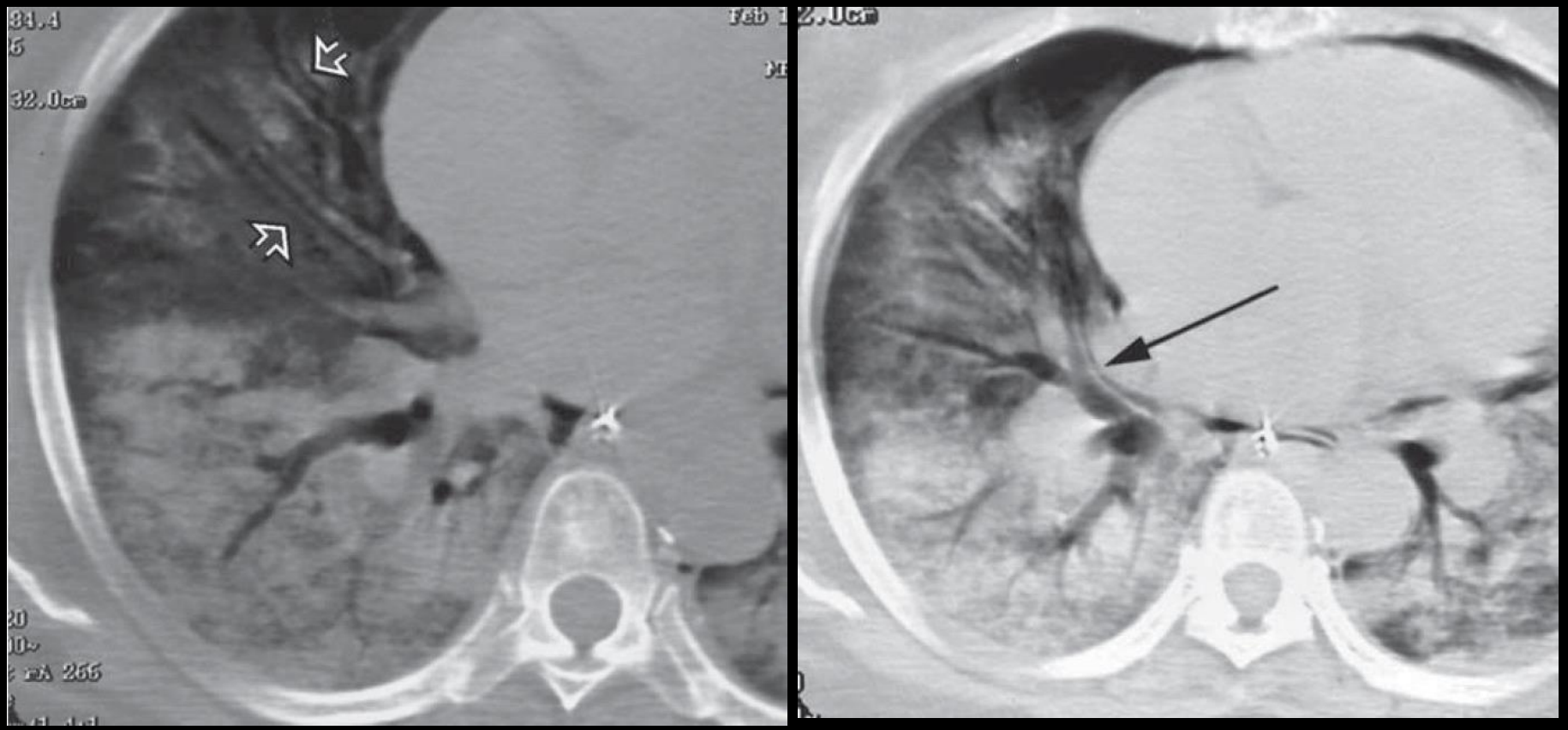

R
L


R
L
P

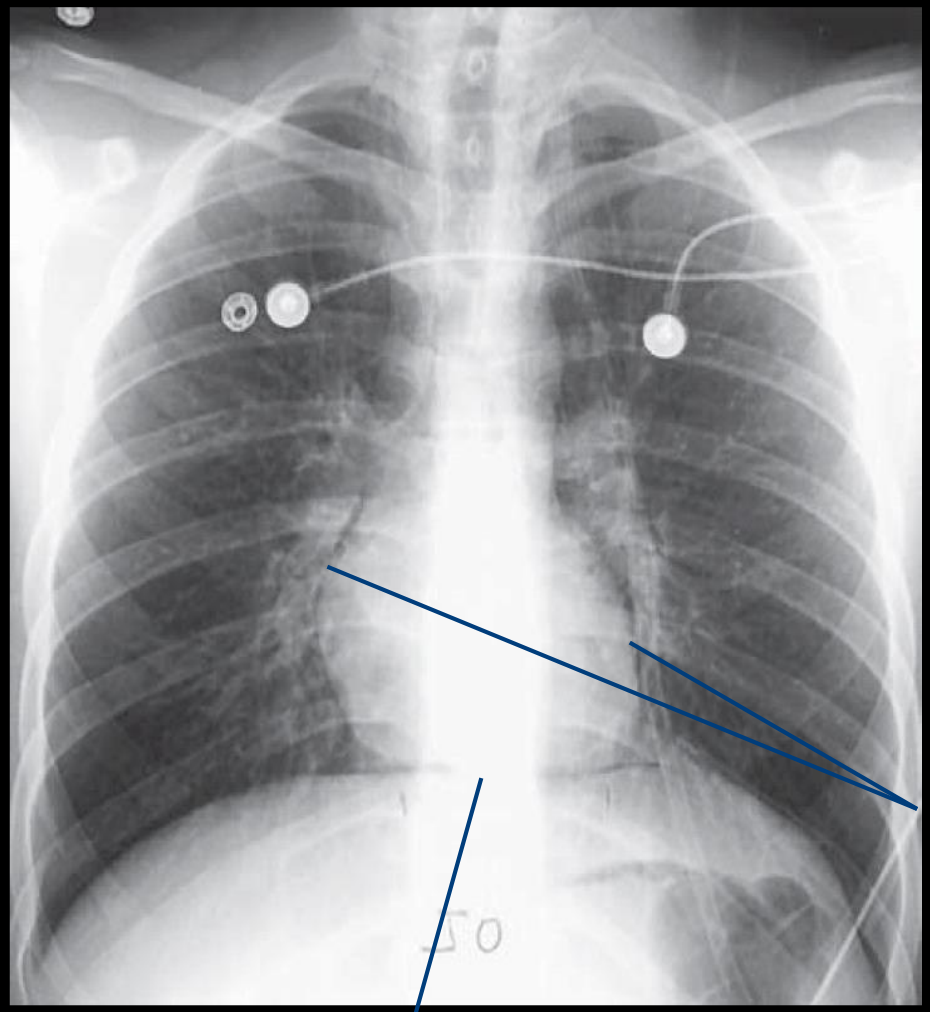

R
L

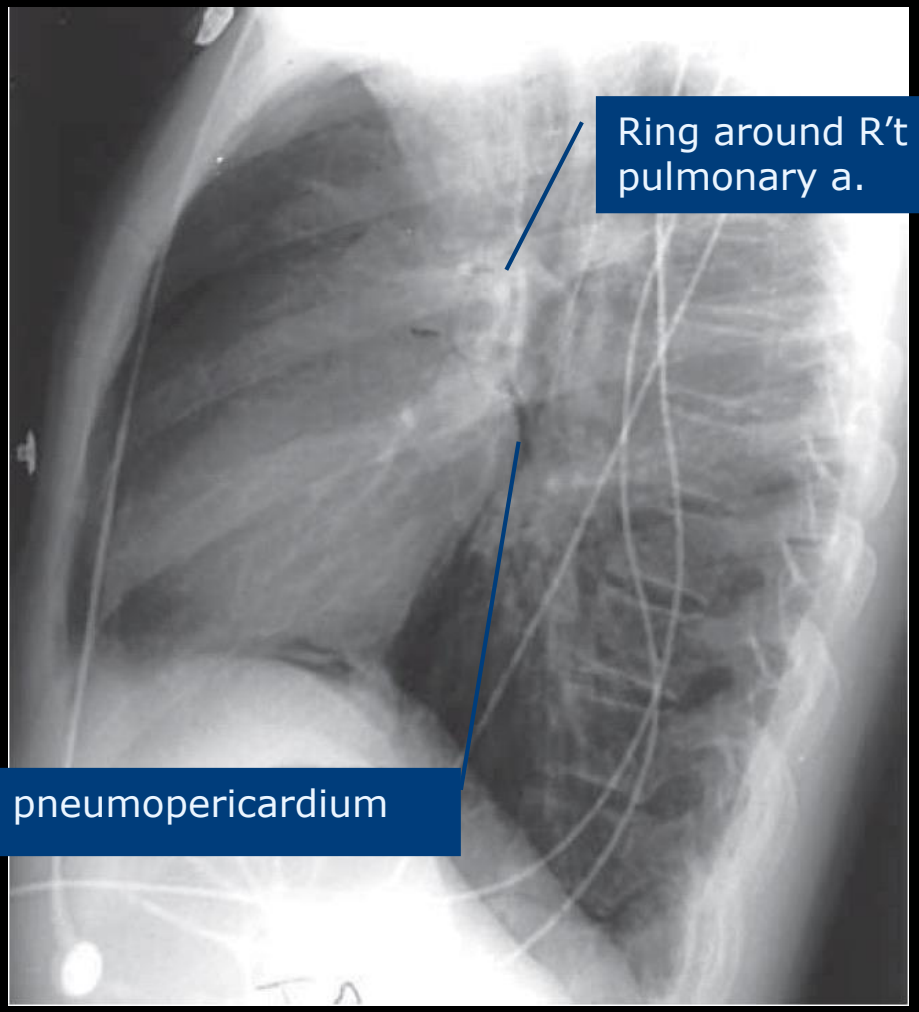


pneumomediastinum and air in the perivascular and peribronchial sheaths

RadioGraphics 2000; 20:1043–10

Continuous diaphragm sign
Ring around the artery sign





Continuous diaphgram sign → air trapped posterior to the pericardium

RadioGraphics 2000; 20:1043–1057

List of Mediastinum Lesions

- Shift
- Widening
  - Aortic aneurysm
  - Lipomatosis
  - Mediastinitis (air-fluid level)
- Soft tissue density
  - Mass, Neoplasm
- Air or air-fluid level
  - Pneumomediastinum
  - Esophagus reconstruction
  - Achalasia
  - Hernia

Hint of Mediastinal Mass

Tapered border

Center within mediastinum: 圓心落在縱膈腔內

Sharp margin

Bilaterality: 病灶跨在左右兩側的胸腔

Tumors of Mediastinum

Anterior mediastinum

Substernal thyroid gland

Thymoma

Teratoma

Lymph nodes; lymphoma

Middle mediastinum

Vascular; aneurysm, enlarged heart

Lymph nodes; lymphoma, metastatic cancer

Esophageal; achalasia, diverticula

Bronchogenic or pericardial cyst

Posterior mediastinum

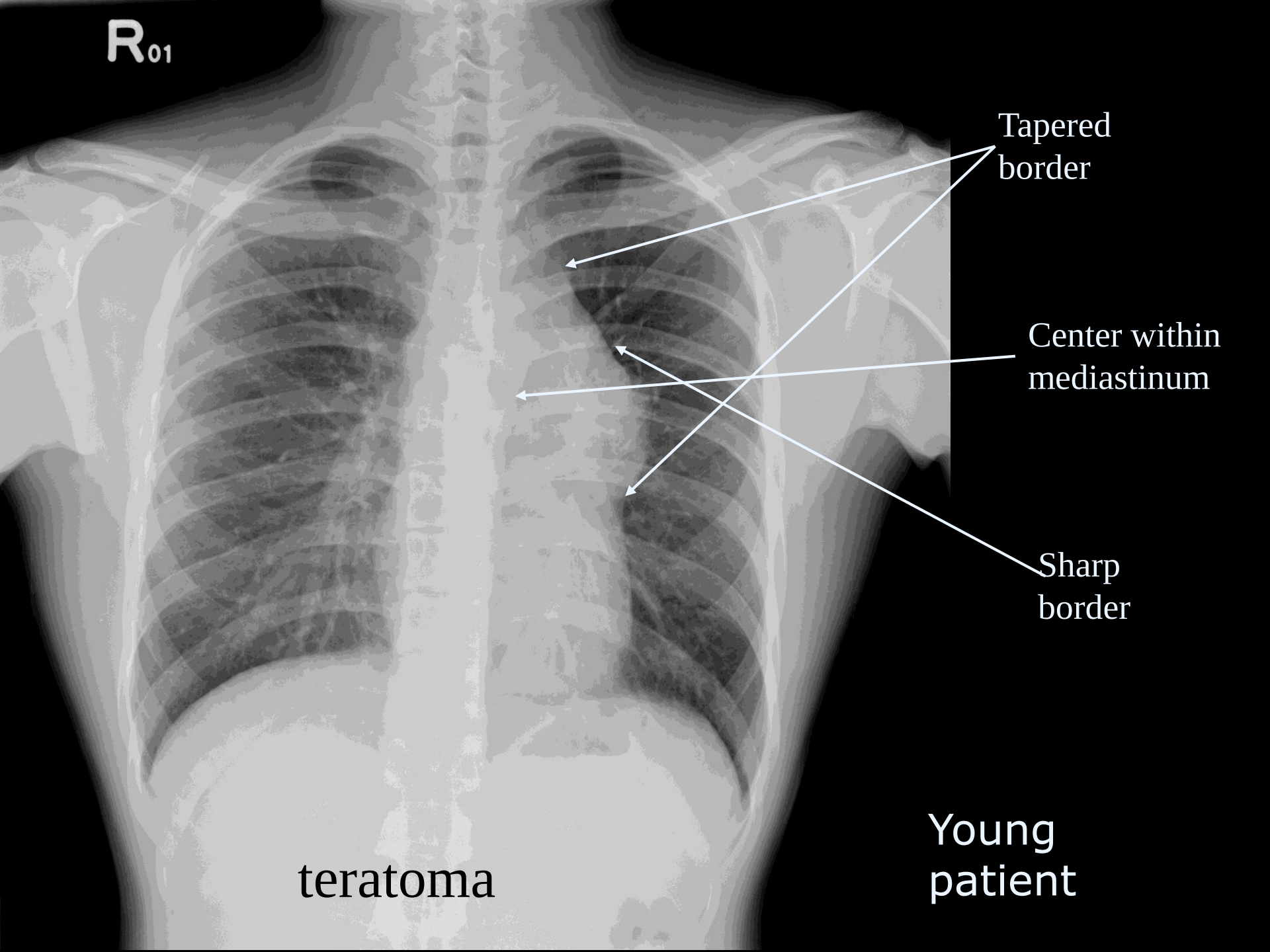
Neurilemoma
Neurofibroma
Ganglioneuroma
Schwann-cell tumor

F. Netter M.D.

Mediastinum

Distribution of lesions(n=400)

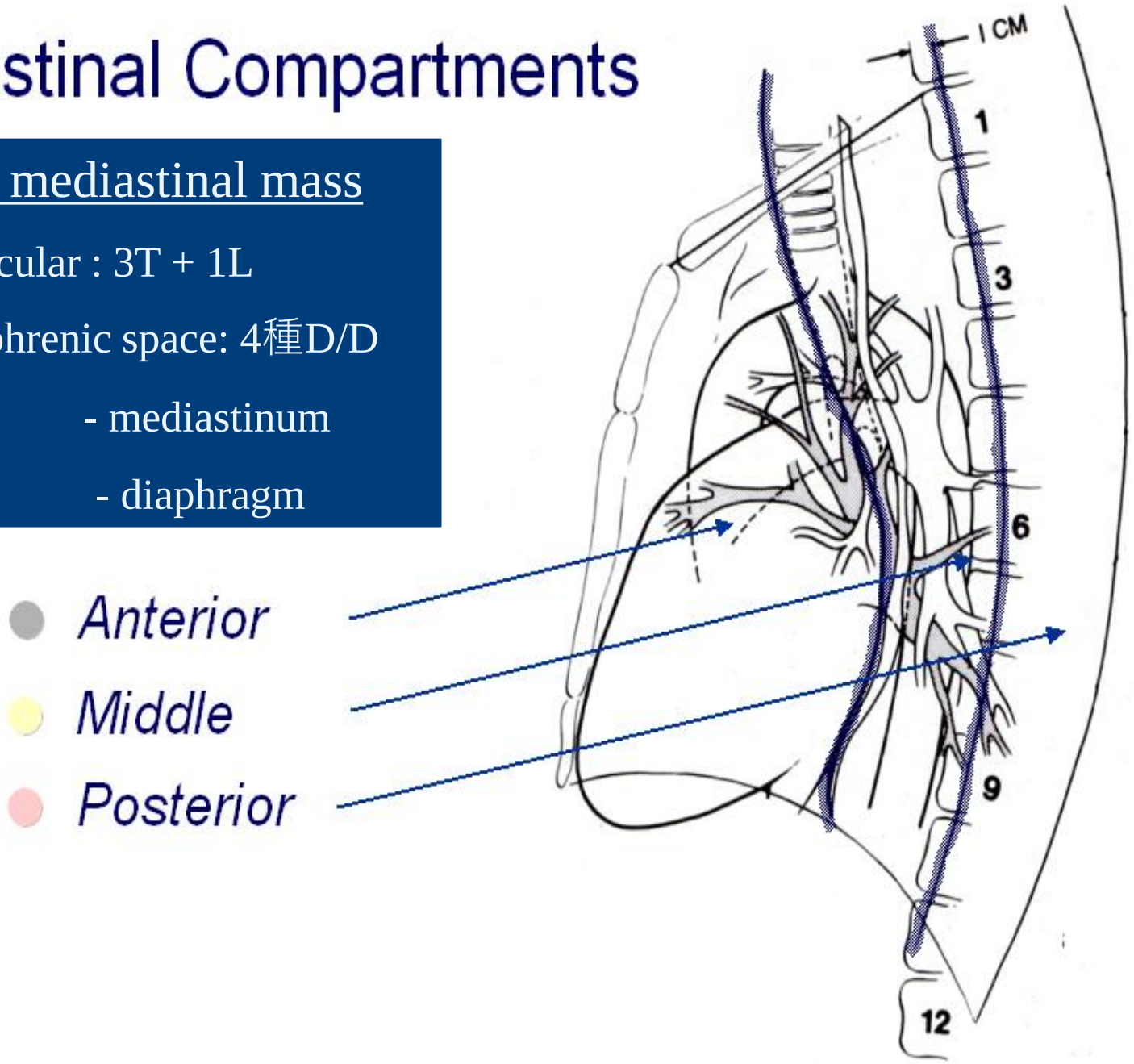
	Anterior	Middle	Posterior
Thymic lesions	30%	0%	0%
Lymphomas	20%	21%	20%
Germ cell tumors	18%	0%	0%
Carcinoma	13%	7%	0%
Cysts	7%	60%	34%
Mesenchymal tumors	5%	9%	9%
Endocrine tumors	5%	0%	0%
Neurogenic tumors	0%	0%	53%
Miscellaneous	2%	3%	2%


R01
Tapered border
Center within mediastinum
Sharp border
teratoma
Young patient

Mediastinal Compartments

Anterior mediastinal mass

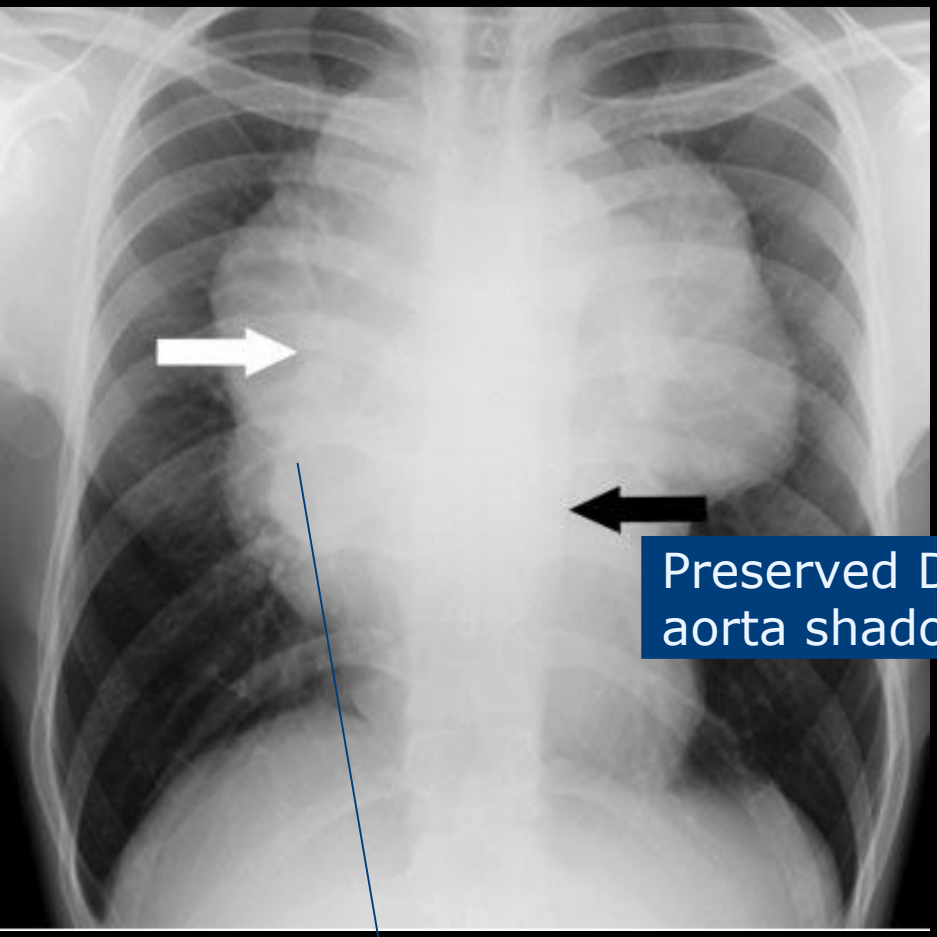
1. Pre-vascular : 3T + 1L
2. Cardiophrenic space: 4種D/D
   - heart - mediastinum
   - lung - diaphragm



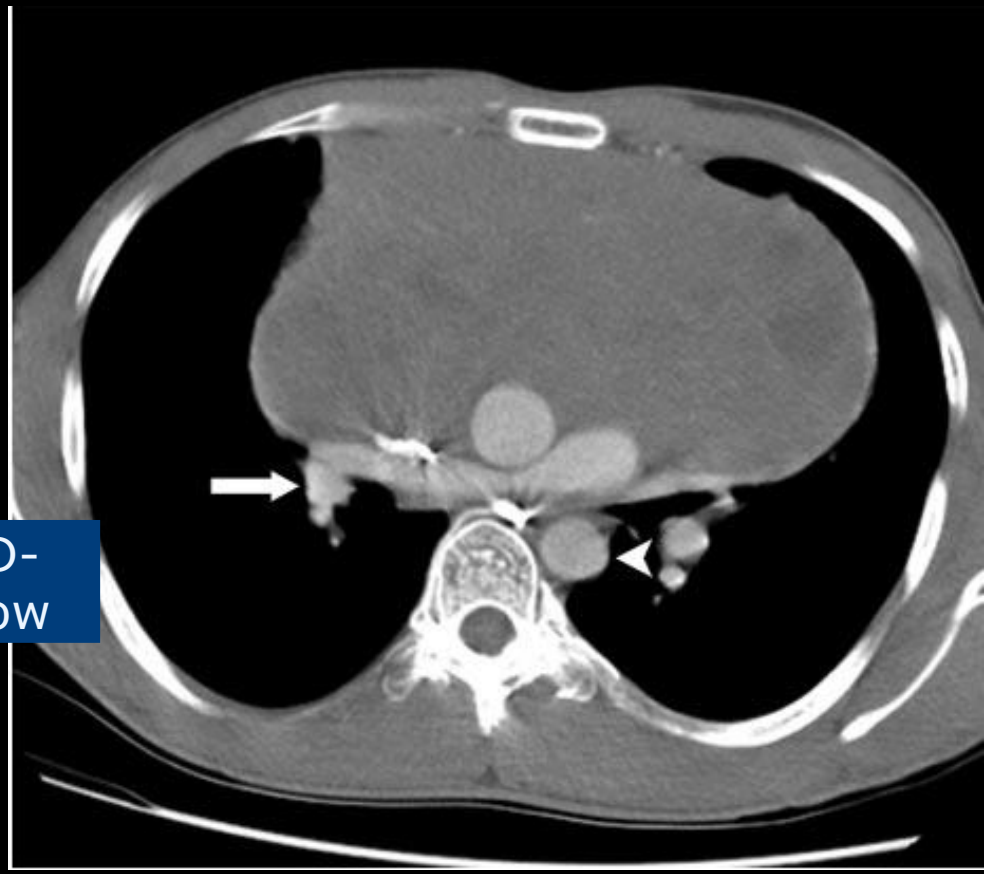
判讀**Anterior Mediastinal Mass**的一般原則

- 定位：
  - Mediastinal (junction) line: Ant. disrupted, Post. preserved
  - Hilum overlay sign(+): anterior or posterior to hilum
  - Location of lesion: 與diaphragm接觸的lesion, 如pericardial cyst/aneurysm, Morgagni hernia, pleuropericardial cyst
  - 利用anatomy的silhoutte sign:
    - A-aorta, SVC, heart border: anterior
    - Aortic arch: middle
    - D-aorta: posterior
- Tissue density

Lymphoma



Preserved D-aorta shadow



Hilum overlay sign

RadioGraphics 2007; 27:657–671

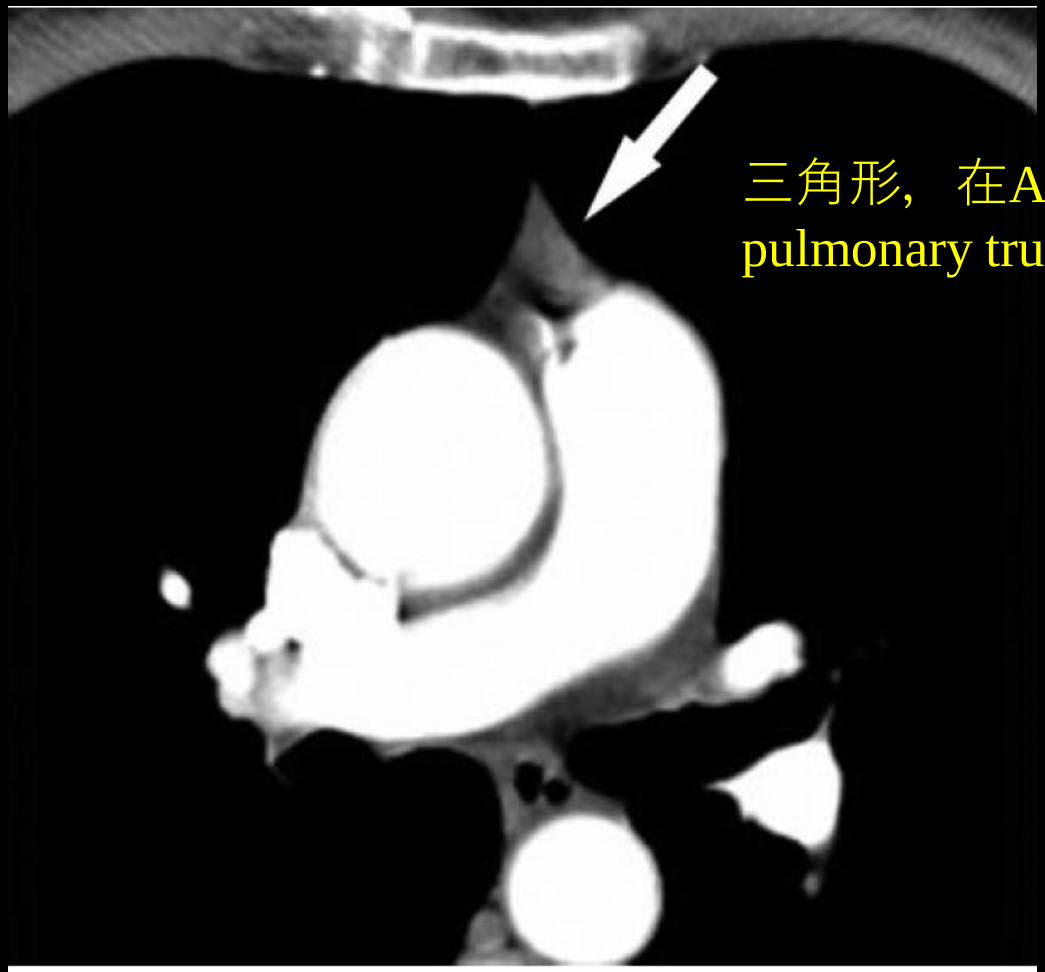
Thymic Lesions

- Thymoma :
  - 以是否有local invasion at surgery來分類
    - 分為invasive or non-invasive
  - 比較不prefer benign or malignant的分類
- Thymic carcinoma
- Thymic cyst

Thymoma(1)

- **Normal thymus**: located in the superior anterior mediastinum, usually anterior to the proximal A-aorta and distal SVC.
- 最常見的原發性前縱膈腔腫瘤， 約20%
- Middle-aged male adults(> 40 y/o)
- 10~15% MG p’t有thymoma， 35~40% thymoma p’t有MG
- Pure RBC aplasia (PRCA): thymoma最常見的hematologic abnormality, 5%
- Slow-growing, encapsulated
- Recurrence or local invasion常發生於anterior mediastinal soft tissue, pericardium, or pleura

Normal Thymus



三角形， 在A-aorta和main pulmonary trunk前面

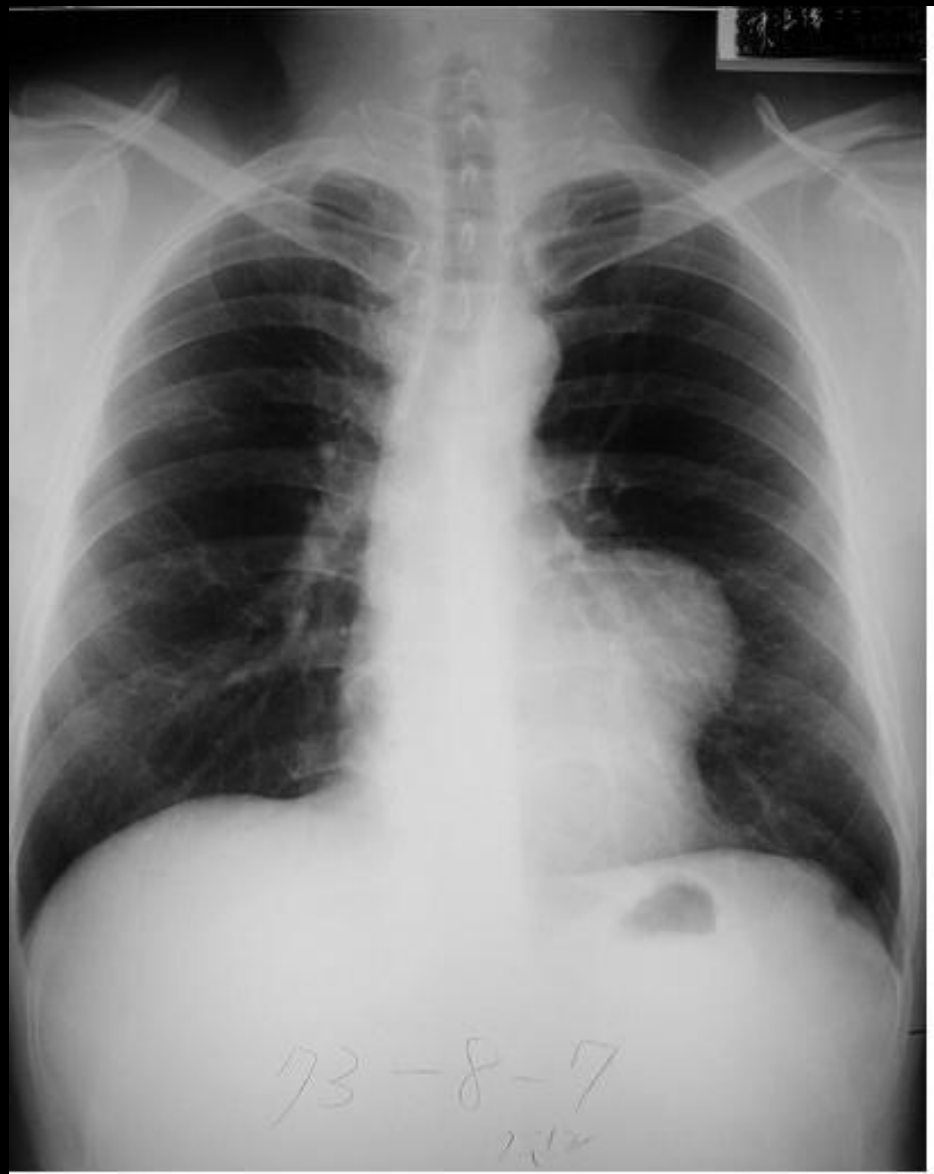
Figure 2. Contrast material–enhanced chest CT scan shows a normal thymus (arrow) as a triangular structure in the mediastinum anterior to the ascending aorta and the main pulmonary arterial trunk.

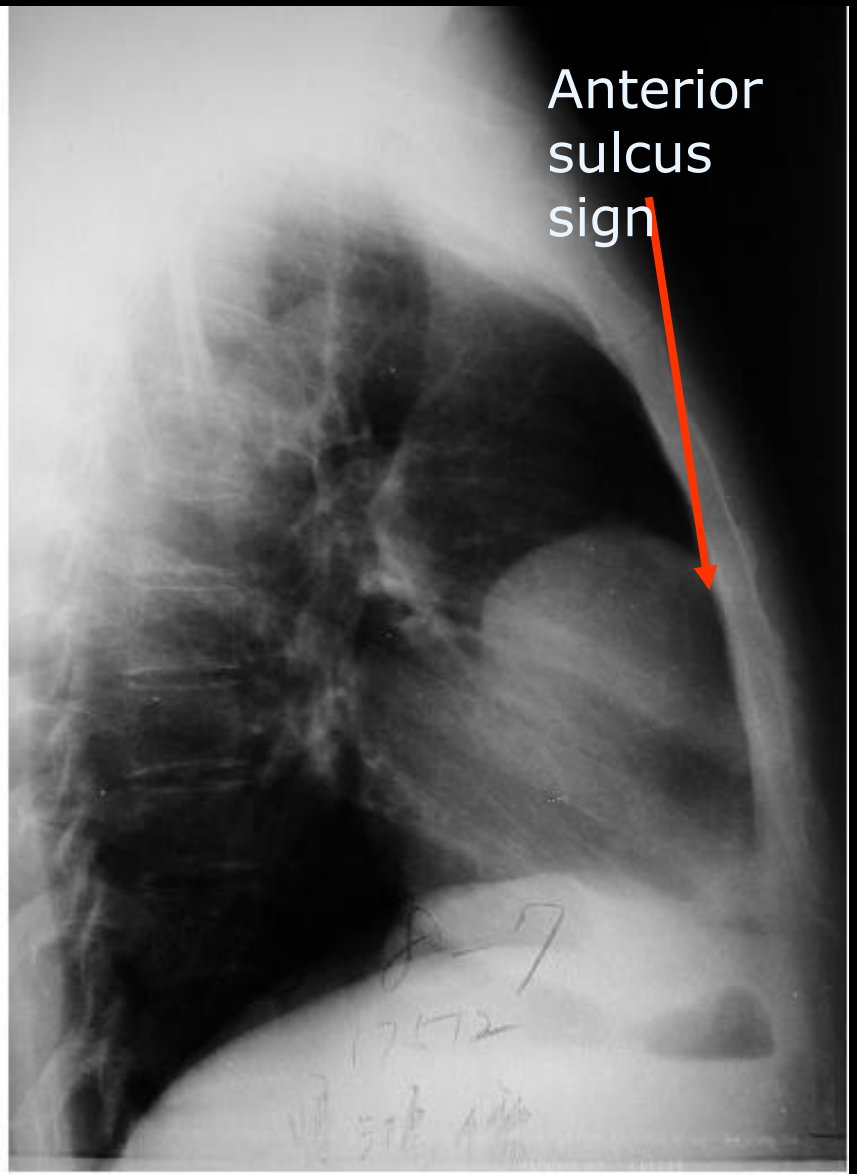
RadioGraphics 2006; 26:335–34

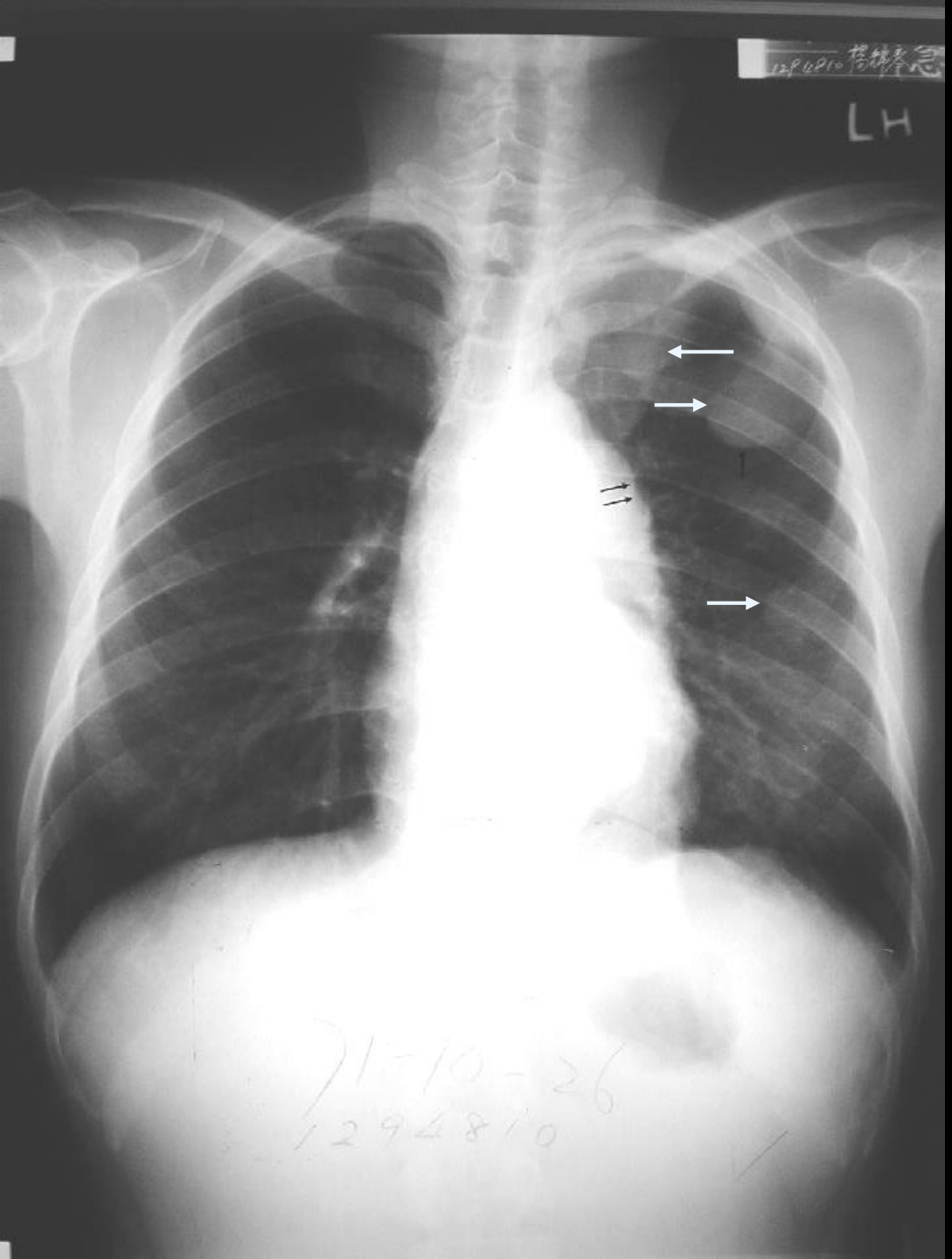
Thymoma(2)

- CXR:
  - Most near the junction of the heart and great vessels
  - Round or oval; smooth or lobulated margin
  - Anterior sulcus sign: when touching the sternum, not flattened against it (very firm)
  - Protrude to one or both sides of mediastinum
  - Calcification: thin, linear and peripheral or throughout its substance
  - Radiographic appearance between invasive or non-invasive thymoma is indistinguishable.
  - **Invasive thymoma**: rarely metastasis, but more commonly extends locally or seeds the pleural or pericardial surfaces.
- CT:
  - Bilateral, larger size, lobulated contour, poorly-defined margin, and associated pleural effusion/nodules/masses – favor **invasive thymoma**

Thymoma





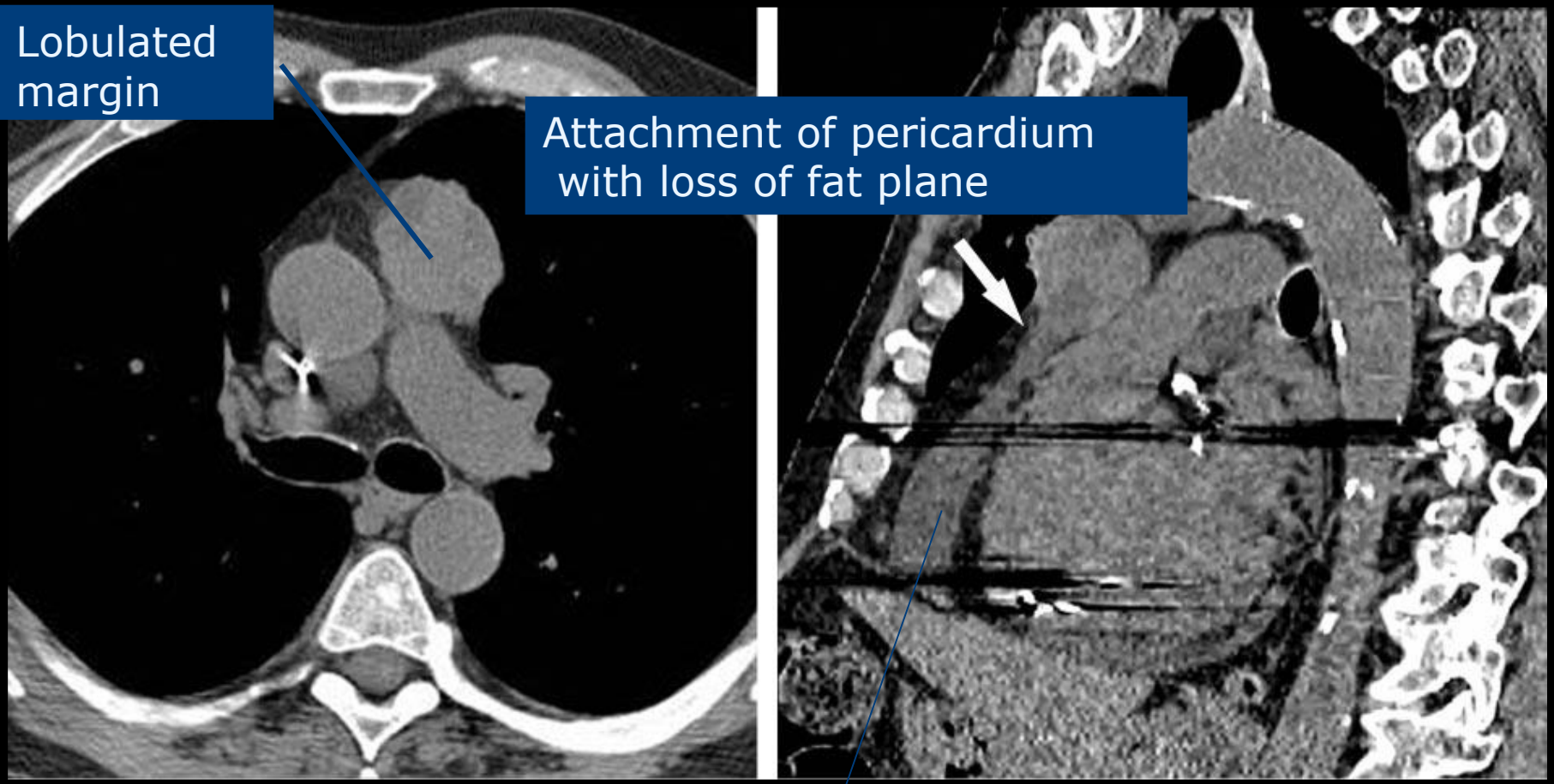


Invasive thymoma with pleural metastasis

Thymic Carcinoma

- CXR: lobulated, irregular marginated, large anterior mediastinal mass
- CT:
  - Heterogeneous enhancement with area of necrosis
  - Usually aggressive invasion of pericardium and pleura, great vessels and other mediastinal structures

Thymic Carcinoma

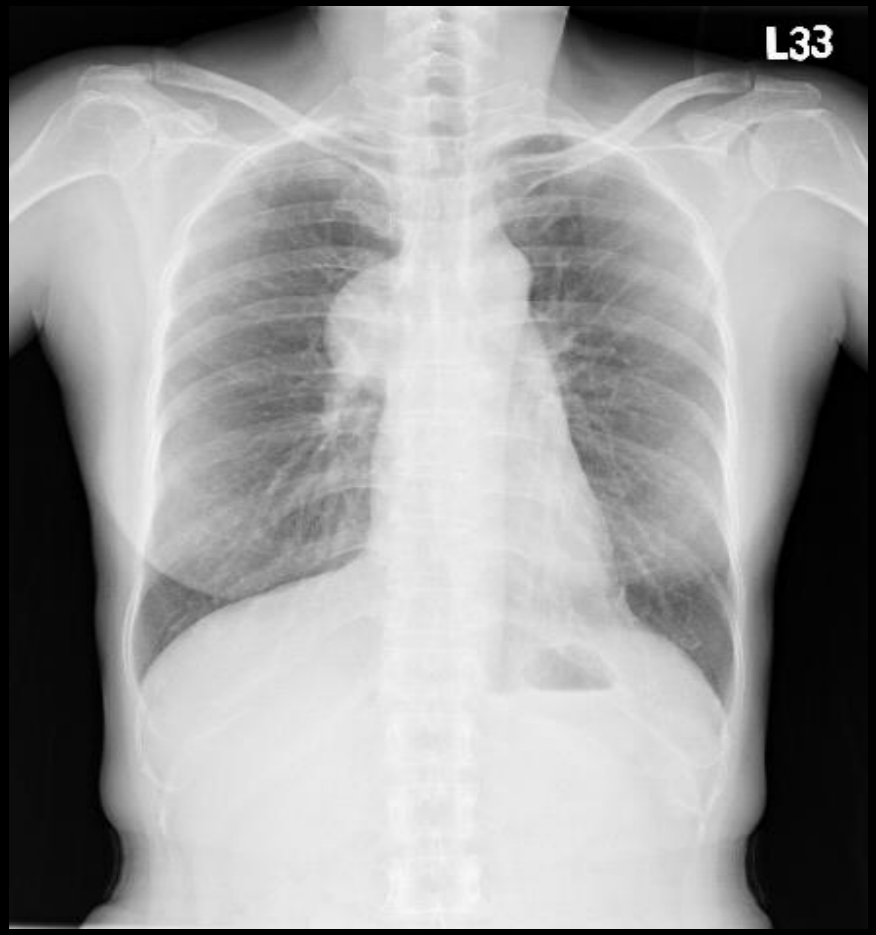


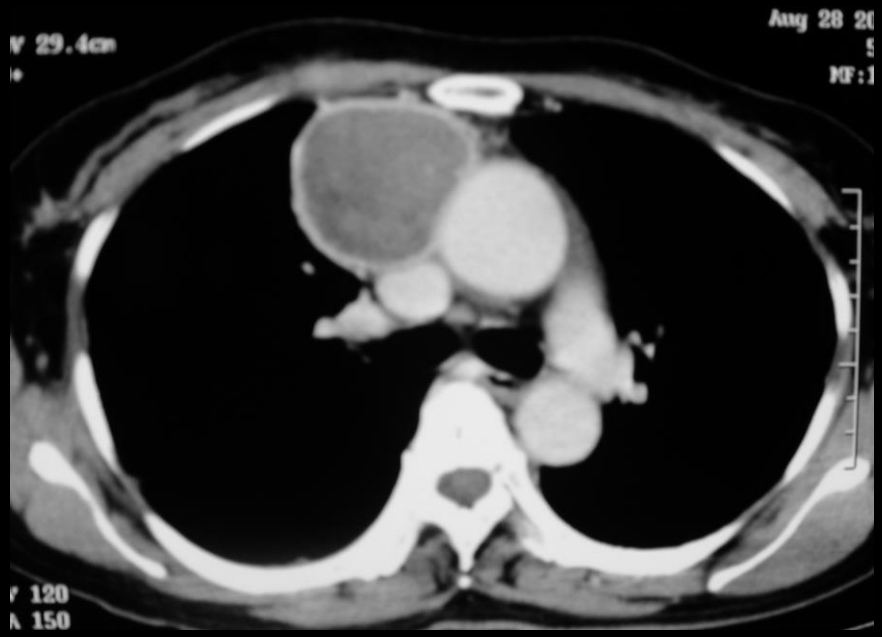
RadioGraphics 2006; 26:335–34

Thymic Cyst

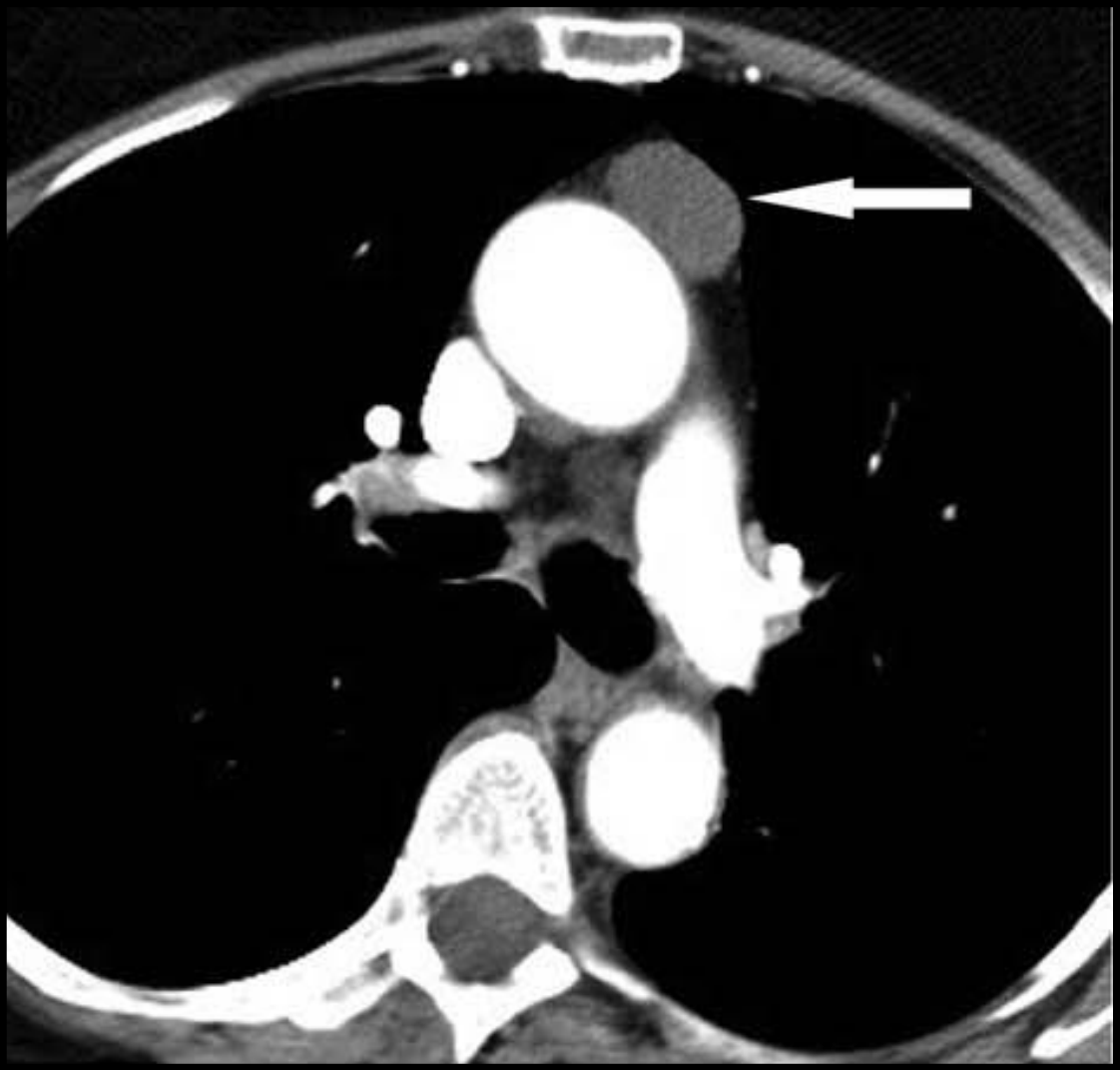
- CXR: well-marginated anterior mediastinal mass
- CT:
  - Anterior mediastinal mass with a single dominant or multiple thin-walled cysts

Thymic cyst





Thymic Cyst



RadioGraphics 2006; 26:335–34

Germ Cell Tumor

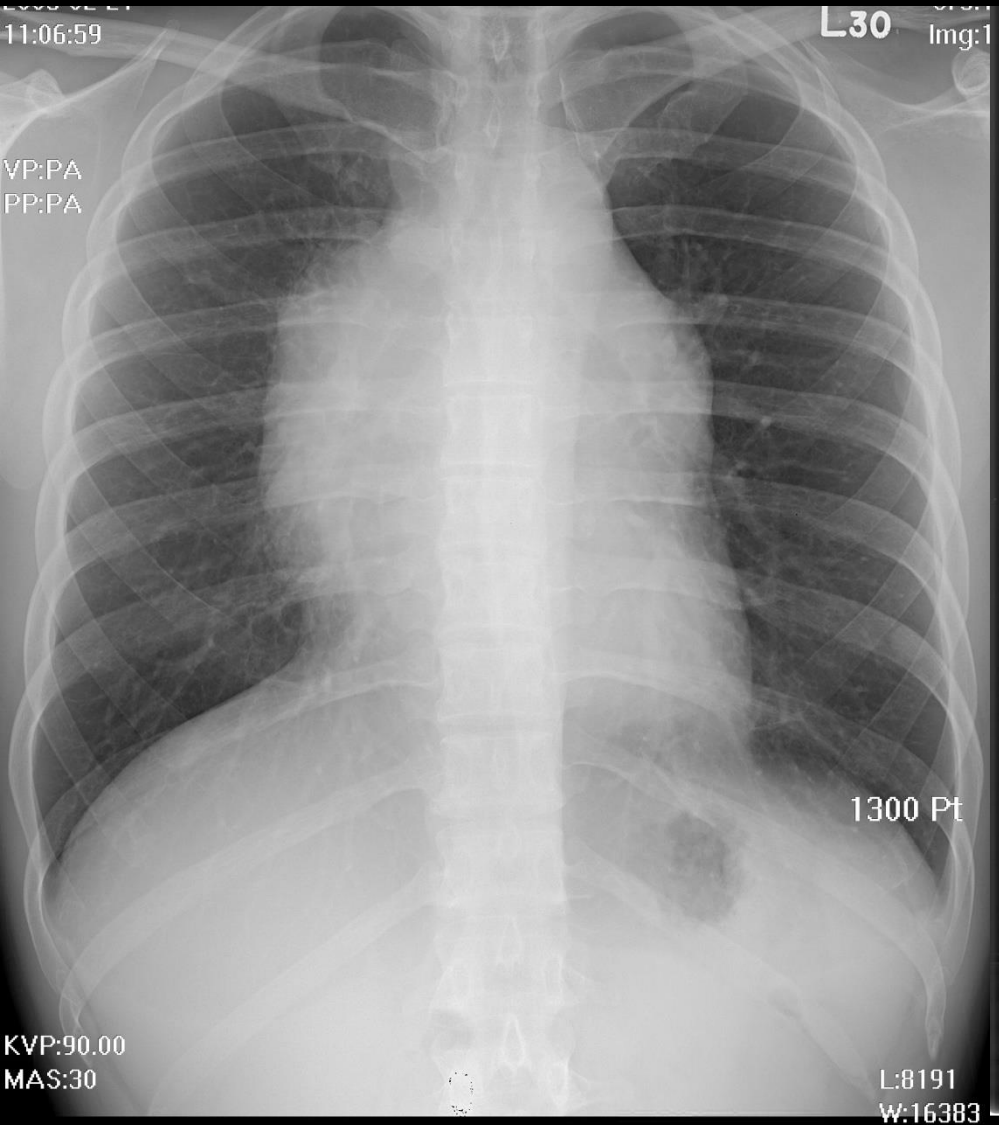
- Classifications:
  - Teratoma
  - Seminoma
  - Non-seminomatous germ cell tumor (NSGCT)

Teratoma

- Most common mediastinal GCT; 70%
- Most often in children or young adult(20-30y/o); 男=女
- 3 histologic types:
  - Mature teratoma: benign
  - Immature teratoma: low potential to malignancy
  - Teratoma with malignant transformation: aggressive malignant
- CXR:
  - Lopsided(偏向一邊), lobulated, well-marginated mass; most common in anterior mediastinum(85%), usually near thymus
  - 25% calcification
  - Soft, tend to be flattened against mediastinum: 與thymoma不同
- CT:
  - Multiloculated cystic mass with variable thickness wall (80%), may contain fat, fluid, soft tissue and calcification densities; finding of teeth is pathognomonic

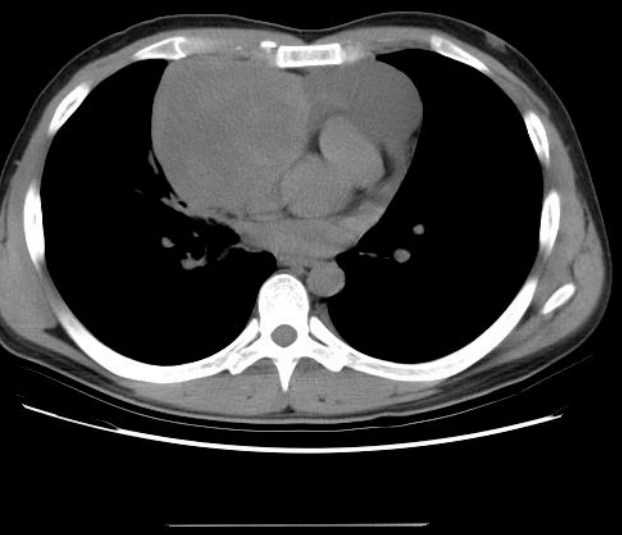
【比較】位置相近，同為well-defined anterior mediastinal mass

	年齢	與sternum 接觸時
Thymoma	中年人 (>40y/o)	Not flattened (Ant. Sulcus sign)
Teratoma	兒童或年輕人	Flattened

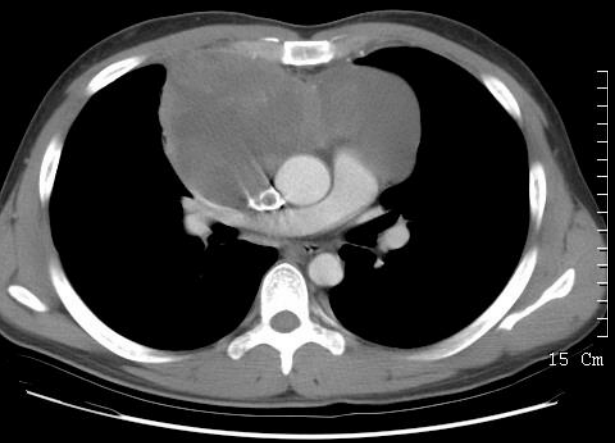
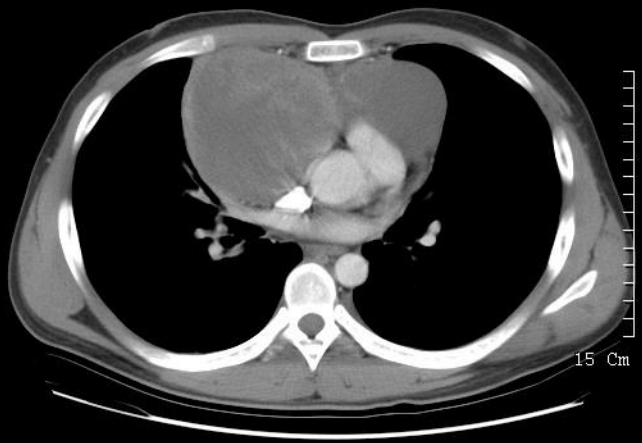
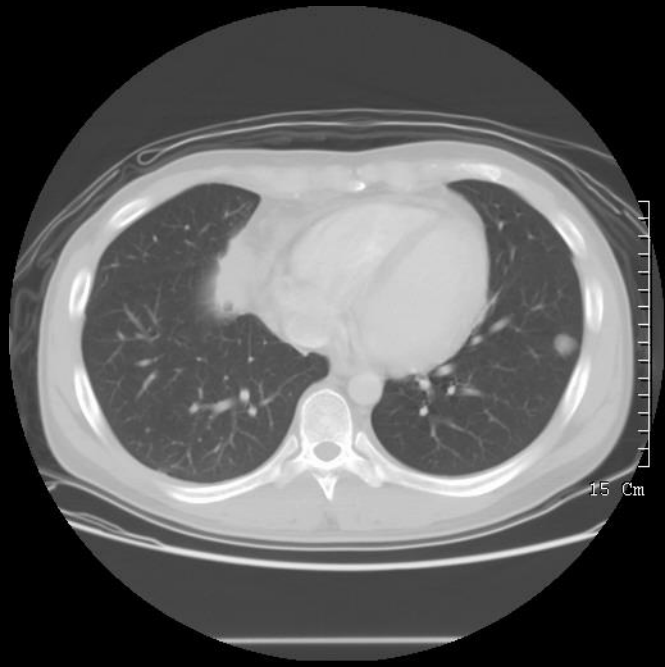


Germ cell tumor
high AFP

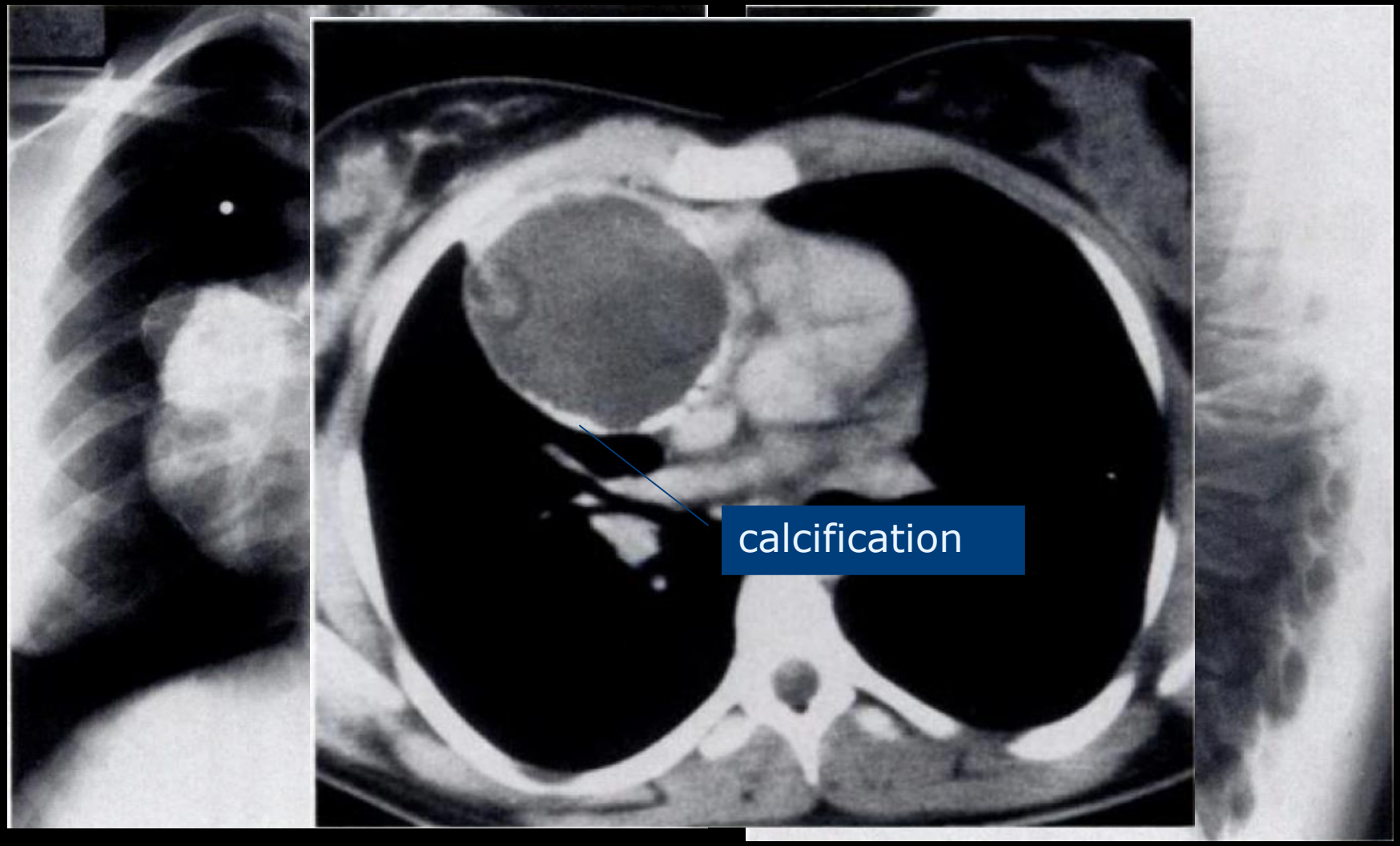
29 y/o man, Chest pain with radiation to right chest wall for 1 month; mild eyelid and facial swelling



15 Cm

15 Cm

15 Cm

15 Cm

15 Cm

Mature Teratoma

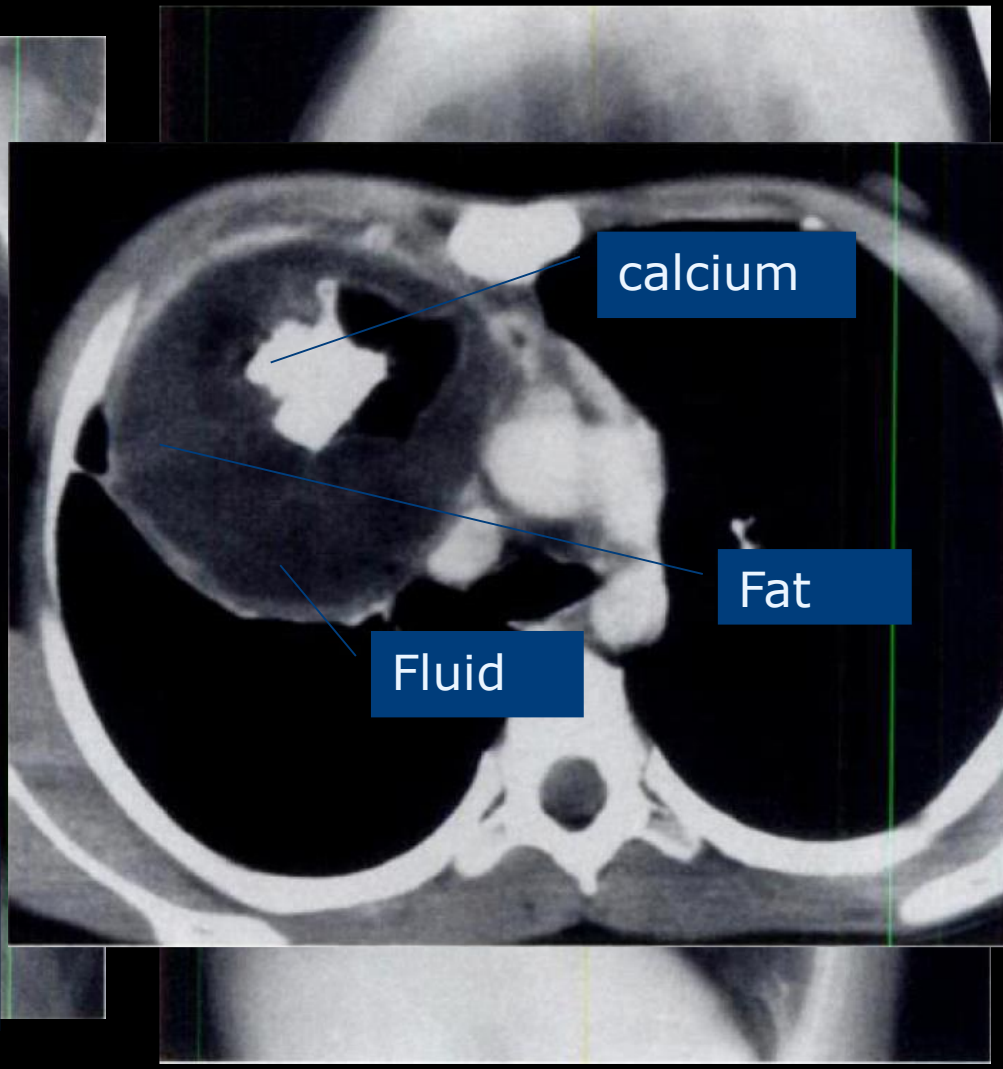


16 y/o girl, asymptomatic; a lobulated ant. Mediastinal mass

RadioGraphlcs 1992; 12:1013-1030

Mature Teratoma

Radiology of excisional specimen: Rudimentary mandible with teeth



11 y/o girl, asymptomatic

RadioGraphlcs 1992; 12:1013-1030

Calcified Mediastinal Mass

- **3T+1L**
  - Teratoma
  - Thyroid goiter
  - Thymoma
  - “Treated” lymphoma
- **Calcified LAP**
  - Fibrosing mediastinitis: histoplasmosis, TB
  - Silicosis
  - Sarcoidosis
- **Aortic aneurysm**
- **Rim calcification**
  - Cystic teratoma
  - Thymic cyst
  - Aortic aneurysm
  - Duplication cyst
    - Bronchogenic cyst
    - Neuroenteric cyst

Thyroid Lesions

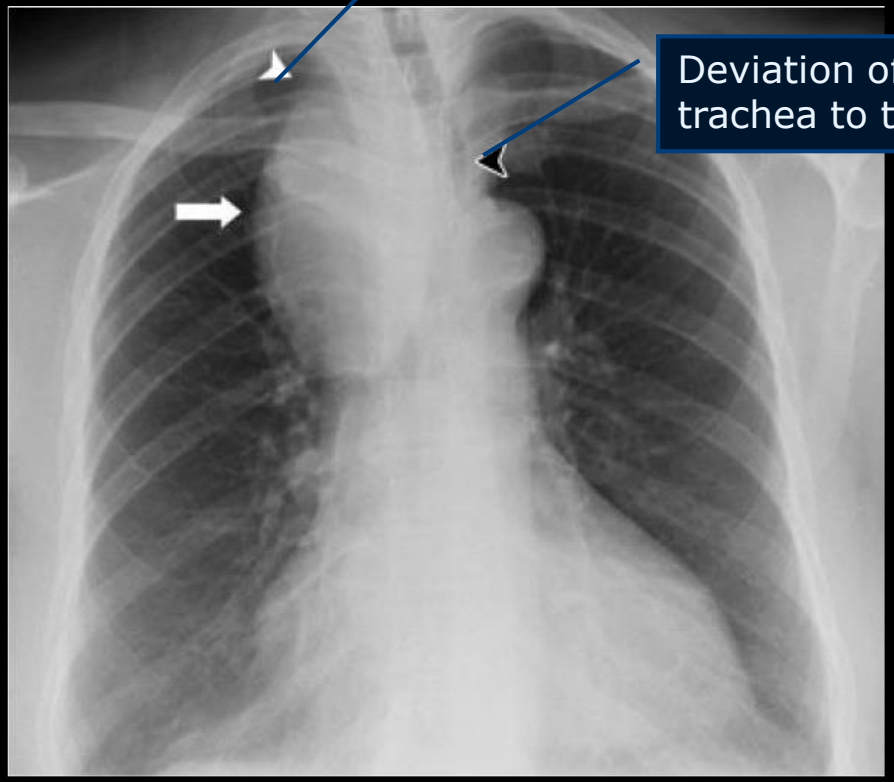
- The most frequent pathologic finding is multi-nodular goiter
- 75-80% arise from a lower pole or the isthmus and extend into the anterior or middle mediastinum.
- Frequently associates with a palpable neck mass
- D/D with other thoracic inlet lesions

Thyroid Lesions

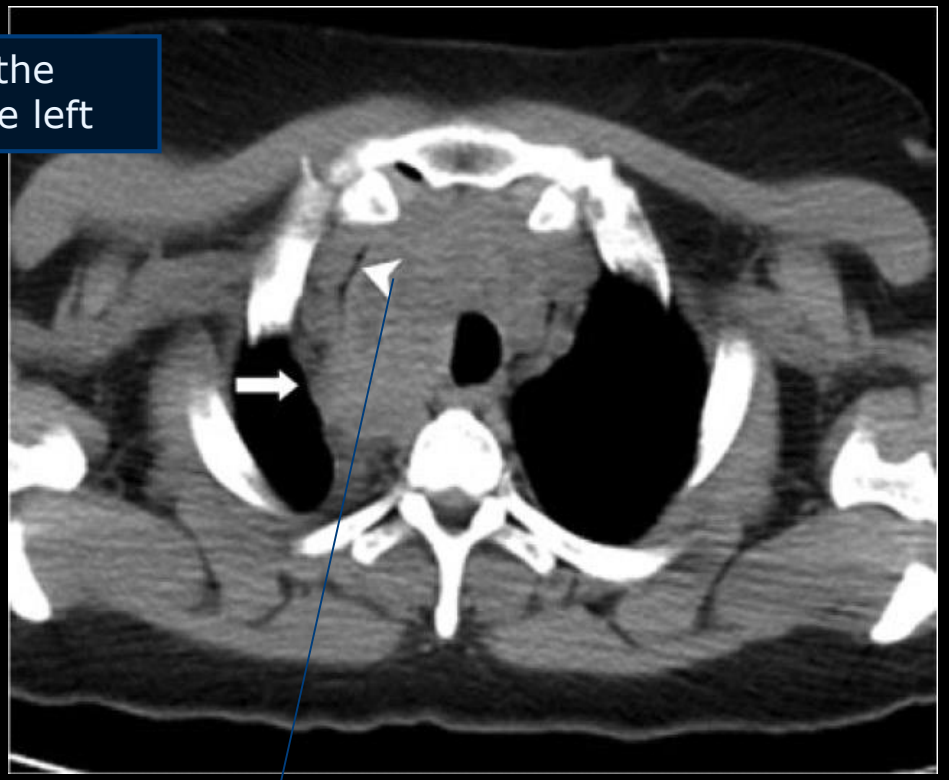
- CXR:
  - ★ 邊緣平滑清楚的mass + tracheal deviation at the level of thoracic inlet.
  - ★ Tend to extend above the clavicle.
  - 25% calcification
  - Lat. view: anterior goiter fill in retrosternal clear space, and deviate trachea posteriorly.
- Chest CT:
  - NECT:
    - High attenuation due to natural iodine
    - Sharply demarcated heterogeneous mass
  - CECT:
    - Strong enhancement

Right-sided retrosternal goiter

The margins of the mass above clavicle are not sharp, indicating that the mass has an anterior mediastinal component.

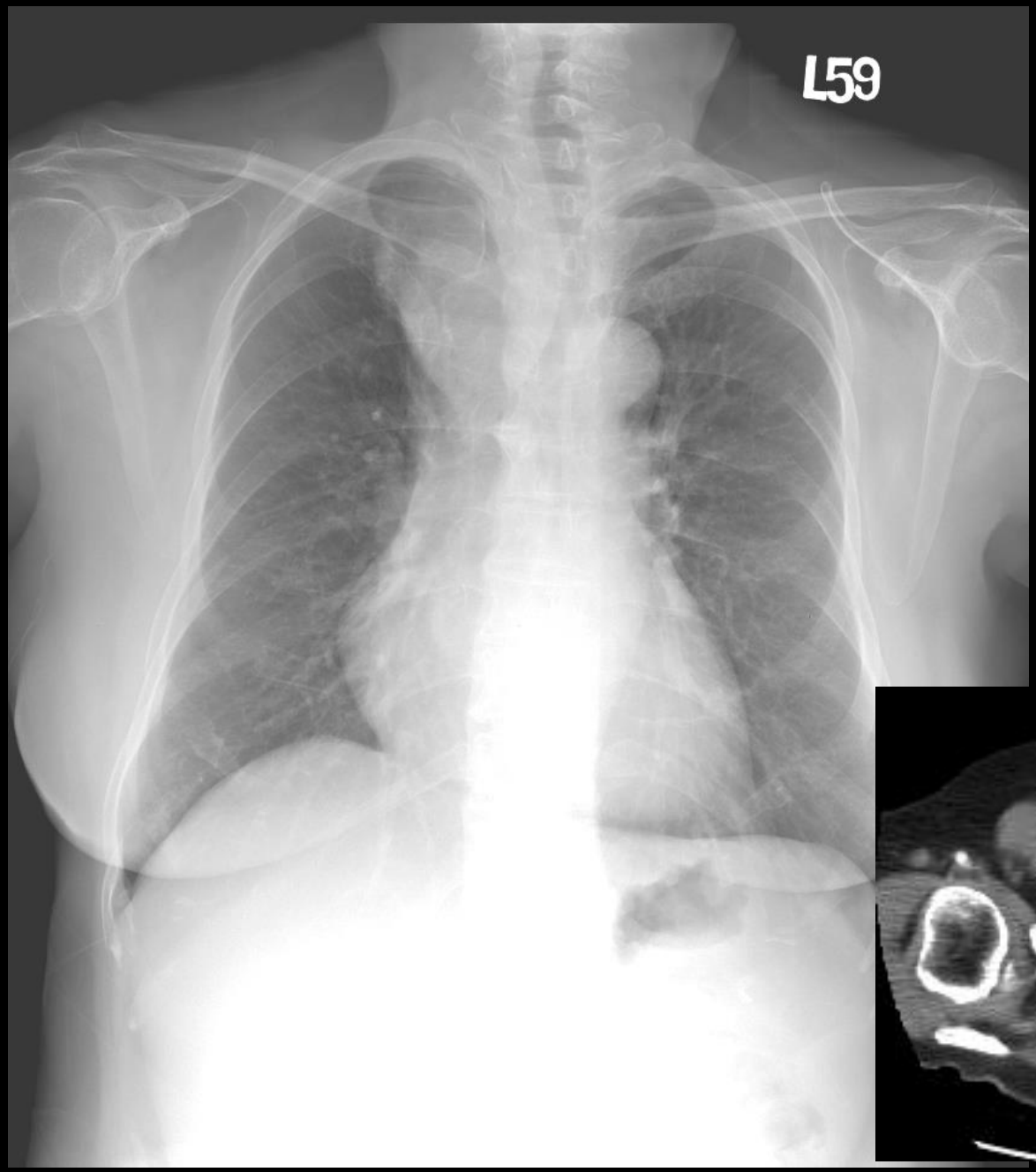


Deviation of the trachea to the left



No contact between the anterior component of the mass and the lung at the level of the clavicular heads, a relationship that continues above the level of the clavicles. This finding explains why the lateral border of the anterior mediastinal component above the level of the clavicles is not sharp

RadioGraphics 2007; 27:657–671



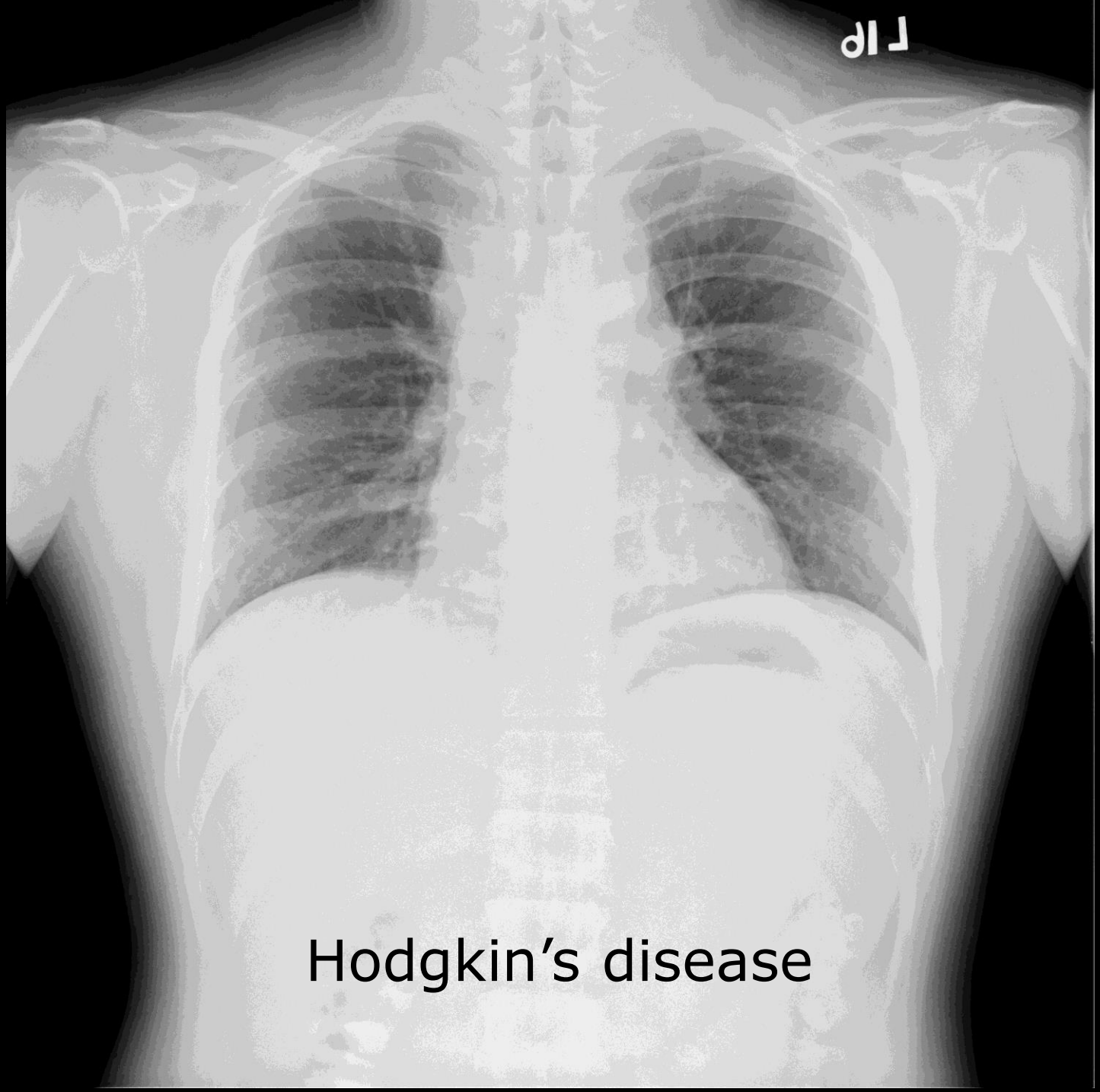
Intrathoracic goiter

Lymphoma

- As a mediastinal tumor, **H.D.(85%) > NHL(50%)**
- CXR:
  - Most commonly involve anterior, superior mediastinal LN (prevascular, paratracheal), bilateral, bulky and asymmetric
  - Bilateral mediastinal widening with lobulation
  - 20% calcification after R/T; rim or mulberry(桑椹)
  - Lung involvement: usually peripheral and subpleural
    - Consolidation with air-bronchogram
    - Single or multiple discrete pulmonary nodules/masses, less well-defined and less dense
    - Diffuse reticulonodular opacities (LIP)
- Chest CT
  - Minimally enhanced in CECT
  - 通常會encase or displace鄰近的structures, 很少會侵犯或是造成狹窄。

TABLE 1: Frequency of Findings in Hodgkin Disease and Non-Hodgkin Lymphoma

Finding	No. of Patients (%)		
	Hodgkin Disease (n = 15)	Non-Hodgkin Lymphoma (n = 16)	Total (n = 31)
Nodules	10 (67)	9 (56)	19 (61)
Masses	12 (80)	9 (56)	21 (68)
Infiltrates	6 (40)	5 (31)	11 (35)
Pleurally based masses	5 (33)	5 (31)	10 (32)
Peribronchial thickening	6 (40)	11 (69)	17 (55)
Pleural effusion	6 (40)	7 (44)	13 (42)
Adenopathy	8 (53)	3 (19)	11 (35)



Hodgkin’s disease

Middle Mediastinum

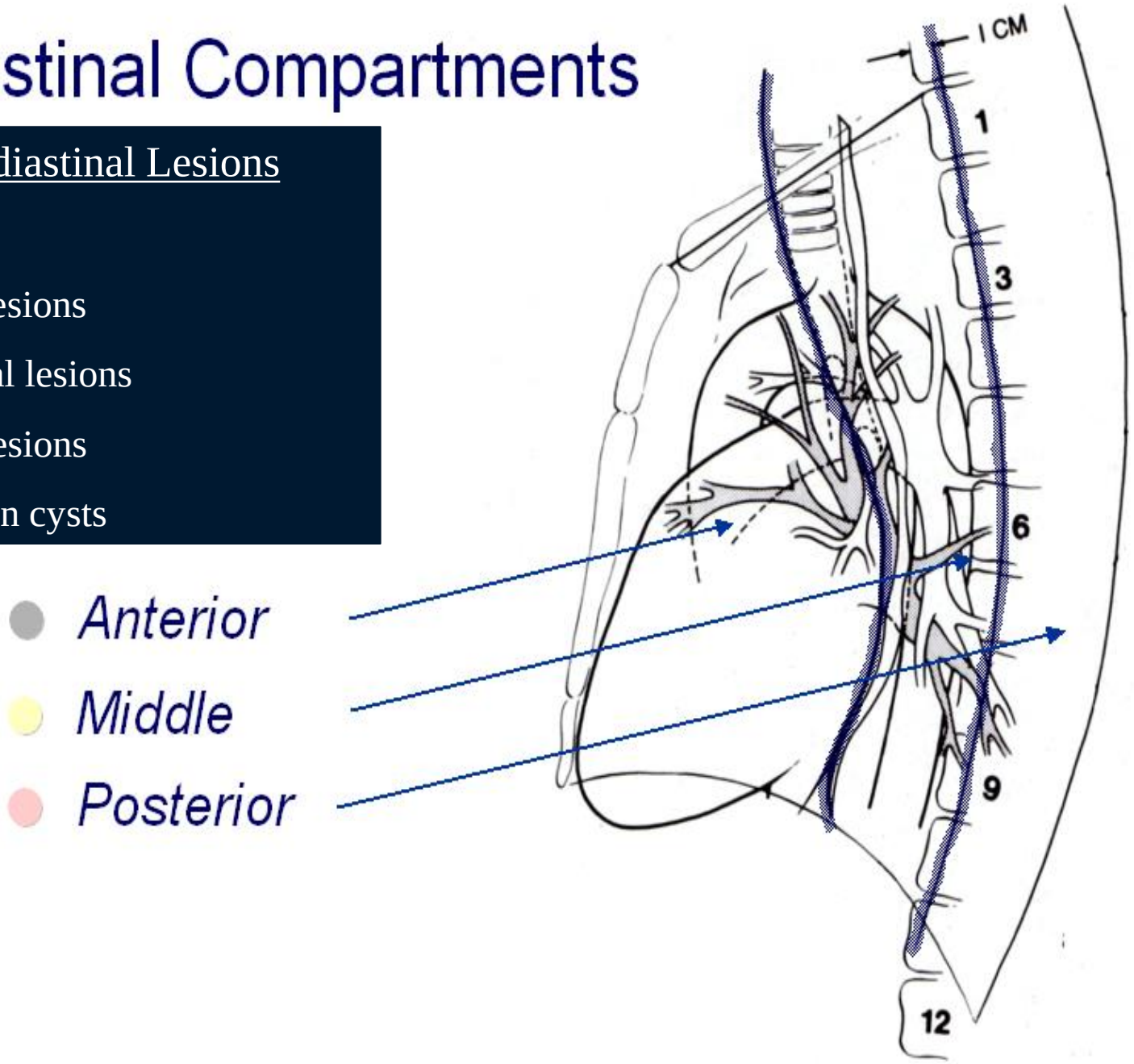
Table 2
Middle Mediastinal Masses

Lymphadenopathy
Aortic arch aneurysm
Enlarged pulmonary artery
Foregut duplication cysts (bronchogenic, esophageal, neurenteric)
Pericardial cyst
Tracheal lesions

Mediastinal Compartments

Middle Mediastinal Lesions

1. LAP
2. Vascular lesions
3. Esophageal lesions
4. Tracheal lesions
5. Duplication cysts



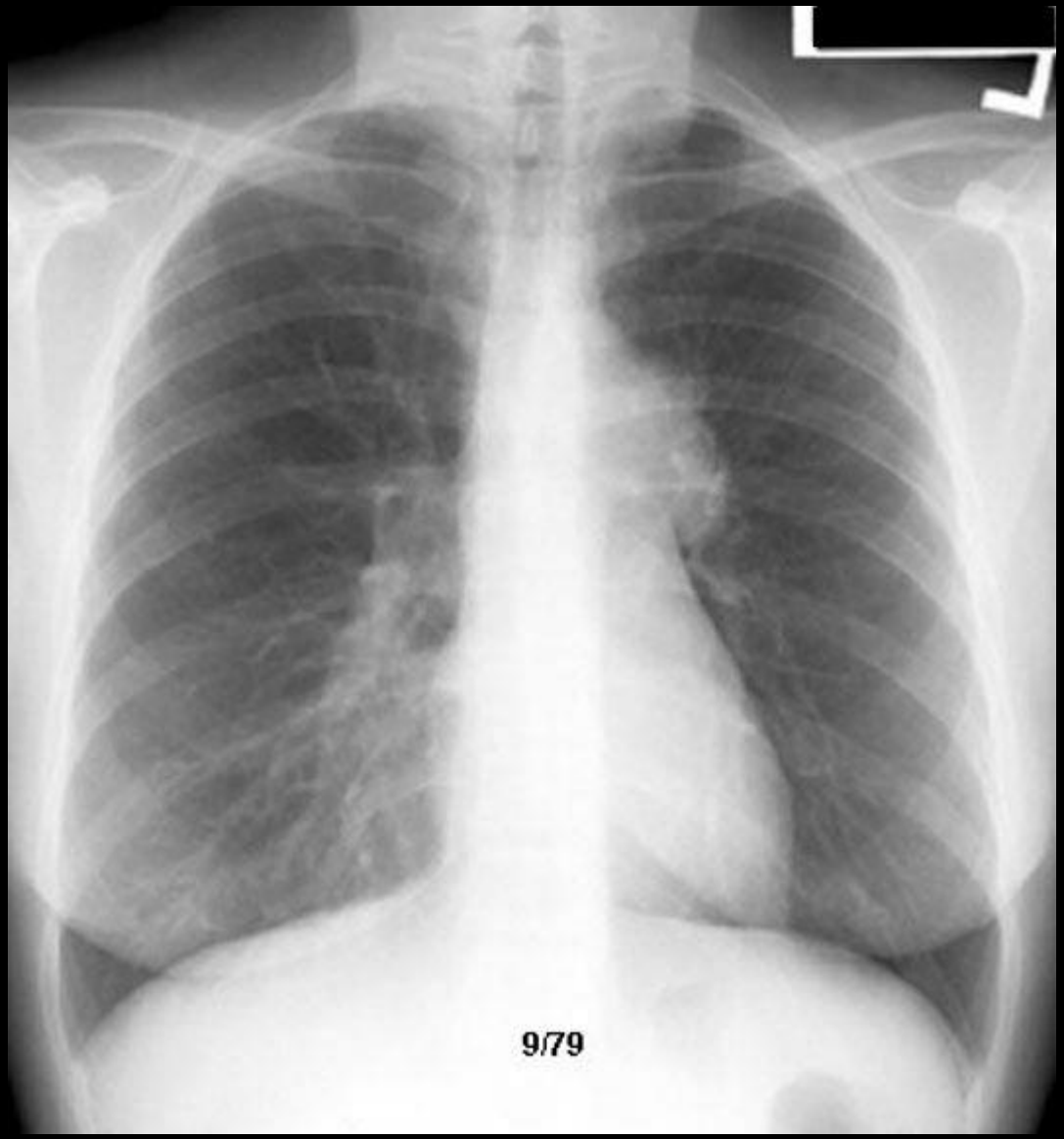
Lymphadenopathy (LAP)

- Neoplastic
- Infection / Inflammatory
- Inhalational

Neoplastic Adenopathy

- Neoplastic LAP is the most common middle mediastinal lesions
- Causes :
  - Lung cancer is the most common cause for neoplastic LAP
  - Lymphoma
  - Small cell lung cancer can mimic lymphoma
- Neoplastic adenopathy很少產生 calcification, 除了:
  - Osteogenic sarcoma (OGS)
  - Hodgkin's lymphoma s/p R/T

Small cell lung cancer with hilar lymphadenopathy



Inflammatory Adenopathy

- Primary TB
- Fungus: Histoplasmosis
- Viral pneumonia (measles pneumonia)
- Infectious mononucleosis
  (rare pulmonary infiltrates, spleen enlargement)
- Sarcoidosis
- AIDS

Inflammatory Adenopathy (1)

- **Primary TB:**
  - Primary complex (Ghon complex)
    - Localized air space consolidation (esp. in the middle or lower lobe) + LAPs in a child is a classic CXR presentation.
  - After recovery, LN calcification can occurs.

- **Histoplasmosis:**
  - In endemic area, more common than TB.
  - Tend to have bulky nodes and higher incidence of calcification than TB.

Inflammatory Adenopathy (2)

- **Viral pneumonia:**
  - Particularly measles pneumonia.
  - Pulmonary infiltrates + mediastinal LAPs in child.
  - D.D: primary TB, fungus infection

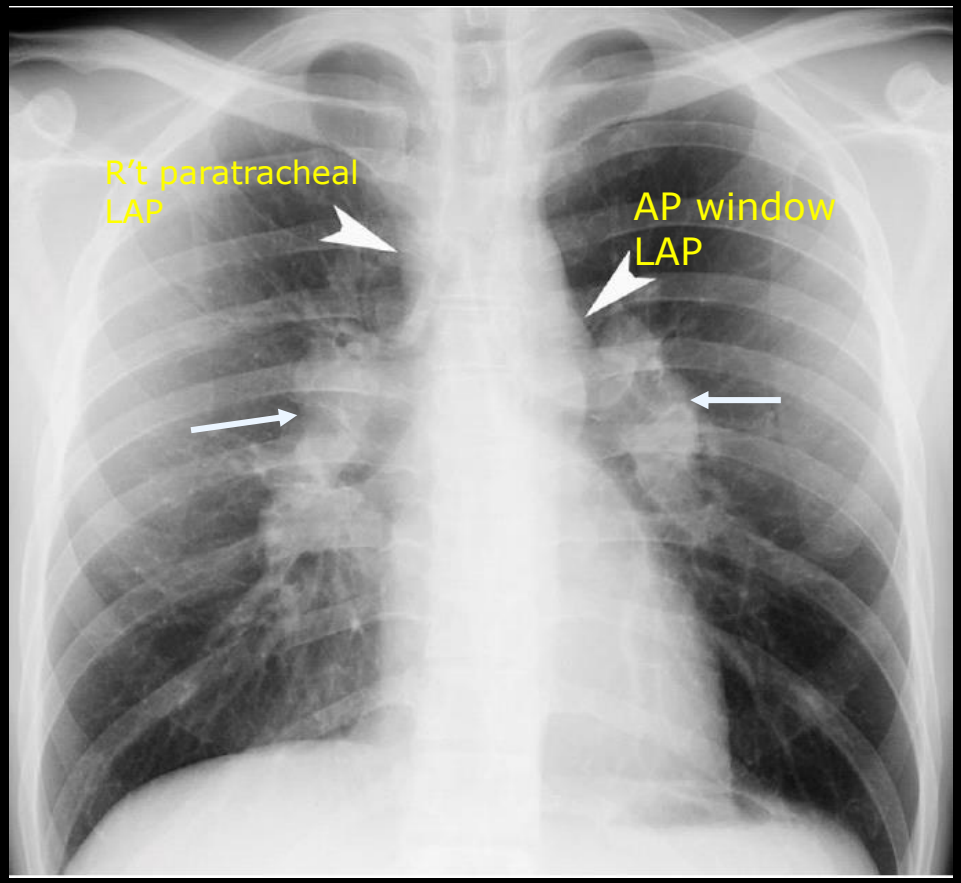
- **Infectious mononucleosis:**
  - 常有widespread LAP, 但是少有 pulmonary infiltrates
  - 常有spleen enlargement

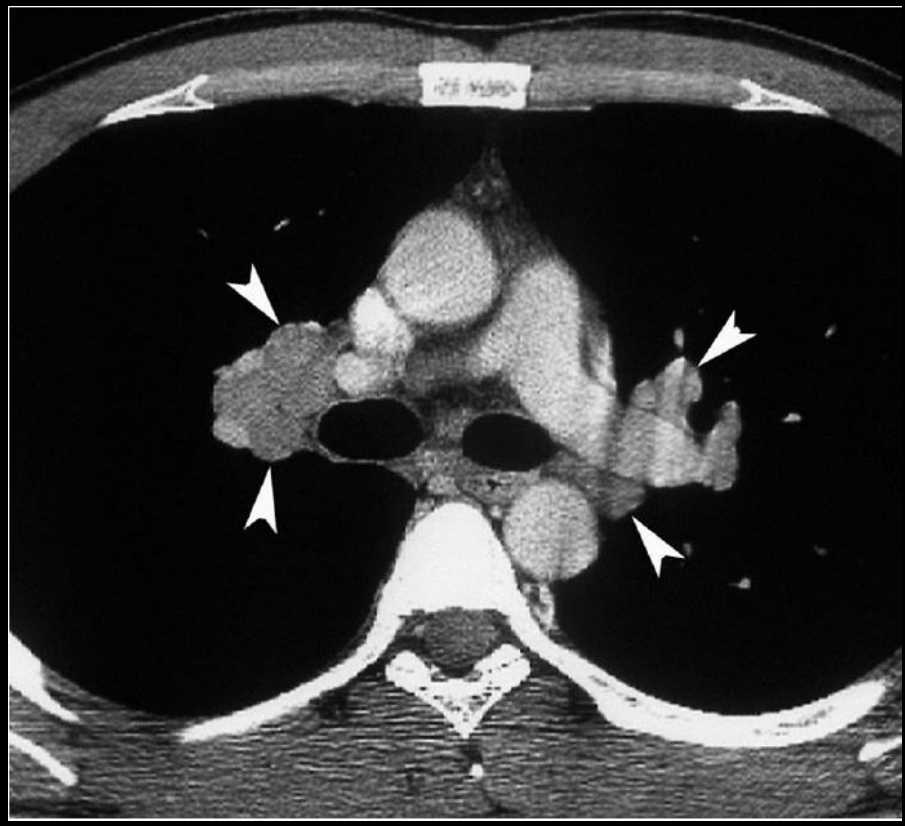
Inflammatory Adenopathy (3)

- **Sarcoidosis:**
  - Characteristic CXR: 1-2-3 sign
    - symmetric hilar LAPs + right paratracheal LAPs

- AIDS:
  - Massive LAPs in AIDS 須考慮:
    - Infection: TB, NTM
    - Malignancy: NHL, Kaposi's sarcoma
    - Drug reactions

Sarcoidosis with mediastinal and hilar lymphadenopathy



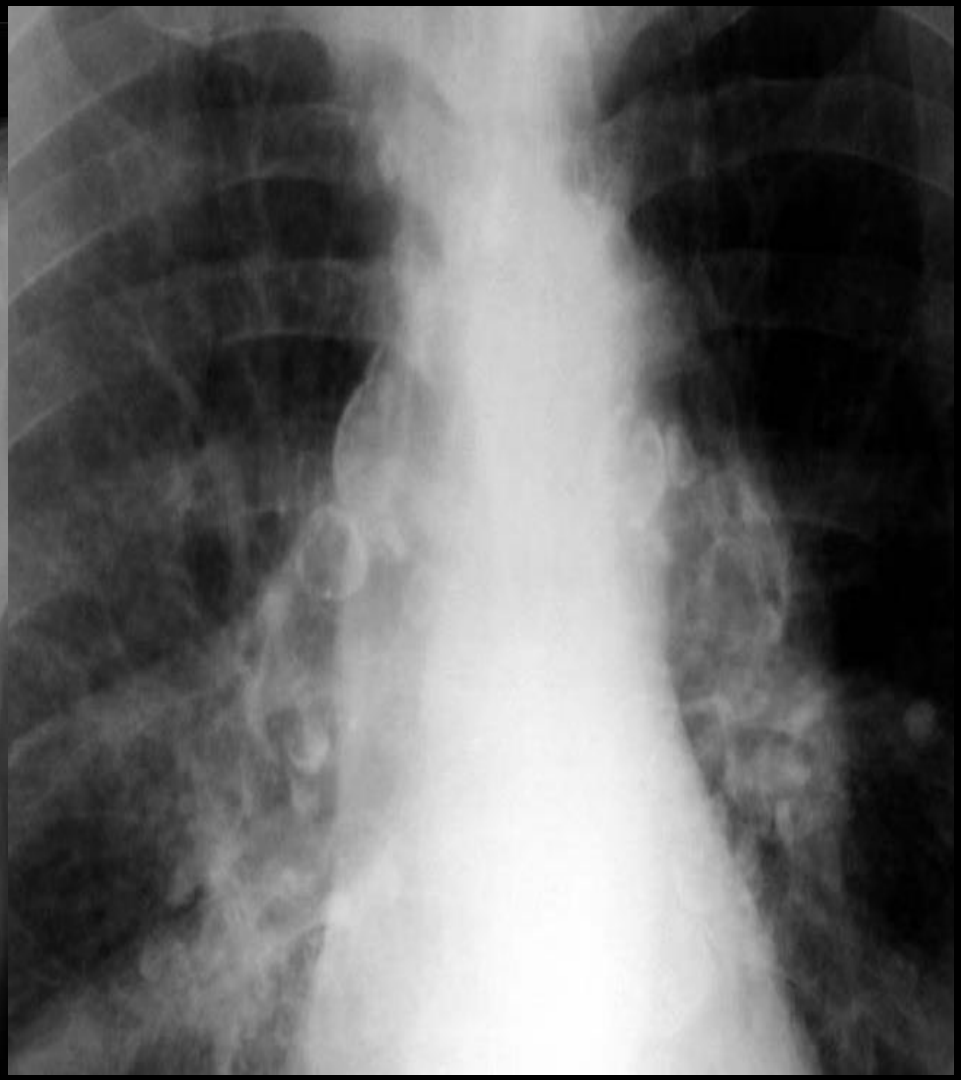


RadioGraphics 2004; 24:87–104

Inhalational Disease Adenopathy

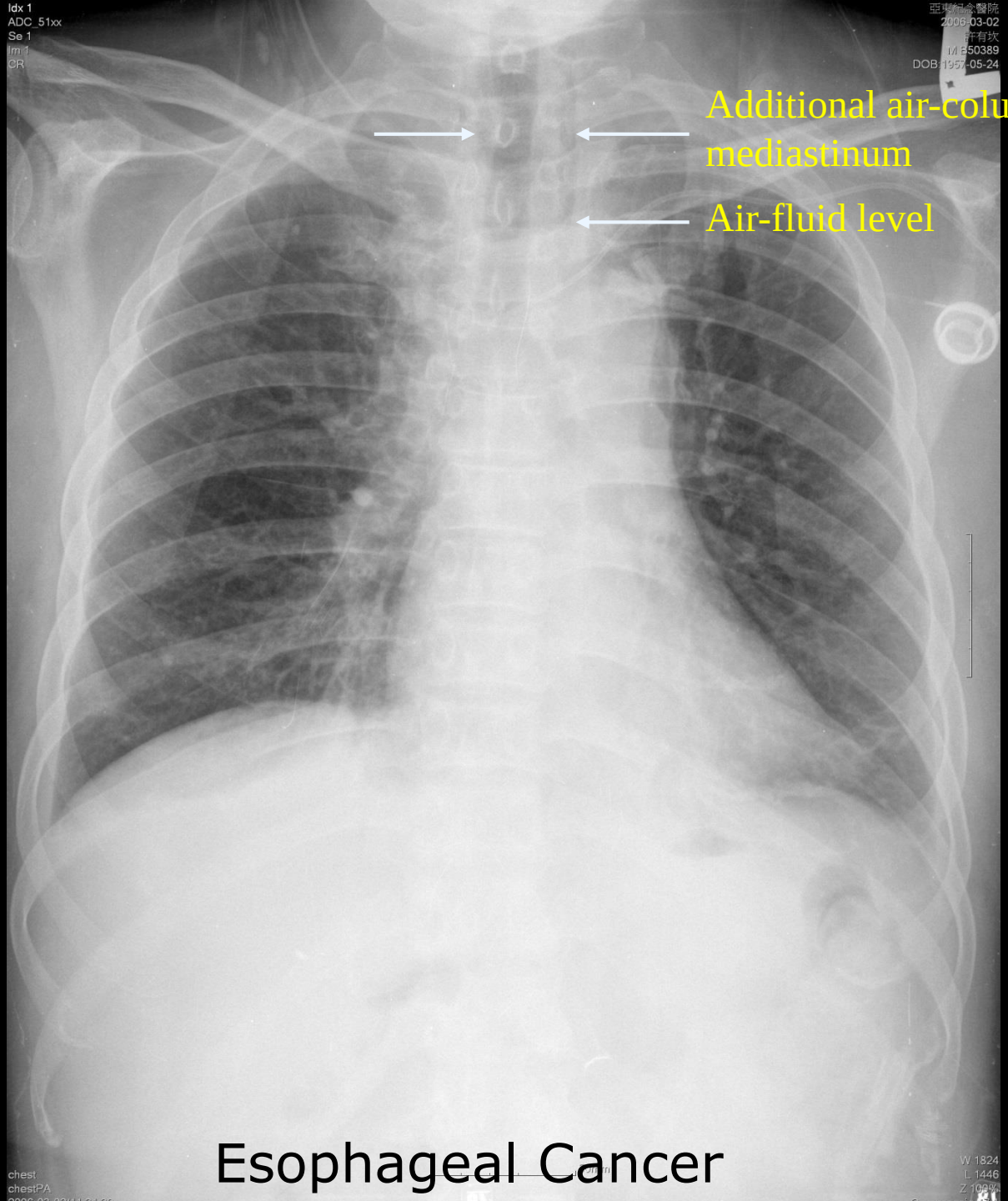
- Silicosis and pneumoconiosis are well-known causes of both hilar and mediastinal LAPs.
- Invariably associated with pulmonary disease: reticulonodular infiltrations.
- Eggshell calcification
- 重要
- 會產生 eggshell calcification 的疾病:
  - Silicosis: most common and typical
  - Sarcoidosis
  - TB
  - Lymphoma post R/T

Silicosis with eggshell calficication of mediastinal and hilar LAP

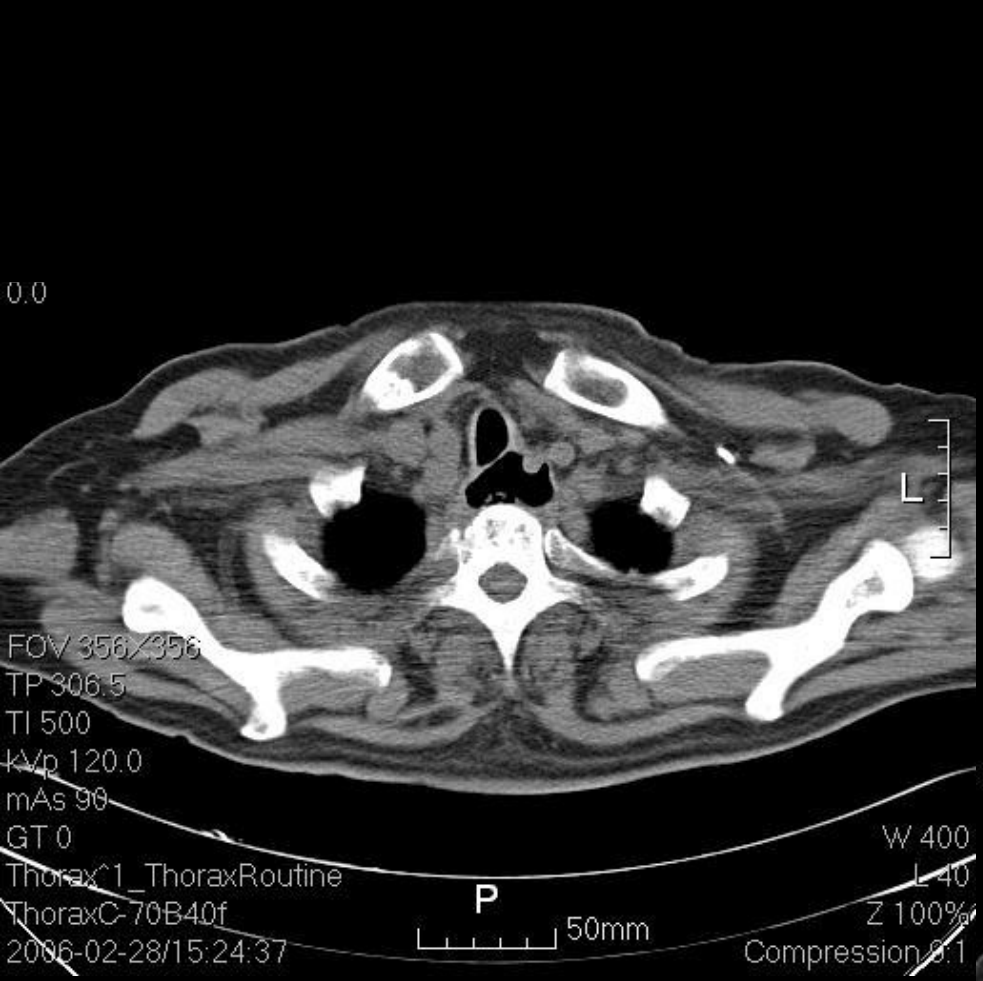


Esophageal Lesions

- **Esophageal cancer**
  - Abnormal azygoesophageal recess(30%)
    - M/3 and L/3 eso. Ca. 可能造成azygoesophageal recess變寬和 azygoesophageal line convex to R't side
  - Widened mediastinum
  - Tracheal deviation
  - Retrocardiac mass
  - 最常見 **Esophageal air-fluid level**
  - Posterior tracheal indentation or mass
  - 最常見 **Widened posterior tracheal stripe**
    - Post. tracheal strip: normal ≦3.5mm, abnormal ≧4mm
    - Causes: paratracheal/paraesophageal lymphatic engorgement, retained secretion by distal obstruction by tumor, U/3 tumor itself



Esophageal Cancer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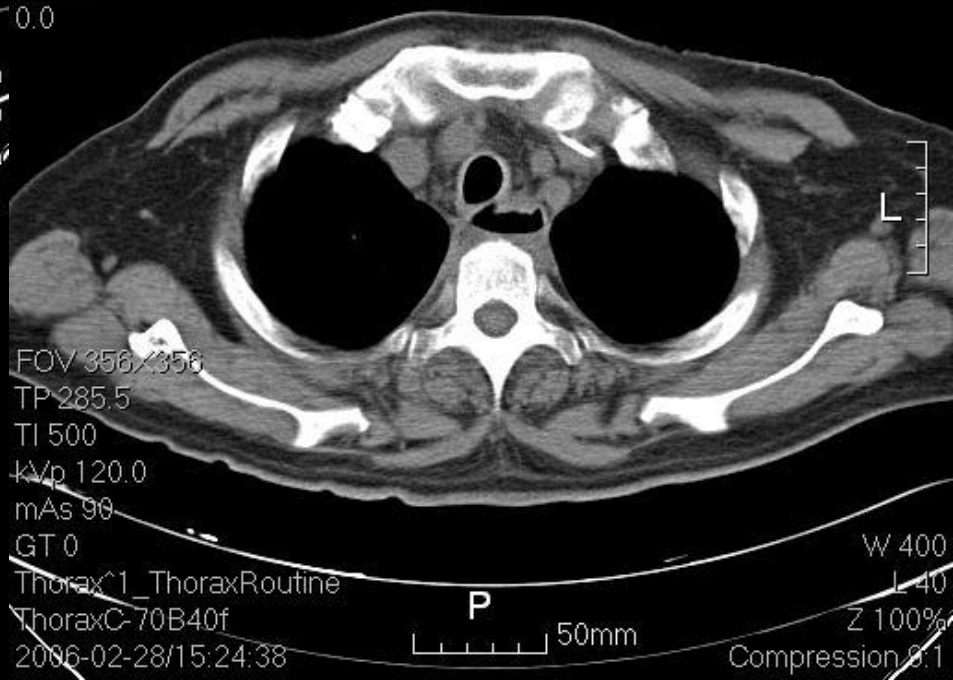
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50mm
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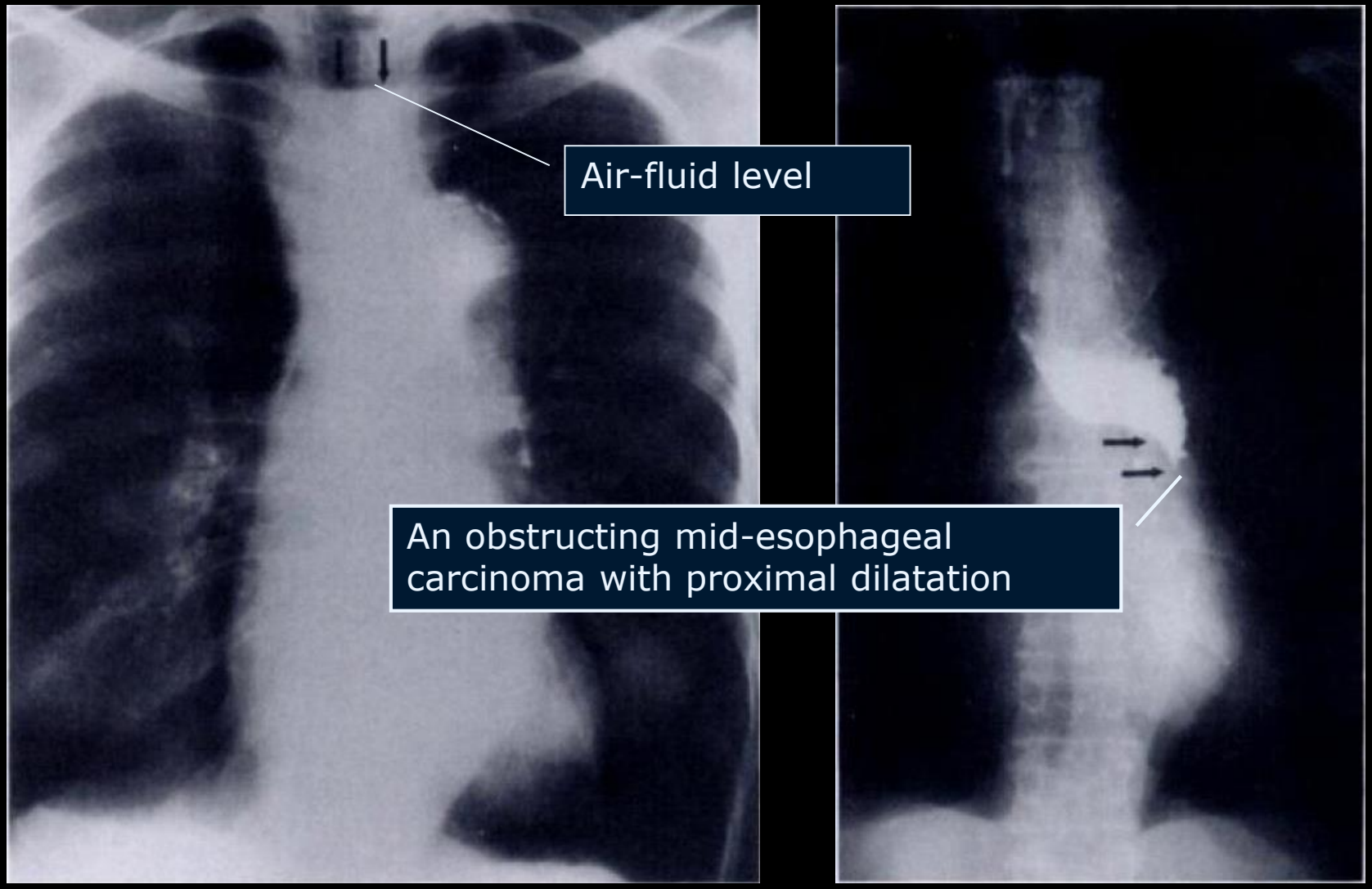
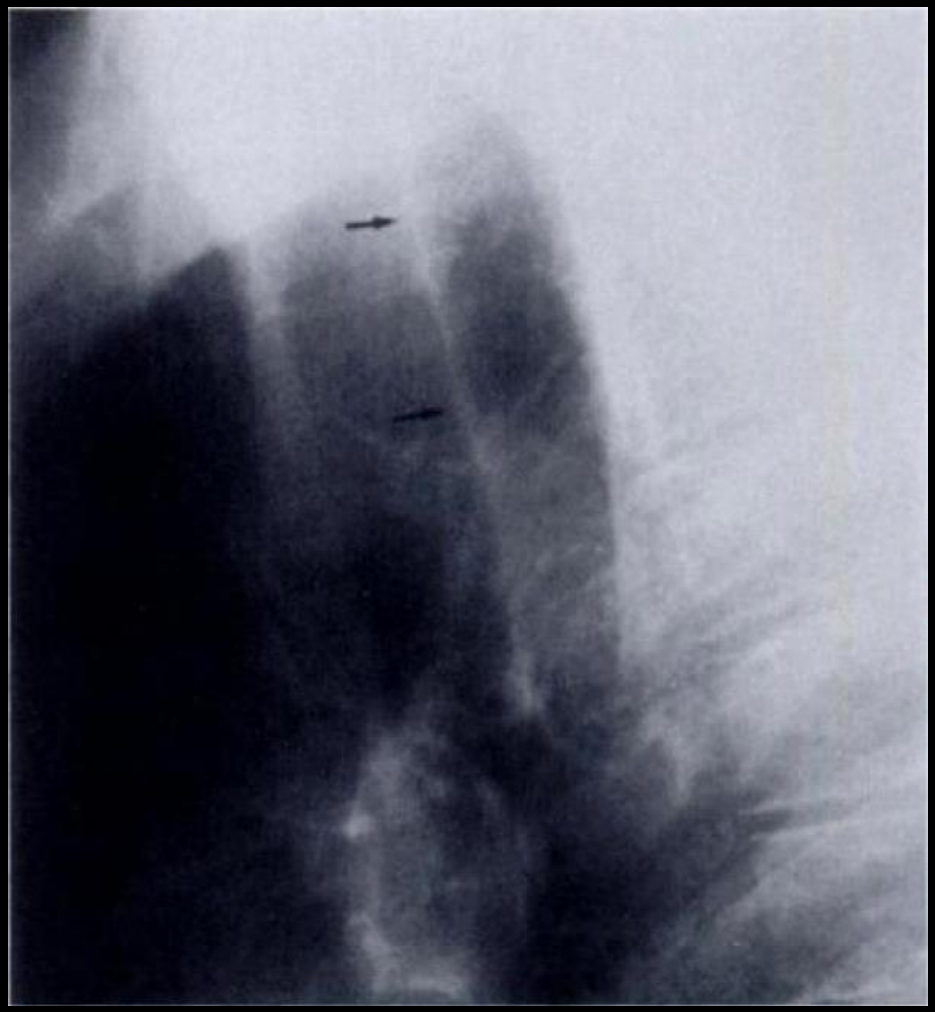
Compression 0.1

Esophageal Cancer

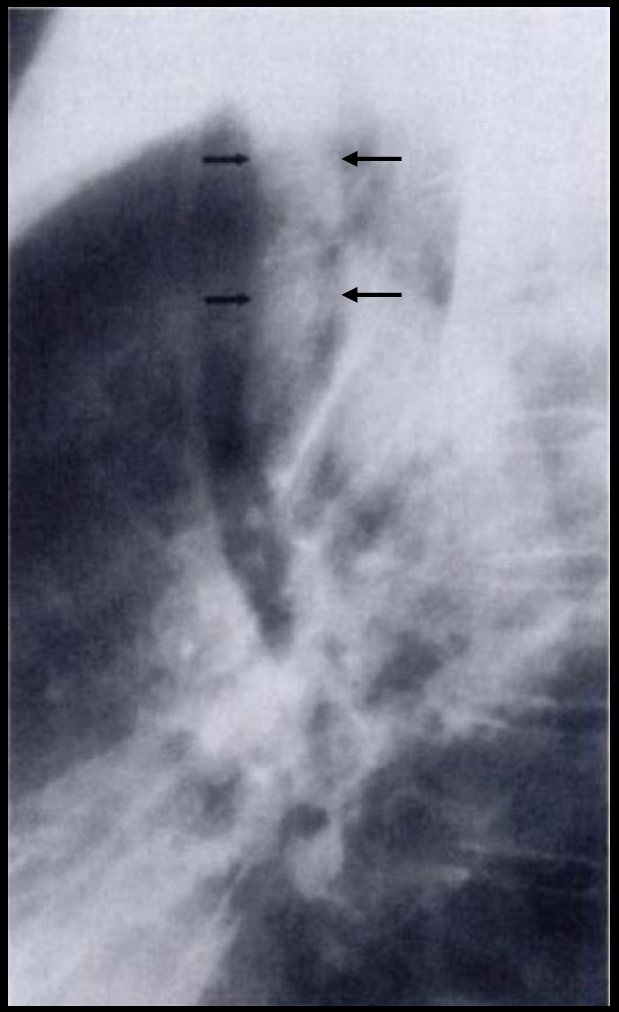


RadioGrapbics 1993; 13:1013-1034

Esophageal Cancer



Normal post. paratracheal strip



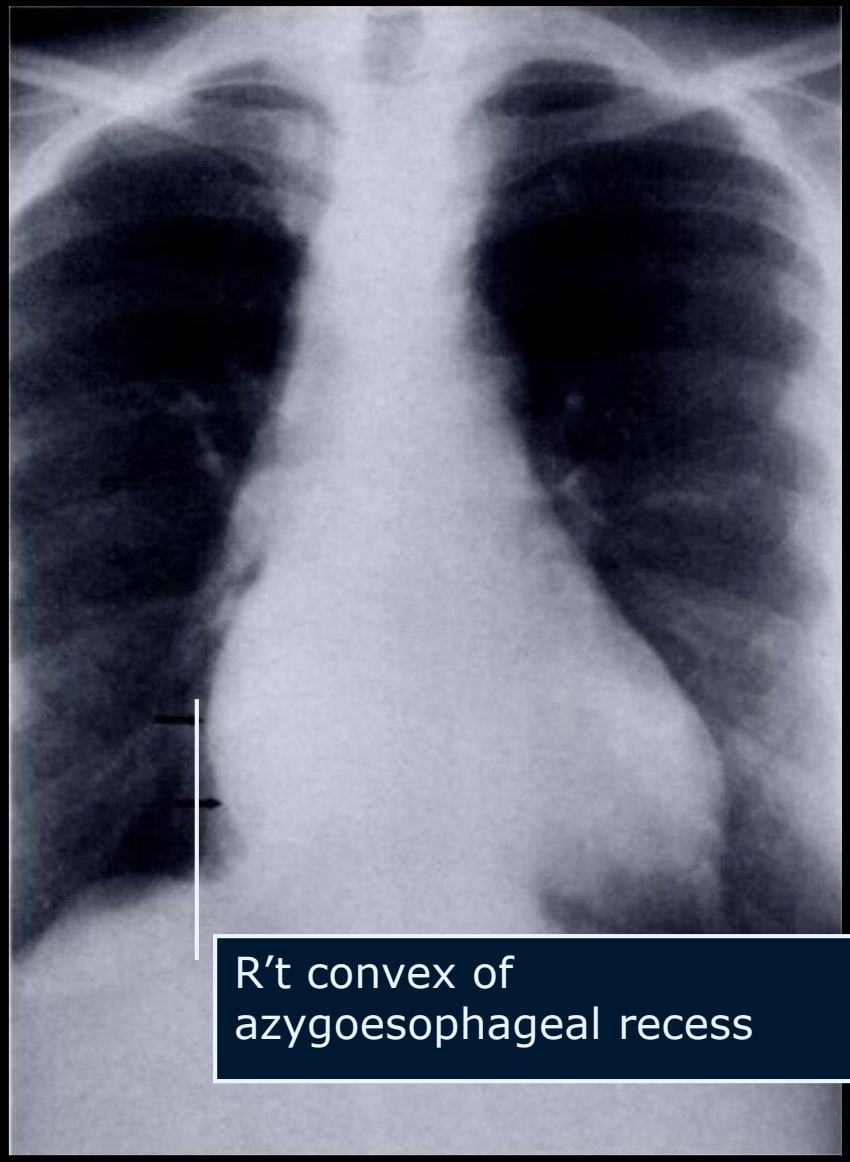
Thickened post. paratracheal strip

RadioGrapbics 1993; 13:1013-1034

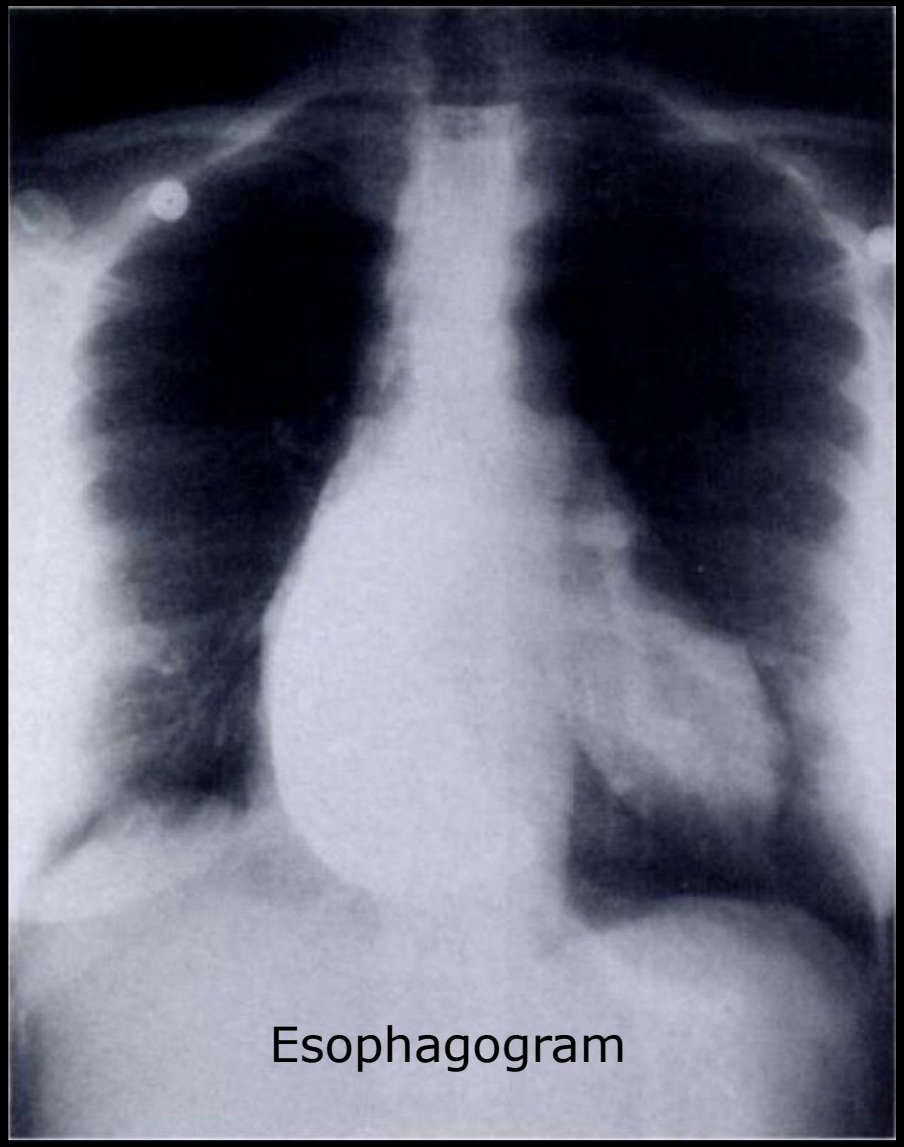
Esophageal Lesions

- **Achalasia:**
  - CXR is usually normal in early phase
  - Azygoesophageal recess becomes more convex to the right as the esophagus dilates and is seen as an opacity behind the right border of the heart
- **Operation**
  - S/p radical resection and reconstruction with an intrathoracic stomach, or colon (usually R't side) pulled up through the mediastinum, retrosternally or subcutaneously.
  - Imaging:
    - Widening of mediastinum, ususally R't side
    - Air-fluid level when upright
    - Linear shadow representing colon haustra over retrosternal region
    - Subcutaneous and mediastinal emphysema: leak from reconstruction

Achalasia



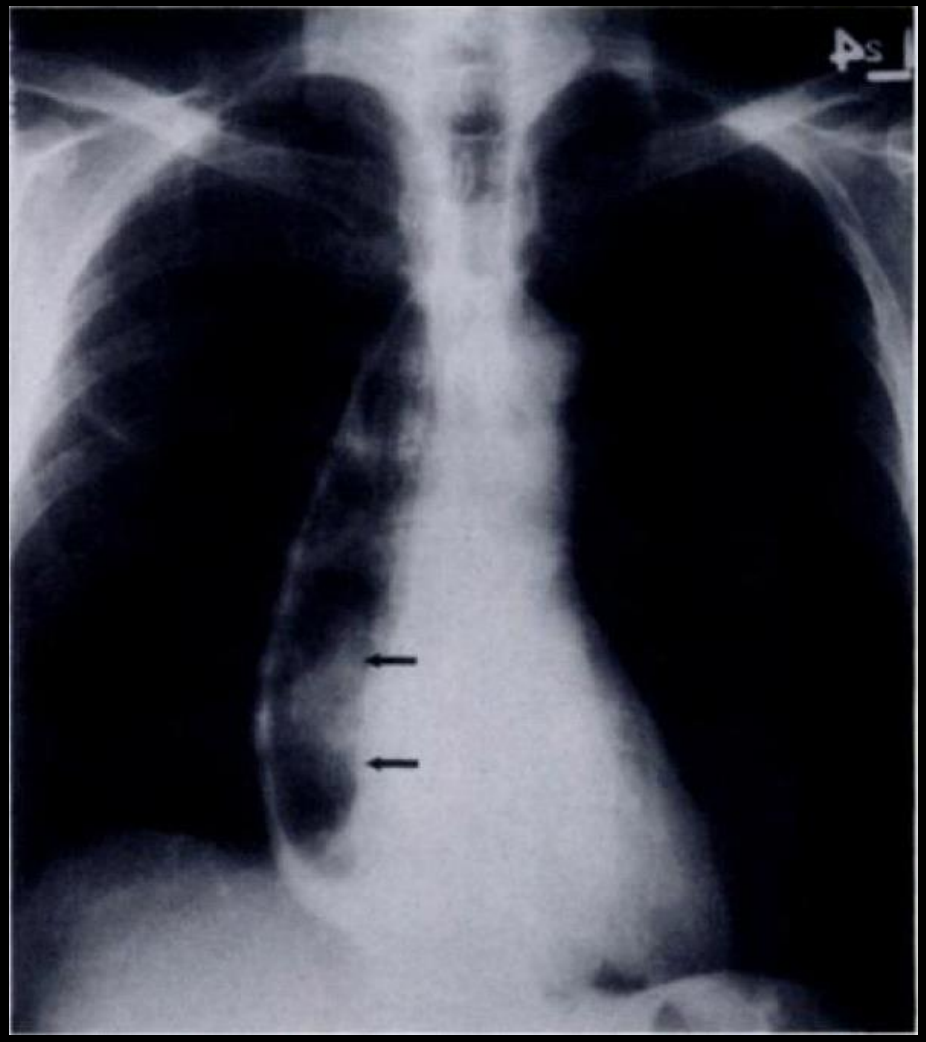
R’t convex of azygoesophageal recess



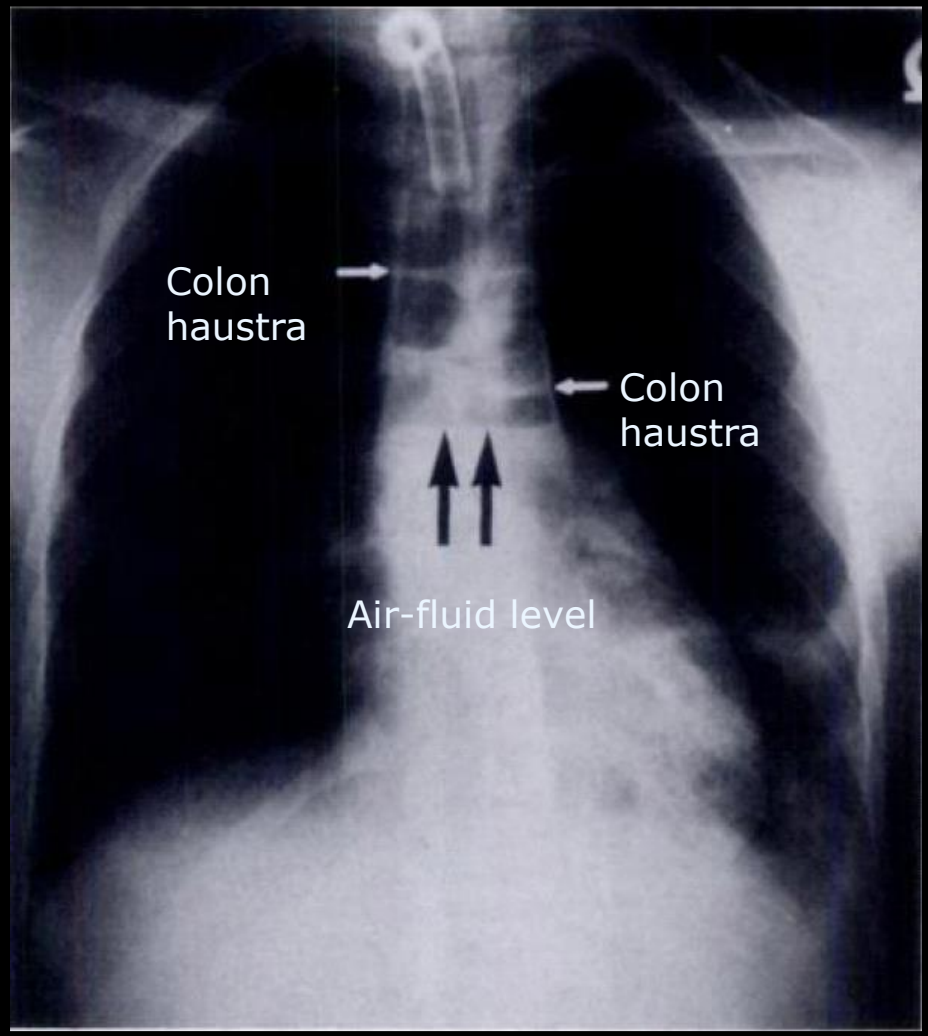
Esophagogram

RadioGrapbics 1993; 13:1013-1034

Esophageal Cancer s/p Reconstruction



Gastric pull-through procedure



Reconstruction by colon

RadioGrapbics 1993; 13:1013-1034

Post. Mediastinum Lesion

Table 3
Posterior Mediastinal Masses

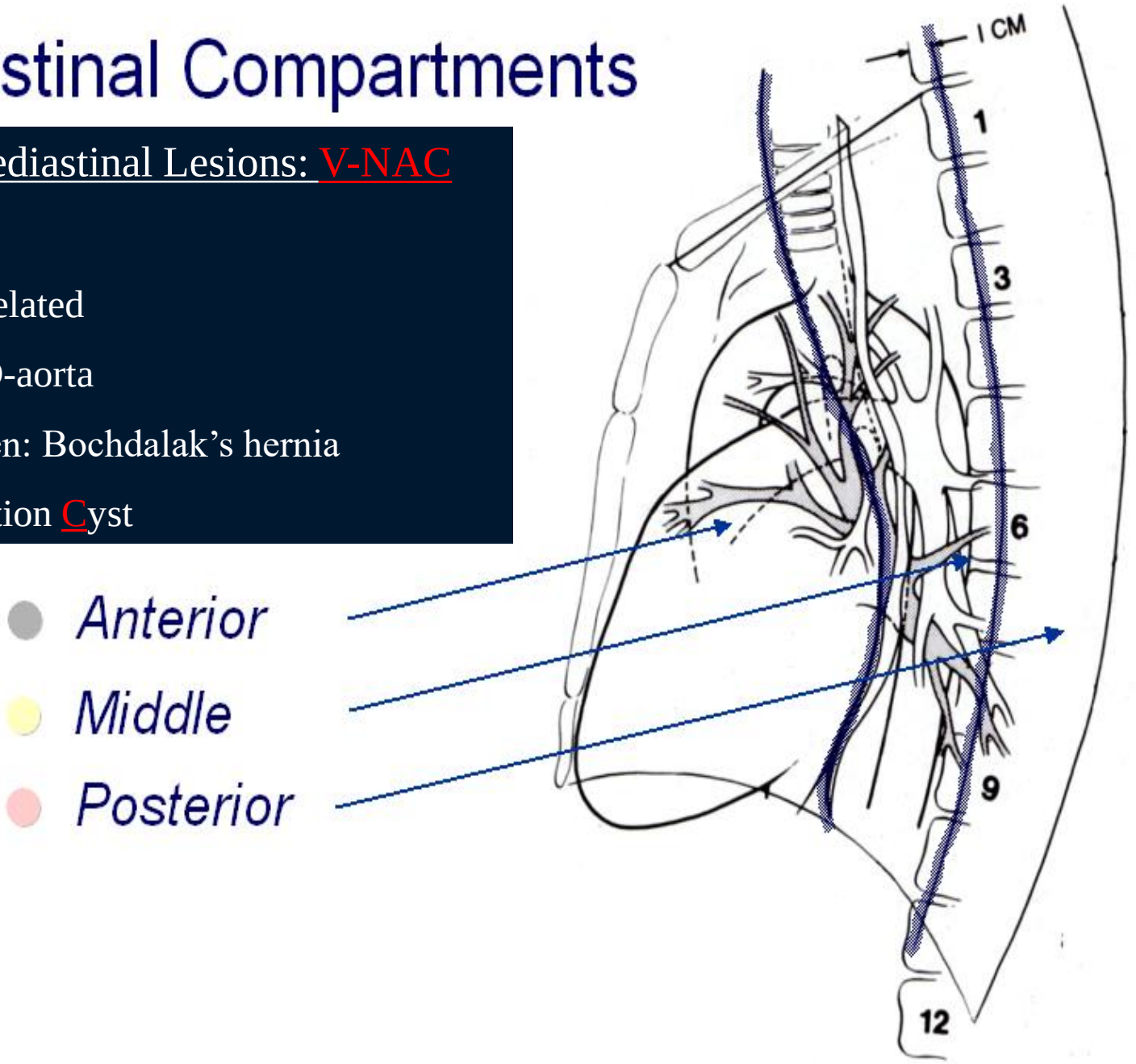
Esophageal lesions, hiatal hernia
Foregut duplication cyst
Descending aortic aneurysm
Neurogenic tumor
Paraspinal abscess
Lateral meningocele
Extramedullary hematopoiesis

Mediastinal Compartments

Posterior Mediastinal Lesions: V-NAC

1. V: Vertebra
2. N: Nerve-related
3. A: Aorta: D-aorta

   Abdomen: Bochdalak's hernia
4. C: Duplication Cyst



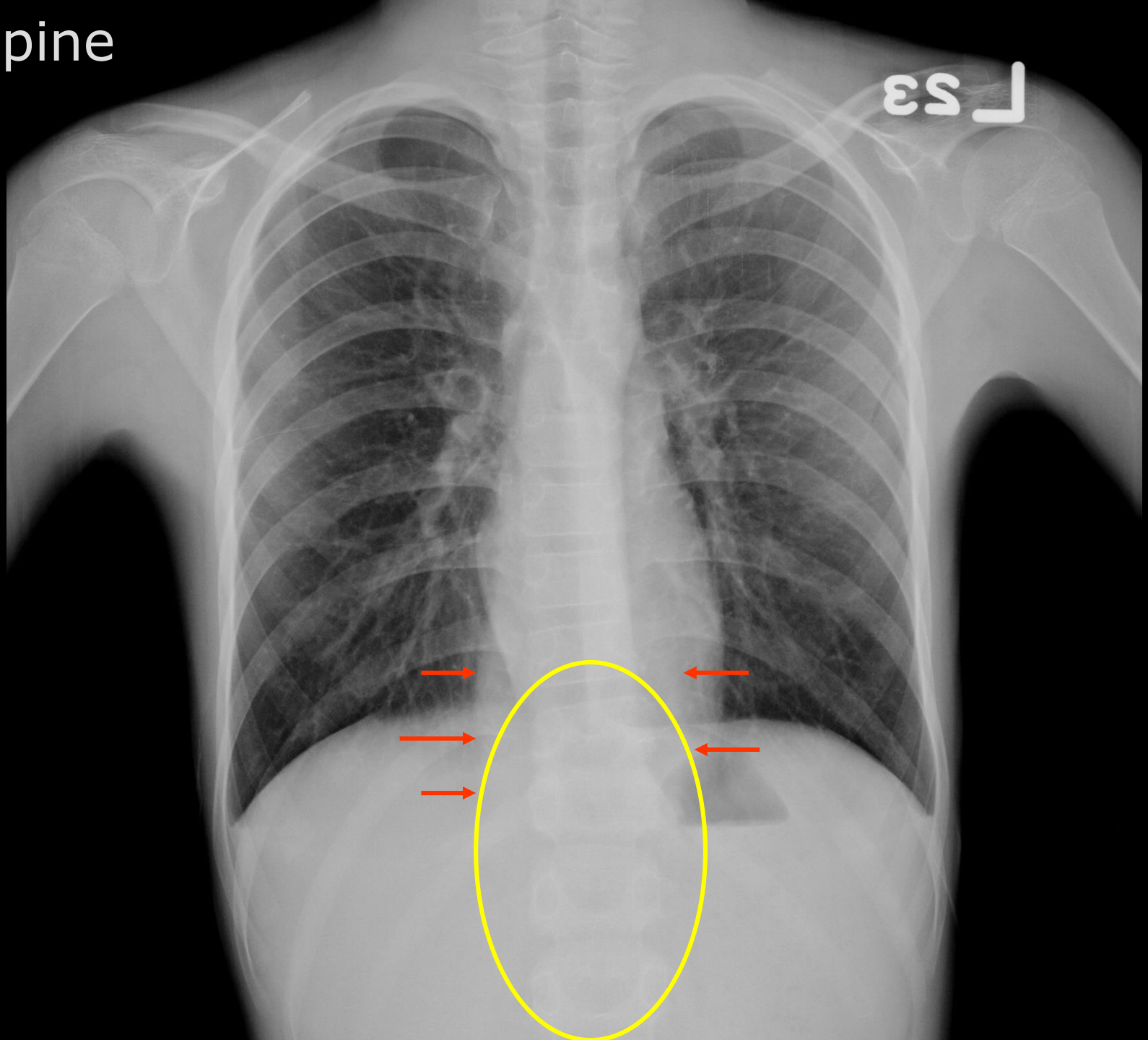
Vertebra

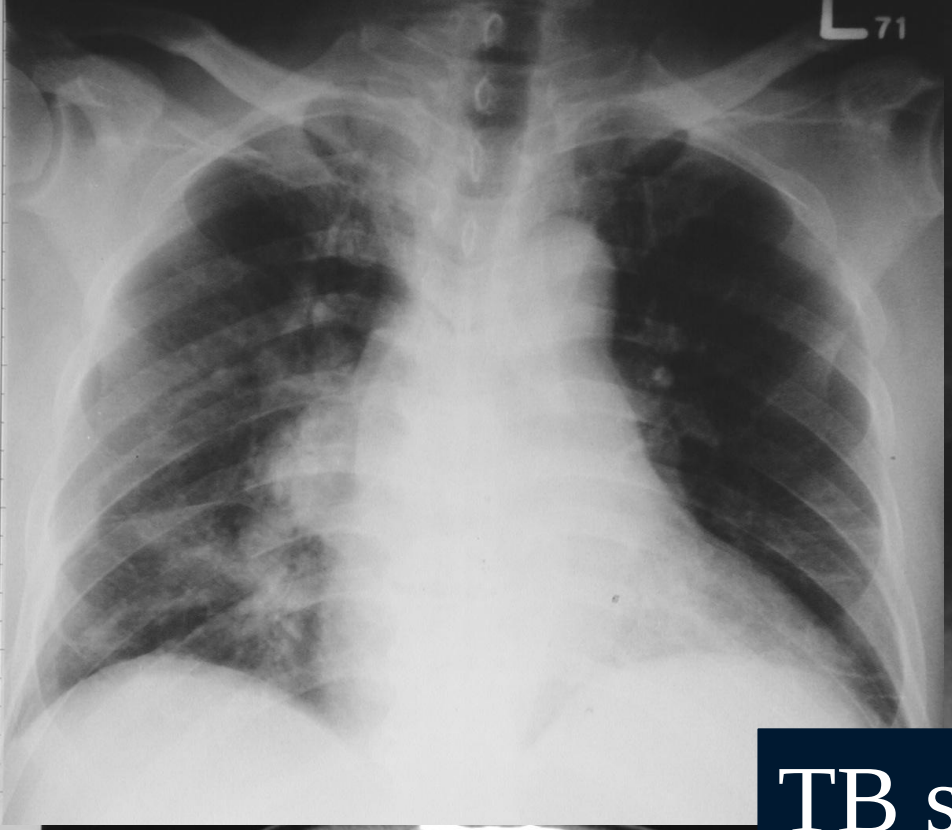
- TB spine (paraspinal abscess)
- Extramedullary hematopoiesis (EMH)

Tuberculous Abscess (TB spine)

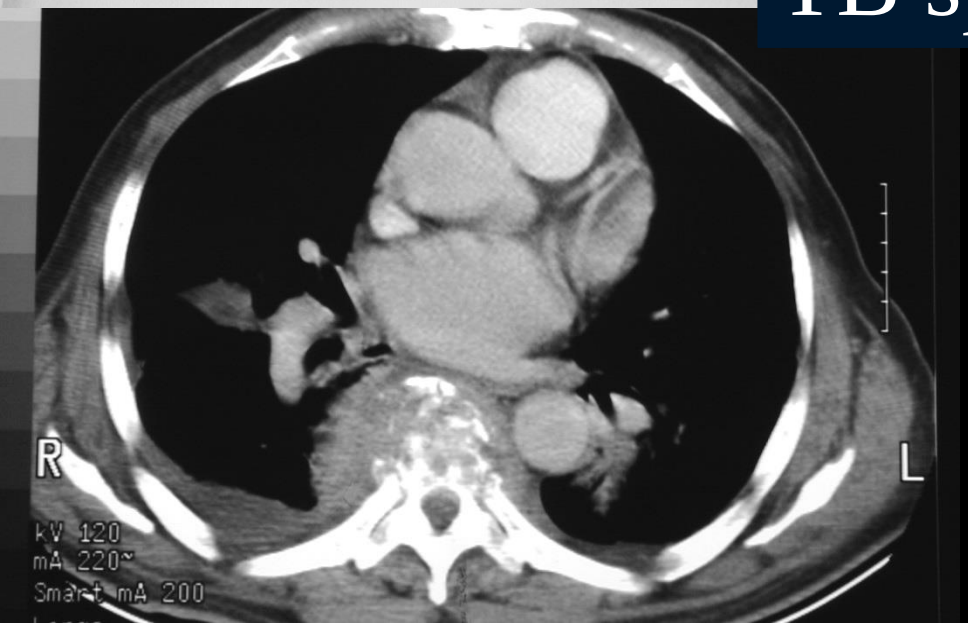
- 好發位置:
  - ★ Lower T (thoracic) and upper L (lumbar) vertebrae
- Early manifestations:
  - Irregularity of the vertebral end plates
  - ★ Decreased height of the intervertebral disc space (吃軟不吃硬)
- Progressive disease:
  - Anterior wedging of the vertebral body
  - Kyphosis
  - ★ Paravertebral abscess: buldging of paraspinal line
- ★ Little or no reactive sclerosis or local periosteal reaction
  - Helps distinguish it from pyogenic infections of the spine
- ★ Rarely affects the posterior vertebral elements (including the pedicles)
  - Distinguish it from metastatic disease

TB spine





TB spine



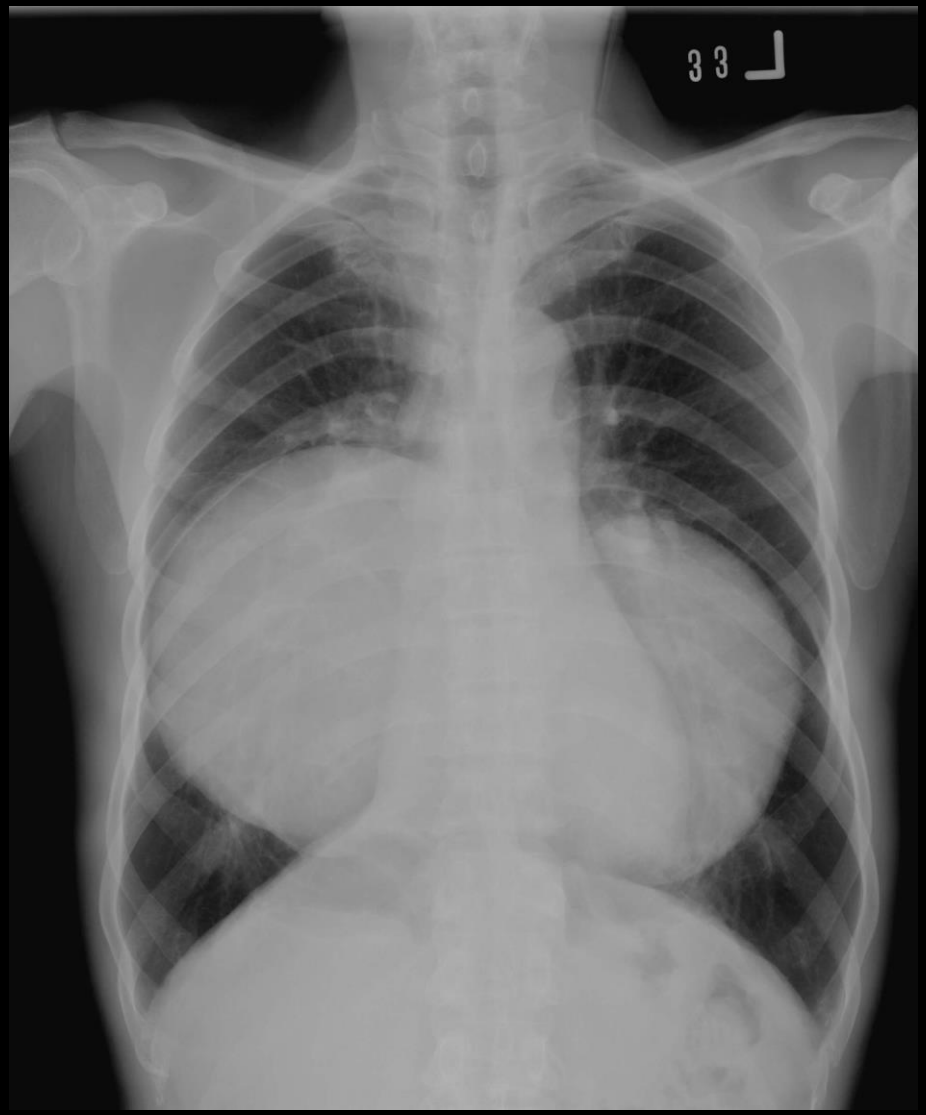
Extramedullary Hematopoiesis (1)

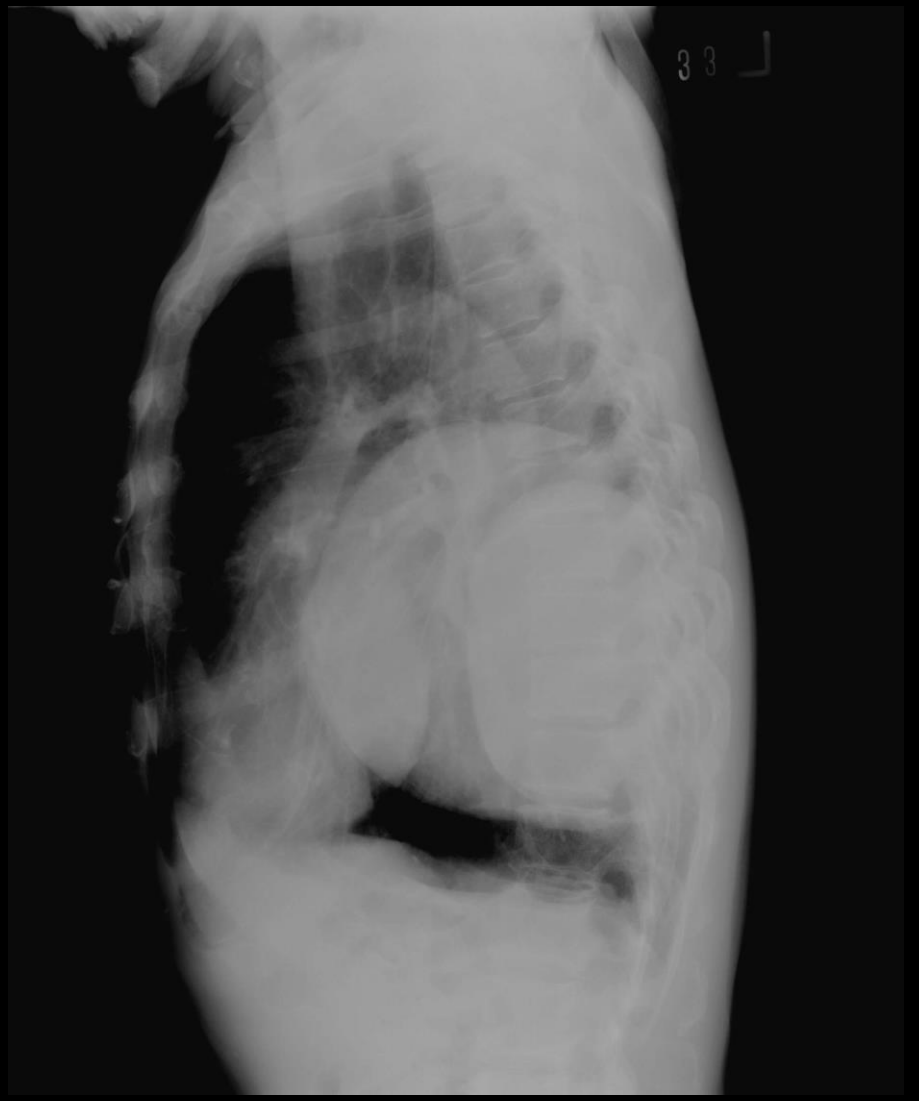
- Common causes of EMH:
  - Thalassemia intermedia or major
  - Congenital hemolytic anemia
  - Congenital spherocytosis
  - Sickle cell anemia
- The most common sites:
  - Liver, spleen
  - Spinal cord: paravertebral areas of the thorax
  - Pleura, pulmonary parenchyma, and bronchial wall
- Most common site of intrathoracic sites:
  - Paravertebral region in lower thorax

Extramedullary Hematopoiesis (2)

- **CXR:**
  - Posterior mediastinal mass
    - 單側 or 雙側
    - 位置：最常出現在 paravertebral area (along costo-vertebral junction), lower T-vertebrae (below T6), 甚至可以involve整個vertebrae
    - 邊緣清楚、lobulated , 以vertebral body為中心
    - 很少有鈣化 or bone erosion
  - Ribs:
    - Marrow expansion造成 rib變寬, 尤其在近vertebra端
    - Trabecula變得明顯

Extramedullary Hematopoiesis



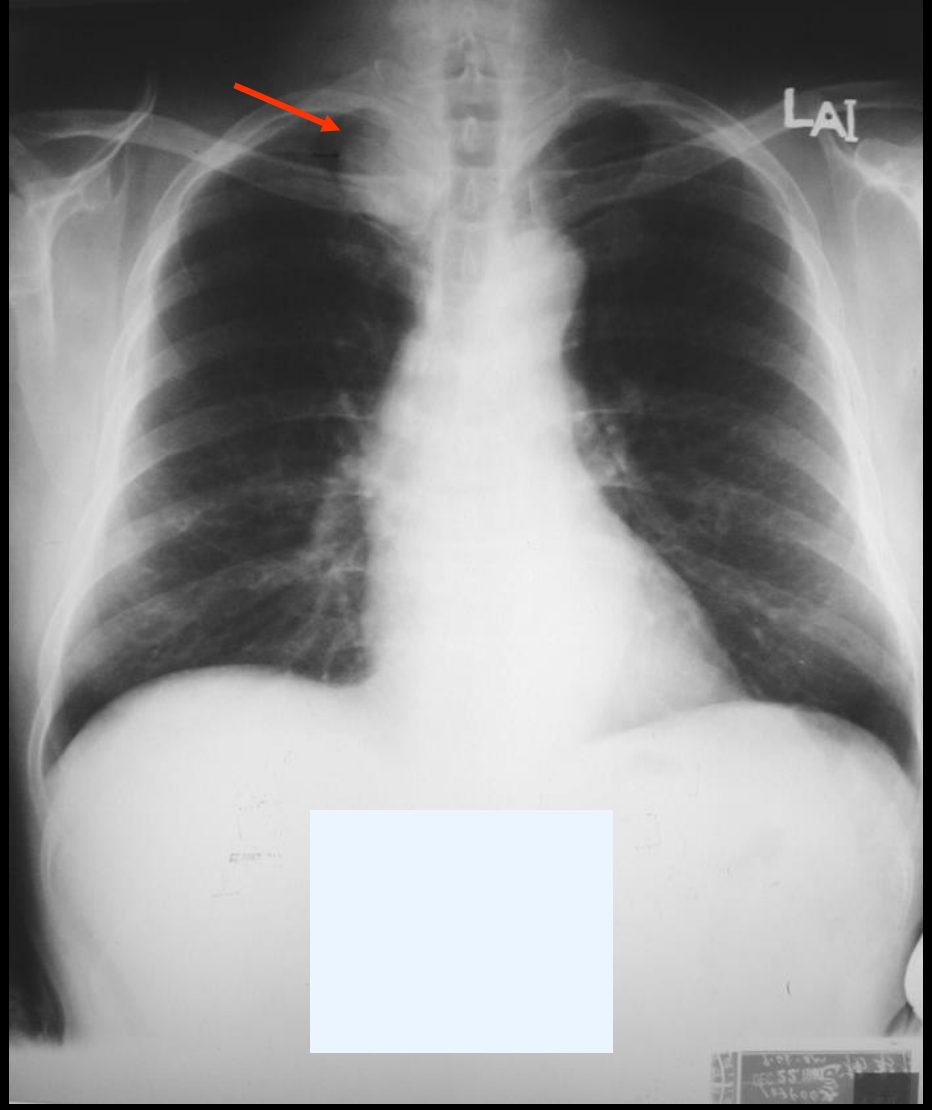


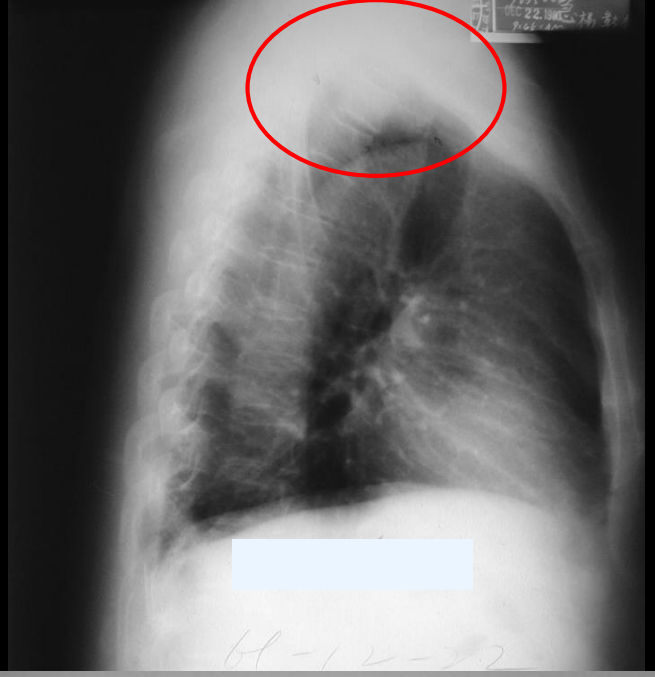
N: Neurogenic Tumors

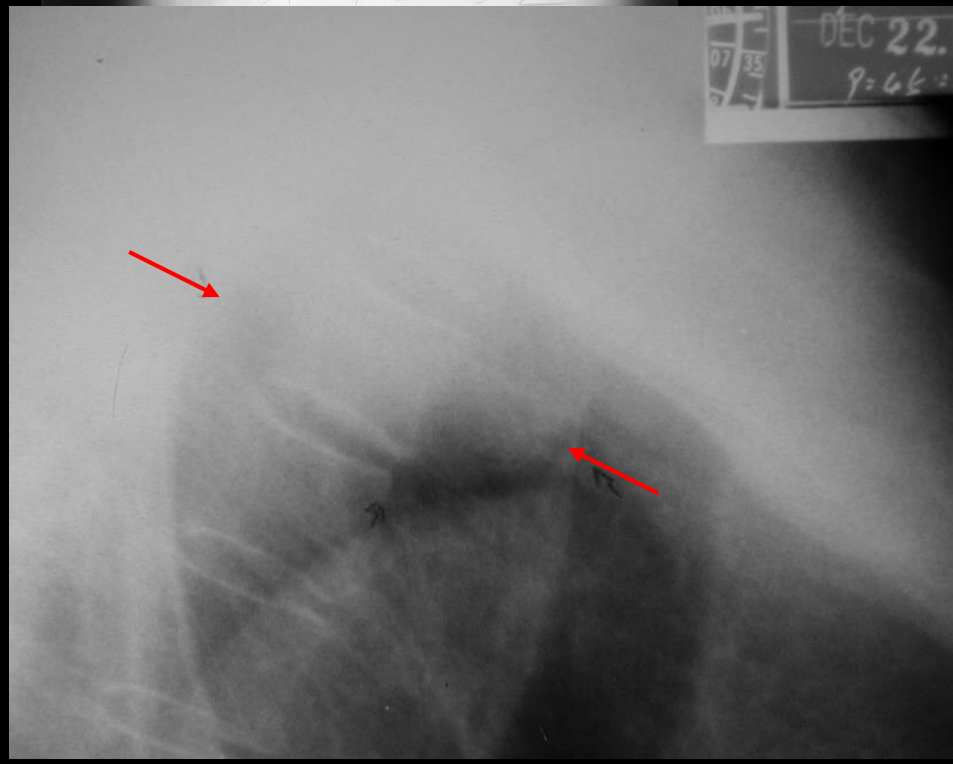
- Posterior mediastinal mass中最常見
- 分成兩類：
  - Nerve root tumor (schwannoma, neurofibroma): more common in adult, most are benign.
    - Schwannoma: The most common neural tumor
  - Sympathetic ganglion tumor (neuroblastoma, ganglioneuroblastoma, ganglioneuroma): more common in infant and childhood.

Nerve root tumor

- Including schwannoma, neurofibroma, peripheral nerve sheath tumor
- CXR:
  - Round or elliptical (圓形或橢圓形), sharp-marginated mass extending 1-2 rib interface (extent: <4 vertebral body)
  - Often centered at neural foramen; widened neural foramen on lateral view
  - Cervicothoracic sign: air-soft tissue interface continues above clavicle indicating posterior location
  - Incomplete border sign





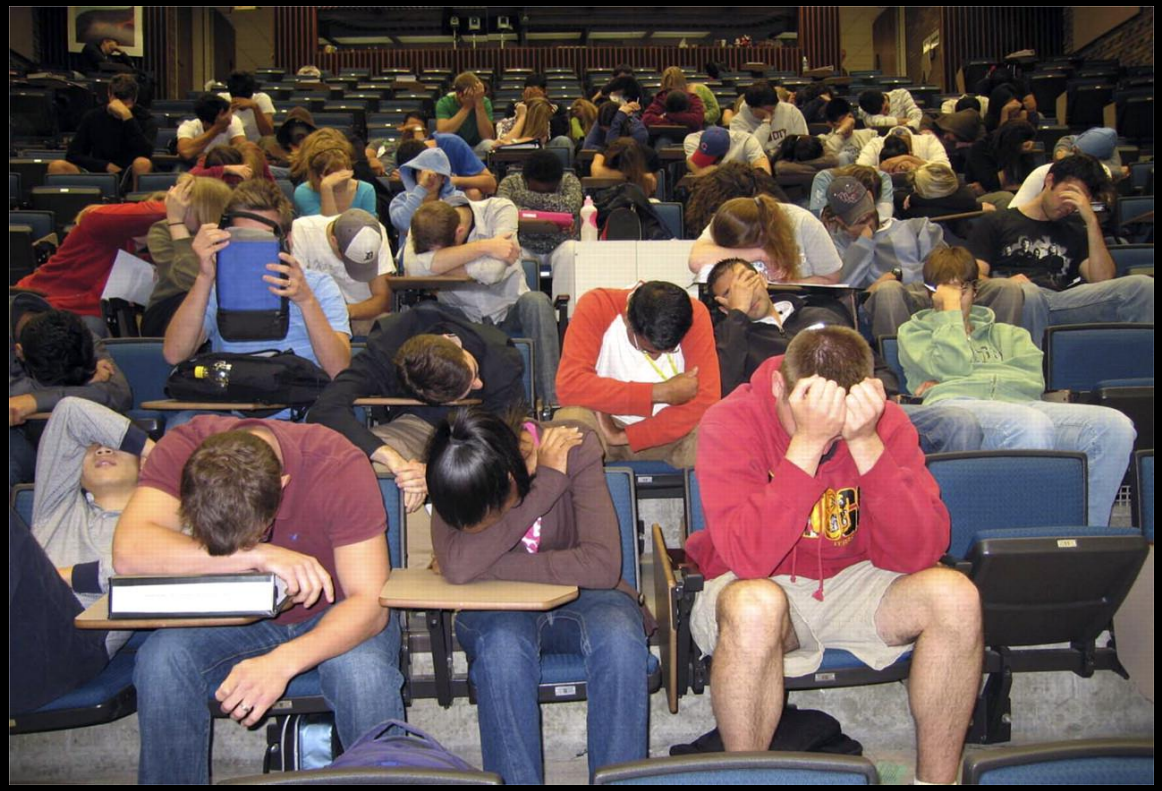


Neurogenic Tumor

Cervicothoracic sign

Schwannoma

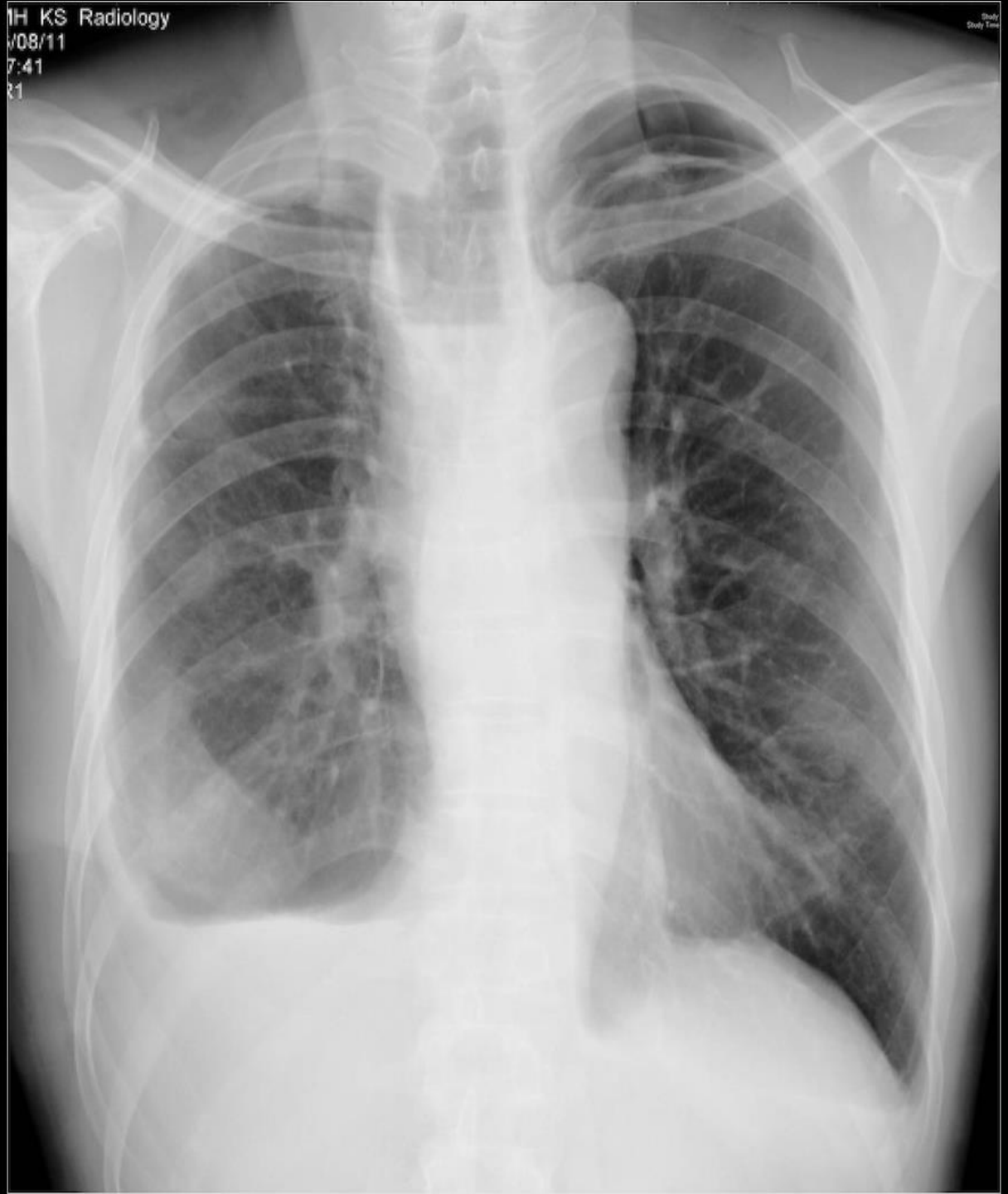
Thank you for staying awake!



Or, you may now wake up and Let's coffee break!

Any Questions!

1.
1/1



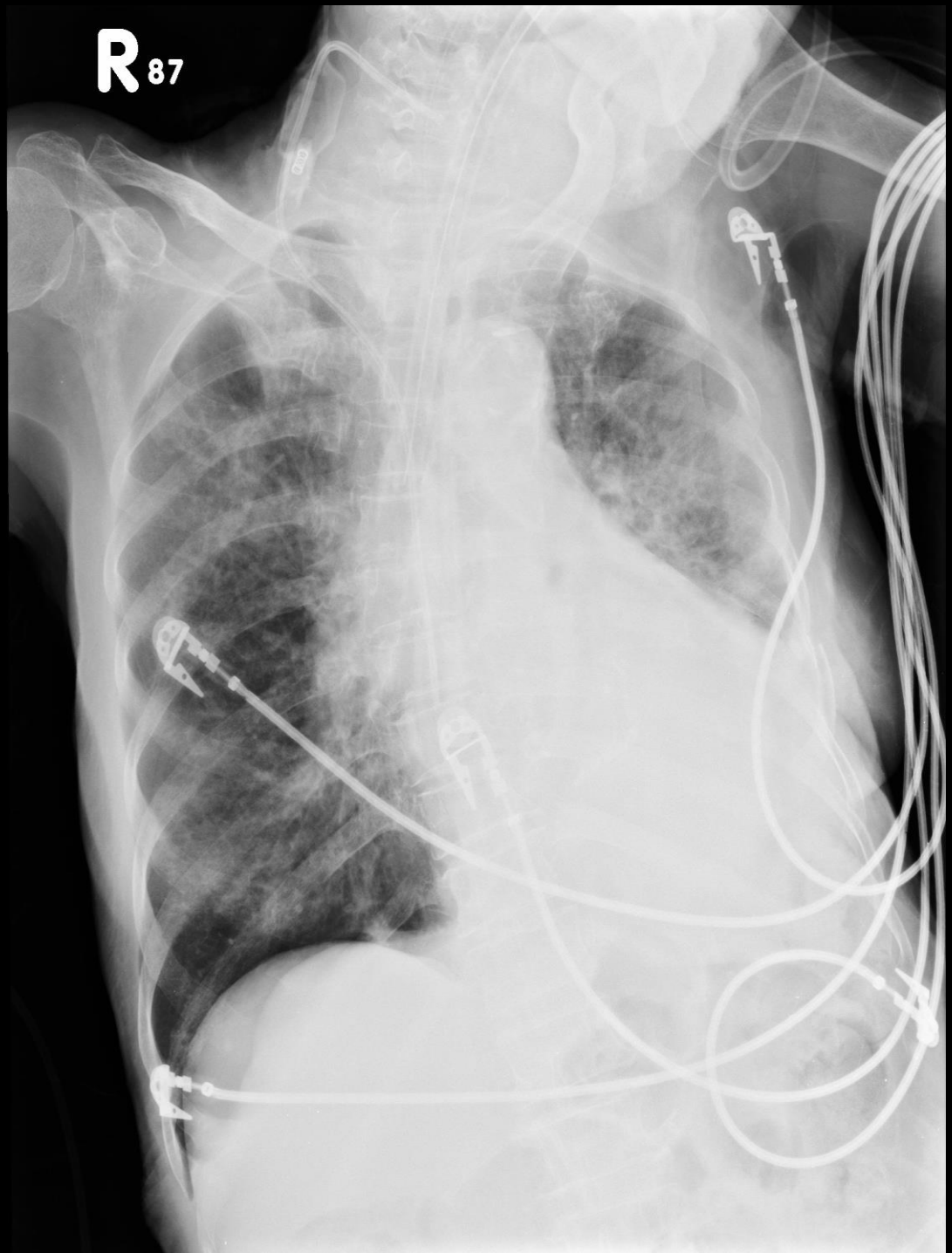
- Esophageal cancer with right pleural effusion

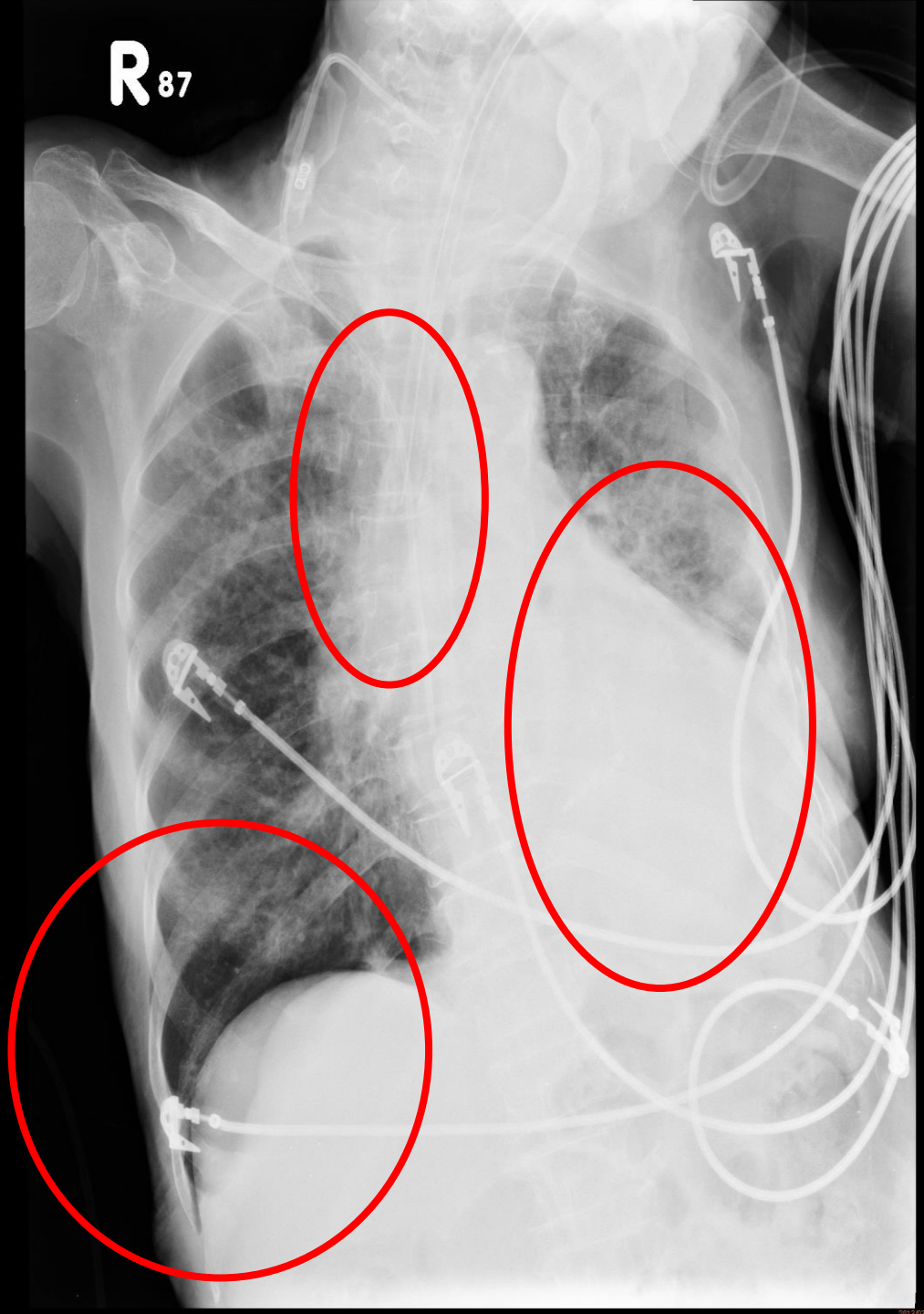
2.
1/1

- Right chest wall cellulitis/necrotizing fasc

3. 1/1

- 93 Y/F, iatrogenic myocardial rupture, s/p emergent cardiac repair




R87

- One lung intubation, LLL collapse and localized pneumothorax