Chest Image: Patterns and Signs

胸腔影像判讀原則與常用徵象

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Outline

- Chest image interpretations
- Basic CXR patterns
- Chest image signs

Chest Image Interpretations

PA view

Note that the x-ray tube is 180cm away

AP view

X-ray tube 100-120cm away

PA vs AP View

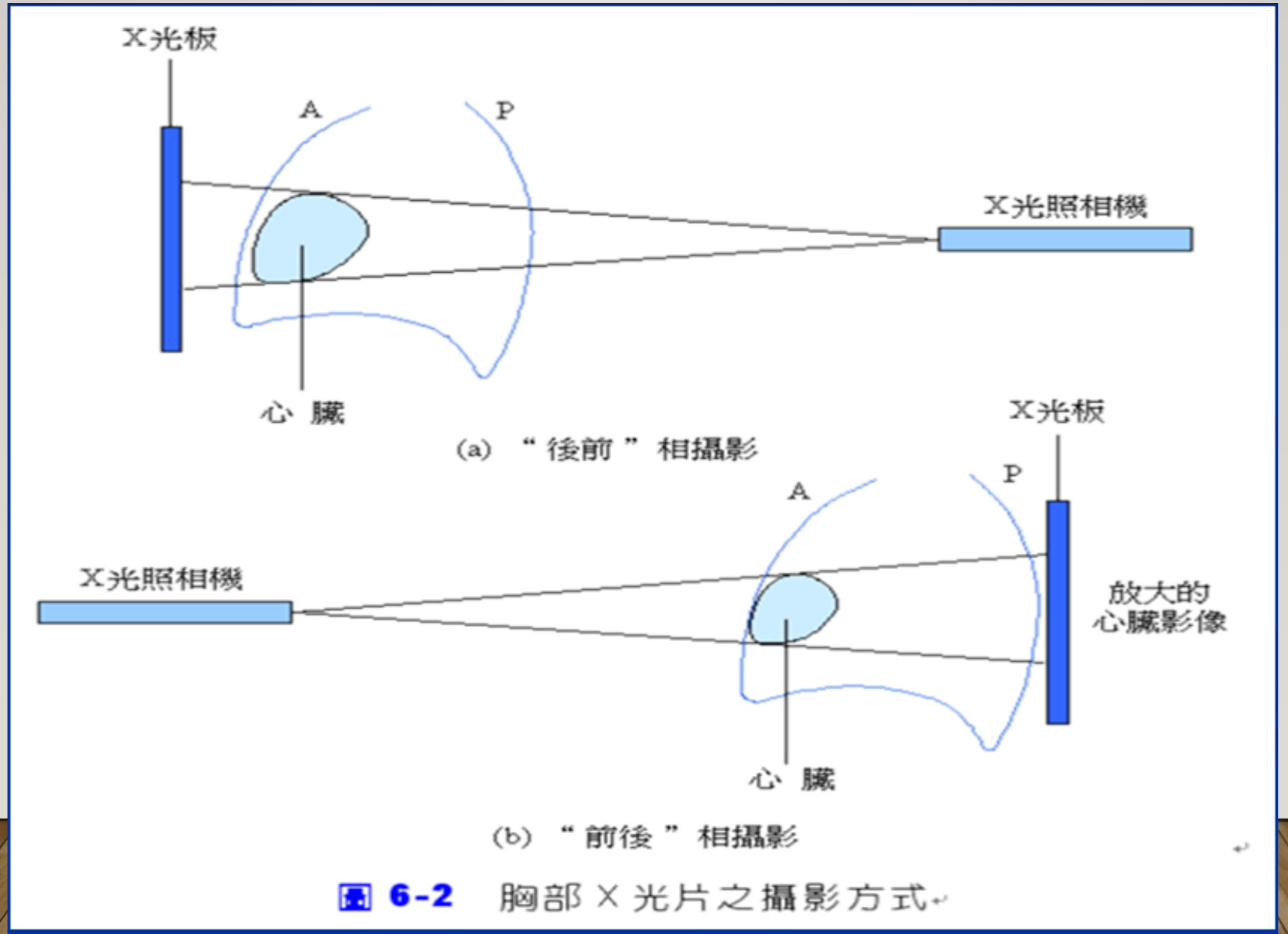
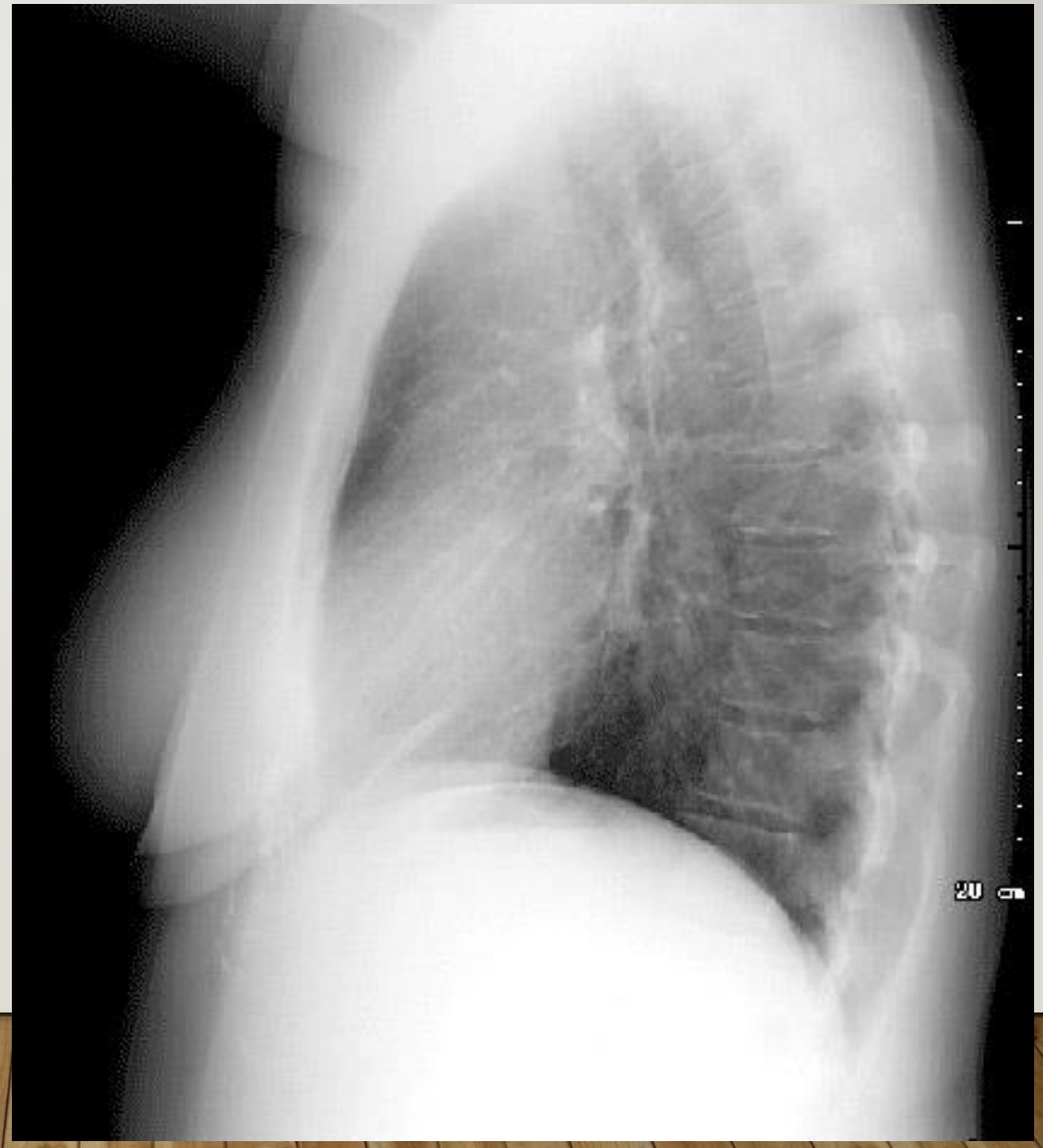
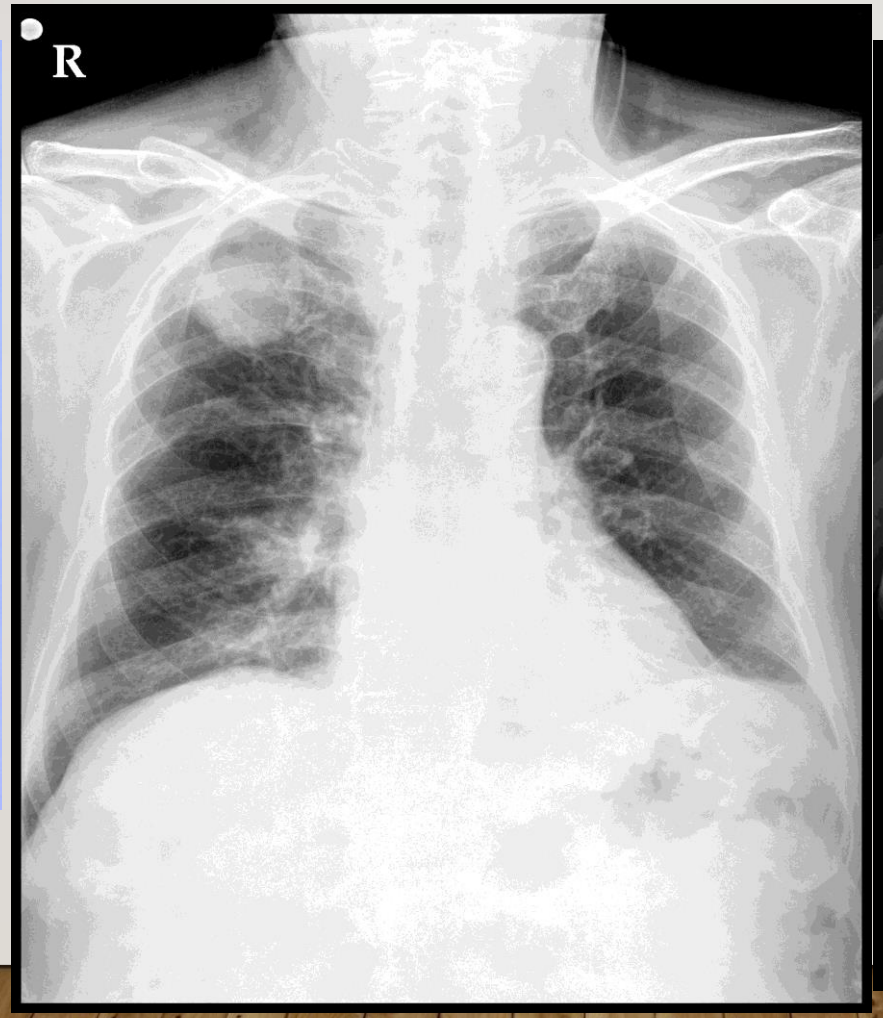


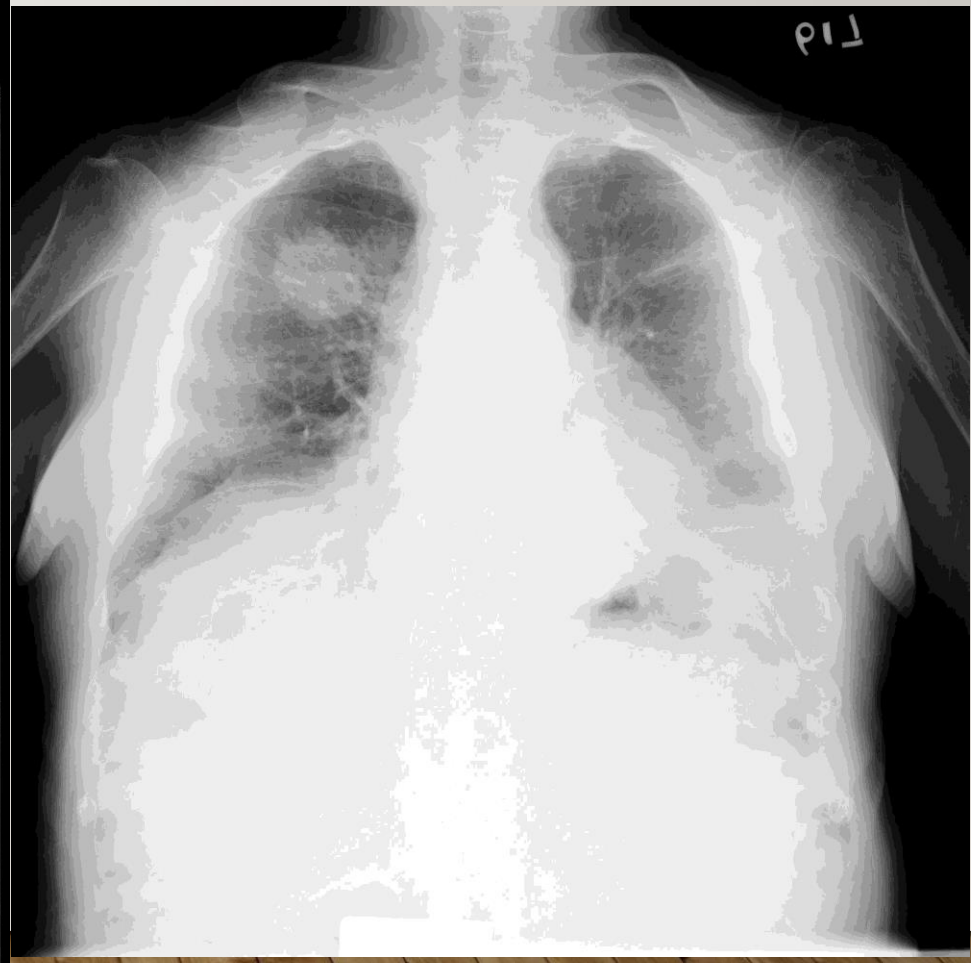
圖 6-2 胸部X光片之攝影方式

Lateral View



Lordotic View



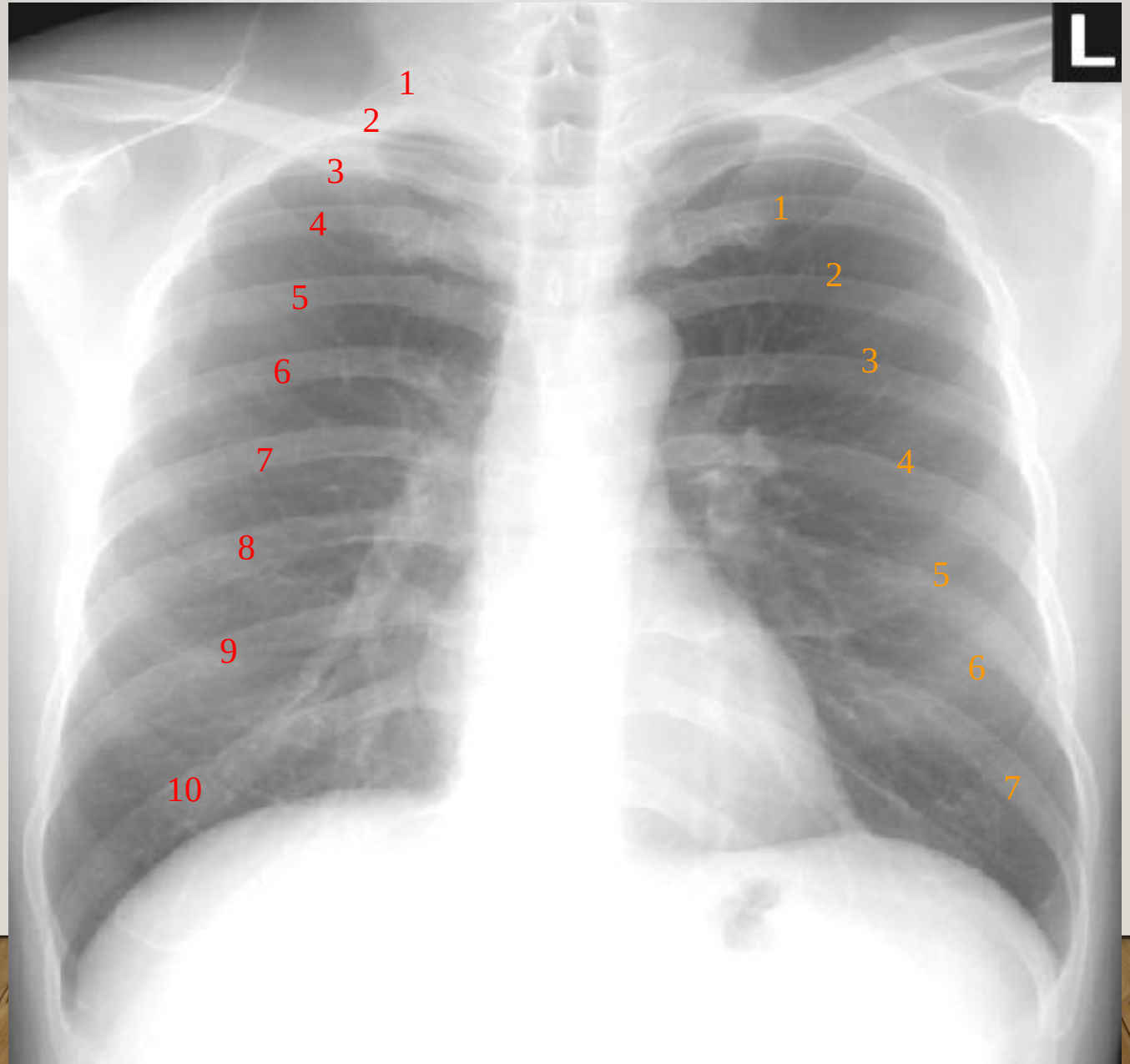


Decubitus View
(for subpulmonary effusion)

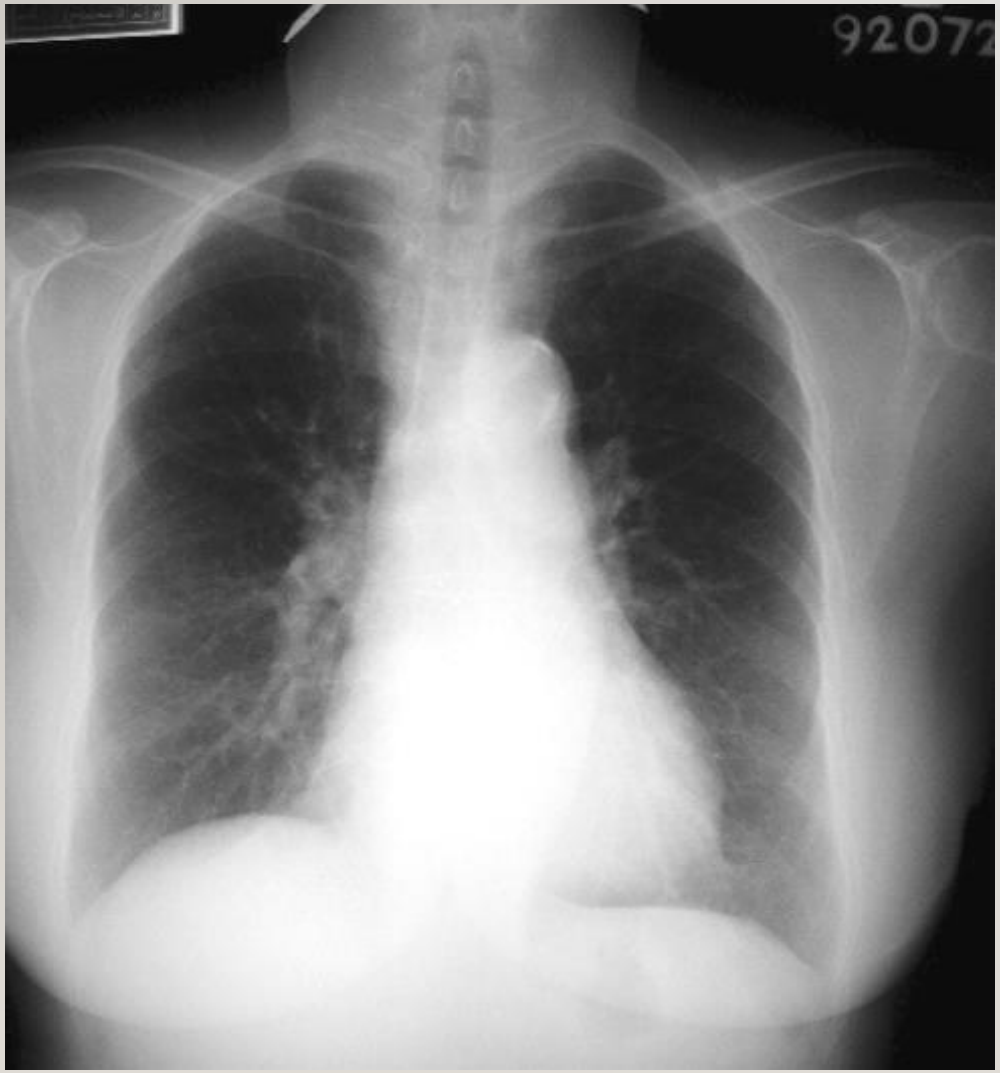
Normal CXR

- 好品質的CXR標準
- 範圍:片子夠大、範圍須包括胸廓全部
- 姿勢:肩胛骨拉開、姿勢端正、吸氣足夠
- 曝光: 心臟後方之肺紋隱約可見，胸椎骨隱約可見

吸飽氣 – 肋骨前六後十



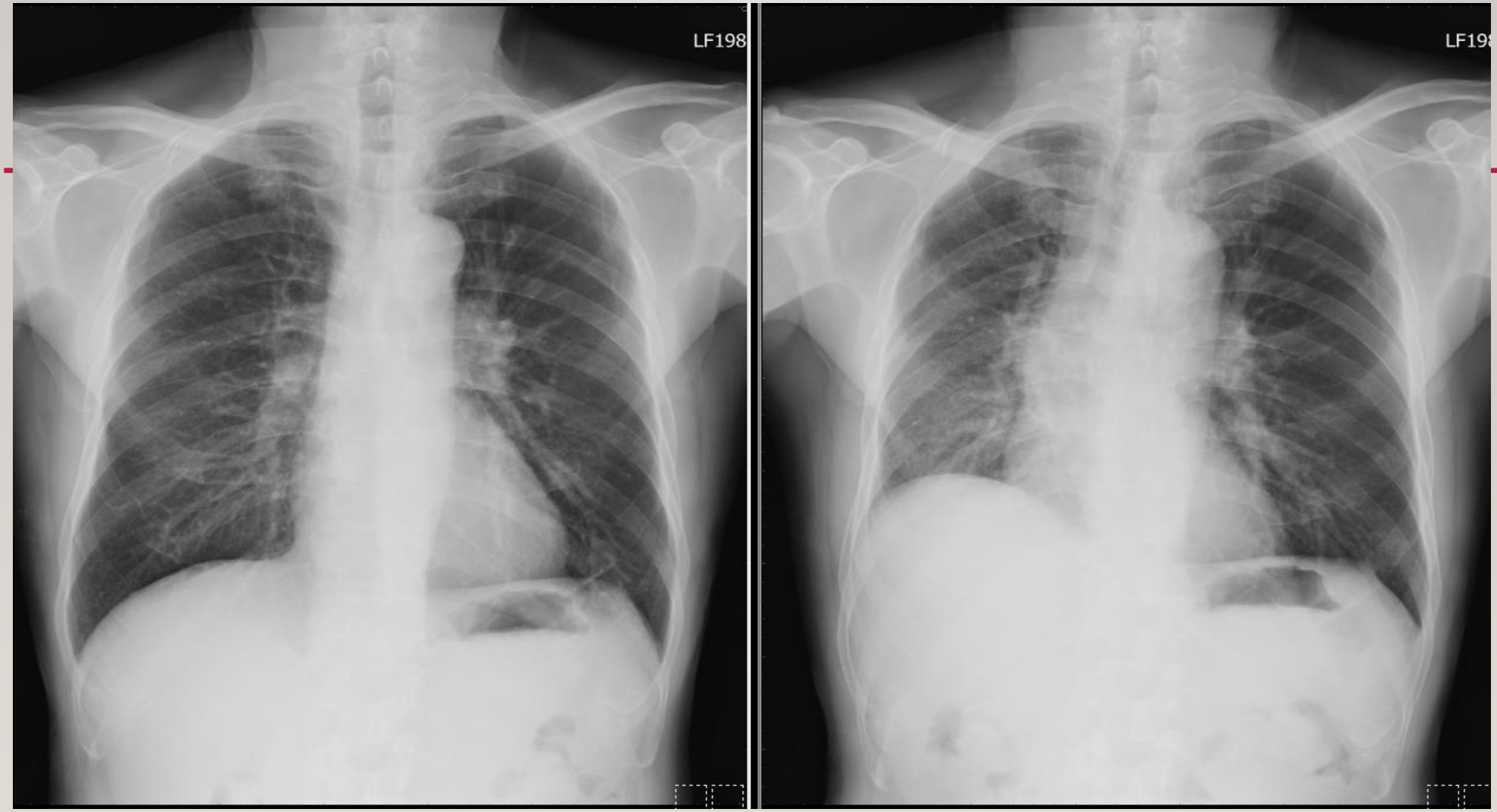
吸氣照 vs. 吐氣照



比較吸吐氣CXR的用途: 1.Pnemothorax吐氣照會較明顯

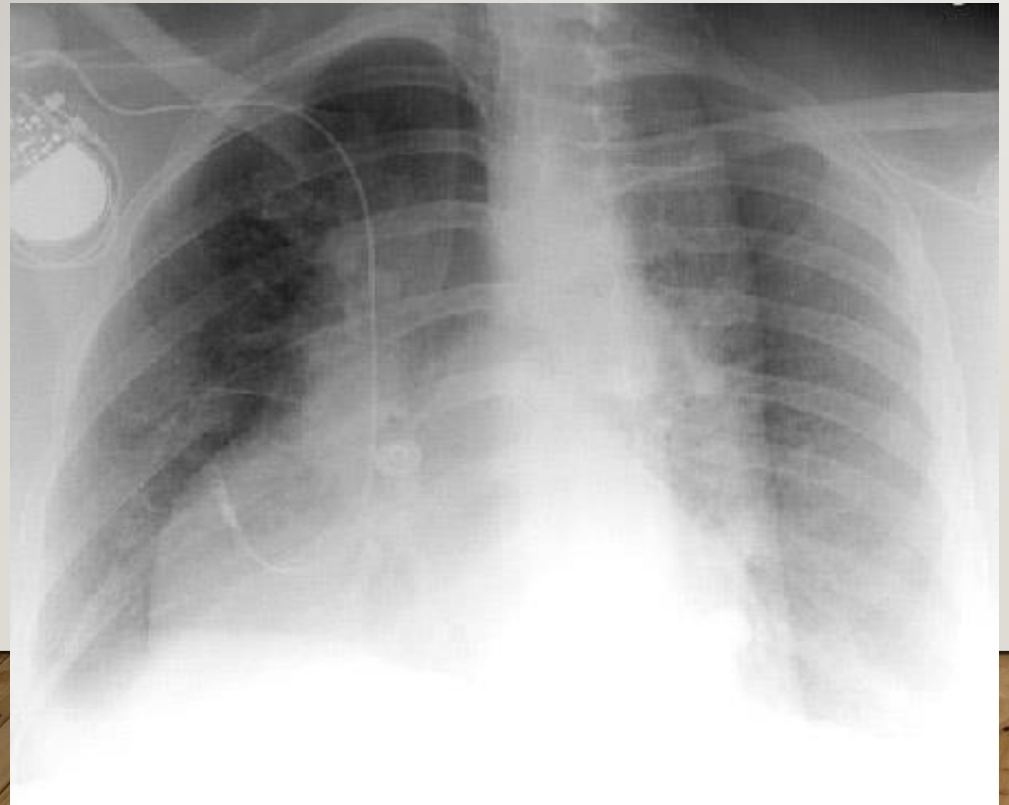
2.判斷diaphragm dysfunction 3.判斷單側肺部air-trapping

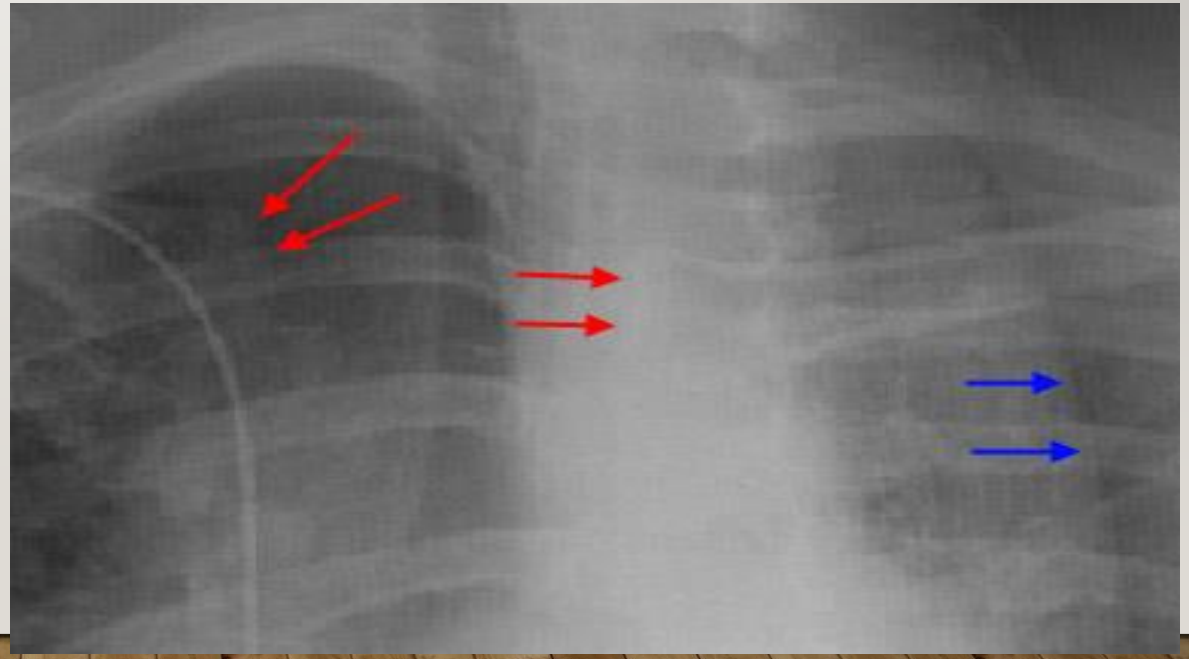
吸氣照 vs. 吐氣照



右圖為吐氣照: 右肺變小，但是左肺沒有變小， 因為有Lt main bronchus tumor 造成左肺air trapping 所以氣吐不出來

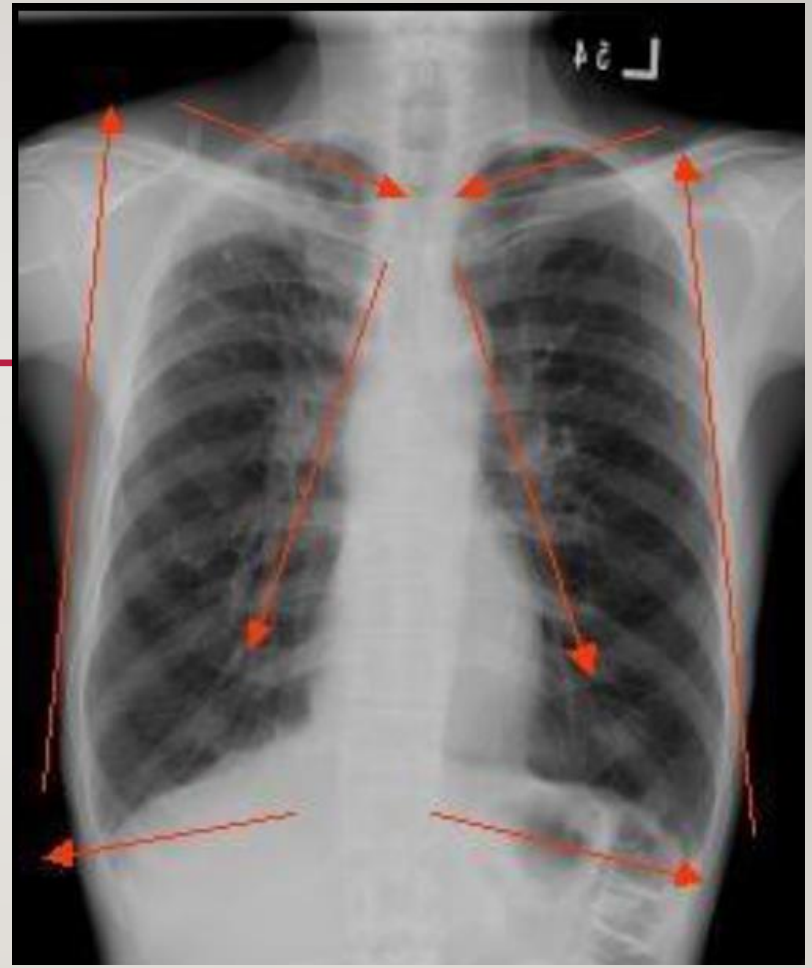
姿勢端正否





Clavicles (red arrows)

CXR 重要判讀原則

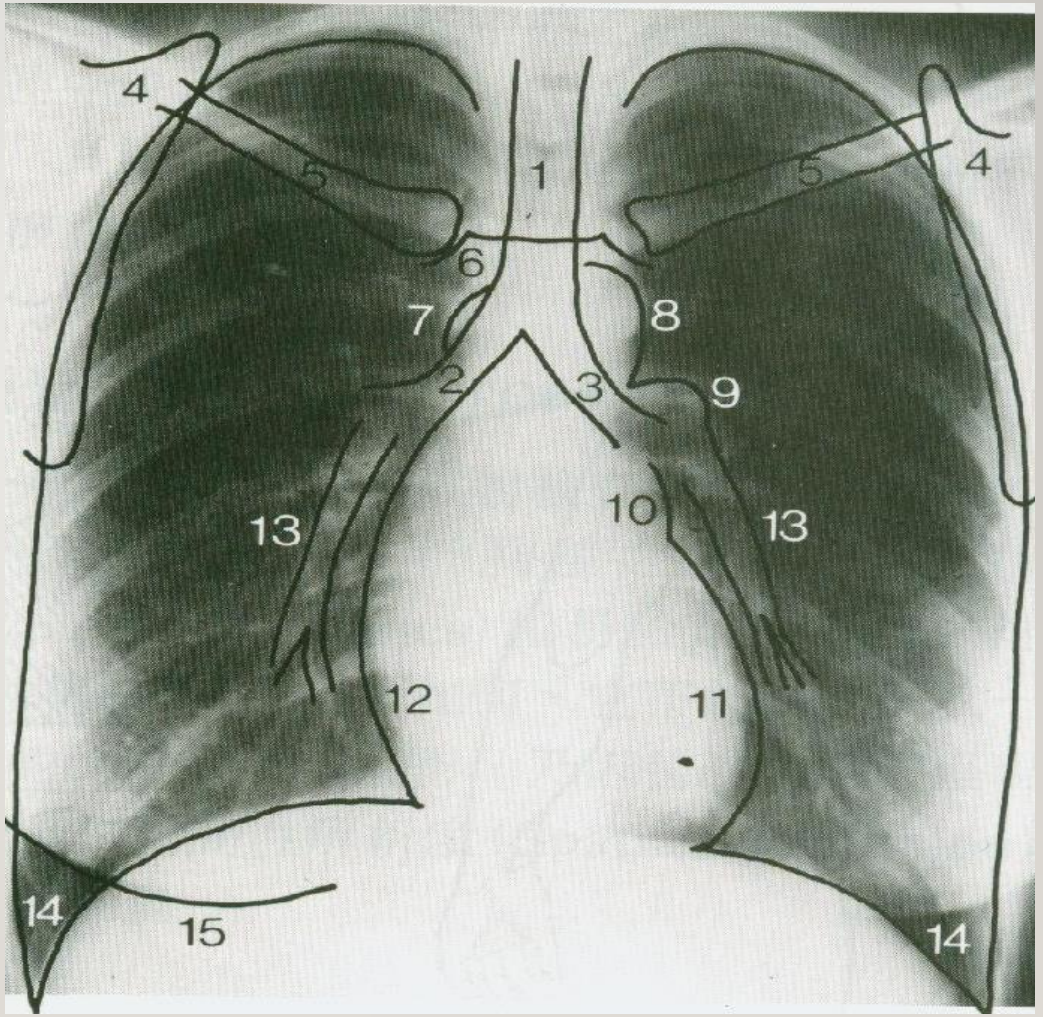


- 注意CXR品質
- 比較舊片
- Systemic reading: 系統性判讀
- CXR 四大死角:
  - Apex, Mediastinum(Heart後面/trachea), Diaphragm後面, 肺外(bone, soft tissue, upper abdomen)

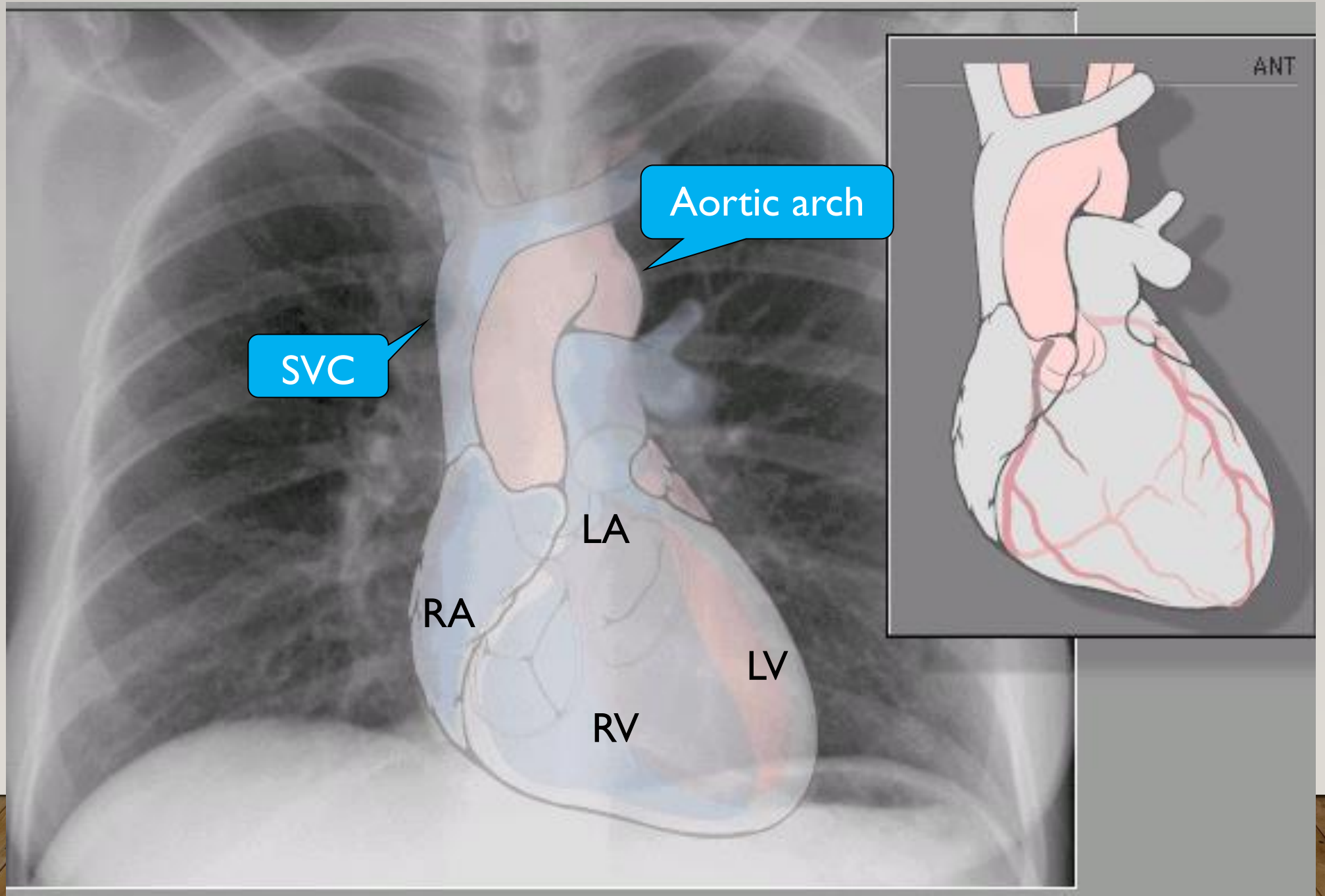
這真的是Normal CXR 嗎?

- 左右放反
- Systemic reading
- 注意四大死角:　Apex, Mediastinum(Heart後面/trachea), Diaphragm後面, 肺外(bone, soft tissue, upper abdomen)
- Pneumothorax
- 管路位置是否正確

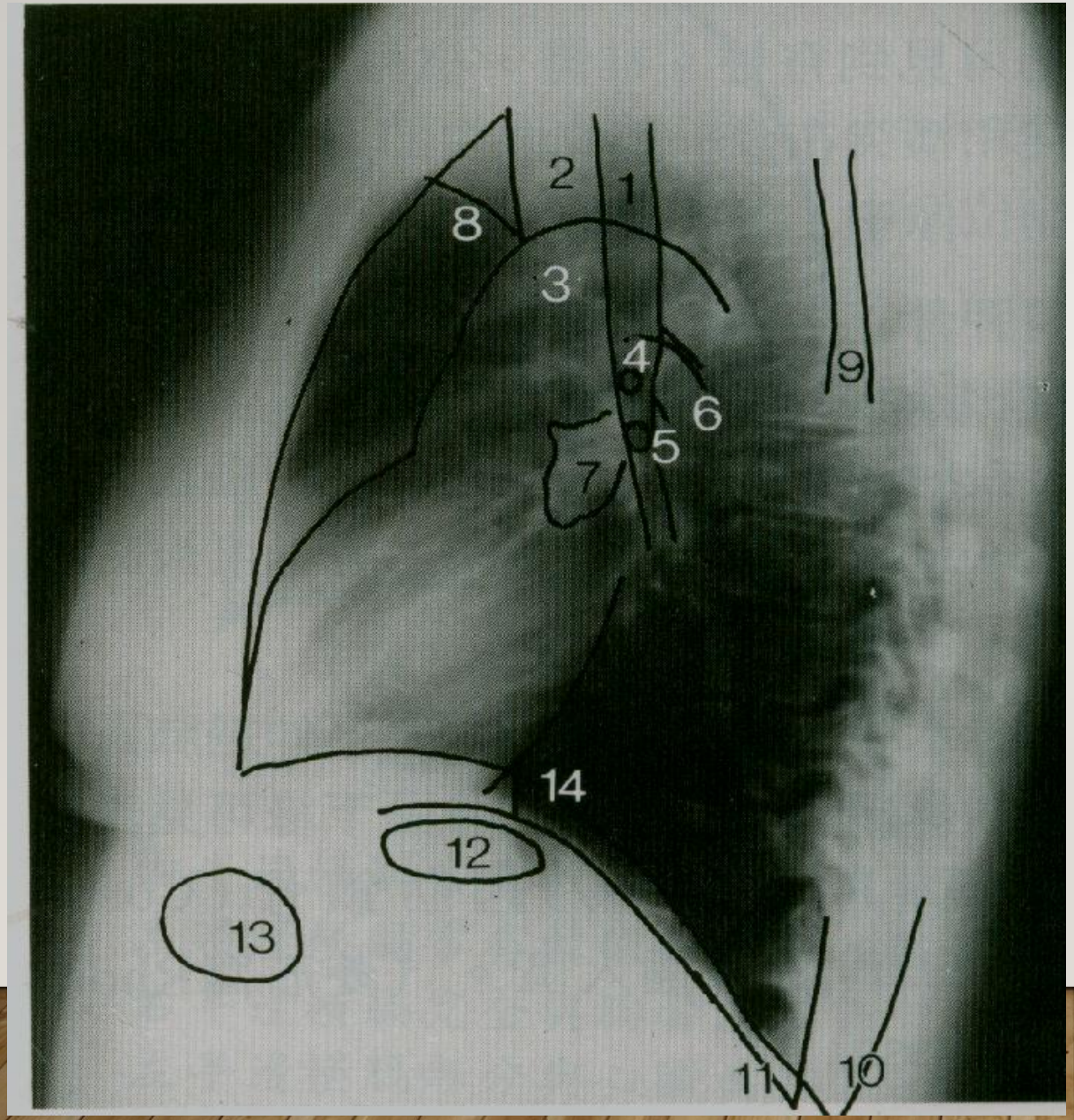
PA View Anatomy



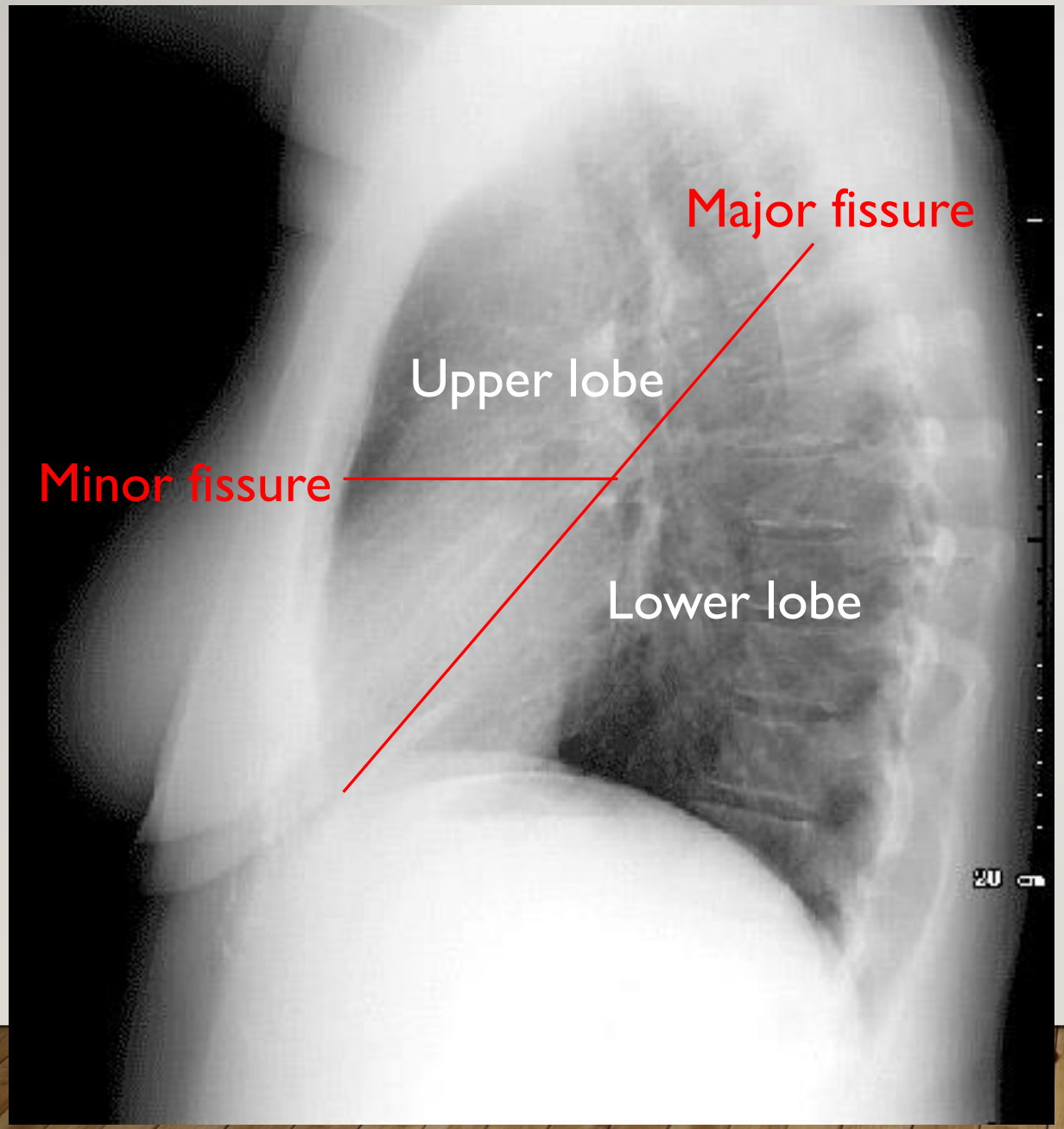
(1)氣管 (2)右主支氣管 (3)左主支氣管 (4)肩胛骨 (5)鎖骨 (6)胸骨上緣
(7)Azygous vein (8)主動脈弓 (9)肺門 (10)左心房 (11)左心室 (12)右心房 (13)肺動脈 (14)橫膈膜 (15)乳房陰影

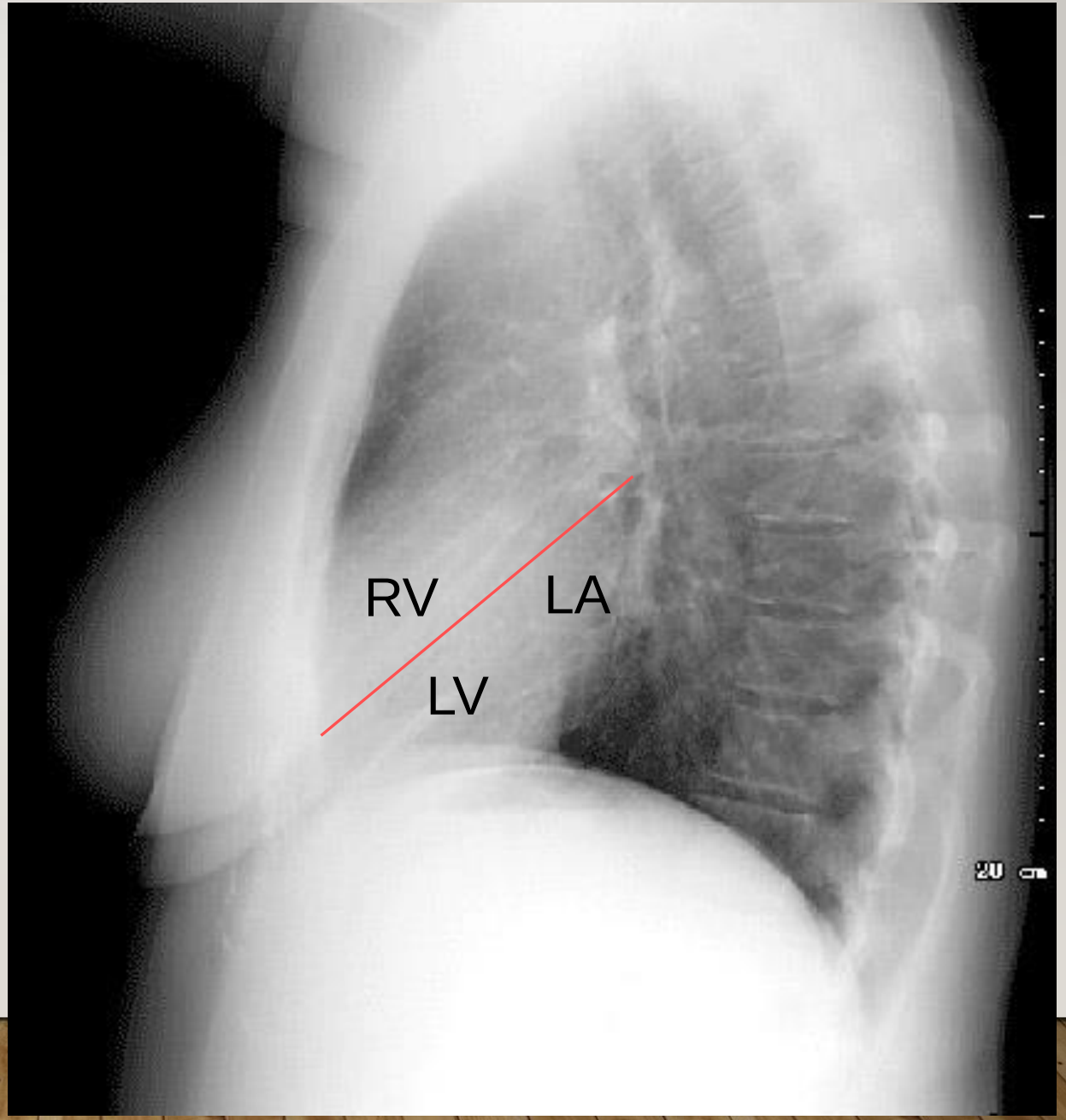

Aortic arch
SVC
LA
RA
LV
RV
ANT

Lateral View Anatomy



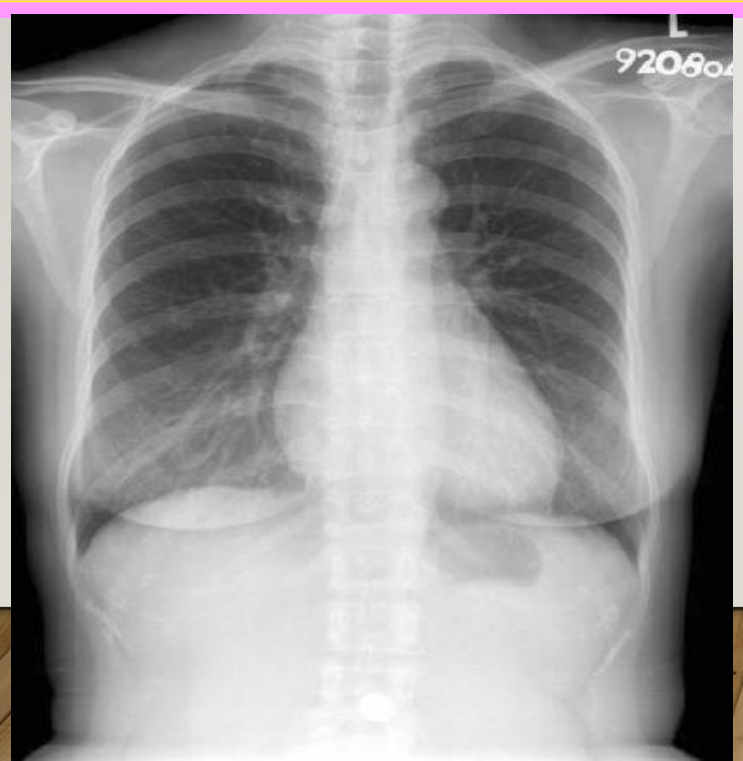
1. Trachea
2. Pretrachea vascular bundle
3. Aortic arch
4. RUL bronchus orifice
5. LUL bronchus orifice
6. Left pulmonary artery
7. Right pulmonary artery
8. Axilla
9. Scapula
10. L't C-P angle
11. R't C-P angle
12. Gastric bubble
13. Transverse colon
14. Inferior vena cava


Major fissure
Upper lobe
Minor fissure
Lower lobe

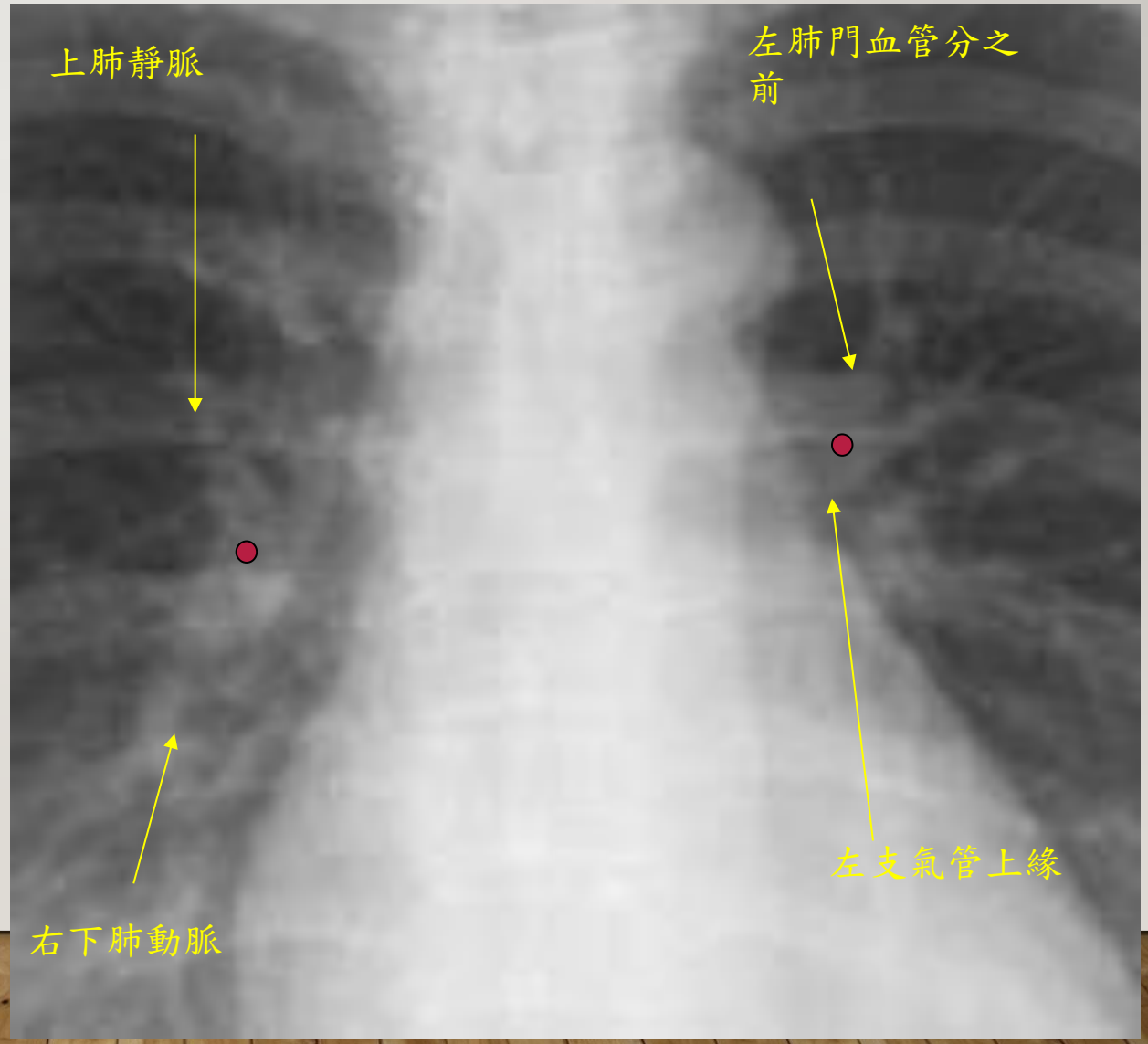

RV
LA
LV

Hilum (肺門):
肺部血管進出縱隔腔的門戶

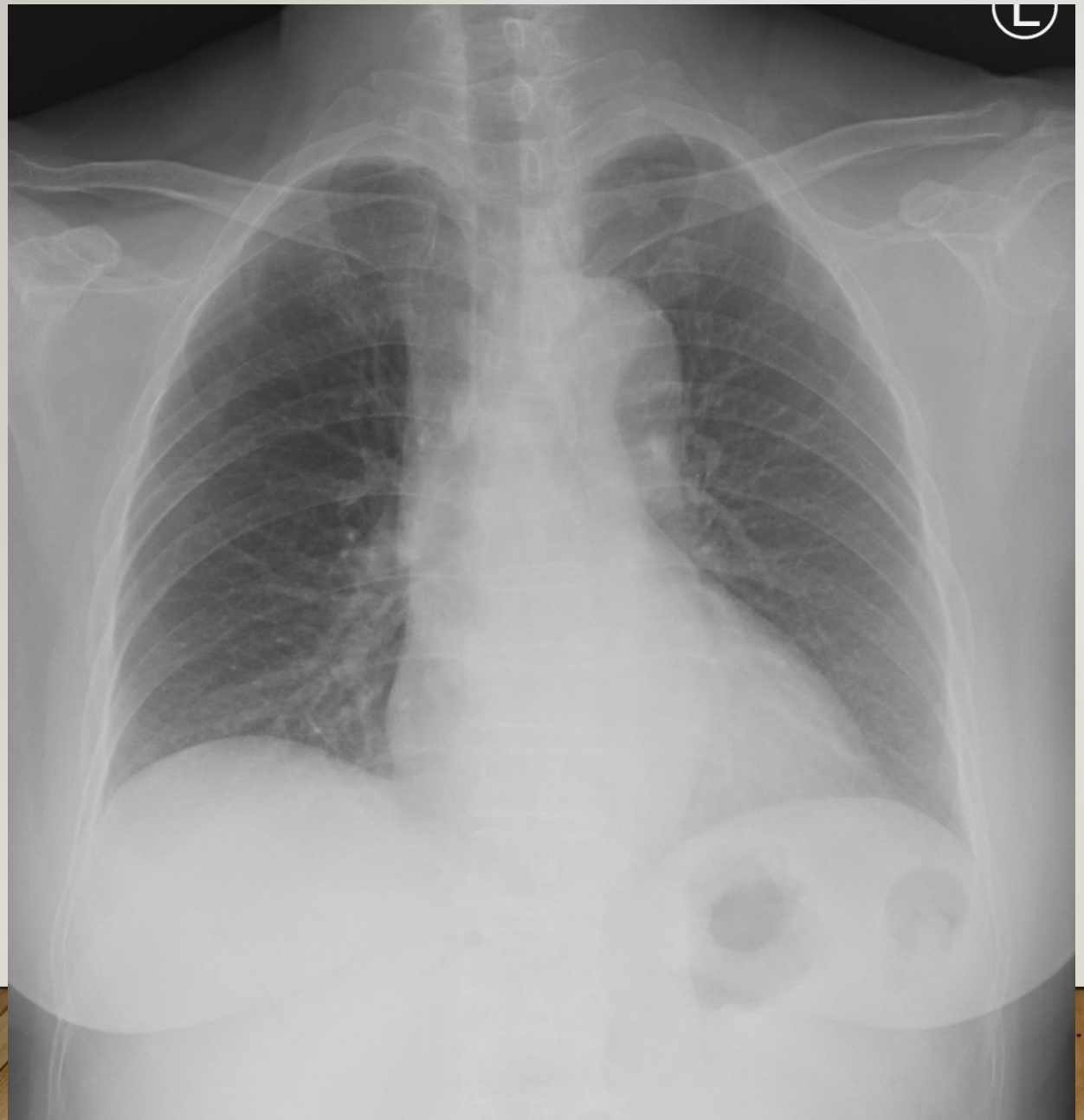
Relative Levels	Number of Cases	Per Cent of Cases
Left higher than right	485	97.0
Less than 0.75 cm	57	11.4
0.75 to 2.25 cm	402	80.4
2.25 to 3.00 cm	24	4.8
More than 3 cm	2	0.4
Same level	15	3.0
Right higher than left	0	0

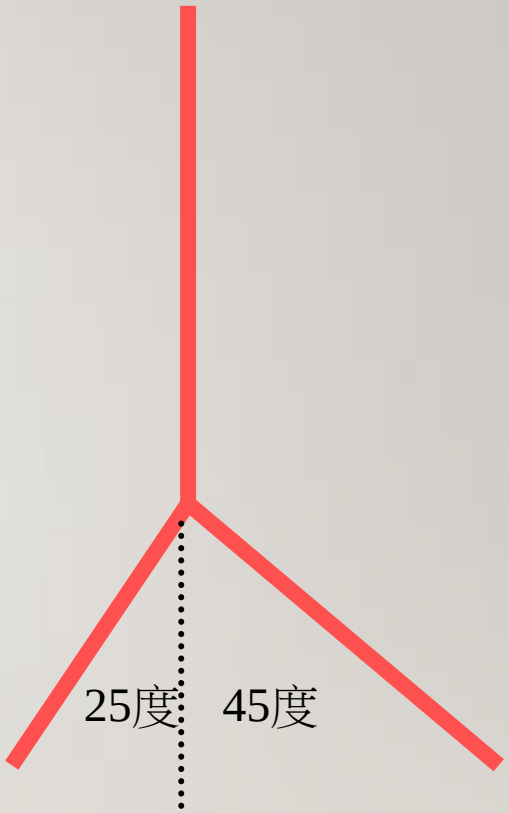


Hilum 右低左高



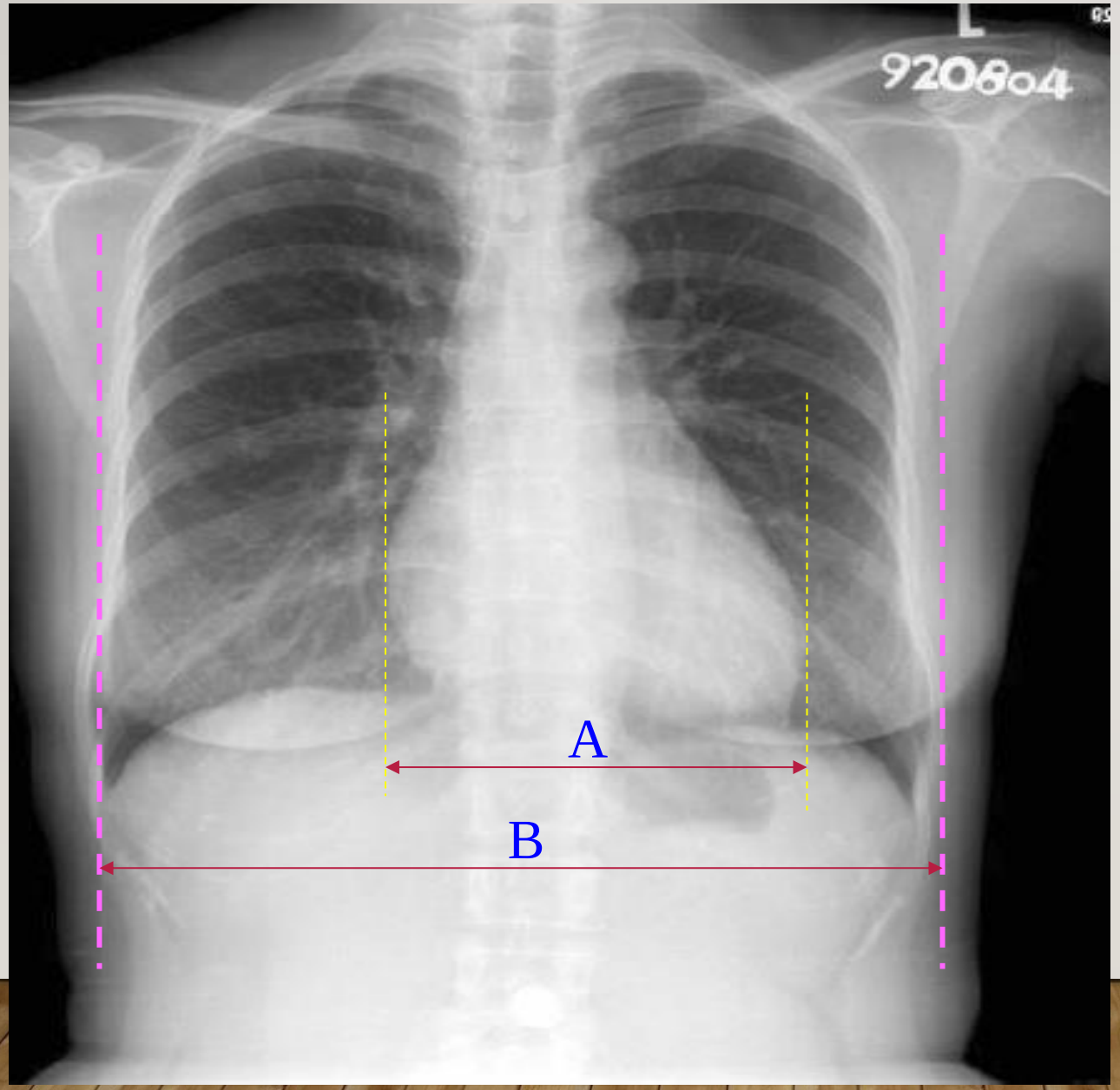
Central Airway





Carina夾角正常是70度
>90度就是不正常:
Left atrium enlargement,
Subcarinal LN or tumor

Cardiothroacic Ratio (CT Ratio)



CT ratio = A/B

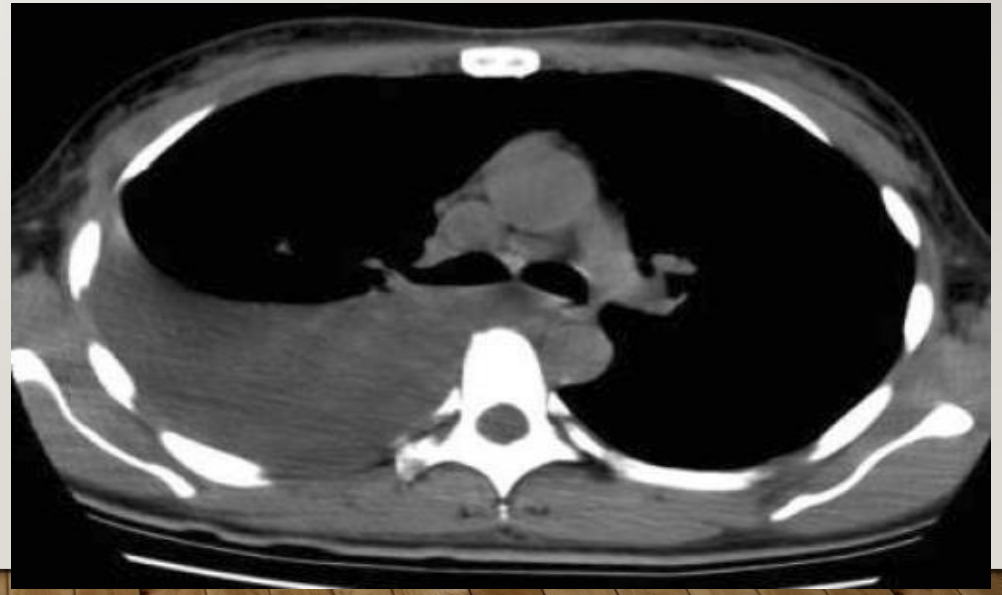
正常應 < 0.5

*這個case CT ratio 剛好=0.5, 已經是borderline heart size

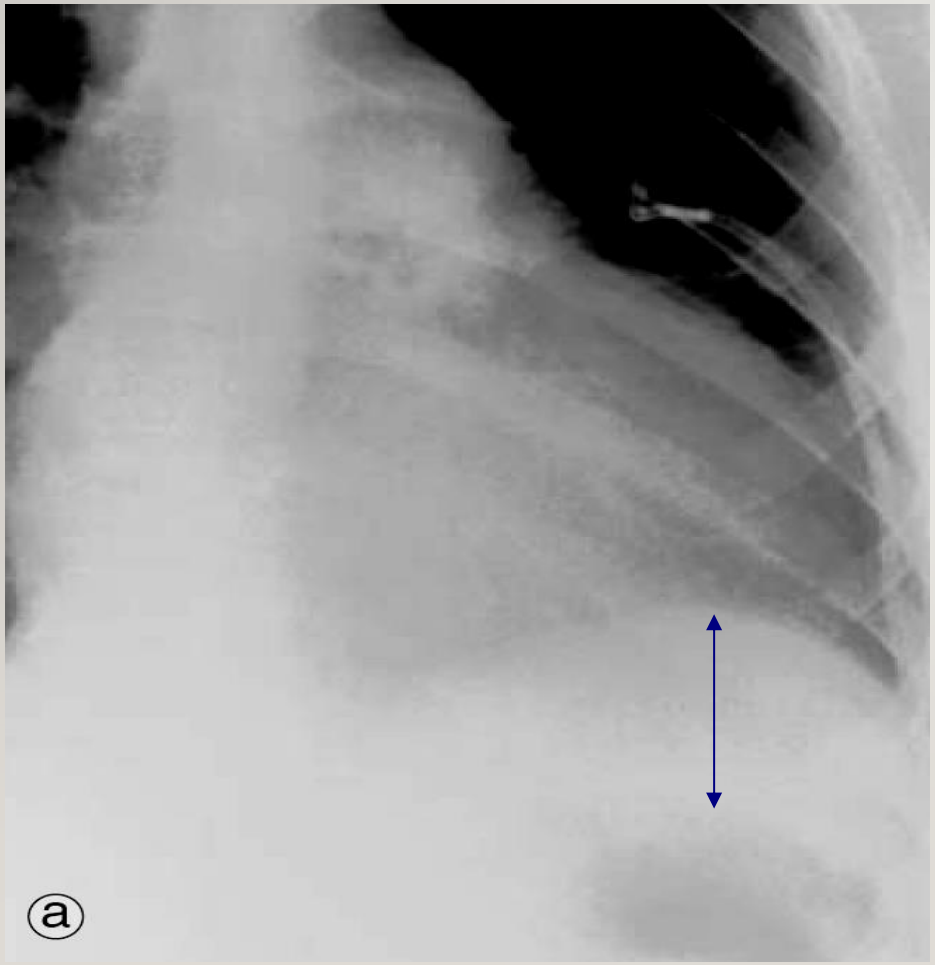
Diaphragm

- 右高左低(差約半個vertebral body)
  - 最高點在內1/3處
  - 前高後低
- 左横膈距離gastric bubble厚度應<2cm
  - >2cm 應懷疑subpulmonary effusion
- Costophrenic (CP) angle

Subpulmonary Pleural Effusion

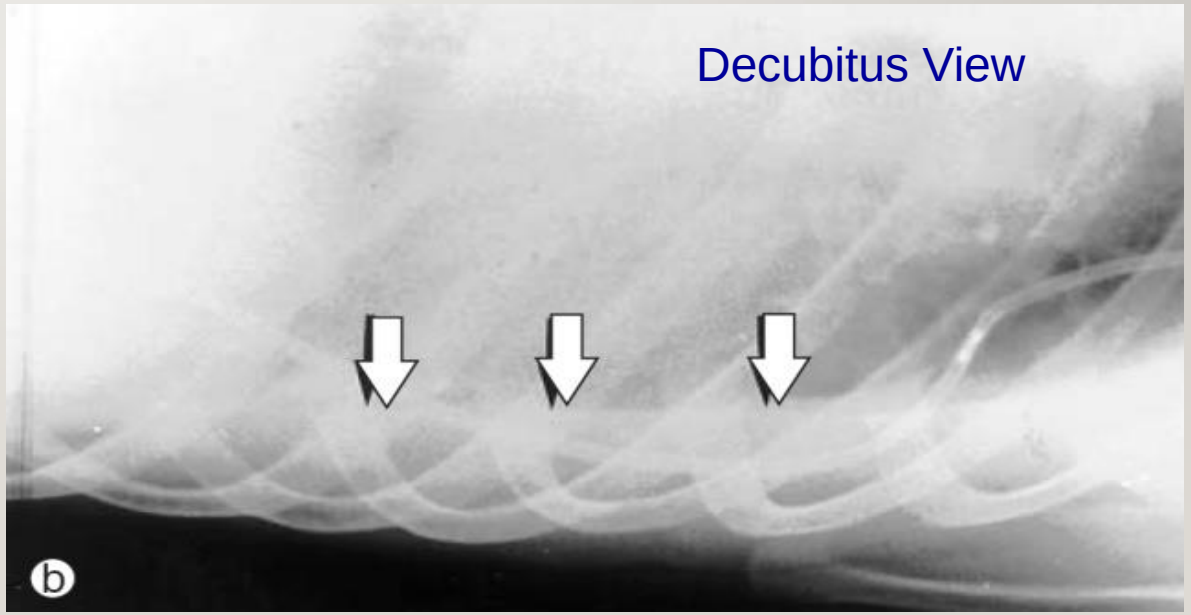


Subpulmonary Pleural Effusion



Gastric bubble與左横隔距離

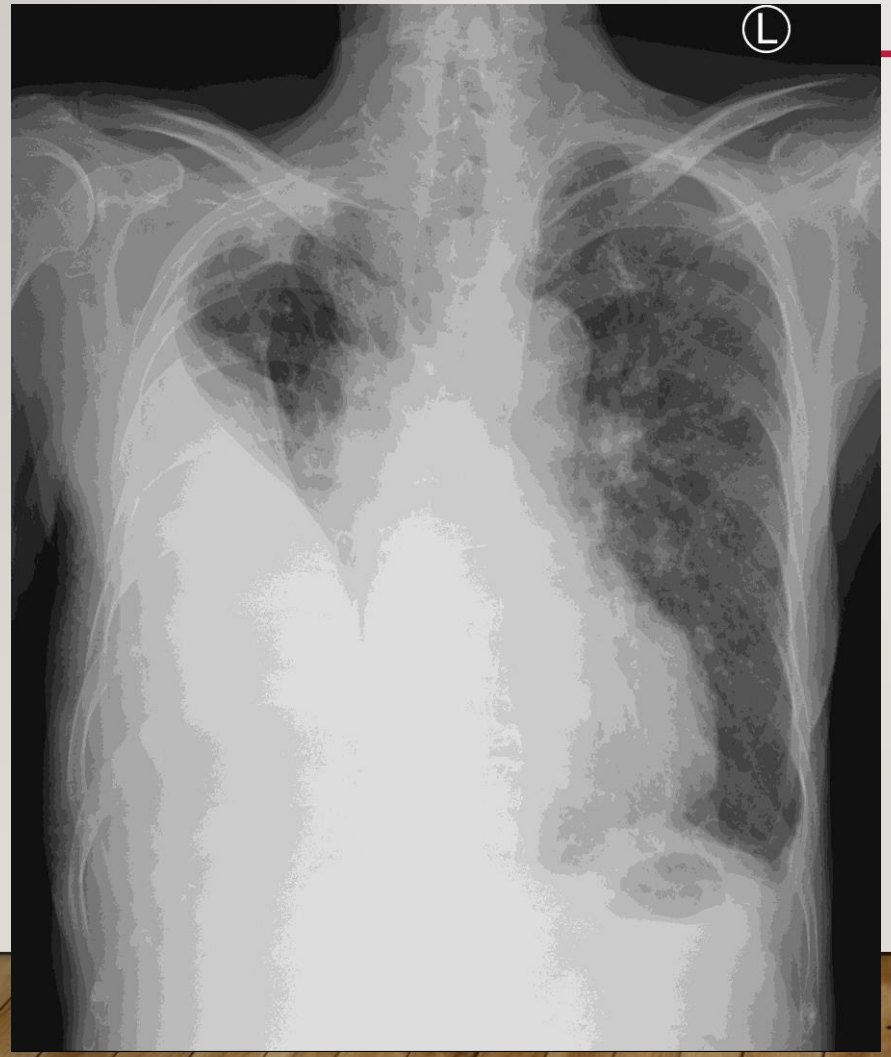
If > 2cm: 表示其實横隔上面有東西
=> Subpulmonary pleural effusion

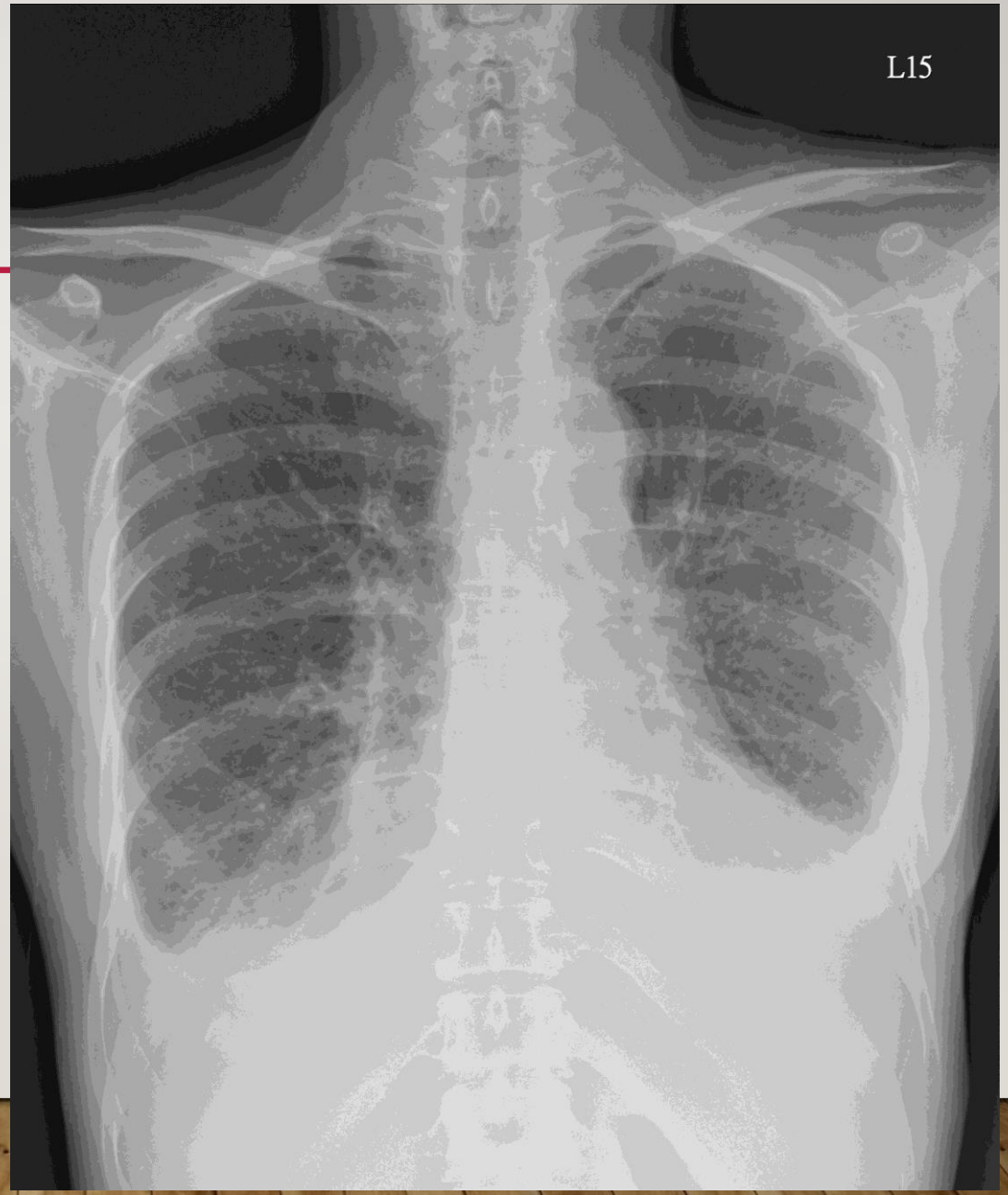


L't subpulmonary pleural effusion

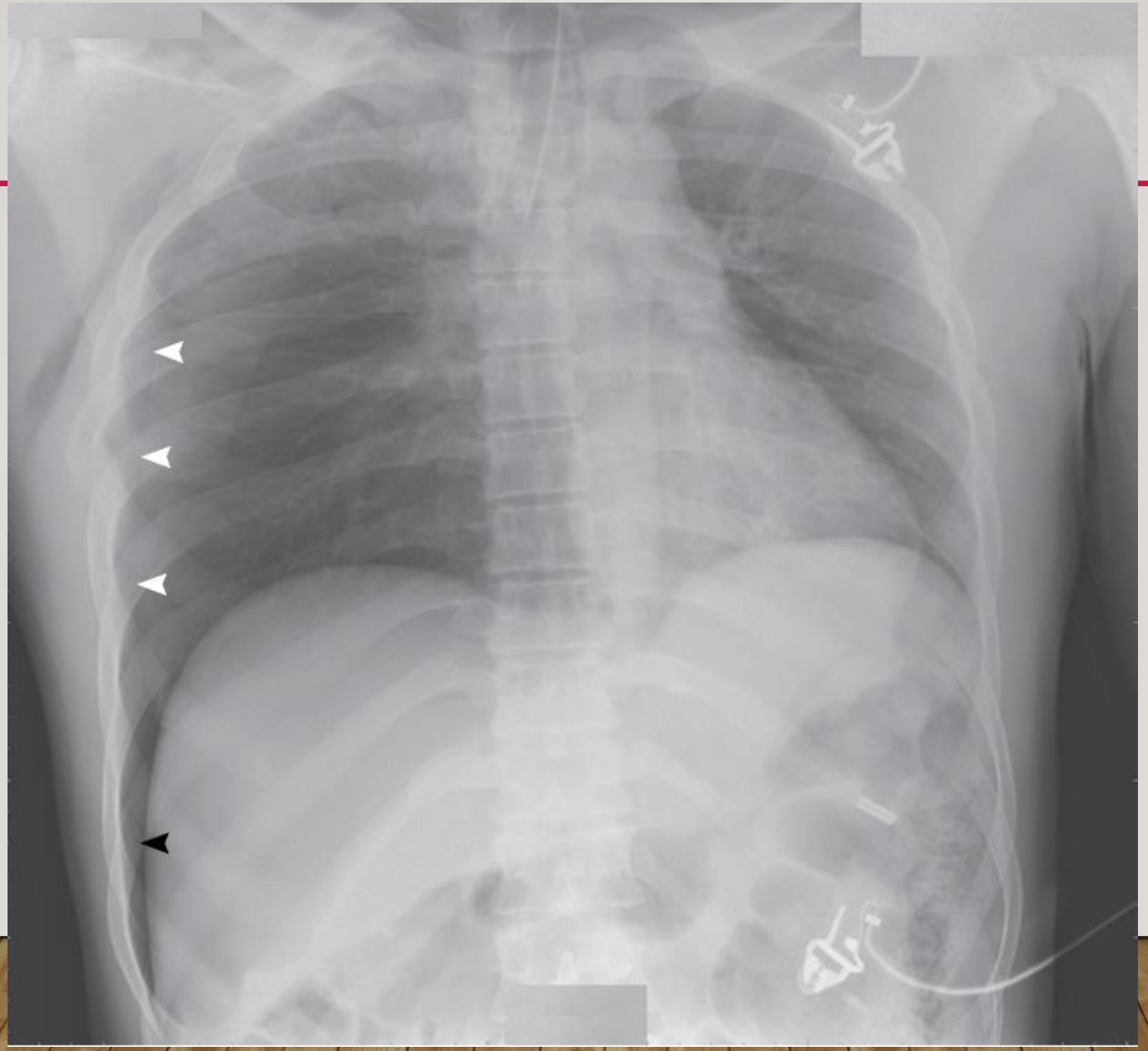
Meniscus Sign:

=> pleural effusion





Deep Sulcus Sign



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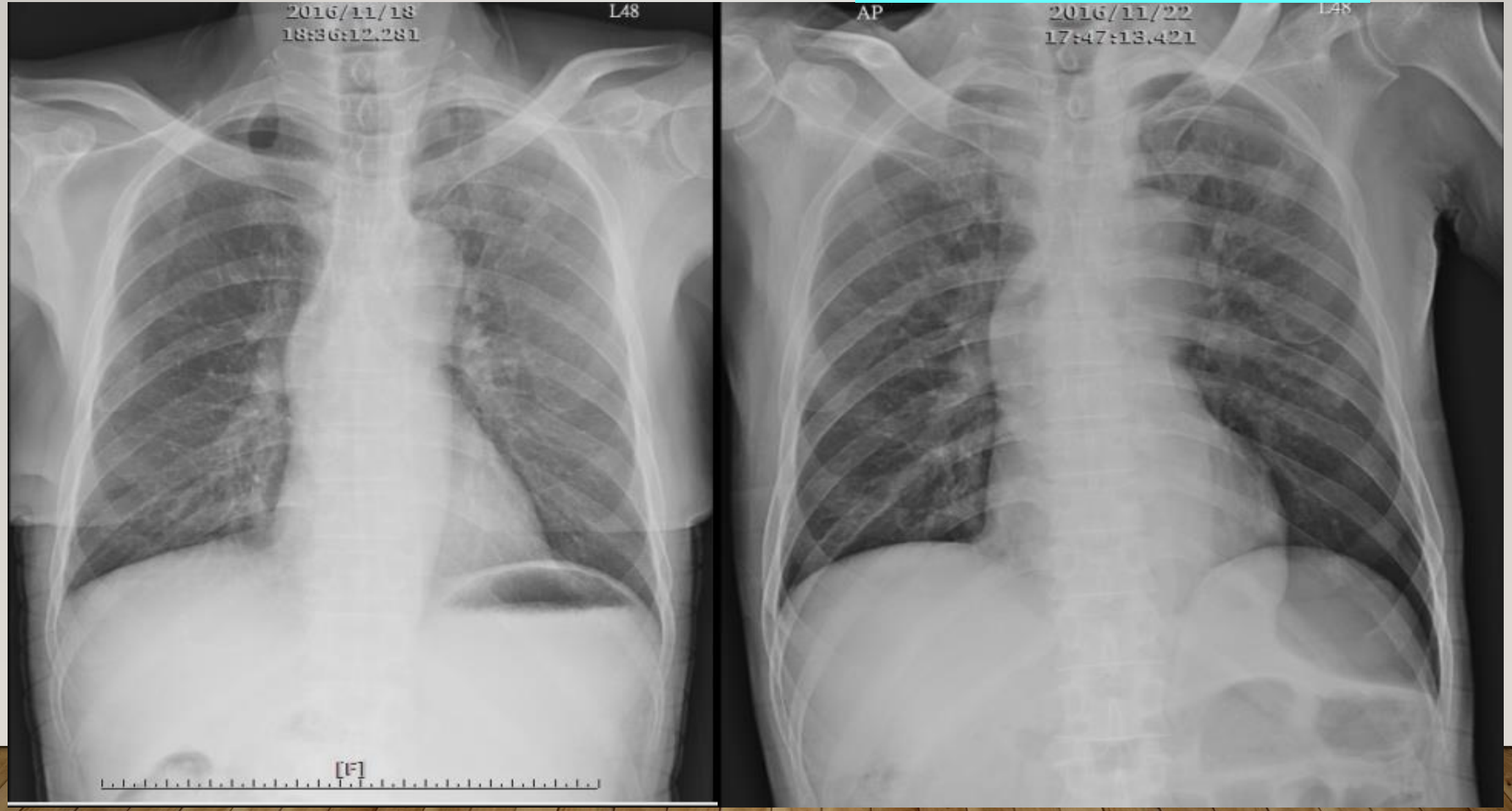
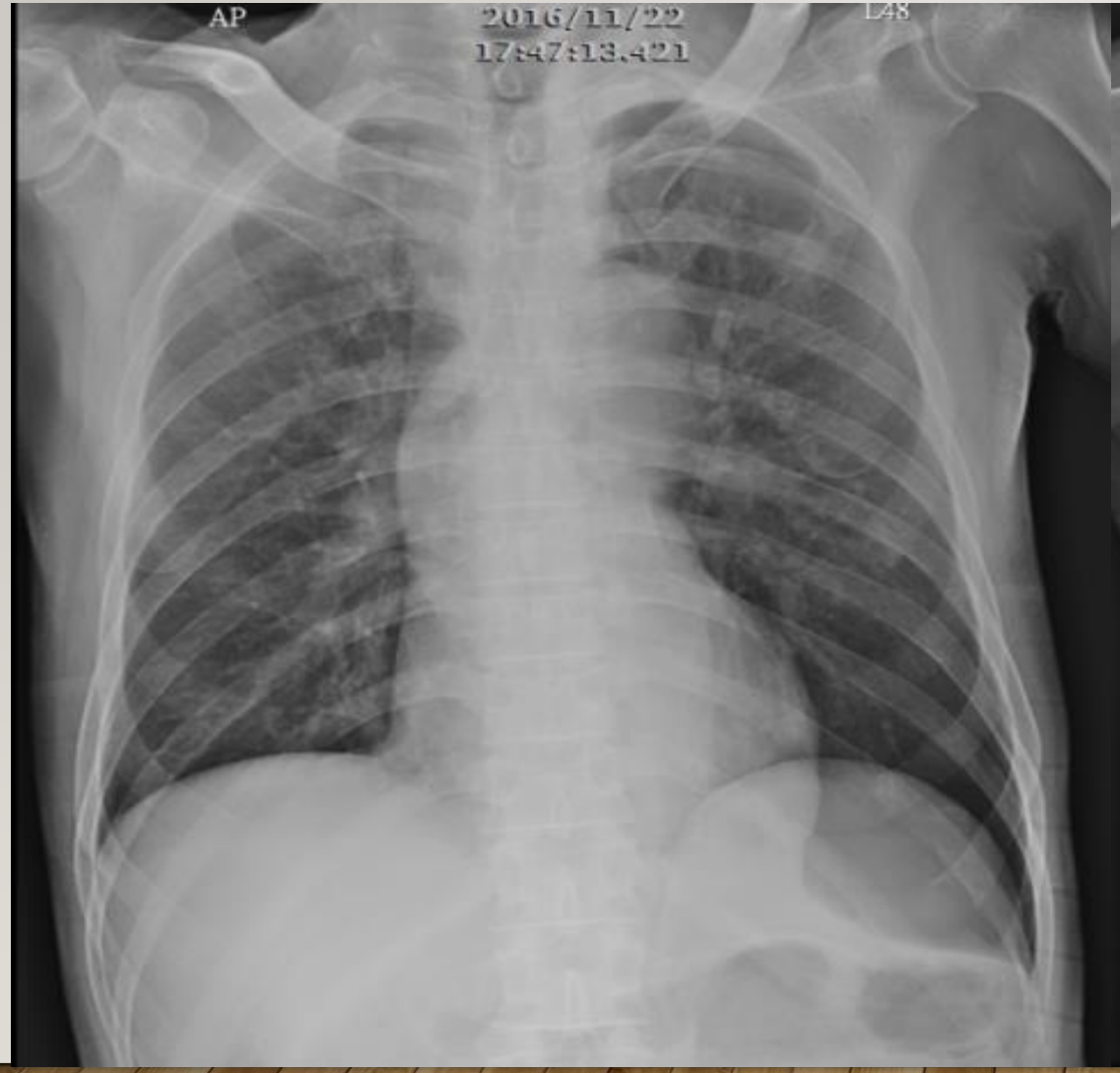
Deep Sulcus Sign

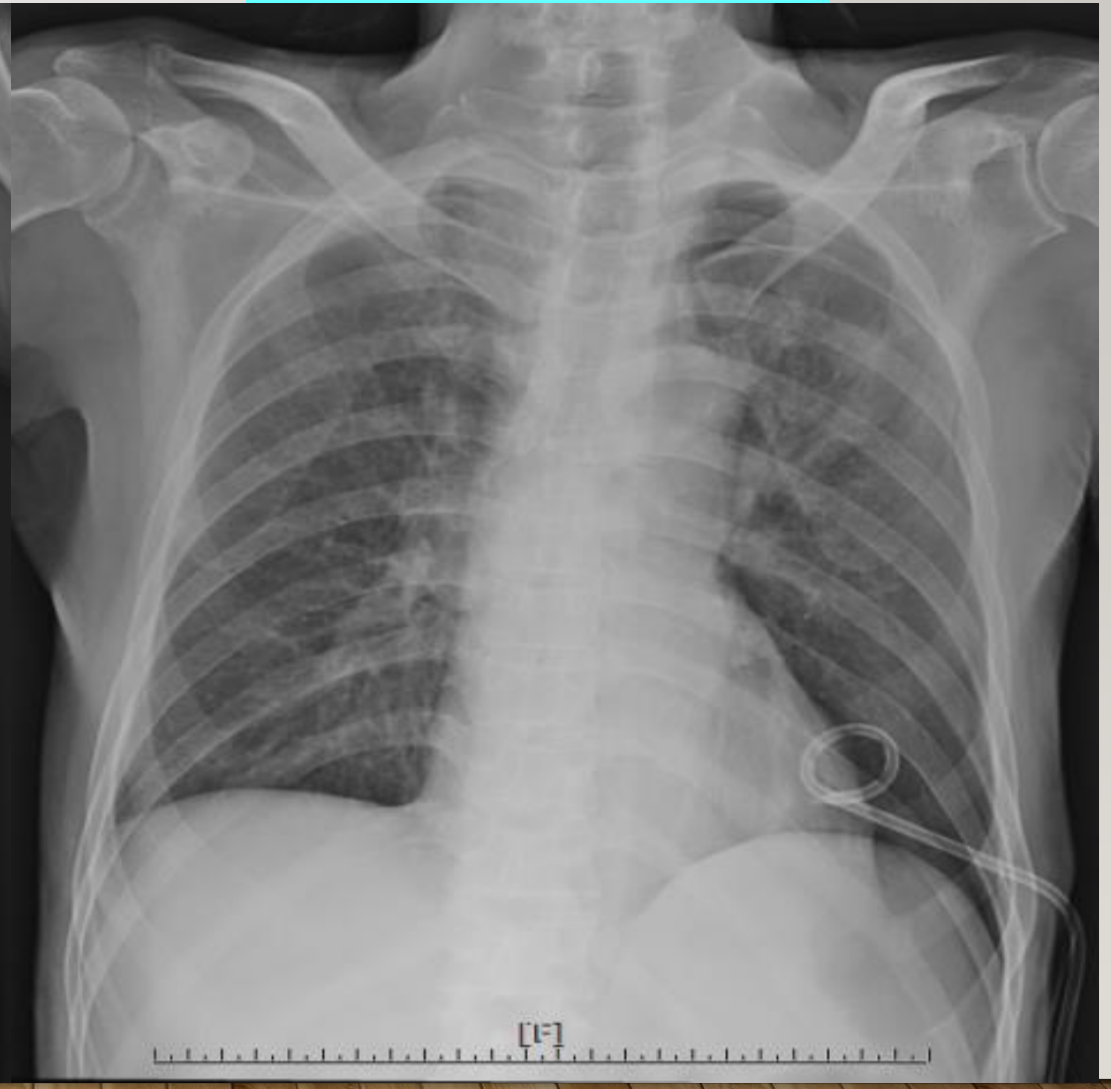
After CT guide lung biopsy



Lt Pneumothorax



After pigtail drainage



Terminology

- Lung marking (肺紋) components:
  - **Vessels (artery/vein)**
    - **the major component of lung marking in normal people**
  - Bronchus
  - Lymphatics
  - Interstitium

Terminology

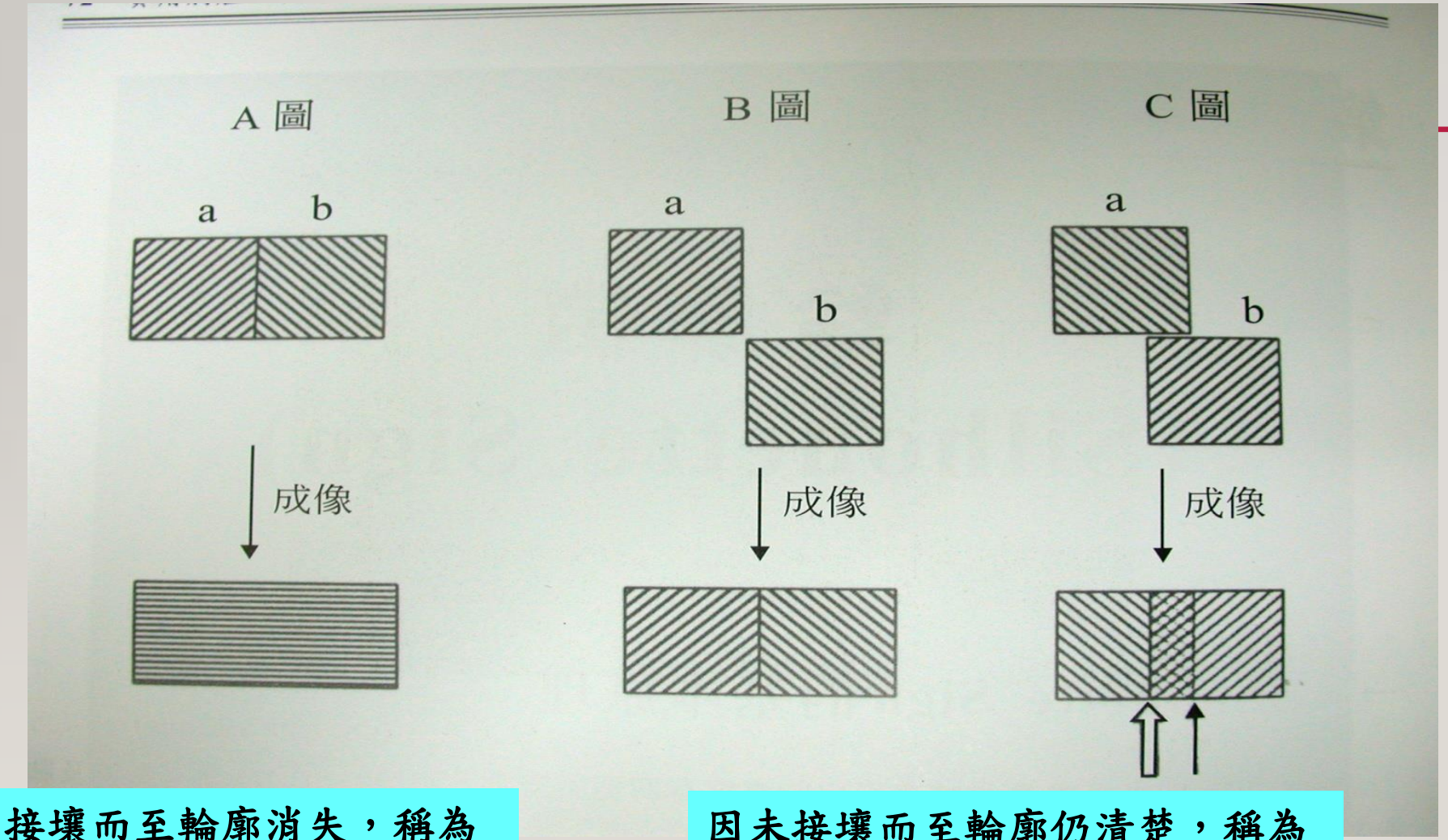
- **Infiltration (浸潤) vs. Opacity (陰影)**
  - Infiltration = Opacity
  - Opacity more favored (減少混淆)
- **Nodule(結節) vs. Mass (腫塊)**
  - Nodule: a rounded opacity ≤ 3cm, well or poor defined margin
  - Mass: any opacity > 3cm, well or poor defined margin

Chest Image Signs

Signs of Localization

- Silhouette sign
- Incomplete border sign
- Extrapleural sign
- Cervicothoracic sign
- Thoracoabdominal sign
- Hilum overlay sign
- Hilum convergence sign
- Air bronchogram sign

Silhouette Sign (輪廓徵)

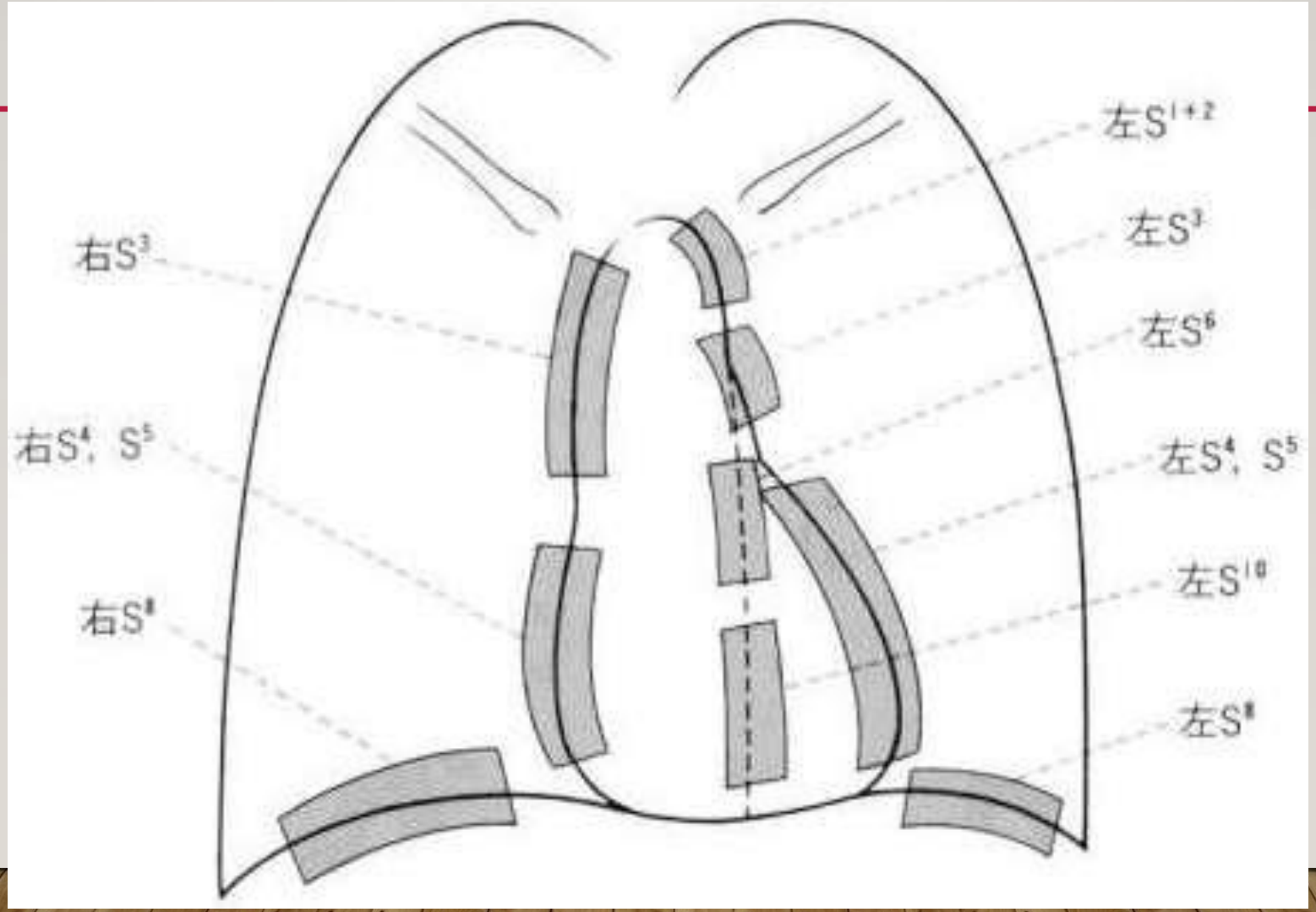


a和b為放射線濃度相同的構造

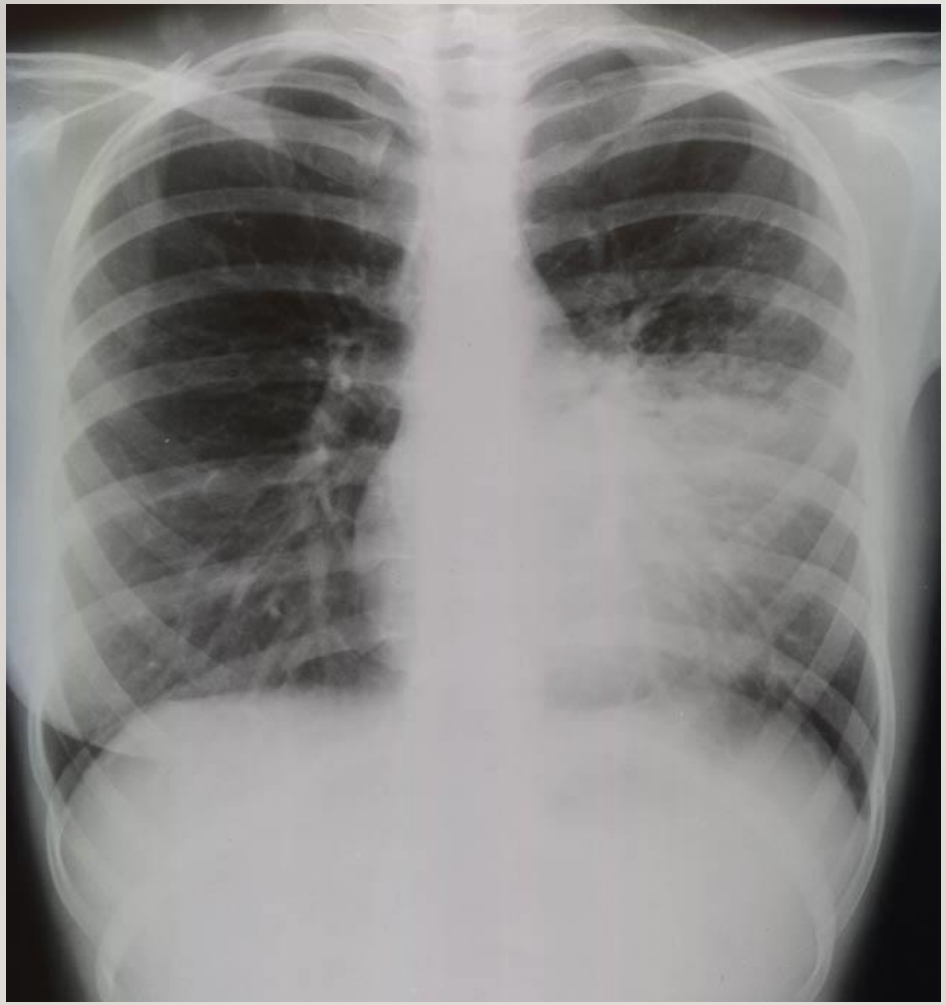
因接壤而至輪廓消失，稱為positive Silhouette sign

因未接壤而至輪廓仍清楚，稱為negative Silhouette sign

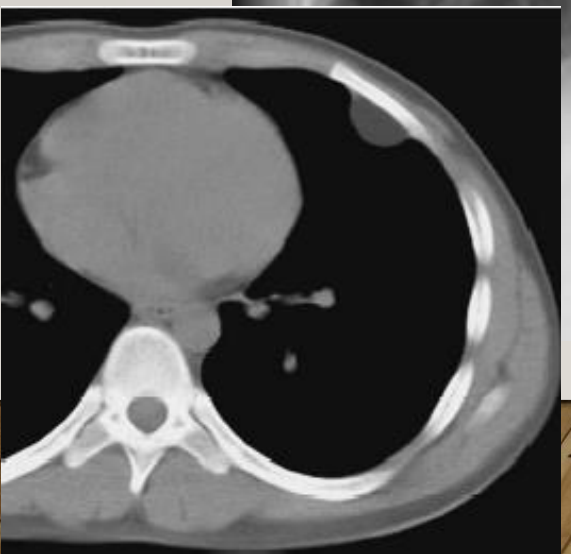
Silhouette Sign (輪廓徵)



Lingual lobe pneumonia (Silhouette Sign+)



Incomplete Border Sign



Chest wall lipoma

肋膜外的病灶，因為與胸壁(或縱膈)相連，所以產生 positive silhouette sign ，該部分的 border消失 。
在 X 光上只有突入肺內部份的 border清楚 (與肺部空氣對比襯托出邊緣) ，稱為 incomplete border sign。

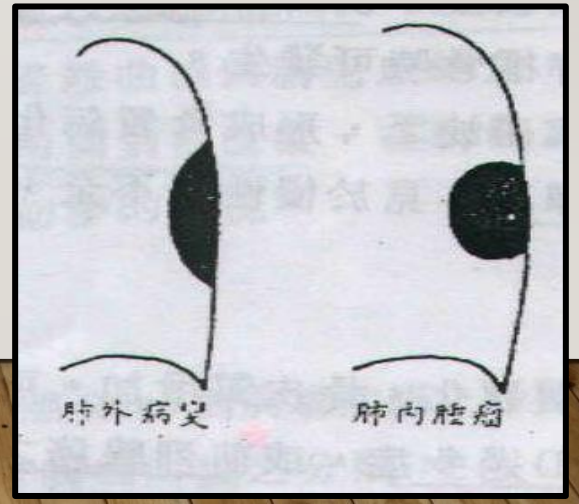
常見於:

1. Chest wall mass
2. Encapulated pleural effusion
3. Interlobar effusion

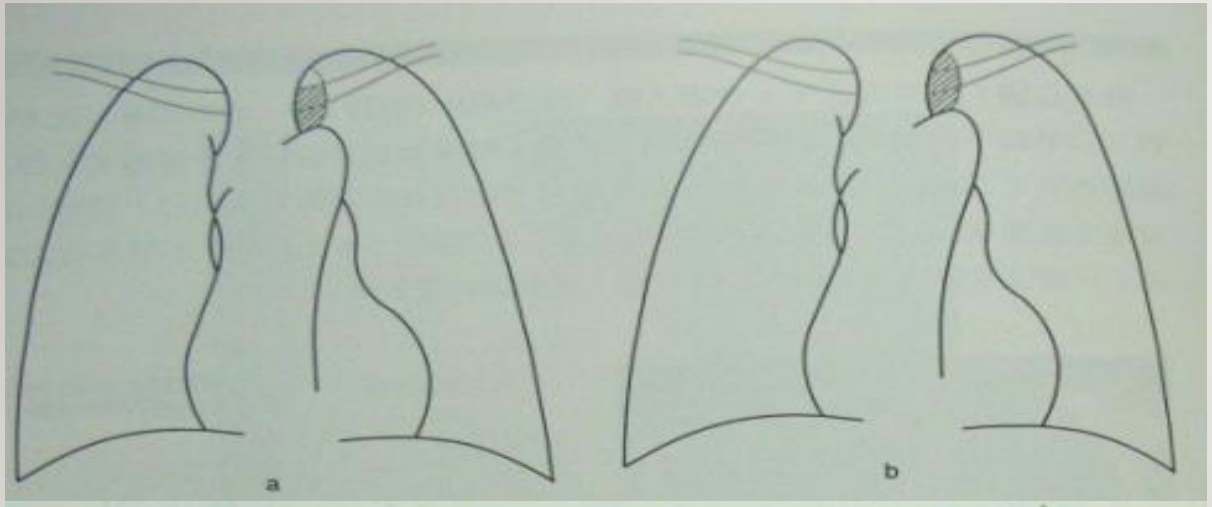
Extrapleural Sign

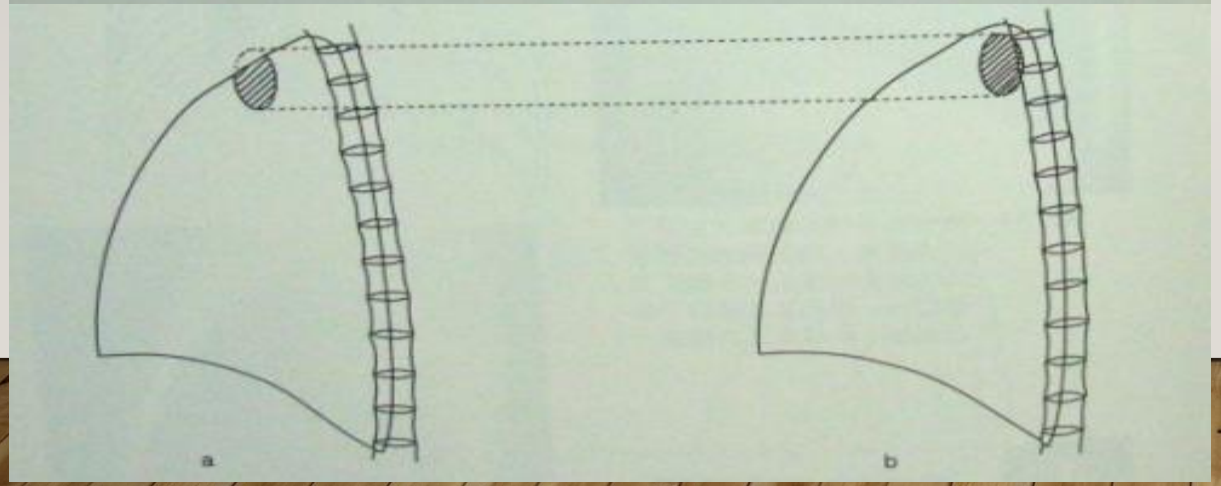
Fibrous dysplasia

- 指肋膜外的病灶往肺內突入，但因其外圍有兩層肋膜包被，故出現底下三個特徵
  - Well-defined border
  - 影像的基底部較寬，與胸廓或橫膈或縱膈之交角為**鈍角**
  - 近胸腔側之外緣所劃成圓形的圓心位於胸腔外



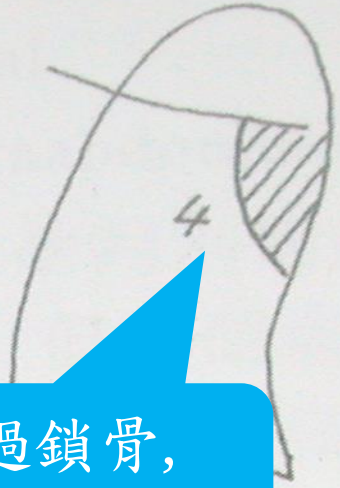
Cervicothoracic Sign
用於判別縱膈腔病灶的相對位置



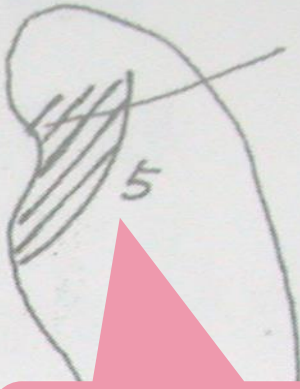


- Cervicothoracic sign+: 表示縱病灶部分在胸腔，部分延伸到頸部， 其進入頸部的部分邊緣消失 (因與軟組織相連，缺少肺部襯托)
- 在clavicle
  - Anterior mediastinum 離開肺部，與soft tissue相連
  - Posterior mediastinum 與肺部相接的高度則超過clavicle。

1,2皆為肺內病灶
3為縱隔病灶



跨不過鎖骨,
前縱膈lesion



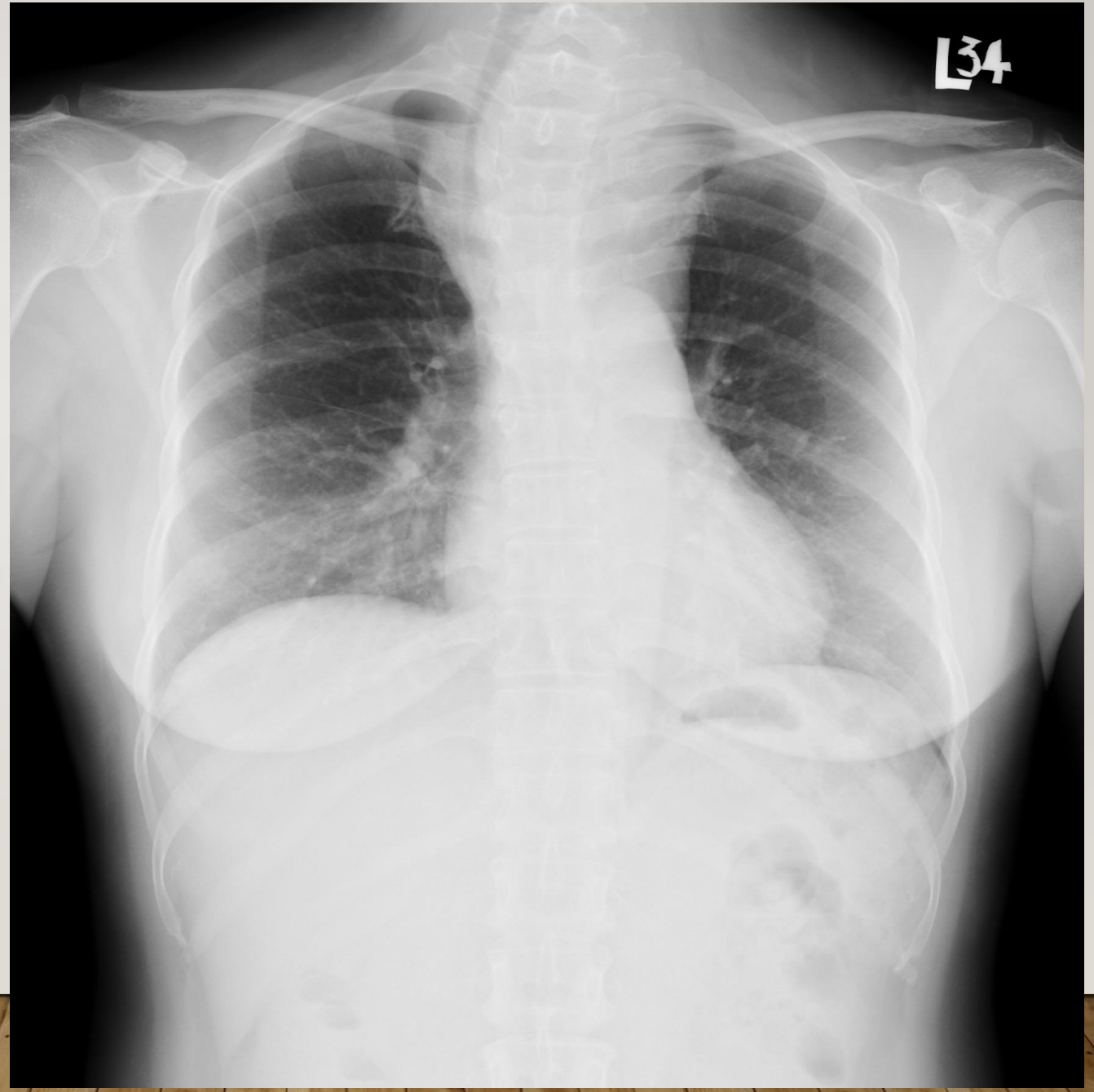
跨過去但邊緣不清楚,**中**縱膈lesion

可以是肺內吃出去頸部, 或是部分縱膈而部分在頸部

邊緣清楚,cephalic border超越鎖骨且延伸到肺尖與頸部連接
→ **後**縱膈病灶

病灶4, 5, 6, 7為 Cervicothoracic sign+

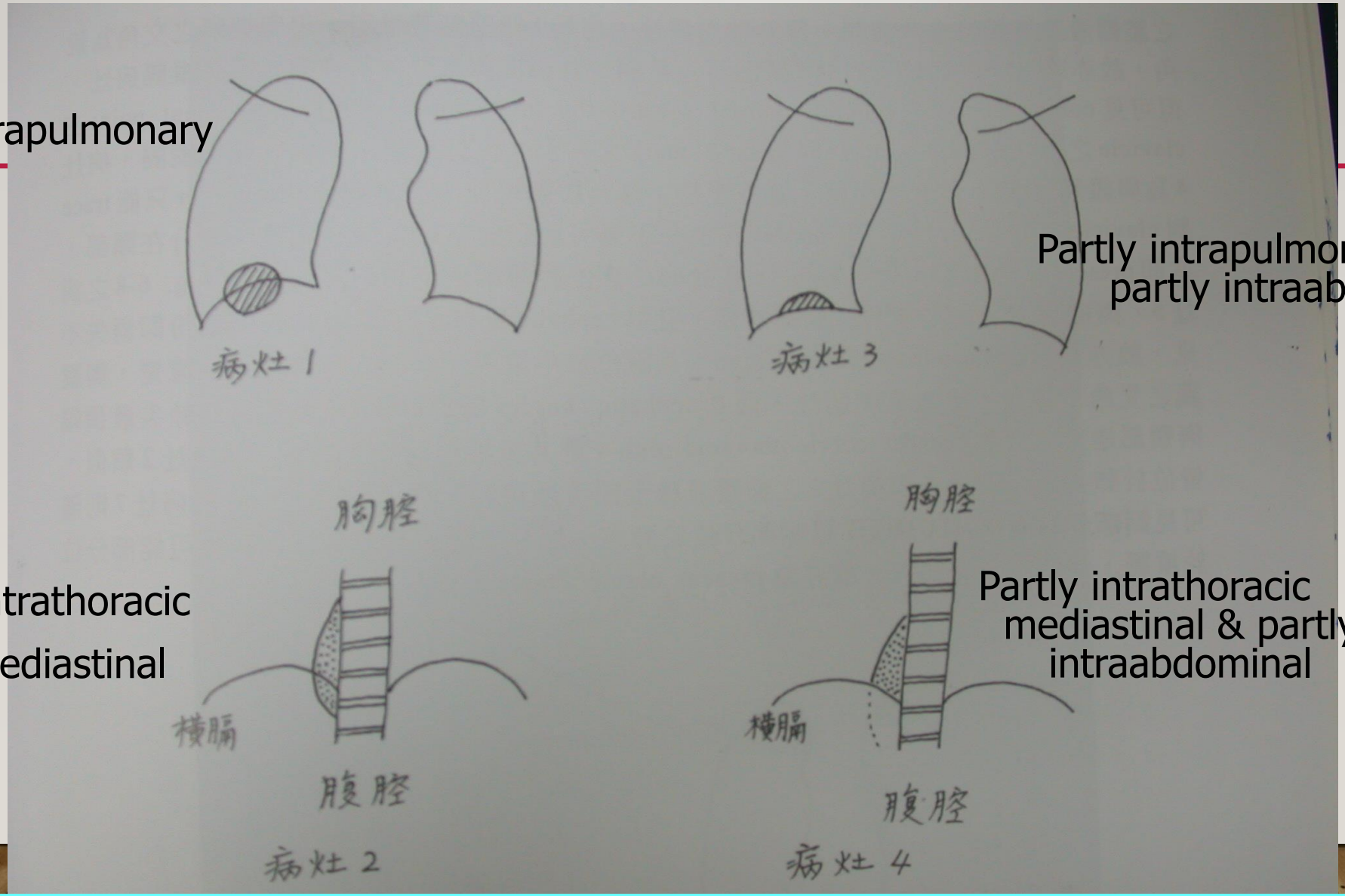
Intrathoracic goiter



mediastinal lesion 之 border 至 clavicle 即消失, 表示此病灶應位於 anterior mediastinum

Thoracoabdominal Sign

Intrapulmonary



Partly intrapulmonary & partly intraabdominal

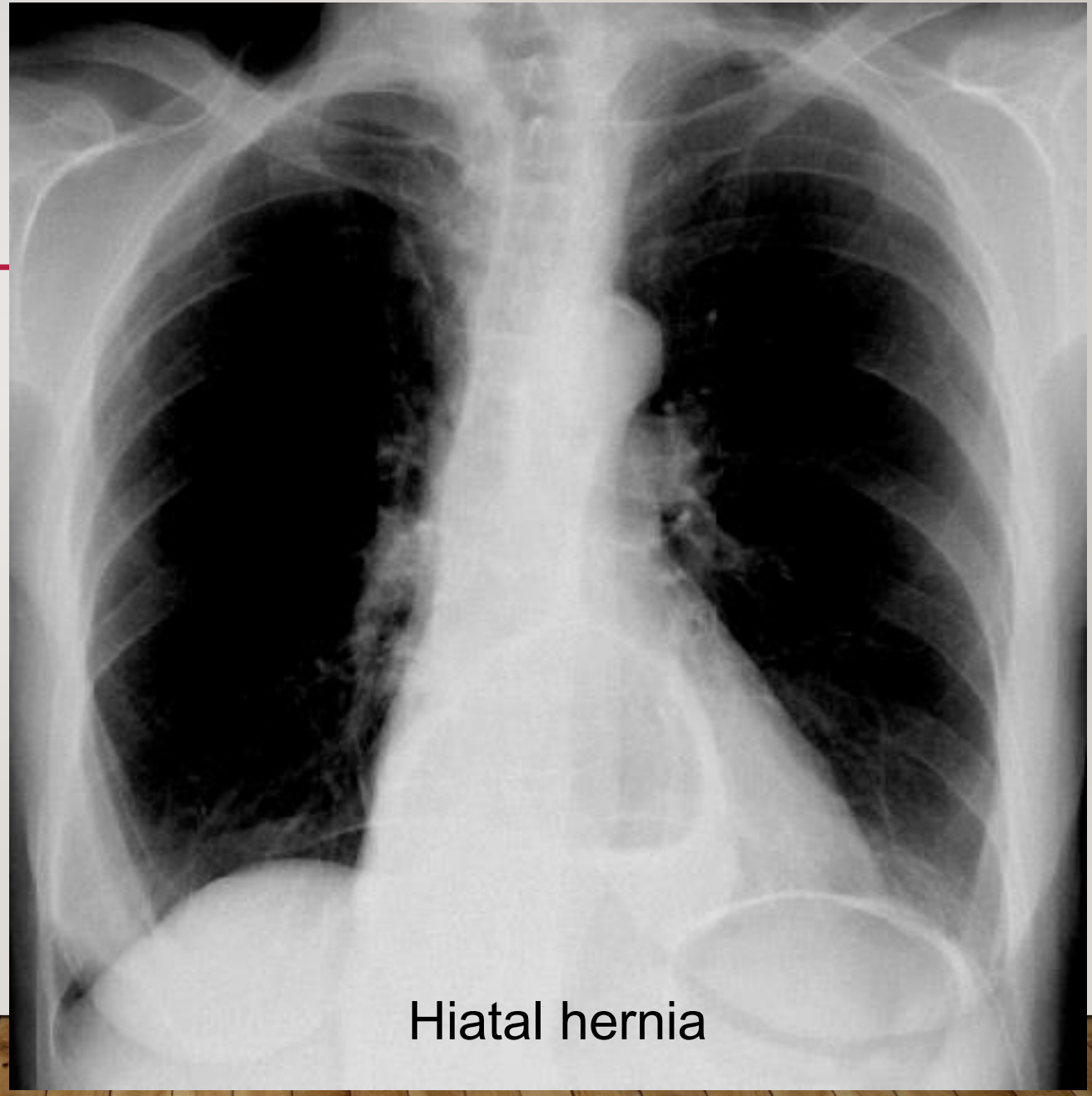
Intrathoracic mediastinal

Partly intrathoracic mediastinal & partly intraabdominal

病灶3,4為Thoracoabdominal sign+，而病灶1,2為Thoracoabdominal sign-

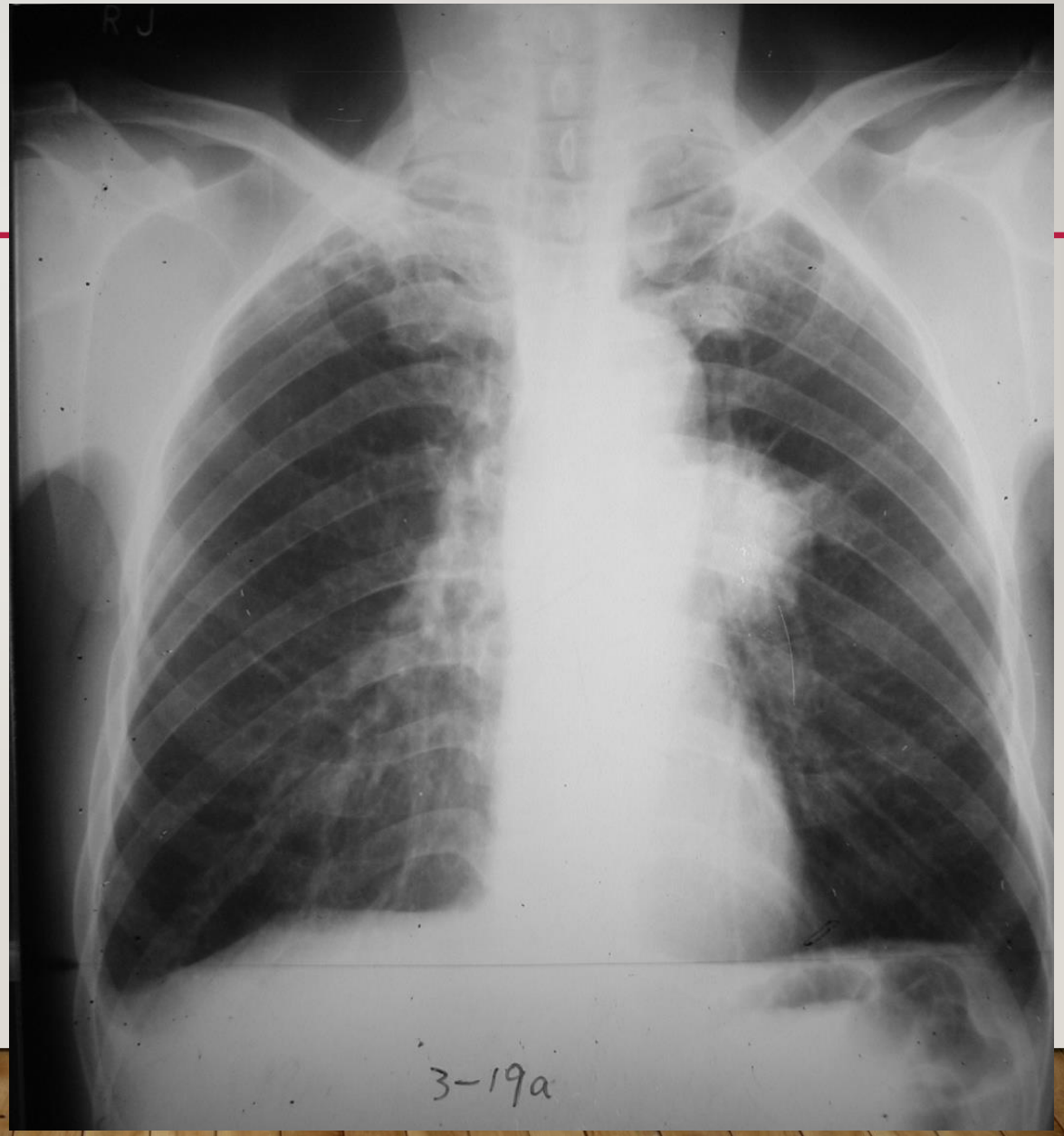
Thoracoabdominal Sign

- Thoracoabdominal Sign+: 表示Lesion跨越過胸部與腹部，因和腹部soft tissue接觸，所以下緣界線消失。



Hilar Overlay Sign

- Hilar overlay sign: 表示是hilar附近縱隔腔病灶,或是心臟旁邊的病灶



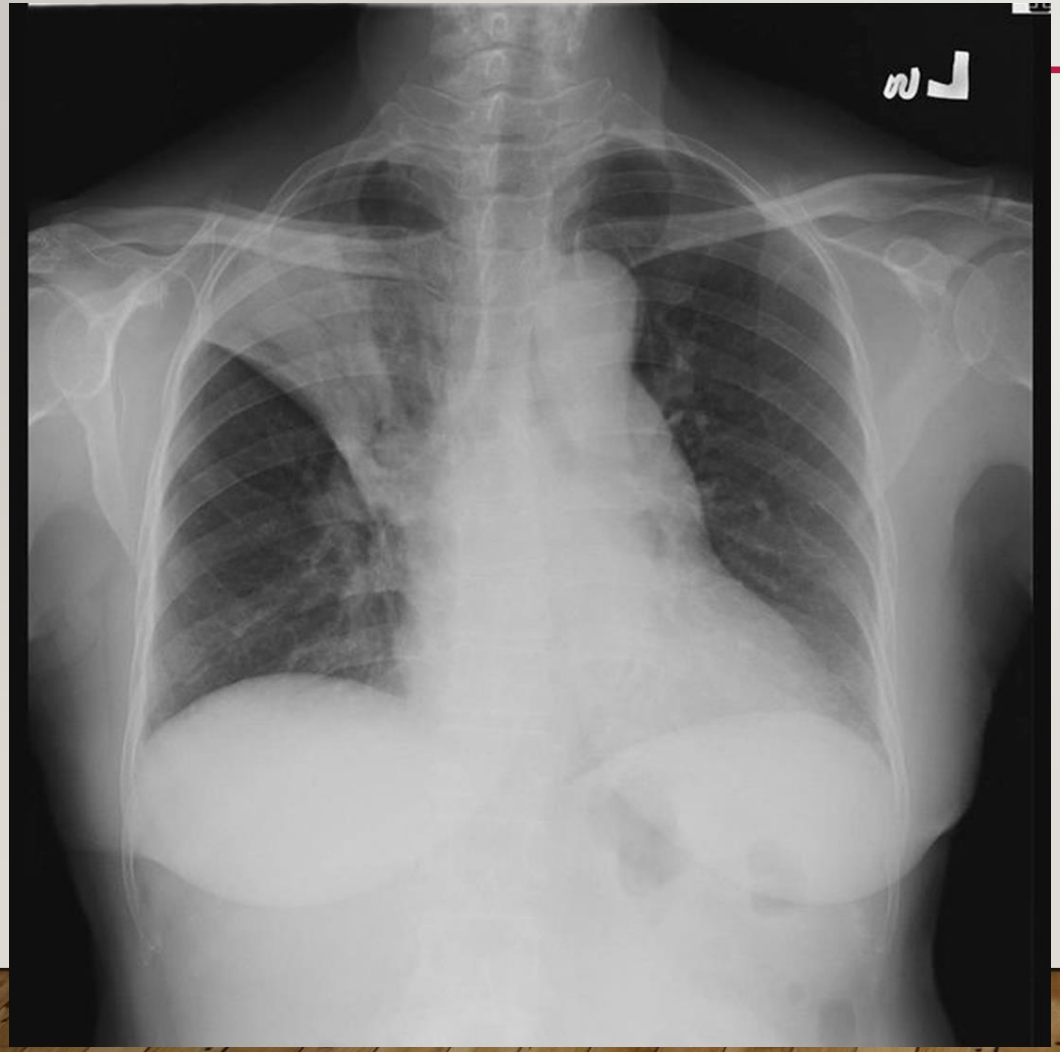
Left hilar enlargement,
Lung cancer, LUL

Hilar Convergence Sign

- 用以分辨hilar enlarge是否因pulmonary artery 變大。
- 假如血管進入肺門即消失，則代表hilar變大是因pulmonary artery enlarge引起 (pulmonary hypertension)

Pulmonary hypertension

Air Bronchogram Sign



- Air bronchogram sign refers to the visualization of bronchial structures containing in the context of consolidation areas of the surrounding pulmonary parenchyma. First described in 1969

Causes:

- Pneumonia
- Pulmonary edema, infarction, pulmonary hemorrhages, aspirations, trauma
- Adenocarcinoma with lepidic pattern, pulmonary lymphoma

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Air Bronchogram Sign

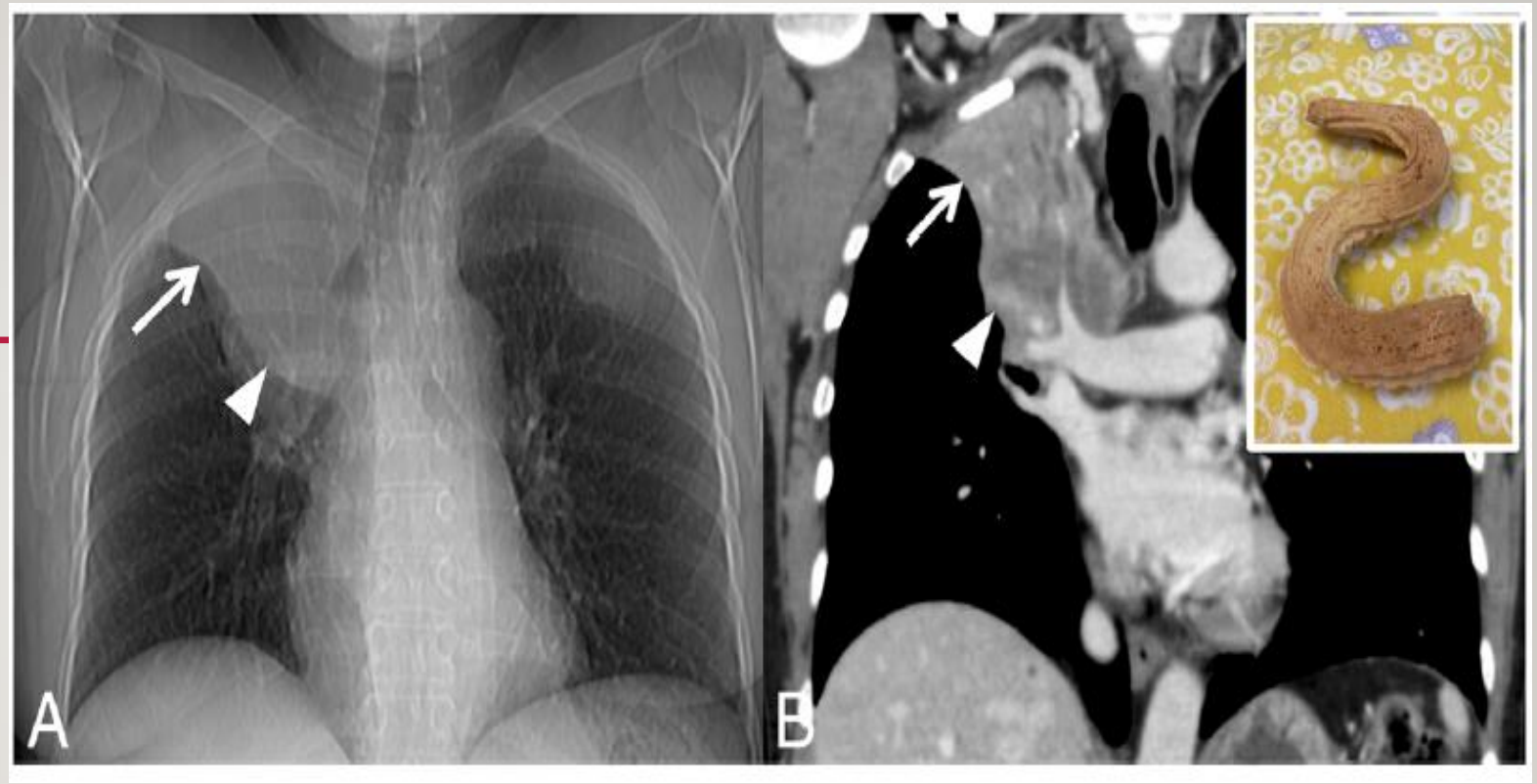
The air bronchogram sign, refers to patent airways seen through opacified lung.

CHEST 2017; 151(6):1356-1374

Signs of Nodule and Mass Lesion

- Golden S-sign
- Popcorn Calcification
- Sunburst Sign (Corona Radiata)
- Galaxy Sign

Golden S-sign



- **RUL atelectasis** (superior and lateral part of the S profile) + **pulmonary neoplasm at the right hilum** (inferior and medial part of the S profile).
- Described by Ross and Golden in 1925, also called "reverse S sign of Golden"
- In pulmonary **bronchogenic carcinoma**, also in lymphadenopathy or mediastinal tumors

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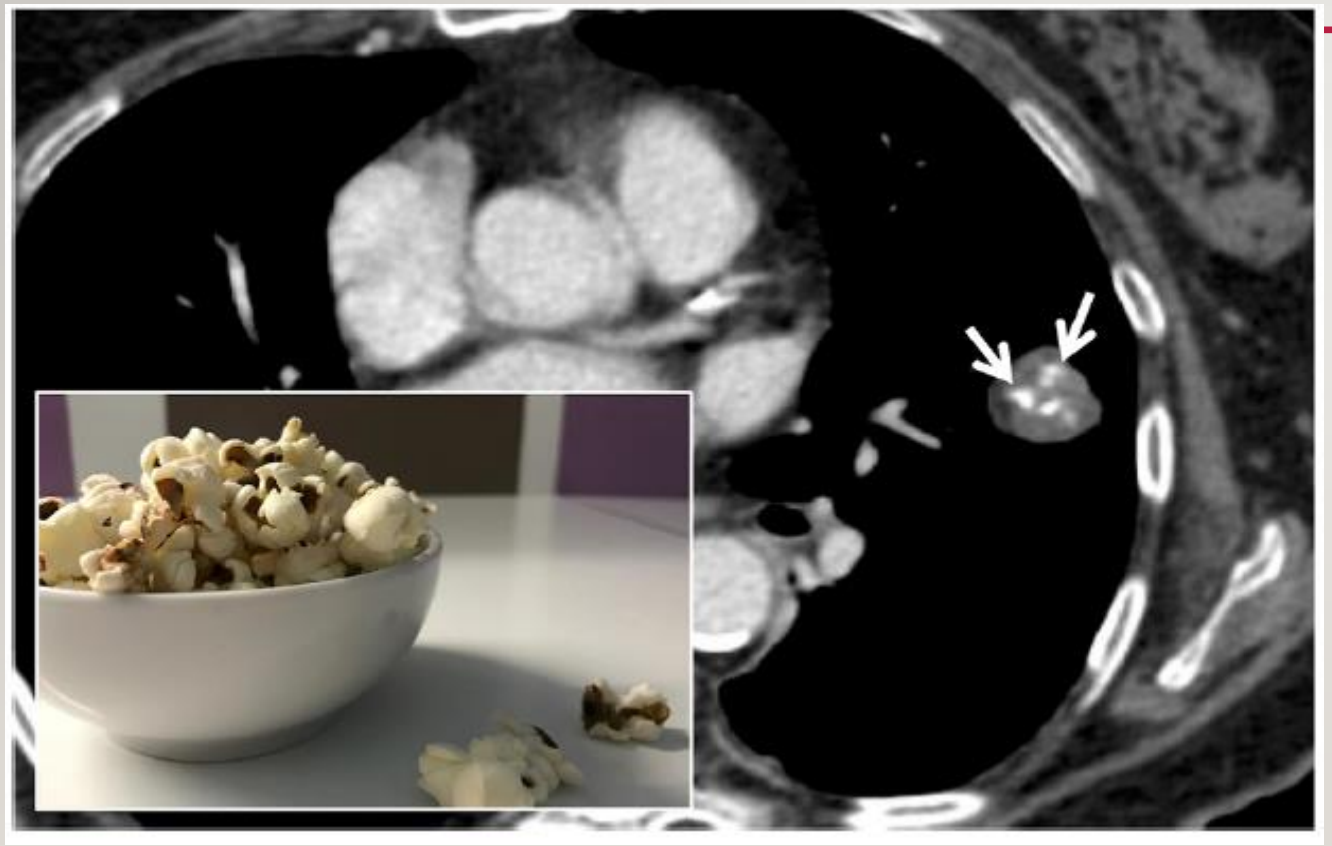
Popcorn Calcification



- Popcorn calcifications may be encountered in cases of patients with **pulmonary hamartoma**.
- The figure shows the presence of a pulmonary hamartoma, which is characterized by the presence of fat and amorphous calcification (white arrow), which remind us of the appearance of a piece of popcorn.

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Popcorn Calcification

- 1993 Briccoli et al study: **Popcorn calcifications** would be present in **only 10%** of **pulmonary harmatoma** (better deteced in chest CT).
- Chest CT also help detect **intra-lesional fat (in ~60% of cases)**
- Other types of calcification suggest benignity are
  - Widespread calcification
  - Centralized calcification
  - Stratified calcification
- Punctate and eccentric calcification are more often associated with malignant (carcinoid or osteosarcoma metastasis)

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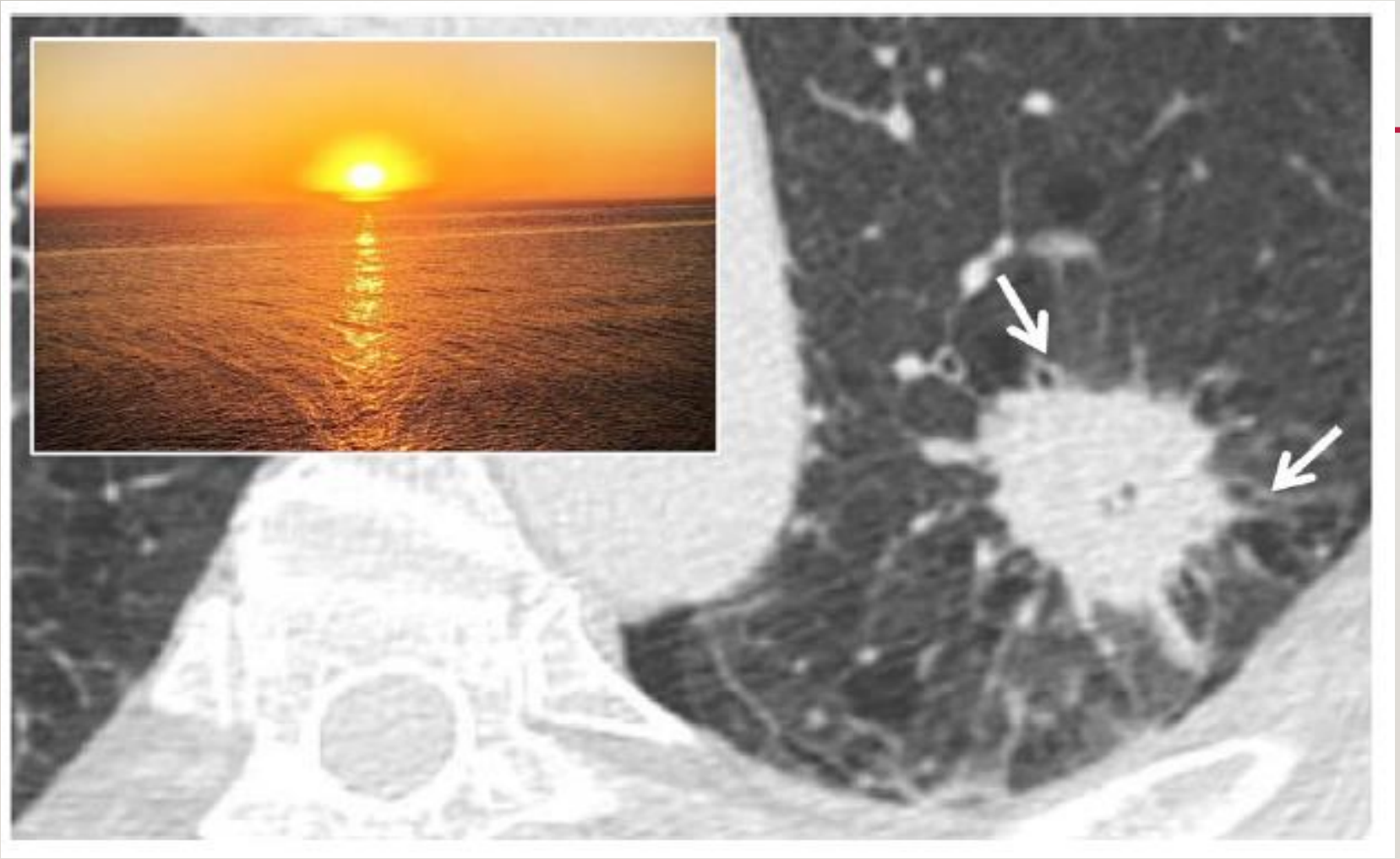
Sunburst Sign (Corona Radiata)



- A CT image of a 61-year-old female affected by **lung adenocarcinoma**.
- The parenchymal neoplastic lesion shows **spiculated and irregular margins,** resembling the appearance of a "**sunburst**"

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Sunburst Sign (Corona Radiata)

- Reported in 1997
- **Sunburst sign:** The rays or the speculated margins are constituted by the distorted blood vessels and/or by thickened septa that surround the pulmonary mass.
- **Very suggestive of malignant lesion**, in particular for **adenocarcinoma**
- It should be differentiated from the galaxy sign (which favor benign diagnosis)

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Sunburst Sign (Corona Radiata)

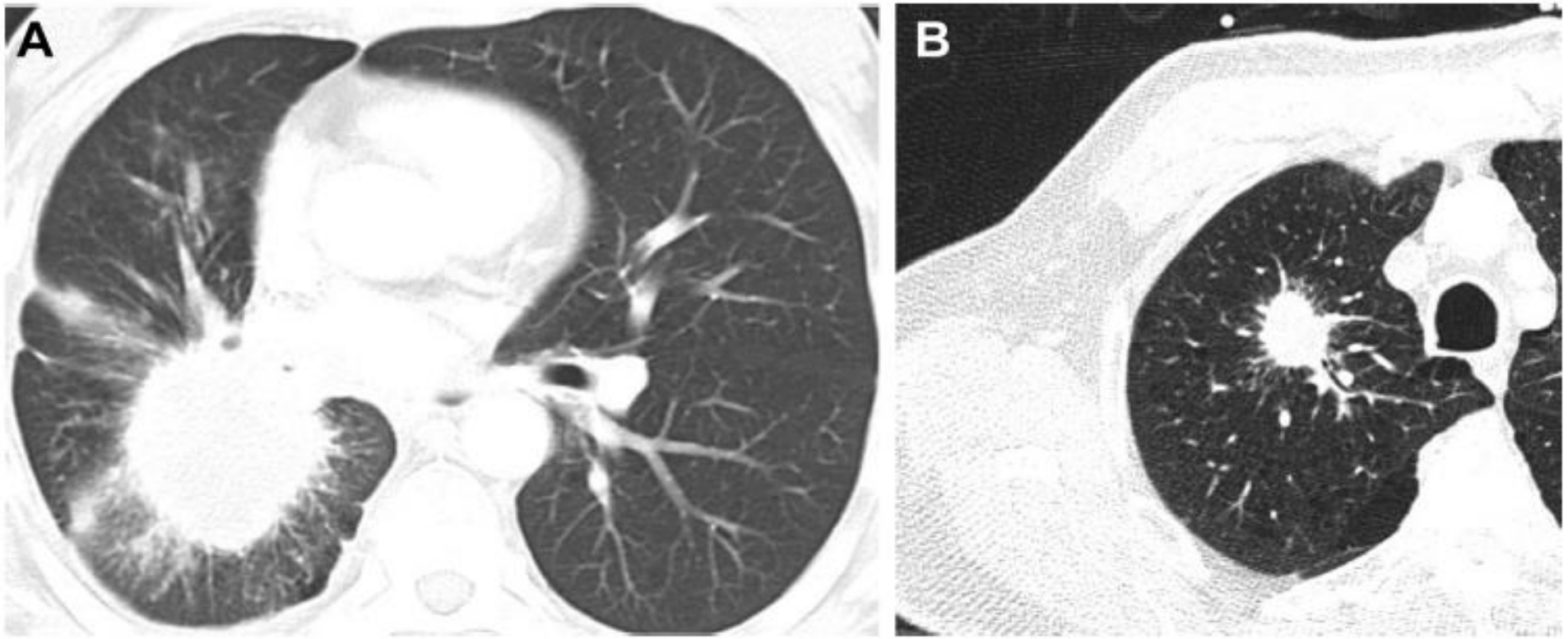

Figure 10 – *A, CT chest scan showing the corona radiata sign in a patient with non-small cell lung cancer. B, CT chest scan showing the corona radiata or sunburst sign in a patient with moderately differentiated squamous cell carcinoma.*

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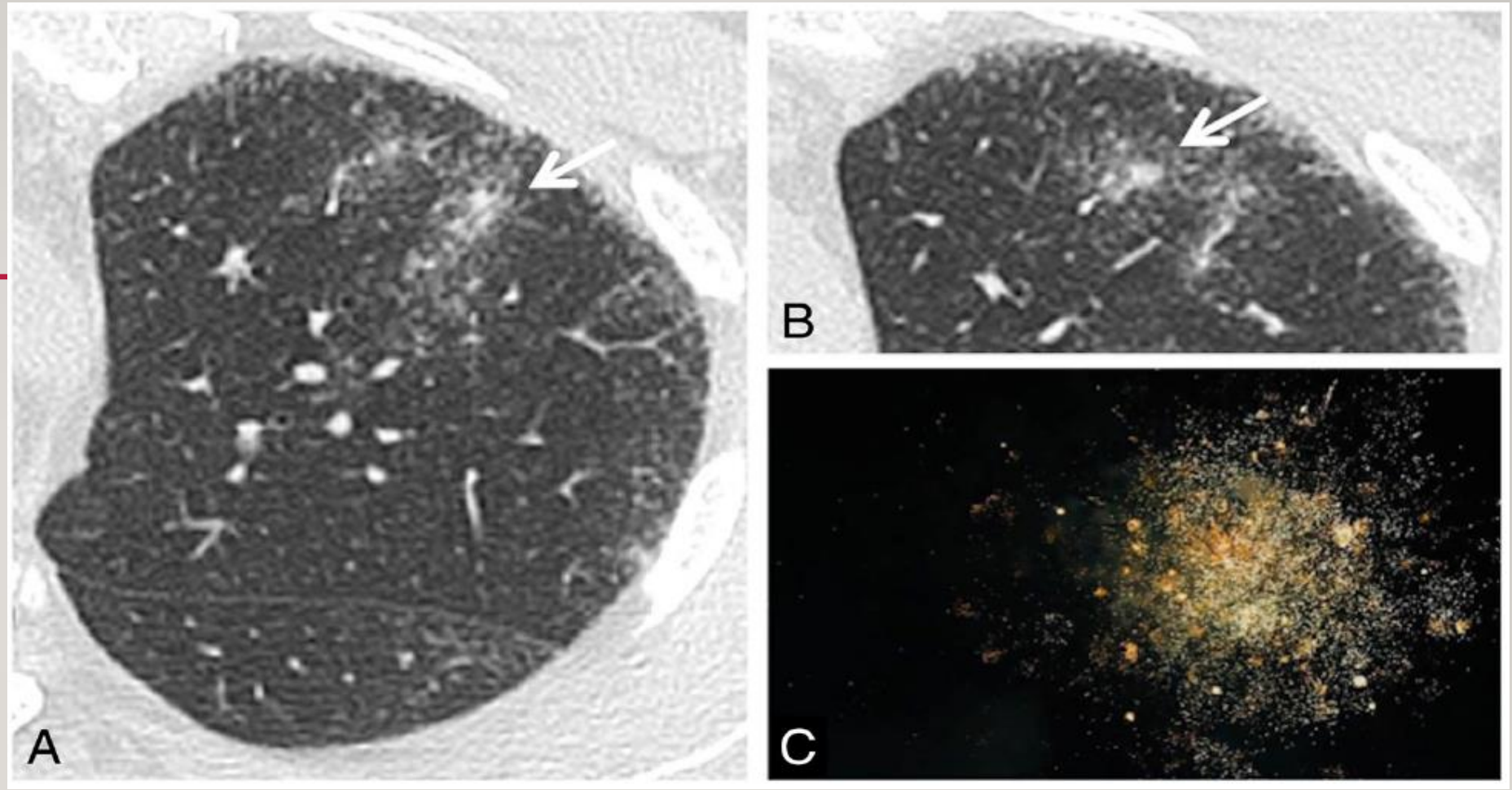
Galaxy Sign



- **ill-defined nodular consolidations** in the left upper lobe, surrounded by **many satellite small nodules** (white arrows in a,b). The presence of small nodules—close to the central nodular areas—resemble the appearance of a "galaxy" (c)

Galaxy Sign

- Firstly defined on 2002

- A typical finding of **sarcoidosis** on CT
  - A central lesion typically >1cm, surrounded by many satellite small nodules
- Also found in **active TB**
- Favor benign diagnosis

Galaxy sign in sarcoidosis

CHEST 2017; 151(6):1356-1374

Signs of Fungal Infection

- Air Crescent Sign
- Halo Sign
- Finger-in-glove Sign

Air Crescent Sign

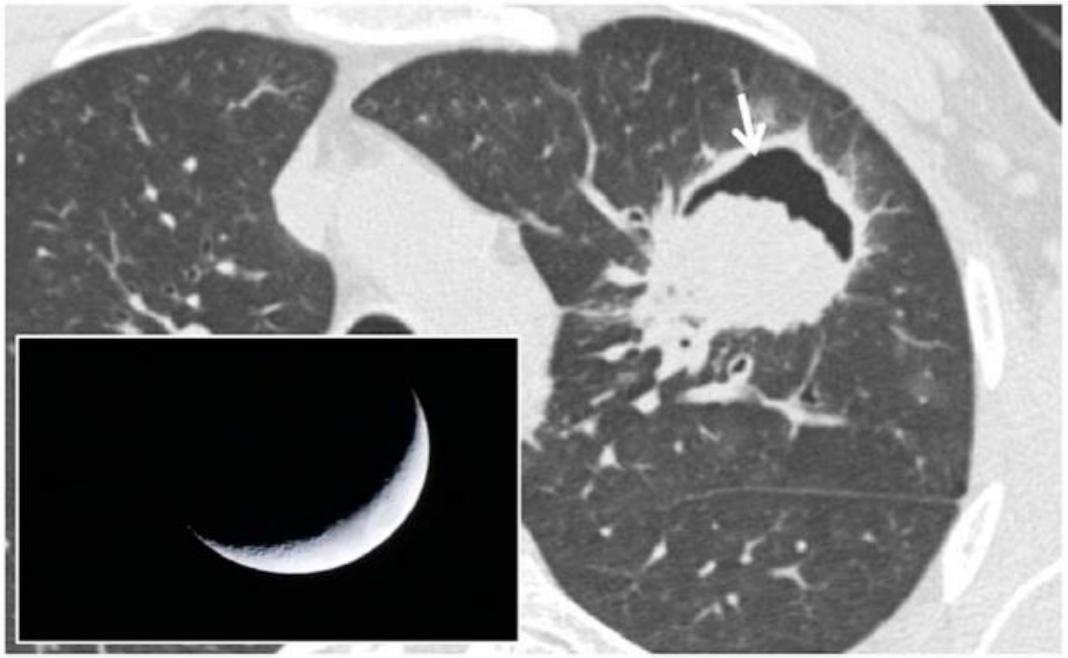


Fig. 2 Air crescent sign. CT scan of a patient with pulmonary aspergillosis showing a necrotic and cavitated lesion (white arrow) in left upper lobe. The air filling the cavitation looks like the shadow of a crescent moon—which is demonstrated in the embedded figure

- Characterized by the appearance of air in **invasive and semi-invasive aspergillosis** lesions (described in 1979)
- Look like the shadow of **crescent moon (新月)**
- Peripheral reabsorption of the necrotic tissue developed in the central portion: the residual part is replaced by air

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Air Crescent Sign

Figure 4 – *Air crescent sign in a patient with invasive aspergillosis.*

- Air crescent sign can be visualized in **50%** of patients affected by **invasive aspergillosis**
- The pulmonary lesion undergo necrosis and cavitation, with formation of air crescent sign required **> 20 days** (at recovery phase).
- Also reported in necrotic areas arise from other causes—such as:
  - tuberculosis, abscesses, bronchogenic carcinomas, or parasitic lesions (hydatidosis)

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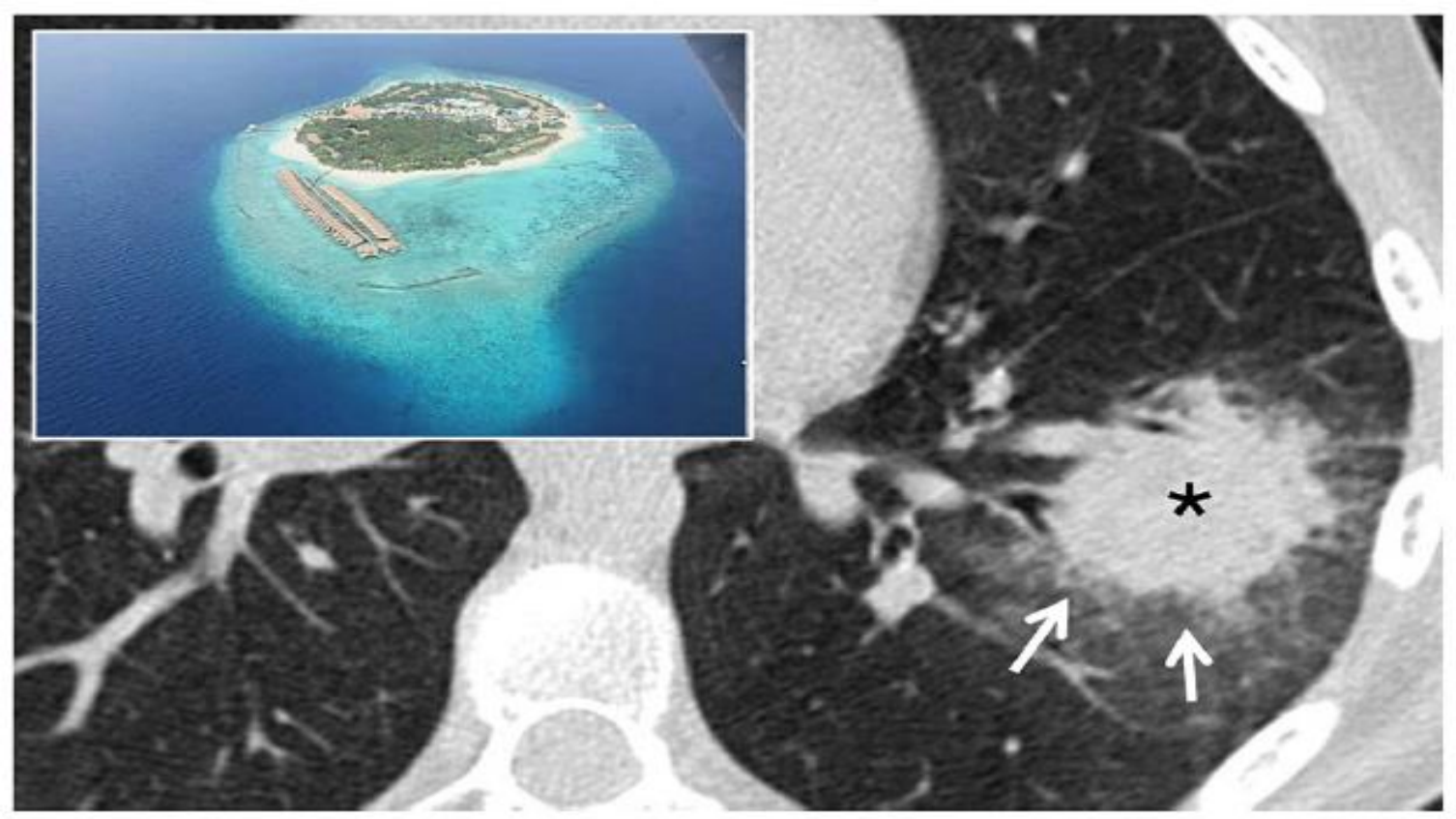
Halo Sign



- Described in 1988, typical for **angio-invasive aspergillosis**.
- Solid lesion surrounded by peripheral ground glass area.
- Central solid area: focus of pulmonary infarction
- The surrounding GGO in most cases are pulmonary hemorrhage.

CT image shows the "halo sign" in a patient with **angioinvasive aspergillosis**

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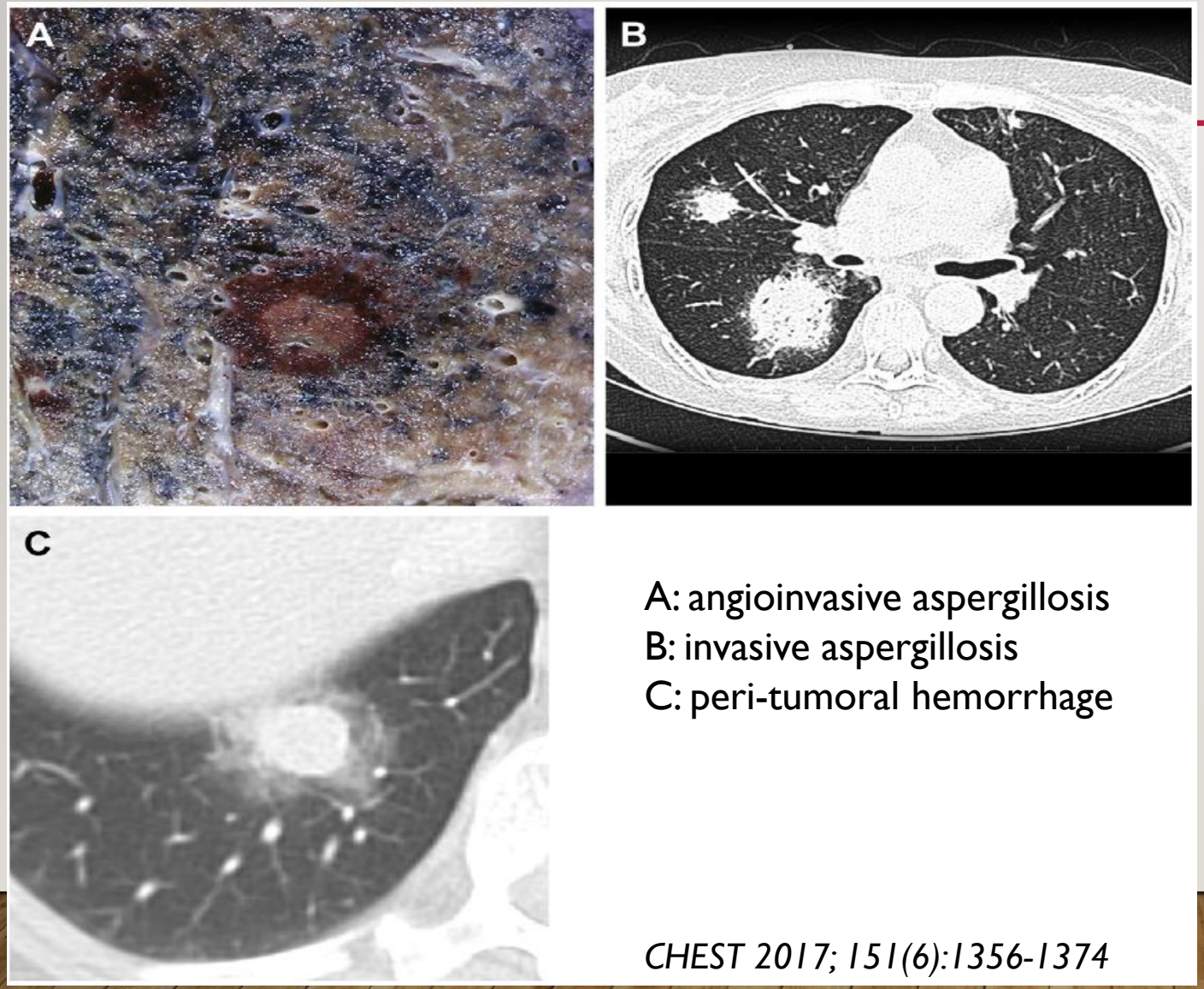
Halo Sign



A: angioinvasive aspergillosis
B: invasive aspergillosis
C: peri-tumoral hemorrhage

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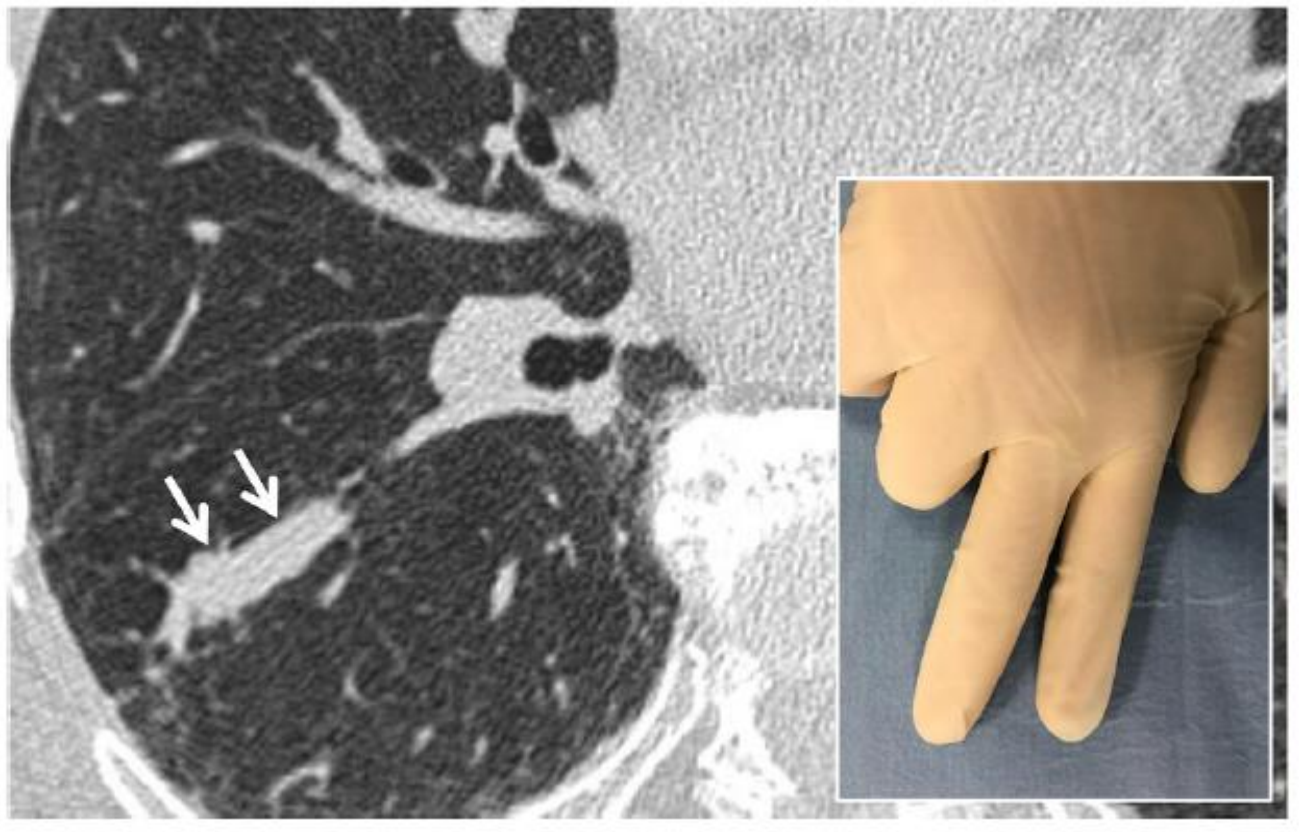
Immunocompromised patient:

- **Fungal infection** (**invasive aspergillosis**, candidiasis, mucormycosis), and lymphoproliferative disorder.

Immunocompetent patient:

- Primary lung cancer, metastases, vasculitis (Wegener), sarcoidosis, and organizing pneumonia

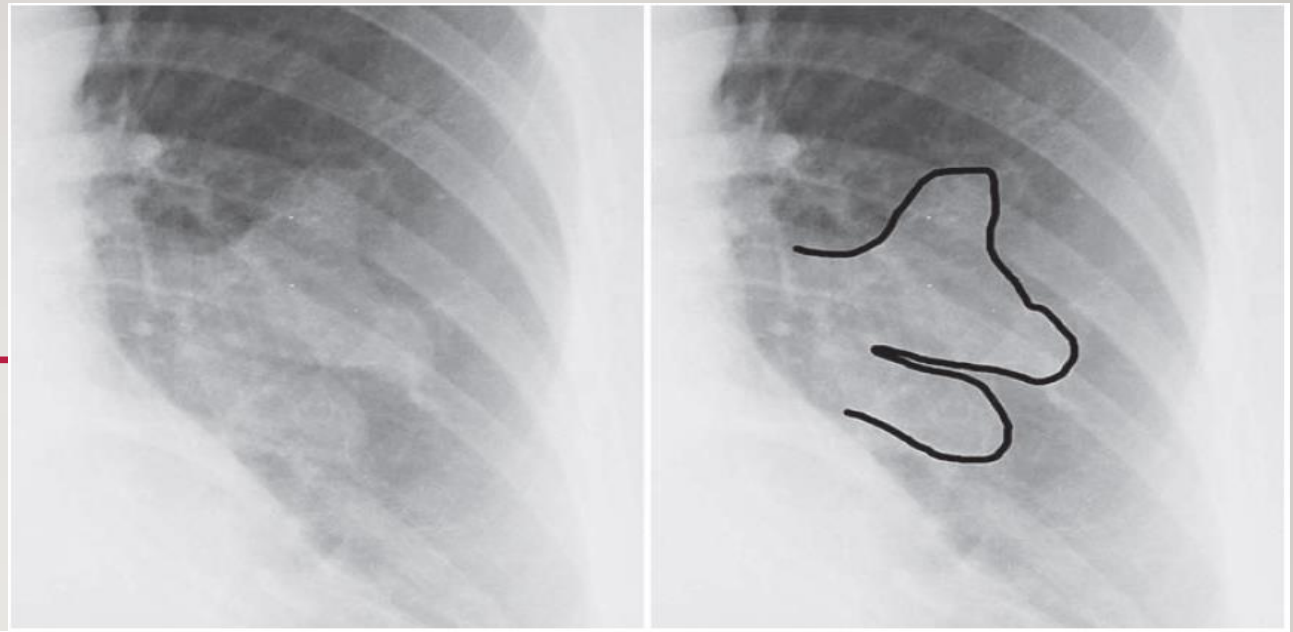
Finger-in-glove Sign



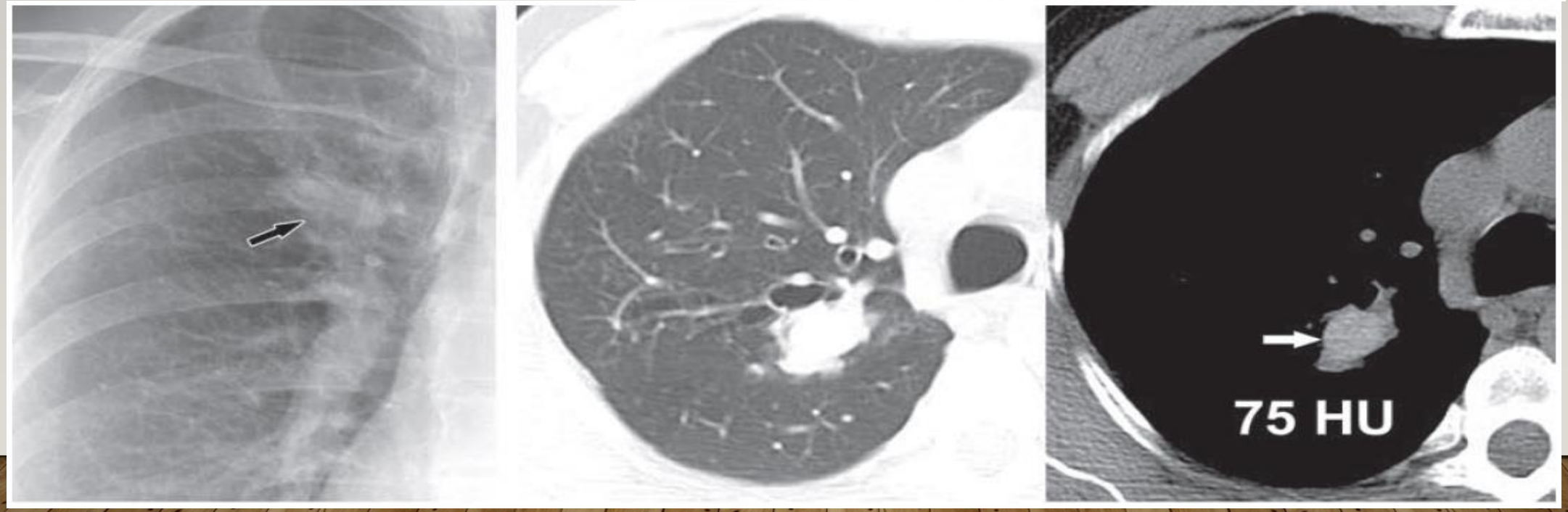
- Described on 2003, CXR and CT sign.
- Dilation of bronchus filled by mucoid material (**bronchocele**, white arrows)
- Pulmonary opacity with characteristic shape (linear, V or Y shape)—with well-defined lobulated margins.

Two causes: 1.Inflammatory disease: **allergic bronchopulmonary aspergillosis**, asthma, cystic fibrosis.
2.Obstructive disease: congenital or acquired (foreign body)

Finger-in-glove Sign in ABPA



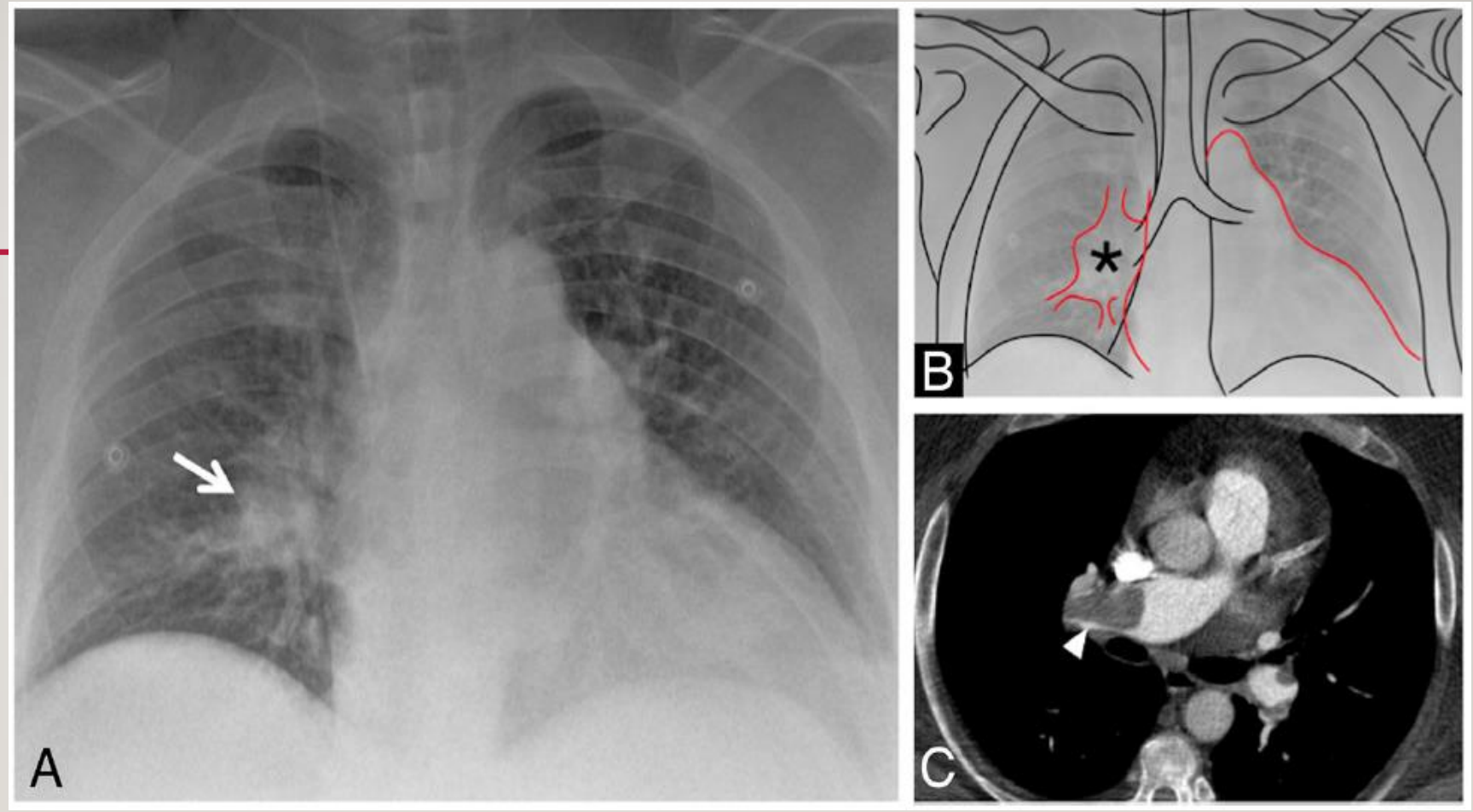
RadioGraphics 2008; 28:1369–1382



Signs of Pulmonary Embolism

- Knuckle sign (Fleischner's sign)
- Polo Mint Sign

Fleischner Sign



- A prominent central pulmonary artery upstream of cutoff (white arrows in a, black asterisk in b). It is frequently caused by a **large embolus** into the central pulmonary artery

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Fleischner Sign

- Described by Felix Geogrge Fleischner in 1961

- One of the most important CXR sign of **pulmonary embolism.**
- This sign can also be observed in pulmonary HTN
- Often associated with "**knuckle sign**" on CT => abrupt interruption of pulmonary artery, due to presence of blood clot.

Knuckle sign
指關節

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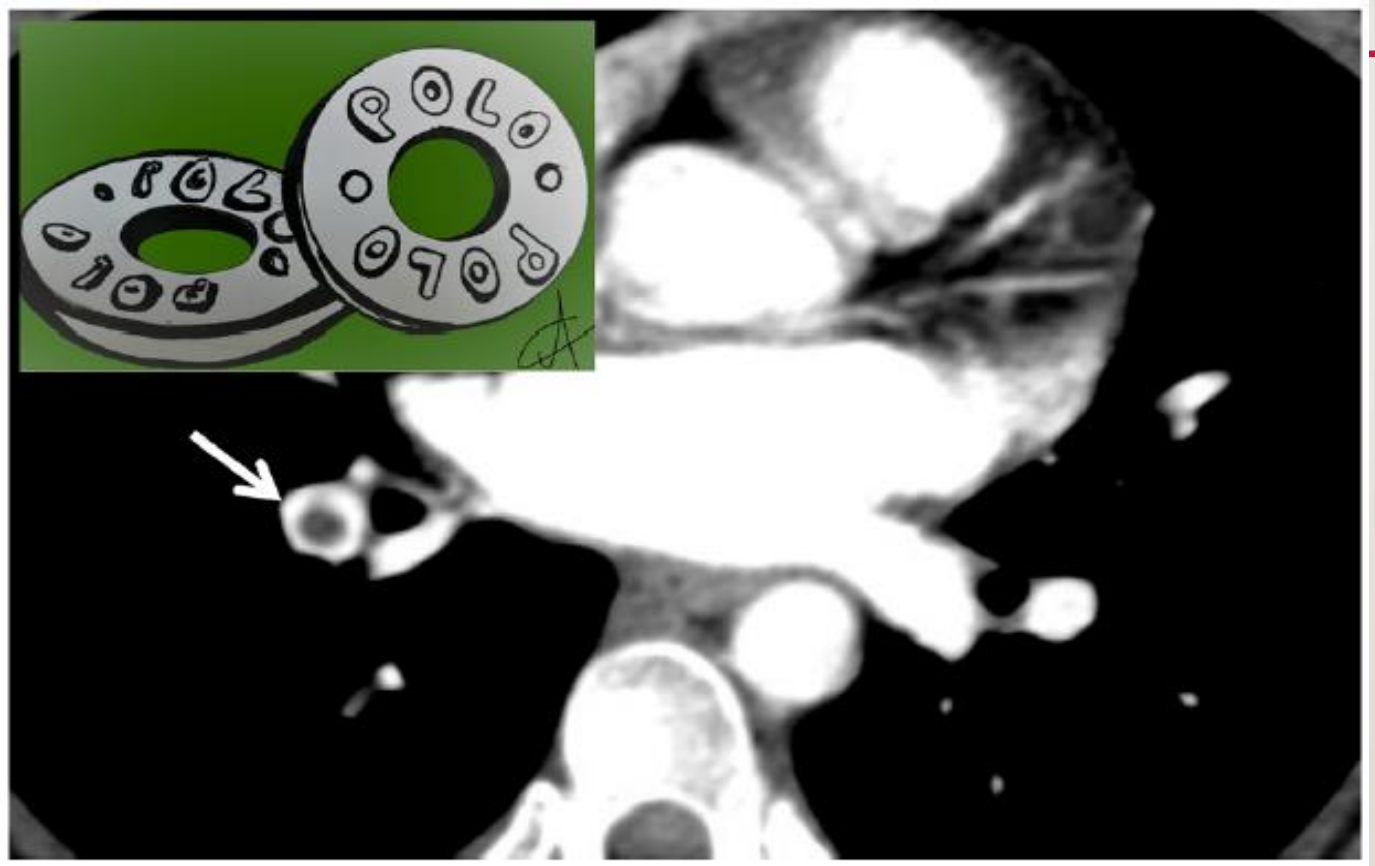
Polo Mint Sign



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- A patient with **acute pulmonary embolism**: a blood clot (white arrow) surrounded by contrast media, reproduces inside the pulmonary vessel the **"polo mint sign"** appearance (similar to the famous polo mint in the embedded figure).
- Its recognition is very important for radiologists, because it represents a **marker of acute embolism**.

Polo Mint


POLO
original
THE MINT WITH THE HOLE
alamy
Image ID: FATD66
www.alamy.com

Signs of Interstitial Pattern

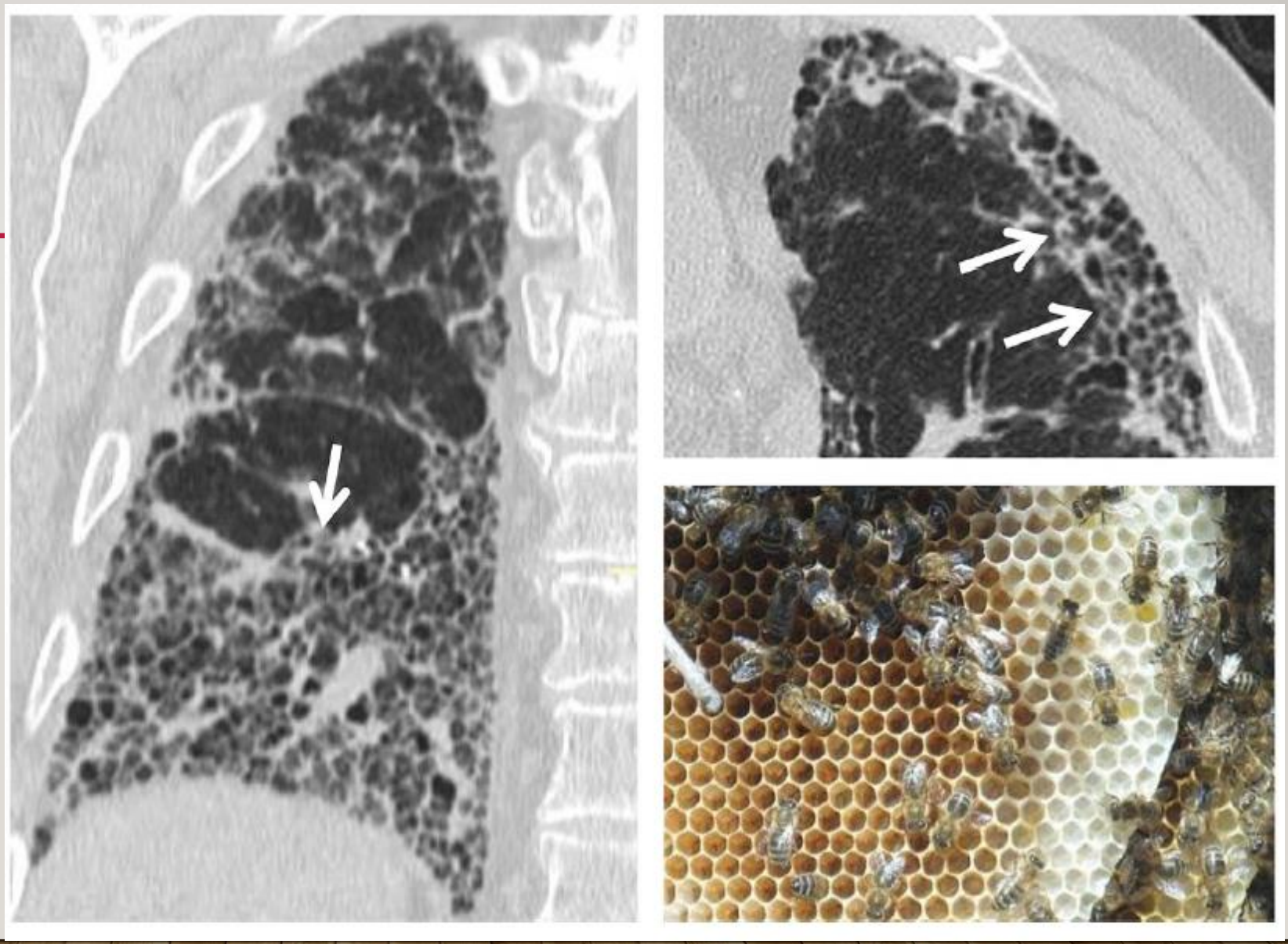
- Honeycomb
- Tram Track Sign
- Signet Ring Sign

Honeycombing

The small cystic areas—seen on coronal scan (left image) and axial scan (right image) is very similar to a honeycomb.

Honeycombing

The small cystic areas—seen on coronal scan (left image) and axial scan (right image) is very similar to a honeycomb.



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Honeycombing (described in 1949)

- Definition: cystic spaces with a wall, located in subpleural regions, with diameter 3~10mm.
- Final stage of lung parenchymal **fibrosis**.

Cause:

- Usual interstitial pneumonia (Basal and peripheral honeycomb distribution)
- Chronic hypersensitivity pneumonitis
- Fibrotic stage of sarcoidosis (stage IV)
- Pneumonia

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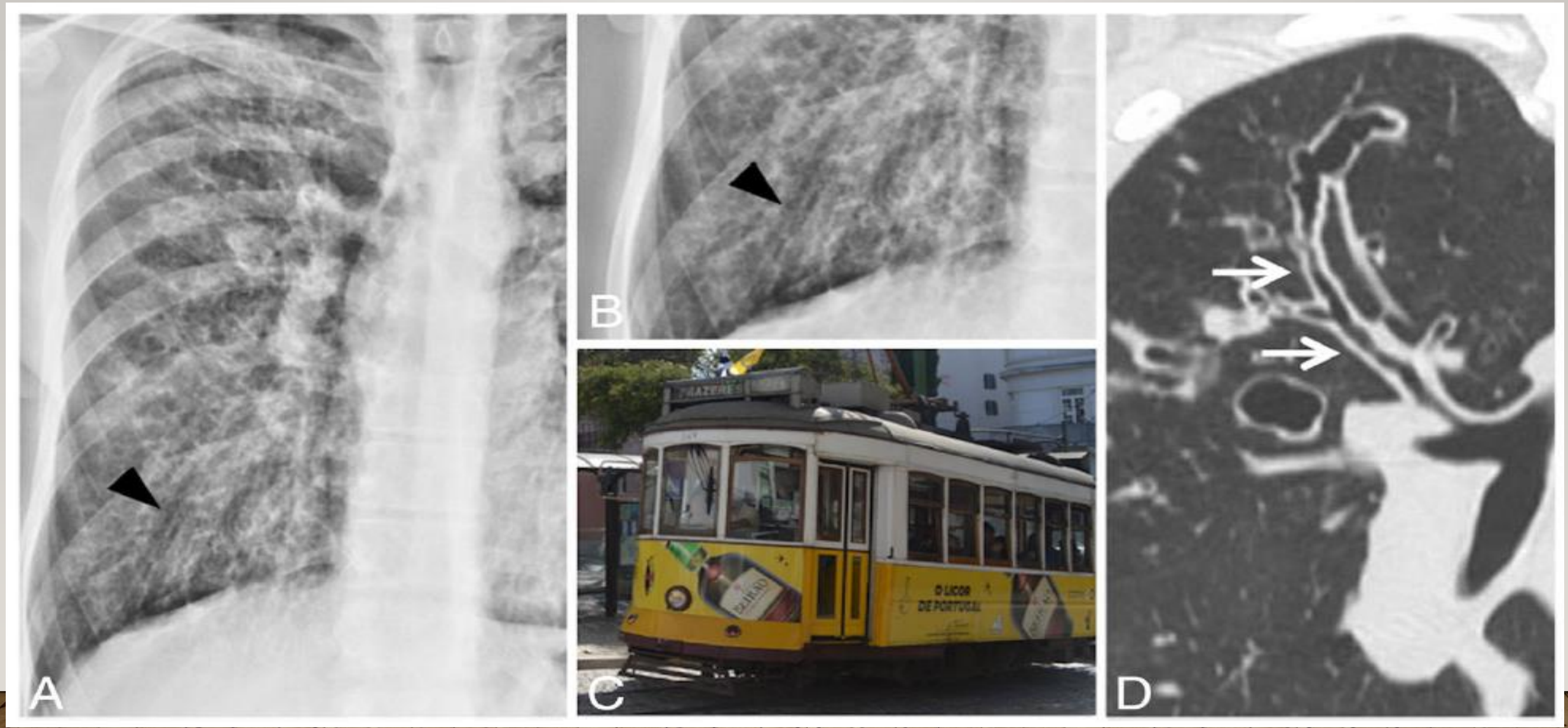
Tram Track Sign



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Tram Track Sign (電車軌道)

- In patient with **Cylindrical bronchiectasis.**
- The tram track sign may be explained by the presence of **thickened bronchial branches** on radiographs (black arrowheads in a and b), which reproduce a "**tram line**" (電車軌道) appearance clearly shown on c.
- In d, the same appearance could be also described in a CT of a patient with cystic fibrosis: the coronal CT image shows thickened bronchial branches (cylindrical bronchiectasis).

Tram Track Sign

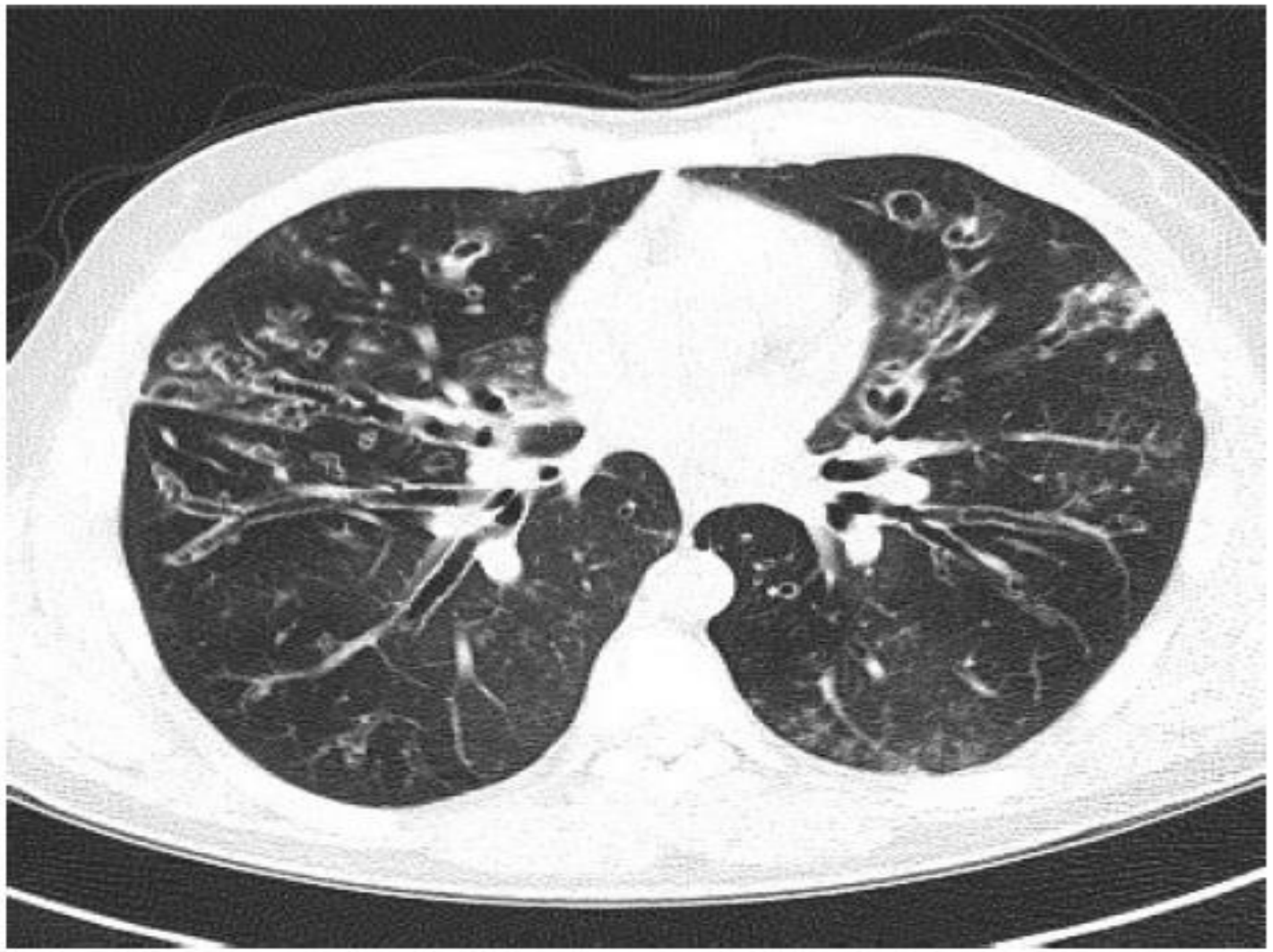
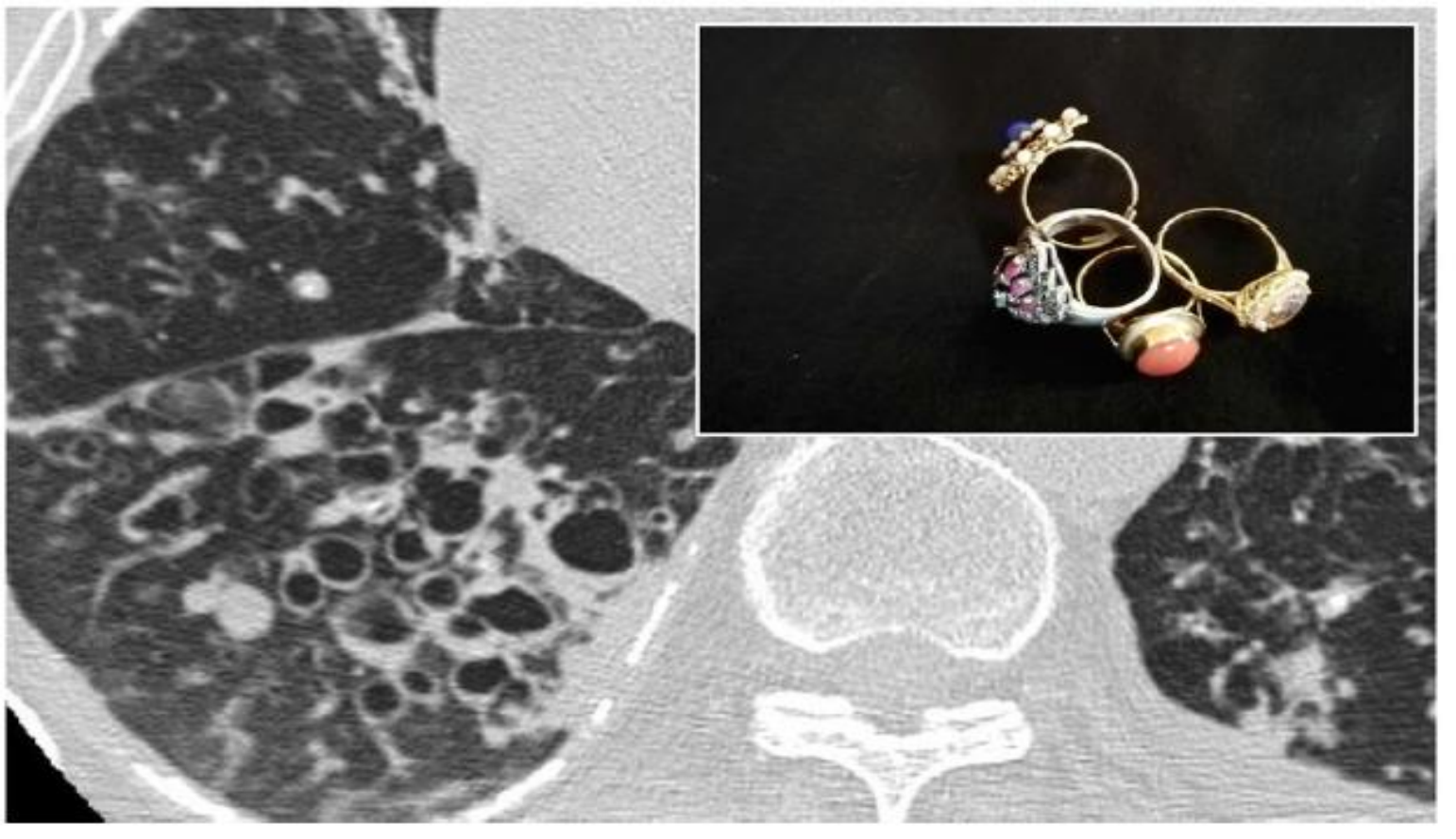


Figure 21 – *Tram-track sign seen in cylindrical bronchiectasis on the chest CT scan in a patient with advanced cystic fibrosis.*

CHEST 2017; 151(6):1356-1374

Signet Ring Sign



- Described in 1999.
- CT in a young patient affected by cystic fibrosis, multiple air-filled **bronchiectasis** are flanked by respective pulmonary vessels:
  - This appearance reproduces the signet ring sign

The bronchus and the artery should have similar size in normal pulmonary parenchyma; in case of bronchiectasis, this ratio is altered, with increased size of the bronchus

Signet Ring Sign

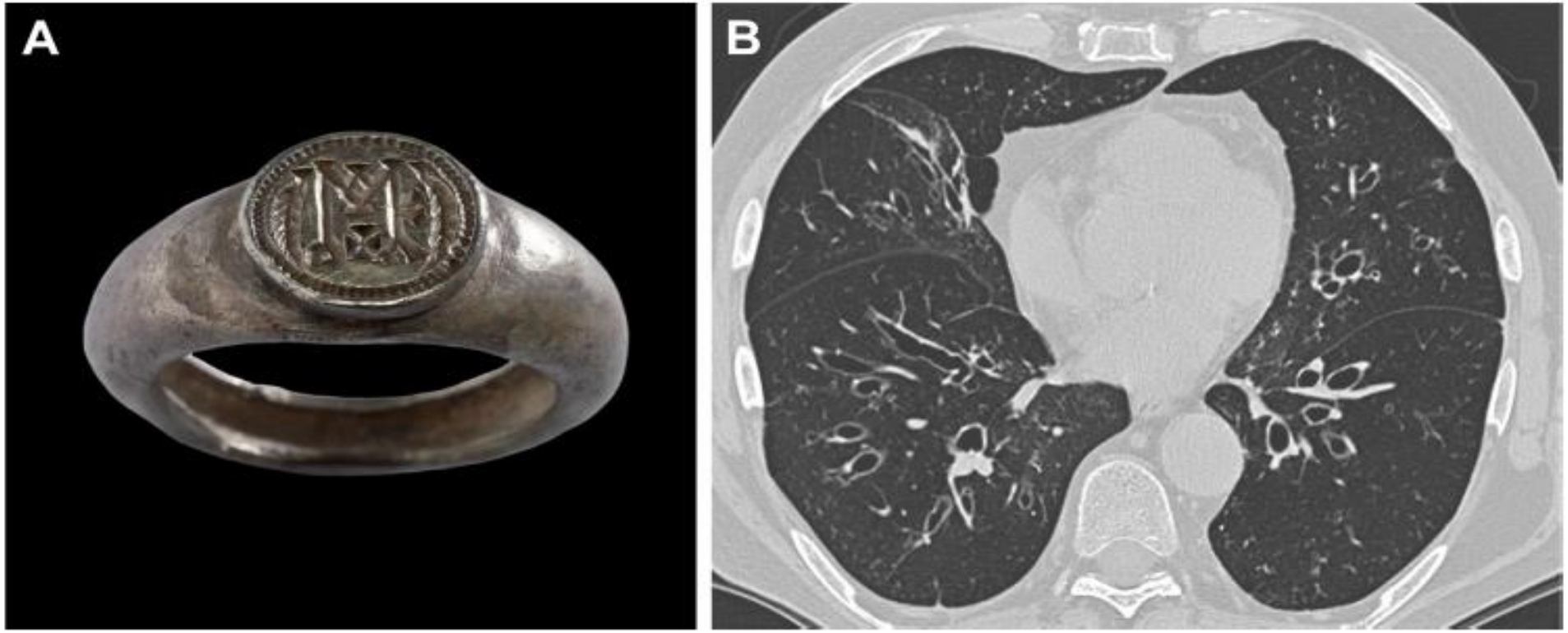


Figure 20 – *A, Image of a signet ring. (Image courtesy Wikimedia Commons.) B, Note classic signet ring sign on axial CT images in a patient with cystic fibrosis. Also note the tram-track sign.*

CHEST 2017; 151(6):1356-1374

Other Signs

- Double density sign
- Doughnut Sign
- Ginkgo Leaf Sign
- Continuous Diaphragm Sign

Double Density Sign

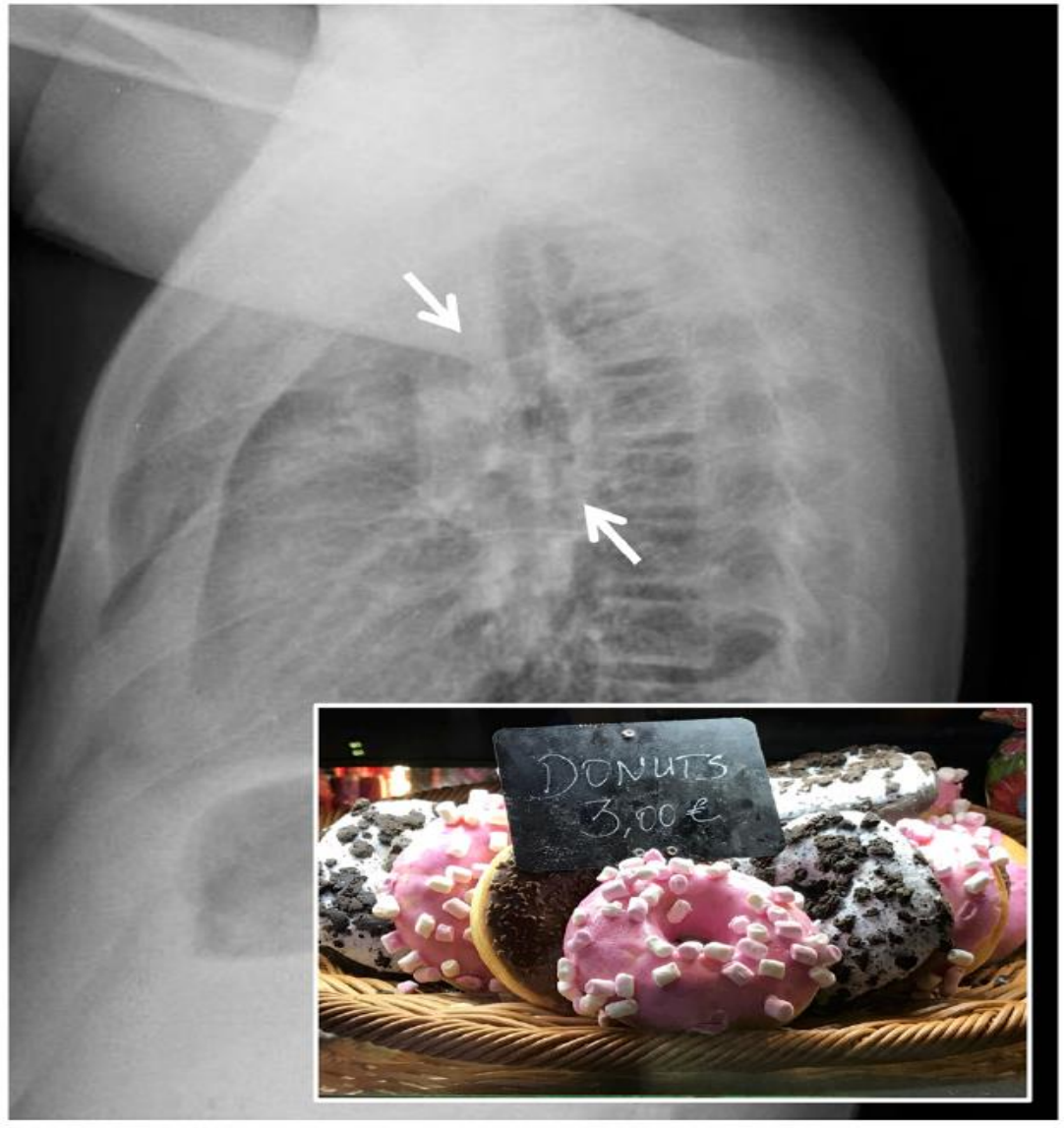
- Heart should be of uniform density except over vertebra and descending aorta
- Increased density in one portion compared to rest of the heart consider an abnormal density either in front or behind the heart.
- **Double Density Sign+ 要考慮:**
  - Left lower lobe disease
  - Esophageal disease
  - Posterior mediastinal masses
  - Hiatal hernia
  - Descending aorta
  - Left atrial enlargement

Double density sign+ (LLL tumor)

Double Density Sign In LAE

- LAE (Left atrial enlargement), 會在右心看到2個border, 其實外側的才是真的right heart border, 內側border是擴大的左心房邊緣 -> double density sign +
- 此CXR也有Carina angle > 90度, Cardiomegaly, Right heart enlargement

Doughnut Sign



- Lateral CXR: white radiopaque ring at hilar region. => **enlarged lymph nodes at hilar and subcarinal region**, located around intermedius bronchus, and normal profiles of right and left pulmonary arteries and aortic arch anteriorly and superiorly.
- Suggestive of **lymphadenopathy—tuberculosis or lymphoma**

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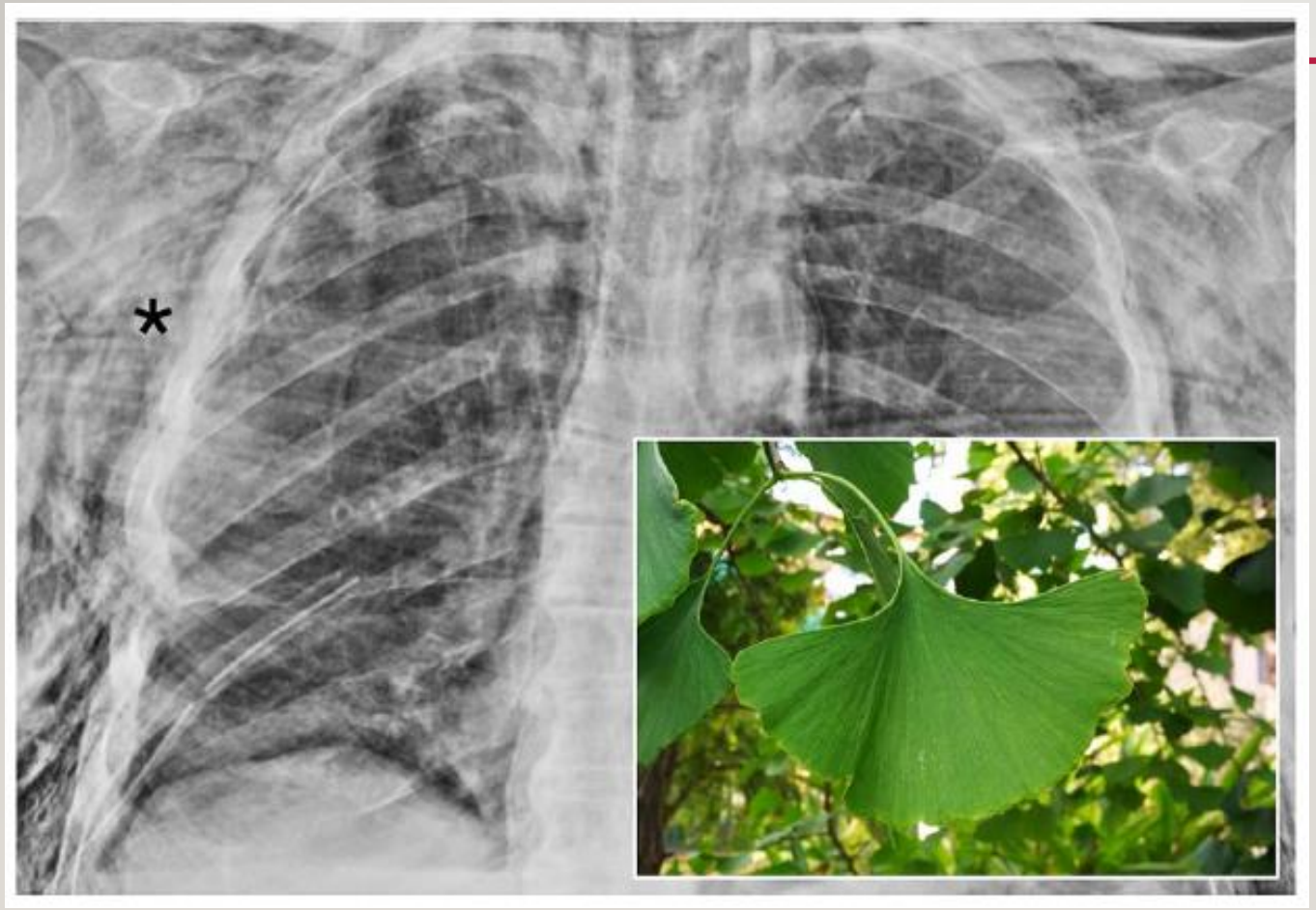
Ginkgo Leaf Sign



- Patient with diffuse **subcutaneous emphysema.**
- Air located inside the subcutaneous tissues of chest wall, penetrating into the pectoralis major muscle fibers (black asterisk).
- Ginkgo (銀杏)

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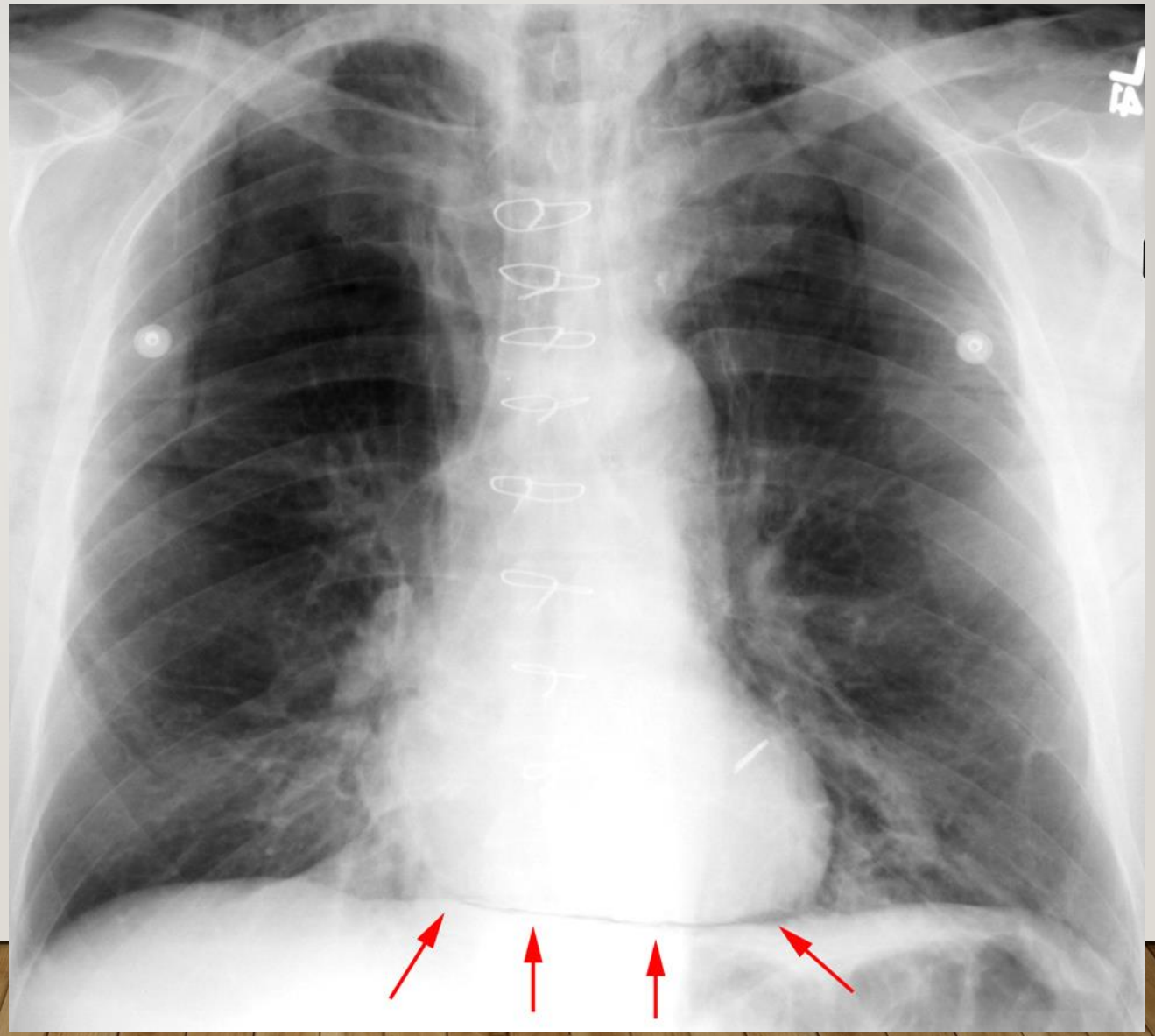
Continuous Diaphragm Sign

Pneumomediastinum:
=> Continuous diaphragm sign (red arrow)
=> Upper mediastinuum也可看到黑色的氣縱膈線條

Bilateral shoulder subcutaneous emphysema



Thank You For Listening~