肺實質化病變與肺塌陷


Consolidation
Atelectasis

AIR-SPACE CONSOLIDATION

- **Definition of consolidation:**
  Replacement of air in one or more acini by fluid or solid material
  - ✓ Water or Fluid
  - ✓ Blood
  - ✓ Pus
  - ✓ Cells
  - ✓ Other materials

Differential diagnosis

Identify the *location* and *extent* of the consolidation

Narrow down DDx *by pattern*

Further narrow down DDx *by clinical correlation*

Further diagnostic procedures

DIFFERENTIAL DIAGNOSIS

- **Acute or Chronic**

Acute Consolidation	Chronic Consolidation
Pulmonary edema Pneumonia Aspiration Hemorrhage / Contusion Infarction	Neoplasm • post-obstruction • Bronch-alveolar ca • Lymphoma Sarcoidosis Organizing Pneumonia Eosinophilic pneumonia Alveolar proteinosis

By Robin Smithuis - Radiology Department of the Rijnland Hospital, Leiderdorp, the Netherlands

- **Pattern:** lobar, diffuse, or multi-focal

Lobar consolidation

Lobar pneumonia
- Streptococ pneum.
- Klebsiella
- TB
- Aspiration

Neoplasm
- Lungca with obstructive pneumonia
- BAC
- Lymphoma

Hemorrhage
- Contusion
- Infarction

Others
- Organizing pneumonia
- Eosinophilic pneum.
- Sarcoidosis
- Sequestration
- Mitral regurgitation with RUL edema

Diffuse consolidation

Edema
- Heart failure
- Volume overload
- ARDS
- Low albumin
- Renal failure
- Transfusion reaction

Bronchopneumonia
- Staph Aureus
- Gram negative
- PCP
- Viral - fungal

Hemorrhage
- SLE
- Henoch-Schönlein
- Wegener
- Goodpasture

-Others
- BAC
- Lymphoma
- Organizing pneumonia
- Eosinophilic pneumonia
- Hypersensitivity pneum

Multiple ill-defined

Bronchopneumonia
- Staph Aureus
- Legionella
- Gram negative
- Streptococcus pneumonia
- Klebsiella
- Pseudomonas
- Anaerobe
- PCP
- TB

Vascular
- Septic emboli
- Wegener's

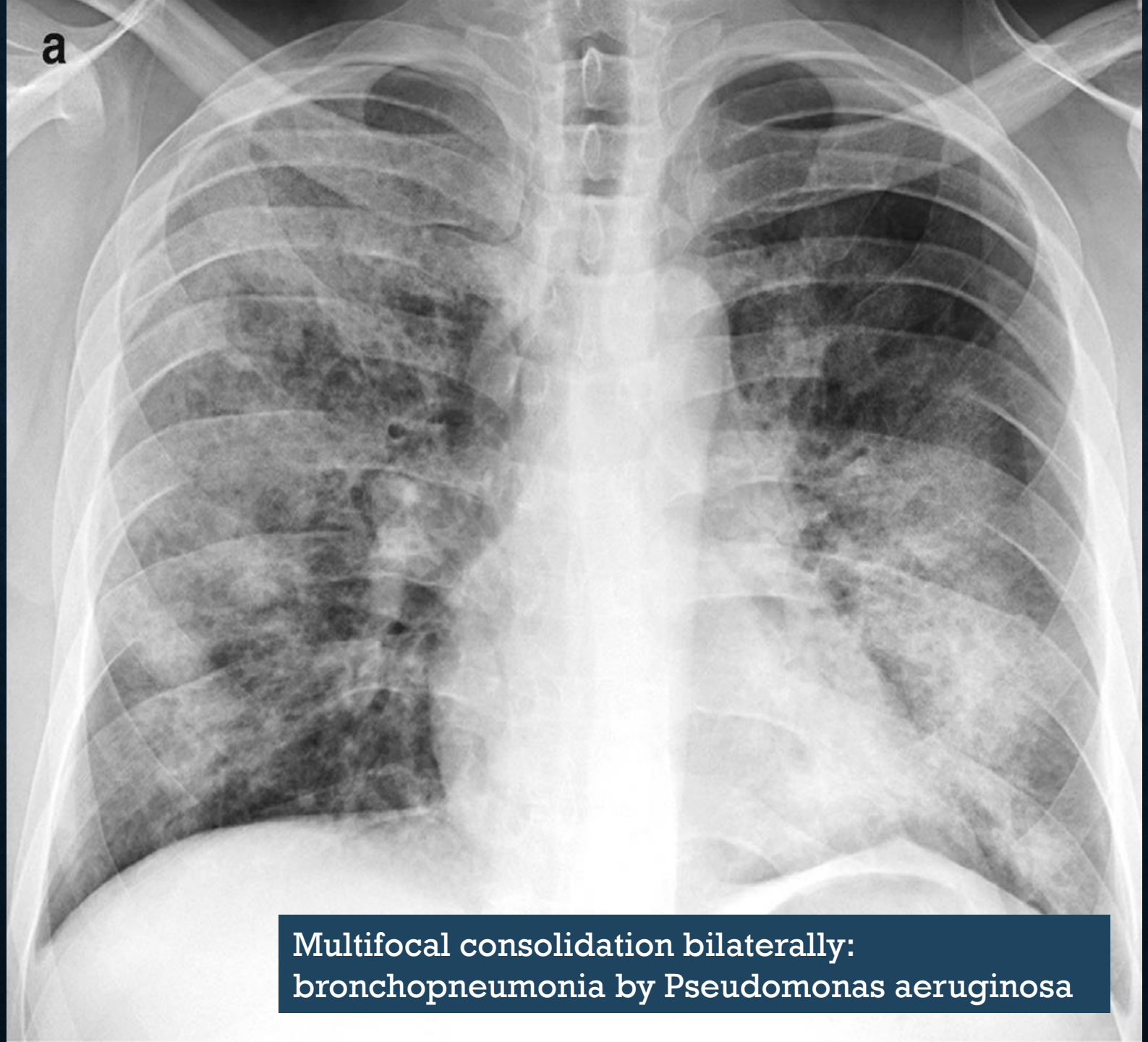
Neoplasm
- BAC
- Lymphoma
- Metastases

Sarcoidosis

By Robin Smithuis - Radiology Department of the Rijnland Hospital, Leiderdorp, the Netherlands

Lung infection by Klebsiella Pneumoniae

Expansive **lobar consolidation**, right upper lobe, causing dissural bulging toward the unaffected lobe.



Multifocal consolidation bilaterally:
bronchopneumonia by Pseudomonas aeruginosa

Radiological signs of consolidation

RADIOLOGICAL SIGNS OF CONSOLIDATION

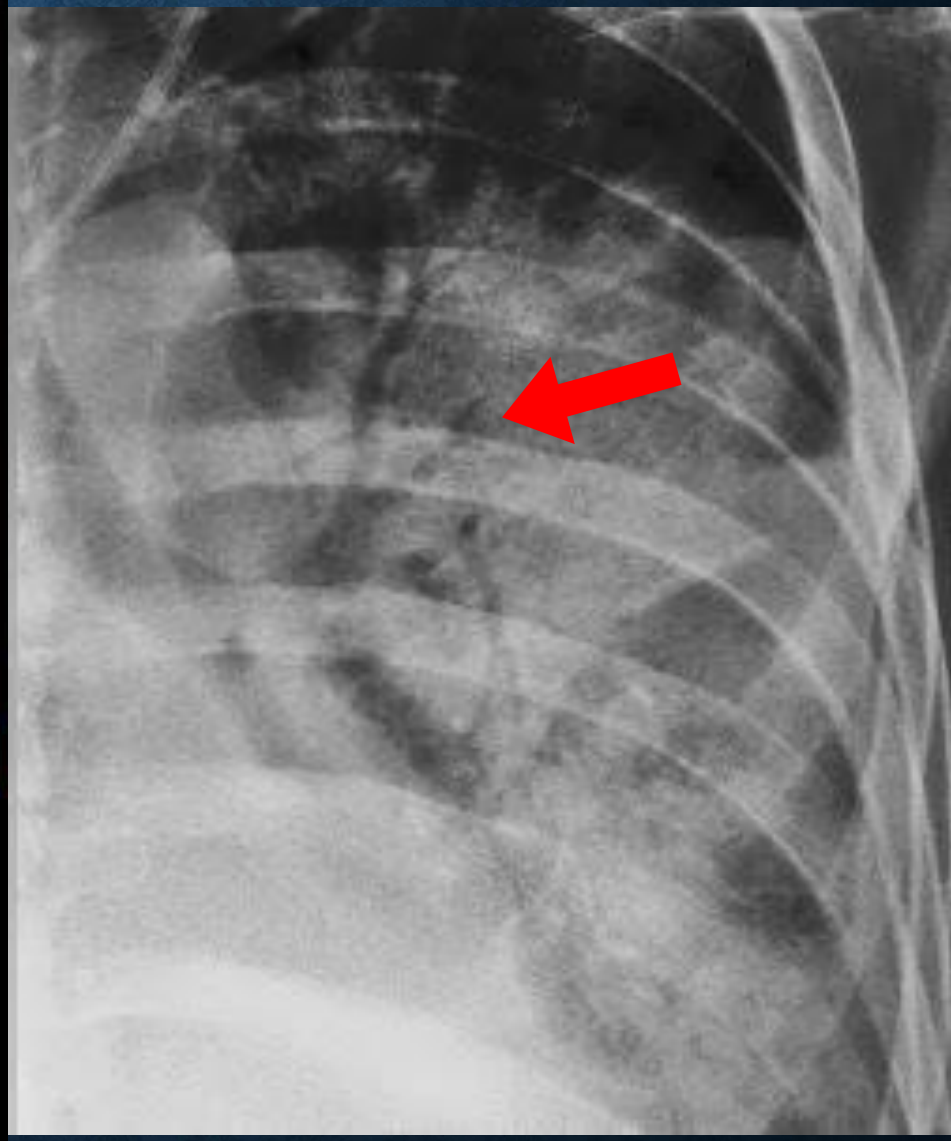
- Air bronchograms
- Ill-defined or fluffy opacities
- "Air alveolograms"
- Patchy opacities
- "Acinar" or air-space nodules
- Preserved lung volume
- Extension to the pleural surface
- "CT angiogram" sign

- W. Richard Webb

AIR BRONCHOGRAM

- It occurs in infiltration or edema in tissues adjacent to patent bronchi
  - Associated with air-space disease
  - Patency of proximal airways, atelectasis, replacement (pneumonia) or both, consolidation, tumor, lymphoma

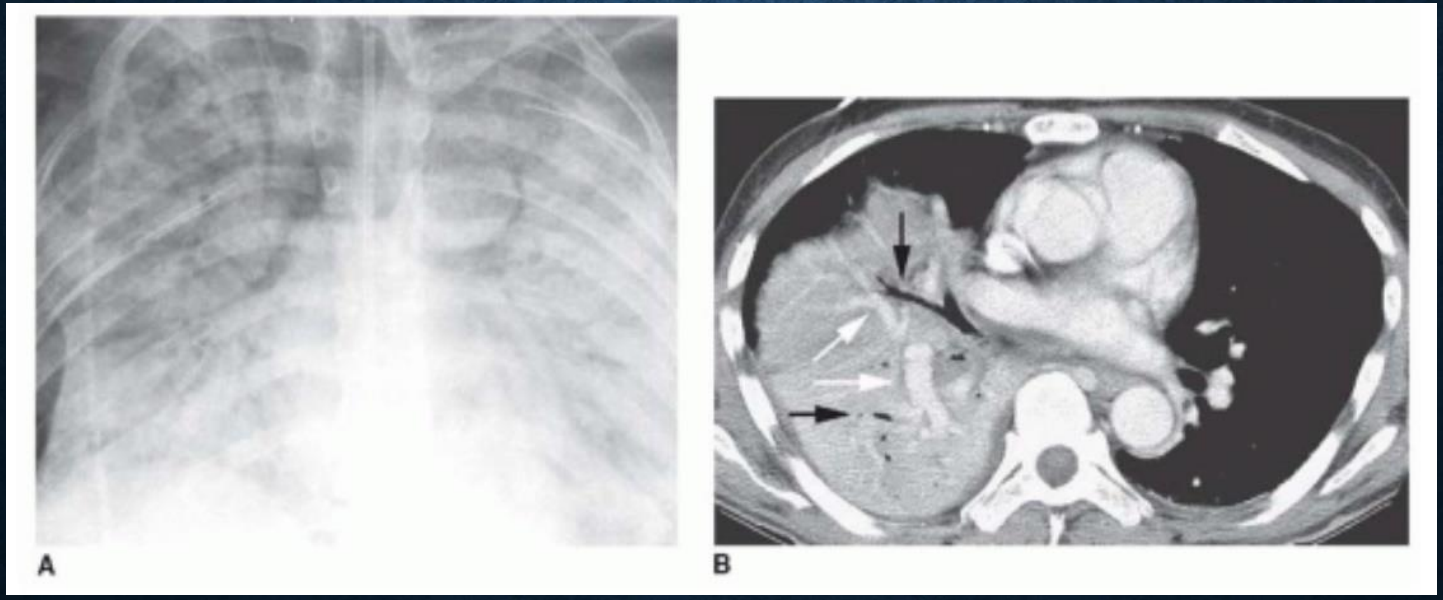
- W. Richard Webb



Air bronchogram

HOMOGENOUS OPACITY WITH OBSCURATION OF VASCULAR MARKINGS

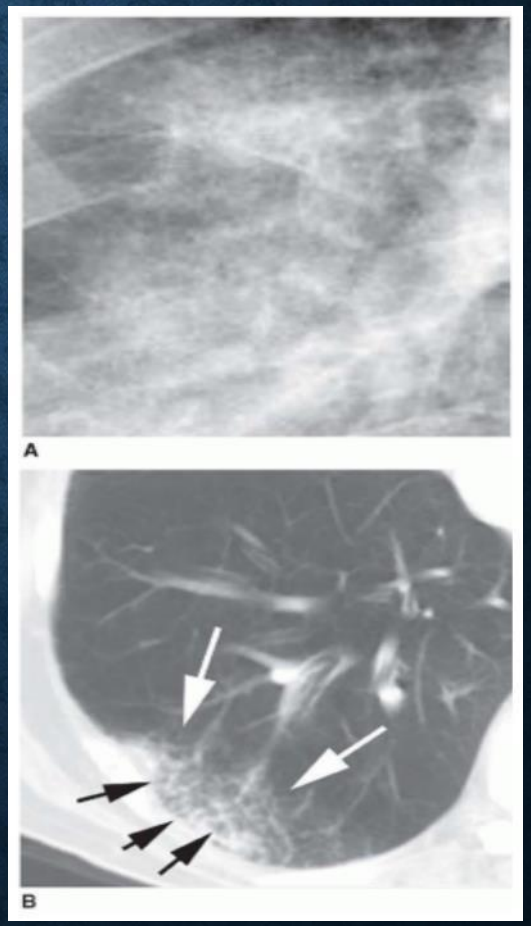
- With complete replacement of alveolar air, homogeneous opacification of the lung results. Vessels within the consolidated lung are invisible



- W. Richard Webb

ILL-DEFINED OR FLUFFY OPACITIES

- Consolidation often results in opacities with ill-defined margins, in contrast to the relatively sharp margins of a lung mass.
- This results from patchy local spread of disease with variable involvement of alveoli at the edges of the pathologic process.

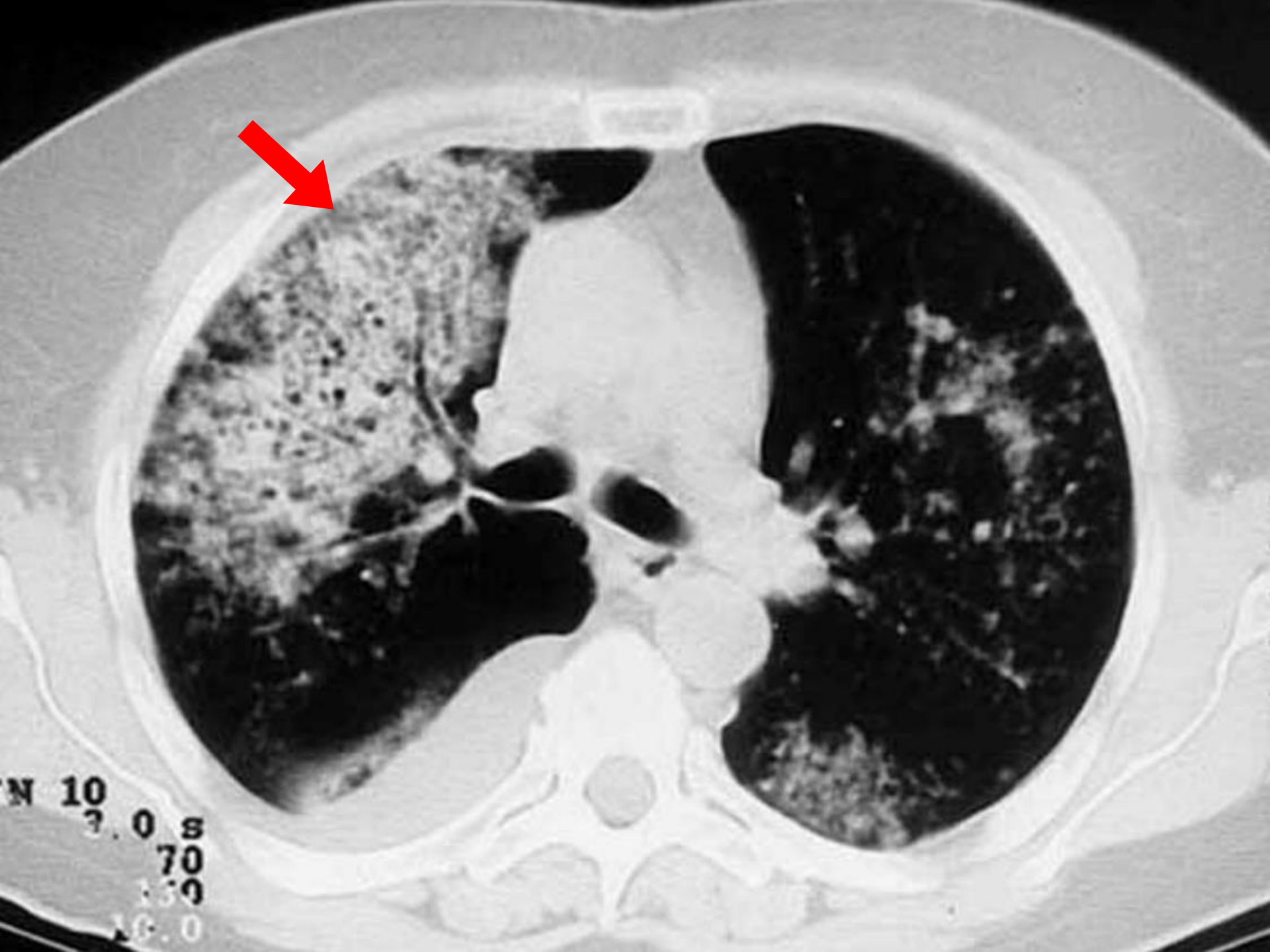


- W. Richard Webb

AIR ALVEOLOGRAMS

- If lung consolidation is not confluent, small focal lucencies representing uninvolved lung may be visible.
  - A misnomer as alveoli are too small to see radiographically.
  - Reflect incomplete lung consolidation.

- W. Richard Webb



PATCHY OPACITIES

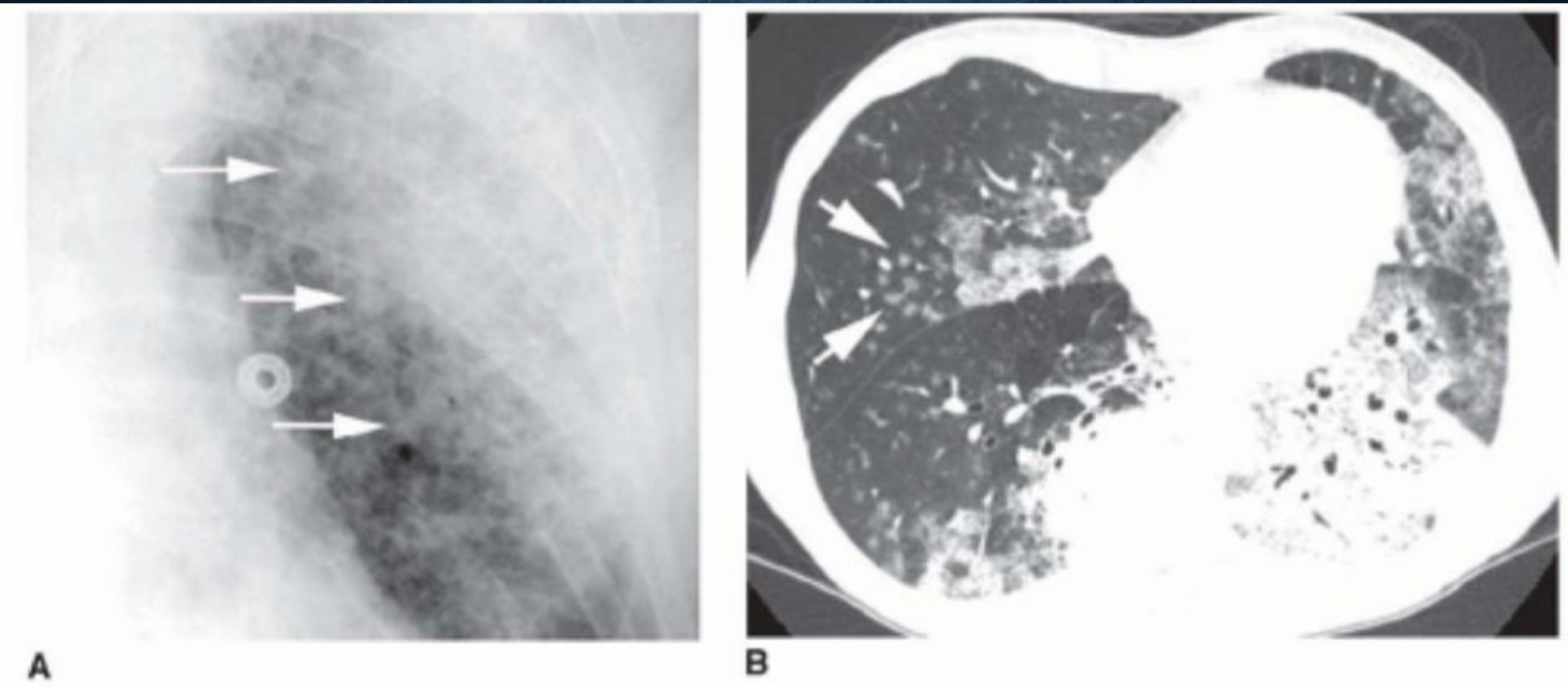
- Variable consolidation in different lung regions results in patchy areas of increased opacity.
- Pulmonary vessels may be obscured or poorly defined.

- W. Richard Webb

"ACINAR" OR AIR-SPACE NODULES

- The terms acinar nodule and air-space nodule are used to describe poorly marginated rounded opacities, usually 5 to 10 mm in diameter, that occur due to focal consolidation.
- Although these nodules approximate the size of acini, they tend to be centrilobular and peribronchiolar rather than acinar.

- W. Richard Webb



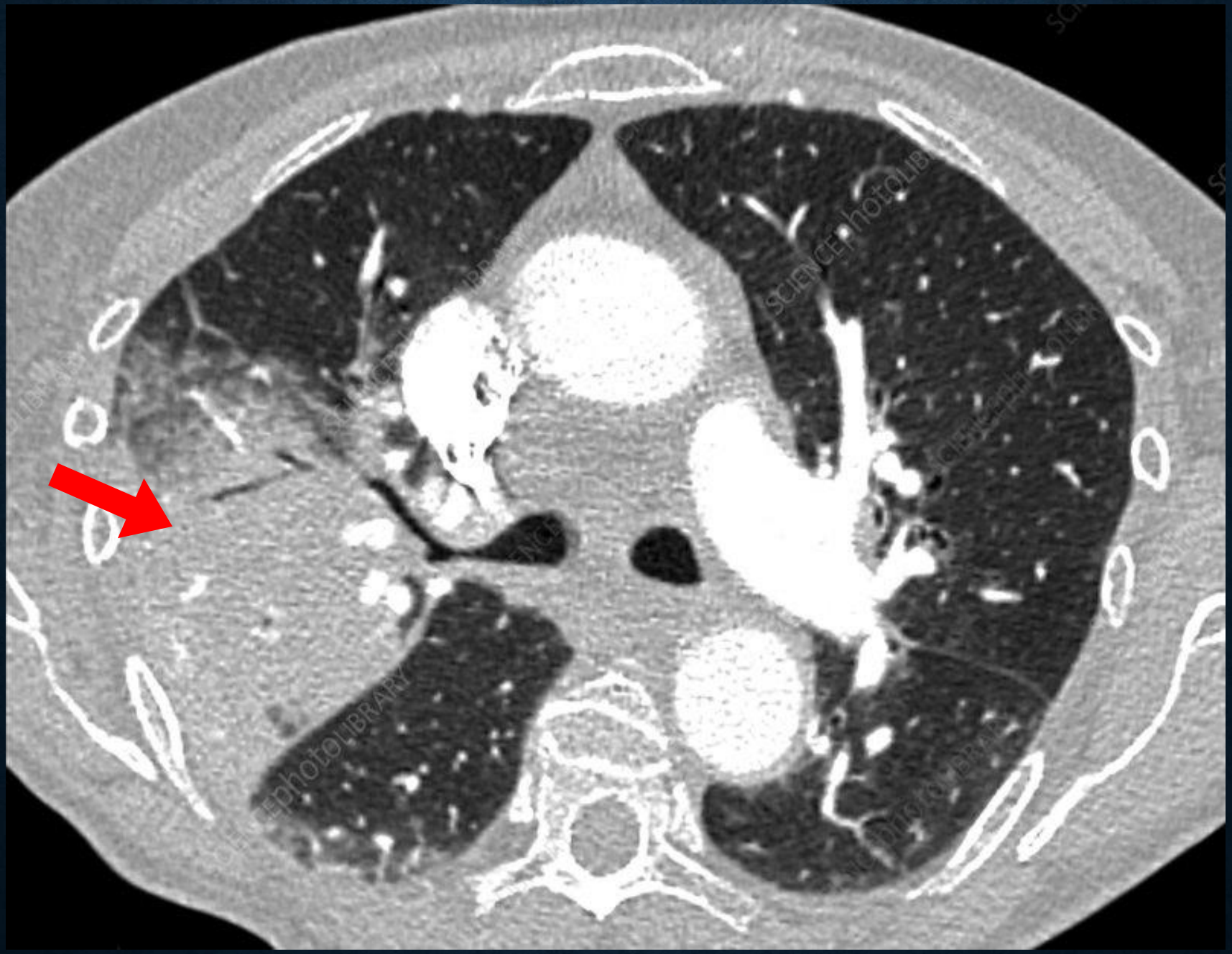
Air-space nodules may be seen as the only finding of consolidation or may be seen in association with larger areas of consolidation, usually at the edges of the more abnormal lung.

- W. Richard Webb

PRESERVED LUNG VOLUME

- In the presence of consolidation, because alveolar air is replaced by something else (e.g., fluid), the volume of affected lung tends to be preserved.
- Although some volume loss may be seen in patients with consolidation, it is usually of a minor degree. Alternatively, in some patients with consolidation, the lobe is **expanded**.

- W. Richard Webb



EXTENSION TO PLEURAL SURFACES

- Pathologic processes resulting in consolidation often spread from alveolus to alveolus until reaching a fissure or pleural surface.
- The pleural surface prevents further spread. When extension to a pleural surface occurs, the process may appear lobar, as in lobar pneumonia.

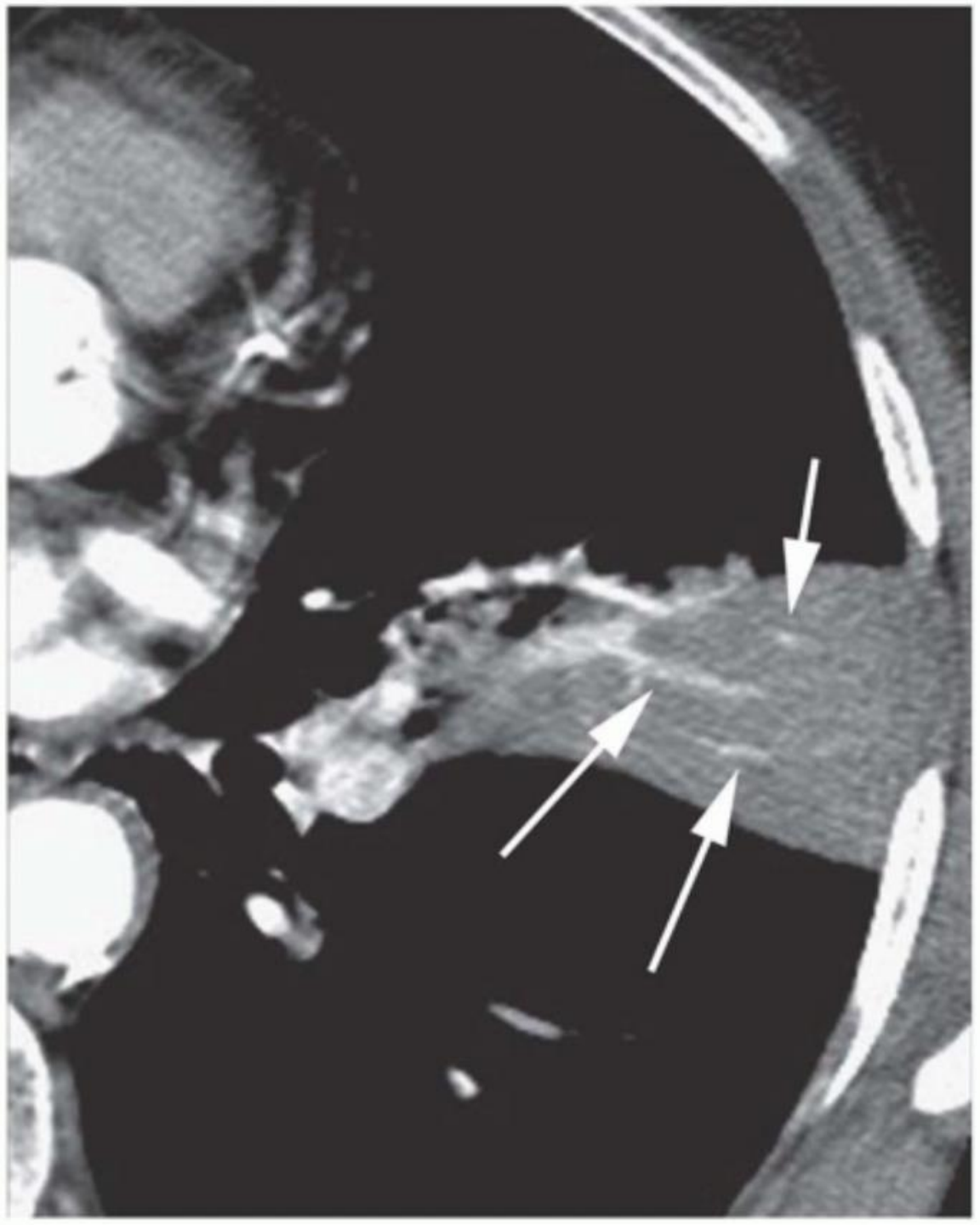
- W. Richard Webb

Lobar consolidation in right lower lobe due to aspiration. Air bronchogram is absent. Centrilobular nodules are seen in dependent location in left lower lobe also

CT ANGIOGRAM SIGN

- This sign is present if normal-appearing opacified vessels are visible within the consolidated lung following the infusion of intravenous contrast.
- Although opacified vessels are sometimes seen within a lung mass, they usually appear compressed or distorted.

- W. Richard Webb



Possible Causes of Batwing Sign:

- Pulmonary edema (especially cardiogenic)
- Pneumonia
  - aspiration pneumonia
  - pneumocystis pneumonia (PCP)
  - viral pneumonia
  - lipoid pneumonia
- Inhalation injury
- Noxious gas
- Liquid
  - pulmonary alveolar proteinosis
  - pulmonary hemorrhage (e.g. Goodpasture syndrome)
- Lymphoma/leukemia
  - bronchoalveolar carcinoma

Batwing

A bilateral perihilar distribution of consolidation is also called a Batwing distribution. It is most typical of pulmonary edema, both cardiogenic and non-cardiogenic. Sometimes seen in pneumonias.

Dr Rohit Sharma and Dr Behrang Amini et al.

Differential diagnosis of consolidation

1. Consolidation

Content of the alveoli

Water	Pus	Blood	Cells
Heart failure ARDS low albumin volumeoverload renal failure	Pneumonia	Trauma Goodpasture Henoch Schönlein SLE	BAC Organizing pneum. Chron eosinophilic Sarcoid

Pattern

Diffuse

Edema
- Heart failure
- volume overload
- low albumin
- renal failure
- ARDS
- Transfusion reaction

Bronchopneumonia
- Staph Aureus
- Gram-negative
- PCP
- viral - fungal

Hemorrhage
- SLE
- Henoch-Schönlein
- Wegener
- Goodpasture

BAC
Lymphoma
Organizing pneum.
Eosinophilic pneum.
Hypersensitivity pneum

Lobar

Lobar pneumonia
- Streptococ. Pneum.
- Klebsiella
- Aspiration

Hemorrhage
- Contusion
- Infarction

Others
- BAC
- Lymphoma
- Organizing Pneum.
- Eosinophilic pneum.
- Sarcoidosis

Multiple ill-defined

Bronchopneumonia
- Staphylococcus
- Legionella
- Gram negative
- Streptoc. Pneum.
- Klebsiella
- Pseudomonas
- Anaerobe
- PCP
- TB

Vascular
- Septic emboli
- Wegener's

Neoplasm
- BAC
- Lymphoma
- Metastases

Acute

Pneumonia
Aspiration
Infarction
Edema

Chronic

BAC
Lymphoma
Organizing pneum.
Eosinoph. pneumonia
Alveolar proteinosis
Sarcoidosis

Batwing

Edema
Bact pneumonia
PCP
viral pneumonia

Reversed Batwing

Broncho-alv. carcinoma
Organizing Pneum (BOOP)
Eosinophilic pneumonia
Sarcoidosis
Radiation

By Robin Smithuis - Radiology Department of the Rijnland Hospital, Leiderdorp, the Netherlands

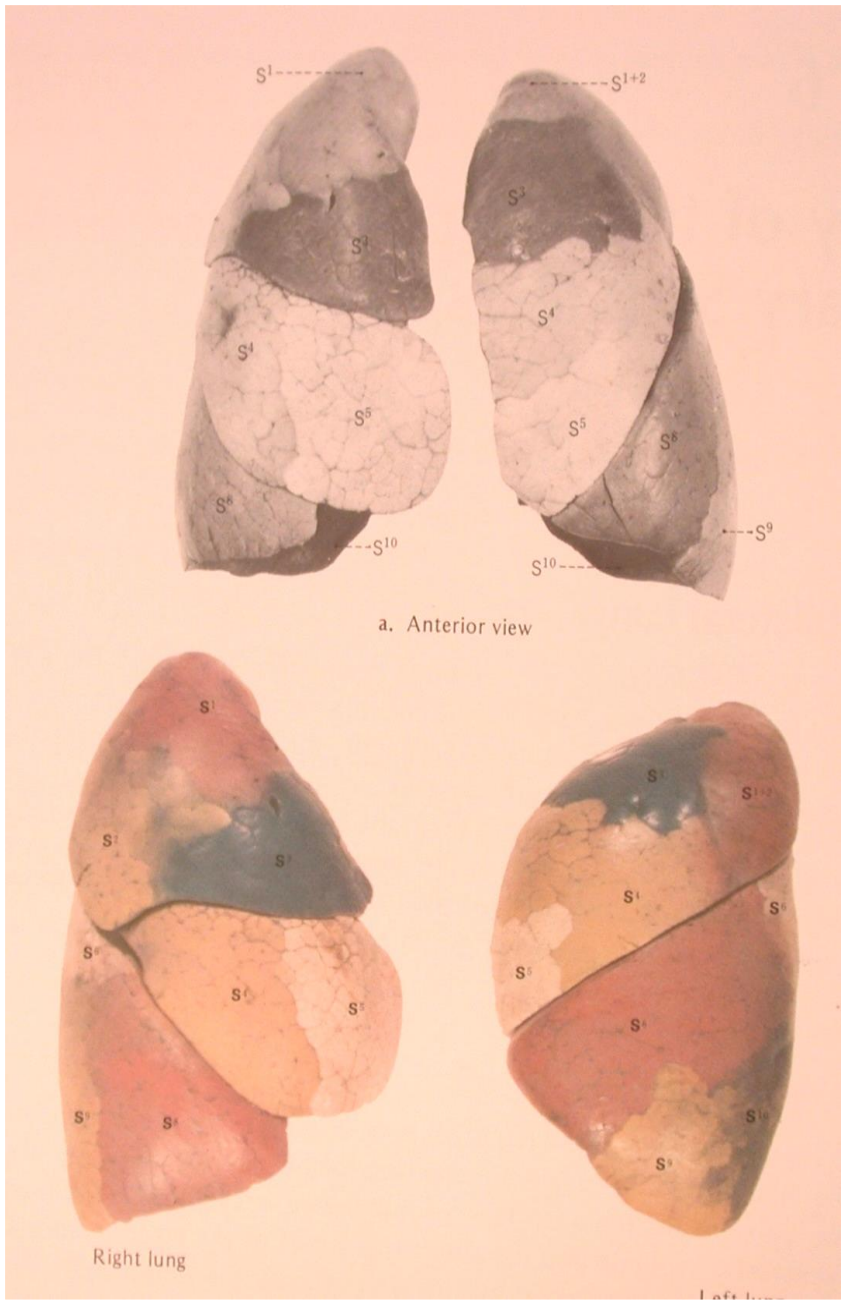

Consolidation
Atelectasis

右肺區

RUL
- S1 Apical
- S2 Posterior
- S3 Anterior

RML
- S4 Lateral
- S5 Medial

RLL
- S6 Superior
- S7 Medial b.s.
- S8 Anterior b.s.
- S9 Lateral b.s.
- S10 Posterior b.s.



左肺區

LUL

Upper division

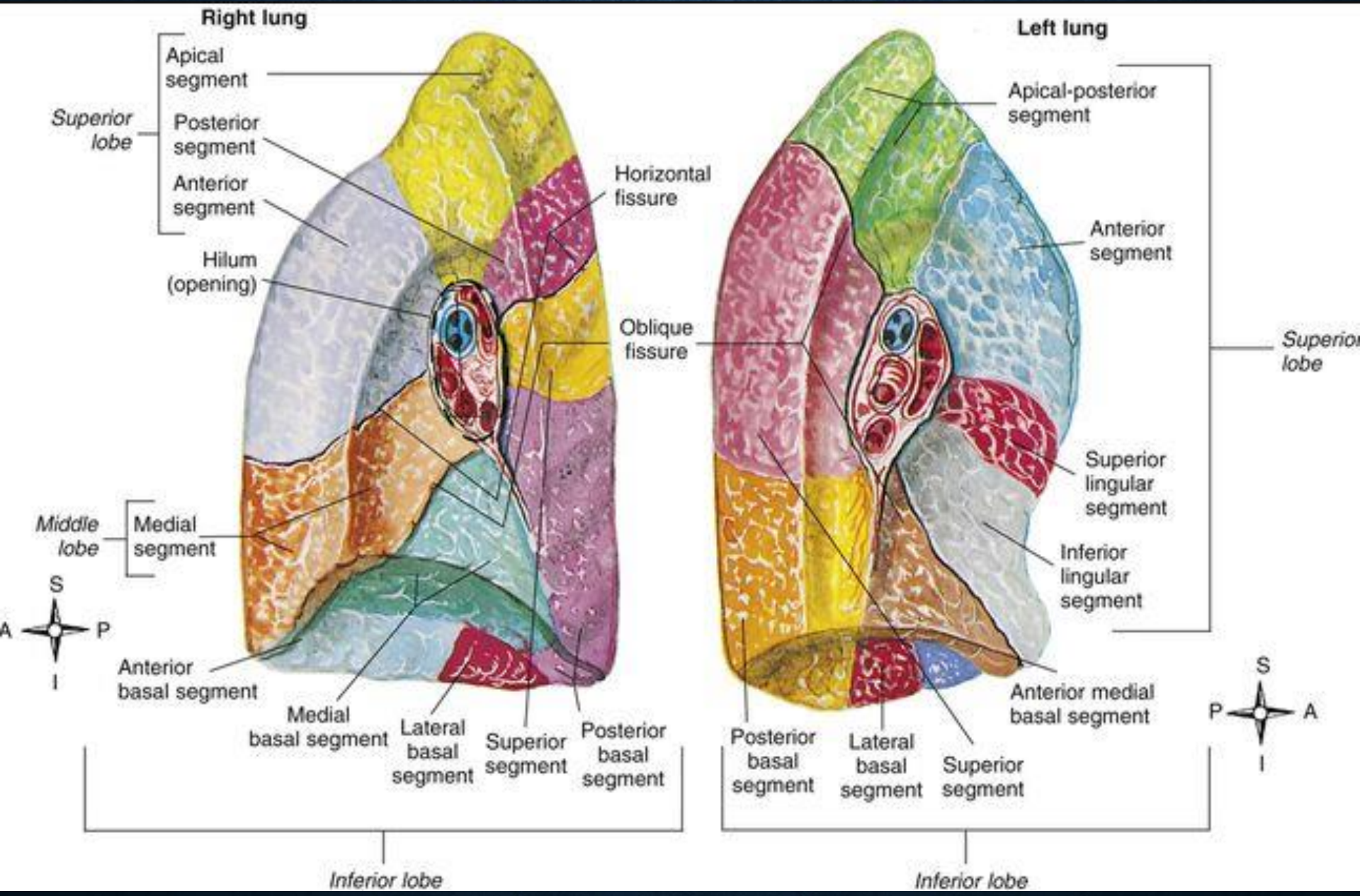
S1+2 Apico-posterior

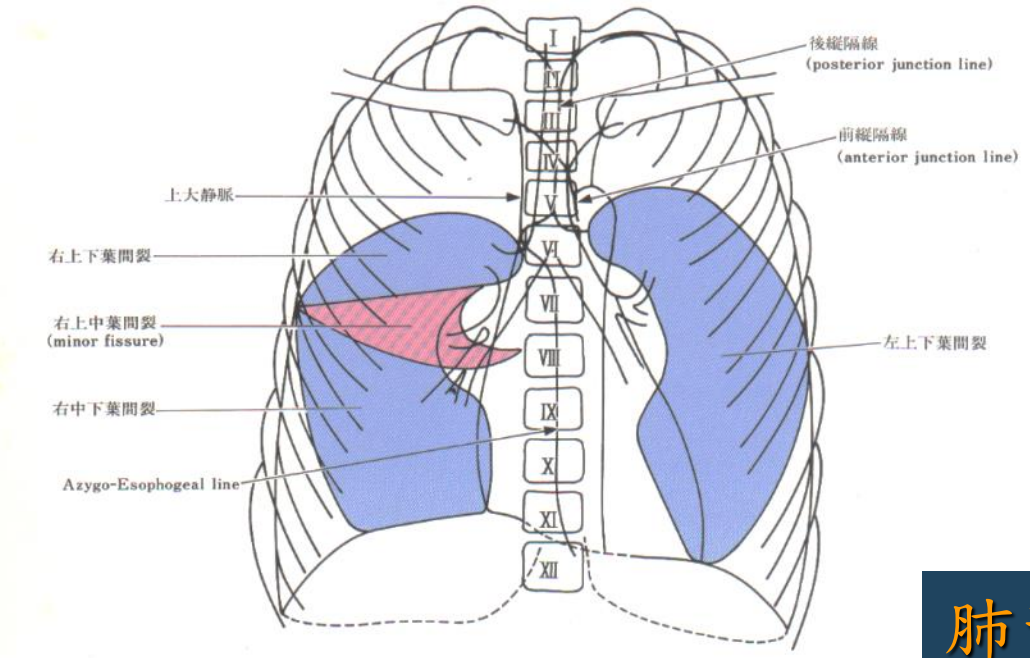
S3 Anterior

Lingular division
- S4 Lateral
- S5 Medial

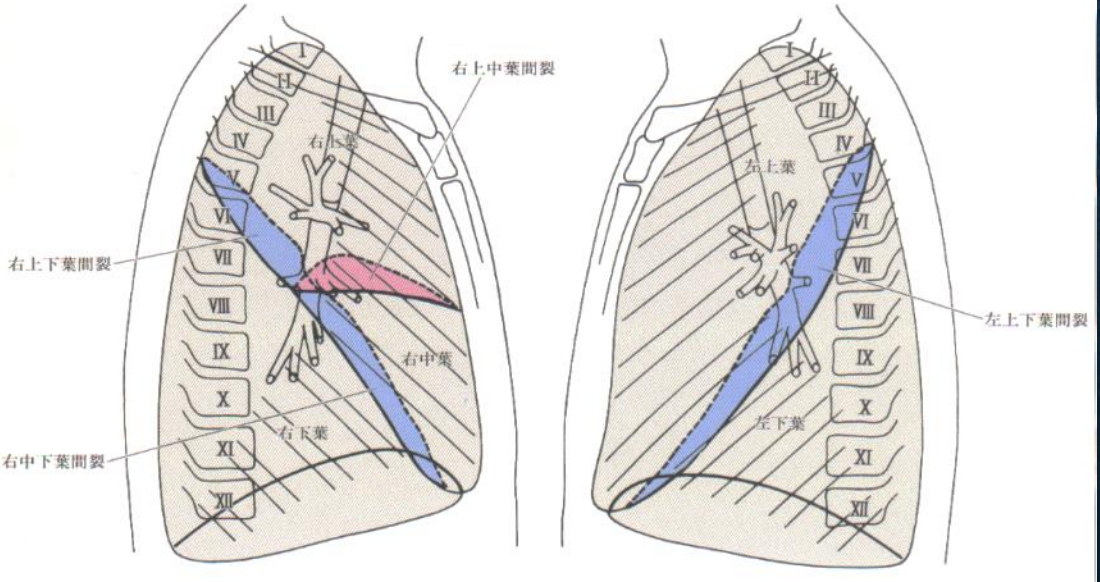
LLL
- S6 Superior

S7+8 Anteromedial b.s.
- S9 Lateral b.s.
- S10 Posterior b.s.

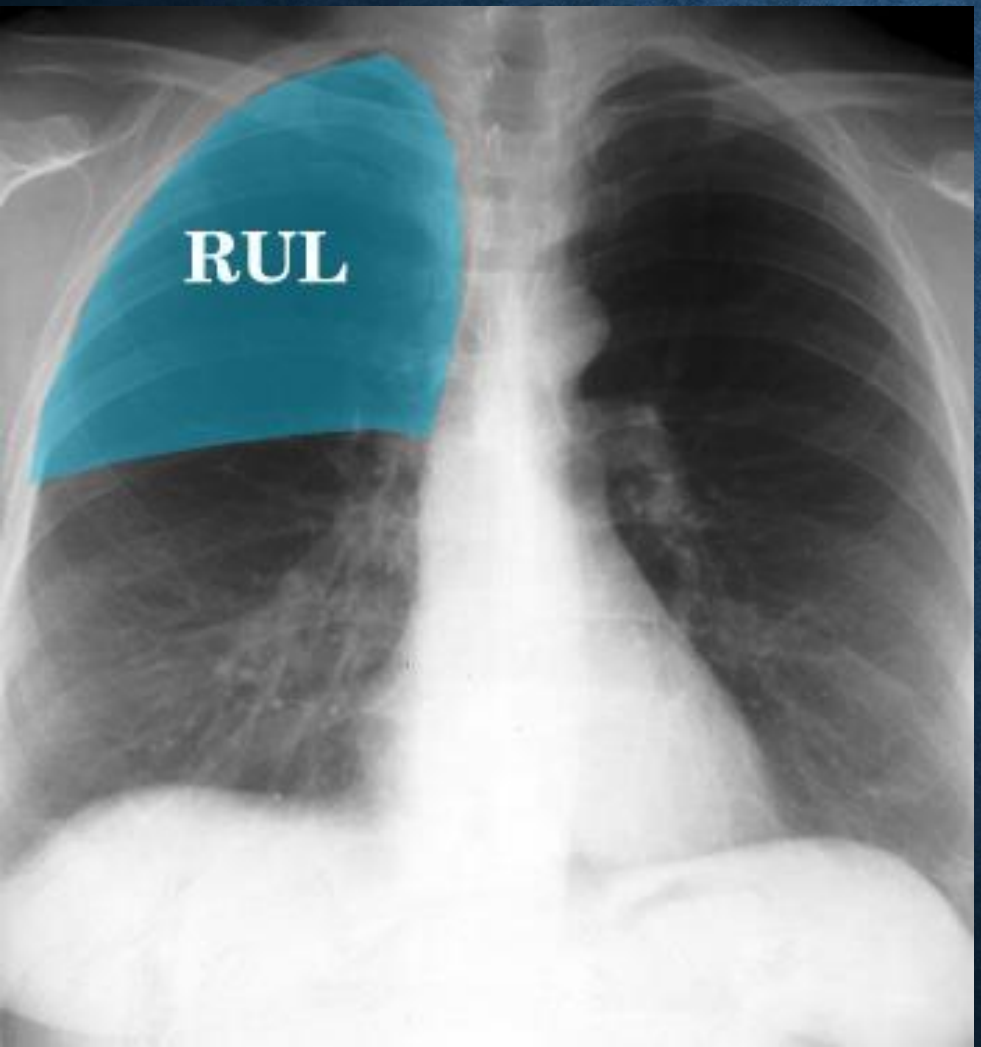

Right lung
Apical segment
Superior lobe
Posterior segment
Anterior segment
Hilum (opening)
Horizontal fissure
Oblique fissure
Middle lobe
Medial segment
S
A
P
I
Anterior basal segment
Medial basal segment
Lateral basal segment
Superior segment
Posterior basal segment
Inferior lobe
Left lung
Apical-posterior segment
Anterior segment
Superior lobe
Superior lingular segment
Inferior lingular segment
Anterior medial basal segment
Posterior basal segment
Lateral basal segment
Superior segment
Inferior lobe

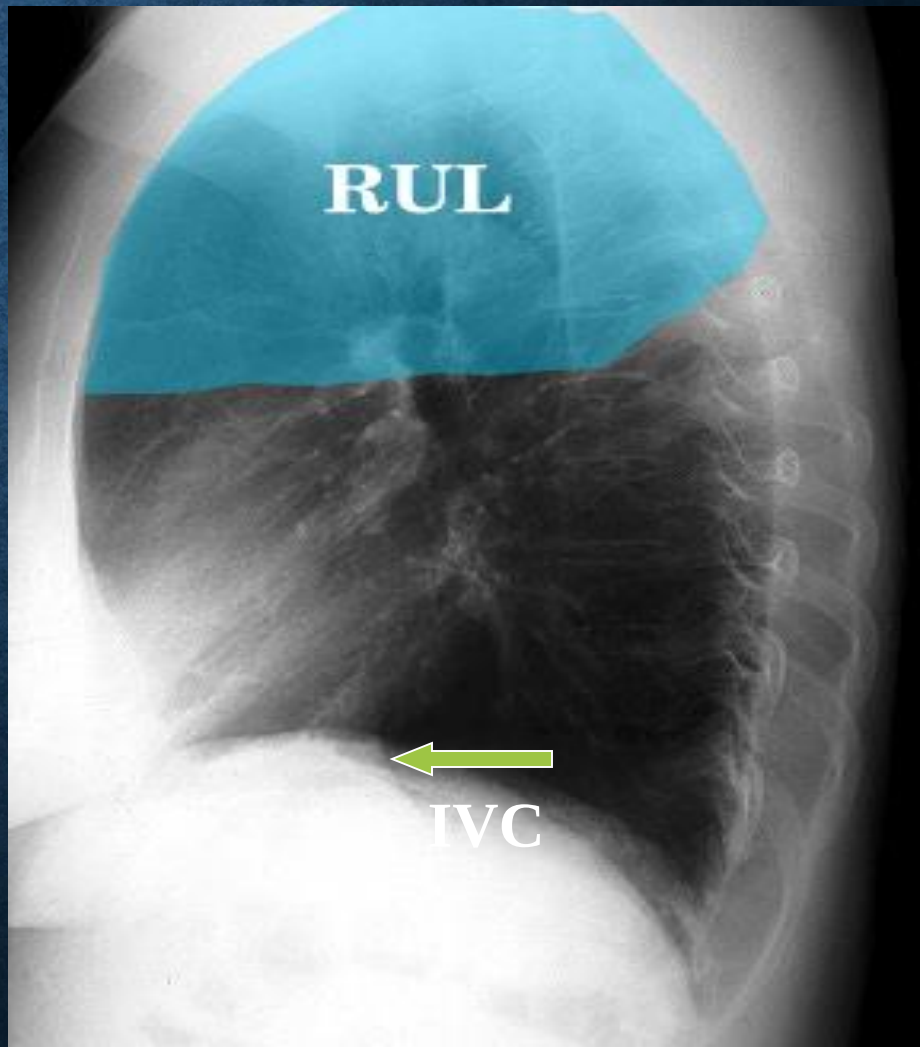

後縦隔線
(posterior junction line)
前縦隔線
(anterior junction line)
上大静脈
右上下葉間裂
右上中葉間裂
(minor fissure)
右中下葉間裂
Azygo-Esophogeal line
左上下葉間裂
I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII

肺葉與葉間裂

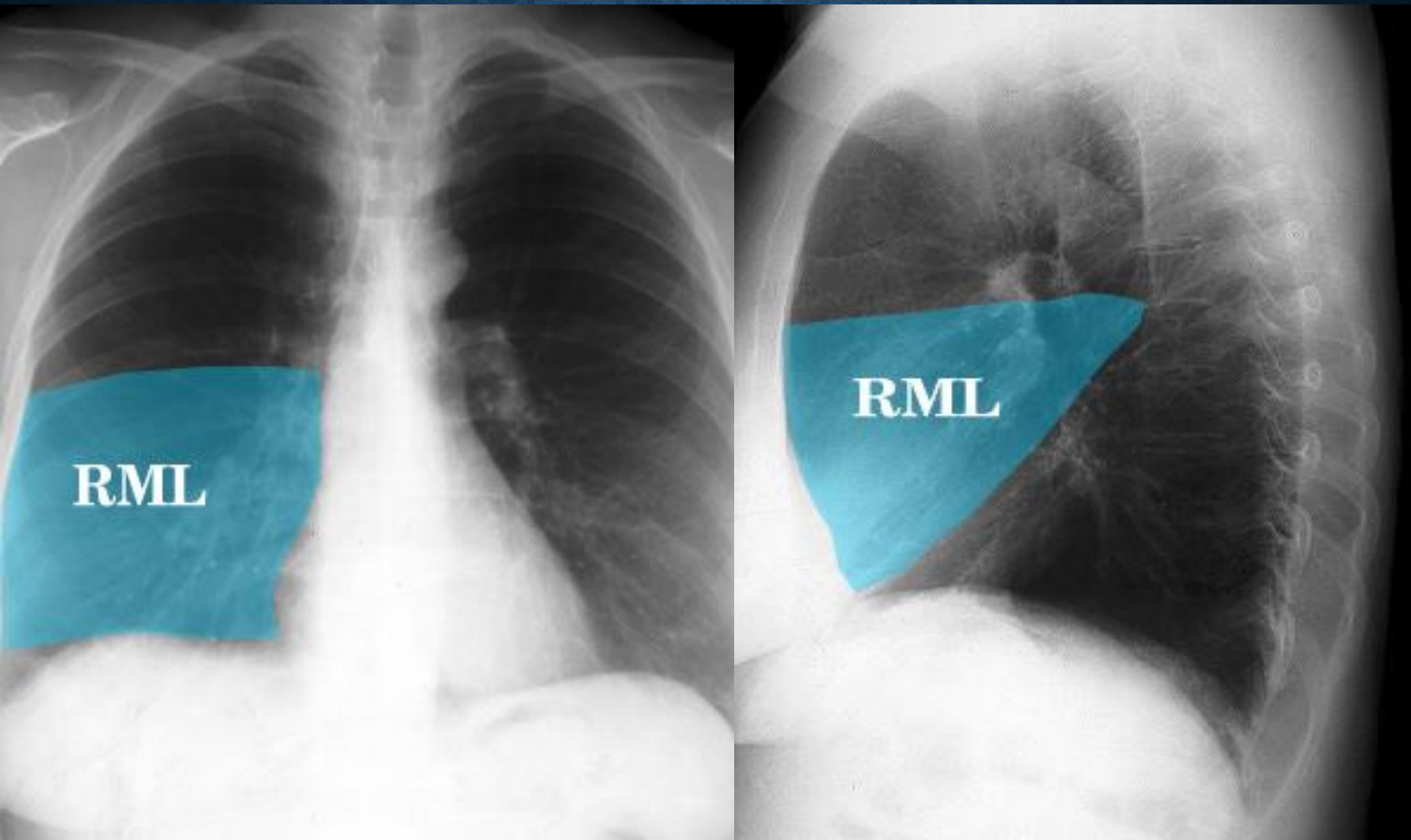

右上中葉間裂
右上葉
右上下葉間裂
右中葉
右下葉
右中下葉間裂
左上葉
左上下葉間裂
左下葉
I
II
III
IV
V
VI
VII
VIII
IX
X
XI
XII

Right upper lobe

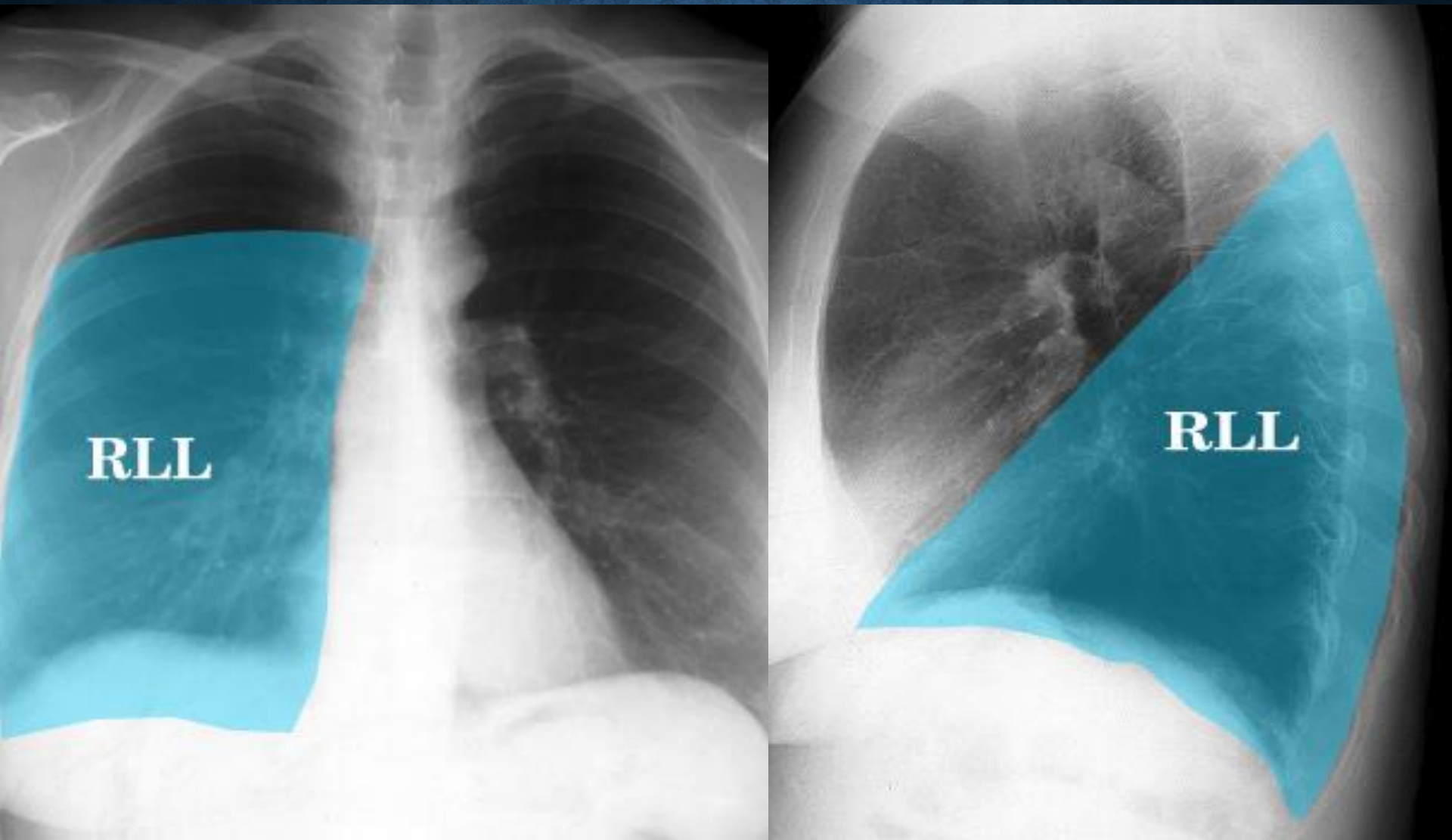




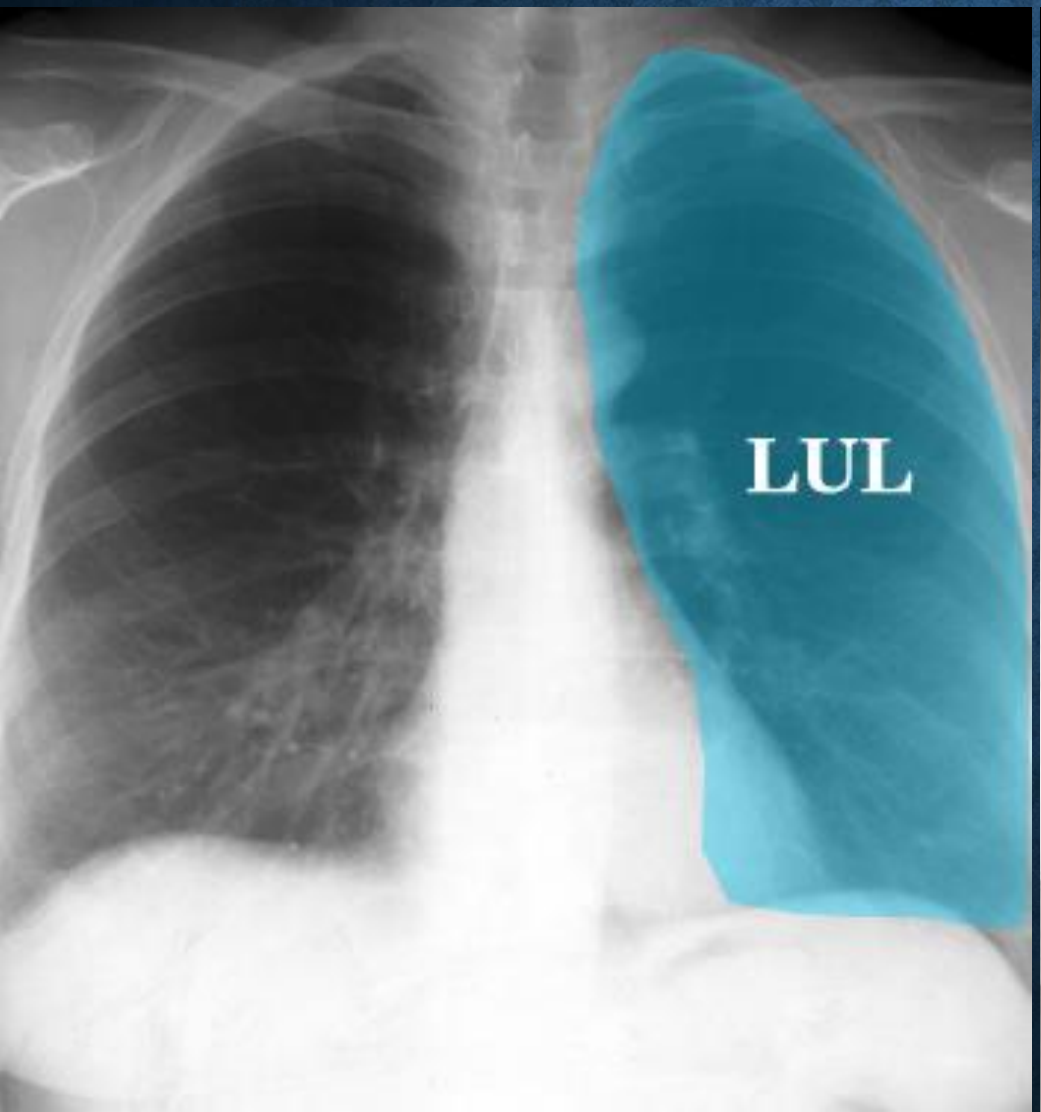
Right middle lobe

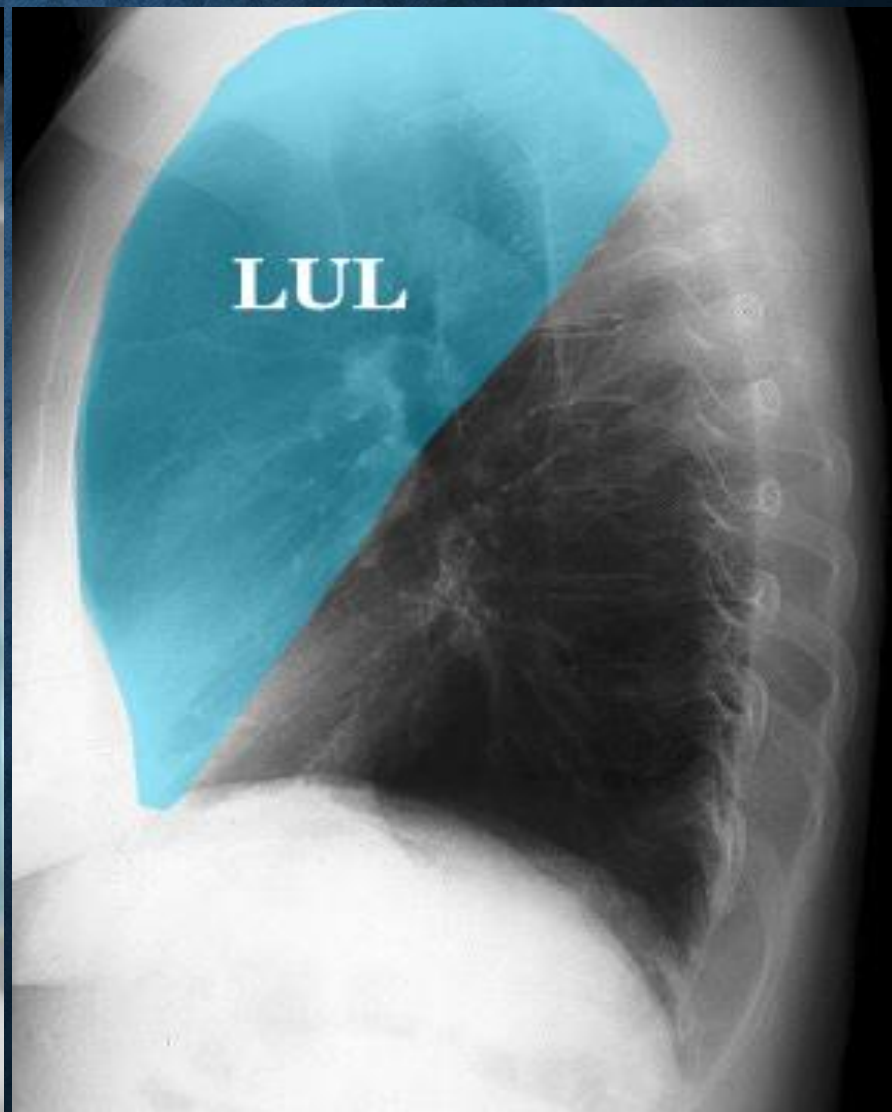


Right lower lobe

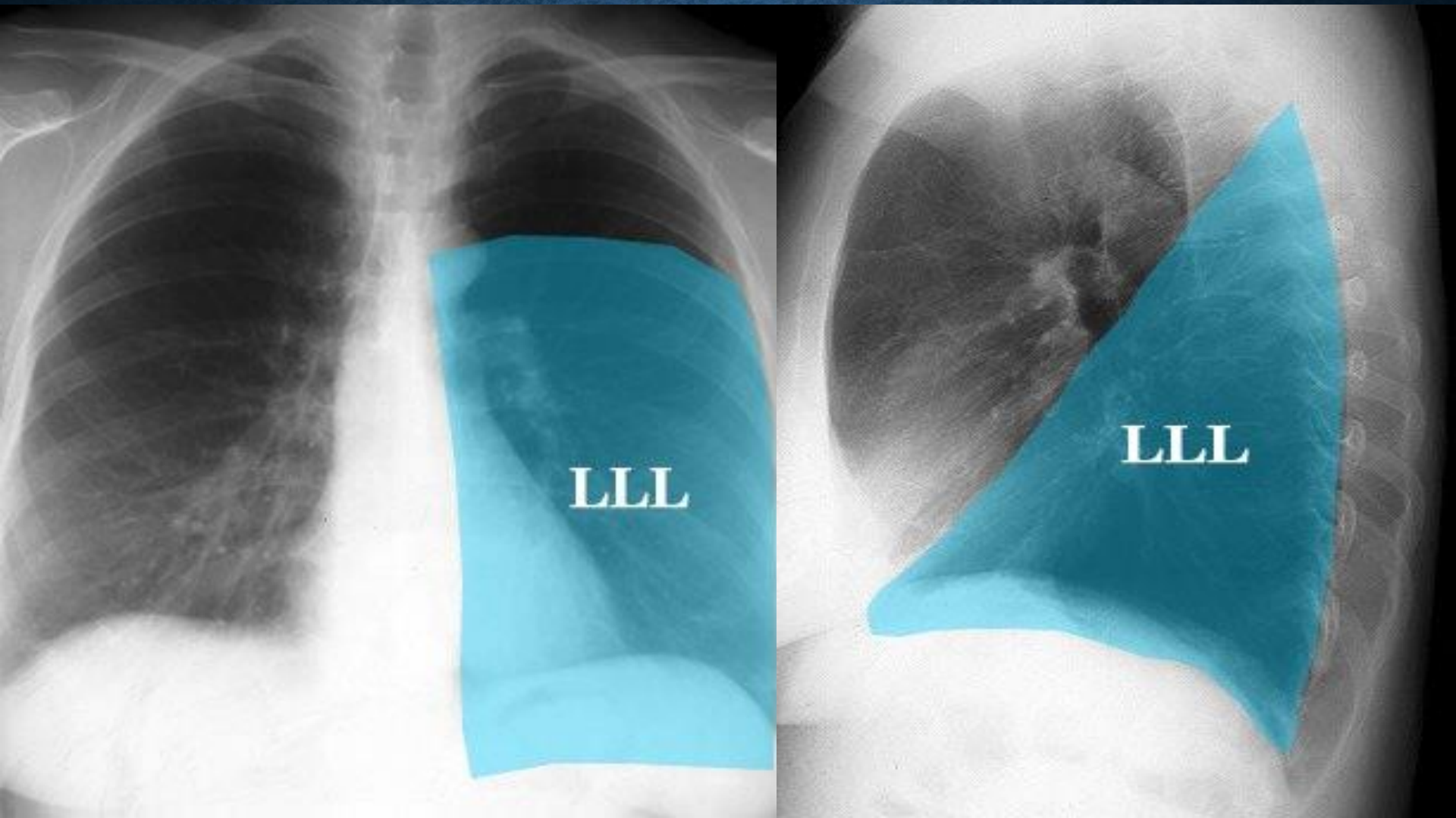


Left Upper Lobe





Left lower lobe

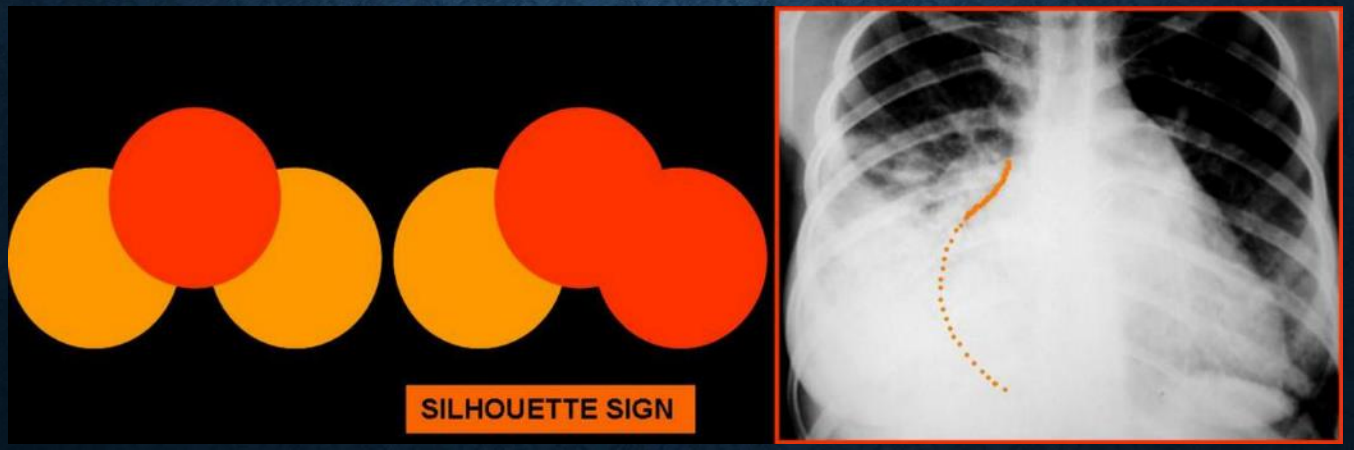


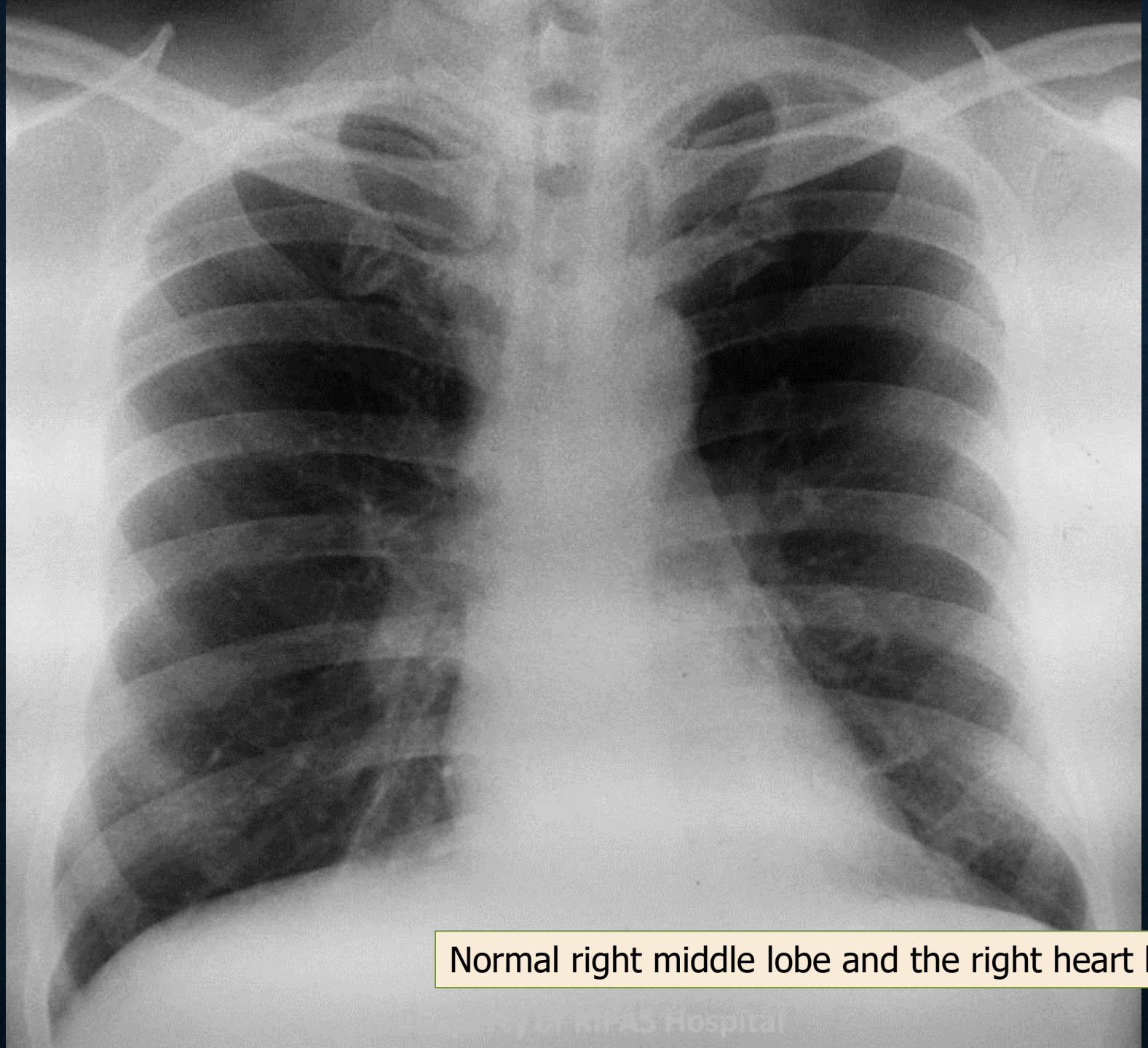
SILHOUETTE SIGN

- Two substances of the same density, in direct contact, cannot be differentiated from each other on an X-ray.

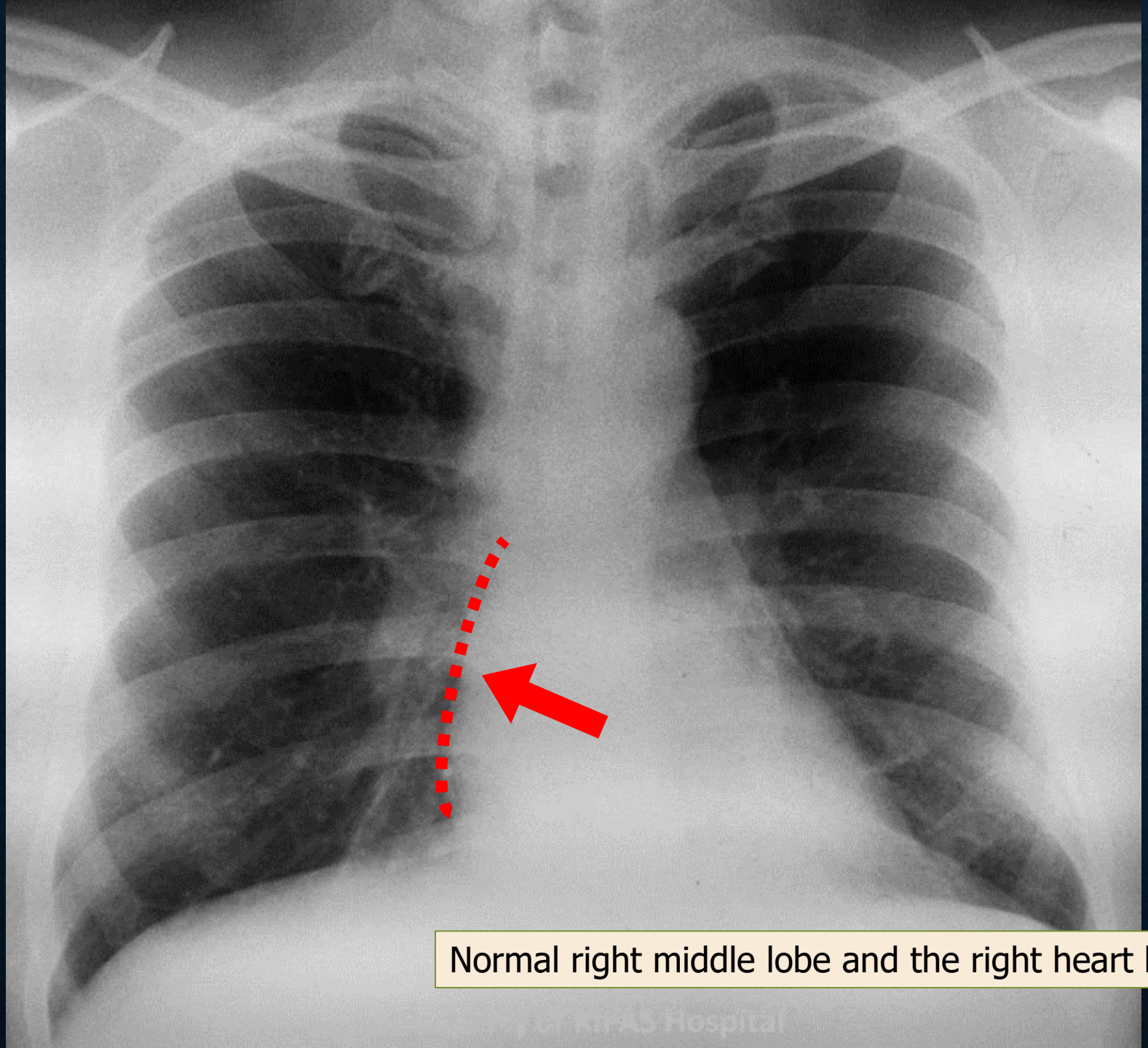
  This phenomenon, the loss of the normal radiographic silhouette (contour), is called the sillouette sign.

  - Felson

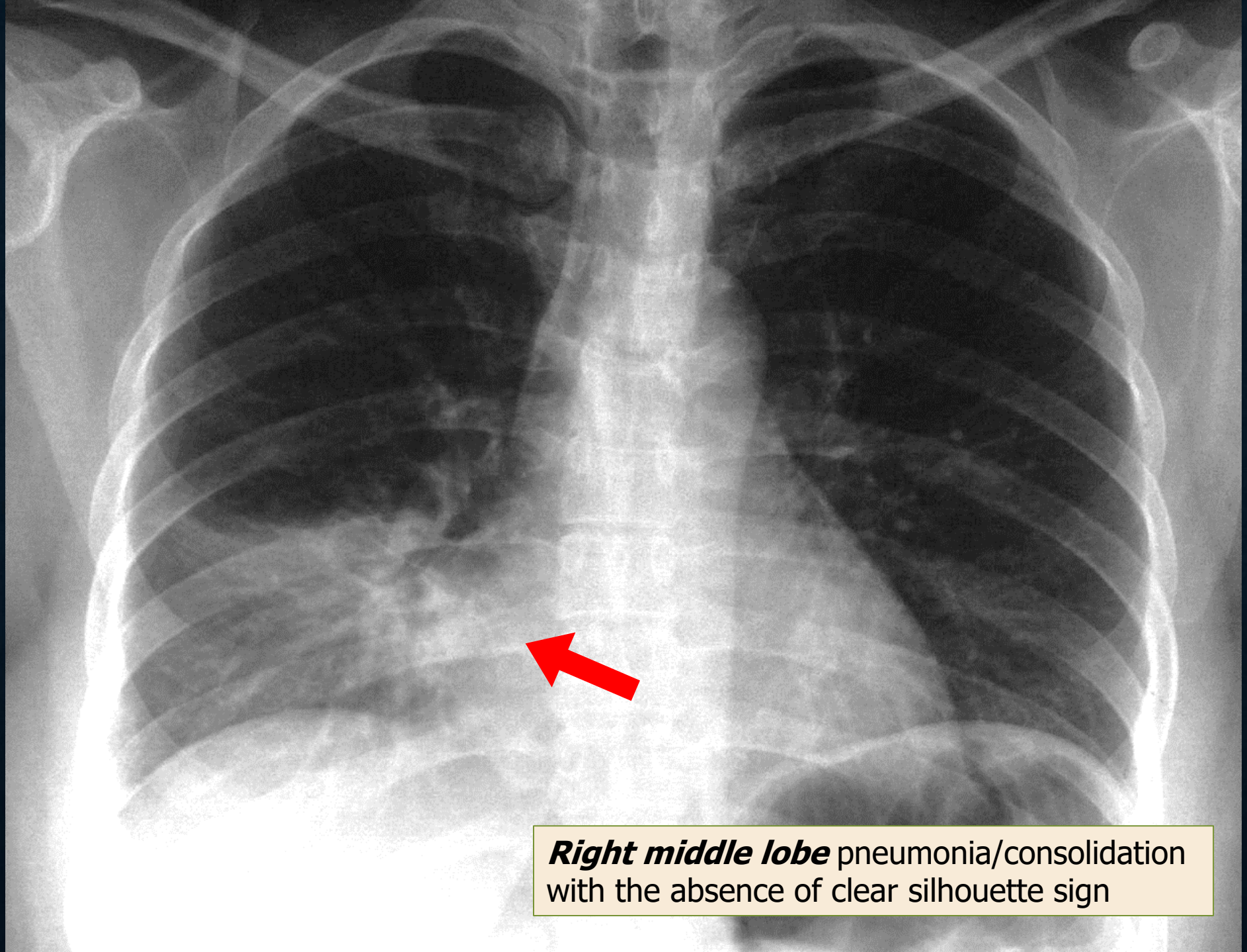




Normal right middle lobe and the right heart border



Normal right middle lobe and the right heart border



Right middle lobe pneumonia/consolidation with the absence of clear silhouette sign

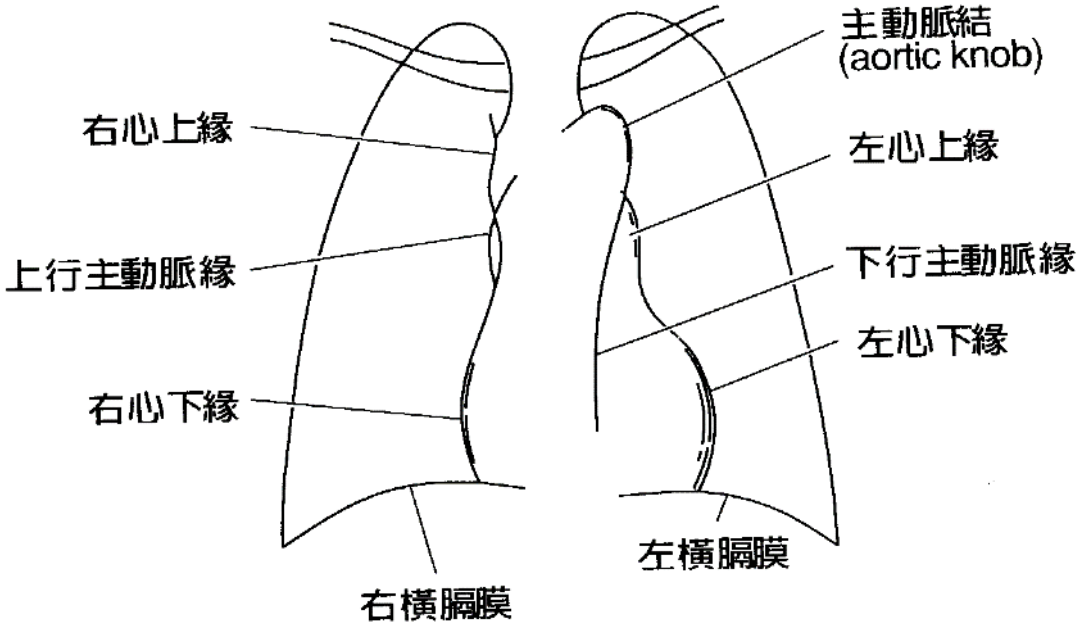


圖1　輪廓徵兆應注意的解剖學構造

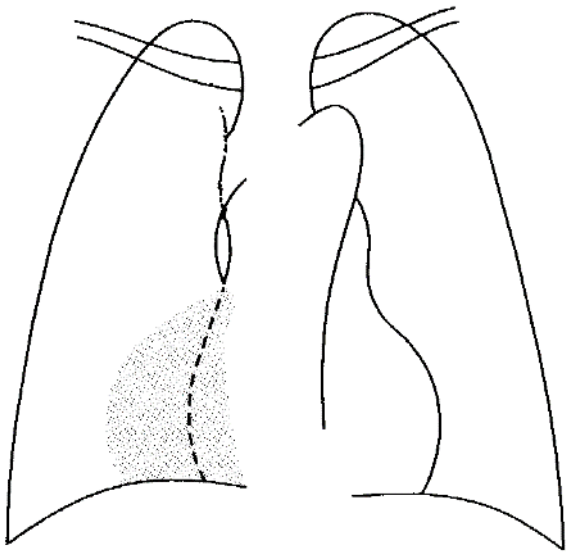


圖2　原則1：右心下緣的輪廓消失→右中葉的病變

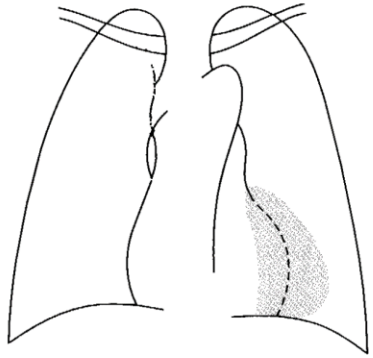


圖3　原則2：左心下緣的輪廓消失→左舌區的病變。

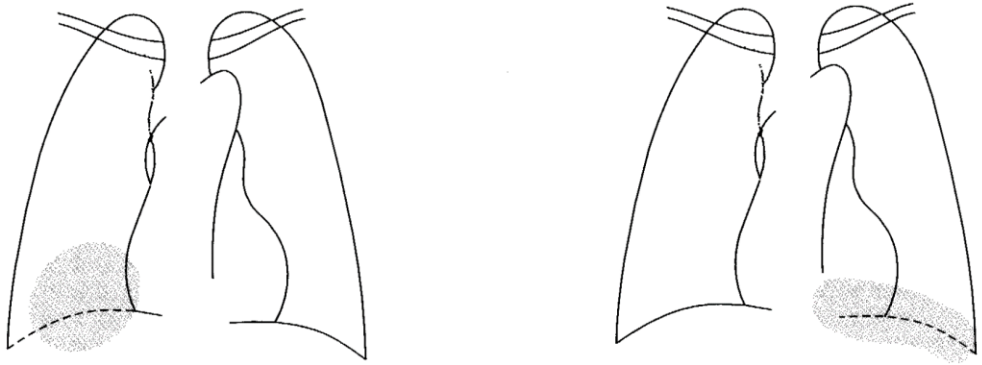


圖4　原則3：橫膈膜的輪廓消失→下葉的病變。

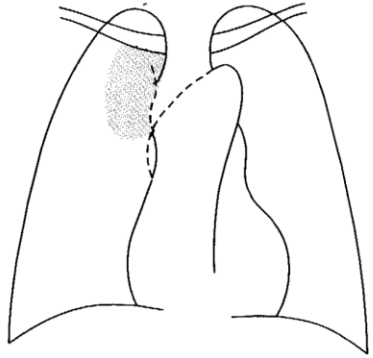


圖5　原則4：右心上緣、上行主動脈的輪廓消失→右上葉前區域的病變

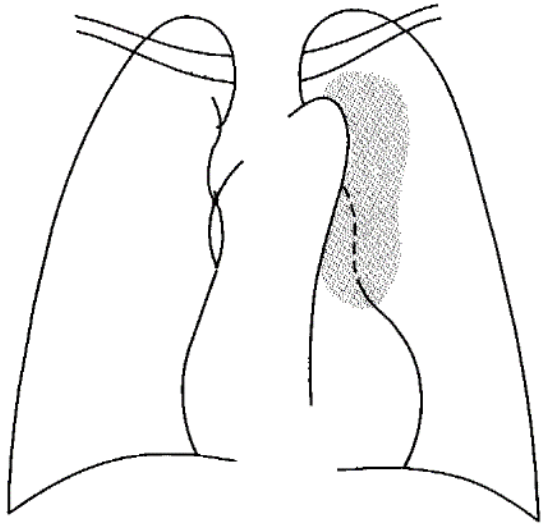


圖6　原則5：左心上緣的輪廓消失
→左上葉前區域的病變。

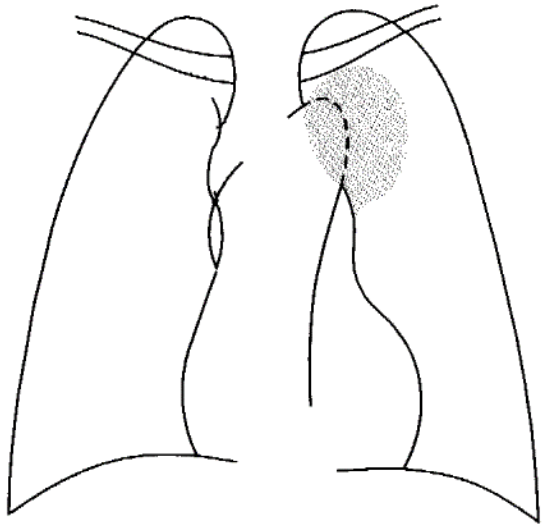


圖7　原則6：主動脈弓左緣的輪廓消失
→左上葉後區域的病變。

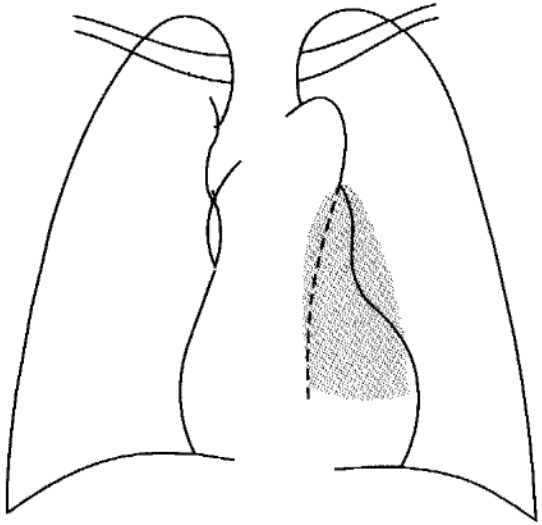


圖8　原則7：下行主動脈右緣的輪廓消失→左下葉的病變

ATELECTASIS

- Atelectasis: reduction in volume of a lung, a lobe, or a segment from any cause
- Types of Atelectasis:
  - Resorption (Obstructive) Atelectasis
    e.g. airway obstruction
  - Relaxation Atelectasis
    Compressive or passive atelectasis
  - Adhesive Atelectasis
    Surfactant lacking: ARDS, alveolar hypoventilation
  - Cicatrization Atelectasis (結疤)

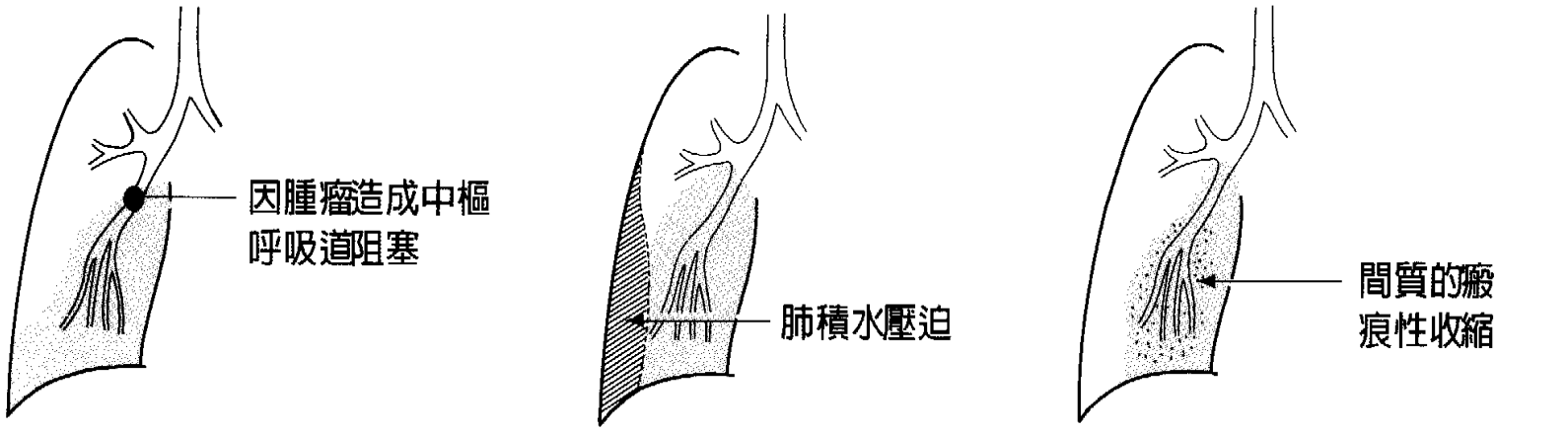
RELAXATION ATELECTASIS

Compressive Atelectasis

- Peripheral tumor
- Extensive interstitial disease
  - Sarcoidosis, lymphoma
- Air trapping in adjacent lung
  - Bullous emphysema,
  - Lobar emphysema,
  - Interstitial emphysema,
  - Obstruction by foreign body

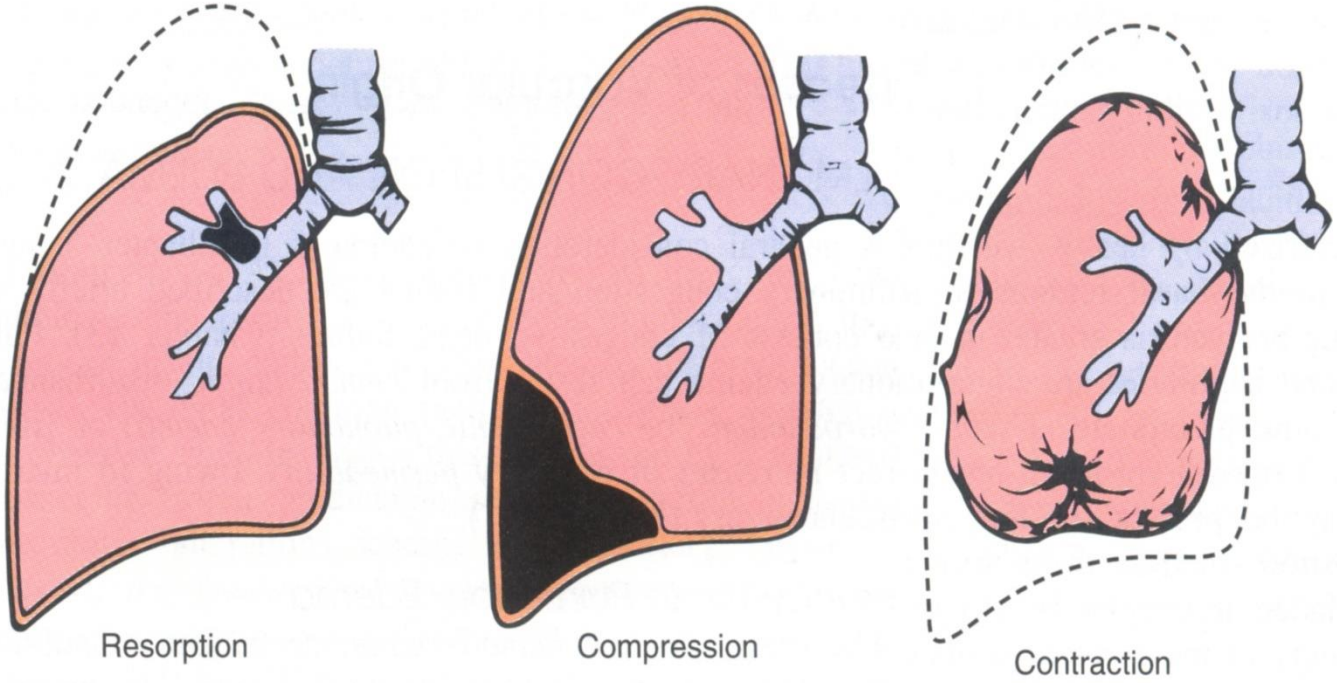
Passive Atelectasis

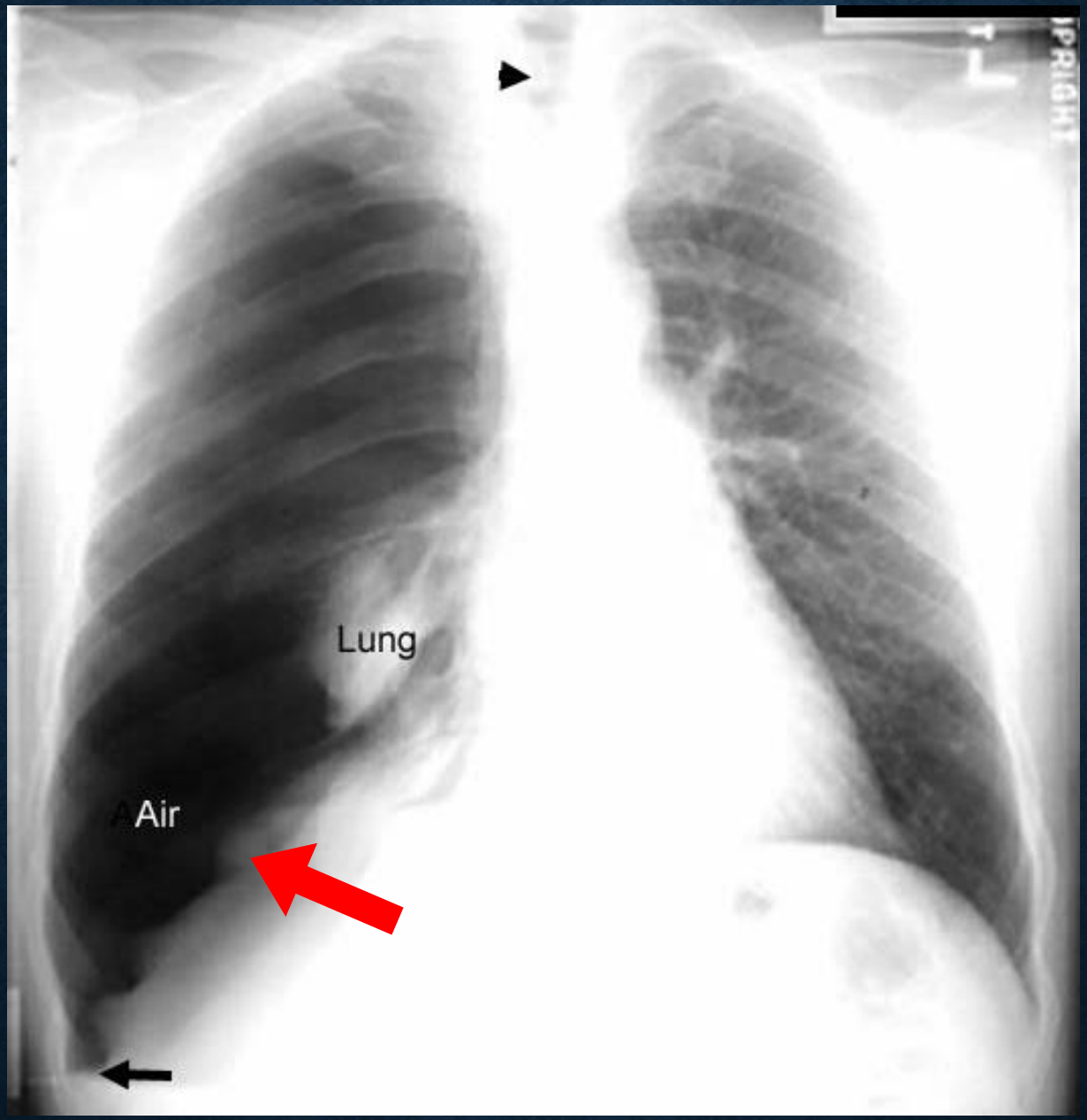
- Pneumothorax
- Hydrothorax, hemothorax
- Diaphragmatic hernia
- Pleural masses
  - Metastasis
  - Mesothelioma



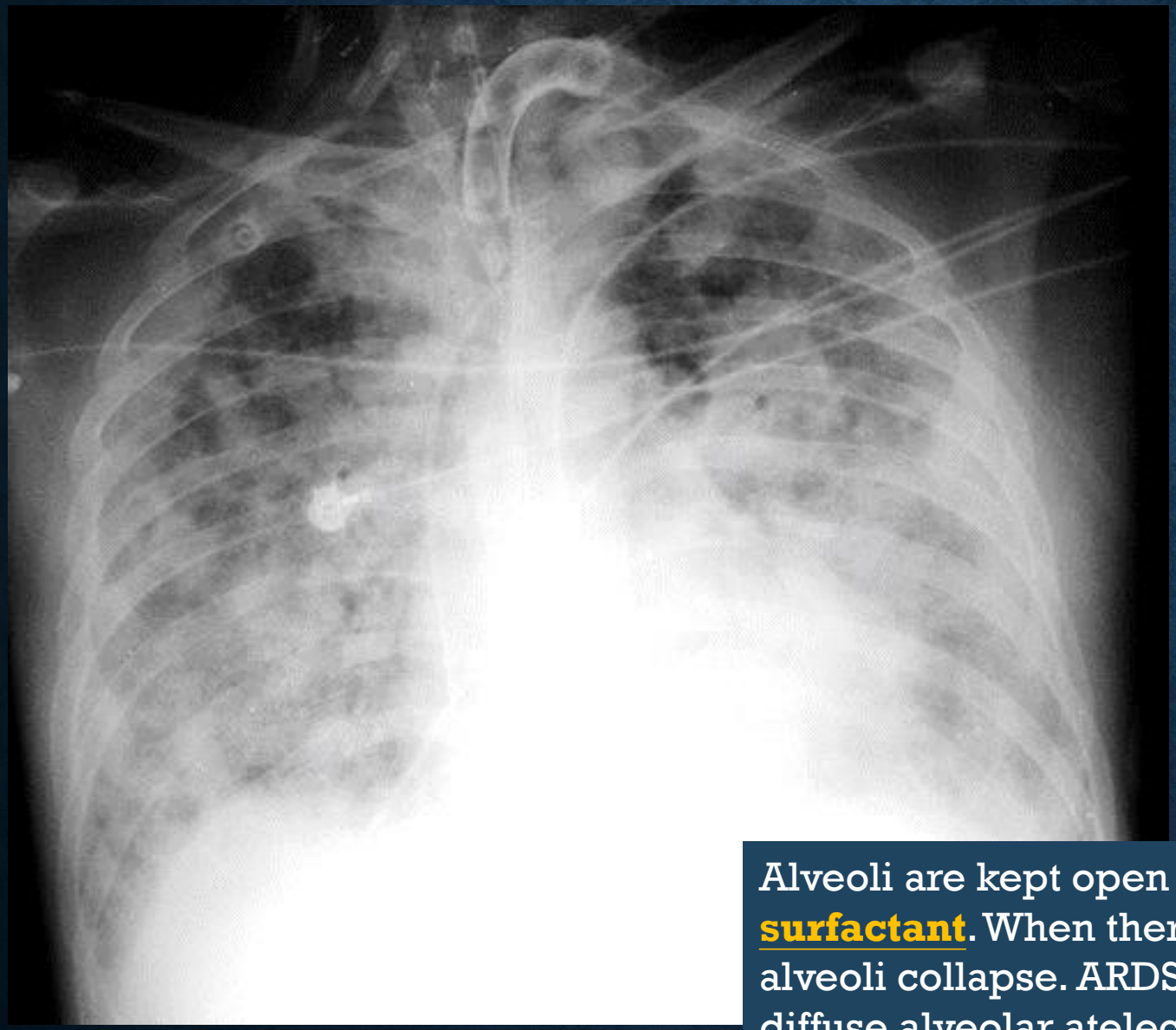
1.阻塞性肺膨脹不全　2.壓迫性肺膨脹不全 (被動性)　3.收縮性肺膨脹不全 (瘢痕性)

圖1　肺膨脹不全病因的分類





Compressive atelectasis by giant **bullous emphysema**



Adhesive Atelectasis - ARDS

Alveoli are kept open by the integrity of **surfactant**. When there is loss of surfactant, alveoli collapse. ARDS is an example of diffuse alveolar atelectasis.
Plate-like atelectasis is an example of focal loss of surfactant.

Direct Signs

(與萎陷肺部內容物直接相關的變化)

- **Displacement of interlobar fissures**
  most reliable direct sign !!
- Bronchovascular crowding
- Increased opacity

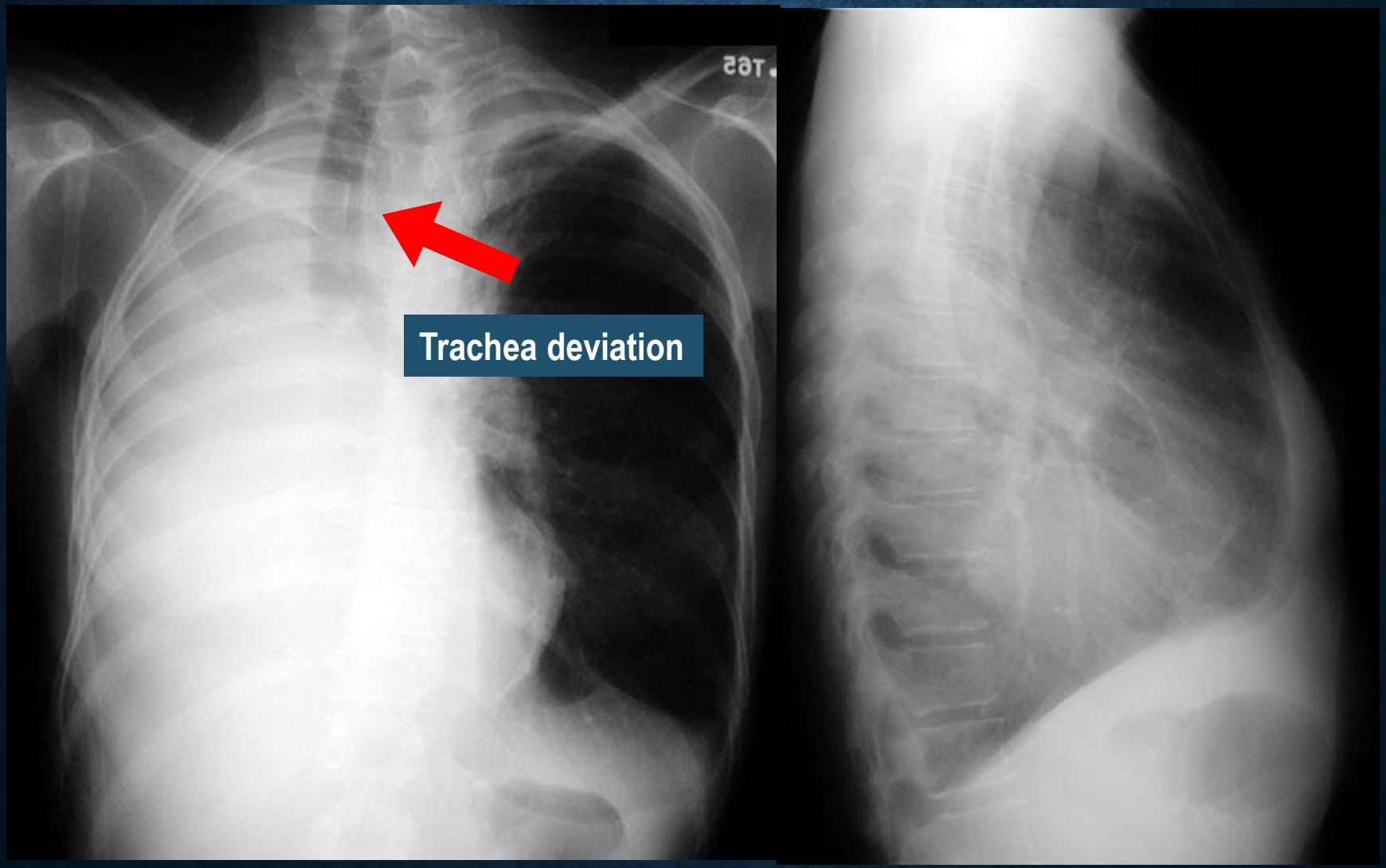
可單一或多項同時出現

Indirect Signs

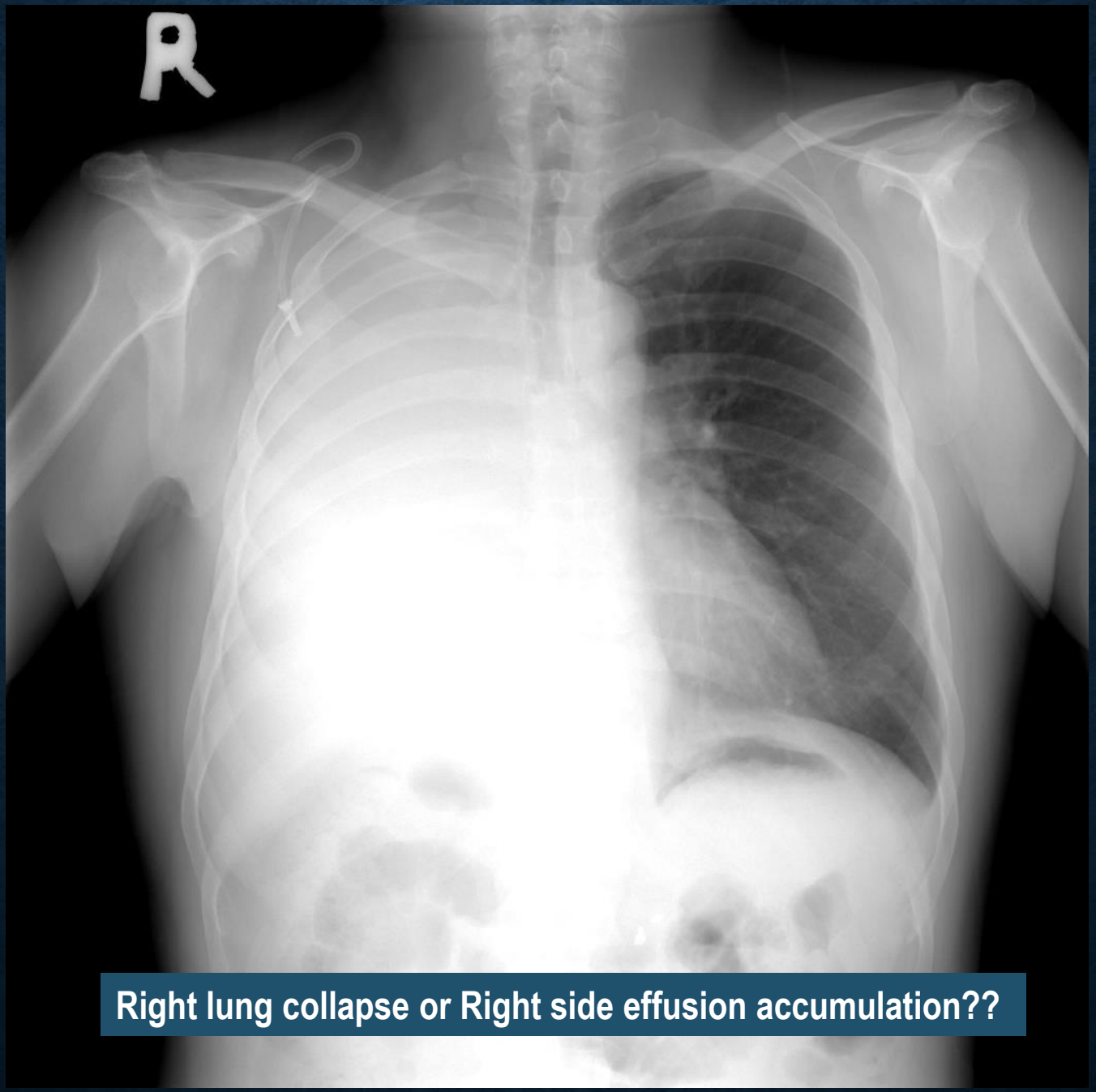
（與萎陷肺部內容物無直接相關的變化）

- **Hilar displacement**
  Most reliable indirect sign !!
- Obscured heart or diaphragm borders
- Diaphragm elevation
- Displacement of mediastinal structures
- Compensatory hyperexpansion
- Narrowing of ICS
- Juxtaphrenic peak (J-P sign)

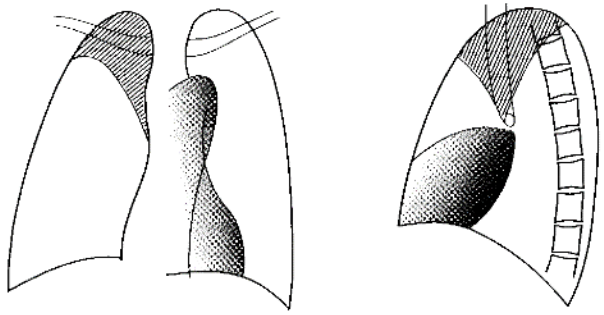
AIRWAY OBSTRUCTION



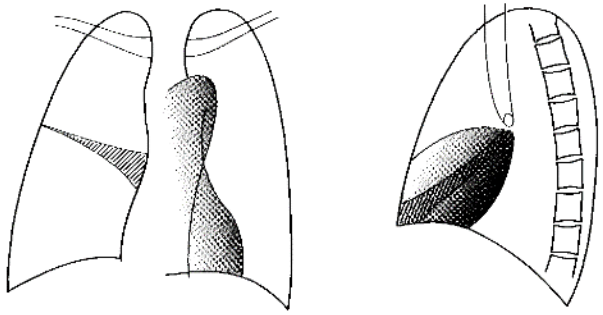
Occlusion of right main bronchus: tumor obstruction



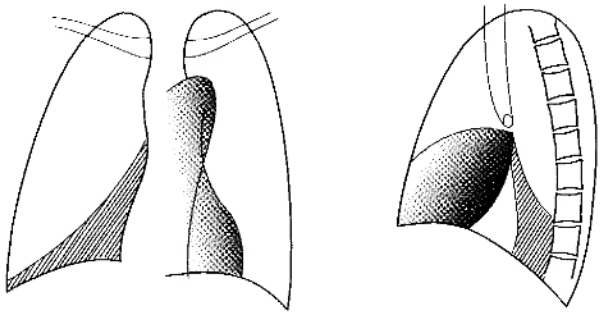
Right lung collapse or Right side effusion accumulation??



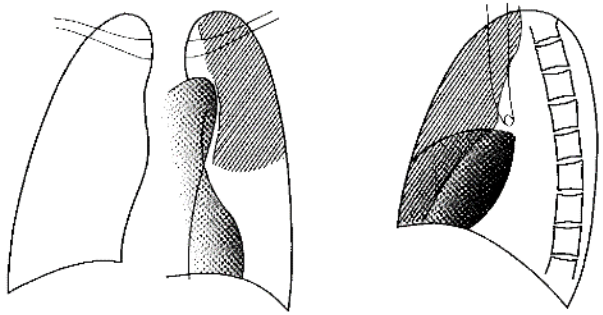
a　右上葉膨脹不全



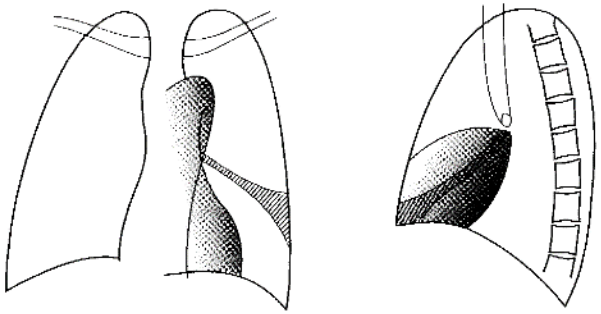
b　右中葉膨脹不全



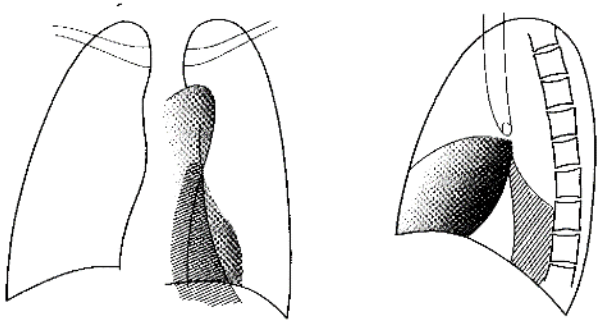
c　右下葉膨脹不全



d　左上葉膨脹不全



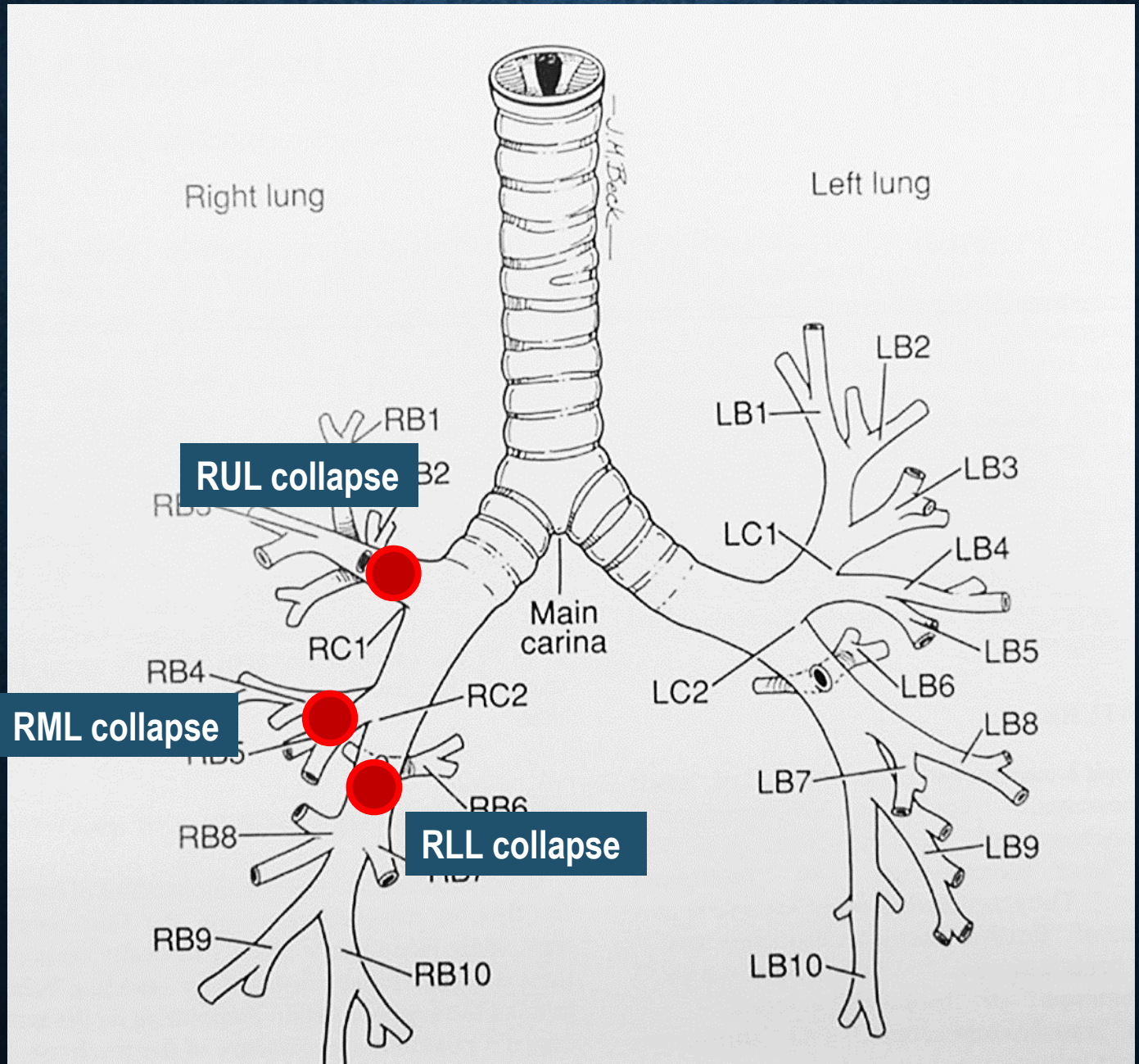
e　左舌區膨脹不全



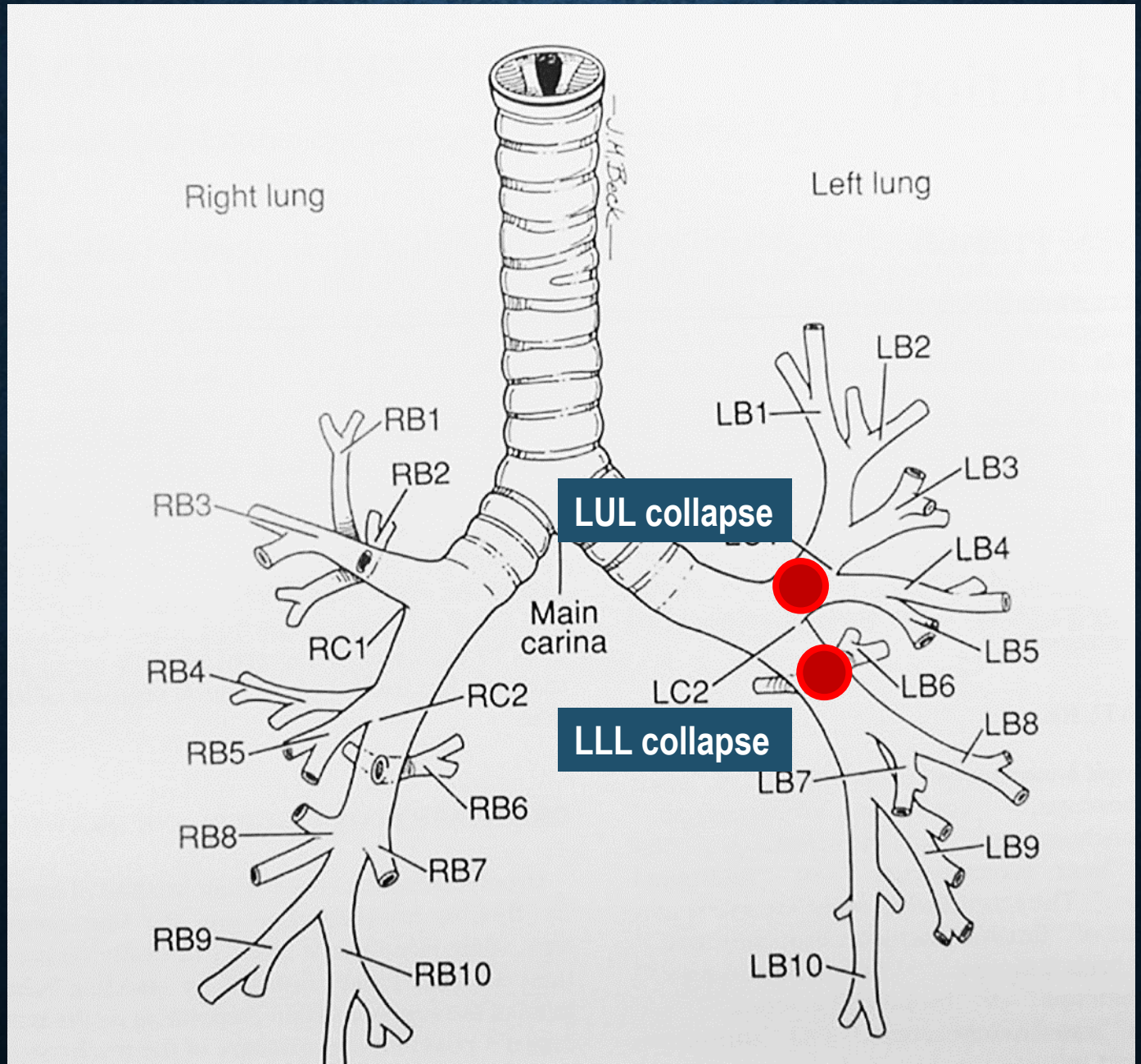
f　左下葉膨脹不全

圖2　胸部X-光片所見的膨脹不全的肺葉

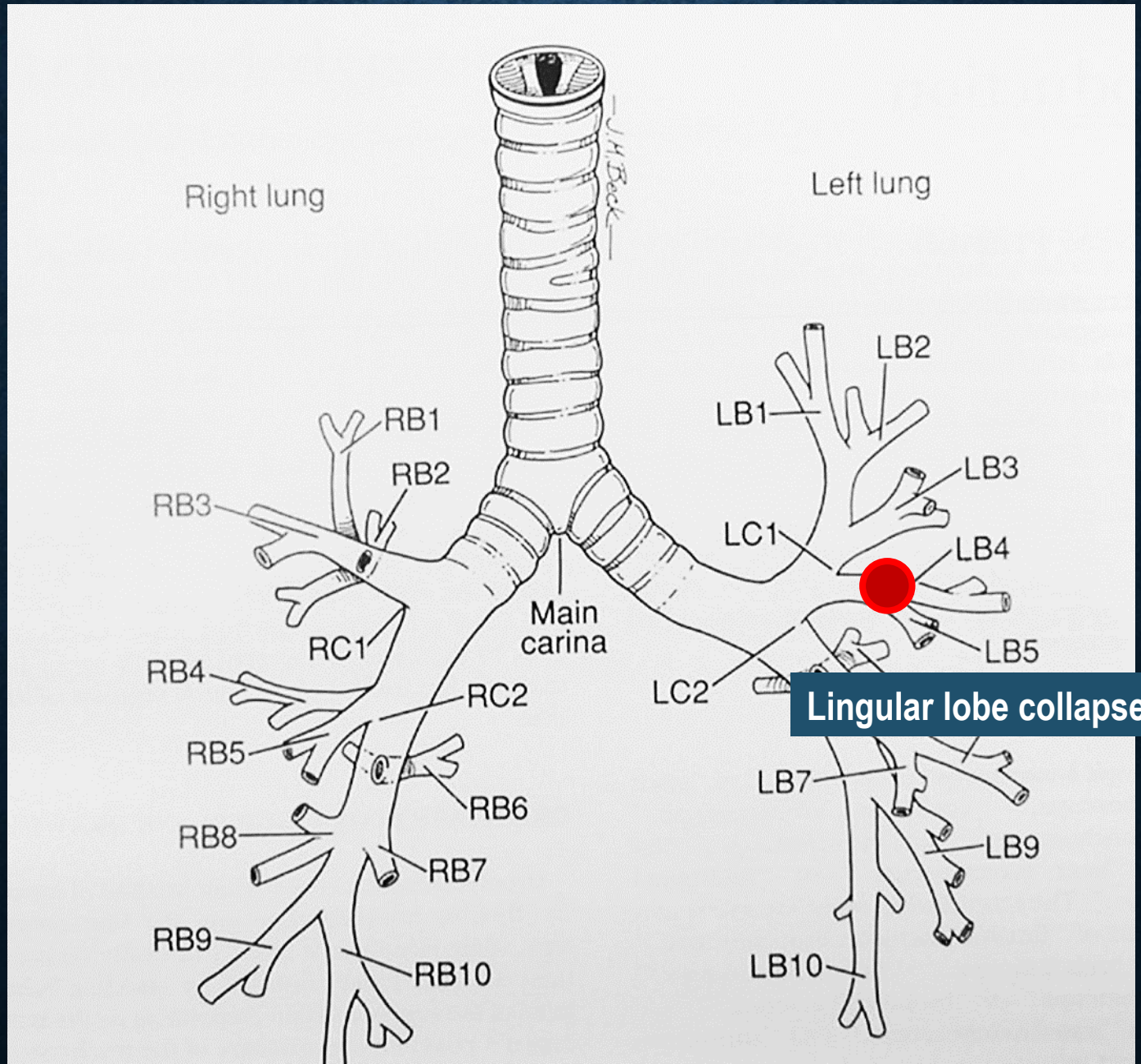
LOBAR COLLAPSE



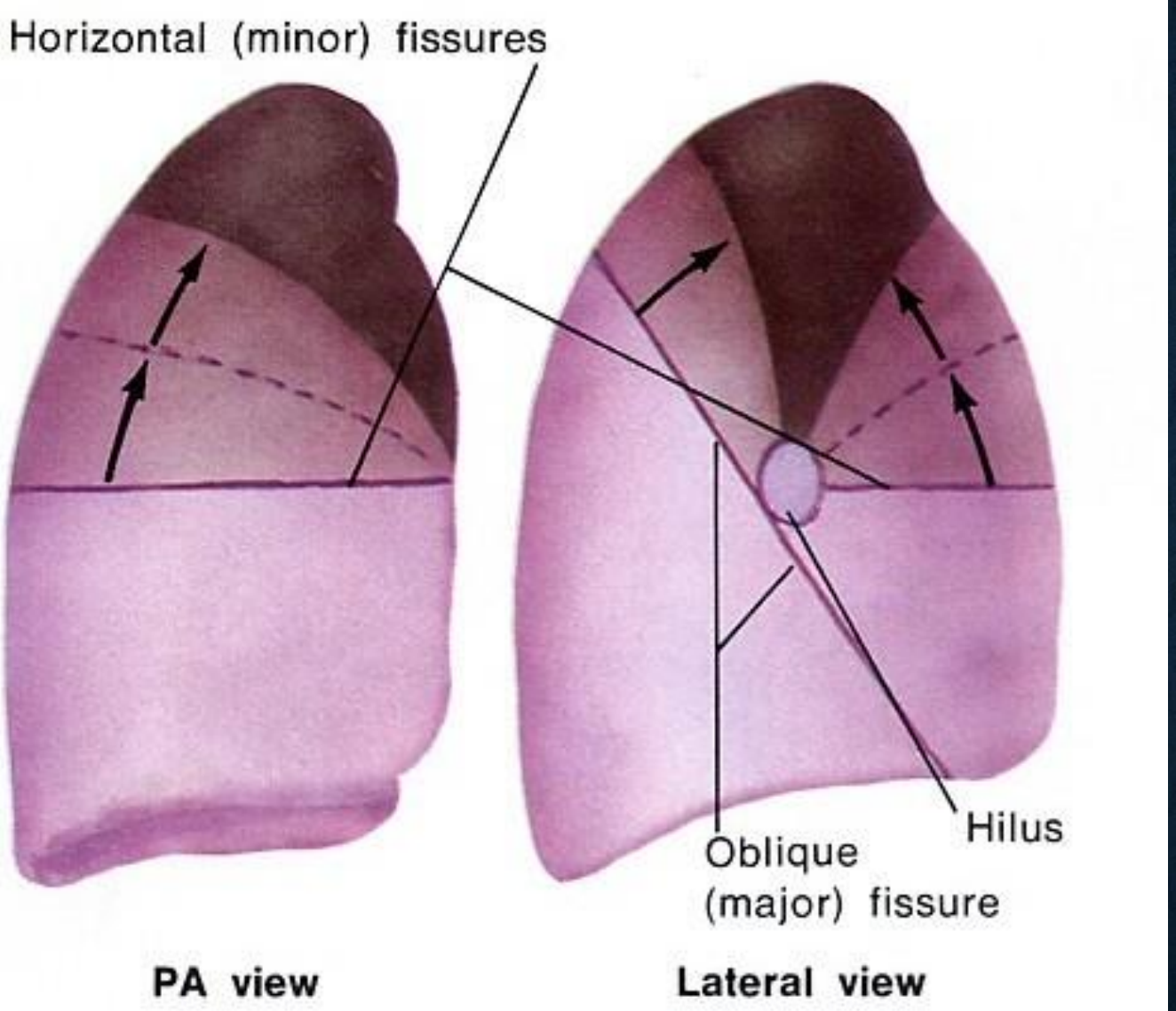
LOBAR COLLAPSE



LOBAR COLLAPSE

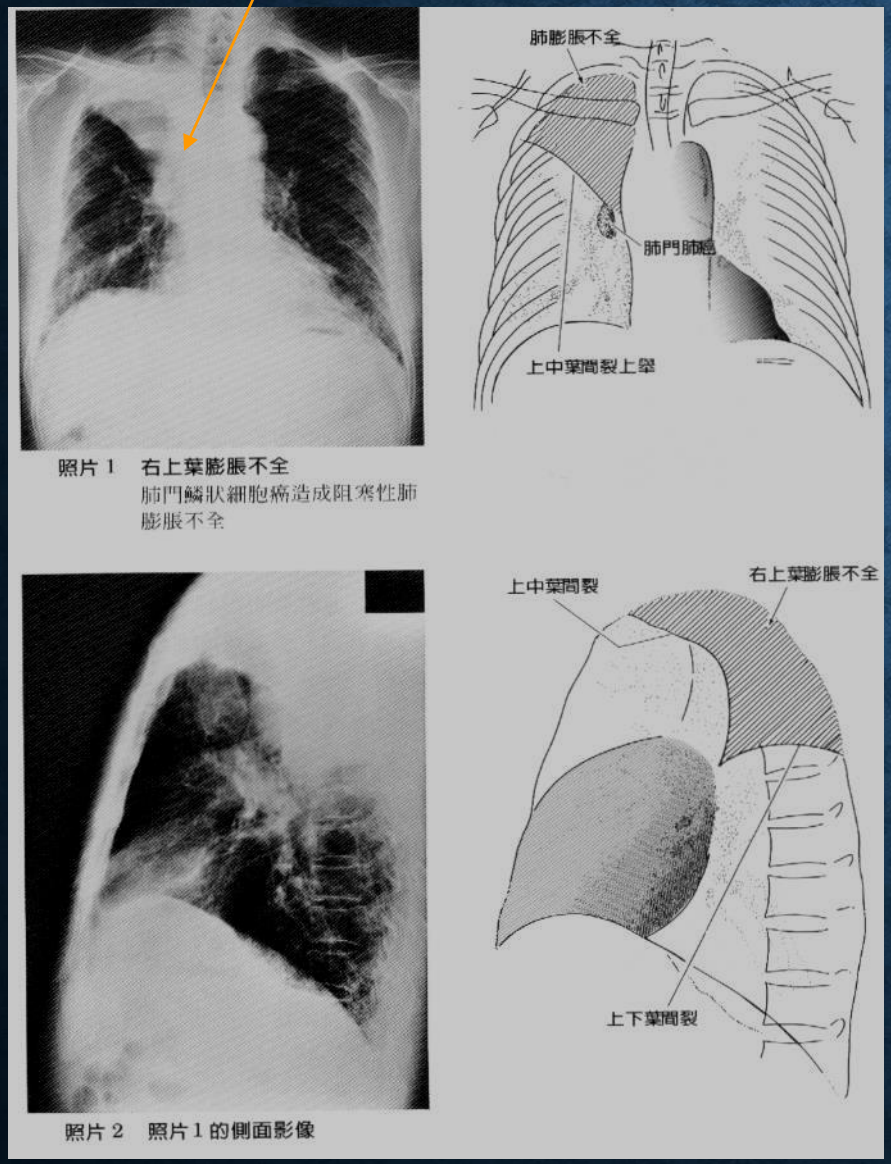



RUL Collapse

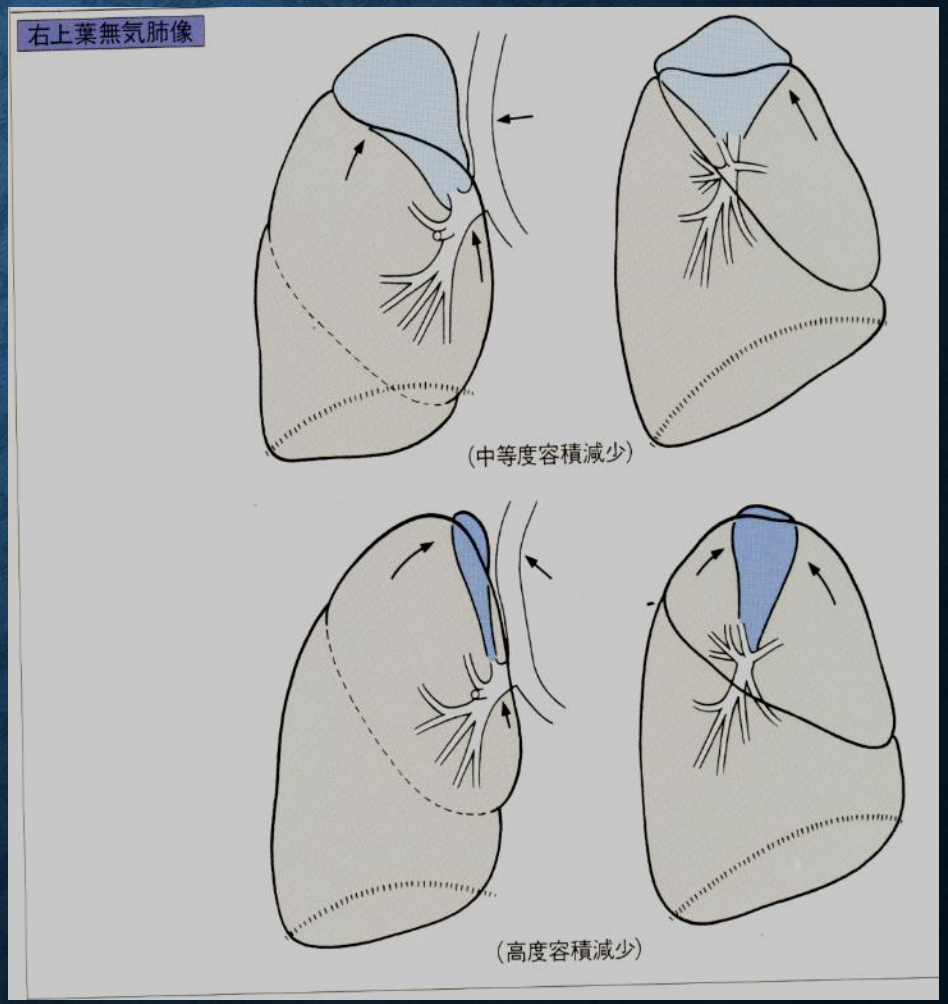


R. upper lobe collapse

Golden S sign



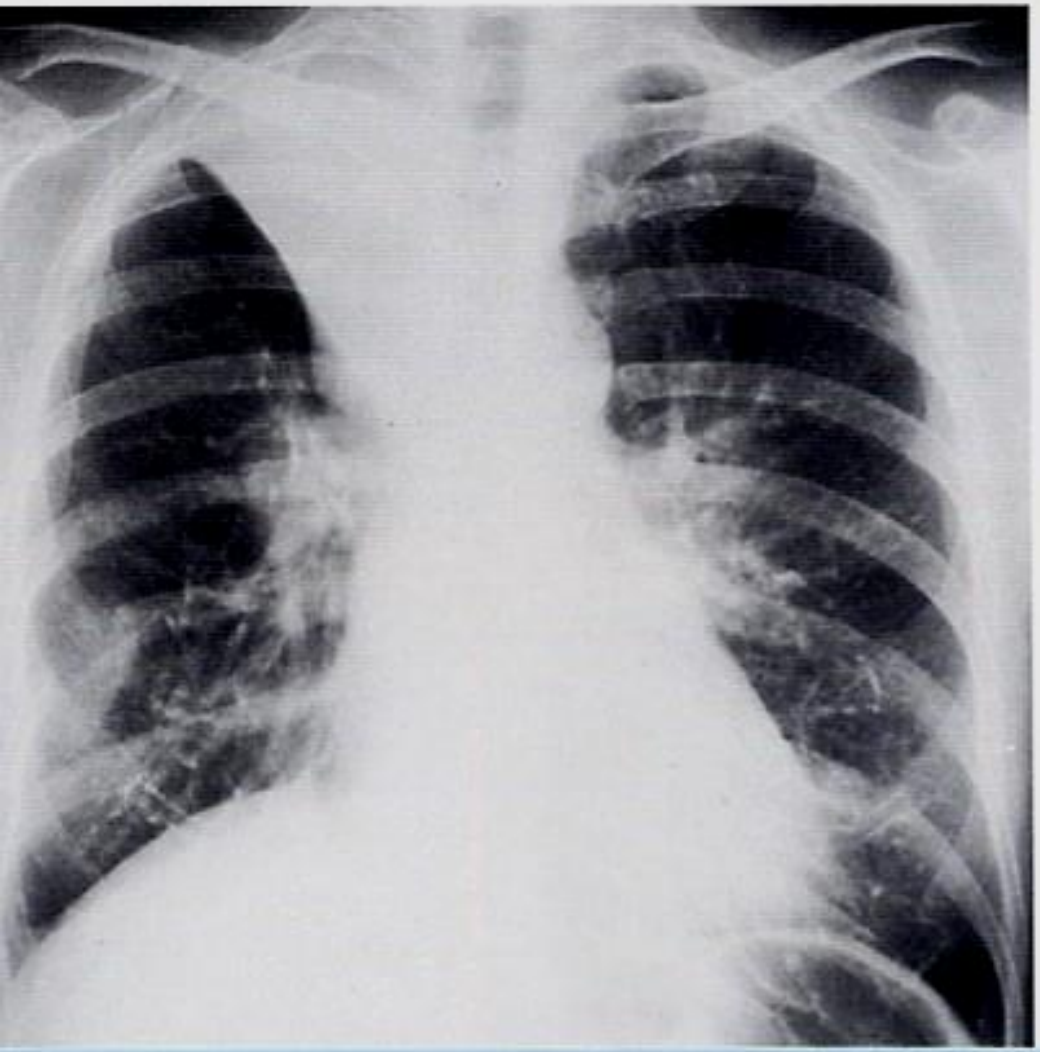
Right Upper Lobe Collapse

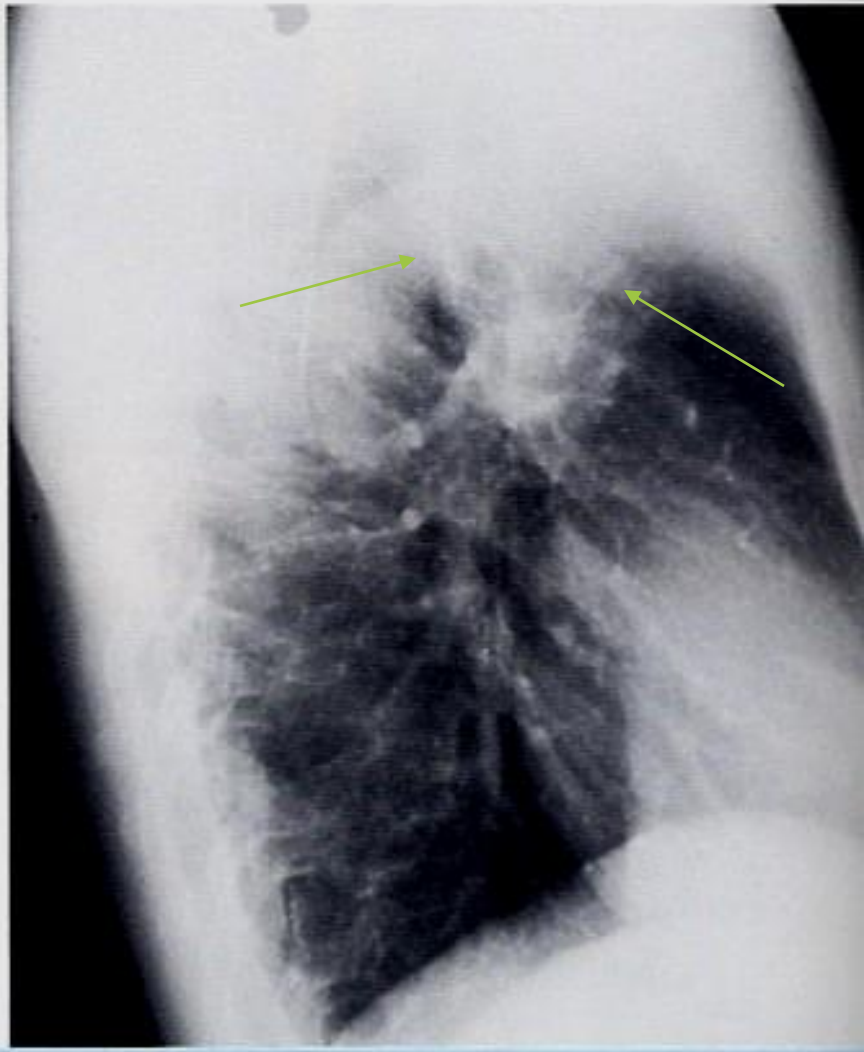


RUL COLLAPSE

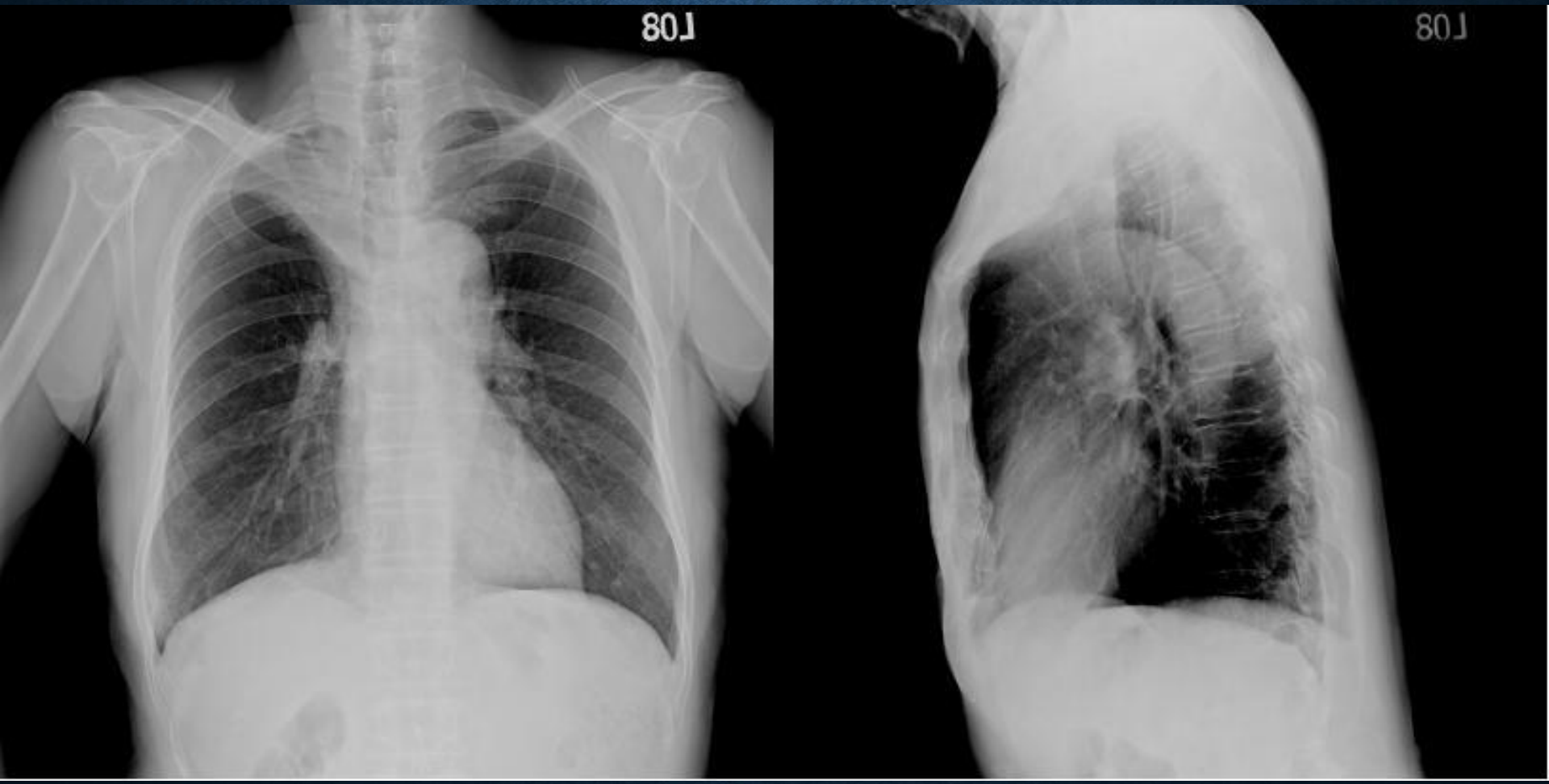
- **Elevation of minor fissure.**
- **Complete RUL collapse:**
  - Only widening of the superior mediastinum is noted
  - Indirect sign (hilum elevation) may be evident.
- **Radiologic Signs**
  - Reverse S sign (or Golden S sign)
  - Juxta-phrenic peak sign (JP sign)

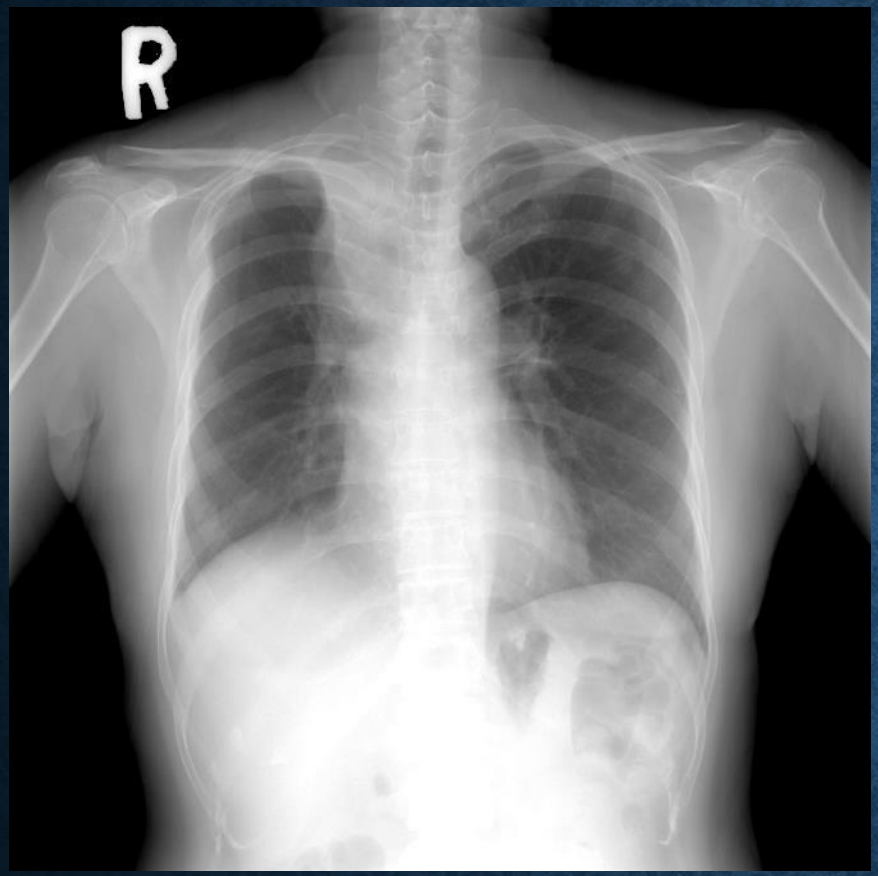
RUL COLLAPSE

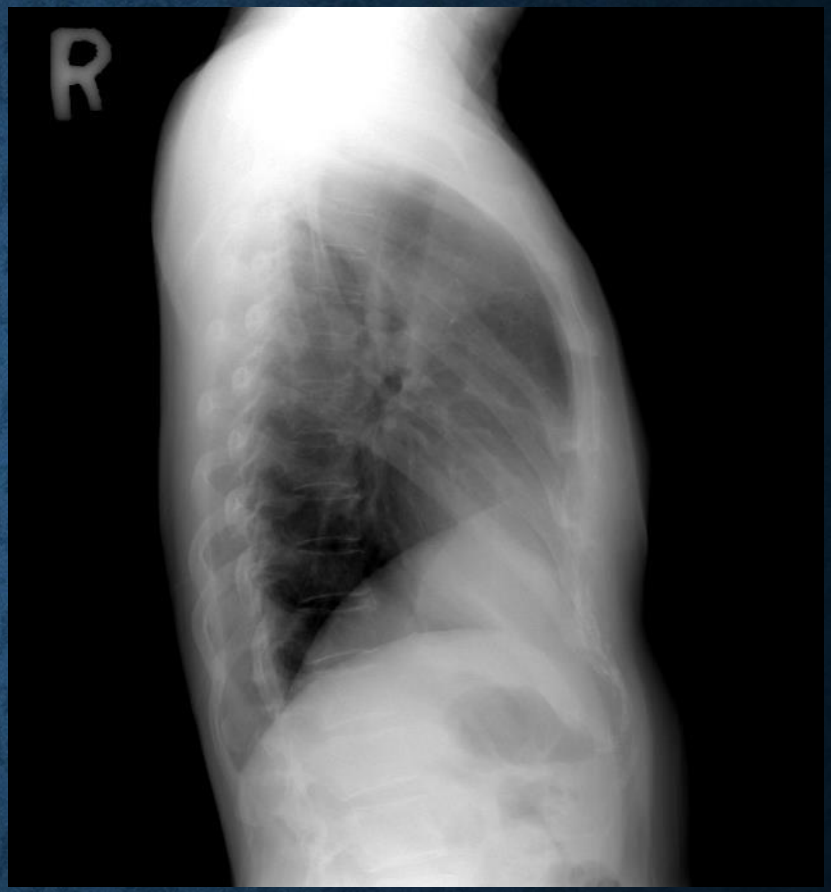




RUL COLLAPSE

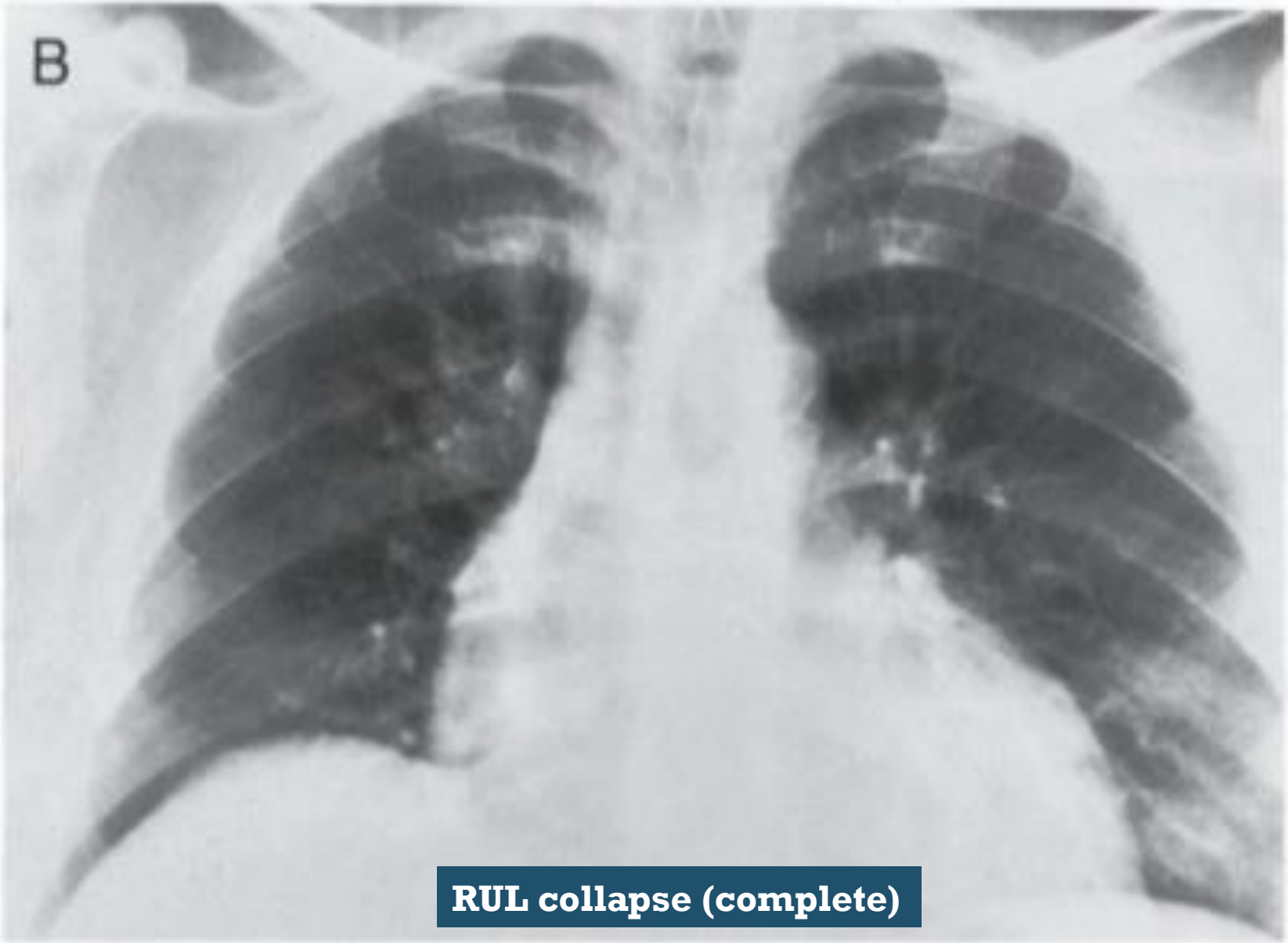






RUL collapse

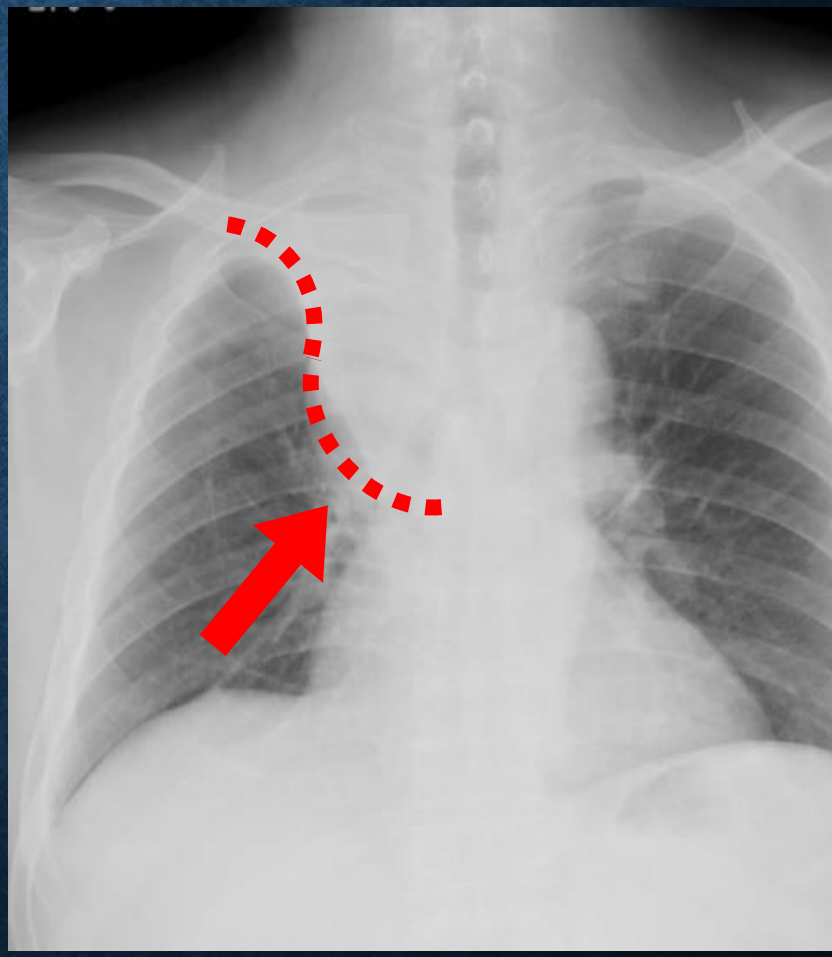
Nearly complete RUL collapse

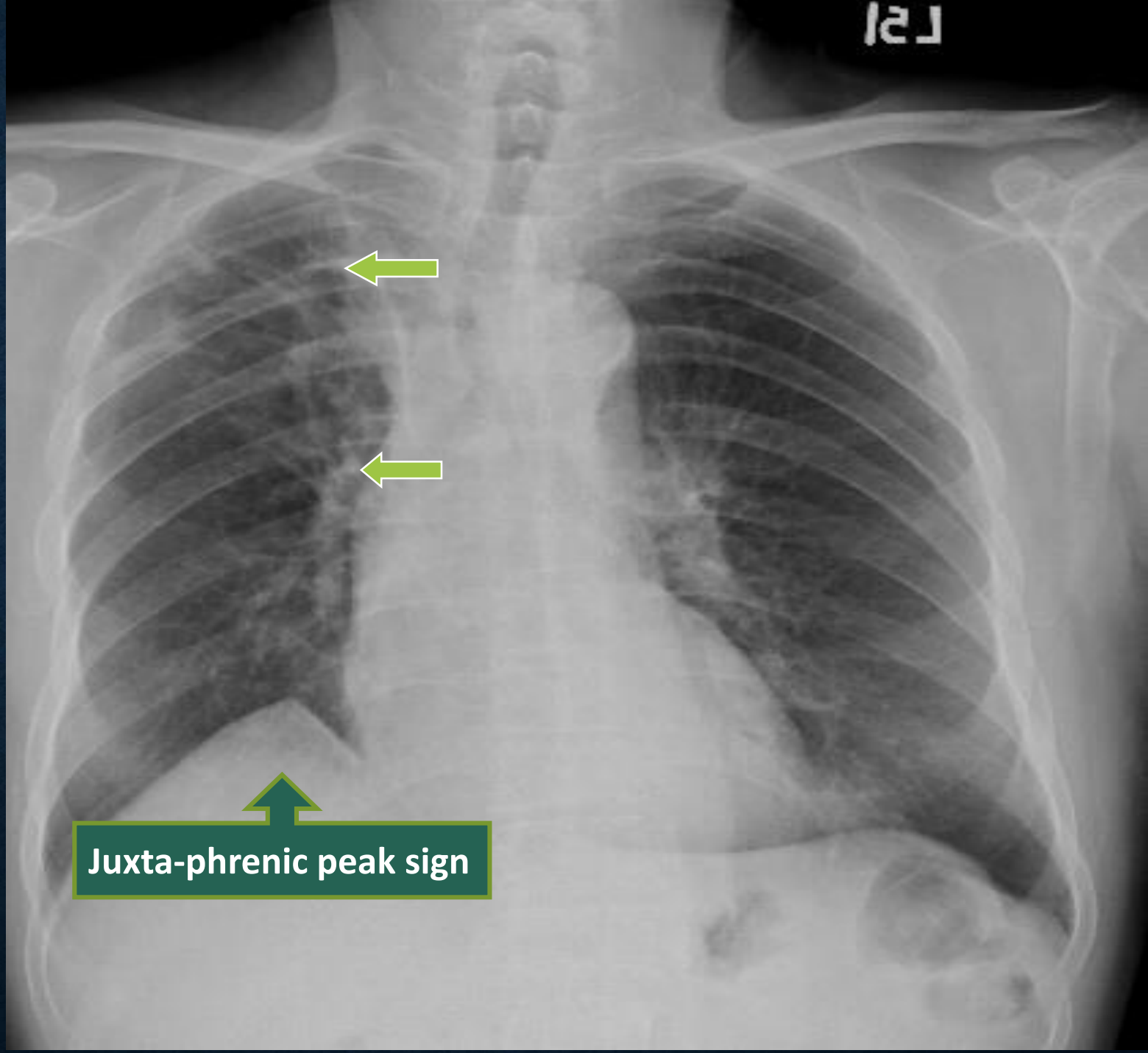


RUL collapse (complete)

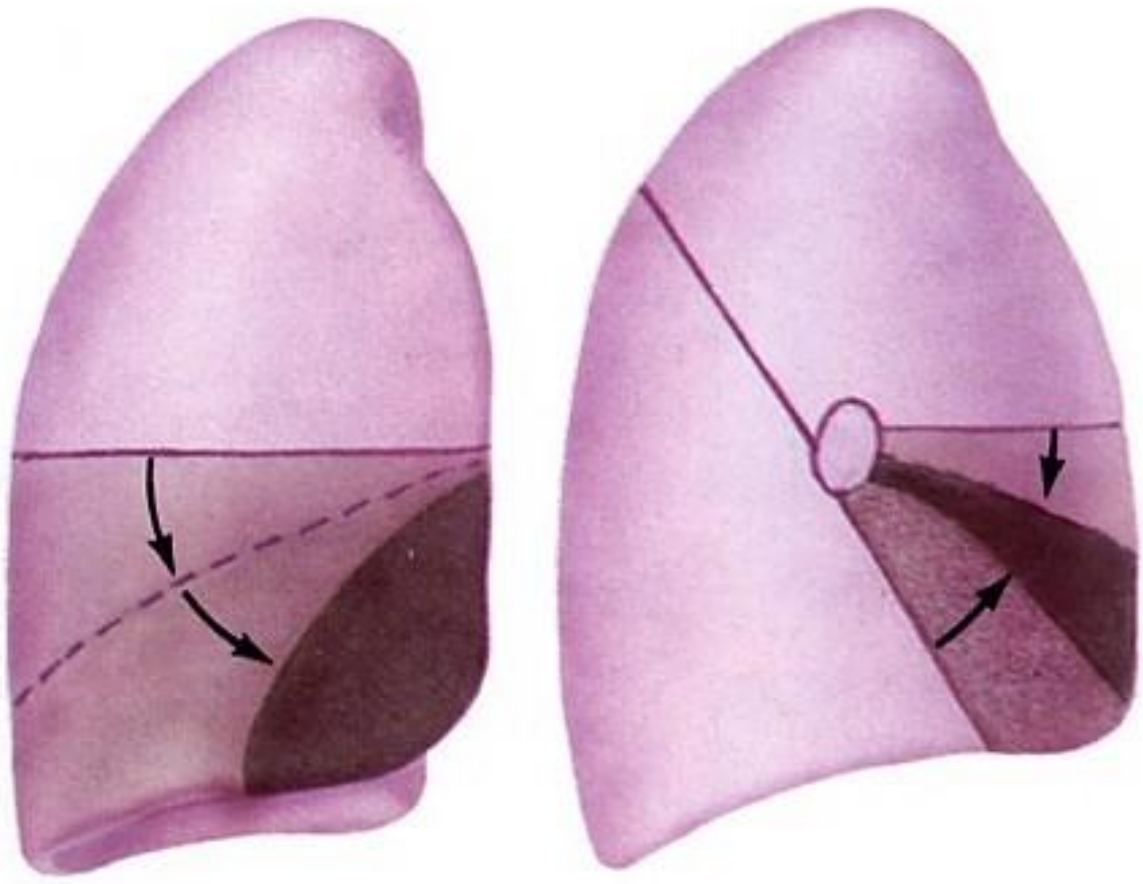
REVERSE S SIGN OF GOLDEN

- On in PA view of RUL collapse with R't hilar tumor
  - **may be bronchogenic Ca., mediastinal tumor, or enlarged LN.**
- The upper part:
  the elevated minor fissure.
- The lower part:
  the tumor mass responsible for collapse.




Juxta-phrenic peak sign


RML Collapse

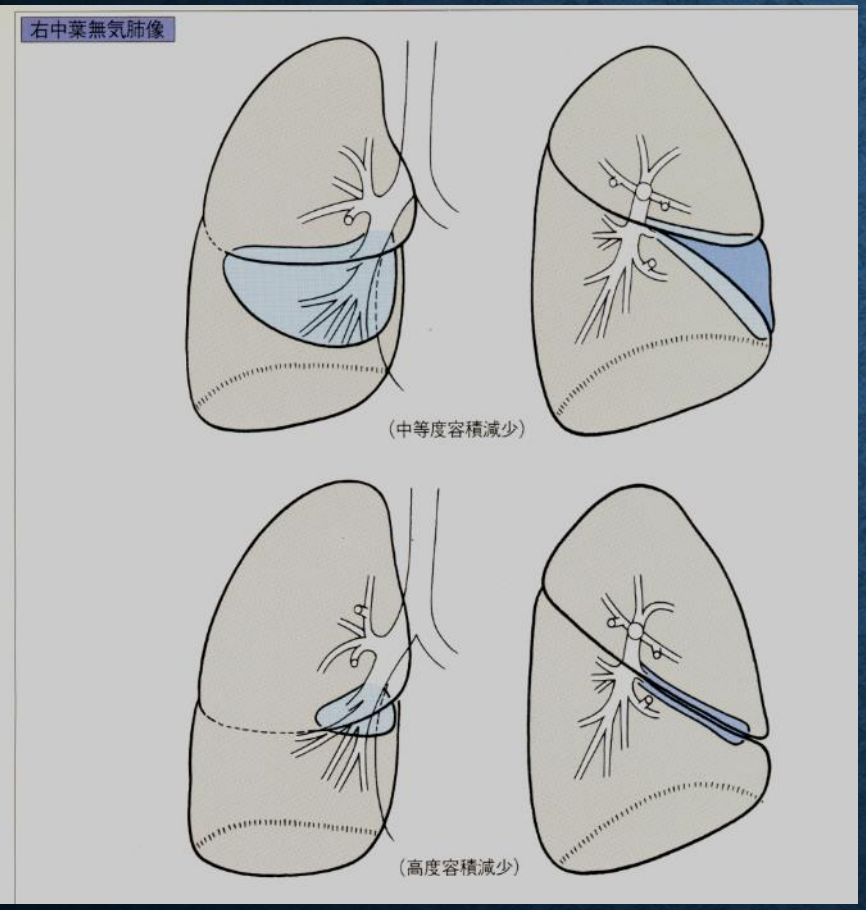


PA view

Lateral view

R. middle lobe collapse

Right Middle Lobe Collapse



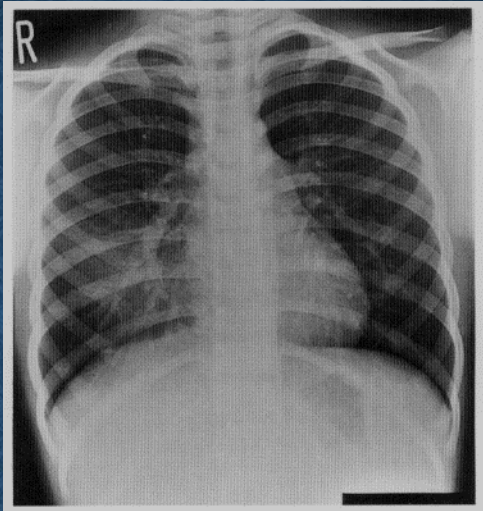
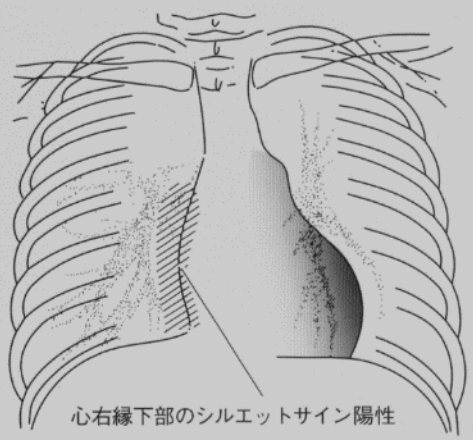


写真 3　右中葉無気肺



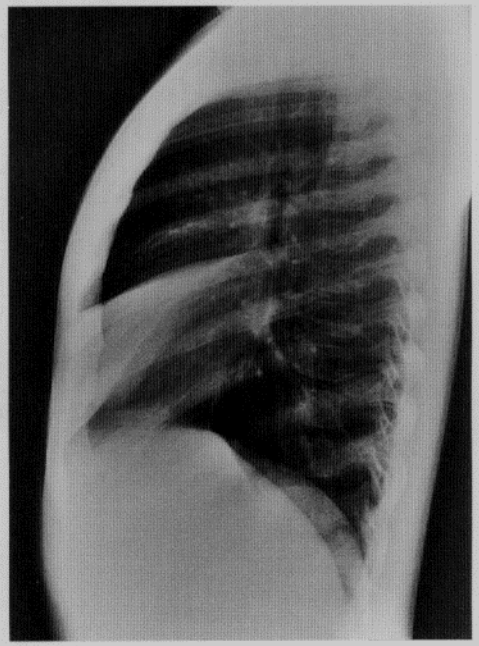
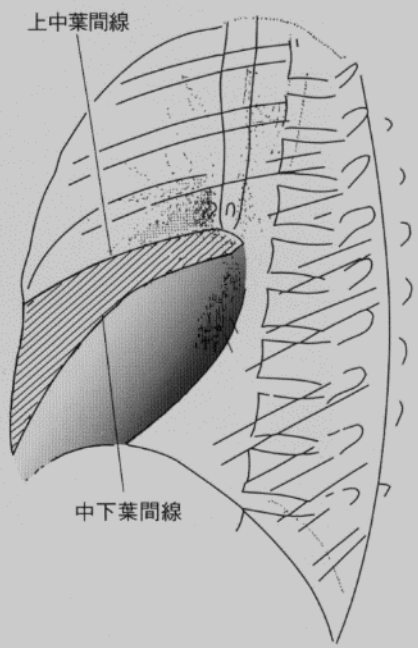
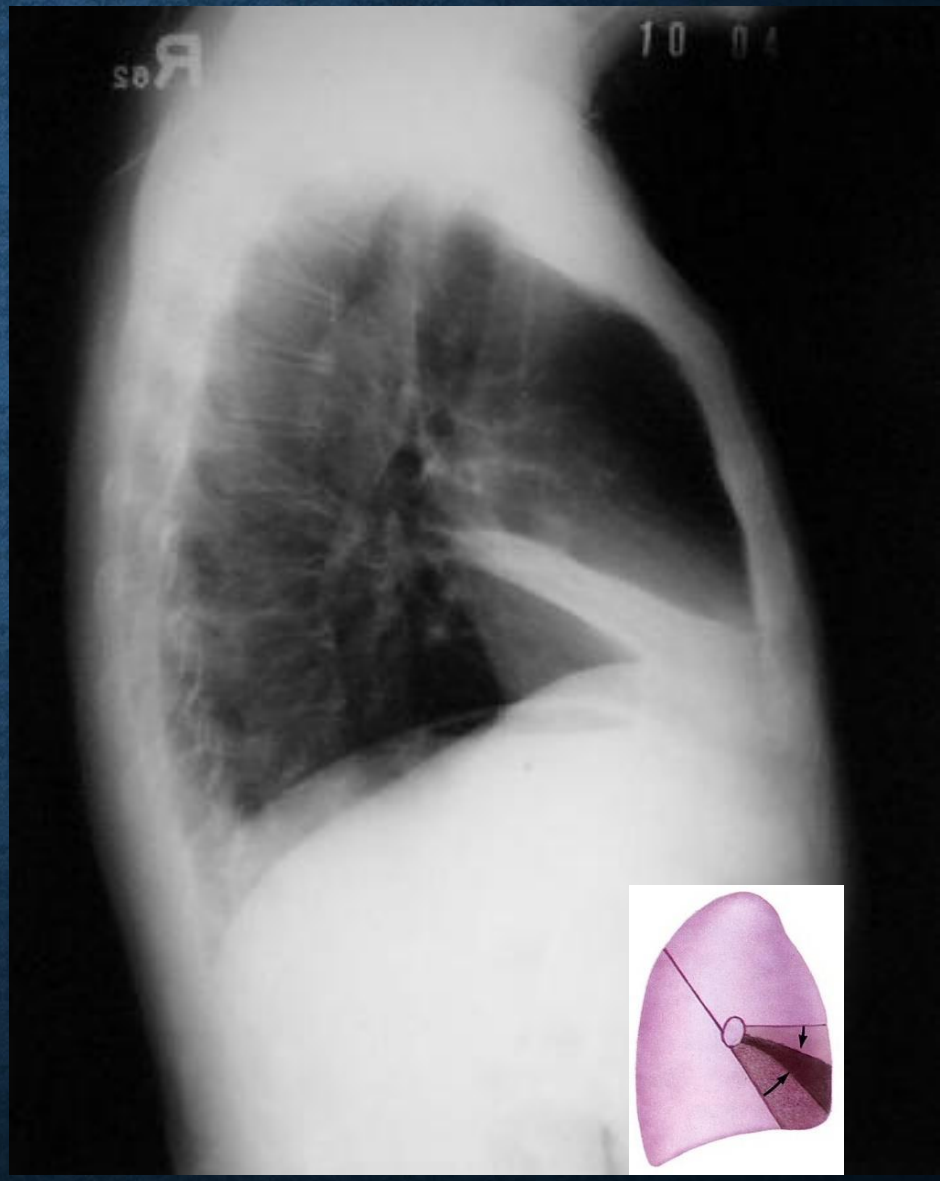


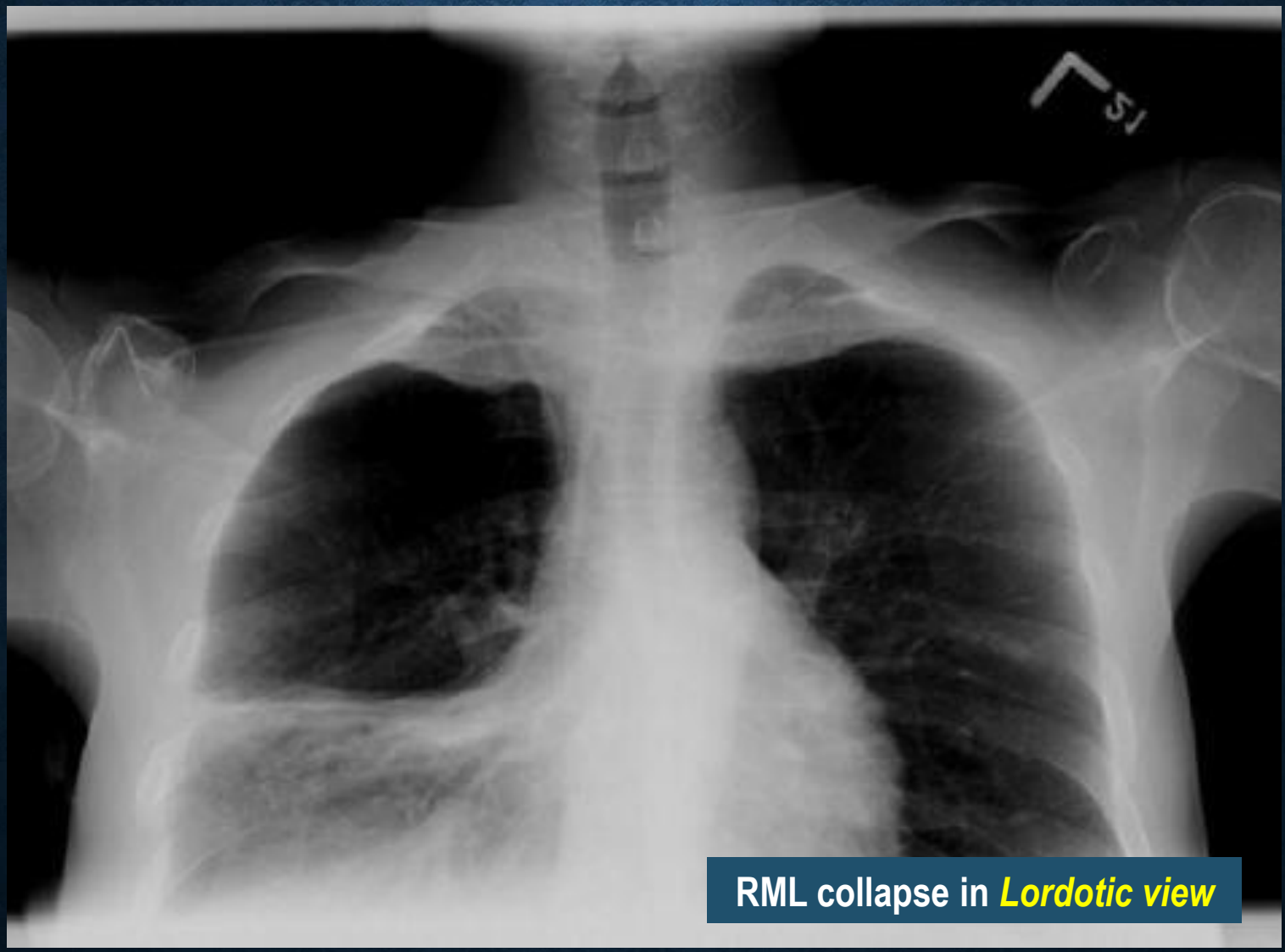
写真 4　写真 3 の側面像



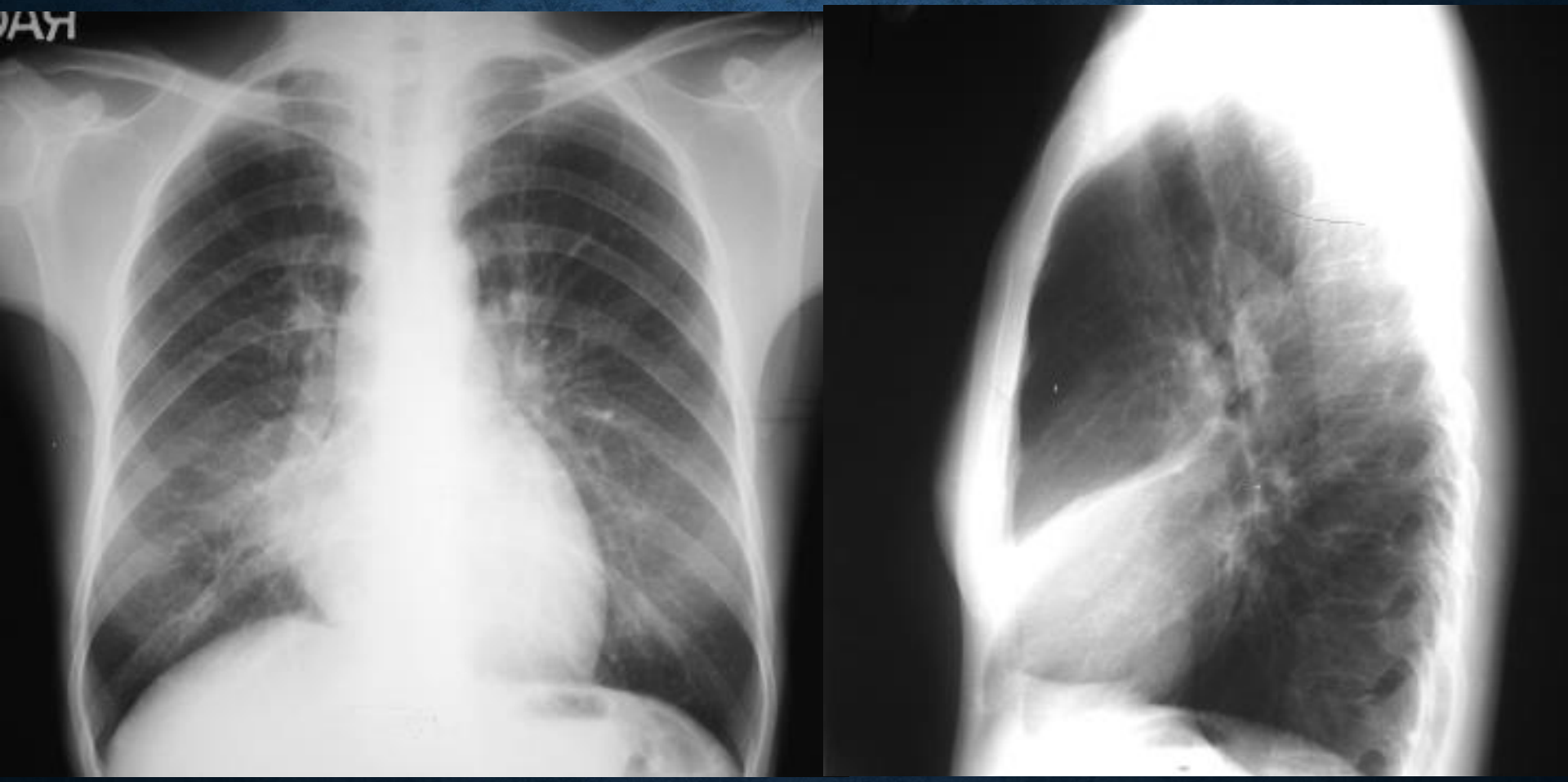
RML COLLAPSE



RML COLLAPSE



RML COLLAPSE

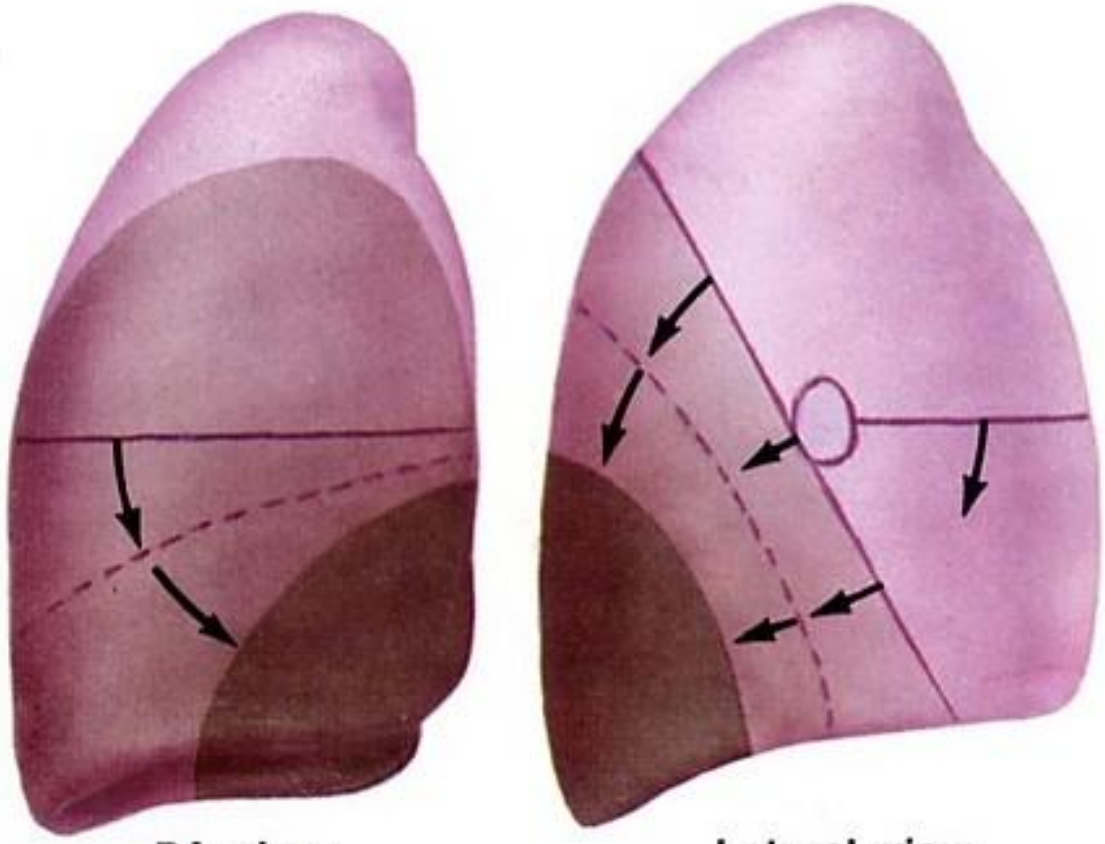


R't heart border is obscure

RML ATELECTASIS


RLL Collapse

F. Netter M.D.
© CIBA

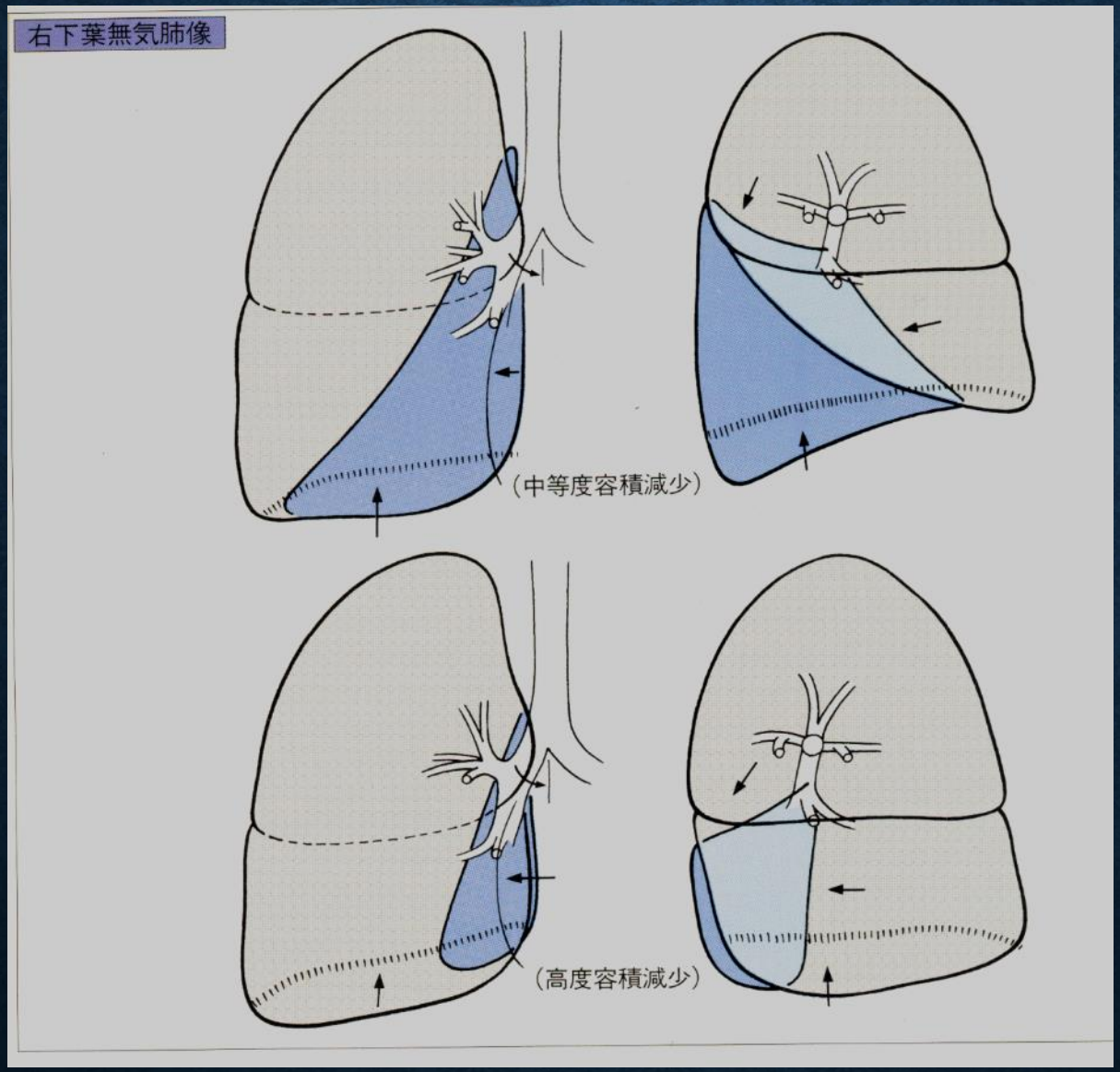


PA view

Lateral view

R. lower lobe collapse

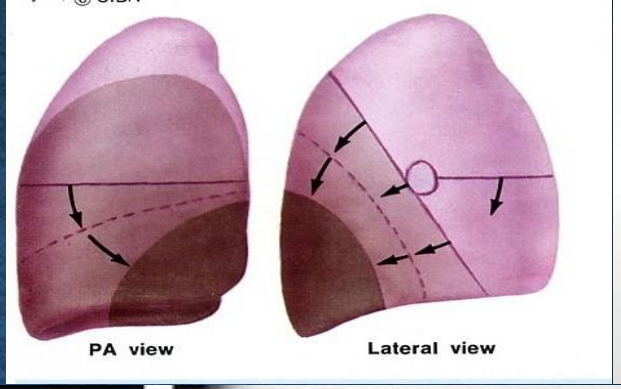
RLL Collapse

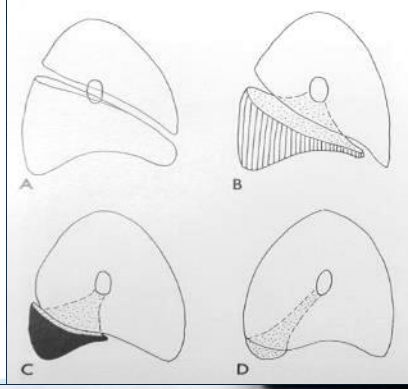


RLL COLLAPSE

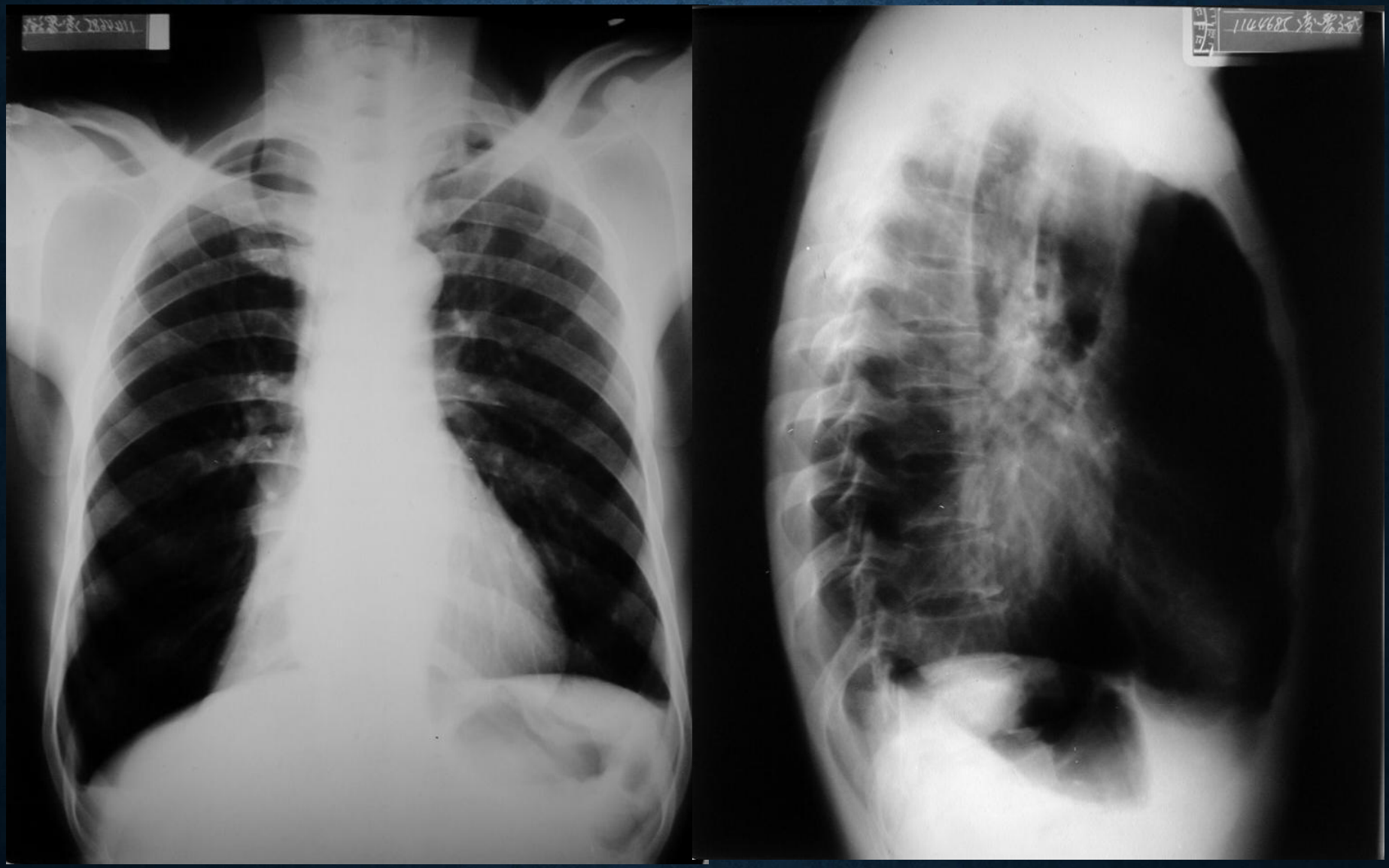
- Increased density in the R't lower thorax
- R't heart border is visible
- Inferior and medial shift of the major fissure
  - The major fissure may become visible on PA view
- The R't interlobar artery may be obscure
- Obscured IVC in lateral view

RLL COLLAPSE

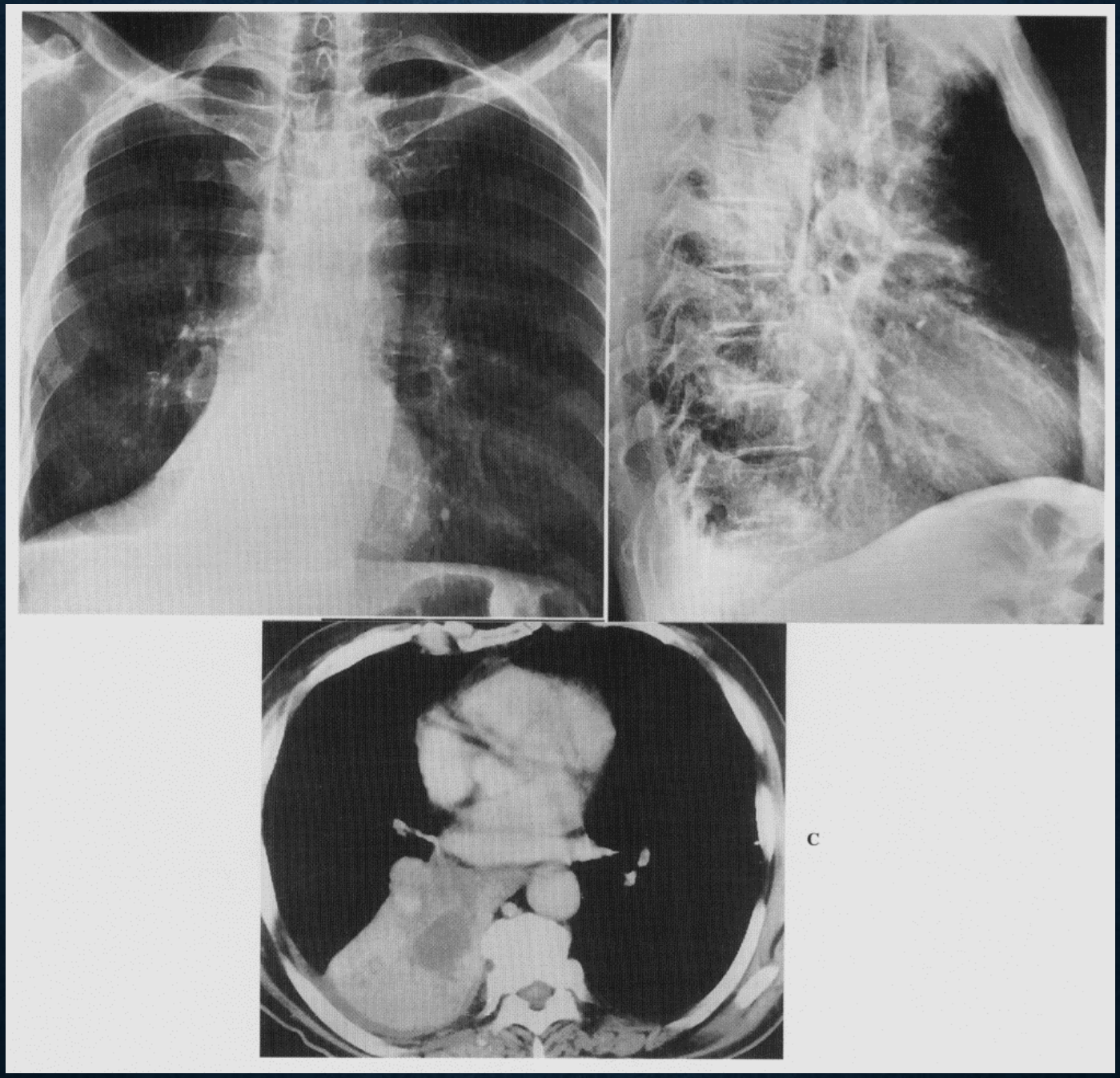




RLL COLLAPSE



RLL ATELECTASIS

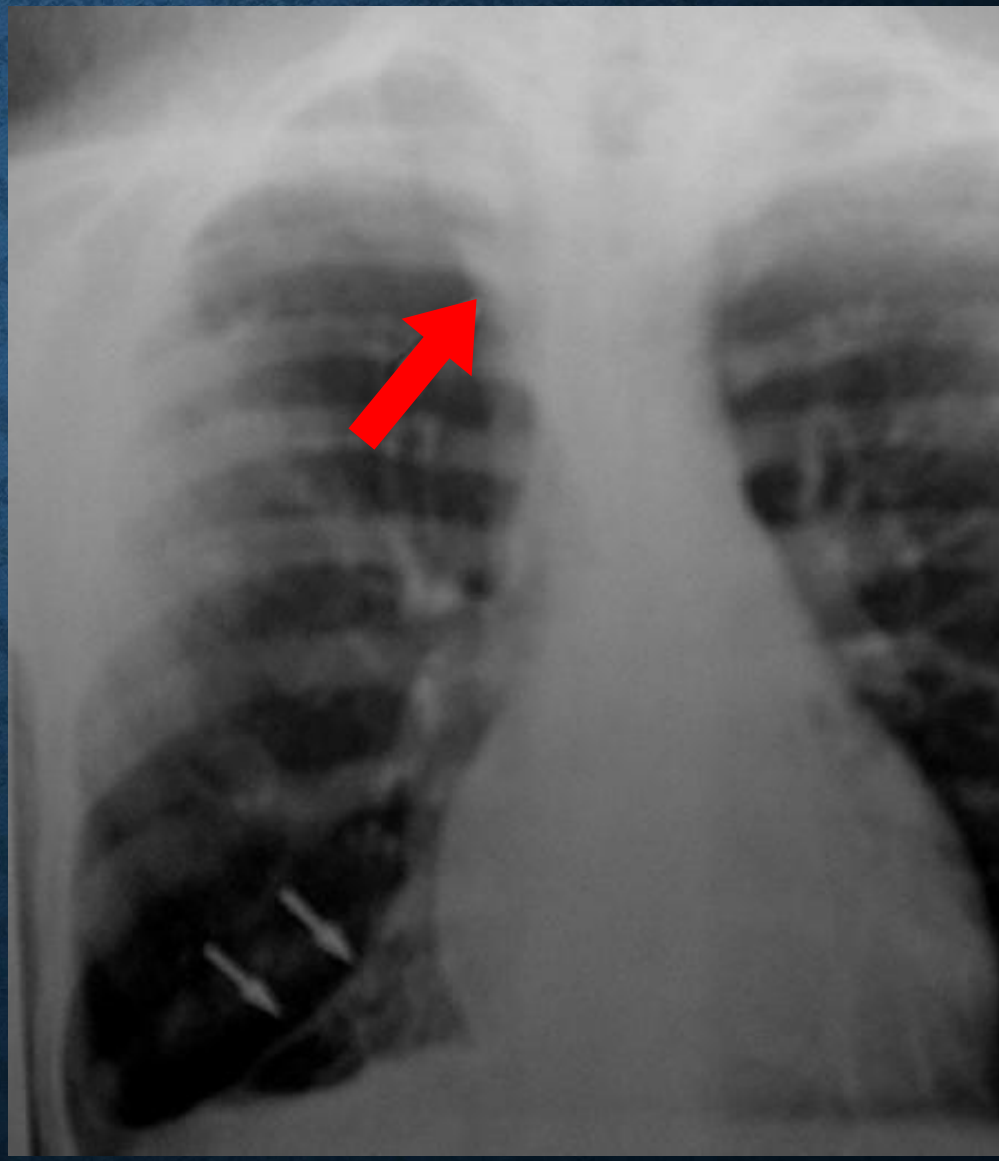


C

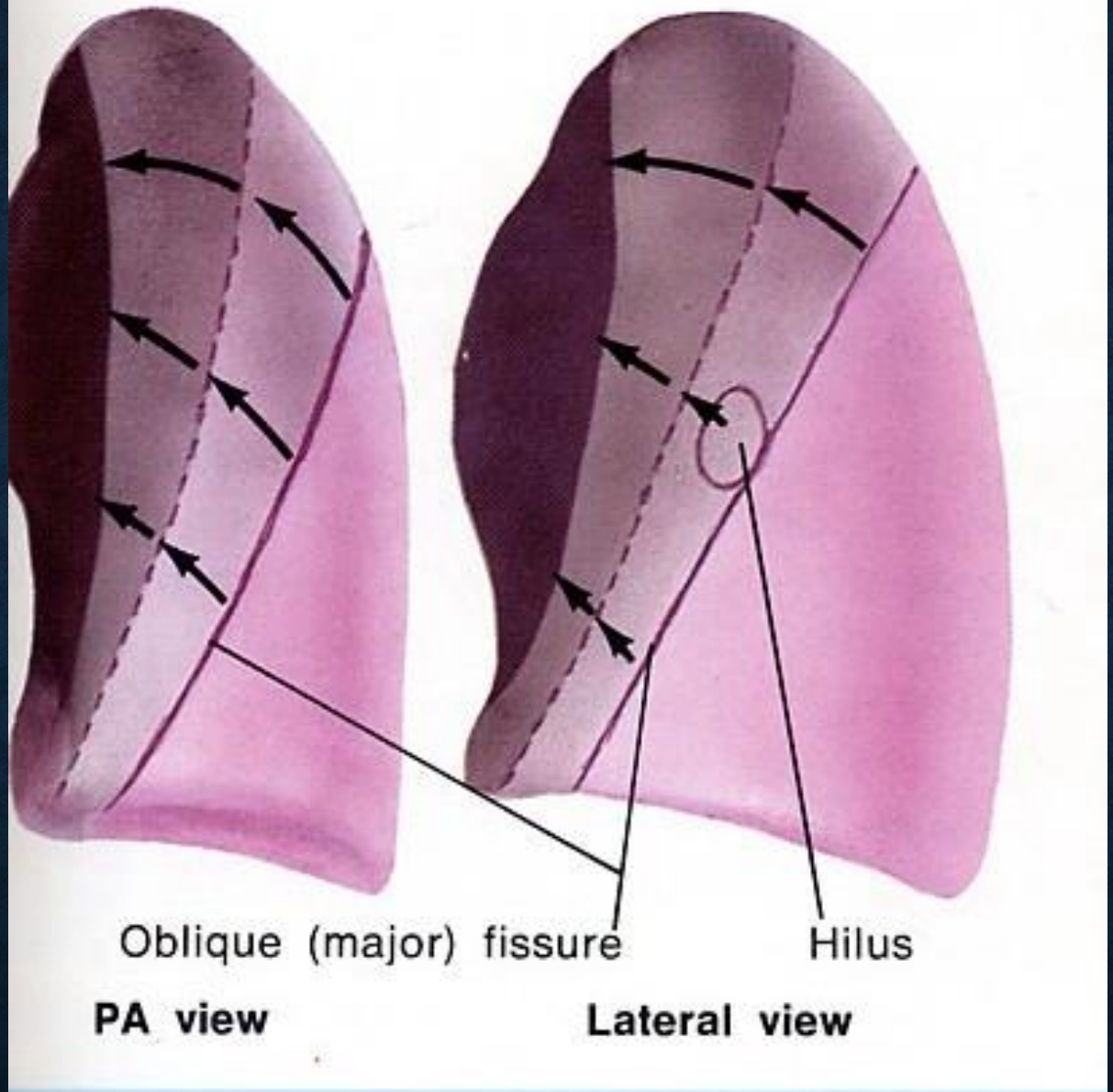
Image of Disease of the CHEST, Armstrong P. 3rd edition

UPPER TRIANGLE SIGN (RLL COLLAPSE)

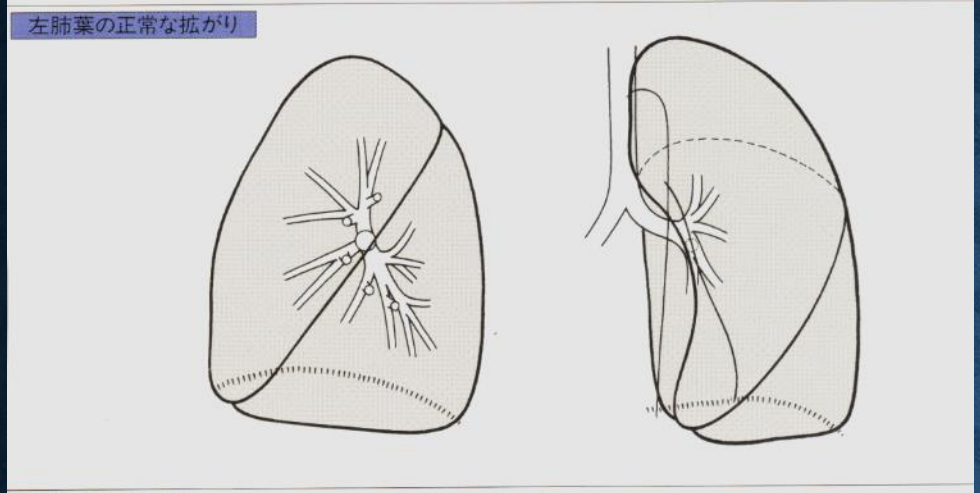
- **Superior mediastinal shift to Rt. in RLL collapse: the "*upper triangle sign*"**
- **In some patients with RLL collapse, a triangular shadow was seen in the right upper lung field, continuous with the mediastinum and with its apex pointing toward the right hilus.**
- **This represents a shift of the upper anterior mediastinum to the right and may be mistaken for RUL collapse**

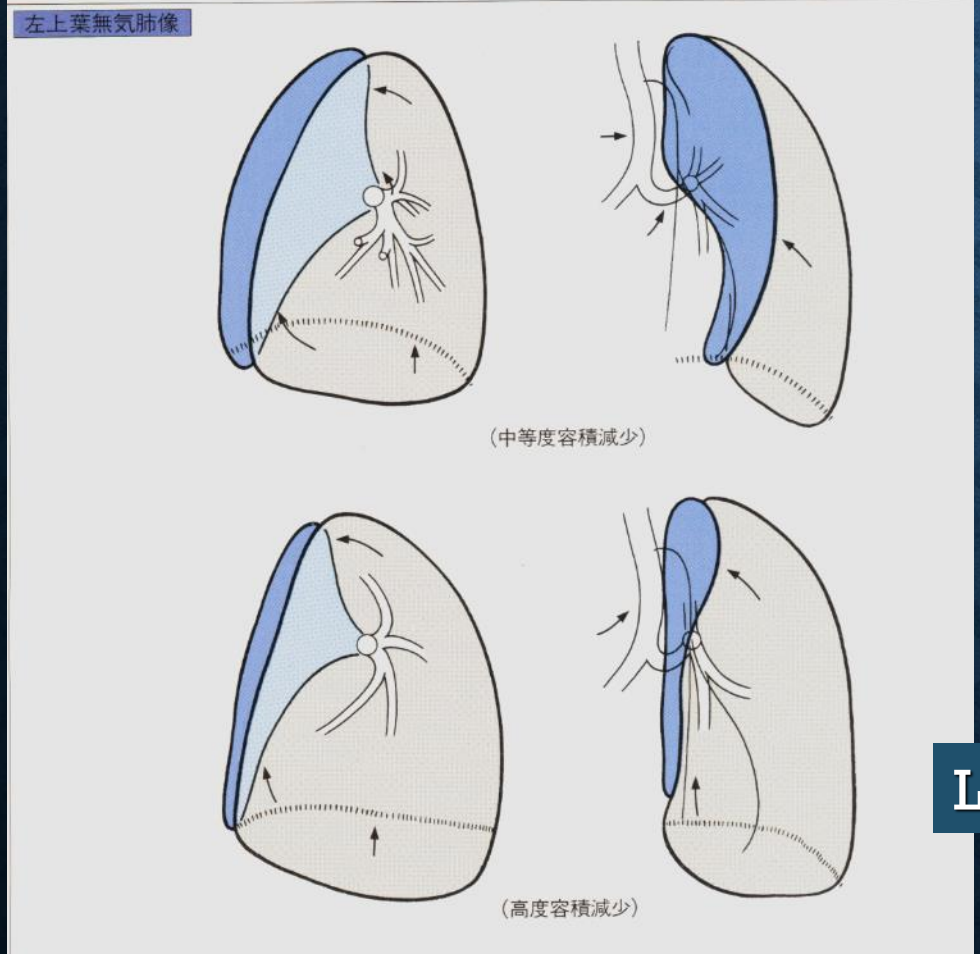



LUL Collapse



L. upper lobe collapse

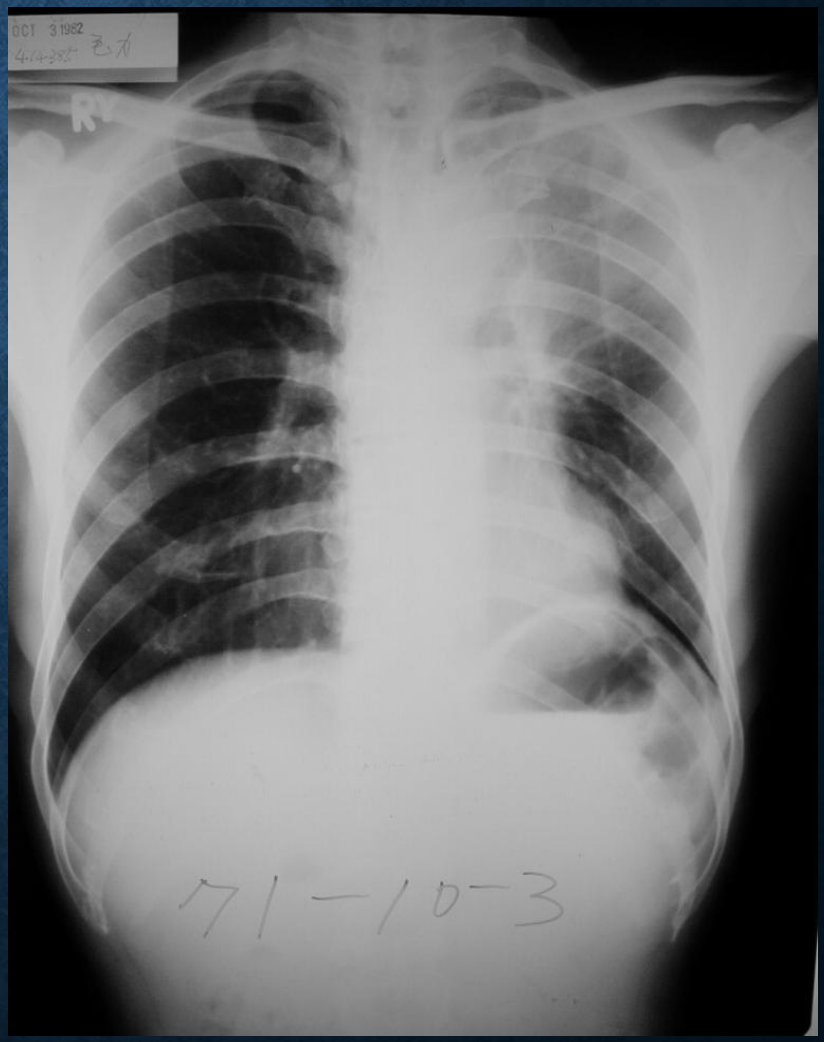




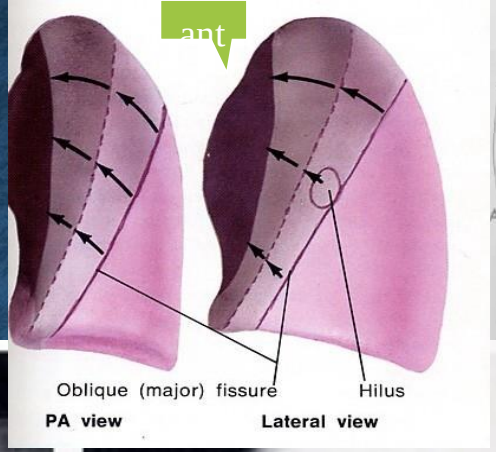
Left Upper Lobe Collapse

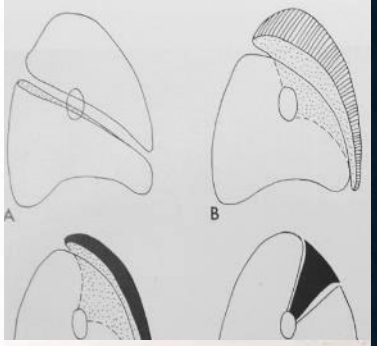
LUL COLLAPSE

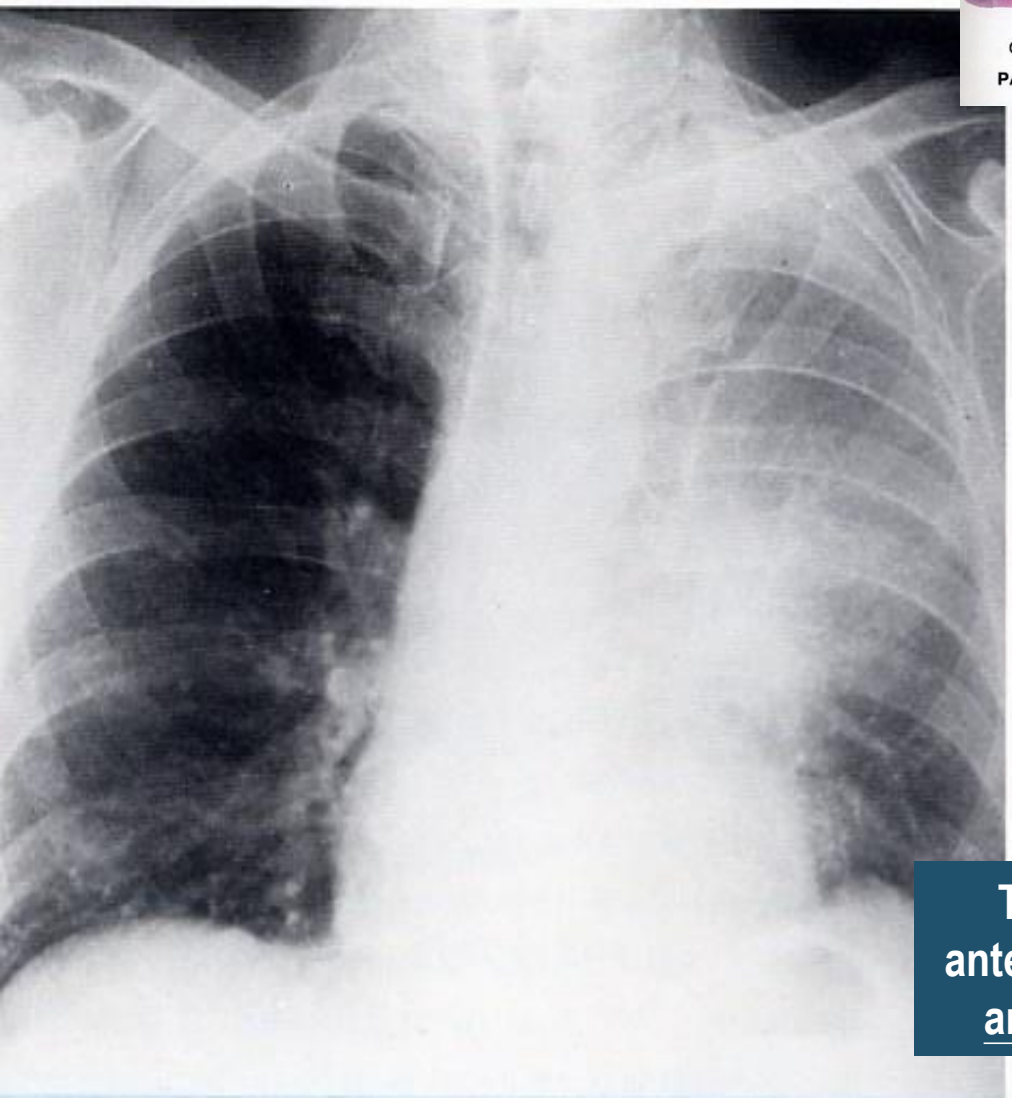
- Moderate opacity of medial portion of L't lung with lateral margin blending into normal lung density
  - Does not have a sharply defined border
- **Aortic knob** and **upper part of L't heart border** may be obliterated by airless lung
- **Luftsichel sign**

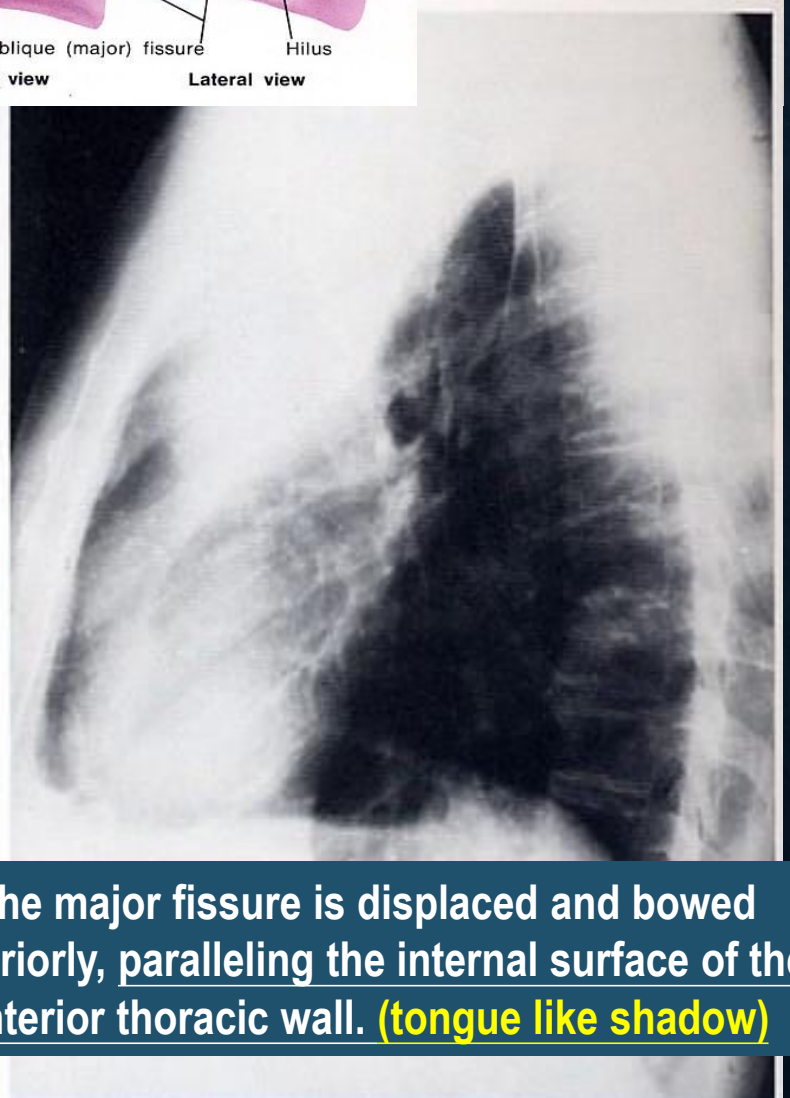


LUL COLLAPSE

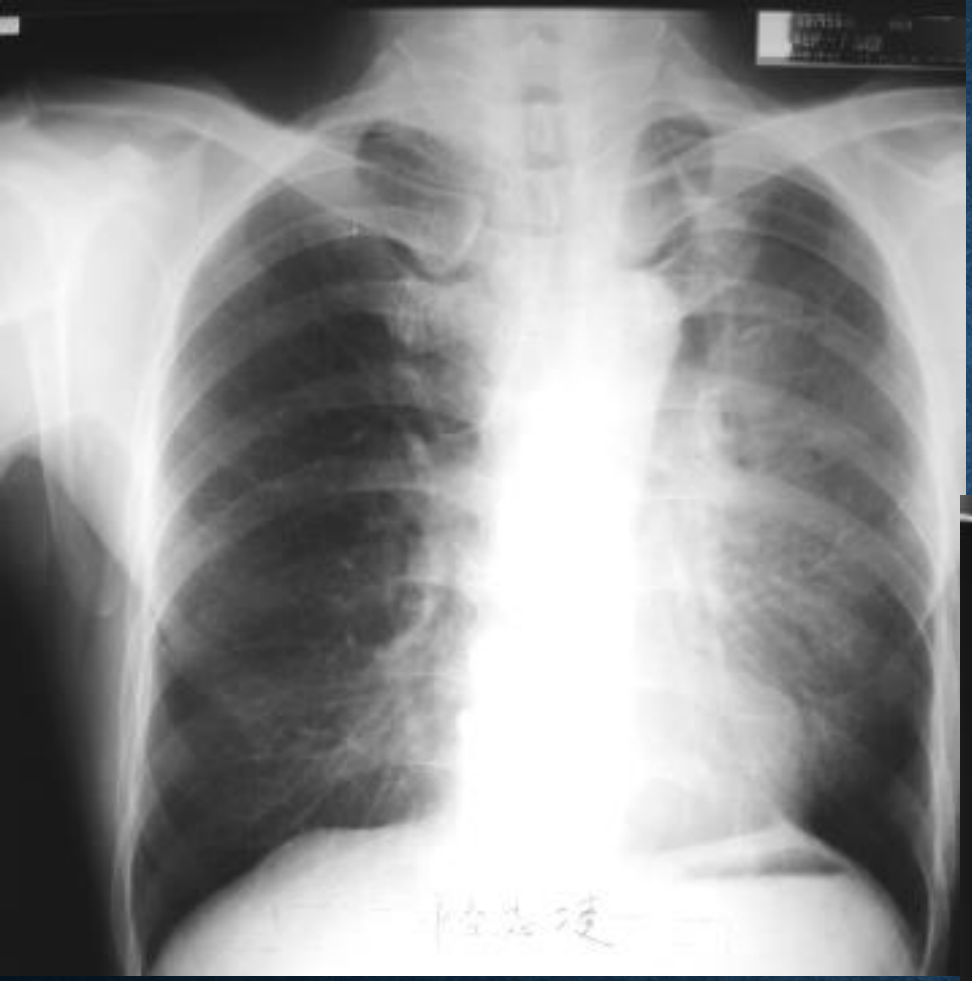




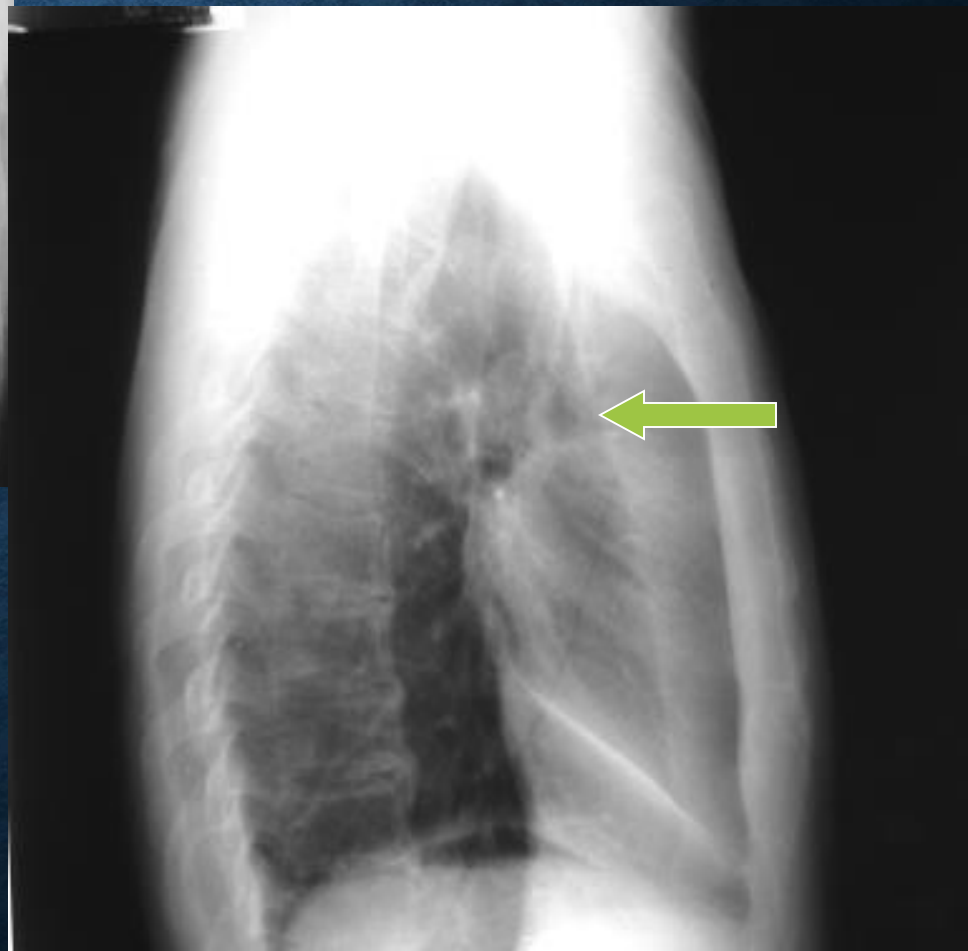




The major fissure is displaced and bowed anteriorly, paralleling the internal surface of the anterior thoracic wall. (tongue like shadow)

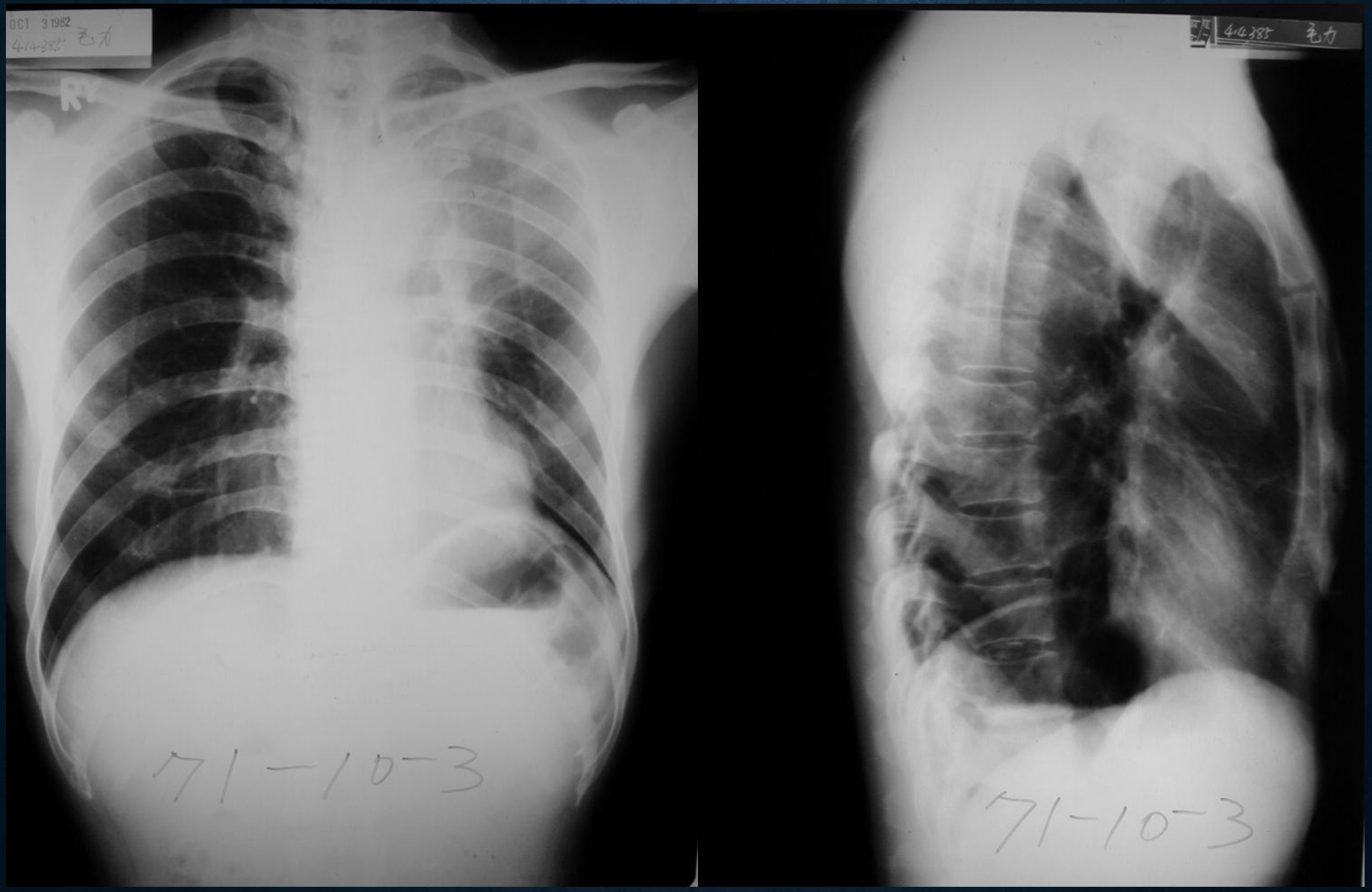


Ground-glass shadow on left upper lung field

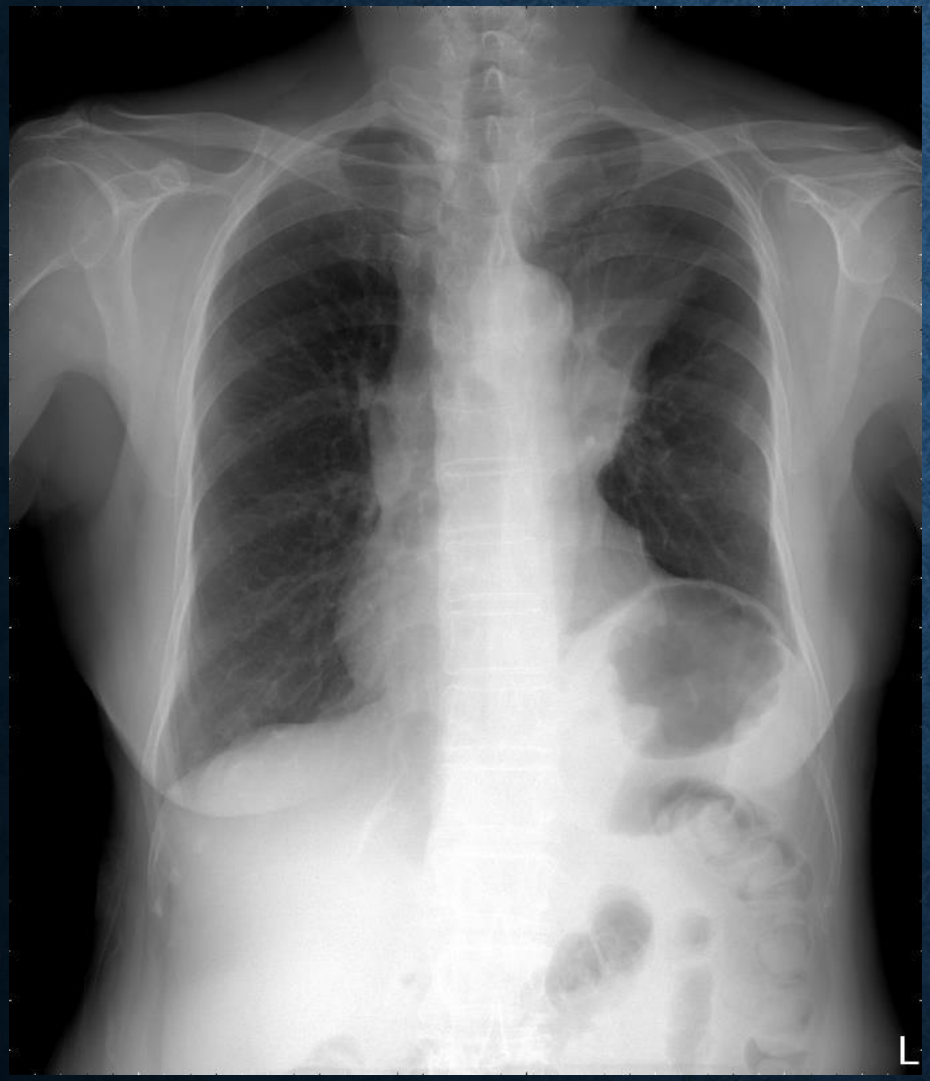


Forward displacement of major fissure LUL collapse

LUL COLLAPSE

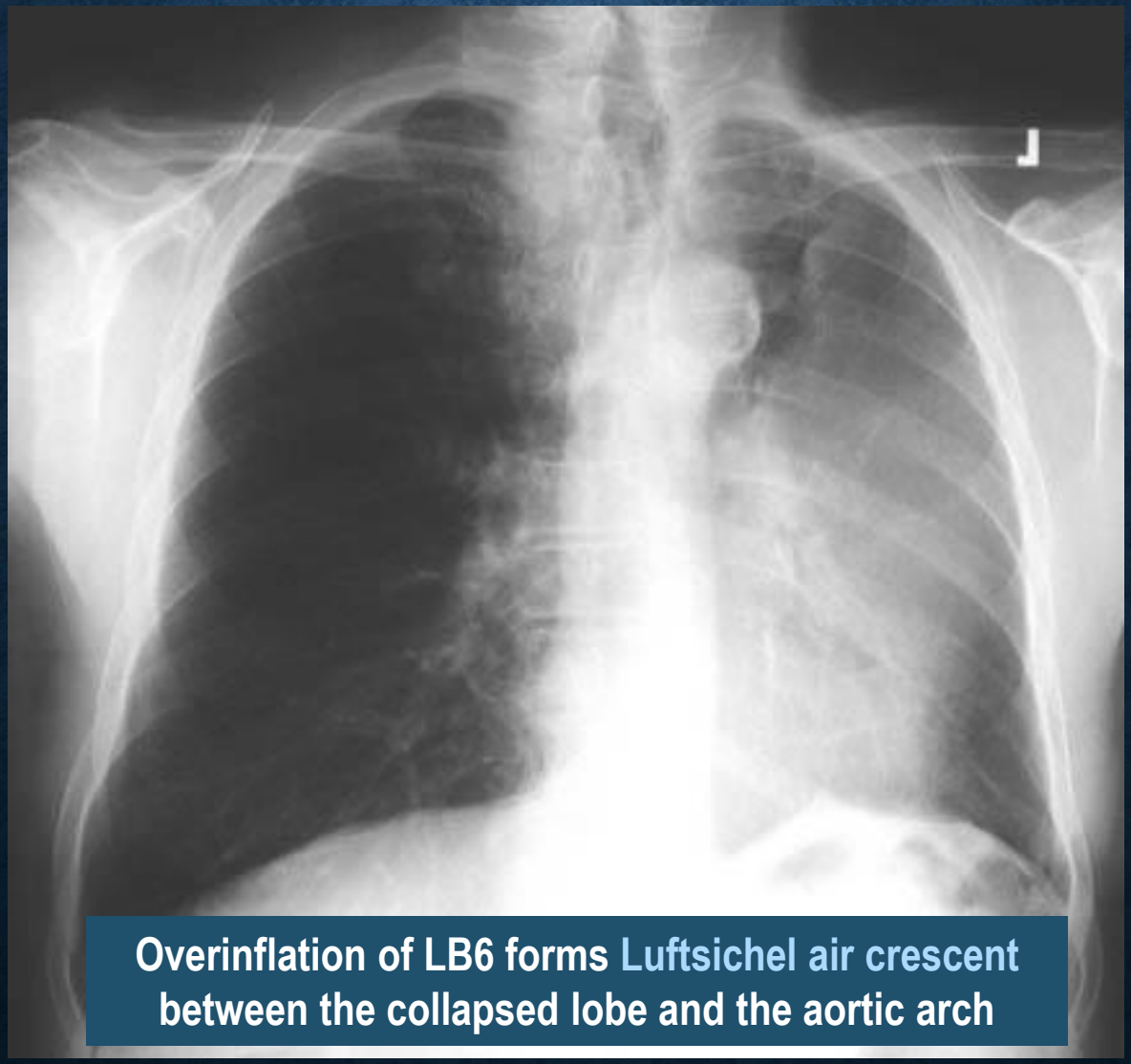


LUL UPPER DIVISION ATELECTASIS



LUFTSICHEL SIGN

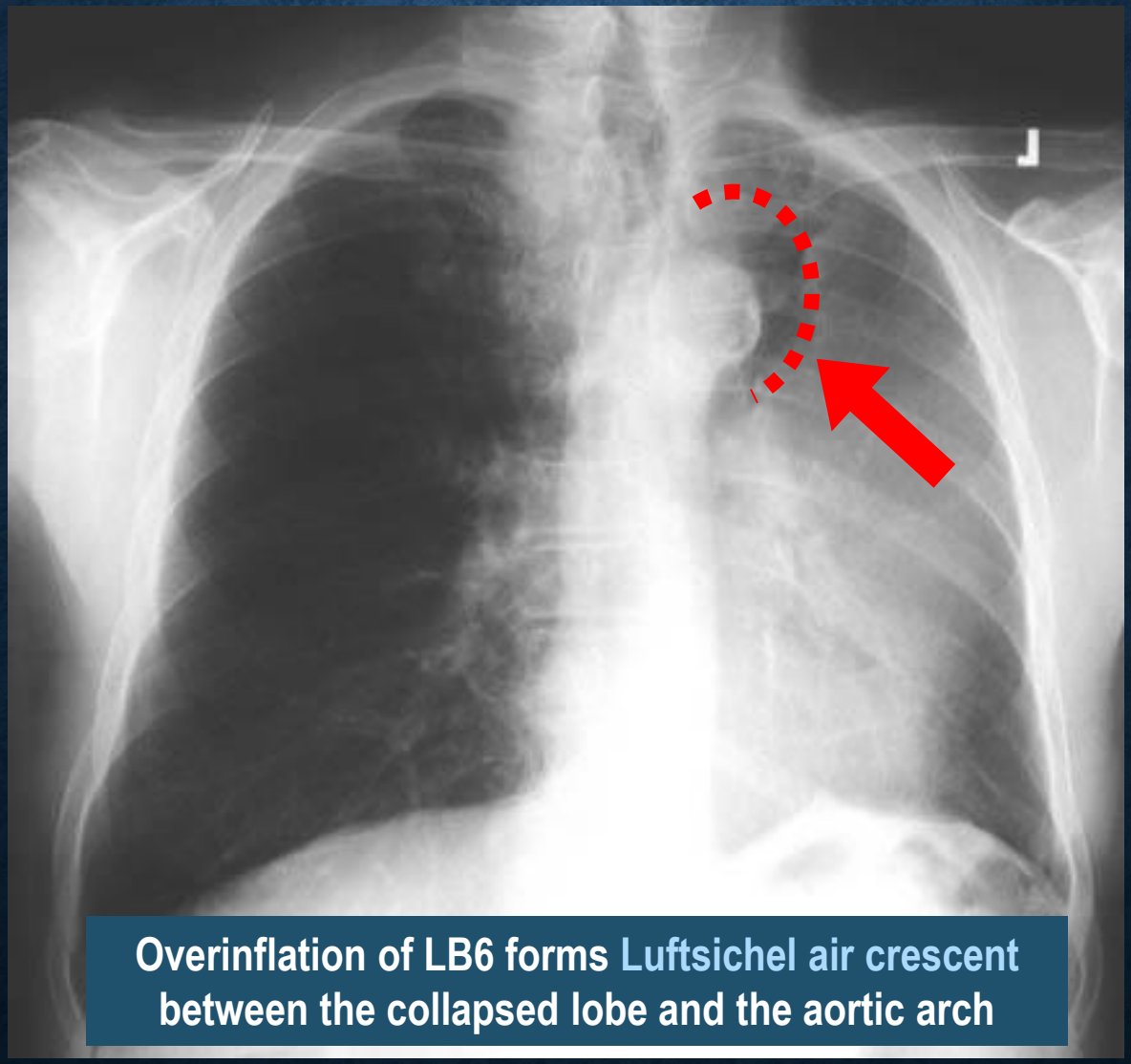
(LUFT = AIR; SICHEL = CRESCENT)



Overinflation of LB6 forms Luftsichel air crescent between the collapsed lobe and the aortic arch

LUFTSICHEL SIGN

(LUFT = AIR; SICHEL = CRESCENT)

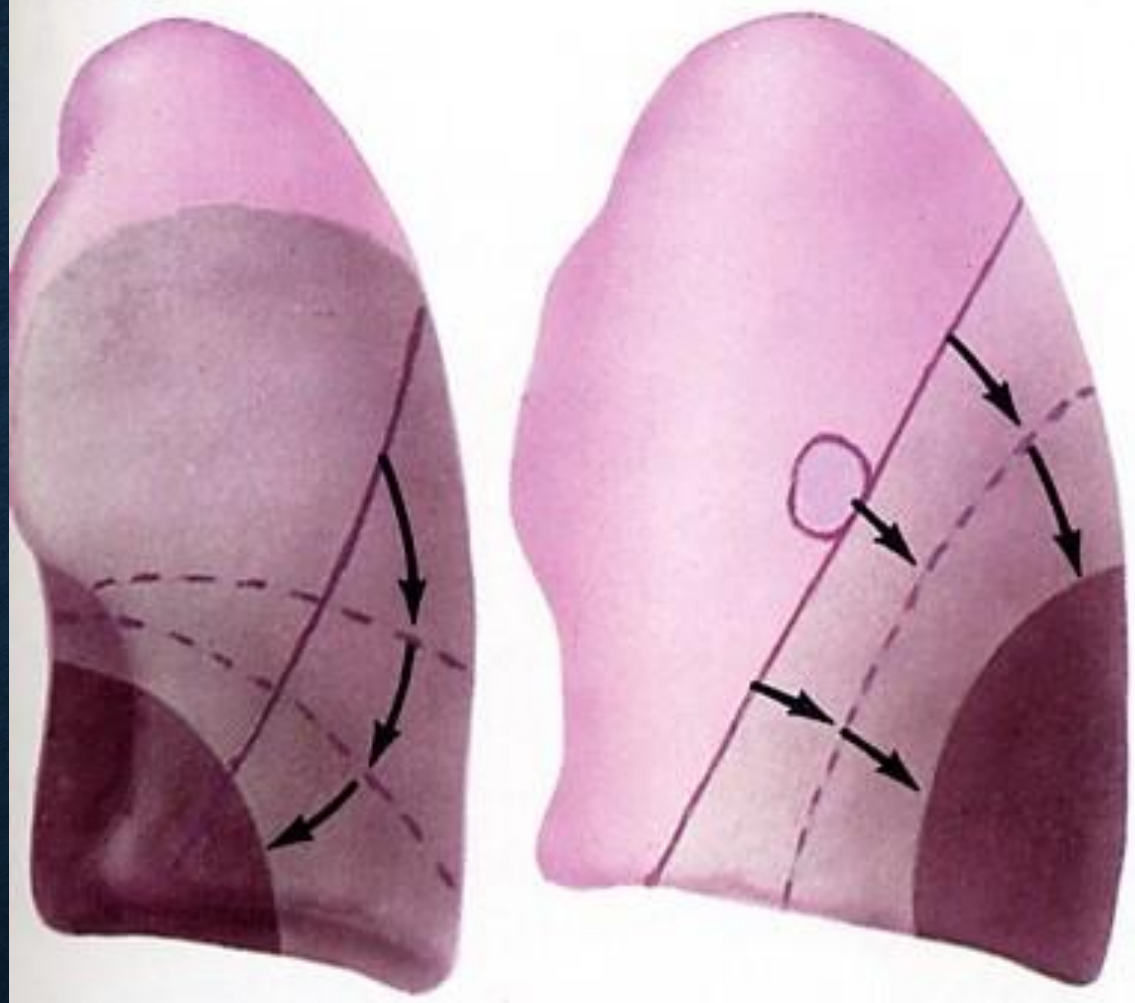


Overinflation of LB6 forms Luftsichel air crescent between the collapsed lobe and the aortic arch


LLL Collapse

F. Netter M.D.

© CIBA

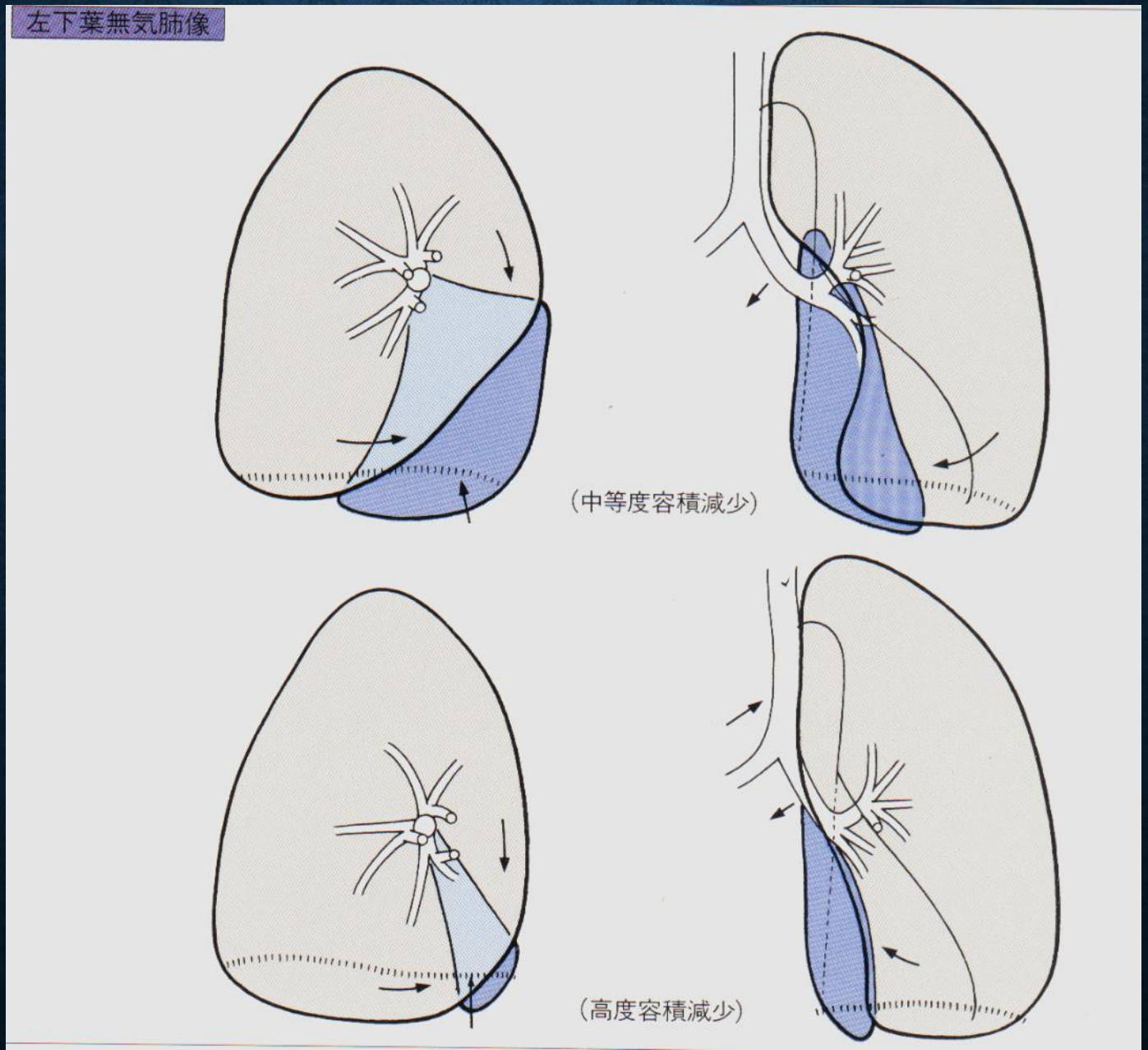


PA view

Lateral view

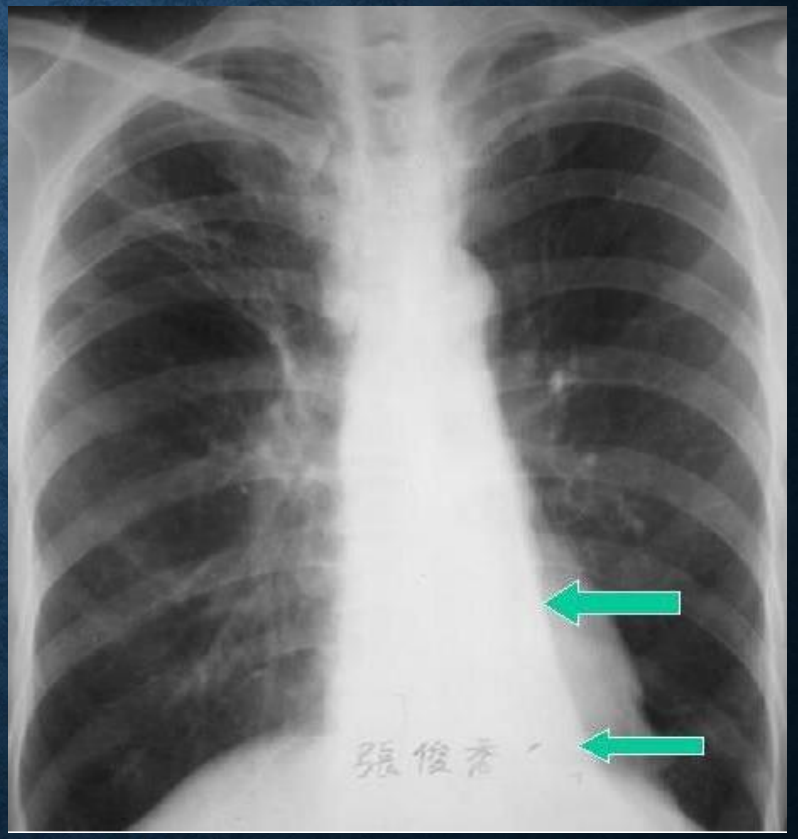
L. lower lobe collapse

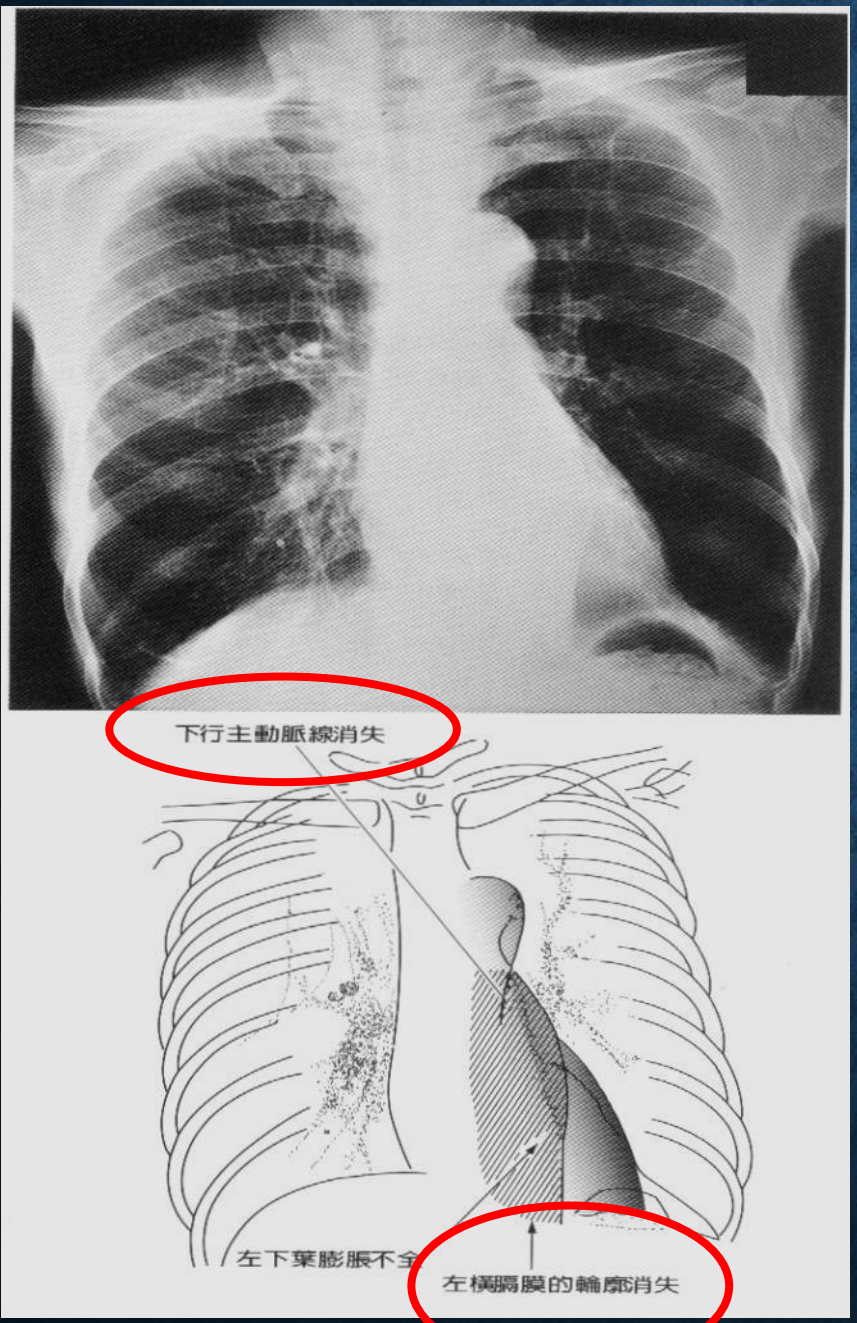
LLL collapse

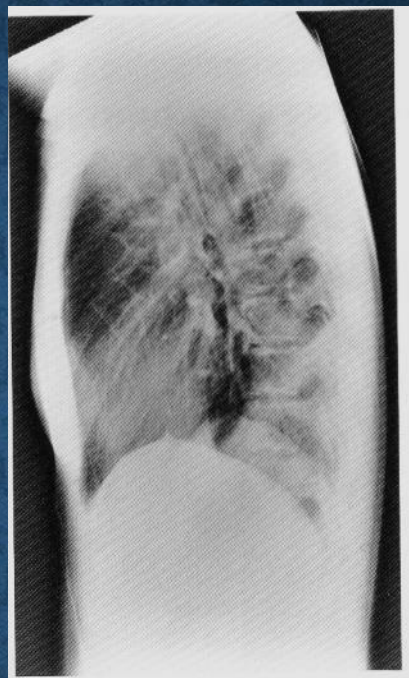


LLL COLLAPSE

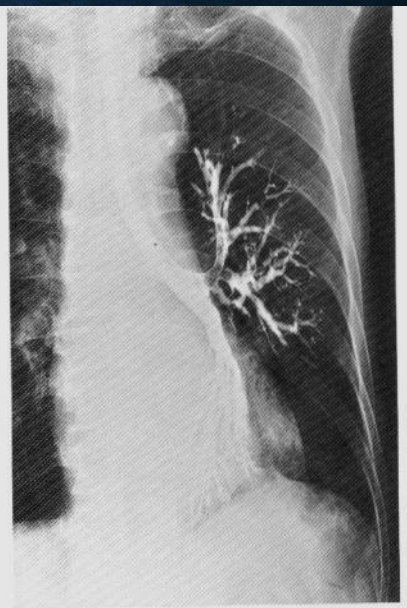
- **PA view and lat. View**
  - **Similar to RLL atelectasis**
  - Upper part of the major fissure: Downward
  - Lower part of the major fissure: Backward
- The collapsed lobe: Downward, posteriorly, and medially.
- Shadow of diaphragm is lost along the airless lobe
- Radiologic sign: ***Flat waist sign***





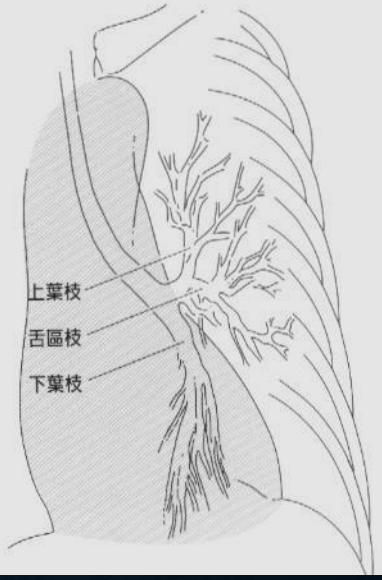


照片 12　照片 11 的側面影像

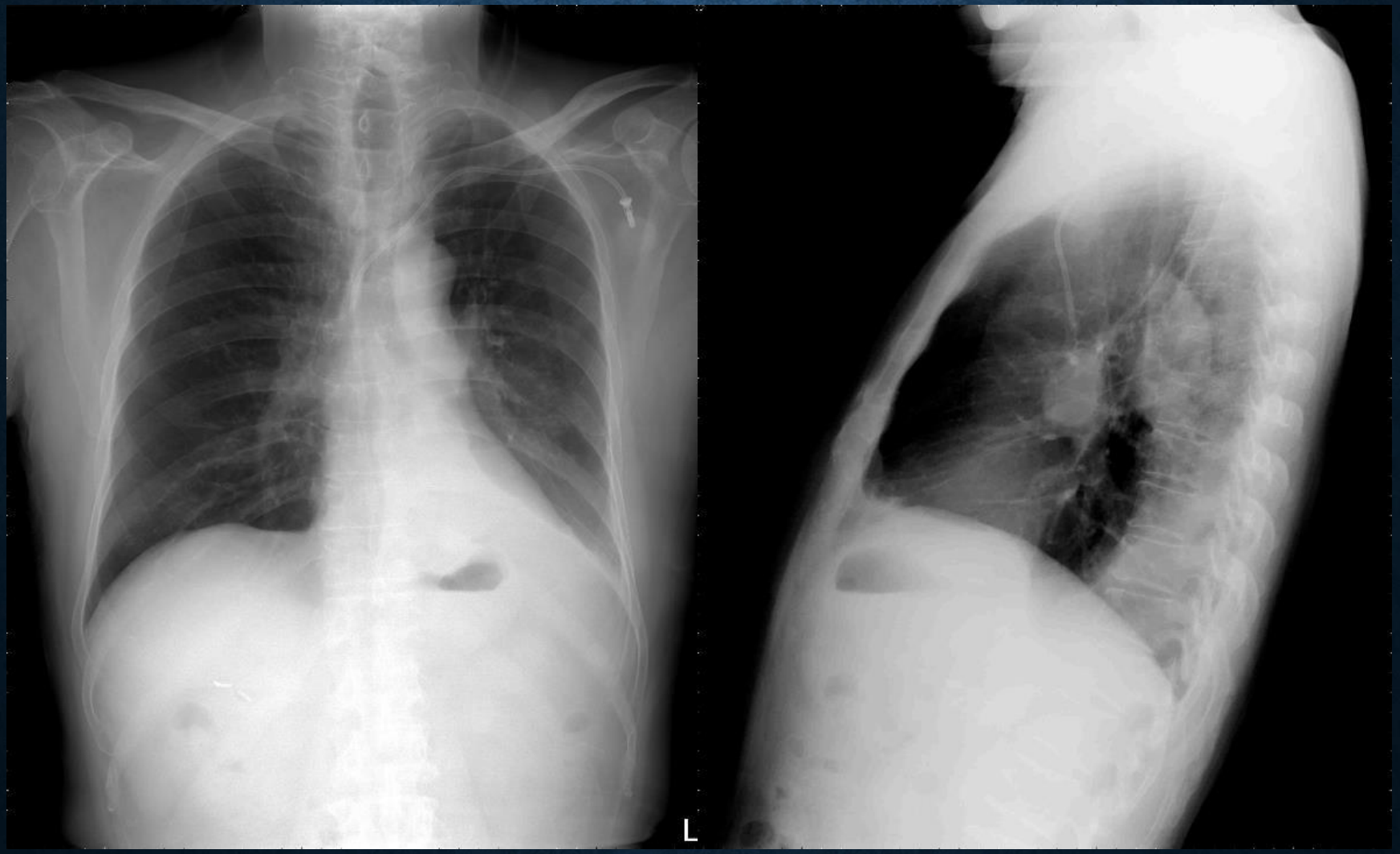


照片 13　照片 11 、12 的支氣管攝影
下葉呈嚴重的萎陷

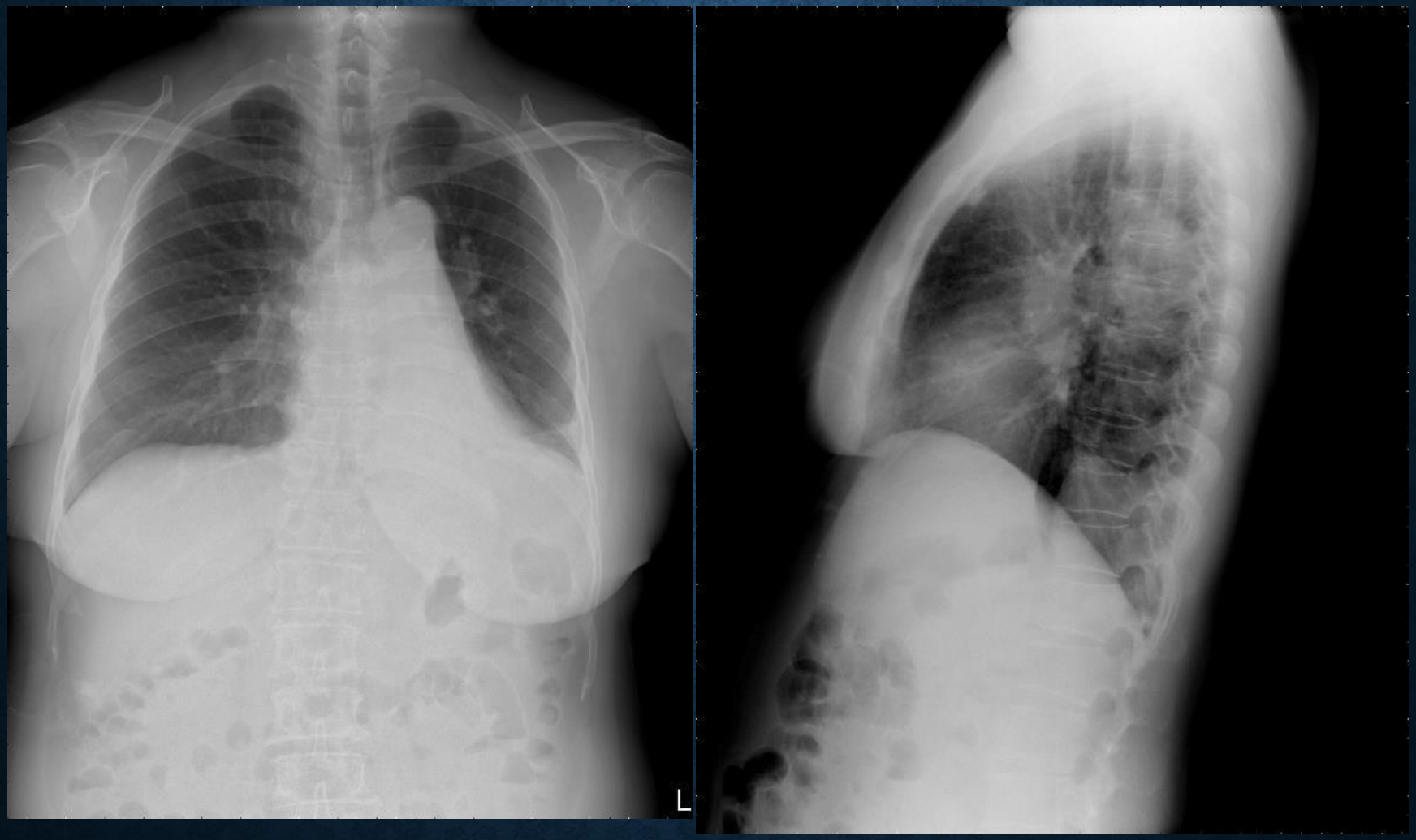
LLL collapse



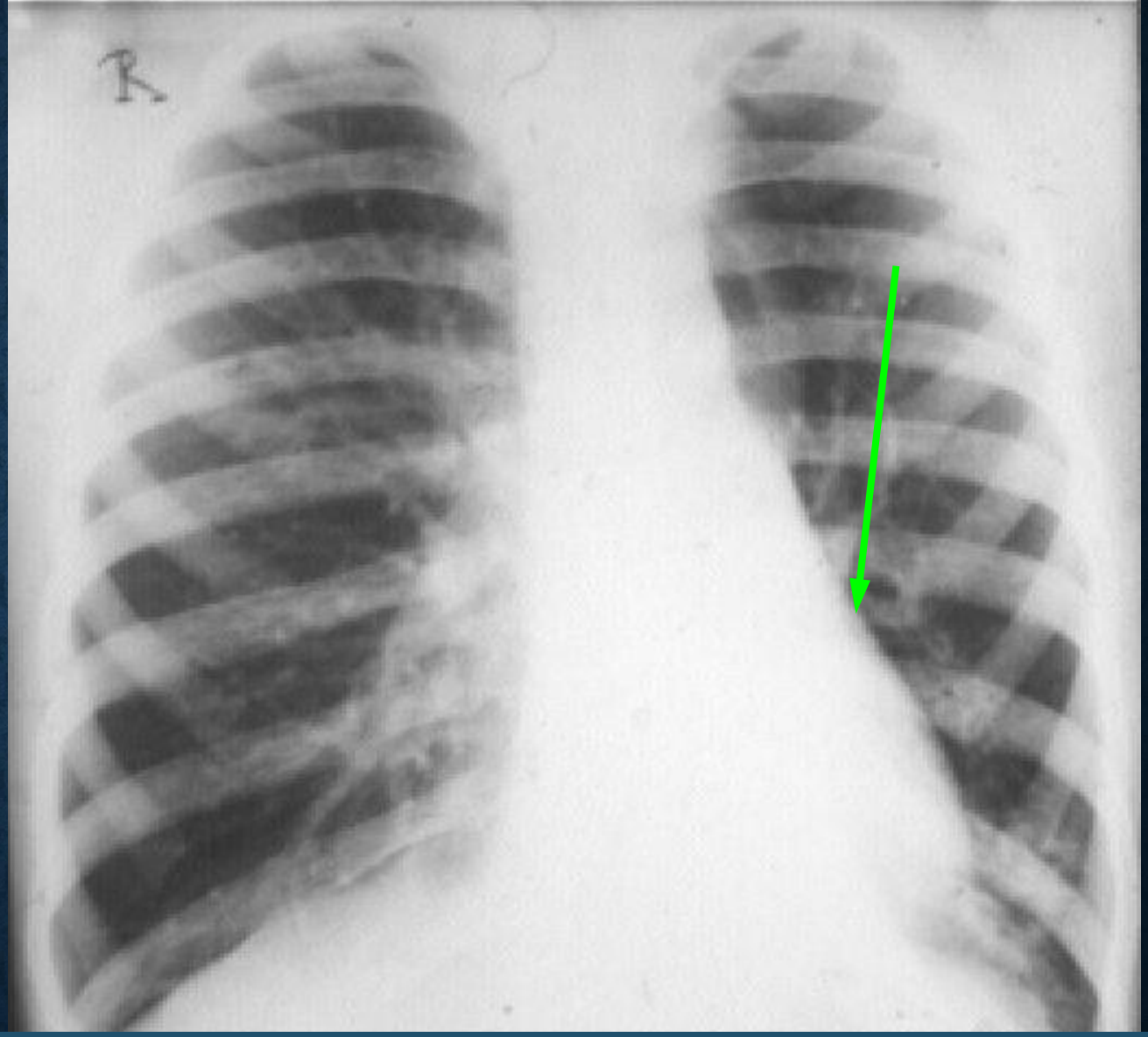
LEFT LOWER LOBE ATELECTASIS



LLL ATELECTASIS



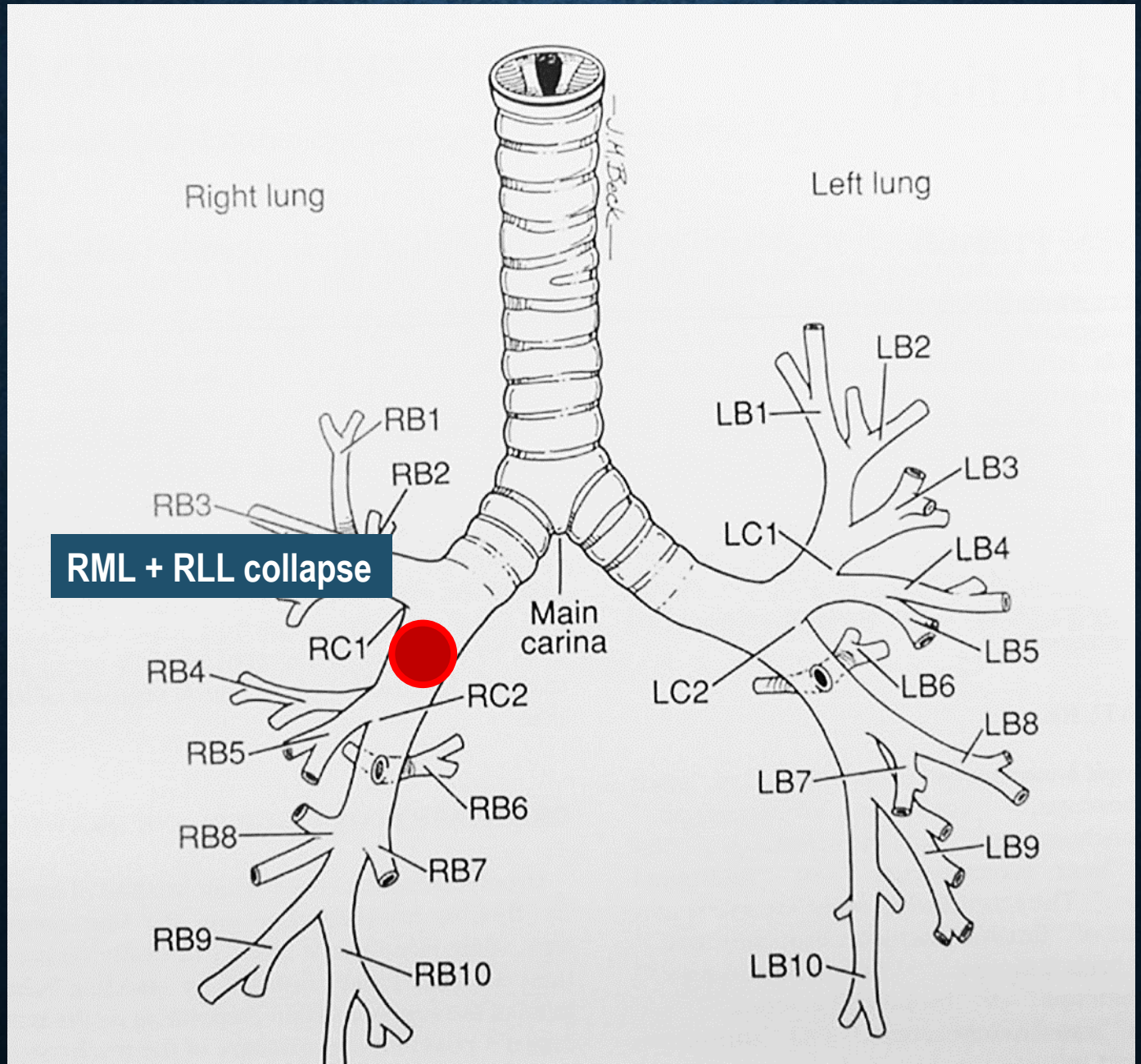
LLL collapse-
Flat waist sign



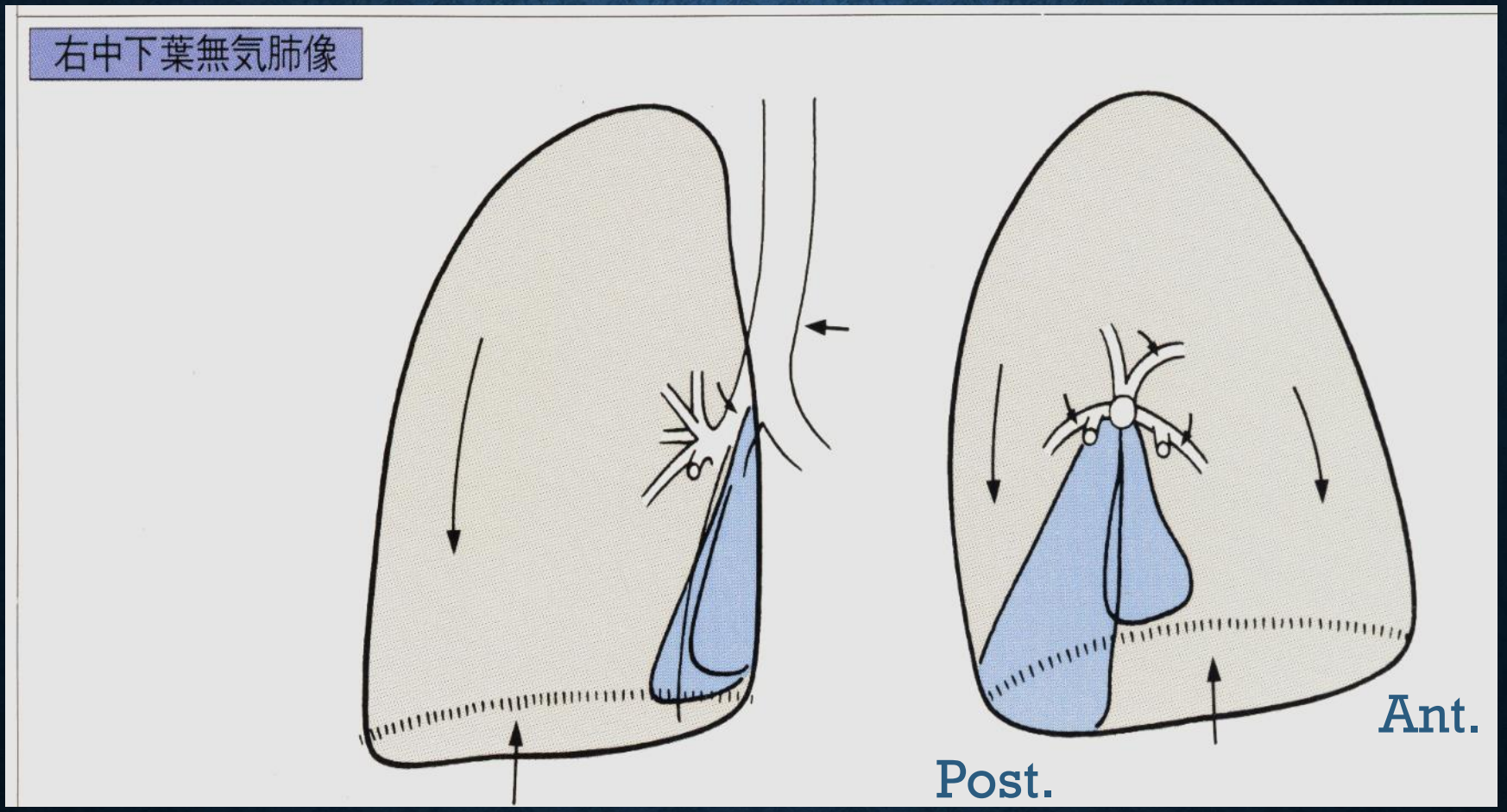
The ***flat waist sign*** refers to flattening of the left heart border, specifically the contours of the aortic arch and adjacent pulmonary trunk. It is seen in severe left lower lobe collapse and is **caused by leftward displacement and rotation of heart.**


Bilobar Collapse

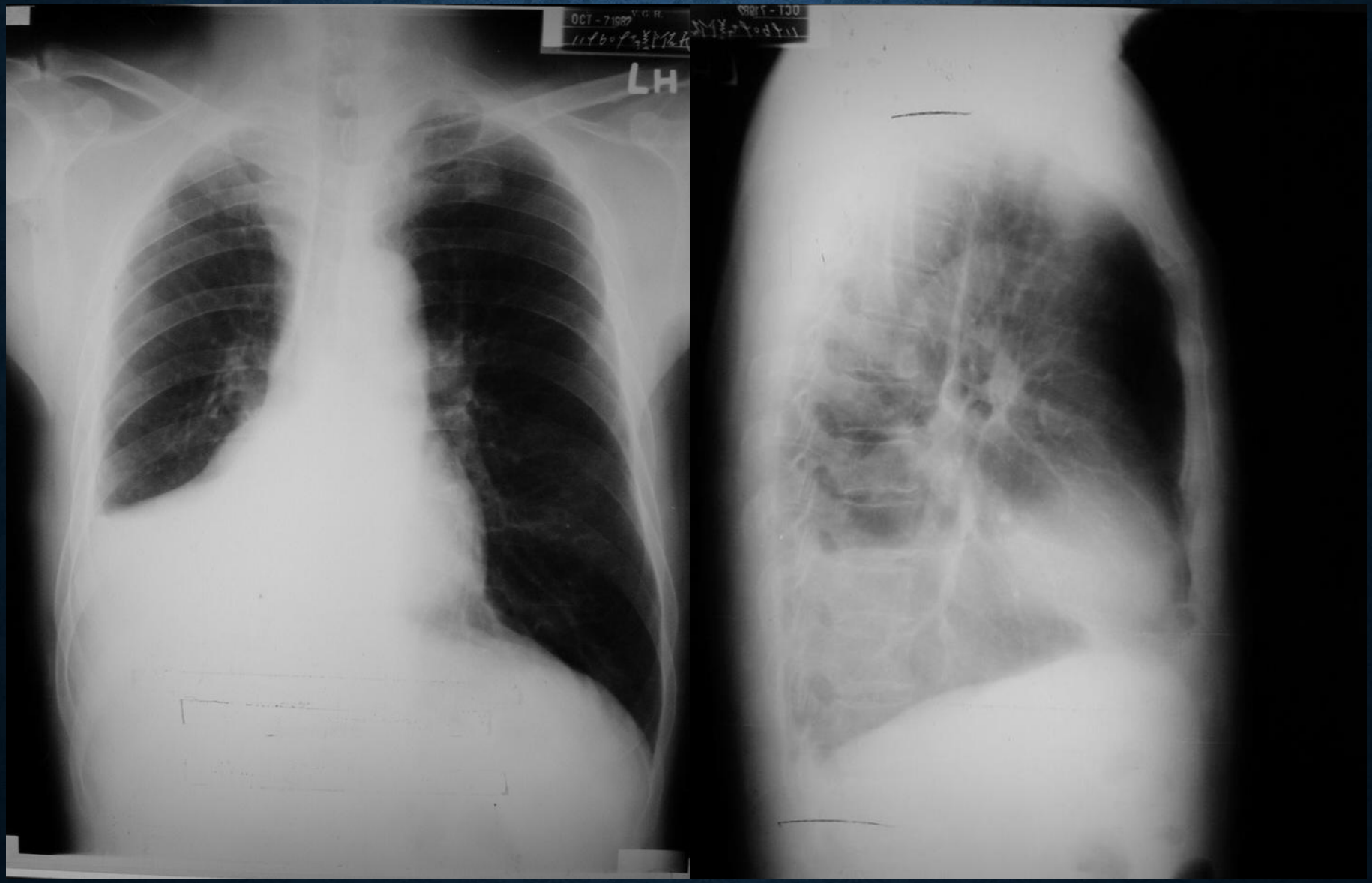
LOBAR COLLAPSE



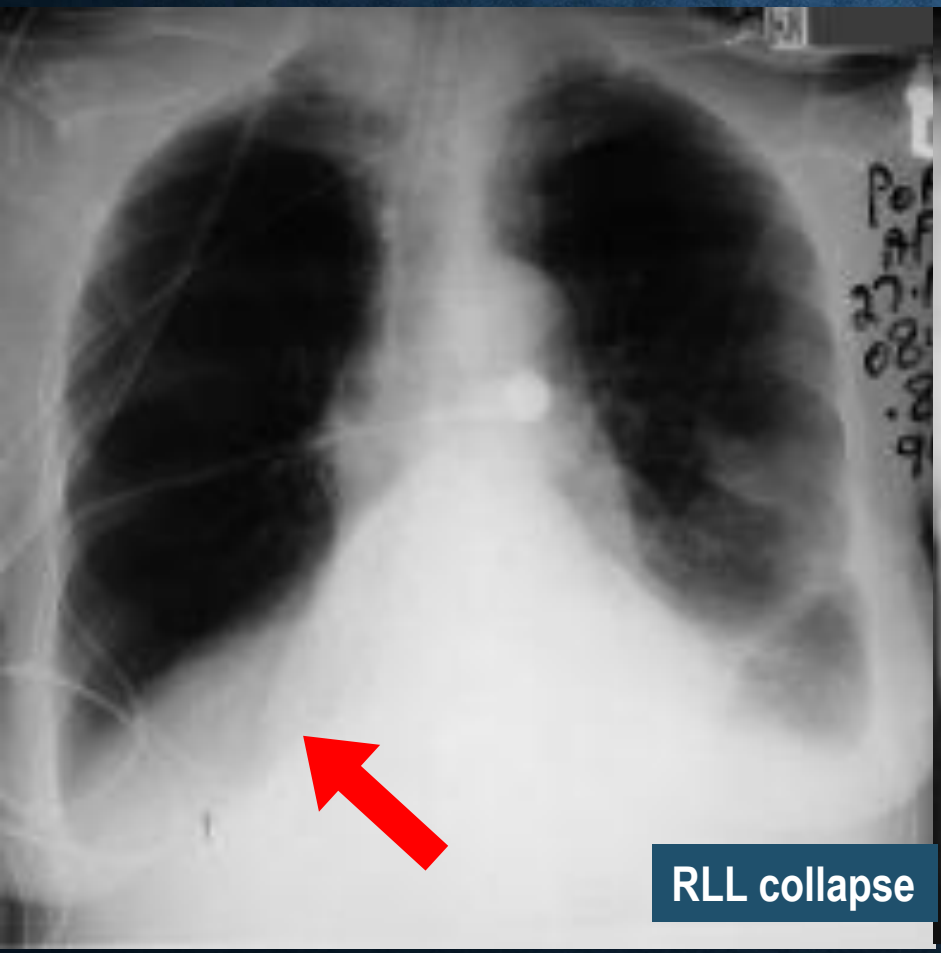
RML AND RLL COLLAPSE



RML + RLL COLLAPSE



RLL COLLAPSE
VS
BI-LOBAR COLLAPSE



RLL collapse

RML + RLL collapse

TAKE HOME MESSEGE

Differential diagnosis of consolidation

1. Consolidation

Content of the alveoli

Water	Pus	Blood	Cells
Heart failure ARDS low albumin volumeoverload renal failure	Pneumonia	Trauma Goodpasture Henoch Schönlein SLE	BAC Organizing pneum. Chron eosinophilic Sarcoid

Pattern

Diffuse

Edema
- Heart failure
- volume overload
- low albumin
- renal failure
- ARDS
- Transfusion reaction

Bronchopneumonia
- Staph Aureus
- Gram-negative
- PCP
- viral - fungal

Hemorrhage
- SLE
- Henoch-Schönlein
- Wegener
- Goodpasture

BAC
Lymphoma
Organizing pneum.
Eosinophilic pneum.
Hypersensitivity pneum

Lobar

Lobar pneumonia
- Streptococ. Pneum.
- Klebsiella
- Aspiration

Hemorrhage
- Contusion
- Infarction

Others
- BAC
- Lymphoma
- Organizing Pneum.
- Eosinophilic pneum.
- Sarcoidosis

Multiple ill-defined

Bronchopneumonia
- Staphylococcus
- Legionella
- Gram negative
- Streptoc. Pneum.
- Klebsiella
- Pseudomonas
- Anaerobe
- PCP
- TB

Vascular
- Septic emboli
- Wegener's

Neoplasm
- BAC
- Lymphoma
- Metastases

Acute

Pneumonia
Aspiration
Infarction
Edema

Chronic

BAC
Lymphoma
Organizing pneum.
Eosinoph. pneumonia
Alveolar proteinosis
Sarcoidosis

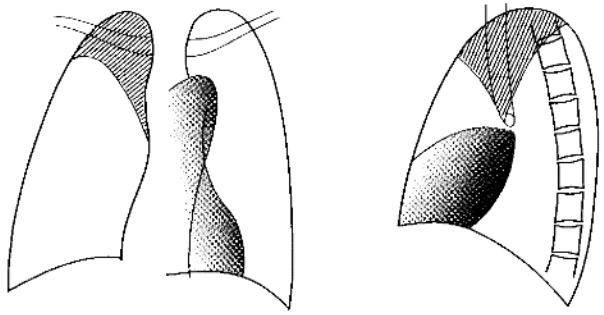
Batwing

Edema
Bact pneumonia
PCP
viral pneumonia

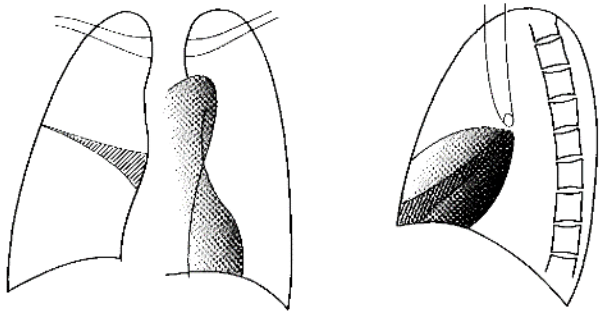
Reversed Batwing

Broncho-alv. carcinoma
Organizing Pneum (BOOP)
Eosinophilic pneumonia
Sarcoidosis
Radiation

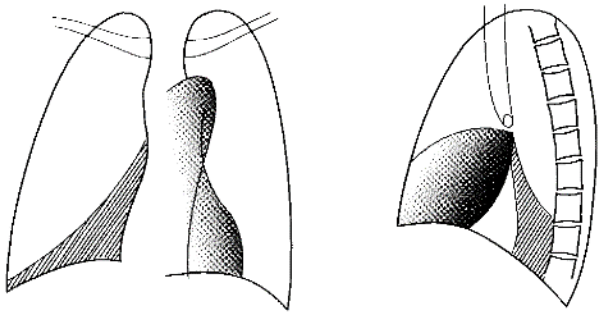
By Robin Smithuis - Radiology Department of the Rijnland Hospital, Leiderdorp, the Netherlands



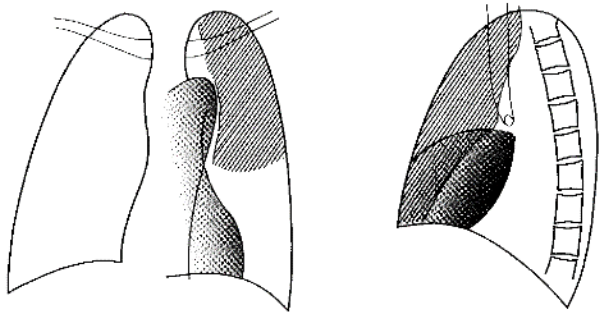
a　右上葉膨脹不全



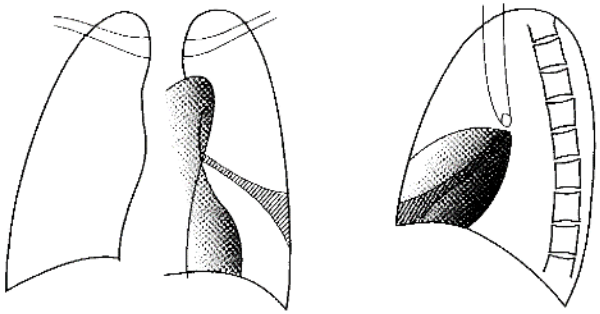
b　右中葉膨脹不全



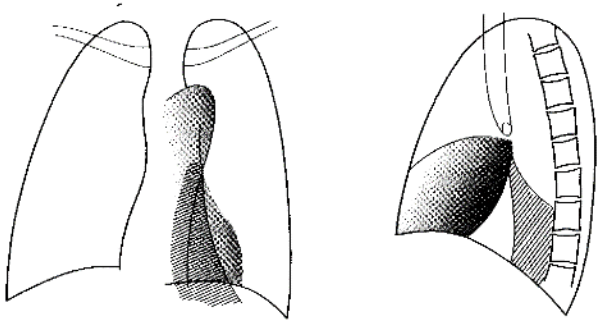
c　右下葉膨脹不全



d　左上葉膨脹不全



e　左舌區膨脹不全



f　左下葉膨脹不全

Radiologic pattern of lung collapse of each lobe

THANK YOU FOR LISTENING ☺