肺實質化(開洞)病灶與肺塌陷

台大醫院新竹台大分院新竹醫院
耿立達 醫師

Outline

General Principles

Airspace Opacity

Dx of Airspace Opacity

Atelectasis/Collapse

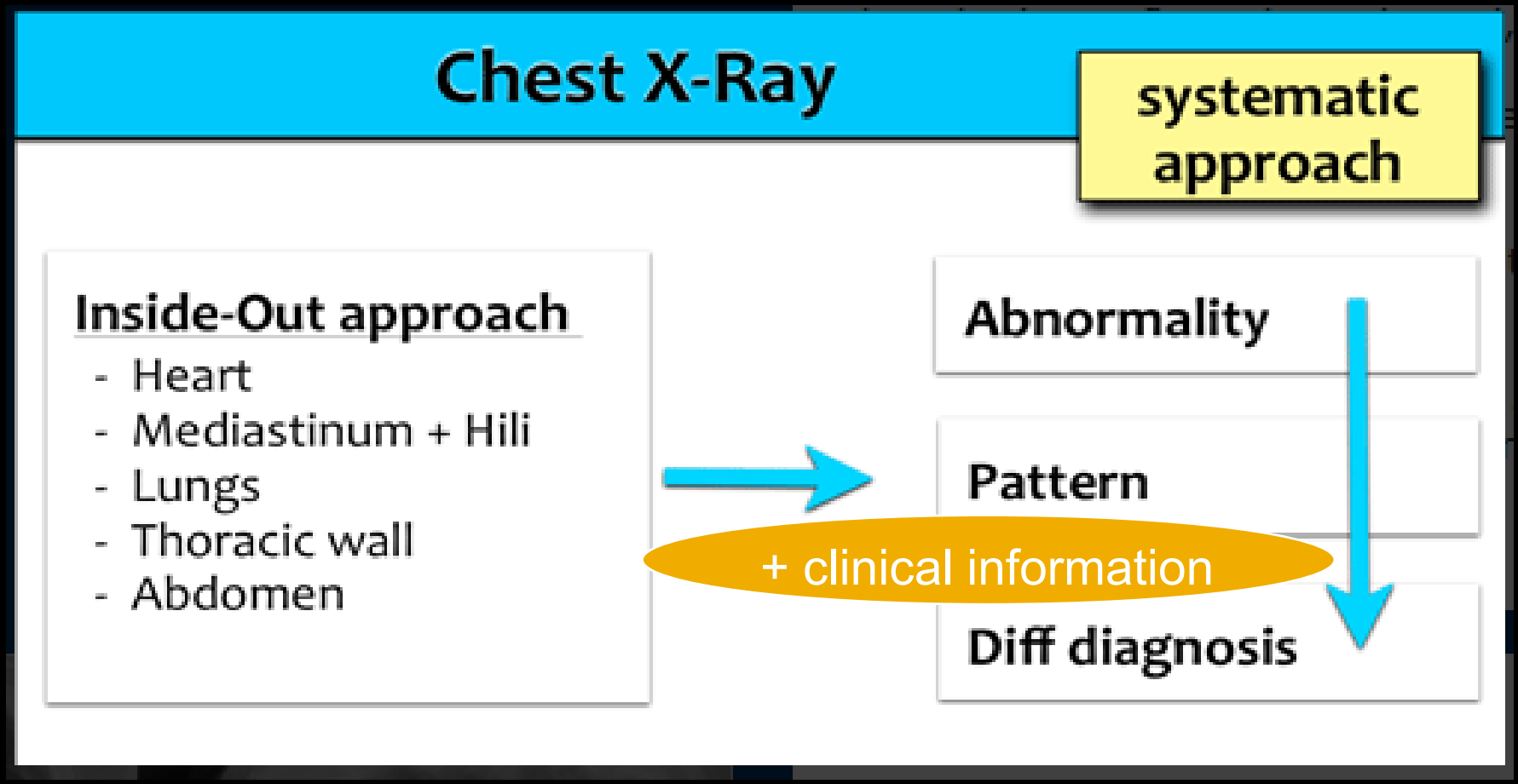
General principles

Interpretation

silhouette sign

basic patterns

Ideal interpretation



apex, hilum, retrocardiac regions, below diaphragm dome, just inside the chest wall

https://radiologyassistant.nl/chest/chest-x-ray/

The birth of silhouette sign

- An intrathoracic lesion touching a border of the heart or aorta will obliterate that border on the roentgenogram;
- An intrathoracic lesion not anatomically contiguous with a border of the heart or aorta will not obliterate that border.

Felson B, Felson H. Radiology. 1950;55:363-74.

In Memoriam

Benjamin Felson, MD
1913–1988

Dr Benjamin Felson, one of the outstanding diagnostic radiologists of his time, died suddenly of a heart attack October 22, 1988, while working on a manuscript. At his death he was professor emeritus of radiology at the University of Cincinnati College of Medicine, where he had served as director of the department of radiology for 22 years. He voluntarily relinquished this position, but continued actively as professor of radiology under the aegis of the distinguished colleague he had trained, Dr Jerome H. Wiot. Dr Felson gave the University of Cincinnati 50 years of dedicated service, establishing a department of radiology whose name and fame were recognized everywhere.

abroad, and the lectures and seminars he presented must have numbered in the hundreds. He gave no less than 32 named lectures, honoring the most prestigious individuals in the history of radiology. He was granted honorary membership in at least 14 U.S. medical societies (mainly radiologic) and in 20 societies in various foreign countries. Just before he died he was accorded honorary membership in the Chinese Radiological Association, a rarely given award for a foreign radiologist.

The number and importance of the awards and honors bestowed on him were legion. He was given the highest honors by most of the important radiologic societies. These included Gold Medals from the Radiological Society of North America and the American College of Radiology. In addition, a special award for outstanding service and contributions was given him by the American Roentgen Ray Society. He was also awarded an Honorary Fellowship in the Royal College of Radiologists of Great Britain, a prestigious award granted to only a handful of Americans. One of the most significant reflections of his reputation was his selection as both the Caldwell lecturer of the ARRS and the lecturer of the annual oration of the RSNA. Under the aegis of the ACR, Dr Felson was videotaped several years ago as a "living legend" in radiology, a truly ap-

Jacobson HG. In memoriam Benjamin Felson, 1913-1988. Radiology. 1989;170:897-8.

HISTORY OF MEDICINE

The CT Scan after 50 Years — Continuity and Change

Joel D. Howell, M.D., Ph.D.

如同聽診器發明改變人們形成疾病的概念

Fifty years ago, in 1971, the first computed tomographic (CT) scan revealed a frontal lobe tumor in a 41-year-old woman. The scan was performed in a town best known for an annual tennis tournament (Wimbledon, England), and the machine was manufactured by a company best known for music recordings (EMI). EMI had become extraordinarily successful by selling the music of a popular English band known as the Beatles. Like many Beatles songs, the CT scanner was an instant hit.[1] Only 8 years later, the Nobel Prize in Physiology or Medicine was awarded to two pioneering researchers who had helped develop the machine, Godfrey Hounsfield and Allan Cormack.[2,3]

原來就是 Hounsfield unit 本人!

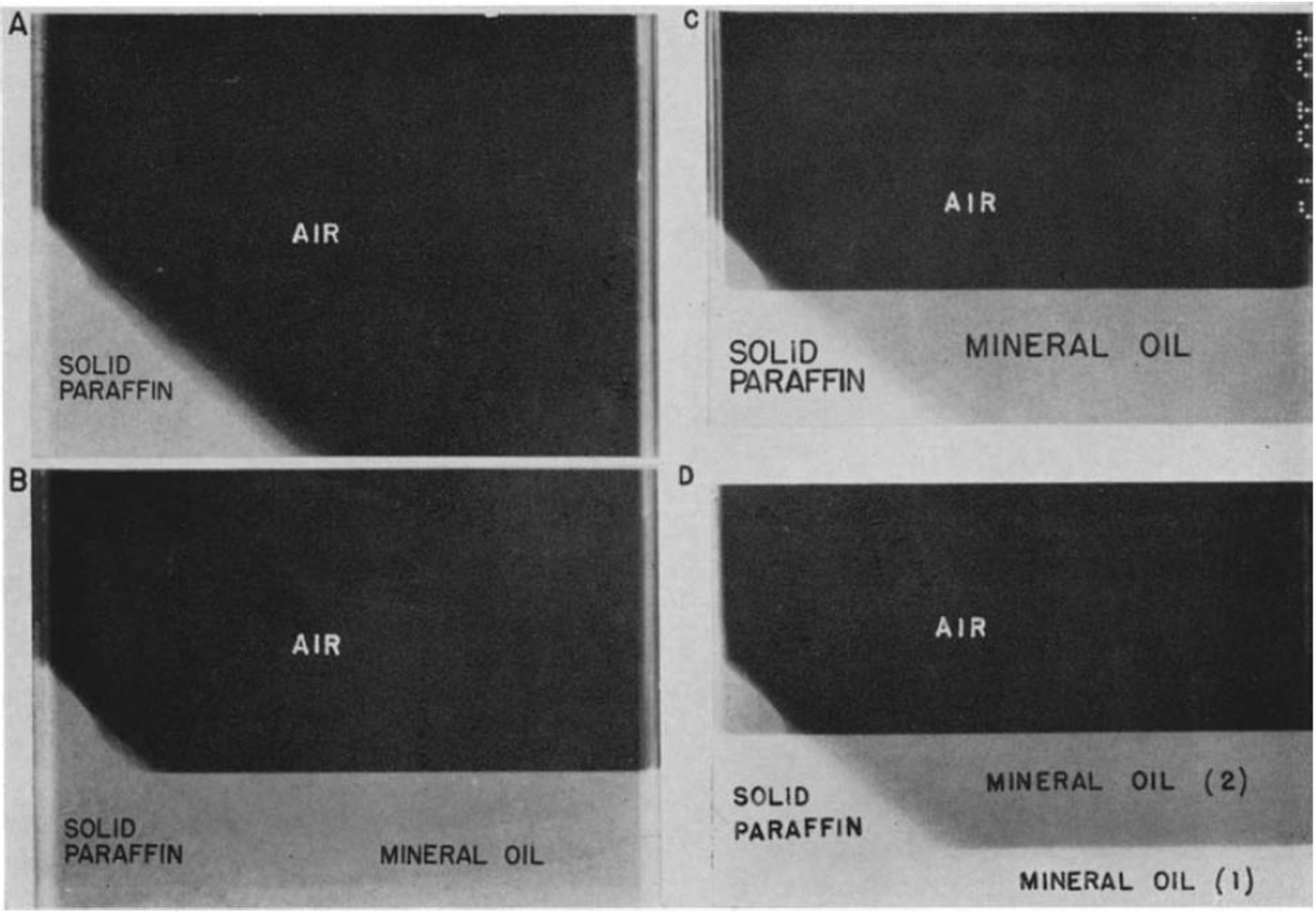
ineffable bodily humors, manifested by symptoms that patients relayed to their caregivers. But out of the chaos of postrevolutionary France arose the notion that disease was not an imbalance in humors but entailed actual physical lesions, and that these lesions could be identified in a living body. In 1816, when René Laennec invented the stethoscope in Paris hospitals, he did more than create a useful tool that can be considered an exemplar of the ways in which physicians localize lesions within the body — he described a new way of conceptualizing disease.[5]

This change had enormous implications. For if disease could manifest not only as patient-

of the body could block the rays from reaching another part. The bones in the head made it essentially impossible to create an image of the brain using x-rays. The CT machine offered a solution to the second problem by creating three-dimensional images with no overlap of structures. It also derived useful information by measuring variation in tissue density. In one sense, the CT scan was just another development in a centuries-long quest to more precisely visualize lesions in the human body.

On the other hand, the invention of the CT scanner marked a radical change. For the first time, digital computers were integral to acquiring and analyzing medi-

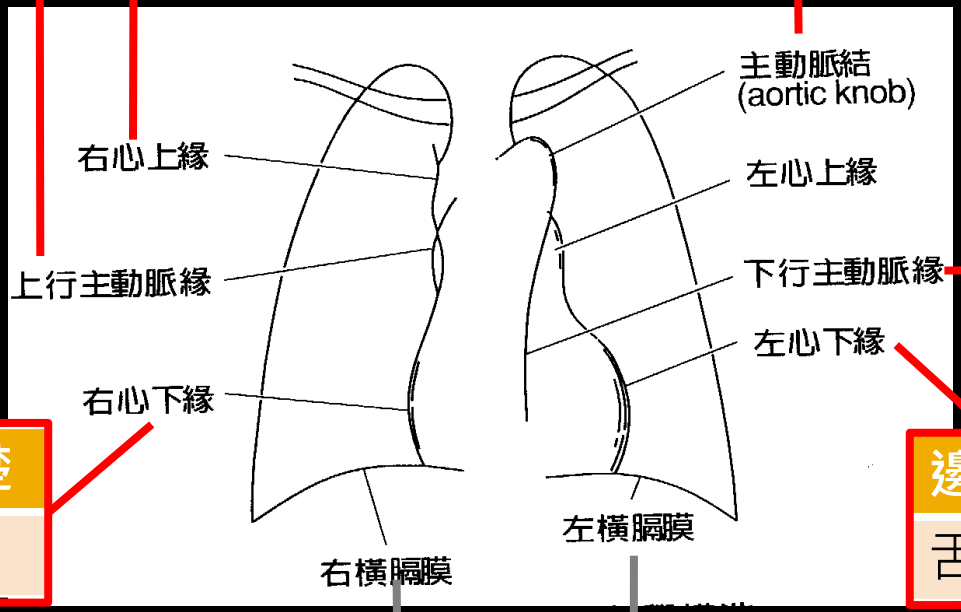
Howell JD. N Engl J Med. 2021;385:104-5.



Felson B, Felson H. Radiology. 1950;55:363-74.

邊界模糊	邊界清楚
右上葉前節(S3) 右中肺葉	右上葉後節(S2) 右下葉上節(S6)

邊界模糊	邊界清楚
左上肺葉頂 後節(S1+2)	前: 左上葉前節(S3) 超後:左下葉上節(S6)



邊界模糊
左下葉

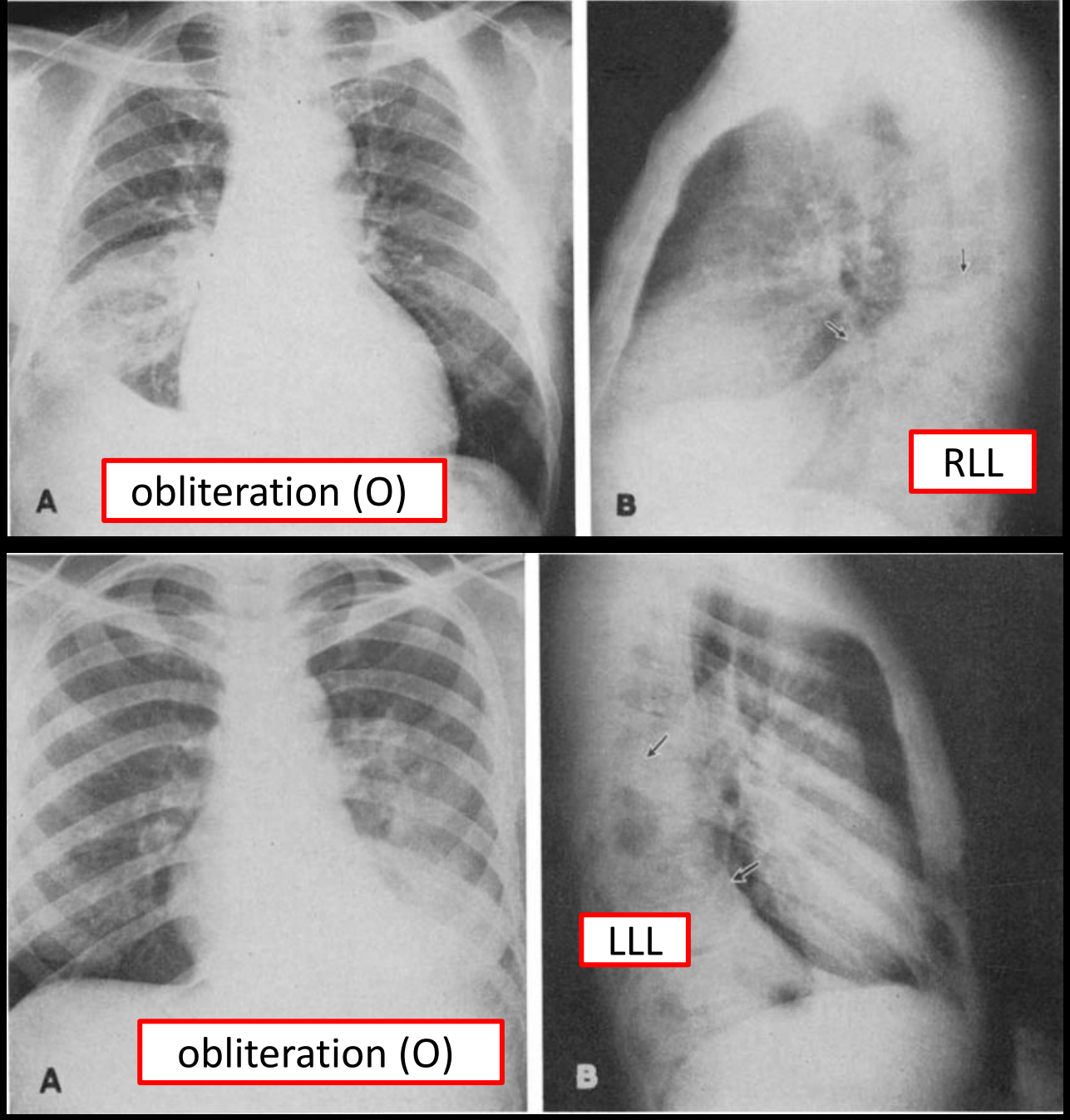
邊界模糊	邊界清楚
右中葉	右下葉

邊界模糊	邊界清楚
舌葉	左下葉

邊界模糊	邊界清楚
左右下葉?	左右中葉?

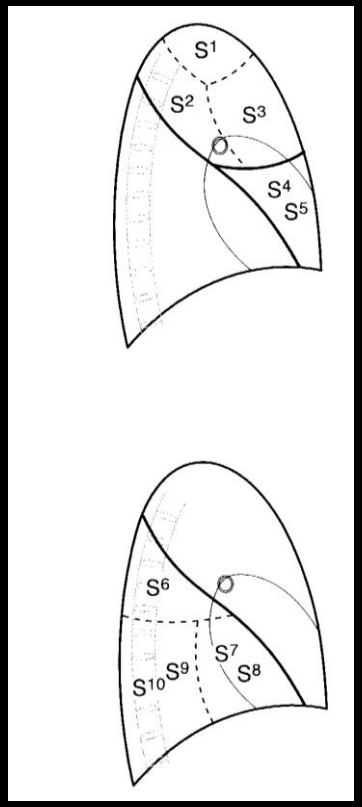
Felson B, Felson H. Radiology. 1950;55:363-74.

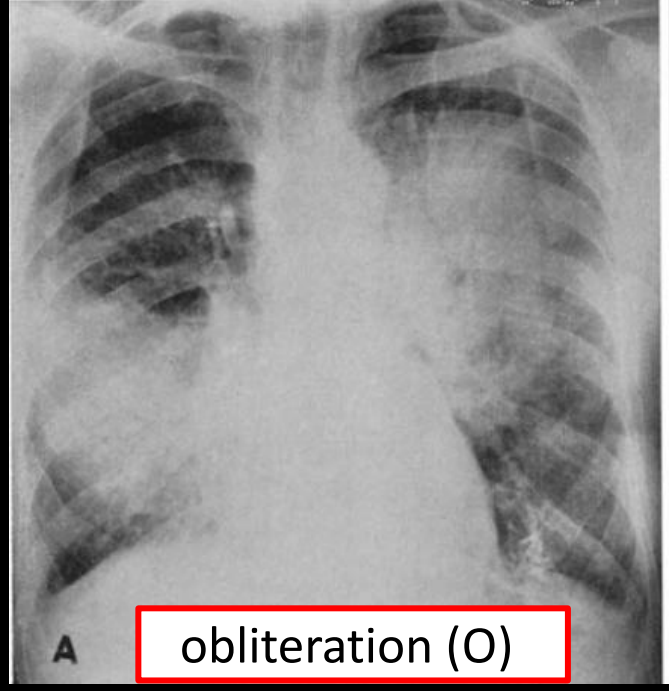
Diaphragm
||
Lower lobe ?

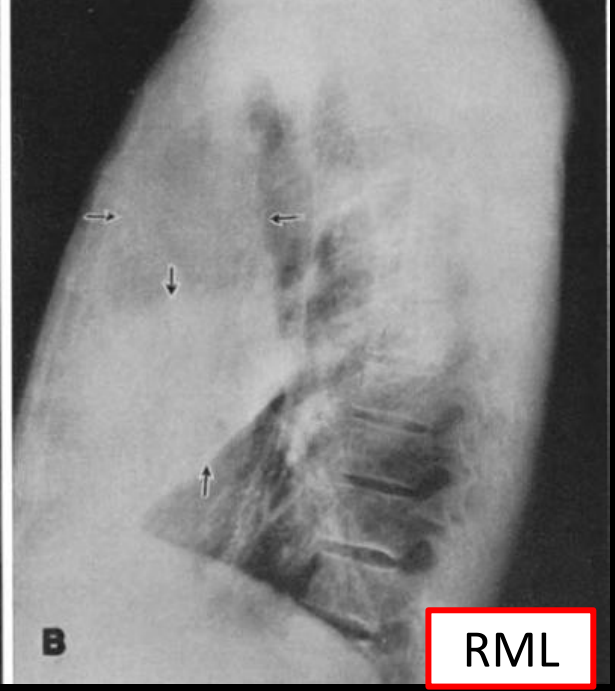


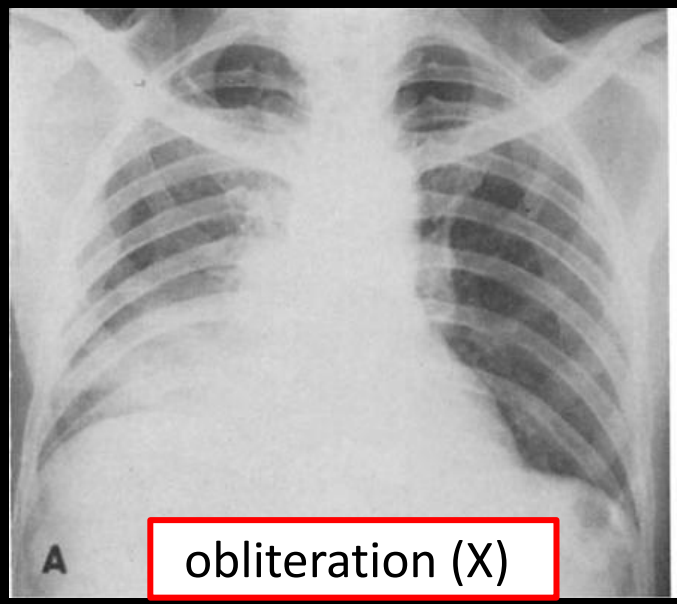
Felson B, Felson H. Radiology. 1950;55:363-74.

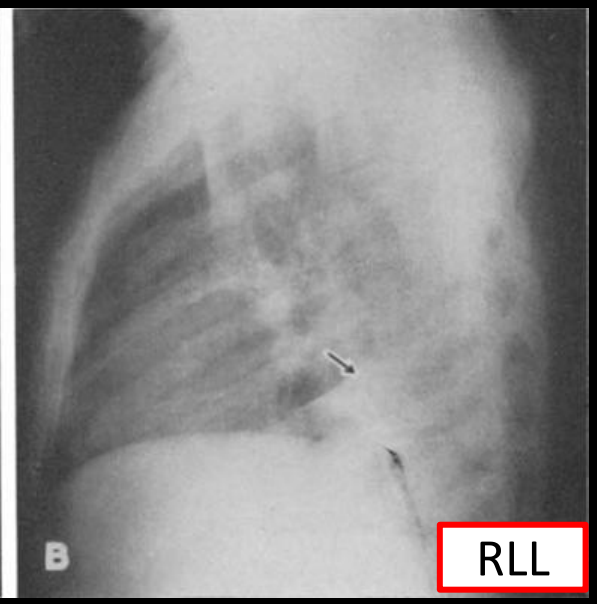
Diaphragm
||
Lower lobe ?







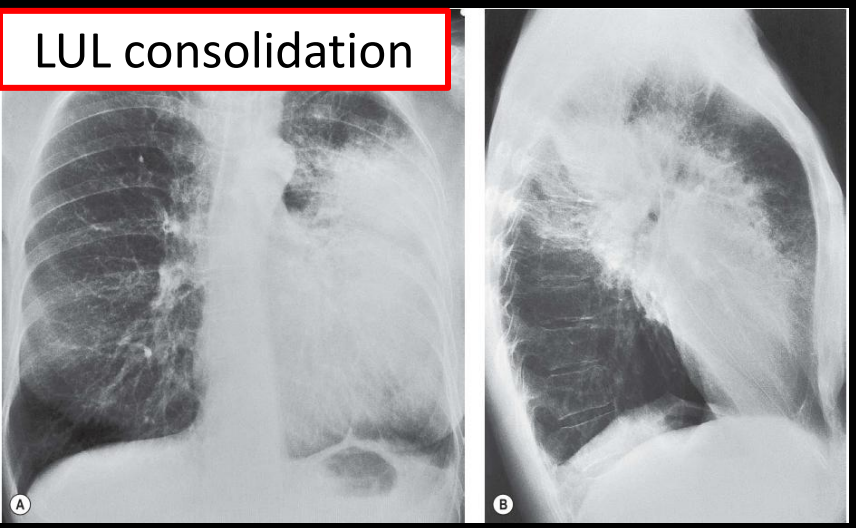


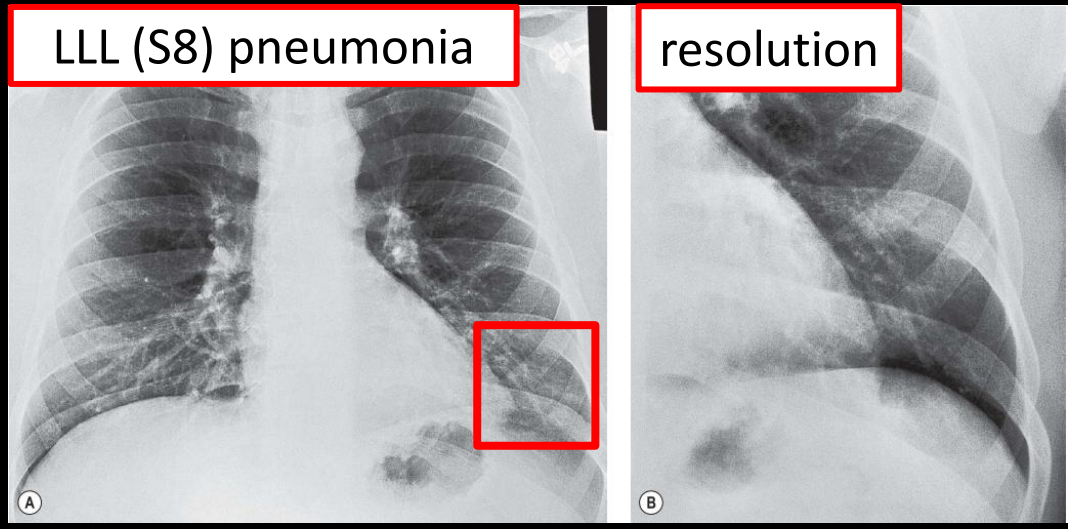


Felson B, Felson H. Radiology. 1950;55:363-74.

Use of silhouette sign

- 定位明顯病灶
- 偵測微小病灶

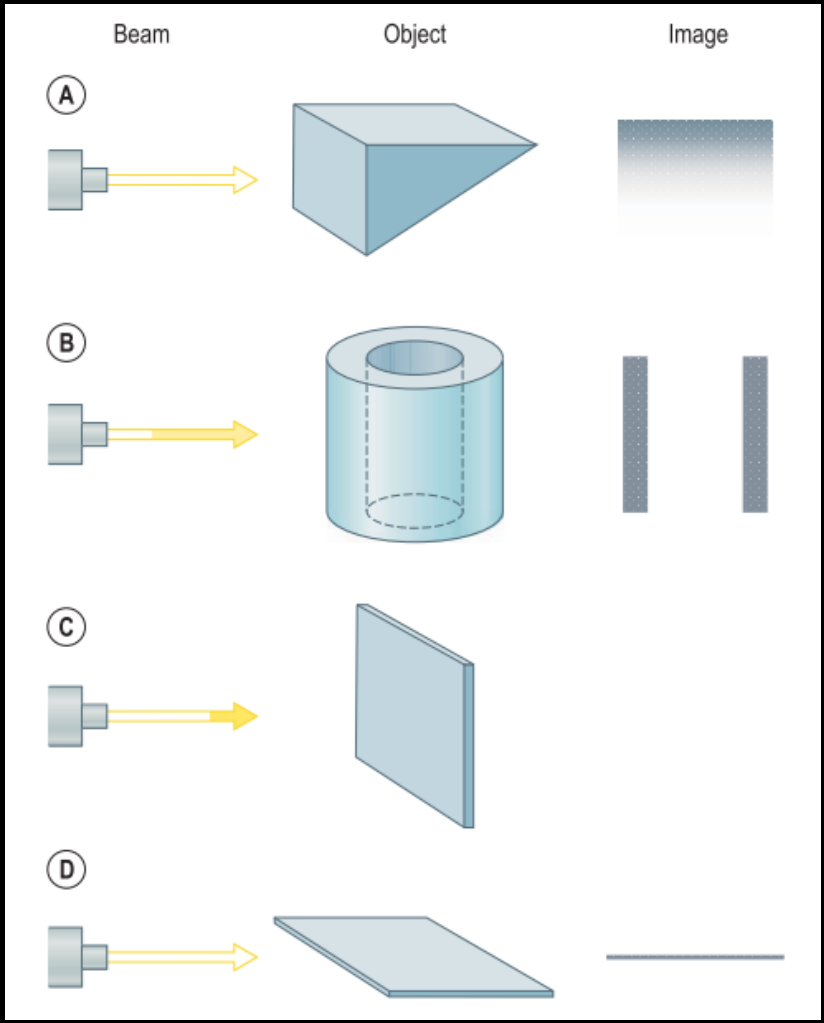




Hansell DM et al. Imaging of Diseases of the Chest, 5th Edition

Classification of pulmonary opacity/shadow/infiltrate
變白的病灶

- airspace opacity
- atelectasis/collapse
- mass/nodule
- linear/band-line opacity
- cysts/bullae
- nodular/reticulonodular opacity and honeycombing

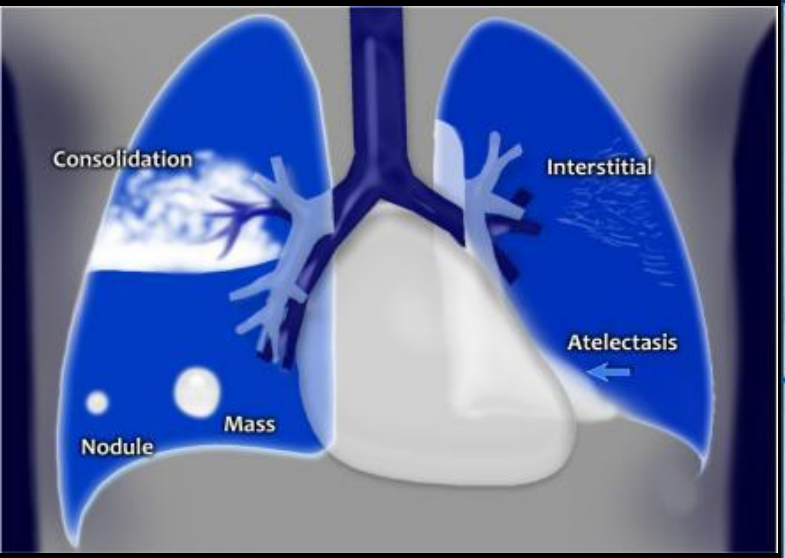


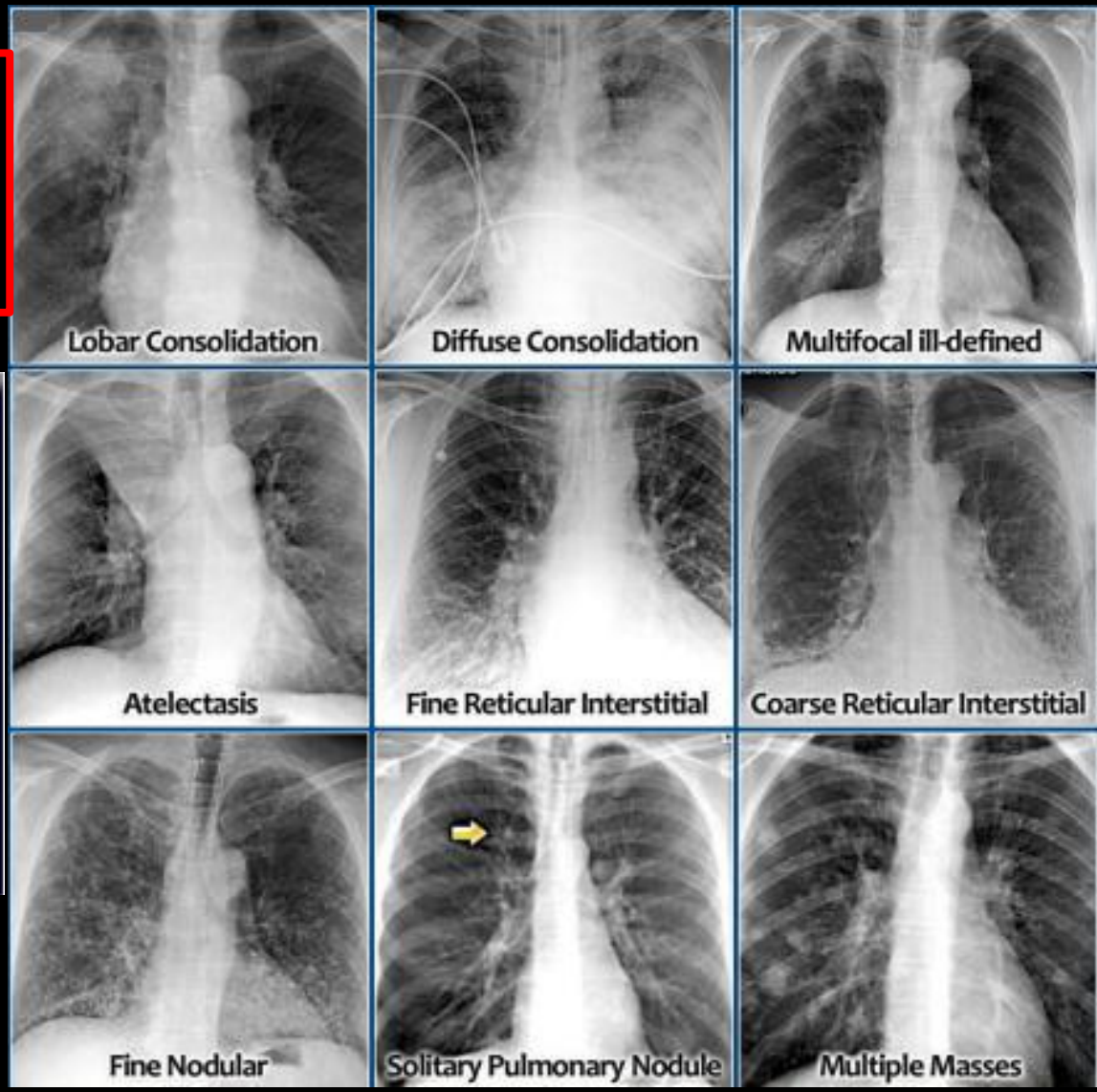
需考量立體幾何變化

Hansell DM et al. Imaging of Diseases of the Chest, 5th Edition

Basic 4 CXR Patterns

點: nodule
線: interstitial
面: consolidation/atelectasis





https://radiologyassistant.nl/chest/chest-x-ray-lung-disease

Mimicker of airspace opacity

Extrapulmonary

Intrapulmonary

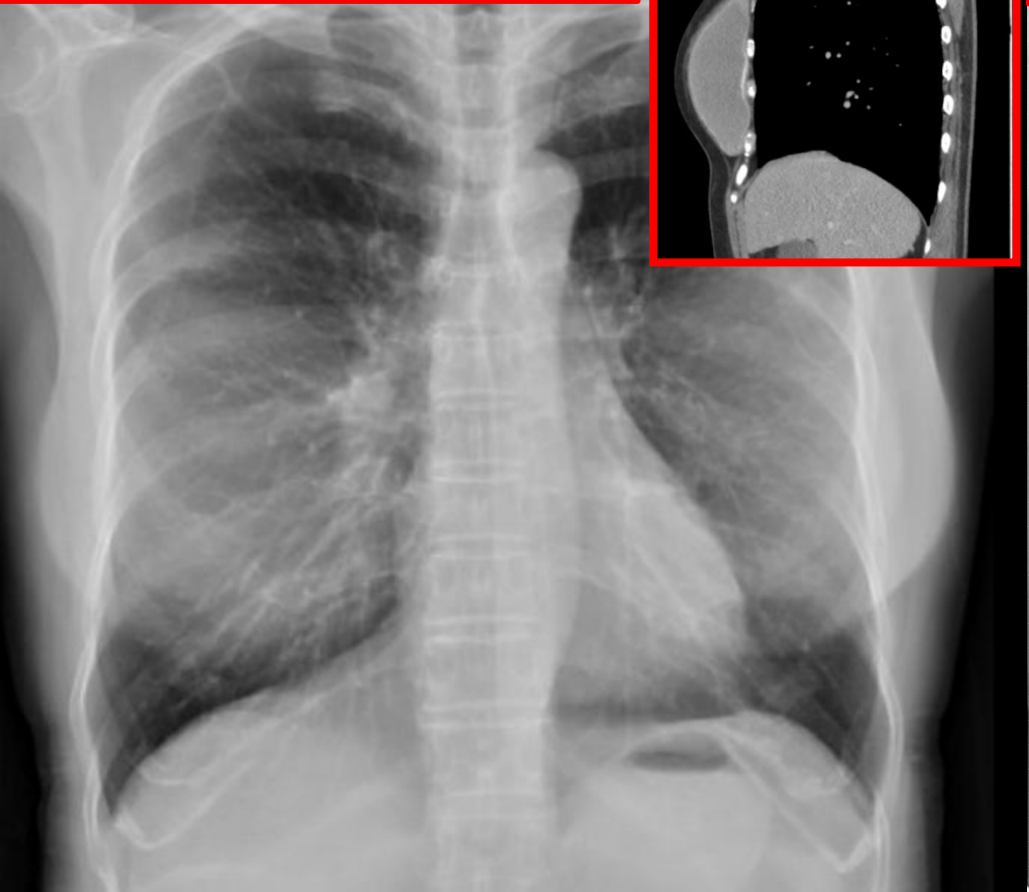
Mimicker of airspace opacity

Extrapulmonary	Intrapulmonary
Soft tissue	Poor inspiration
Foreign body	Mass
Pleural effusion	Atelectasis
Pericardial fat	GGO

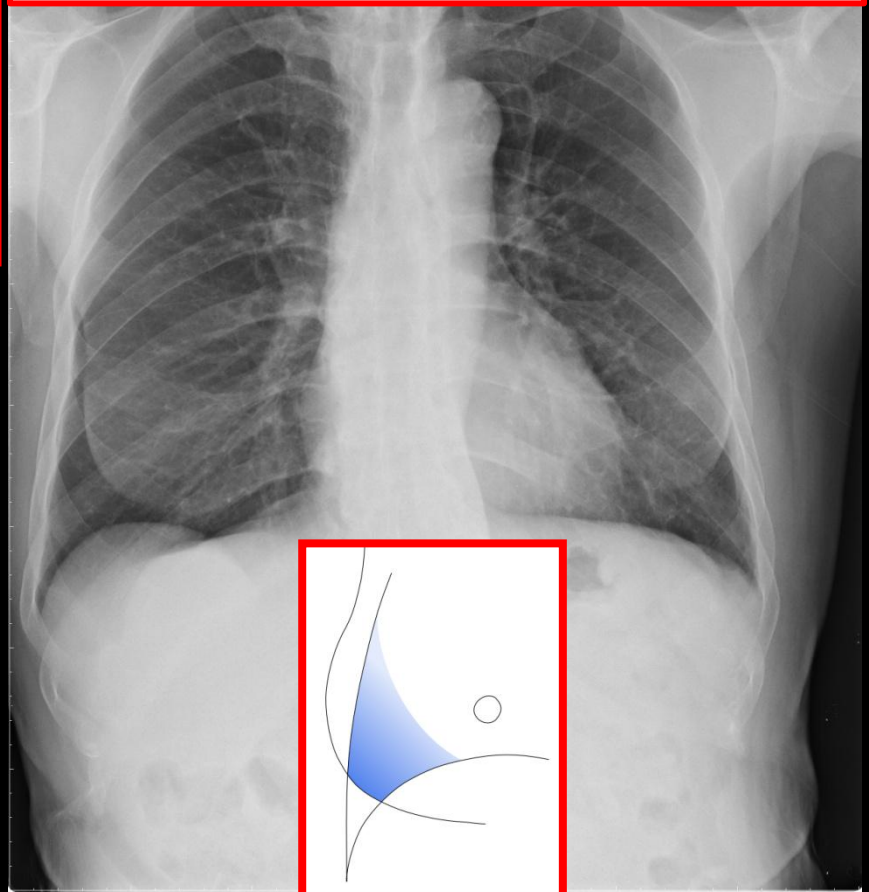
Mimicker of airspace opacity

extra-pulmonary

61F, female breast with bilateral mammoplasty



79M, prostate cancer s/p hormone Tx with gynecomastia

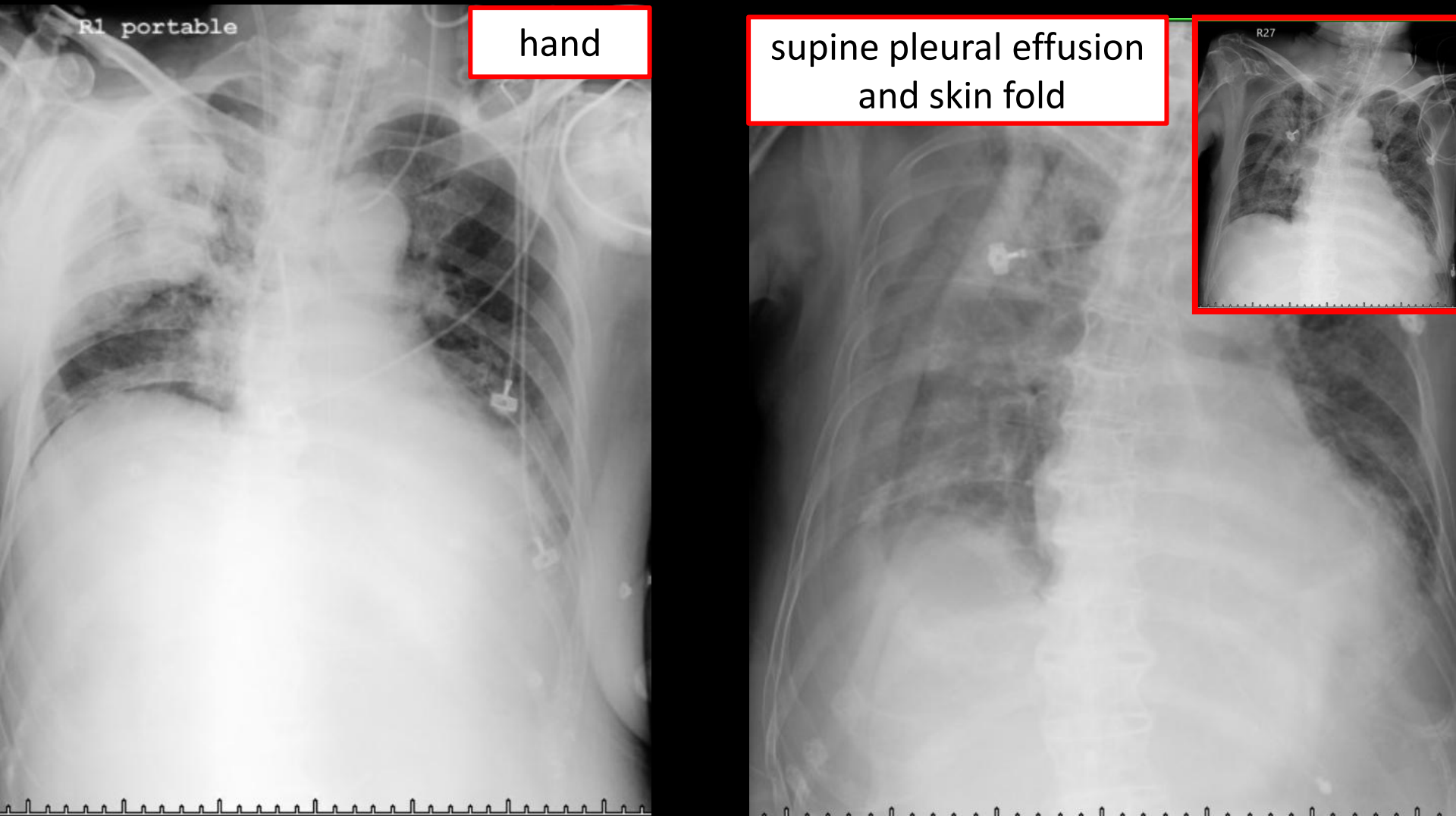


Mimicker of airspace opacity

extra-pulmonary

hand

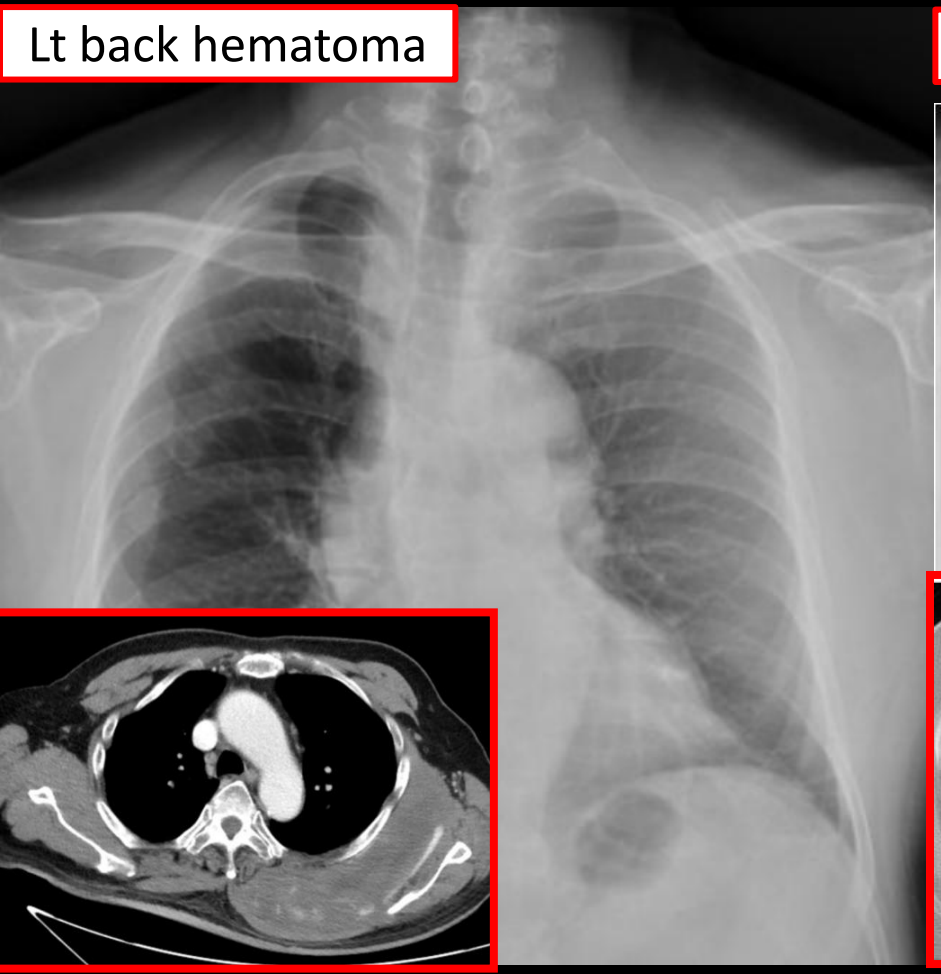
supine pleural effusion and skin fold



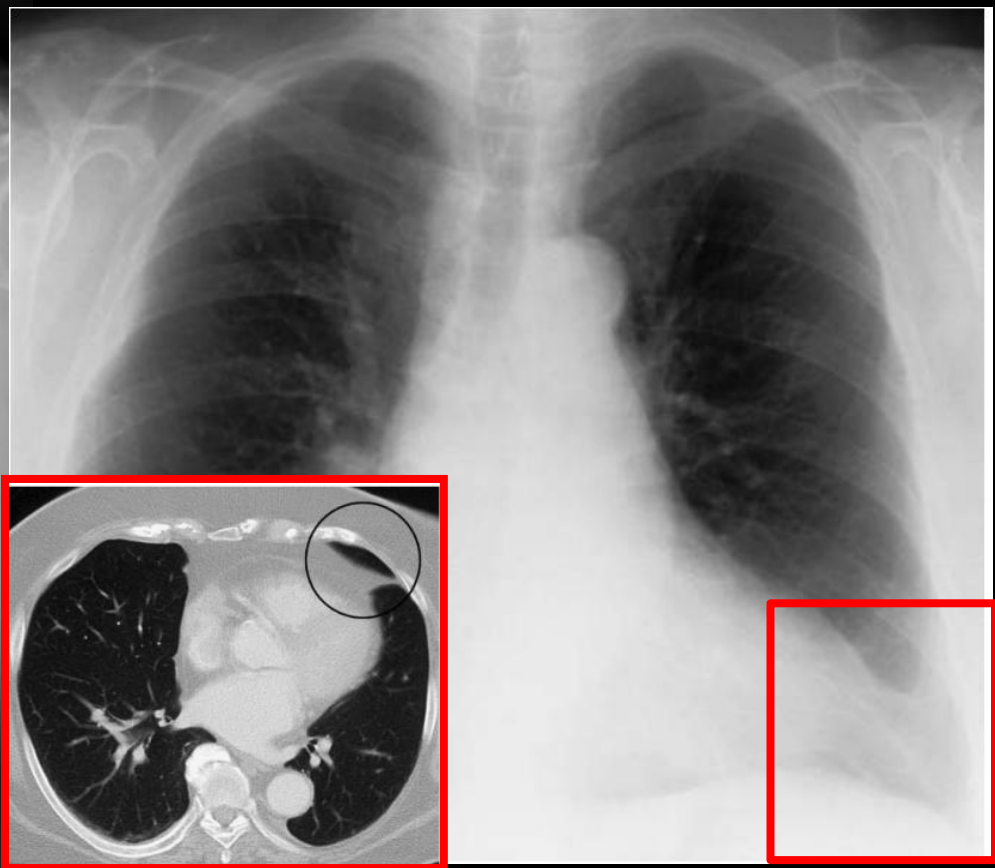
Mimicker of airspace opacity

extra-pulmonary

Lt back hematoma



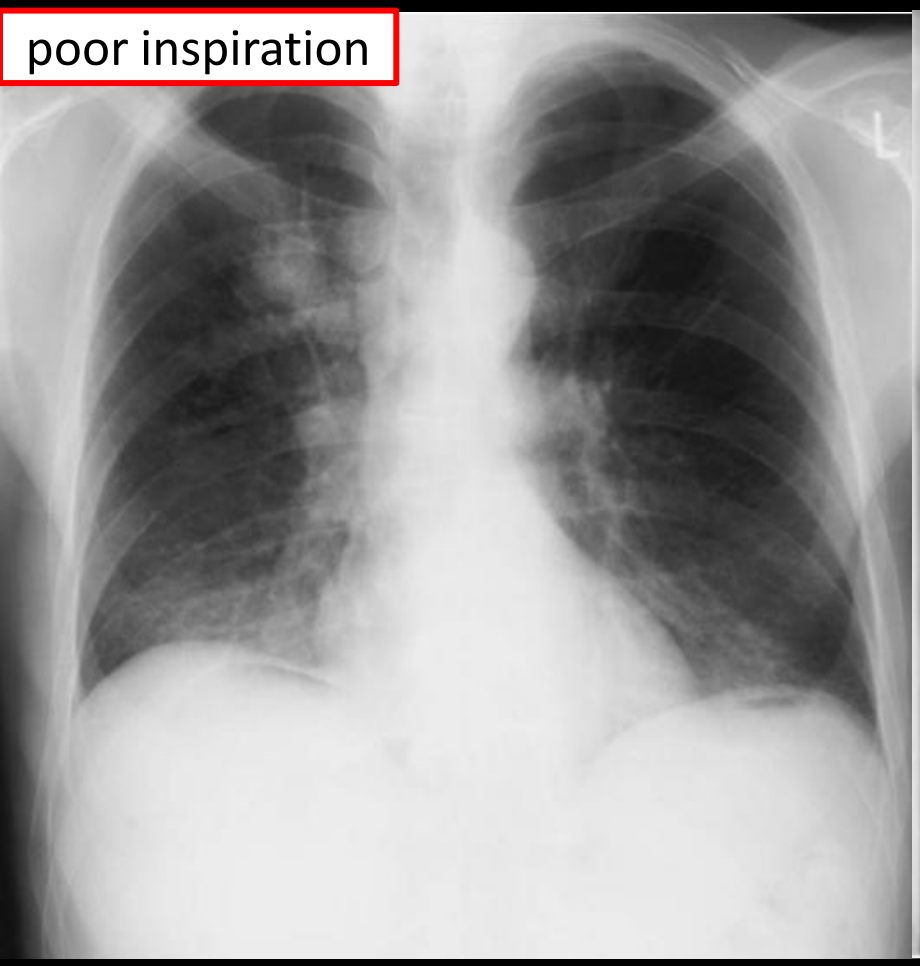
pericardial fat

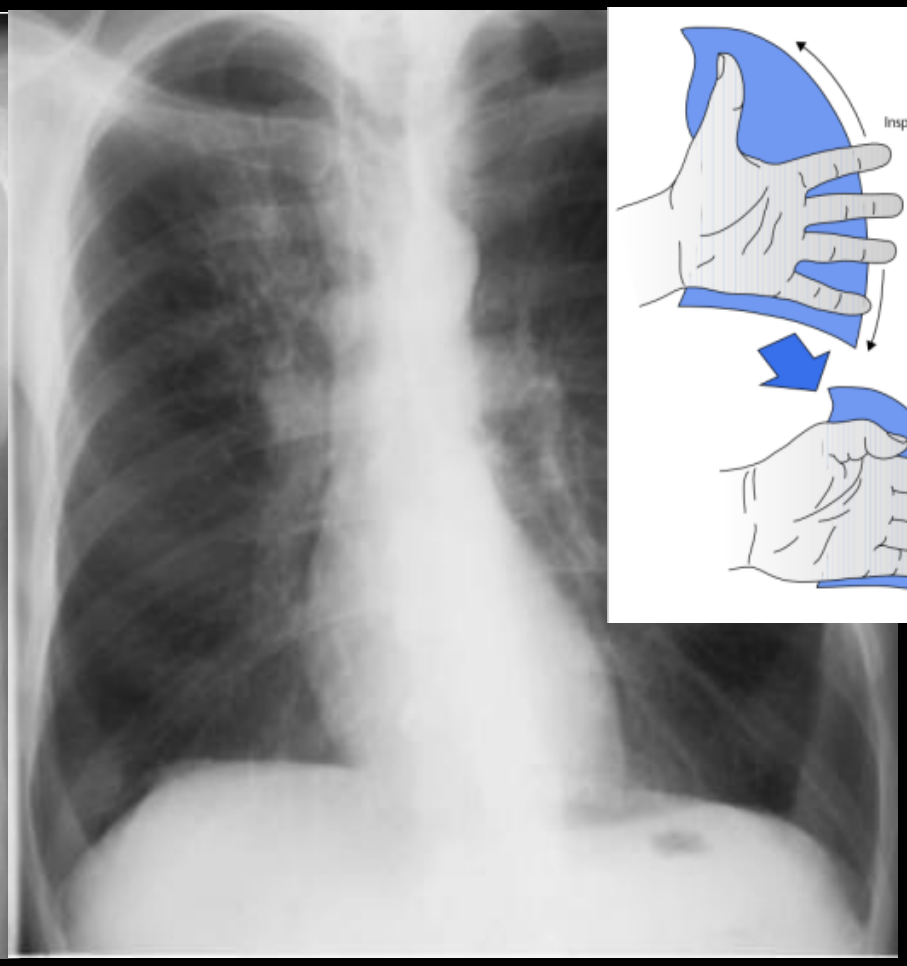


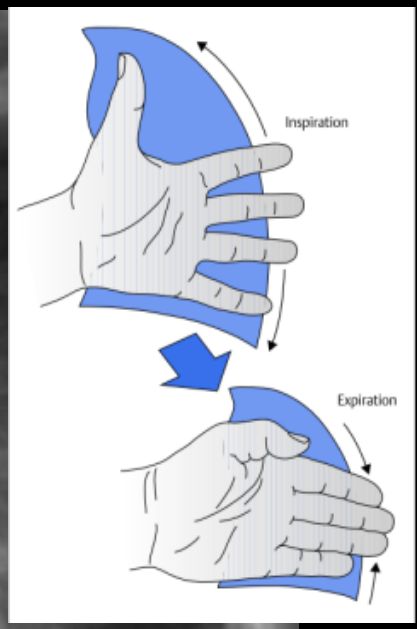
Mimicker of airspace opacity

intra-pulmonary

poor inspiration





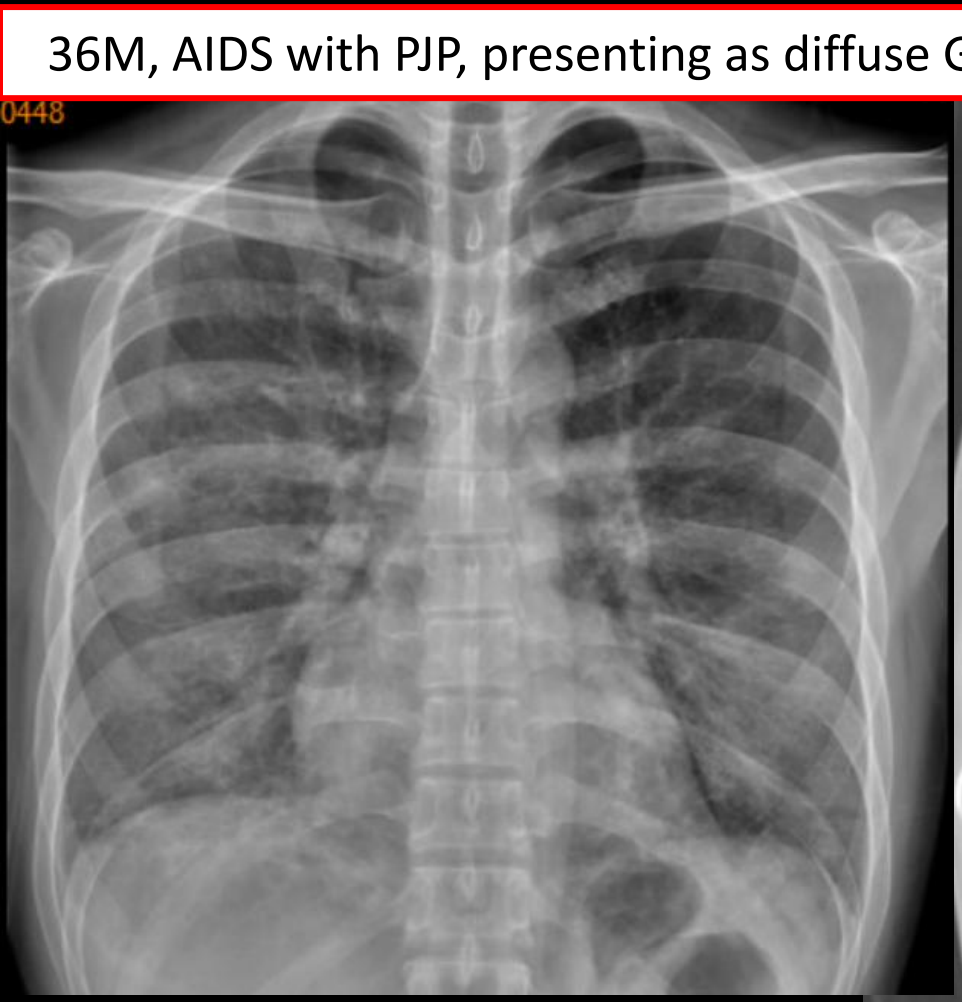


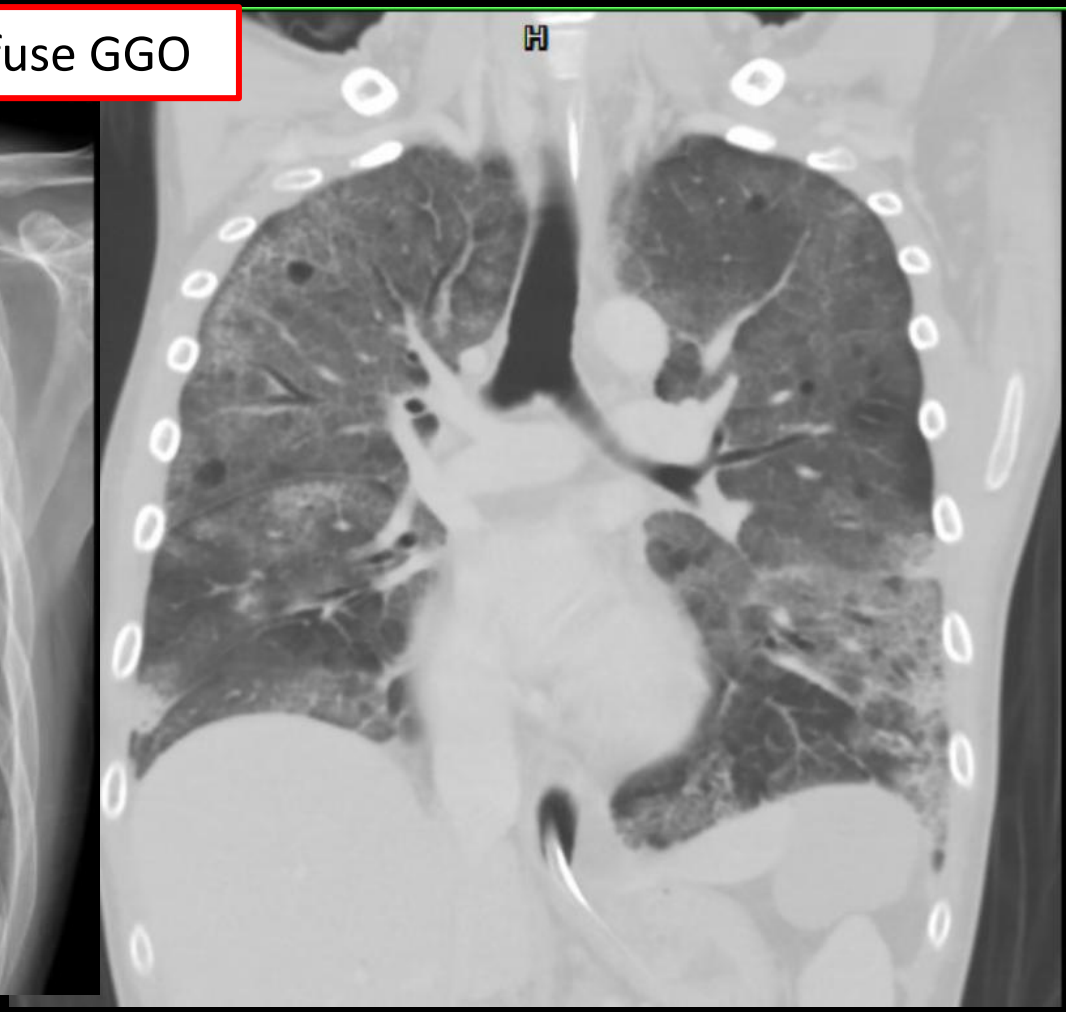
Kirchner J. Chest Radiology: A Resident's Manual, 1st Edition

Mimicker of airspace opacity

intra-pulmonary

36M, AIDS with PJP, presenting as diffuse GGO

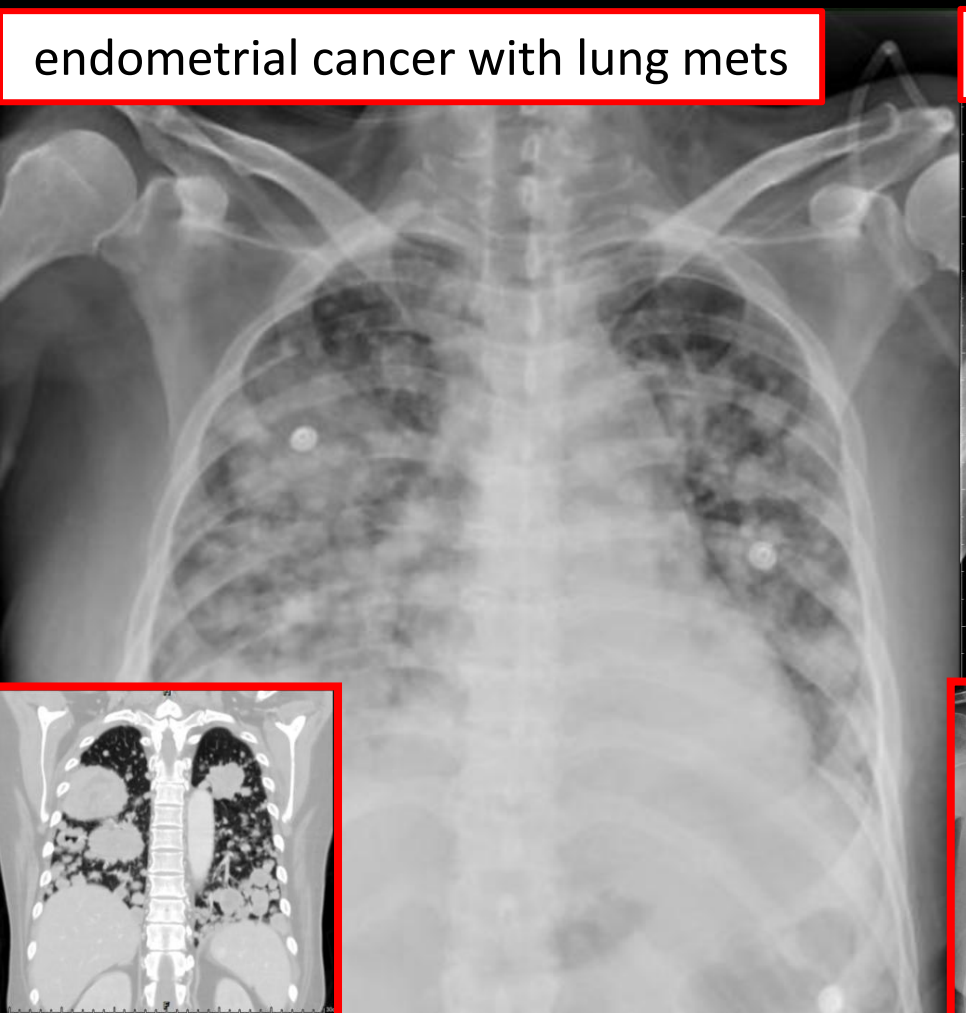




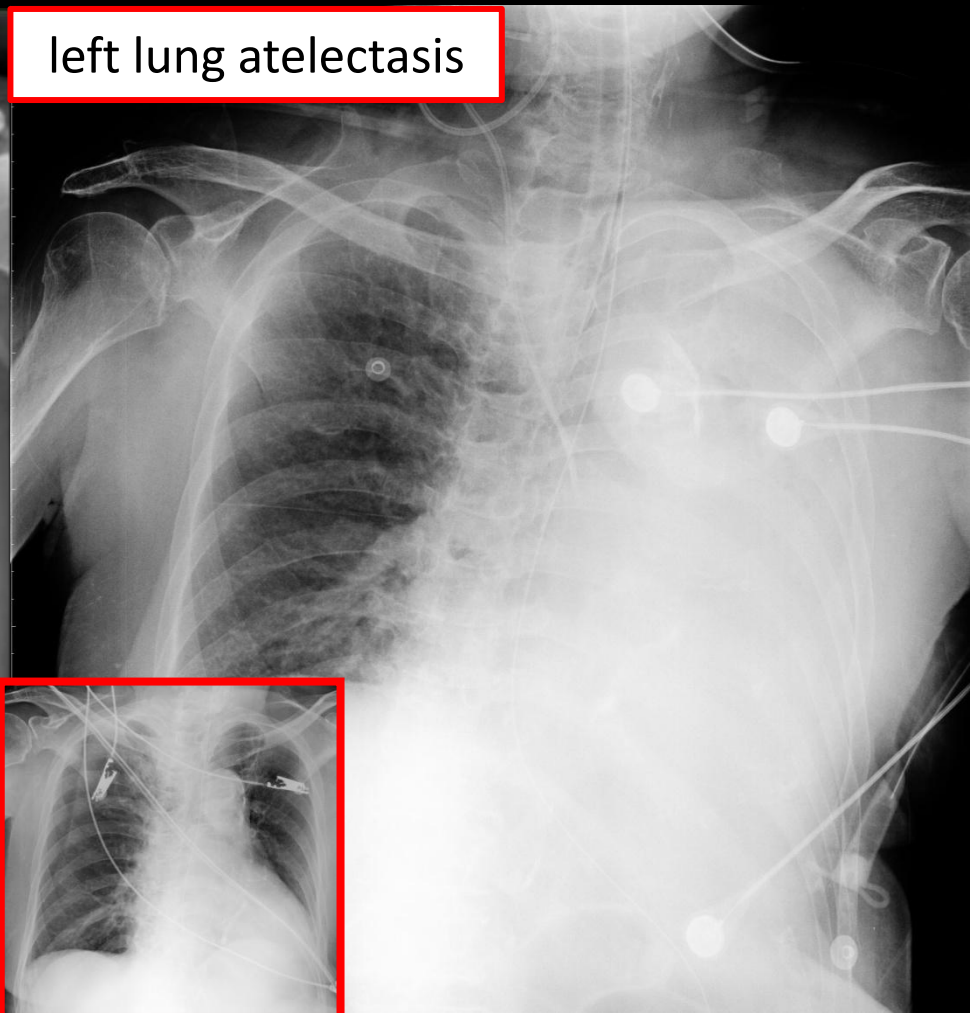
Mimicker of airspace opacity

intra-pulmonary

endometrial cancer with lung mets



left lung atelectasis



Spectrum of airspace opacity

Airspace opacity

pathologic feature

- Replacement of air in the distal airways and alveoli by fluid (transudate/exudate/pus/blood) or other material (tumor/protein)
- No destruction or displacement of the gross morphology of lung

Hansell DM et al. Imaging of Diseases of the Chest, 5th Edition

Airspace opacity

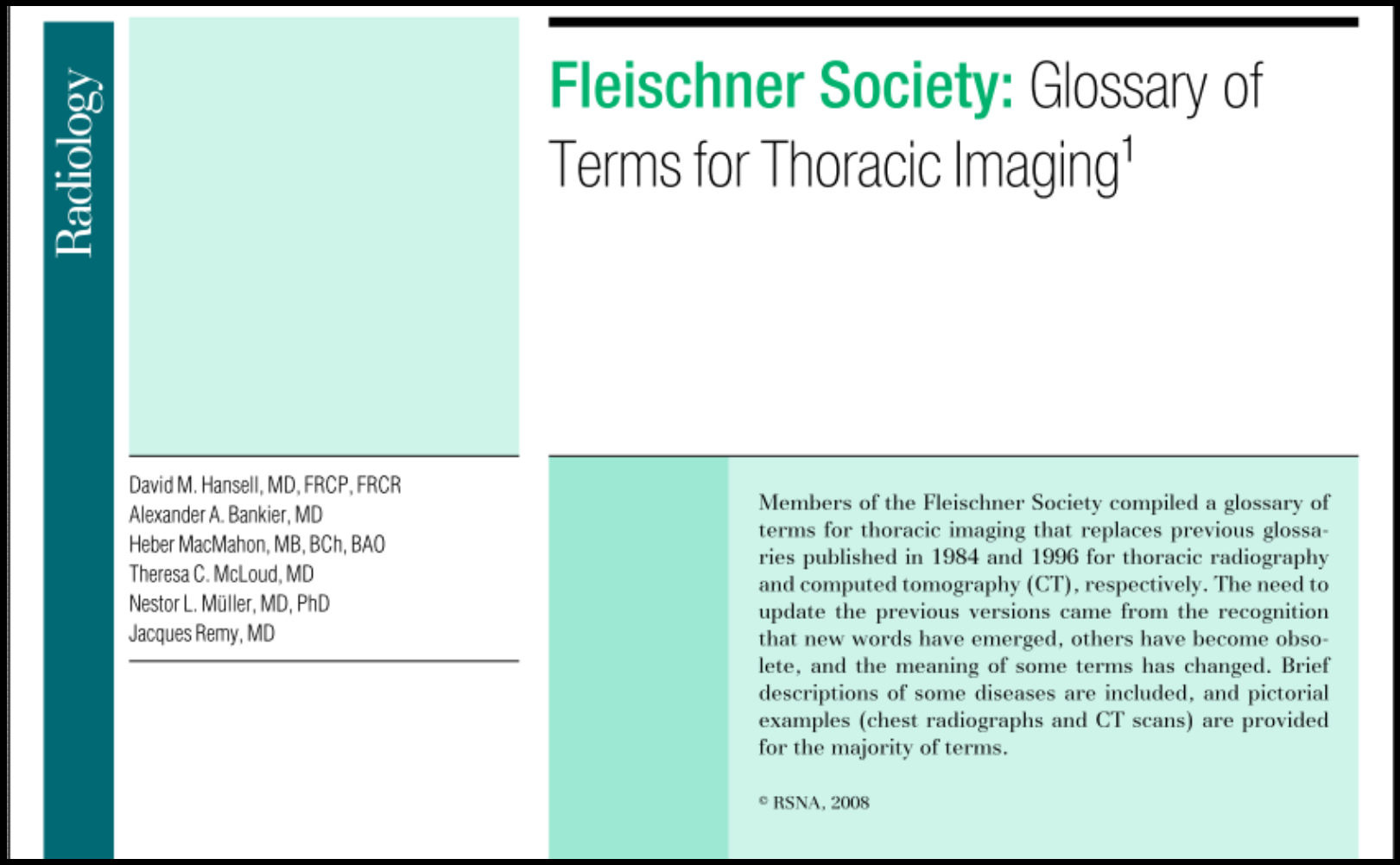
radiological feature

Character	Comment
number	one or multiple, may coalesce.
margin	Ill-defined
vascular marking	indistinct or invisible
shape	conical/segmental/wedge
location	often peripheral

Hansell DM et al. Imaging of Diseases of the Chest, 5th Edition

Glossary of Terms for Thoracic Imaging

basis for communication



Radiology

Fleischner Society: Glossary of Terms for Thoracic Imaging[1]

David M. Hansell, MD, FRCP, FRCR
Alexander A. Bankier, MD
Heber MacMahon, MB, BCh, BAO
Theresa C. McLoud, MD
Nestor L. Müller, MD, PhD
Jacques Remy, MD

Members of the Fleischner Society compiled a glossary of terms for thoracic imaging that replaces previous glossaries published in 1984 and 1996 for thoracic radiography and computed tomography (CT), respectively. The need to update the previous versions came from the recognition that new words have emerged, others have become obsolete, and the meaning of some terms has changed. Brief descriptions of some diseases are included, and pictorial examples (chest radiographs and CT scans) are provided for the majority of terms.

REVIEWS AND COMMENTARY ■ SPECIAL REVIEW

Hansell DM et al. Radiology. 2008;246:697-722.

Airspace(*) opacity
classification

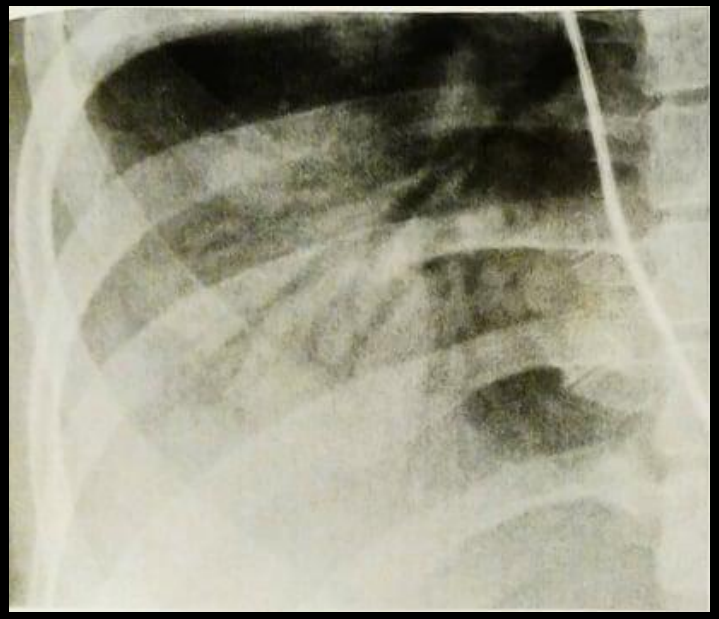
Subdivision	Comment
consolidation(*)	exudate/pus/blood/tumor; obscure vascularity
ground glass opacity(*)	different definition for CXR/CT
acinar shadow acinar nodule(*)	acinus(*) normally not visible; poorly defined nodules pathologically
air bronchogram(*)	airway patency + alveolar air loss
air alveologram	
Infiltrate(*)	pulmonary opacity by airspace/interstitial dz still controversial; no longer recommended

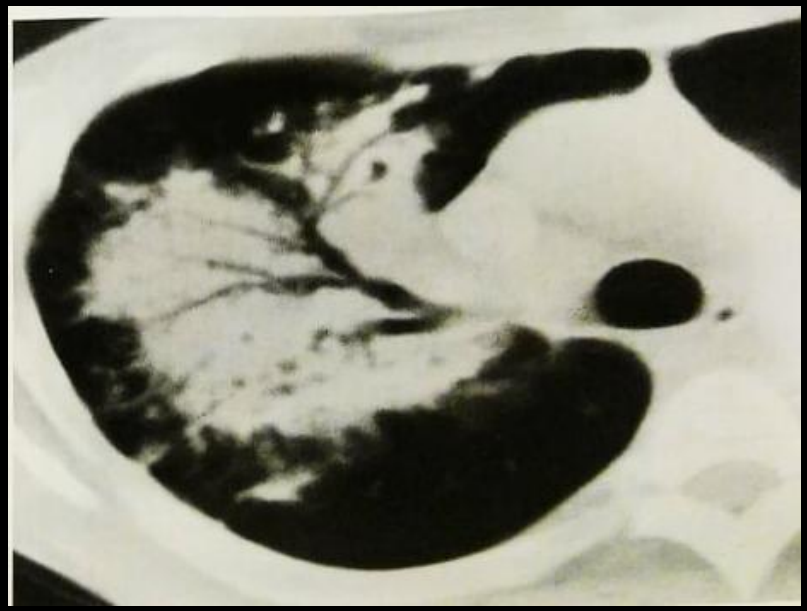
(*) in Fleischner Society

*Hansell DM et al. Radiology. 2008;246:697-722.
Hansell DM et al. Imaging of Diseases of the Chest, 5th Edition

Air bronchogram

- Air within bronchi/bronchioles through airless parenchyma
- Indicating “intrapulmonary” lesion





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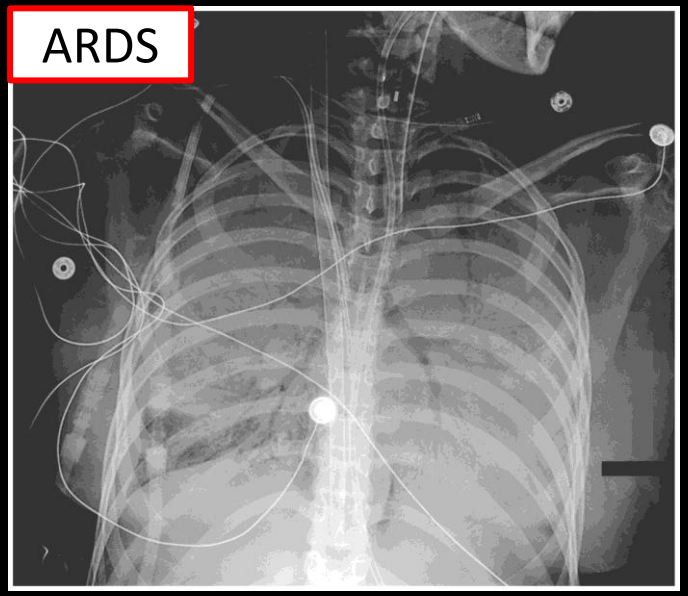
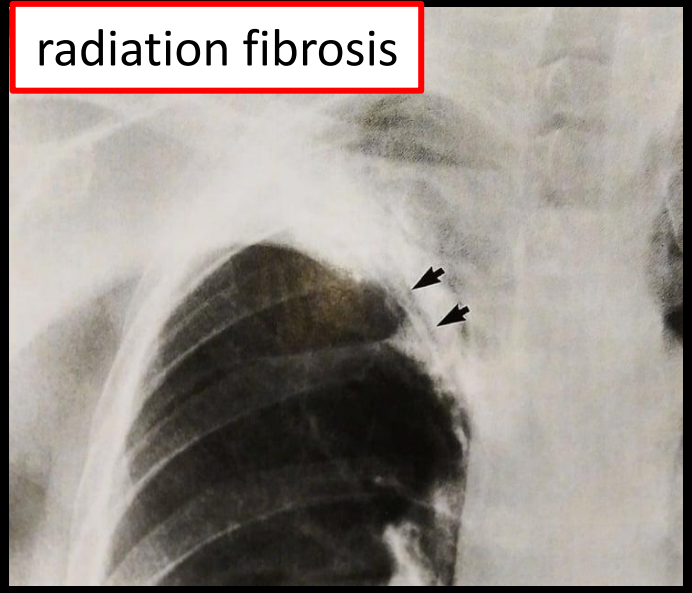
Cause of air bronchogram

Common	Uncommon
consolidation/pneumonia	BAC(formerly called)/lymphoma
pulmonary edema	severe fibrosis (UIP/radiation/sarcoidosis)
ARDS/RDS	Postobstructive pneumonia
atelectasis (compressive)	

ARDS



radiation fibrosis



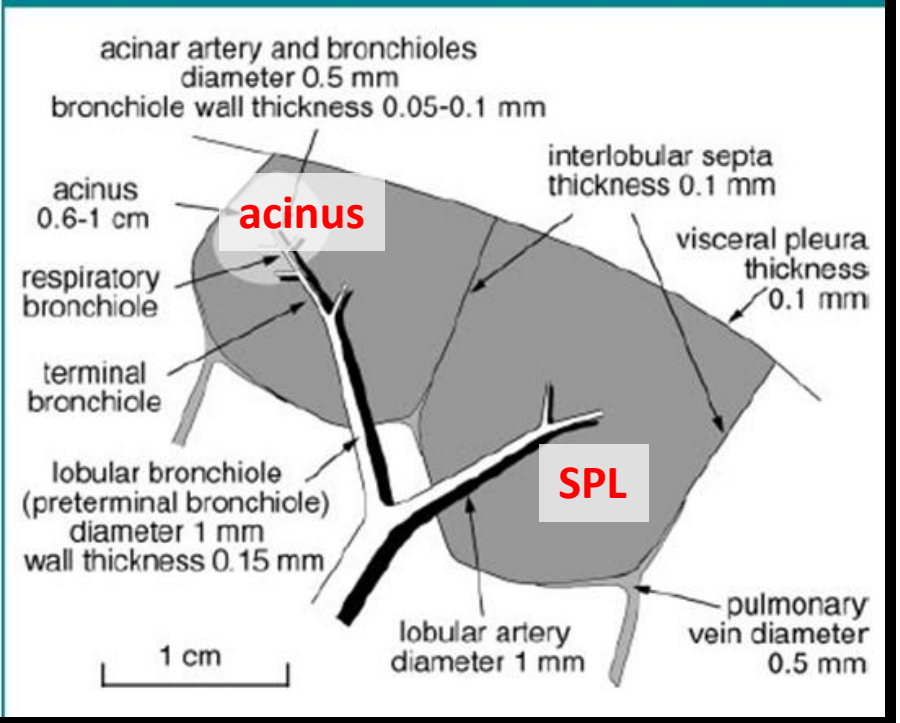
Natt B, et al. N Engl J Med. 2015;373:2663.

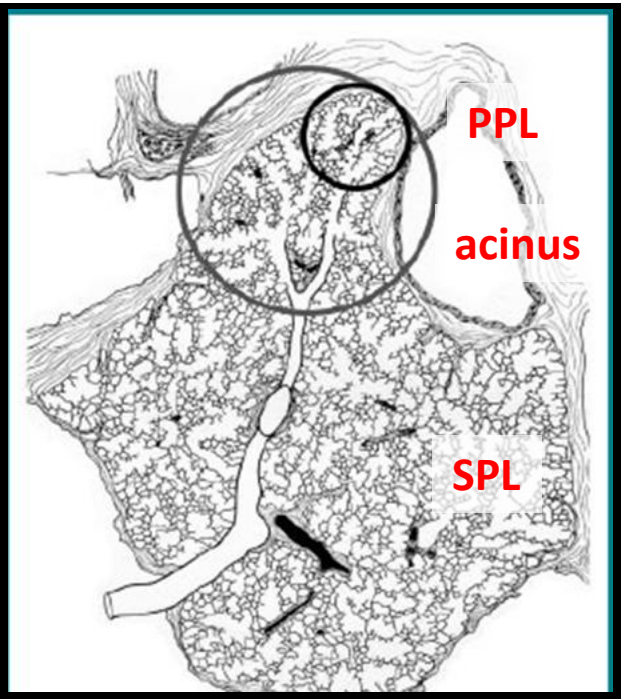
Hansell DM et al. Imaging of Diseases of the Chest, 5th Edition

Anatomical unit of the lung

Definition	Components		
	terminal bronchiole	respiratory bronchiole	alveolar duct/sac & alveolus
2° pulmonary lobule (1-2.5cm) = 3-25 acini	+	+	+
acinus (0.6-1cm)		+	+
1° pulmonary lobule			+

Webb WR. Radiology 2006; 239:322–8.





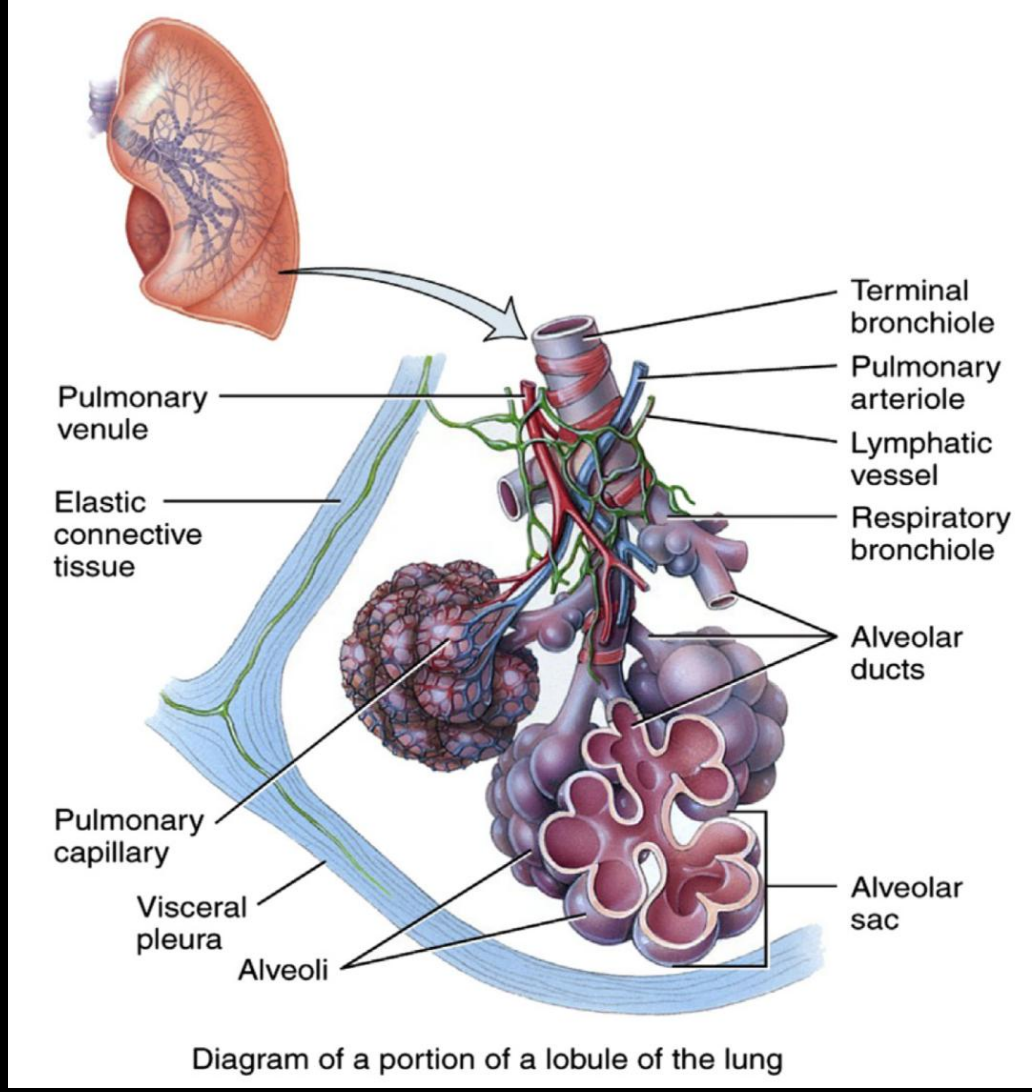


Diagram of a portion of a lobule of the lung

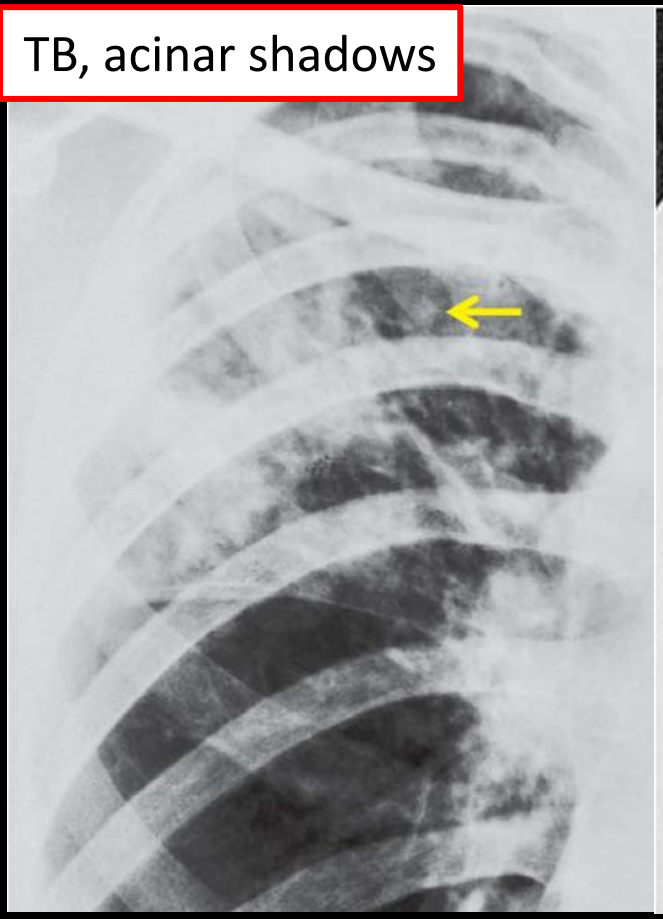
Webb WR. Radiology 2006; 239:322–8.
Raju S et al. Chest. 2017;151(6):1356-1374.
Gruden JF et al. Chest. 2020;157(3):612-635.

Acinar shadows

- Ill-defined nodular shadows (0.5-1cm) within or adjacent to the larger opacities of airspace filling
- Particularly with pulmonary edema or infection (notably varicella or TB)
- Due to opaque acini contrasted against aerated lung
- D/D with other micronodular change

Hansell DM et al. Imaging of Diseases of the Chest, 5th Edition
Kirchner J. Chest Radiology: A Resident's Manual, 1st Edition

TB, acinar shadows



TB, confluent acinar shadows

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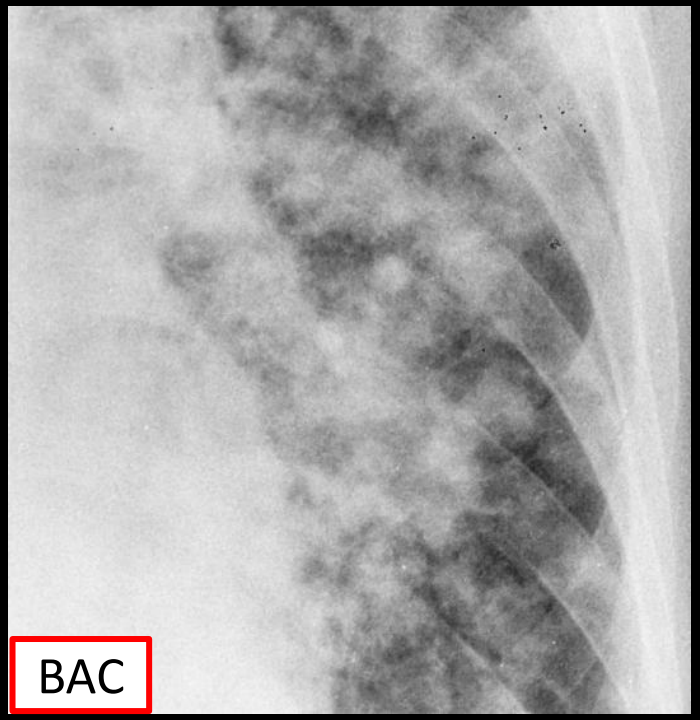
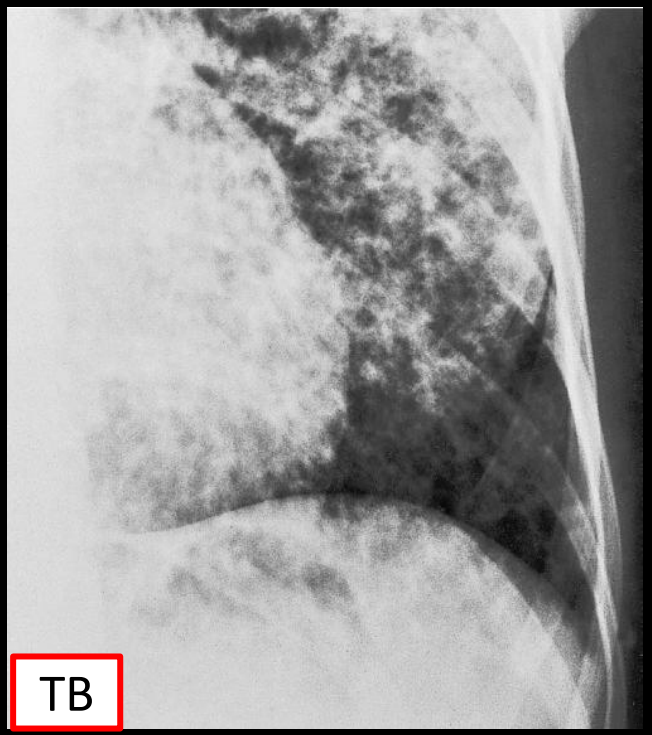
Air alveologram

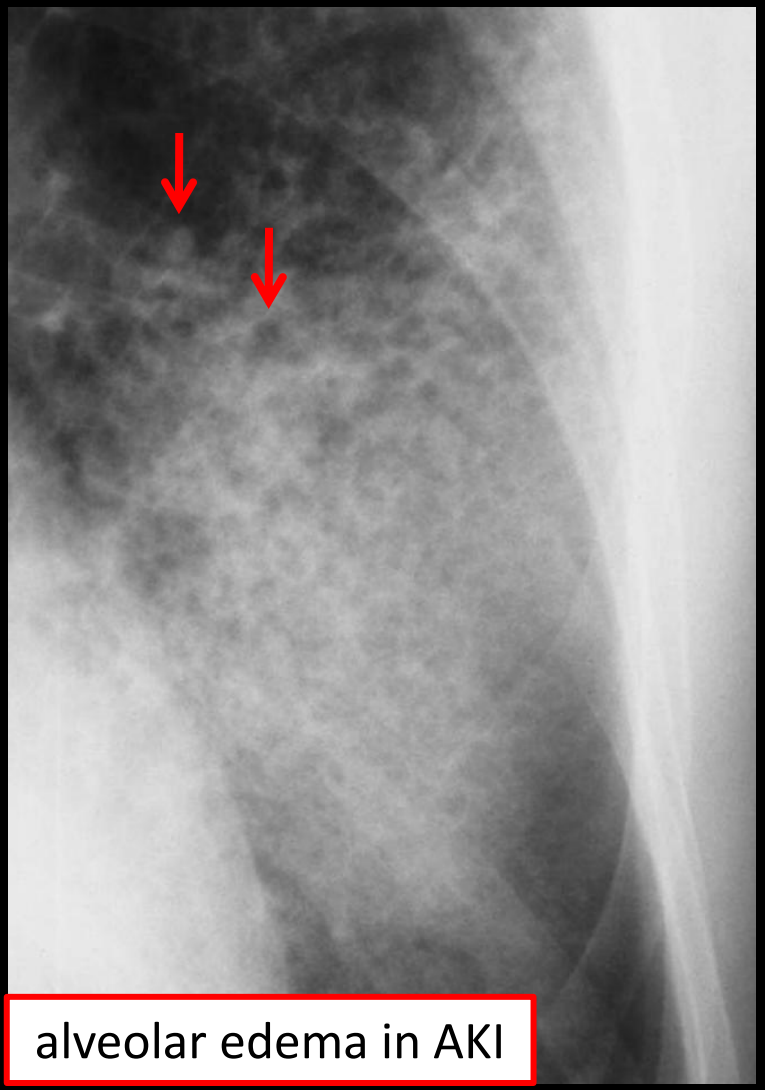
- Small rounded lucencies
- Aerated acini srrounded by opaque lung
- In areas of incomplete consolidation





Murray & Nadel's Textbook of Respiratory Medicine, 6th Edition
Hansell DM et al. Imaging of Diseases of the Chest, 5th Edition

Acinar shadows + Air alveologram



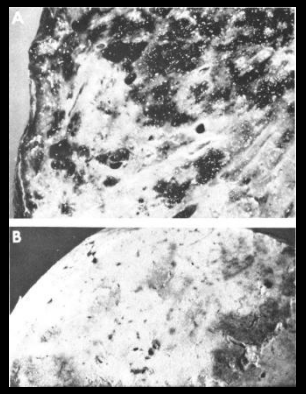
alveolar edema in AKI

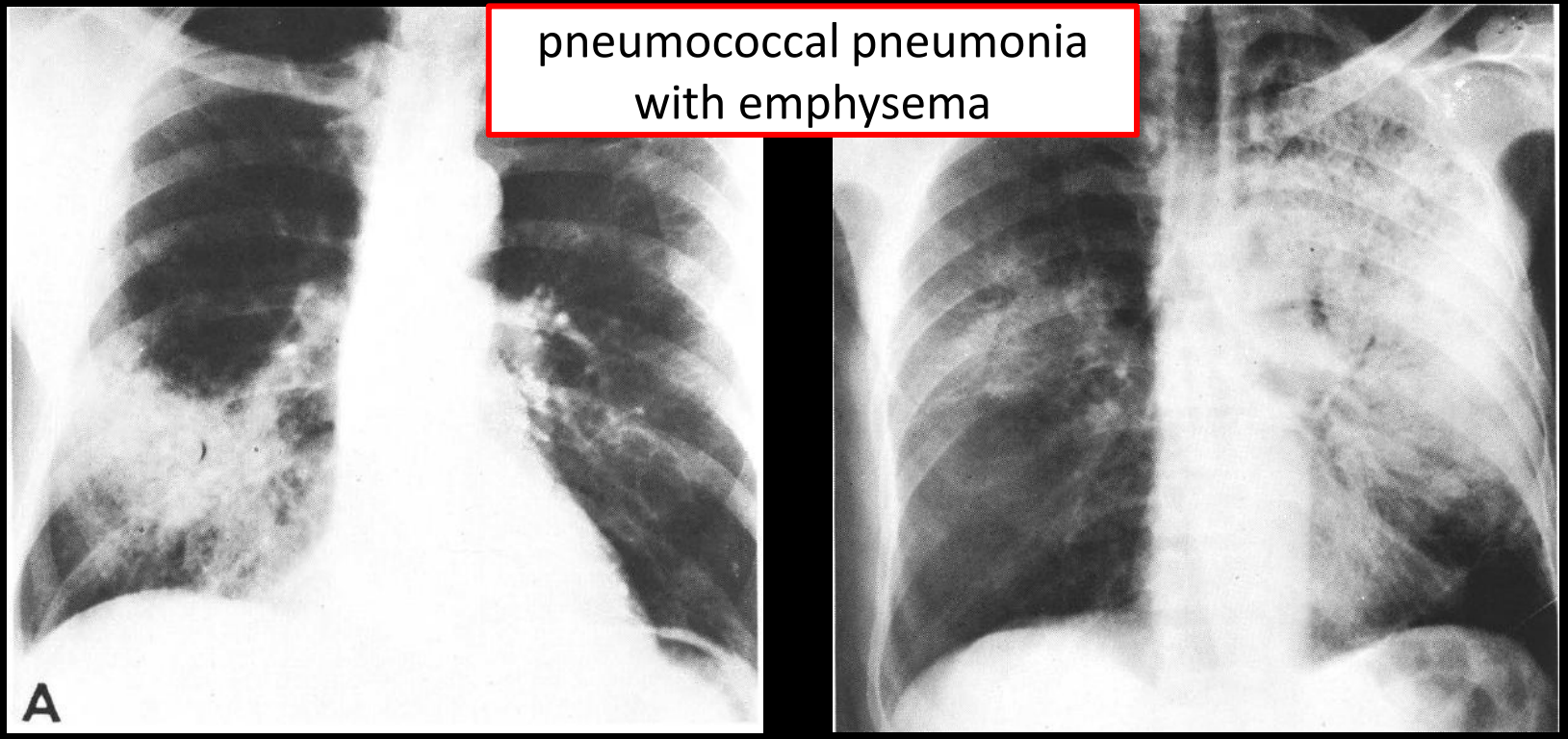
Yin & Yang

Kirchner J. Chest Radiology: A Resident's Manual, 1st Edition

Incomplete consolidation

- Honeycomb appearance
- 合併emphysema (or COPD)
- 影像會低估疾病嚴重度





pneumococcal pneumonia
with emphysema

Ziskind MM, et al. Ann Intern Med. 1970;72:835-9.

Ground glass opacity (GGO)

- CXR
  - area of hazy increased lung opacity, usually extensive, within which margins of pulmonary vessels may be indistinct
- HRCT
  - increase in attenuation of the lung parenchyma without obscuration of the underlying bronchovascular structures

Hansell DM et al. Radiology. 2008;246(3):697-722.
Hansell DM et al. Imaging of Diseases of the Chest, 5th Edition

Fundamental CT Patterns

- GGO: 變白的病灶，血管紋仍可見。
- Consolidation：變白的病灶，血管紋不可見。

Figure 23

Figure 23: Transverse CT scan shows ground-glass opacity.

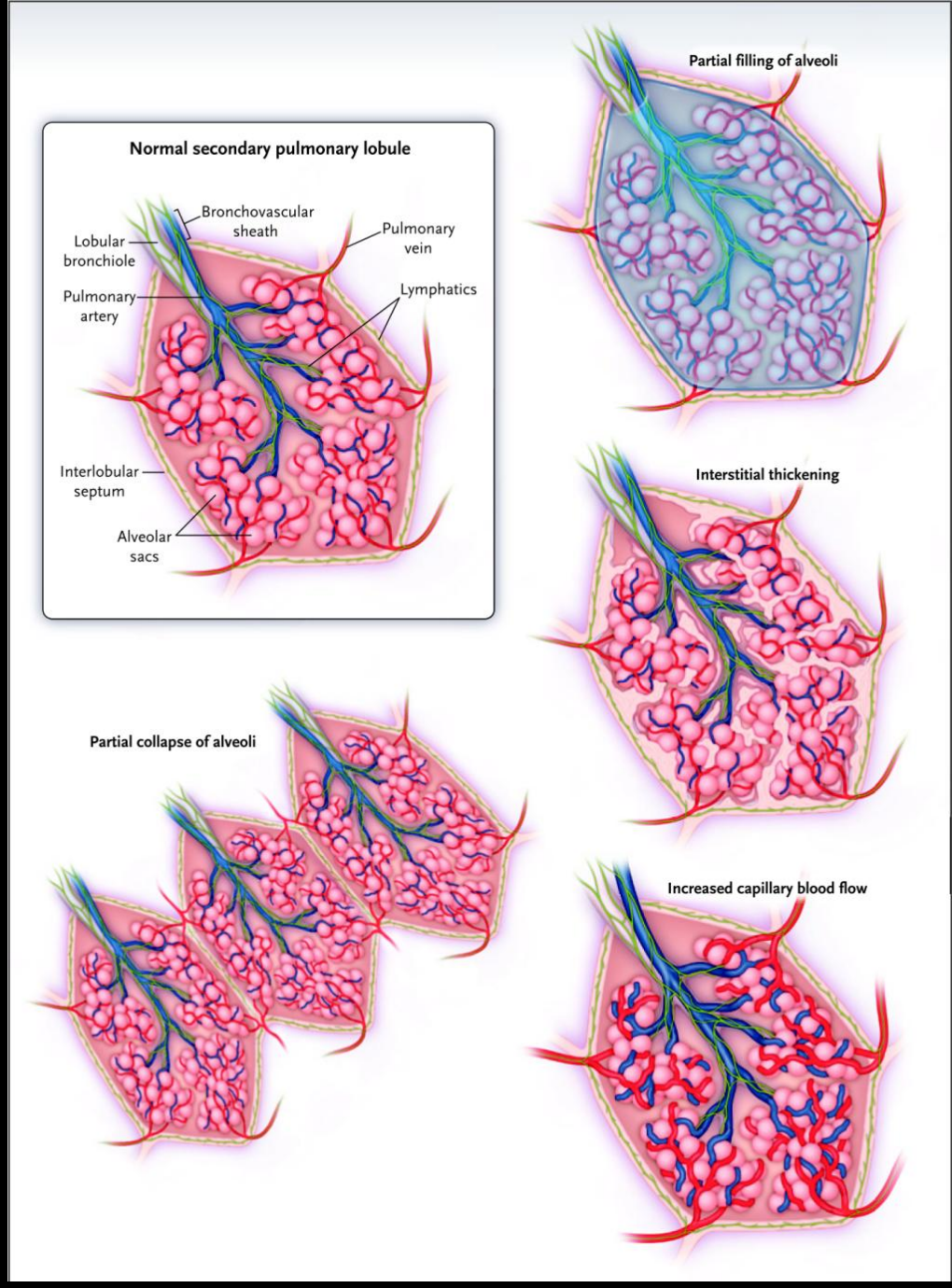
Figure 19

Figure 19: Transverse CT scan shows multifocal consolidation.

Hansell DM et al. Radiology. 2008;246(3):697-722.

Alveolar	Interstitial
partial filling	↑interstitium
partial collapse	↑blood flow

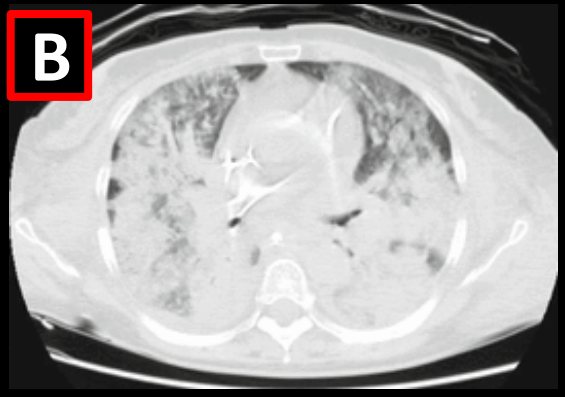
GGO的D/D，除了間質性疾病，還包含所有早期肺泡性疾病



Sharma A et al. N Engl J Med. 2020;10.1056

GGO影像-病理關聯

	Alveolar disease	Interstitial disease
Pathology	incomplete filling of alveoli	active inflammation fine (intralobular) fibrosis
Radiology (Chest CT)	合併consolidation consolidation多於GGO GGO在consolidation周圍	幾乎以GGO為主(isolated) GGO為雙側瀰漫性(diffuse) 不太有pleural effusion
代表疾病	lung edema (A) pneumonia (B)	interstitial pneumonitis (C) (virus/drug/radiation…)



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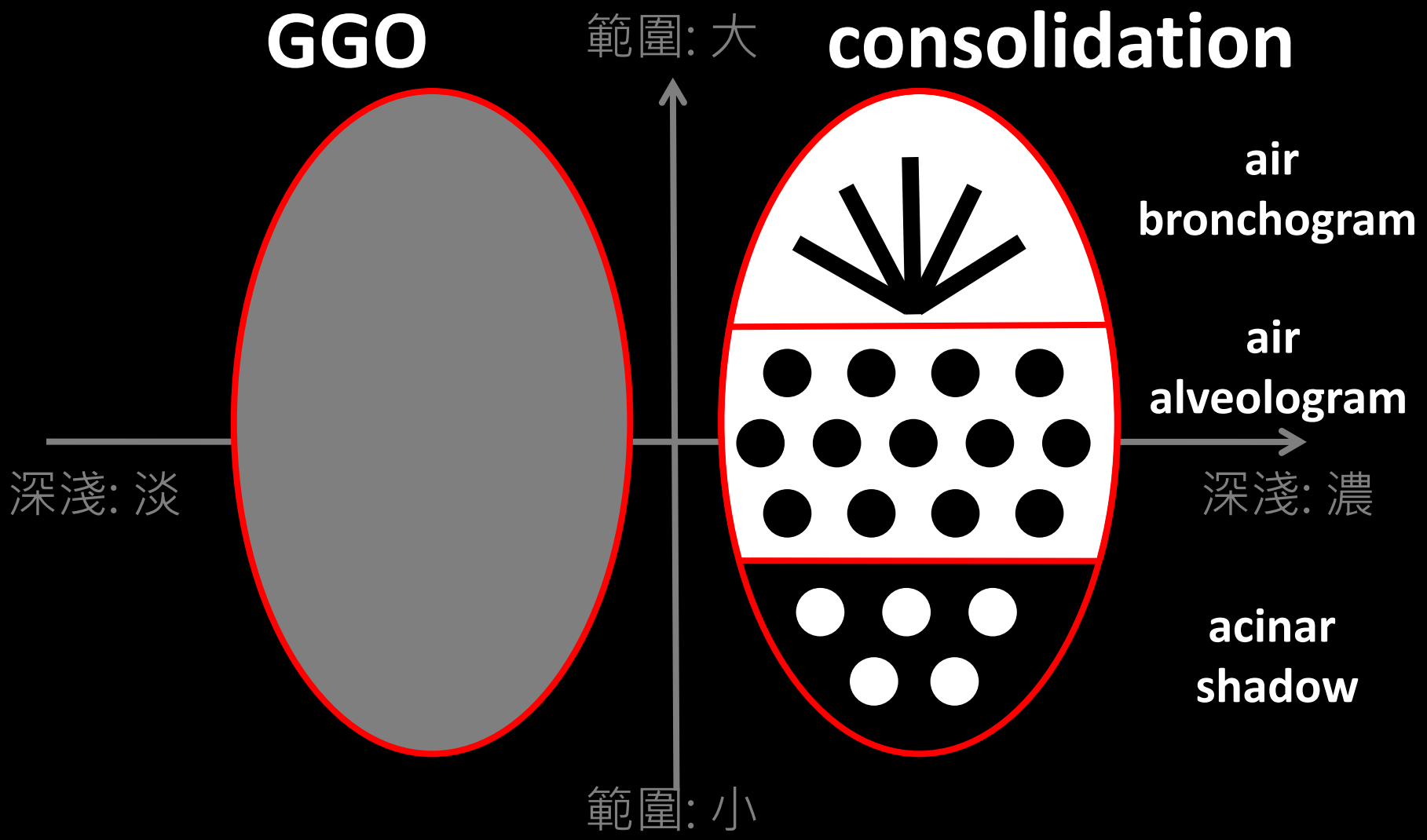
Airspace opacity
spectrum



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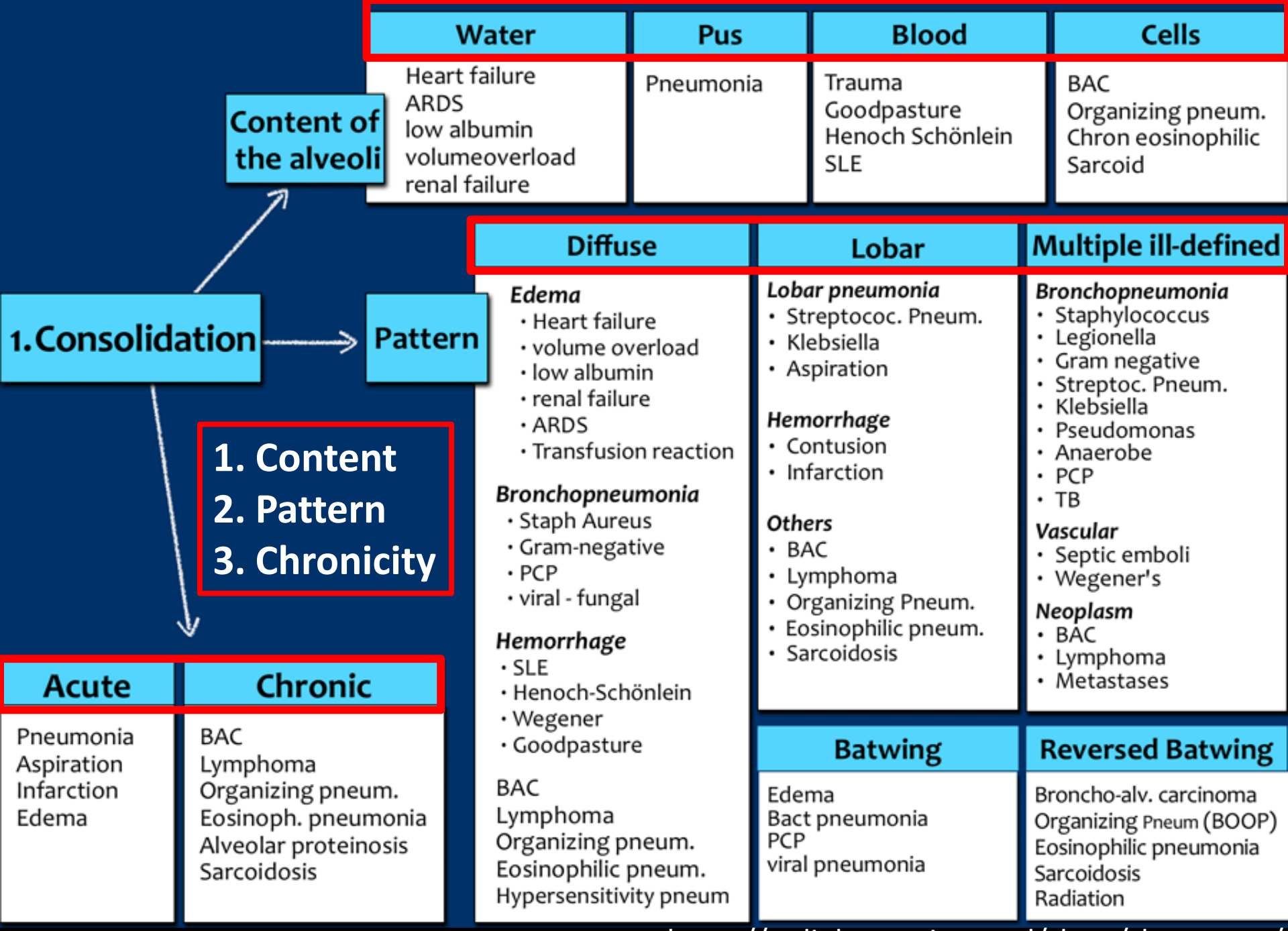
Diagnosis of airspace opacity

Algorithm/Pattern

Reasoning/Information

Special pattern



https://radiologyassistant.nl/chest/chest-x-ray/

Radiological reasoning

Infection
Neoplasm
Trauma
Infarction

Intervening normal lung
D/D as focal lung disease

Lung as a unit
Systemic disorder
Toxic lung injury

Focal
局部性

Multifocal
多病灶性

Diffuse
瀰漫性

pulmonary

systemic

Lobar pneumonia

Mutifocal pneumonia

ARDS

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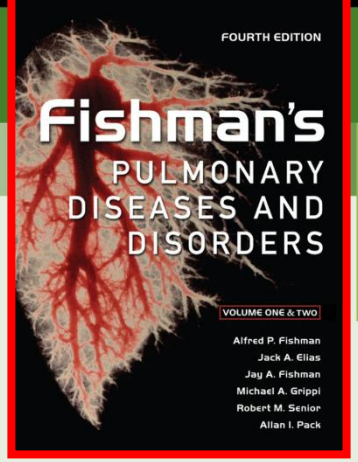
SECTION SEVEN
Diagnostic Procedures

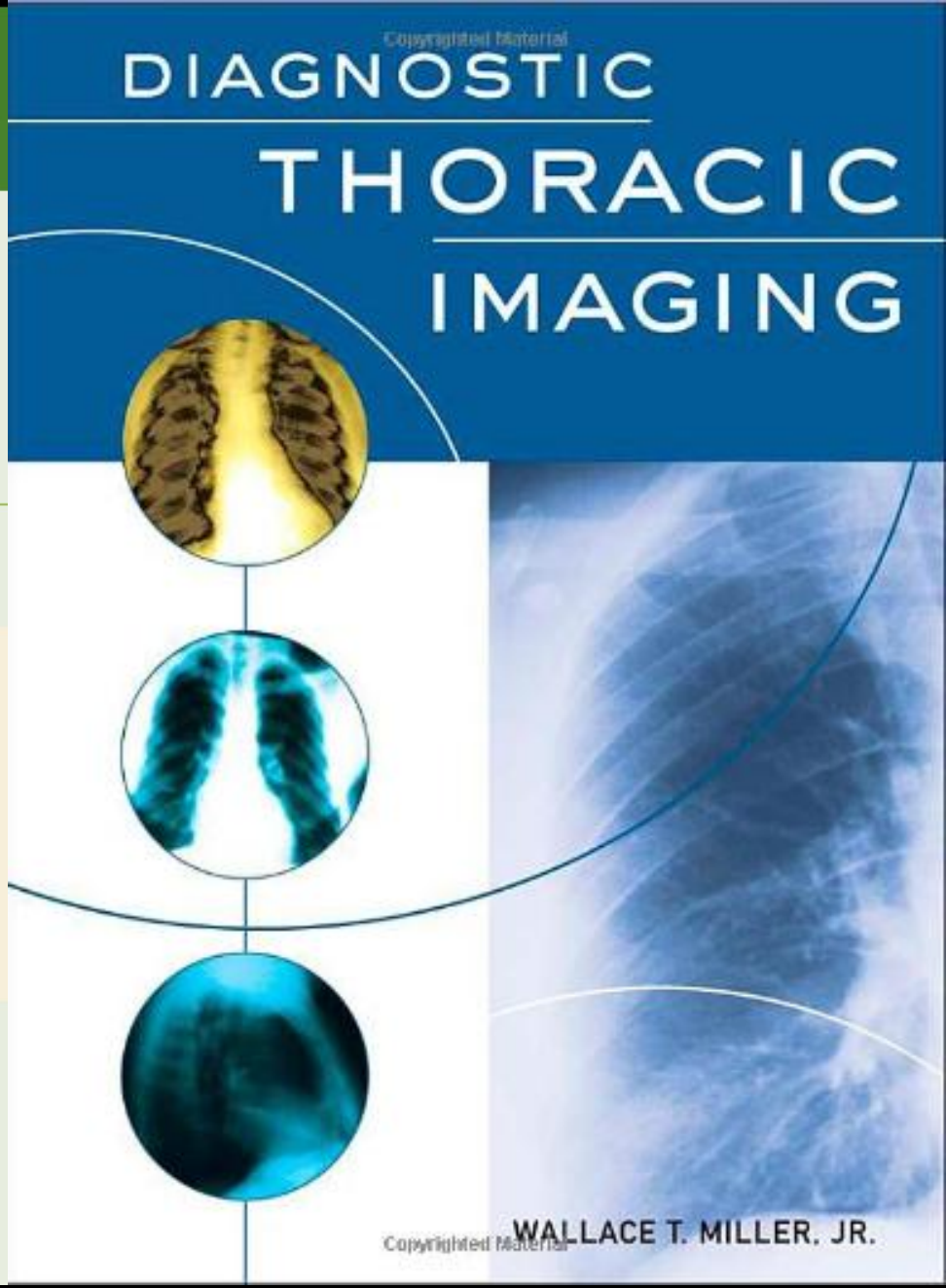


30
CHAPTER

Radiographic Evaluation of the Chest

Wallace T. Miller

Radiographic evaluation of the chest constitutes an important component in assessment of the patient with known or suspected pulmonary disease. In fact, the chest radiograph may provide the earliest or only clue to the presence of clinically significant respiratory disease. This chapter provides a brief overview of chest radiology. First, general aspects are covered; use of more specialized techniques, including computed tomography, nuclear magnetic resonance, and arteriography, is highlighted. Subsequently, radiographic manifestations of diseases that affect the distribution of pulmonary blood flow, the airways, and the lung parenchyma are considered. Finally, disorders are reviewed that are predominantly or exclusively confined to anatomically distinct areas of the thorax, including the mediastinum, diaphragm and chest wall, and pleura. Throughout the presentation, examples of radiographs are provided to highlight the principles and disorders discussed.



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Penn Medicine

Father-Son Duo Works Side-by-Side as Chest Radiologists

Released: 6/19/2006 4:00 PM EDT
Source Newsroom: Perelman School of Medicine at the University of Pennsylvania

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Newswise — For nearly a half a century, Wallace Miller, Sr., MD has been scrutinizing images in the dark at the Hospital of the University of Pennsylvania (HUP) - and for the last 20 years, his son, Wallace Miller, Jr., MD, has been right by his side. Together, as chest radiologists in the Thoracic Imaging Division at Penn, this father-son duo has read close to one and a half million chest X-ray exams over the years!

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Sections: Medicine

Keywords: Thoracic Imaging, Radiology, Imaging, Chest

You can find the father-son duo of Drs. Wallace Miller, Sr. and Jr. working side-by-side as Chest Radiologists at the Hospital of the University of Pennsylvania. Miller, Jr. says, "Occasionally, my dad and I will disagree slightly on the interpretation of an exam. Everyone thinks that's hilarious, a family spat. But in reality, that's the way life is – people who come from similar backgrounds can ultimately have different opinions."

Print-friendly Layout

#1 Diffuse airspace opacity

Content	Clinical
Water Pus Blood Others	Fever, cough pneumonia Poor consciousness aspiration Immunocompromised oppurtunistic infection Hemoptysis hemorrhage Longer than weeks proteinosis, neoplasm

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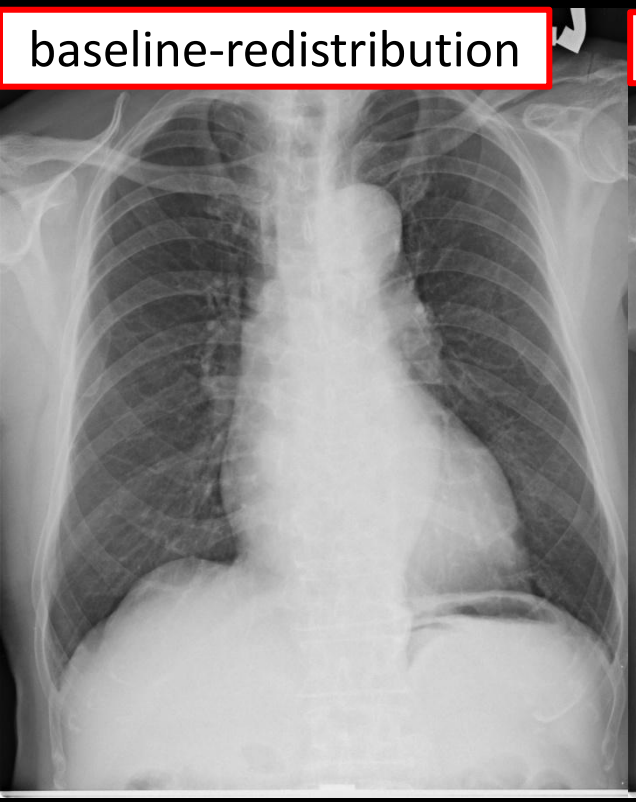
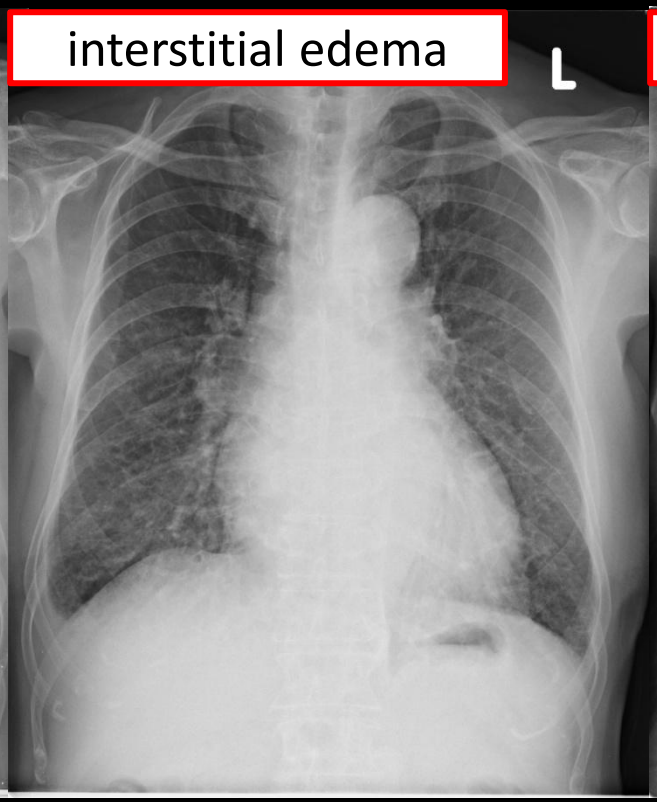
Cardiogenic lung edema

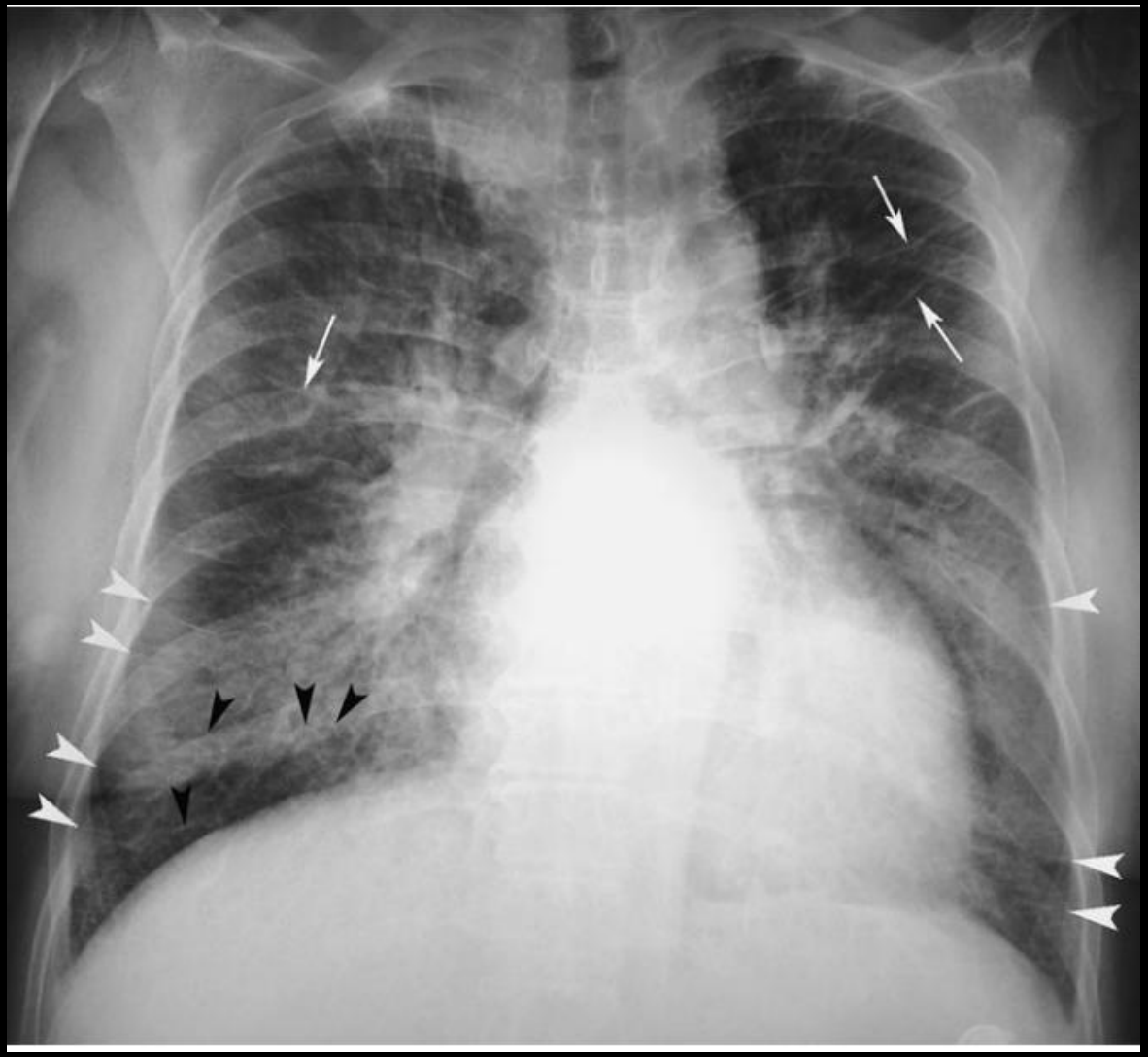
typical trilogy



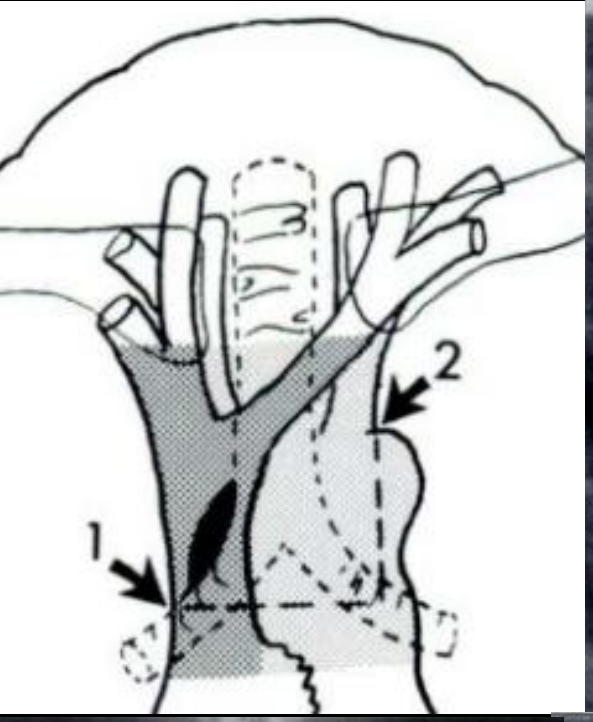


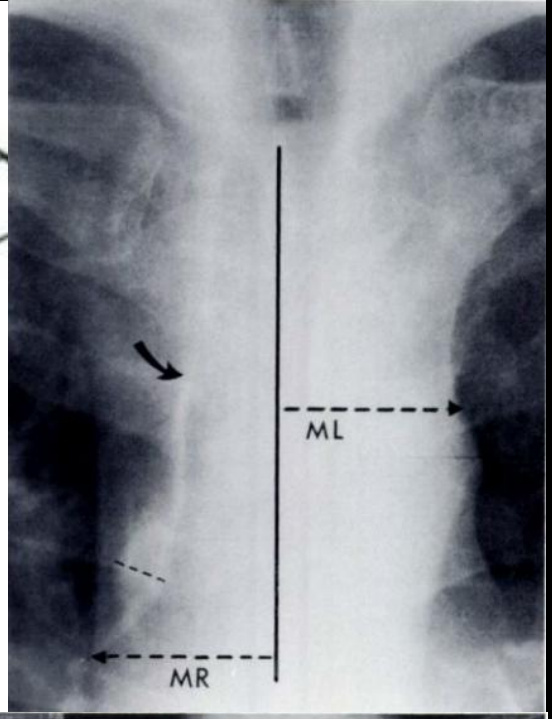
Cardiogenic lung edema

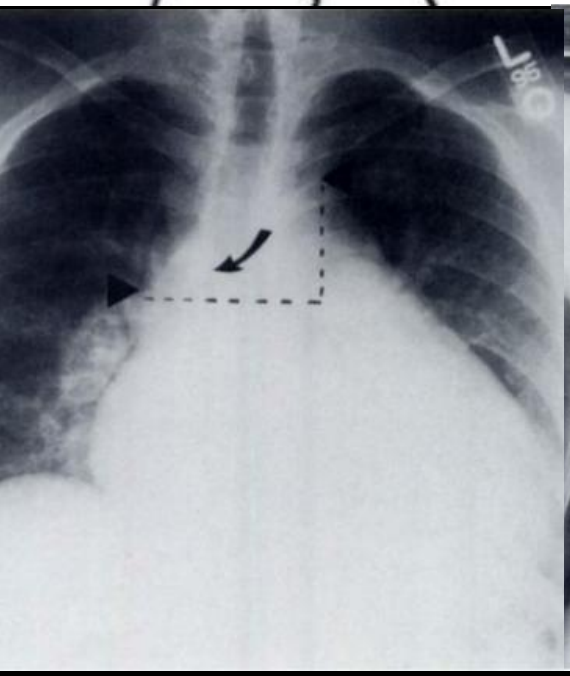
Kerley's A, B, and C lines

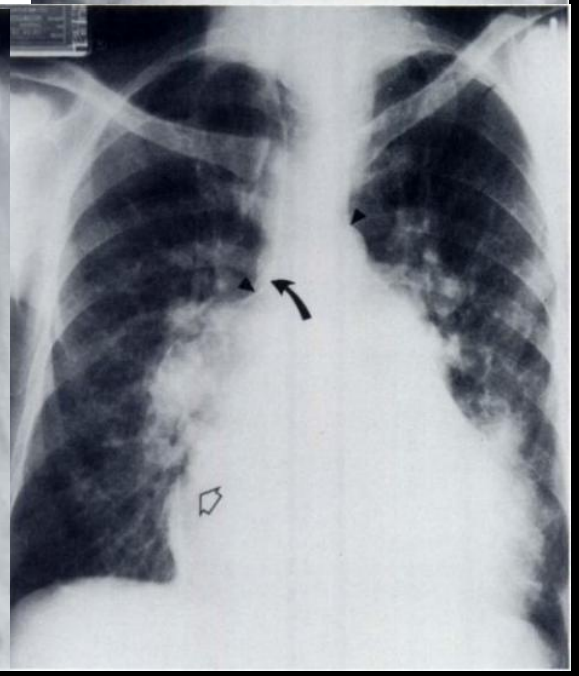


Koga T, et al. N Engl J Med. 2009;360:1539.





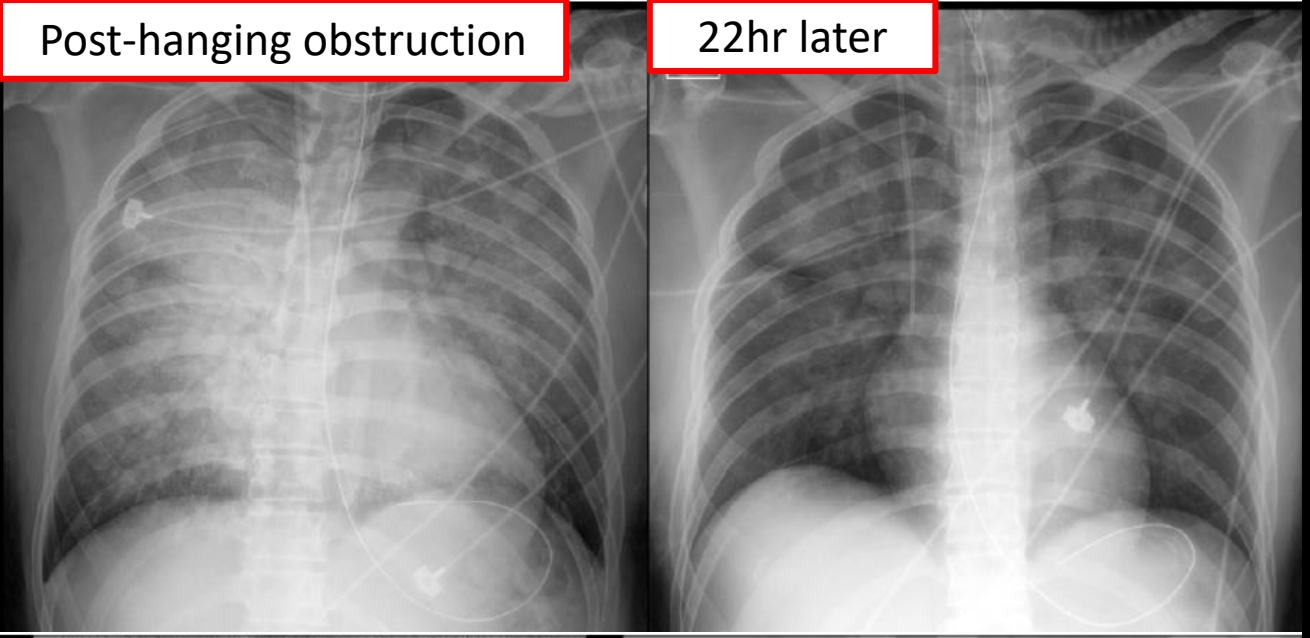


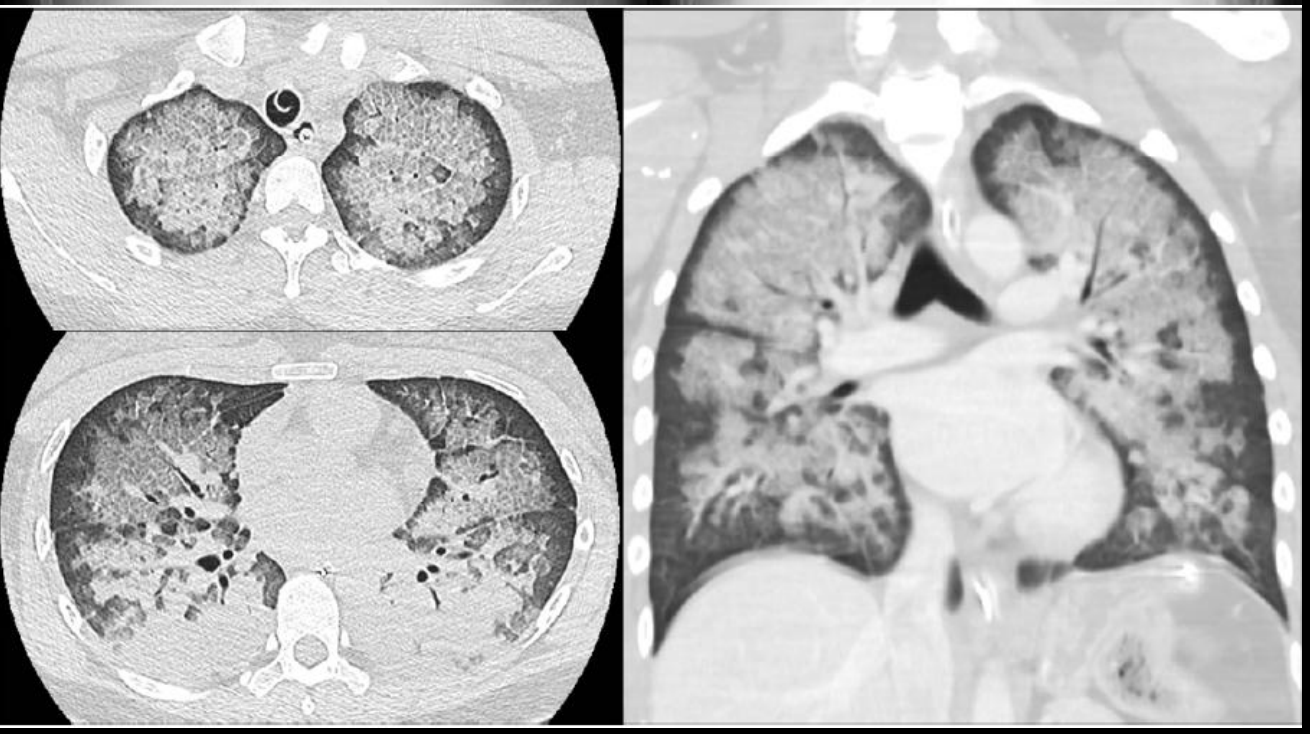


Vascular pedicle width (VPW)

Position	Comment
erect	normal: 48±5mm
supine	≧70mm → lung edema

Milne EN et al. Radiology. 1984;152:1-8.





Noncardiogenic lung edema

Kuo JS, Ruan SY, et al. Am J Respir Crit Care Med. 2021 Jun 16.

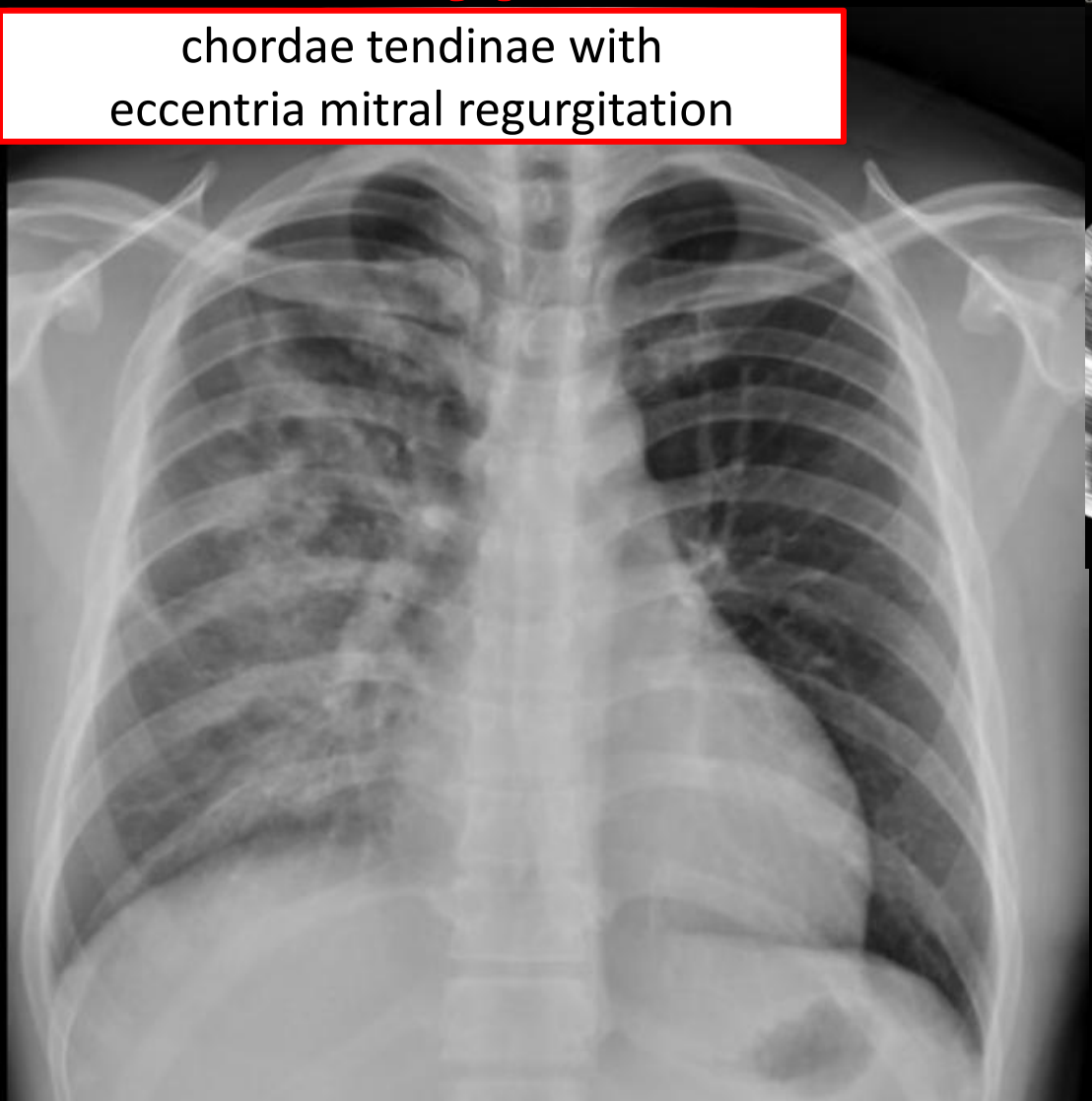
Cardiogenic lung edema

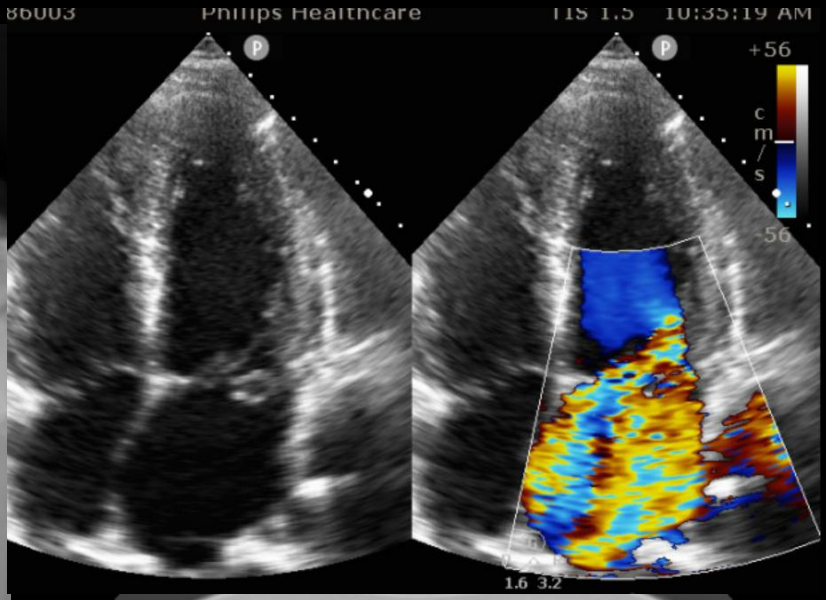
atypical ARDS mimicker

Cardiogenic lung edema

atypical unilateral edema

chordae tendinae with
eccentria mitral regurgitation





Diffuse Alveolar Consolidation

PNEUMONIA

Diffuse pneumonia不管甚麼pattern(interstitial/GGO/alverolar),D/D都一樣: PJP,Virus,Excessive aspiration

Pneumonia commonly results from bacterial infection and usually produces a unifocal or few scattered focal alveolar opacities on chest radiographs and CT scans. Recognition of a diffuse pulmonary abnormality in the setting of a suspected pneumonia should prompt investigation for less common etiologies of pulmonary infection. The differential for diffuse pneumonias is similar regardless of the specific diffuse pattern. Diffuse patterns that are associated with pneumonia include the linear interstitial pattern, diffuse ground-glass pattern, and diffuse alveolar pattern. In general, those cases manifesting as linear interstitial or diffuse ground-glass patterns tend to be milder and those appearing as diffuse alveolar patterns are more severe infections. The pneumonias that most commonly appear as diffuse alveolar opacities are *Pneumocystis jiroveci* pneumonia (PCP) and viral pneumonias (Table 1-2). These viruses include influenza, adenovirus, herpes simplex, and varicella-zoster. The only bacterial pneumonias that commonly appear as a diffuse alveolar process are those secondary to excessive aspiration.

TABLE 1-2

Pneumonia That May Produce Diffuse Alveolar Consolidation

Fungal
Pneumocystis jiroveci
Viral
Influenza A and B viruses
Adenovirus
Herpes simplex virus
Varicella-zoster virus
Hantavirus pulmonary syndrome
Serious acute respiratory syndrome
Other viruses
Bacterial
Aspiration pneumonia

雙側瀰漫性肺炎
小心非一般細菌

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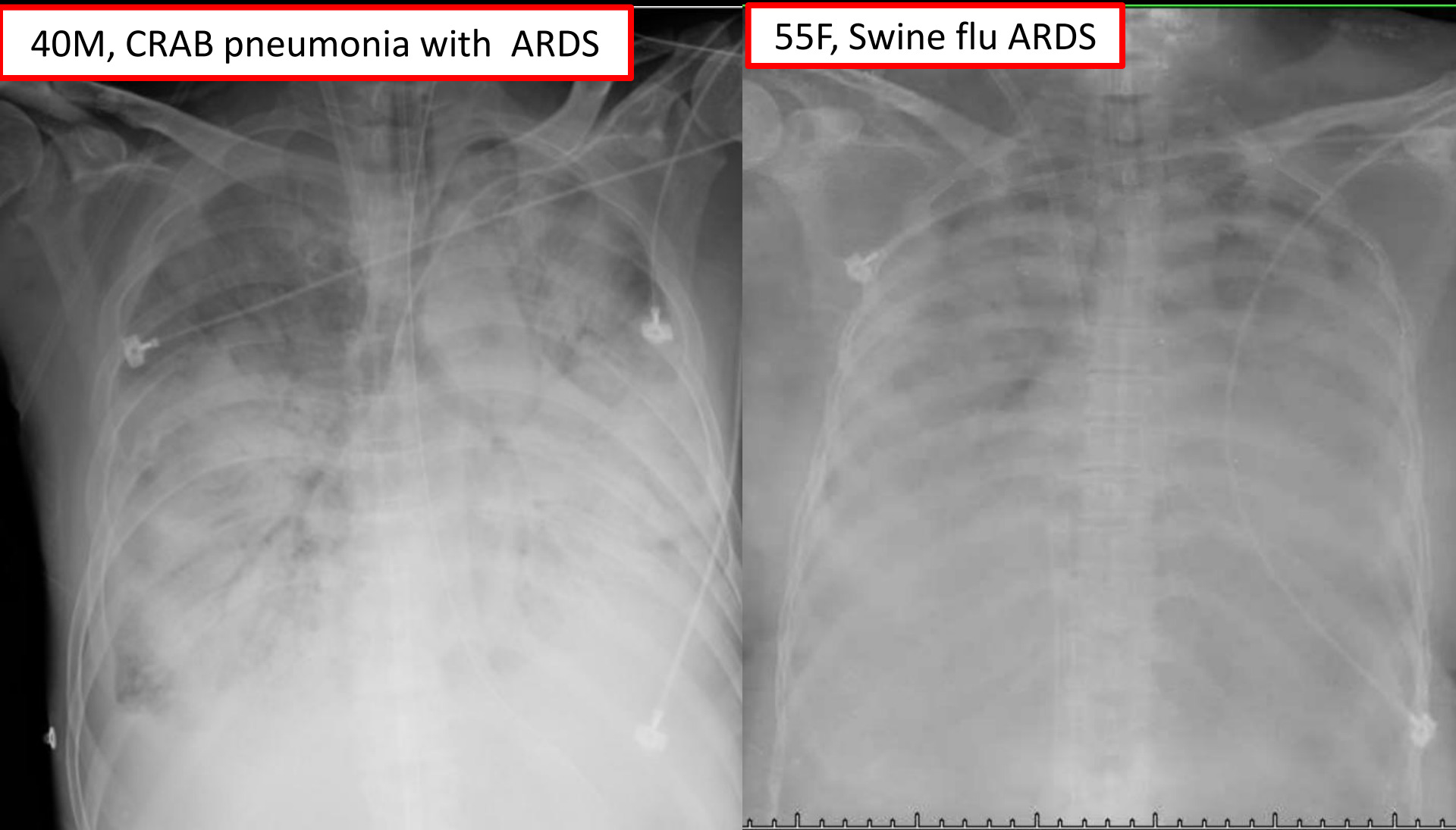
Pneumonia with ARDS

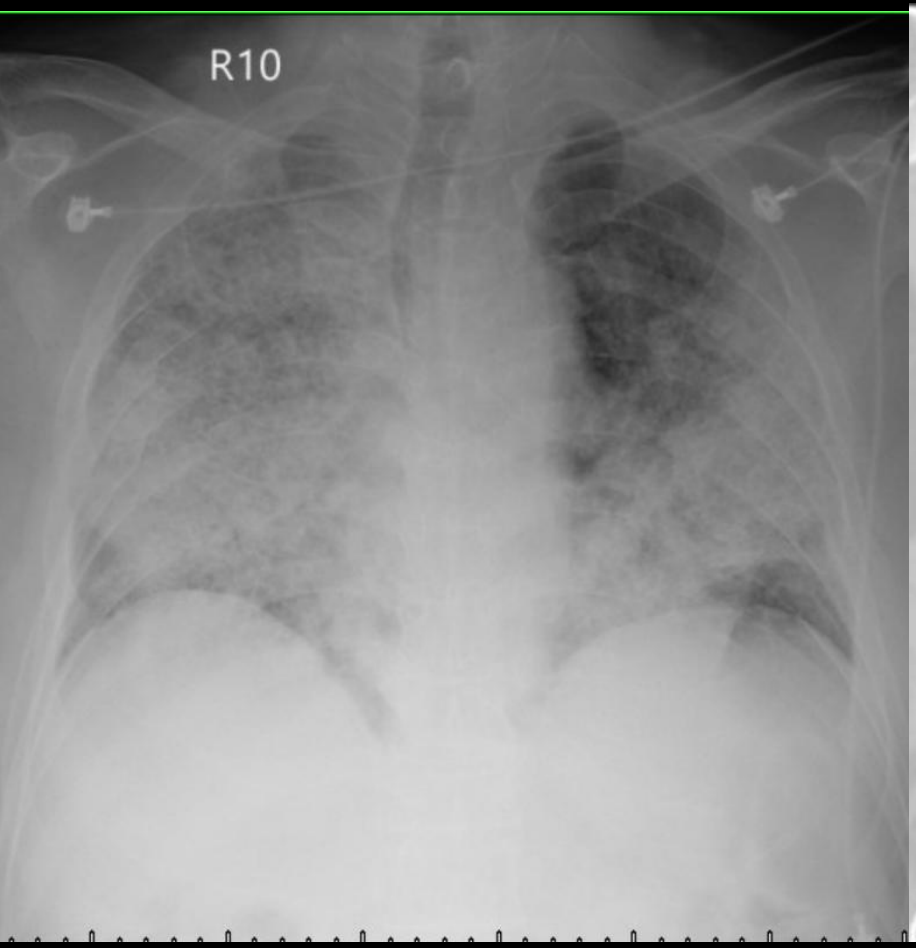
similar images, different microbes



Pulmonary hemorrhage

GGO predominance

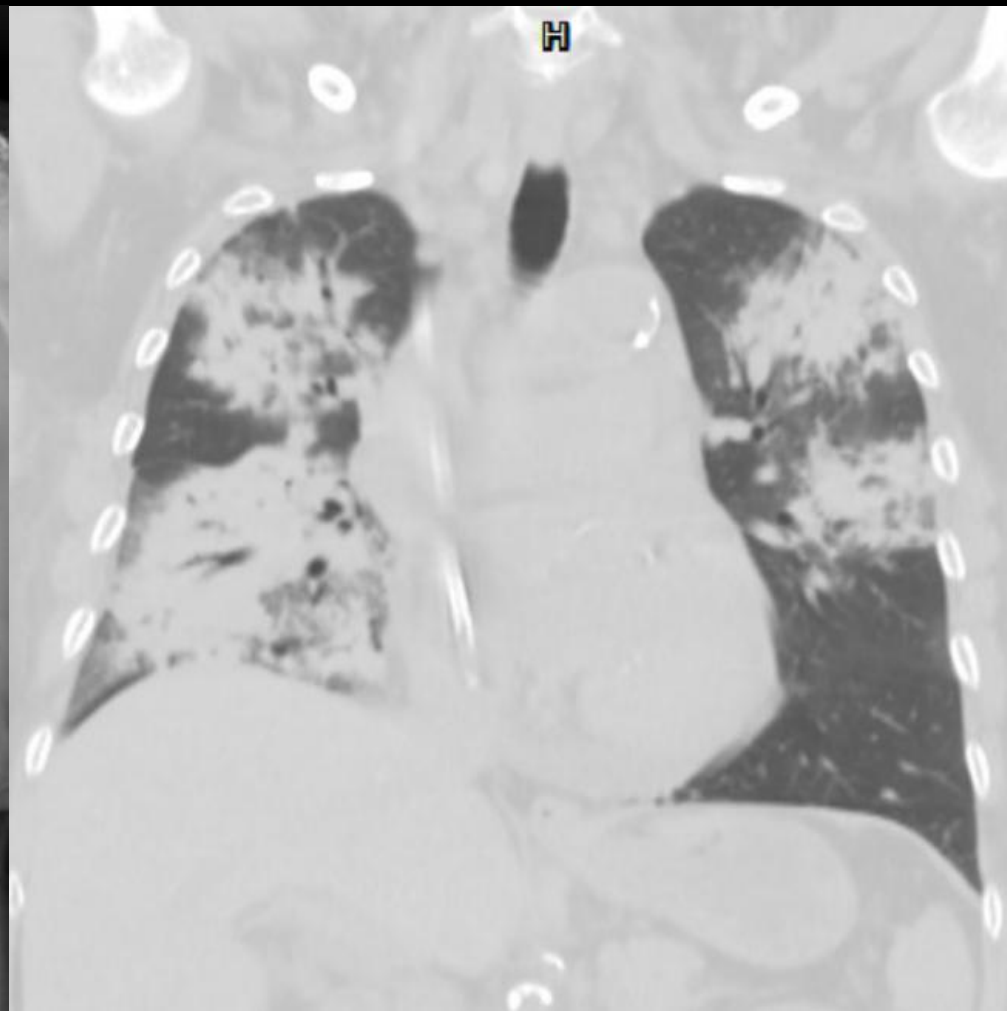
P-ANCA vasculitis with
pulmonary-renal syndrome



Pulmonary hemorrhage

consolidation predominance

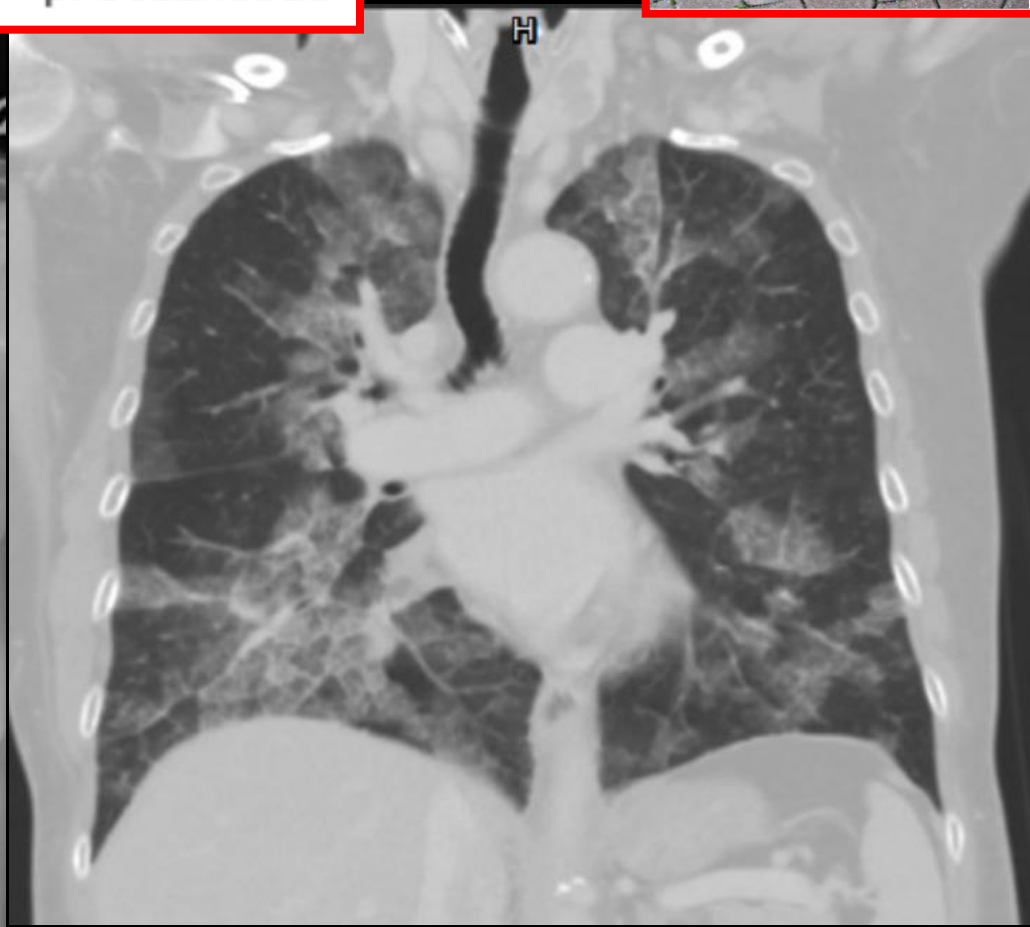
p-ANCA vasculitis



Pulmonary alveolar proteinosis

crazing paving pattern

PATHOLOGICAL DIAGNOSIS
1. Lung, RB3, biopsy, no specific change
2. Lung, RB8, cryobiopsy, alveolar proteinosis



#2 Isolated diffuse GGO

Categories	Types of Diseases and Infections
Opportunistic infections 非典型肺炎 (流感/新冠/PJP/CMV/HSV)	Pneumocystis pneumonia (PCP) Cytomegalovirus pneumonia (CMV) Herpes simplex virus pneumonia (HSV) Respiratory syncytial virus bronchiolitis Other
Chronic interstitial diseases 本身間質肺病 (AEILD)	Hypersensitivity pneumonitis (HP) Desquamative interstitial pneumonia (DIP) Respiratory bronchiolitis interstitial lung disease (RBI Nonspecific interstitial pneumonia (NSIP) Acute interstitial pneumonia (AIP) Lymphocytic interstitial pneumonia (LIP) Sarcoidosis
Acute alveolar diseases 所有肺泡性疾病D/D (血水膿痰)	Pulmonary edema Heart disease Adult respiratory distress syndrome (ARDS) Other Diffuse alveolar hemorrhage
Other causes 其他 (藥物/放療)	Drug toxicity Pulmonary alveolar proteinosis (PAP) Bronchiolitis obliterans with organizing pneumonia (B Bronchoalveolar carcinoma

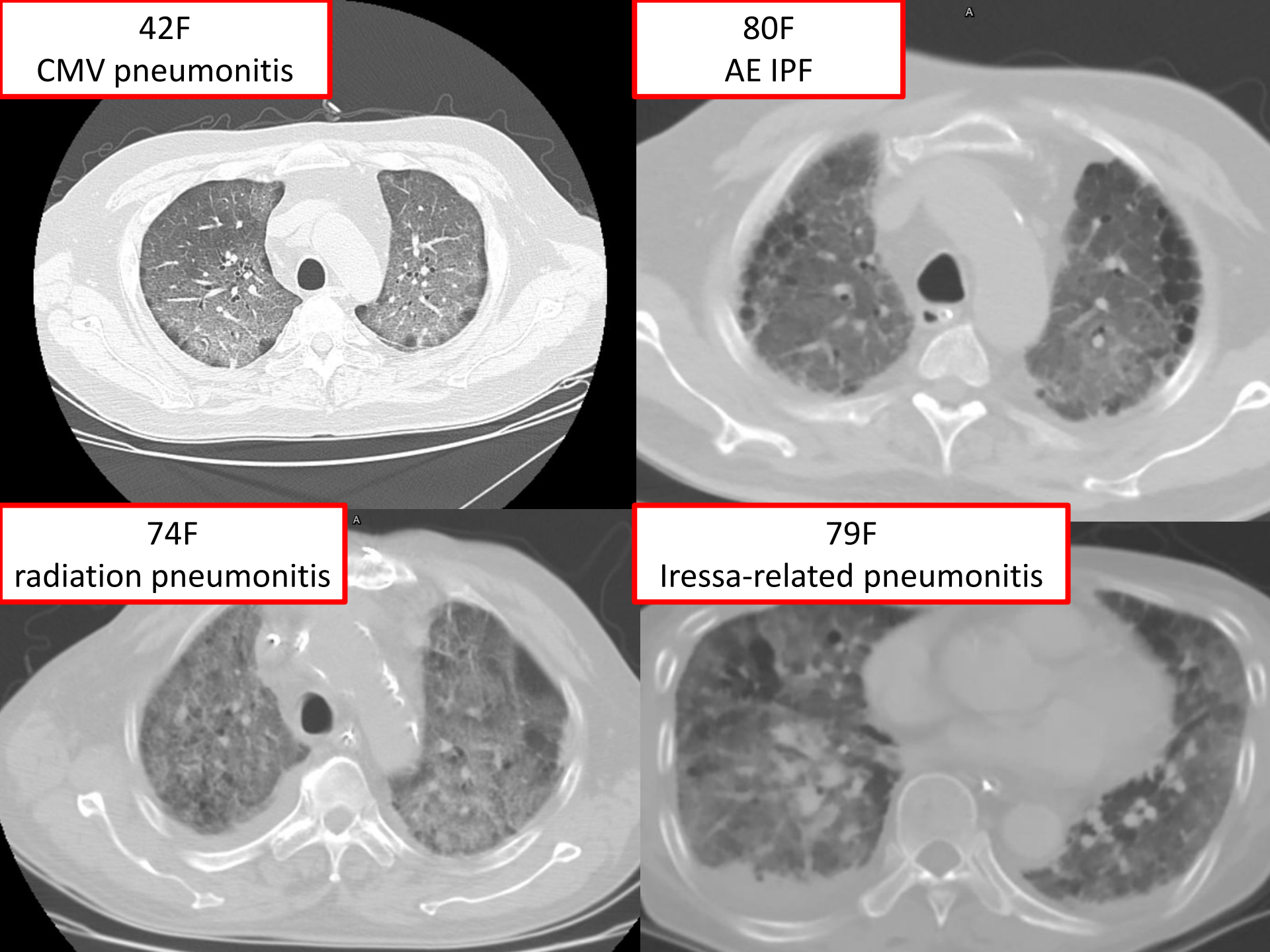
免疫病史
接觸旅遊

慢性病史
慢性影像

慢性病史
臨床表現

腫瘤病史
藥物病史

Miller WT Jr. AJR Am J Roentgenol. 2005 Feb;184(2):613-22.


42F
CMV pneumonitis
80F
AE IPF
74F
radiation pneumonitis
79F
Iressa-related pneumonitis

#3 Focal/lobar airspace opacity

Acute	Chronic	Apical
Pneumonia Atelectasis Contusion Embolism	Infection Nocardiosis Actinomycosis TB/fungus Inflammation EGPA/GPA COP Lipoid Amidoarone Tumor BAC Lymphoma	TB/NTM Fungus (especially aspergillosis) Lung cancer Chronic eosinophilic pneumonia Pneumonia

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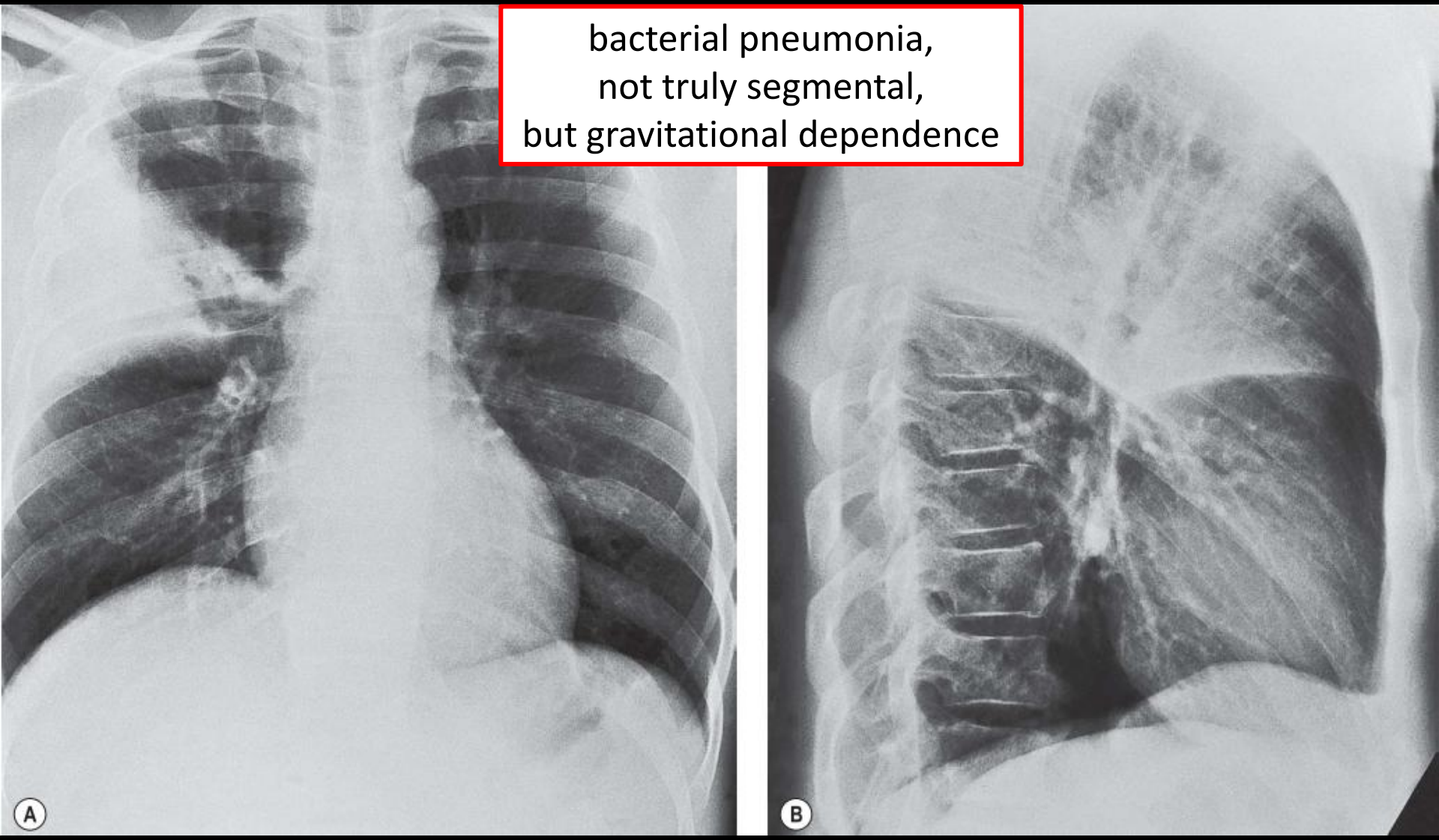

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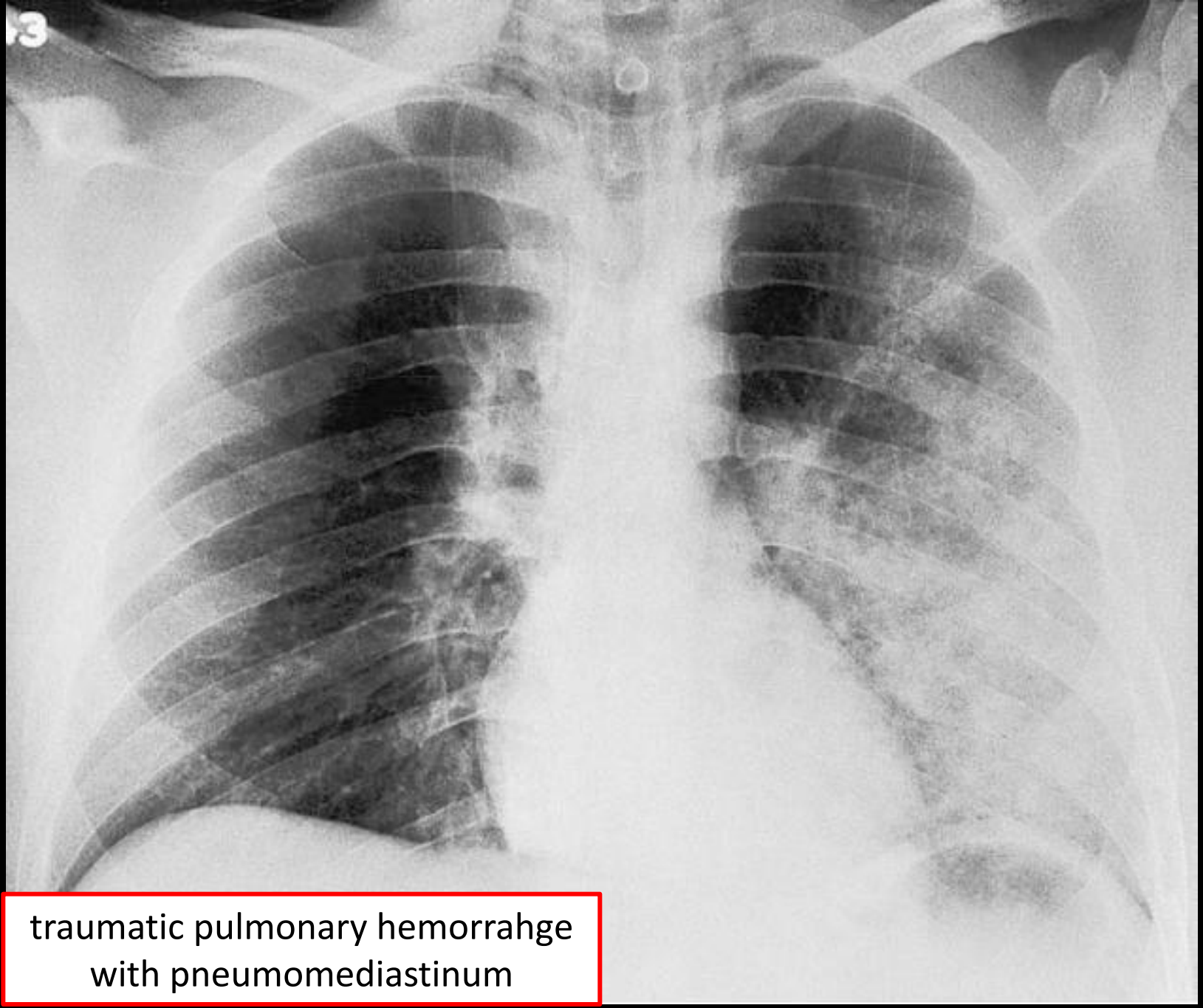

traumatic pulmonary hemorrahge with pneumomediastinum

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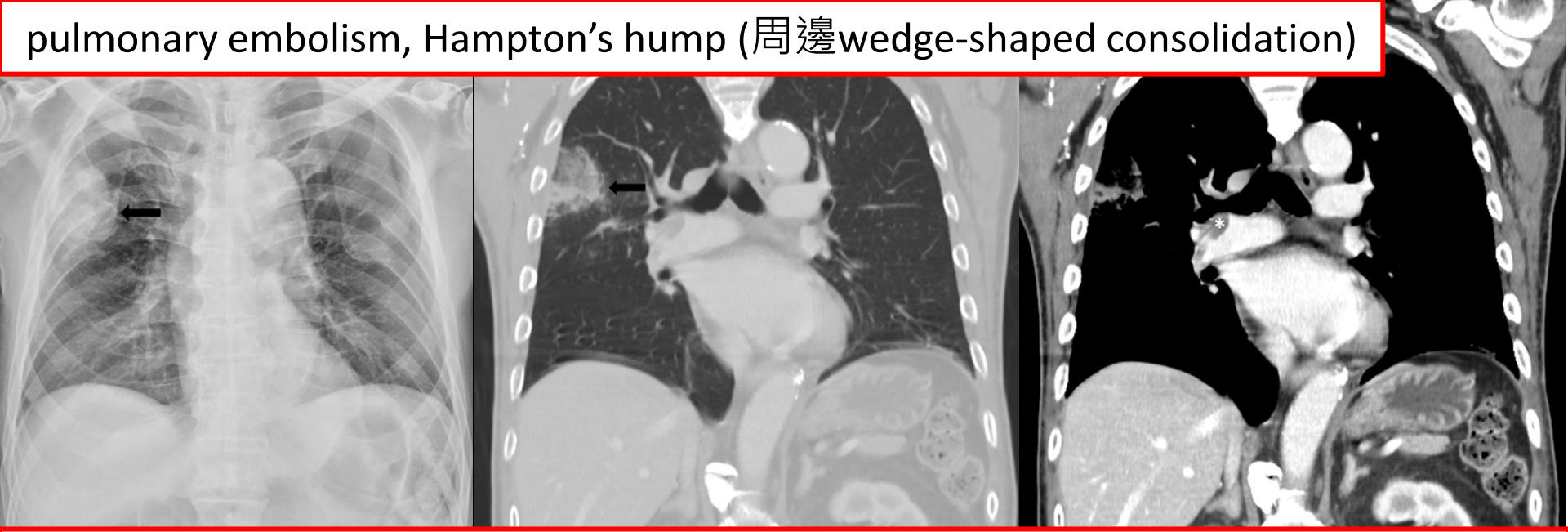
pulmonary embolism, Hampton’s hump (周邊wedge-shaped consolidation)



pulmonary embolism, Westermark (血管紋變少) and Fleischner(粗大肺動脈) signs

Keng LT, et al. Jump to the diagnosis from Hampton‘s hump. Med Intensiva . 2020 Dec 2. In Press.

Case courtesy of Dr Sachintha Hapugoda, Radiopaedia.org, rID: 63997

Special pattern
rib/vertebra destruction

Cause	Comment
malignancy	primary lung cancer more common
infection	TB, fungus >> actinomycosis

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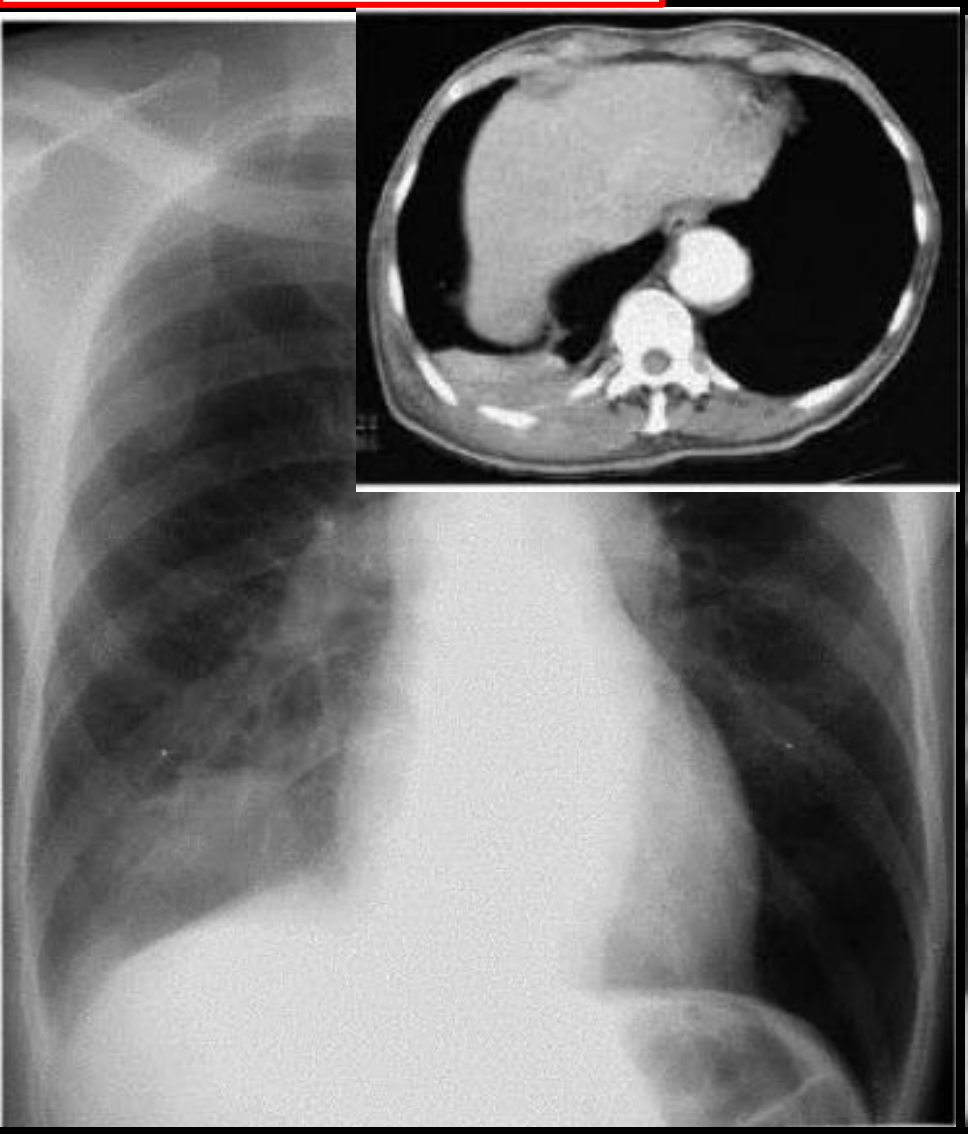
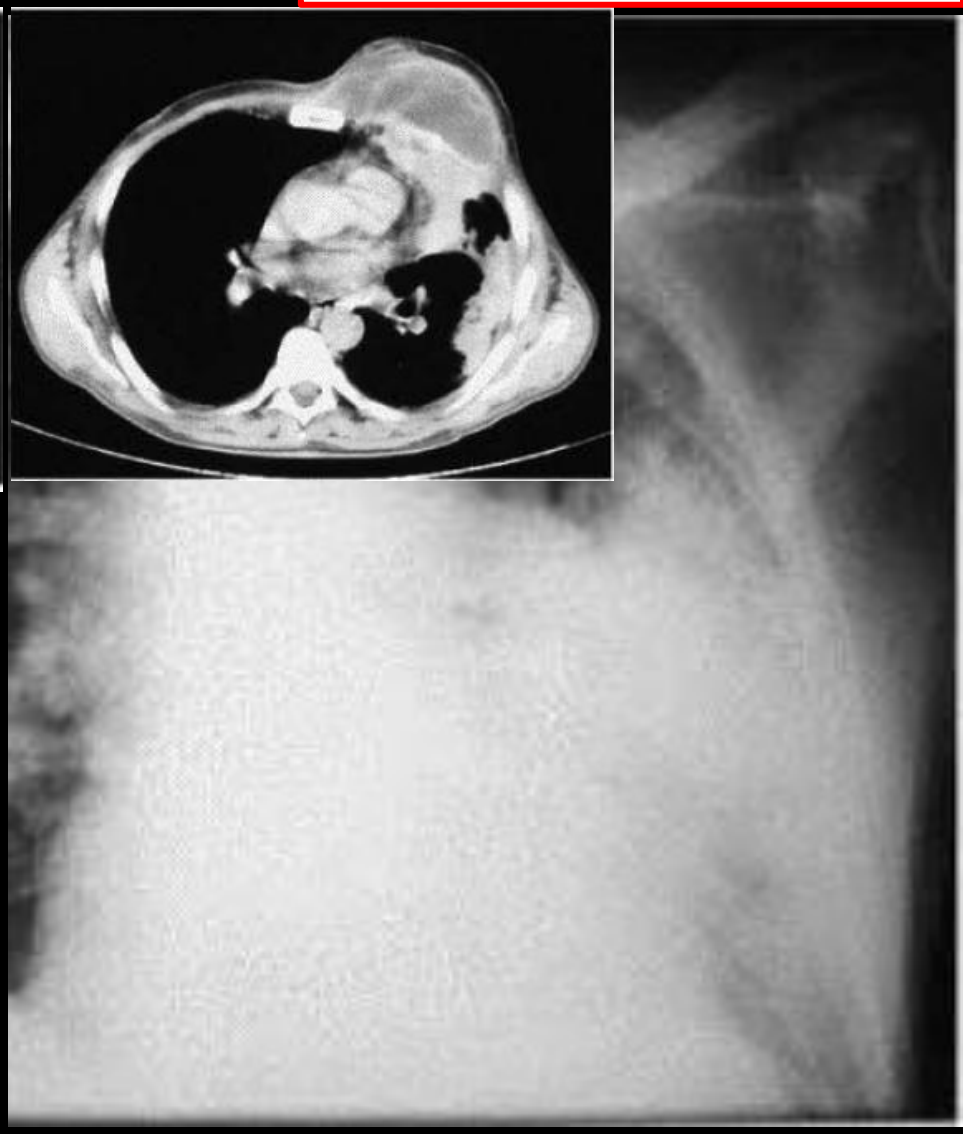
pulmonary actinomycosis, chest wall infiltration

pulmonary actinomycosis, empyema necessitans





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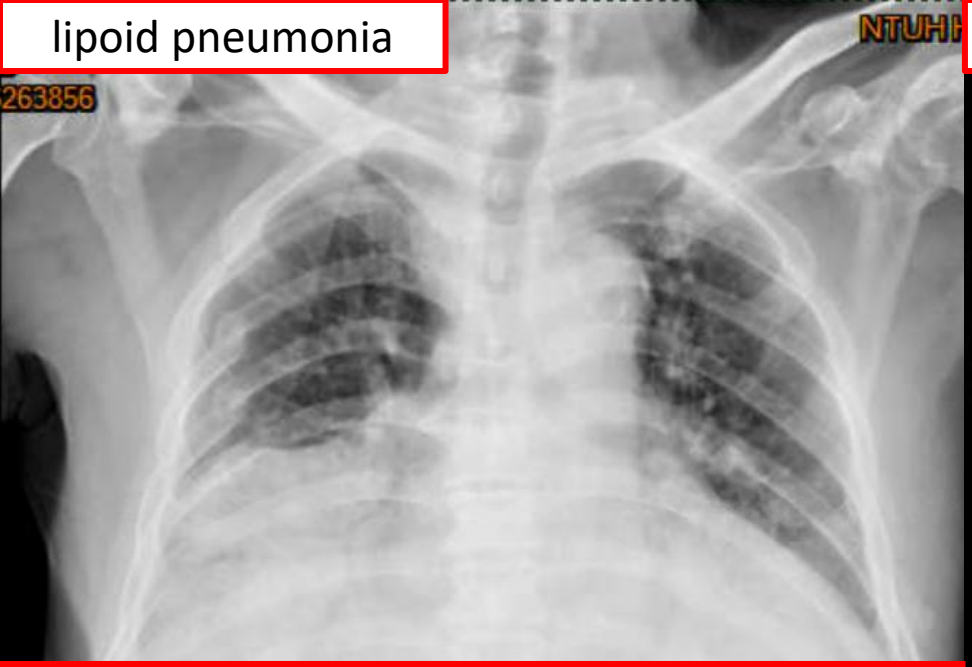
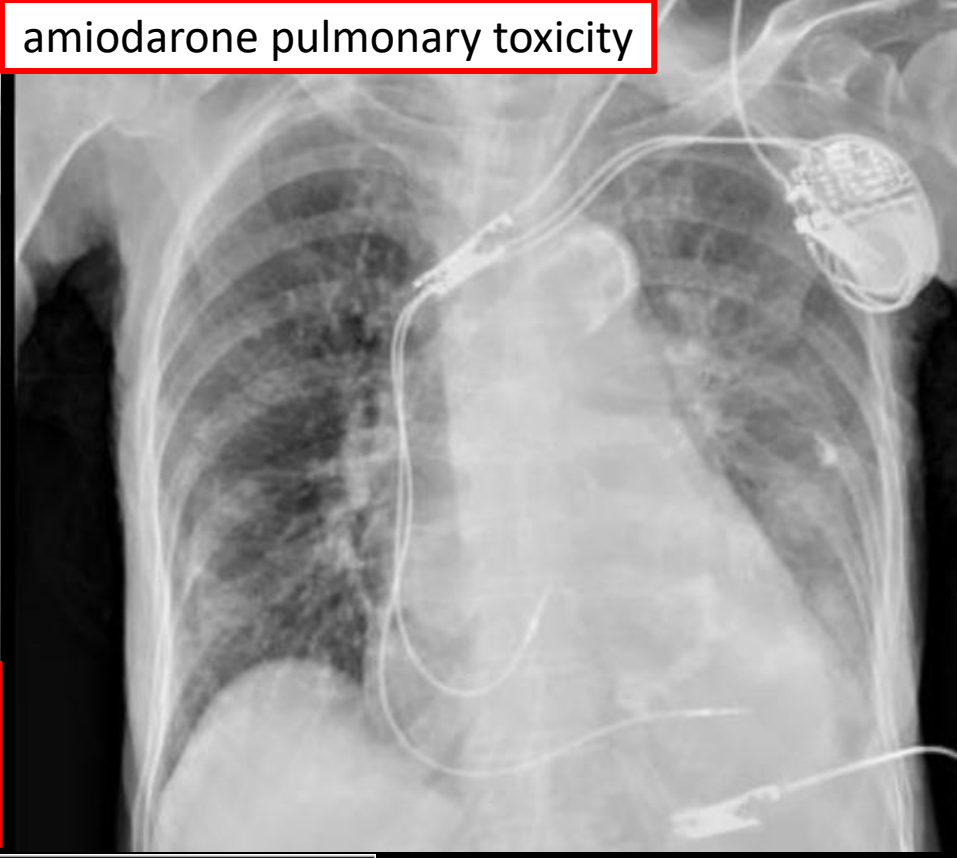
Special pattern
extreme high/low attenuation

Disease	Comment
lipoid pneumonia	low attenuation on CT
amiodarone pulmonary toxicity	high attenuation on CT +/- interstitial change also high liver attenuation

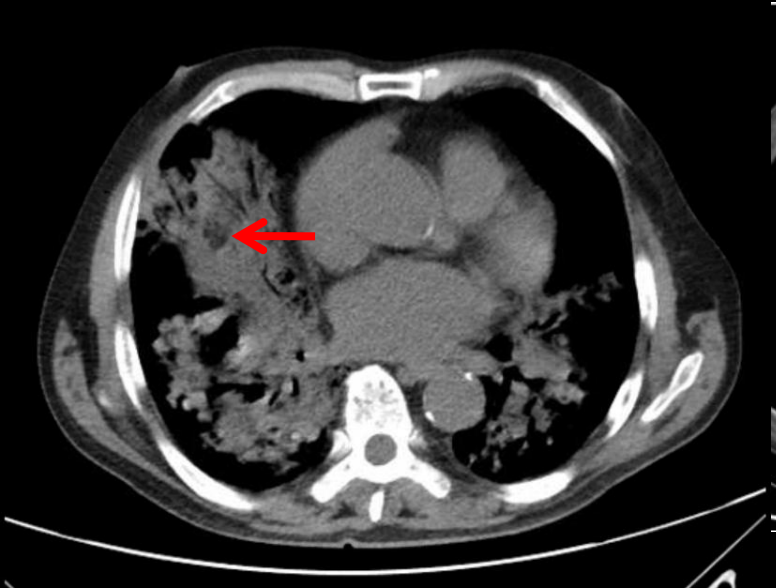
lipoid pneumonia

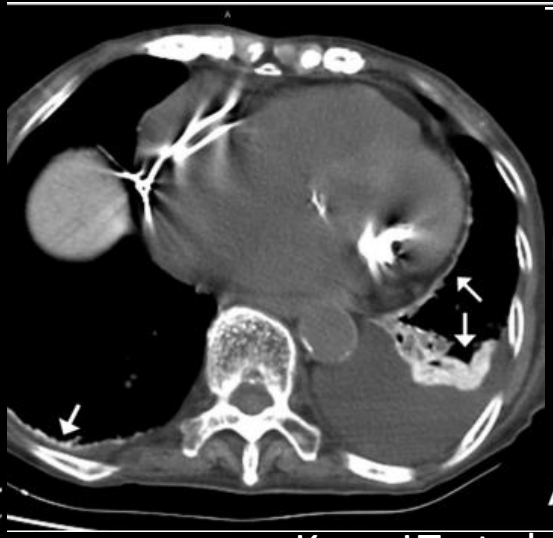
amiodarone pulmonary toxicity



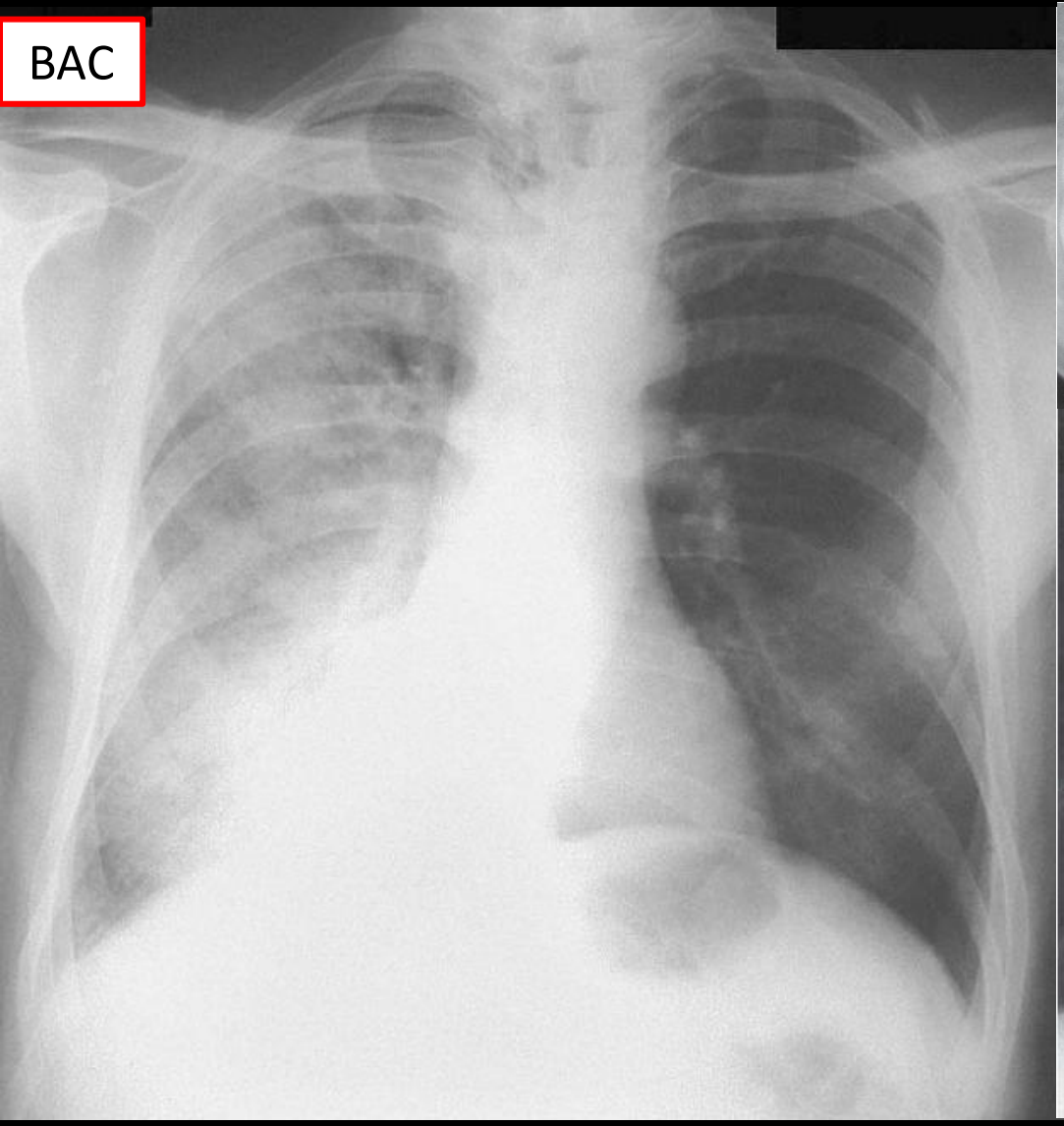


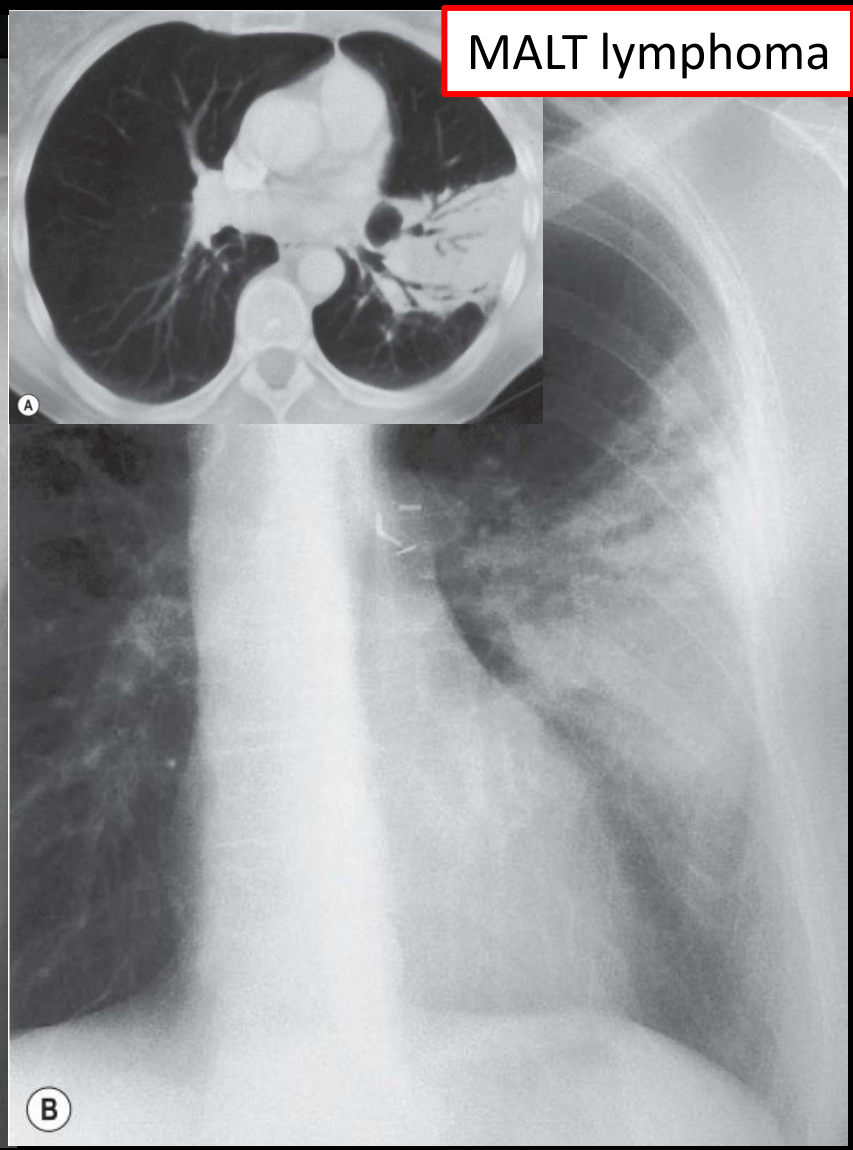
DIAGNOSIS
Lung, RB8, TBB
----Compatible with lipoid pneumonia





Keng LT et al. Postgrad Med J. 2018;94:603.





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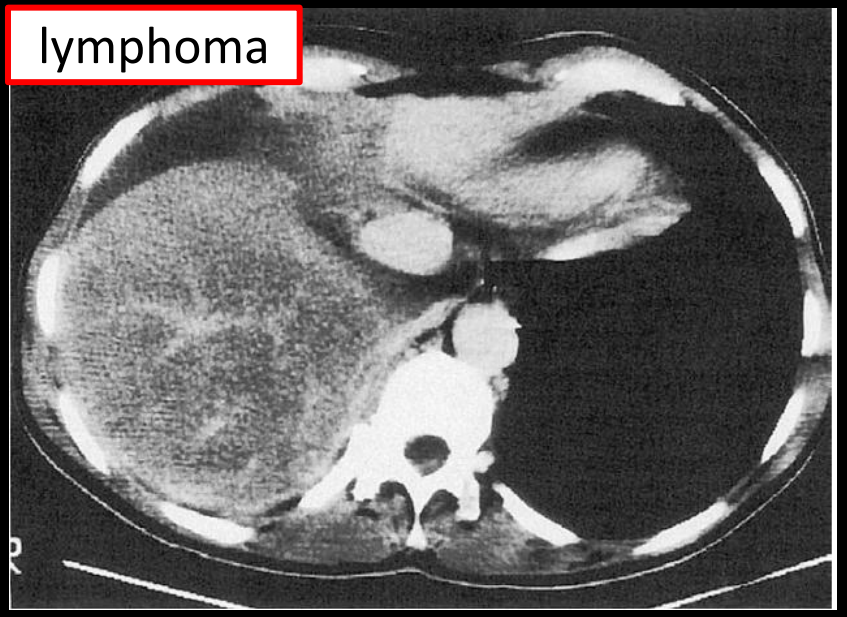
Special pattern

CT angiogram sign

- Visible contrast-enhanced blood vessels coursing through areas of consolidation
- Orignialllly for BAC, but could be in pneumonia, obstructive pneumonitis, pulmonary edema, and lymphoma



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Special pattern
apical lung pattern

Disease	Comment
Pancoast tumor	may mimic symmetric pleural thickening beware of chest wall invasion lordotic view frequently needed
TB	fibronodular or fibroproductive pattern may be cavitary
NTM	fibrocavitary > nodular BXSIS
Aspergillosis (CPA)	usually cavitary

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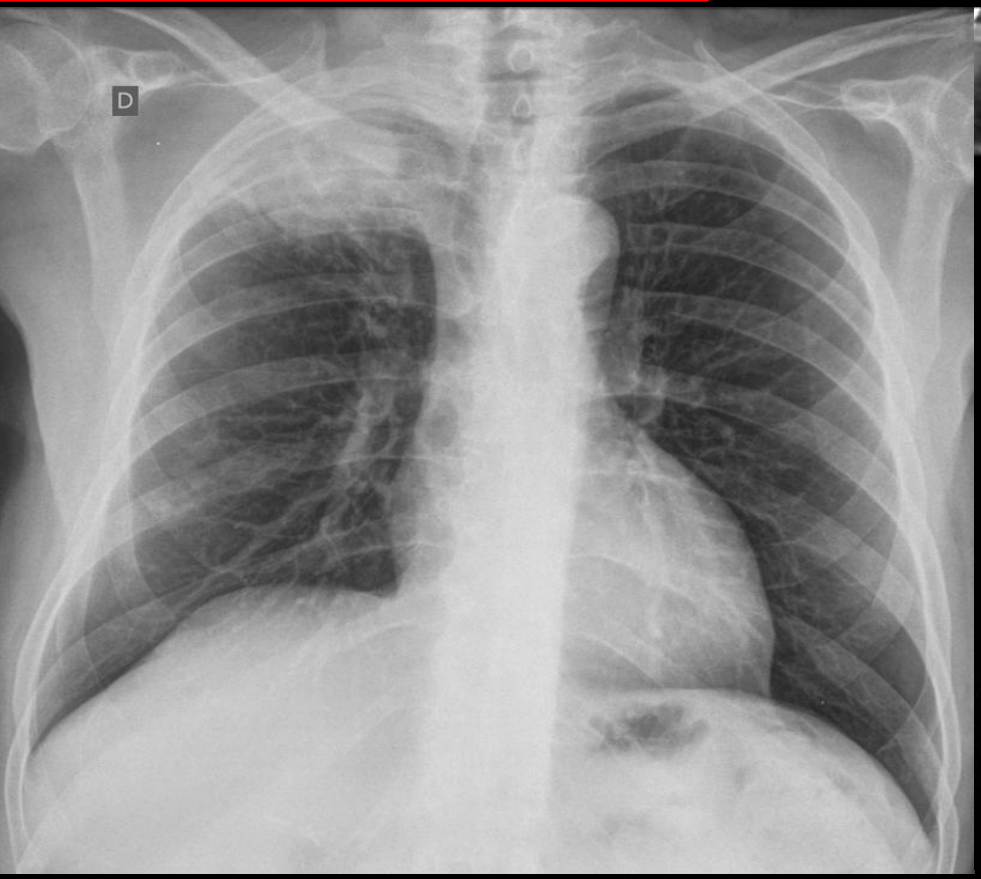
Apical lung pattern

pancoast tumor

SqCC with chest wall invasion

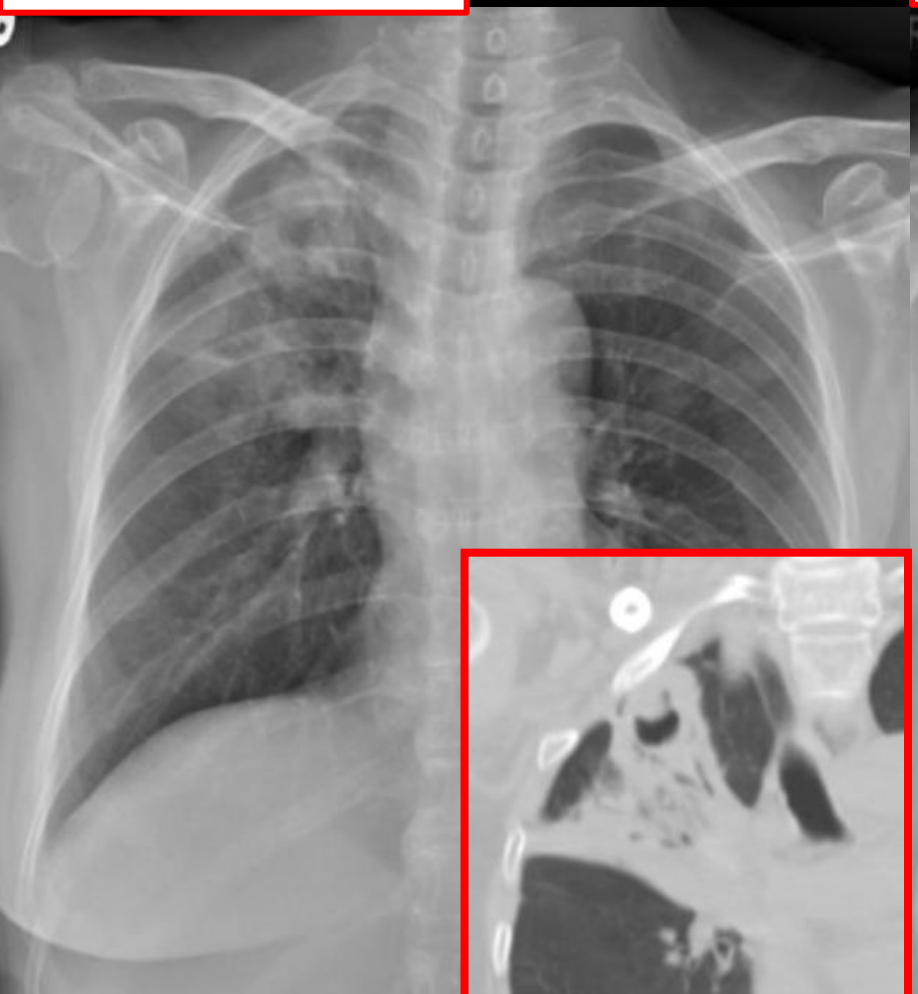


Case courtesy of Dr Bruno Di Muzio, Radiopaedia.org, rID: 29403

Apical lung pattern

TB/NTM

S(+)C(+) cavitary TB



S(+)C(+) cavitary M. kansasii

Apical lung pattern

chronic pulmonary aspergillosis

BAL GM/Bx(+) with blood IgG(+)

BAL GM(+) with blood IgG(+)

Special pattern for pneumonia

volume change

Volume	Etiology
large, no volume loss	pneumonia
expansion (bulging fissure)	pneumonia (**KP**, PsA, SA, pneumococcus)
reduction	chronic pneumonia (TB…)
expasion + reduction	central tumor with obstructive pneumonia

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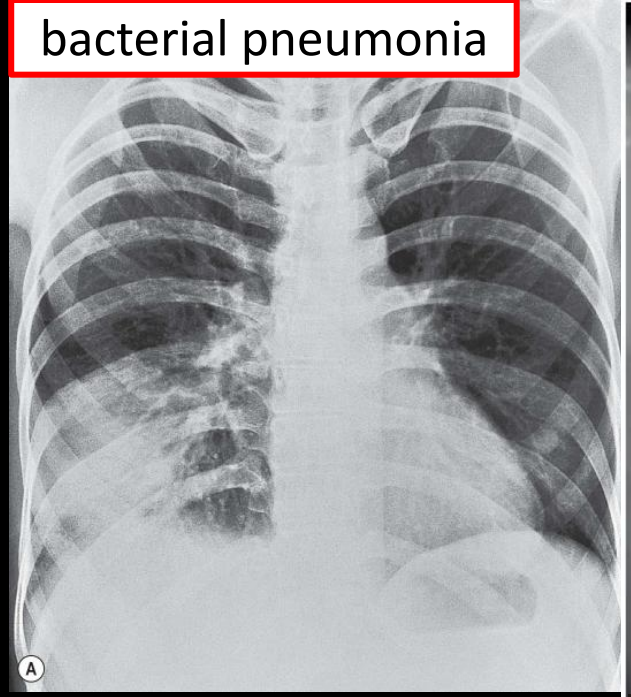
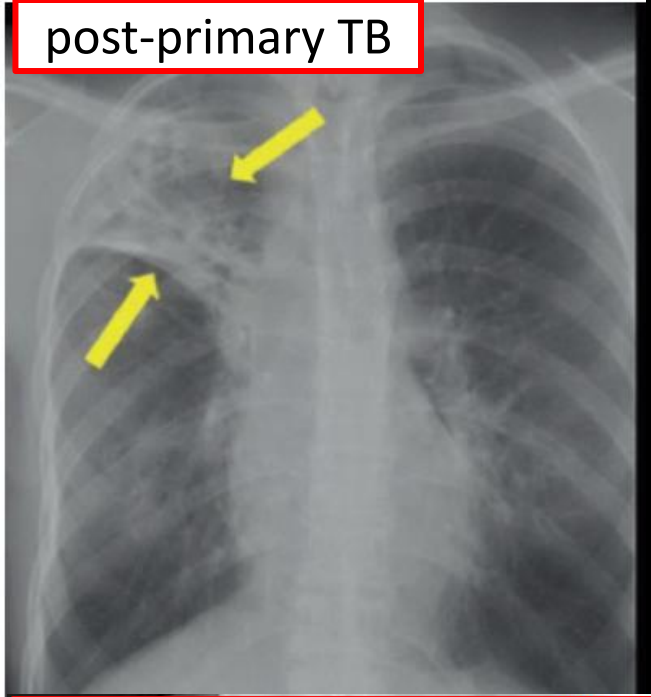
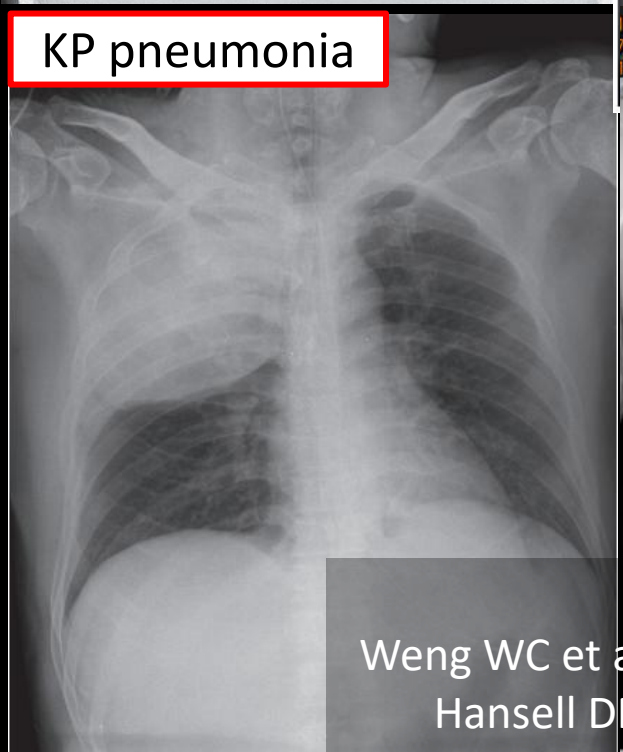
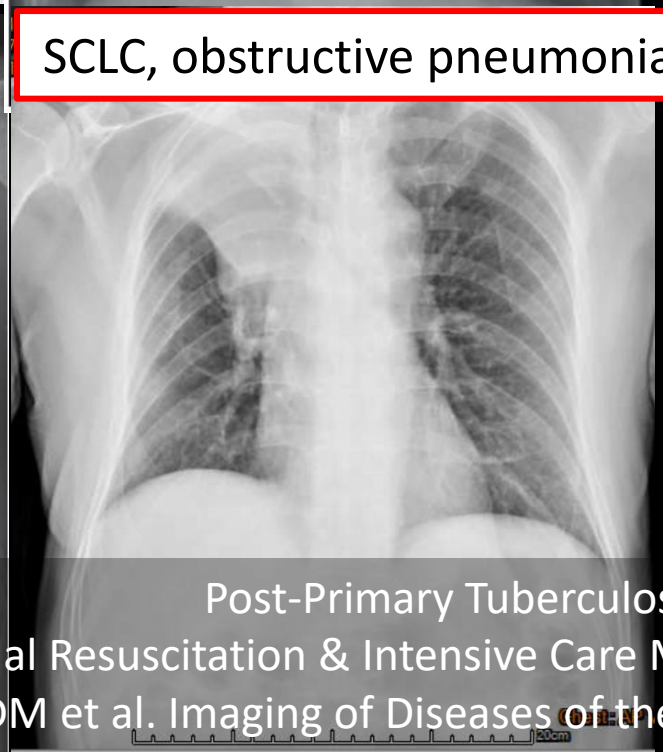






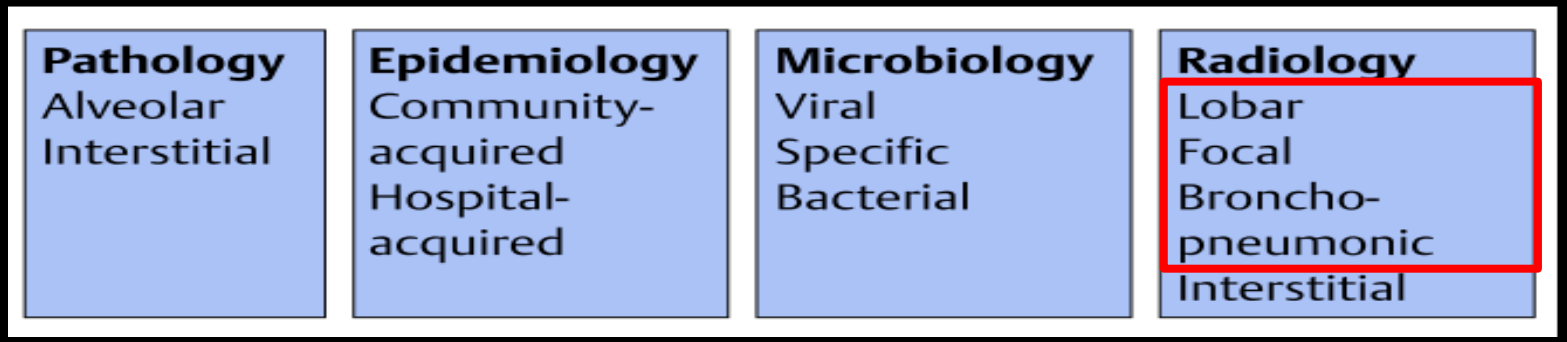


Post-Primary Tuberculosis | Radiology Key

Weng WC et al Resuscitation & Intensive Care Med 2018;3:49-51.
Hansell DM et al. Imaging of Diseases of the Chest, 5th Edition

Classification of pneumonia

- Alveolar pneumonia
  - Lobar pneumonia: related to the virulence of the pathogen
  - Bronchopneumonia: due to bronchial infection or underlying disease
- Interstitial pneumonia

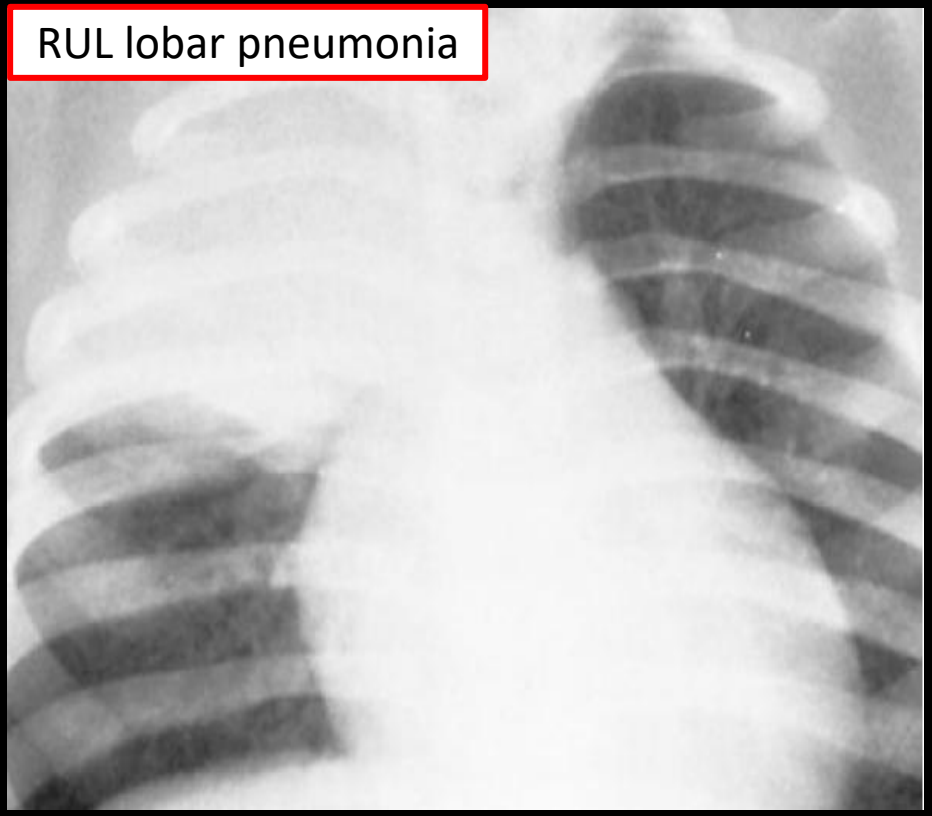


Kirchner J. Chest Radiology: A Resident's Manual, 1st Edition

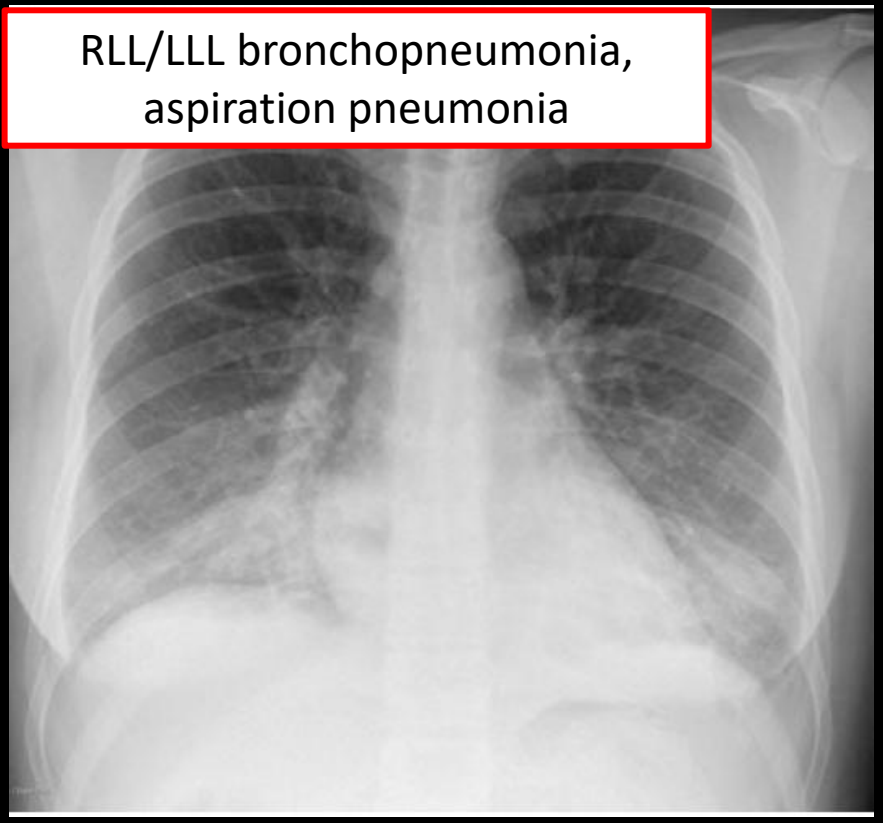
Eisenberg RL. What Radiology Residents Need to Know: Chest Radiology, 1st Edition

	lobar pneumonia	bronchopneumonia
Margin	sharp	Indistinct
Air bronchogram	presence	absence
Character	single homogeneous	multifocal heterogeneous

RUL lobar pneumonia



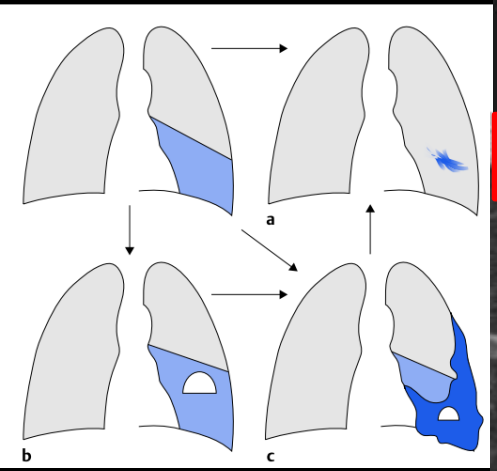
RLL/LLL bronchopneumonia, aspiration pneumonia

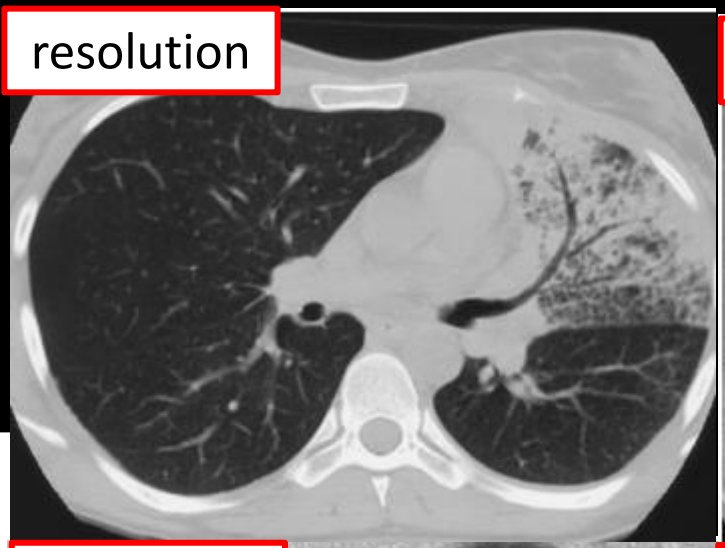


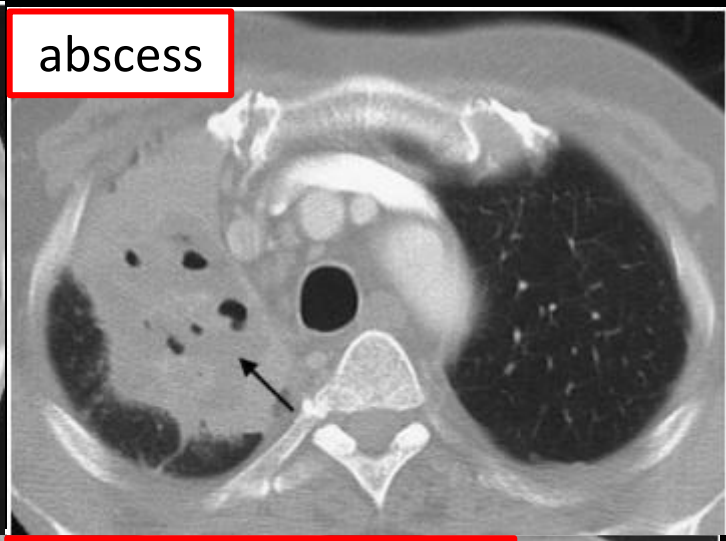
Kirchner J. Chest Radiology: A Resident's Manual, 1st Edition
Eisenberg RL. What Radiology Residents Need to Know: Chest Radiology, 1st Edition

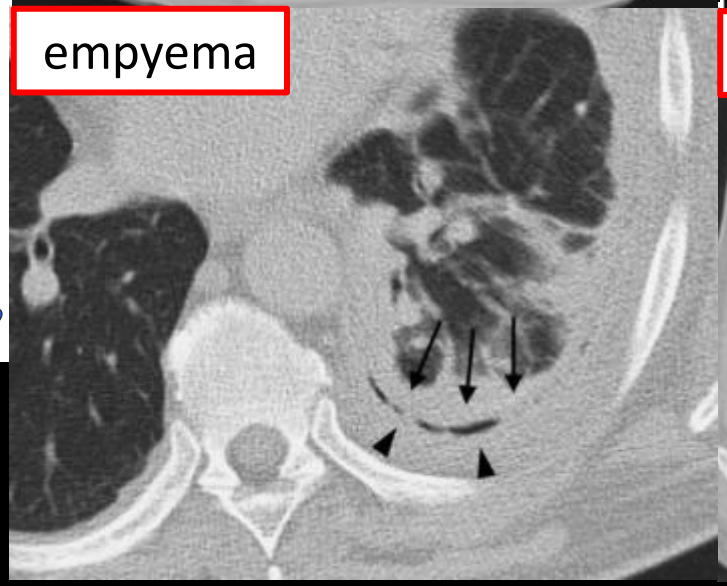
Role of CT for pneumonia

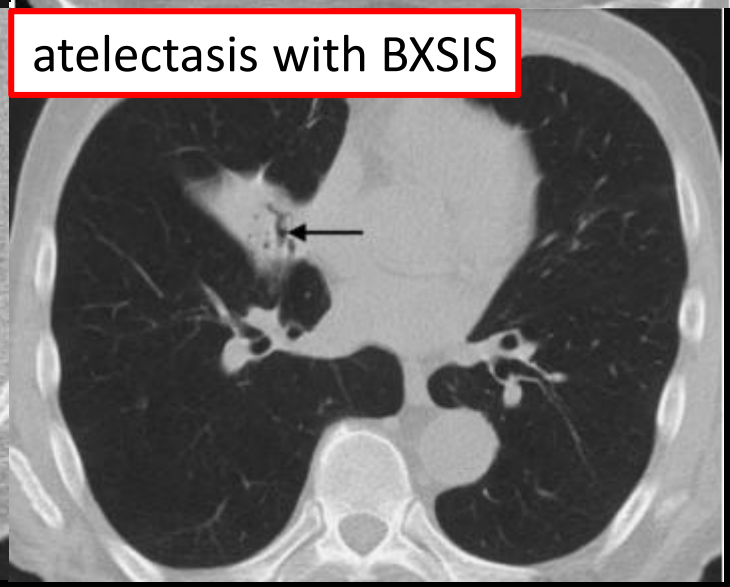
#1 detect complication











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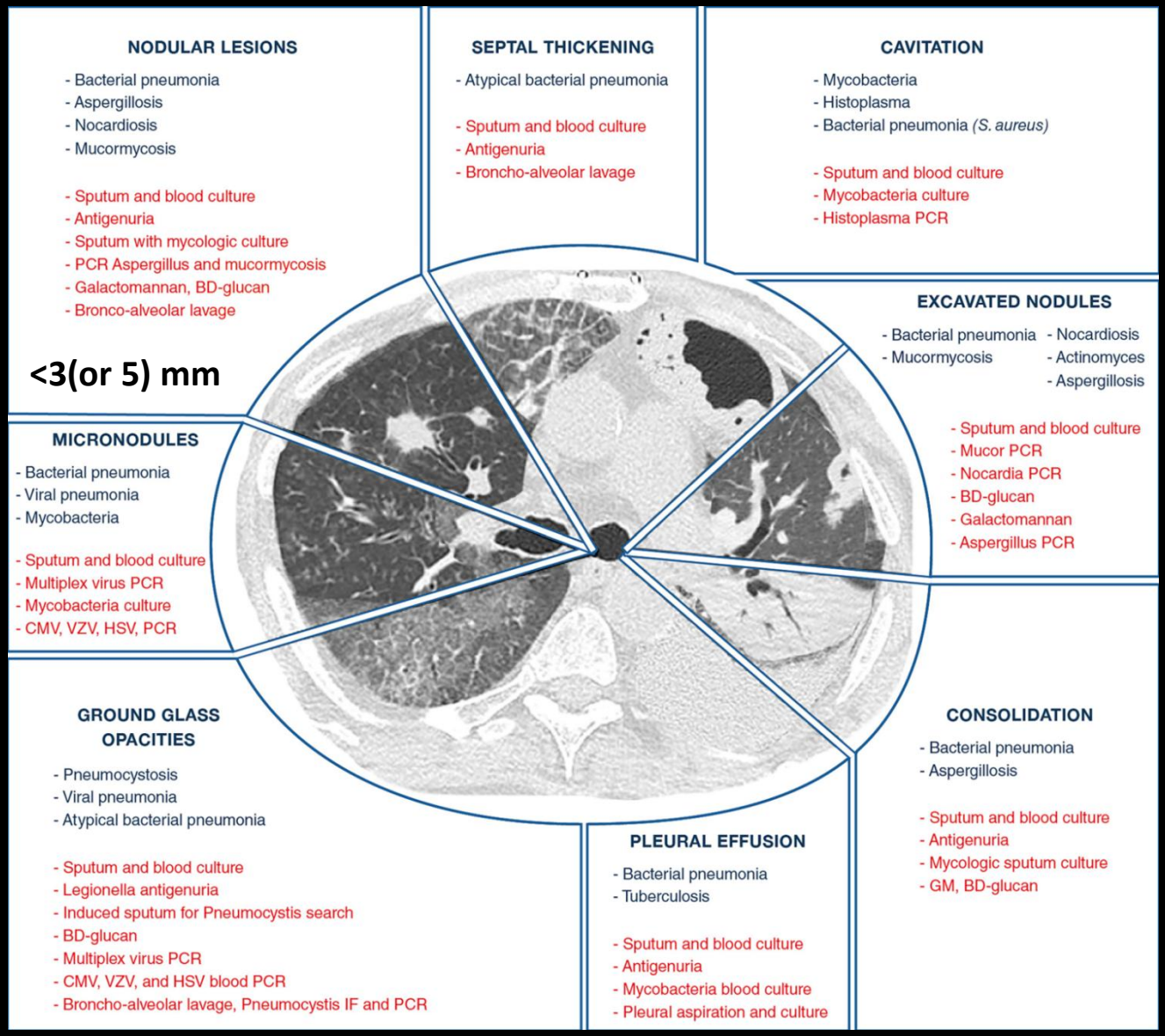
Role of CT for pneumonia

#2 correlate pathogen

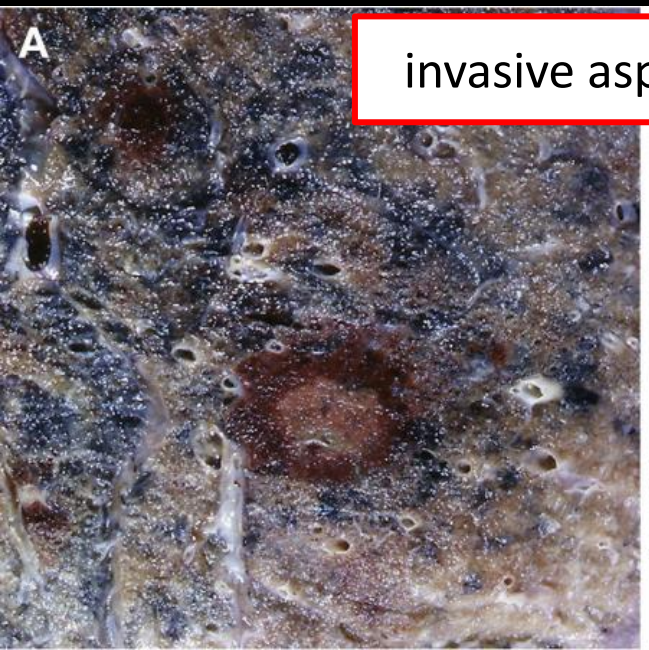


Azoulay E et al. Intensive Care Med 2020;46(2):298-314.

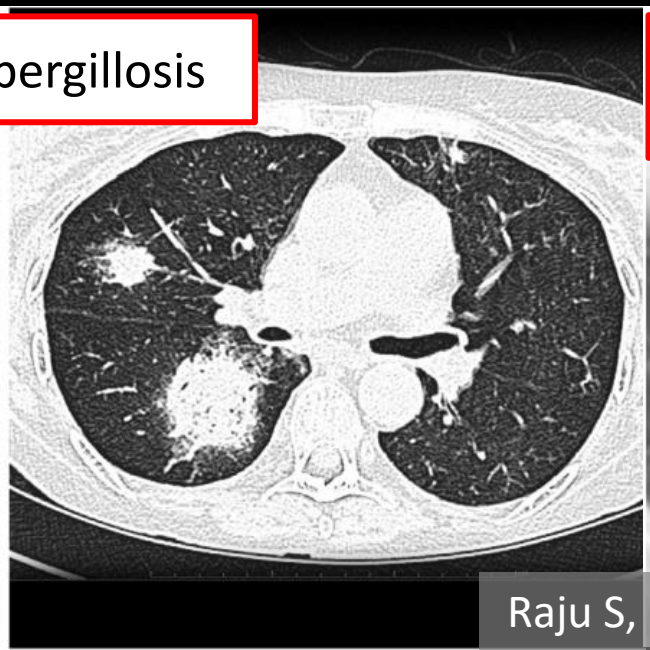
Special pattern

CT halo sign

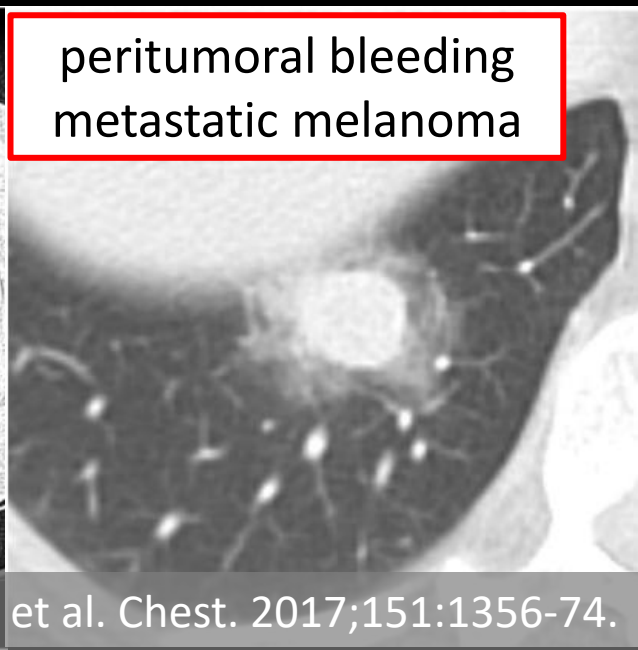
CT halo sign	Comment
Common	Invasive fungal infection (apergillosis/mucormycosis)
	ADC in situ
uncommon	GPA, amyloidosis, sarcoidosis, metastatic cancer



invasive aspergillosis



peritumoral bleeding
metastatic melanoma



Raju S, et al. Chest. 2017;151:1356-74.

Special pattern
lucency within consolidation

Cause	Comment
normal lung	
preexisting emphysema	**Incomplete consolidation**
necrosis with cavity	**necrotizing** pneumonia: SA, GNB (KP, proteus, PsA), anaerobe, TB
	meniscus of air: **IFI**
	noninfectious: vasculitis, lymphoma
pneumatocele	thin-wall cyst, rapid change, infection

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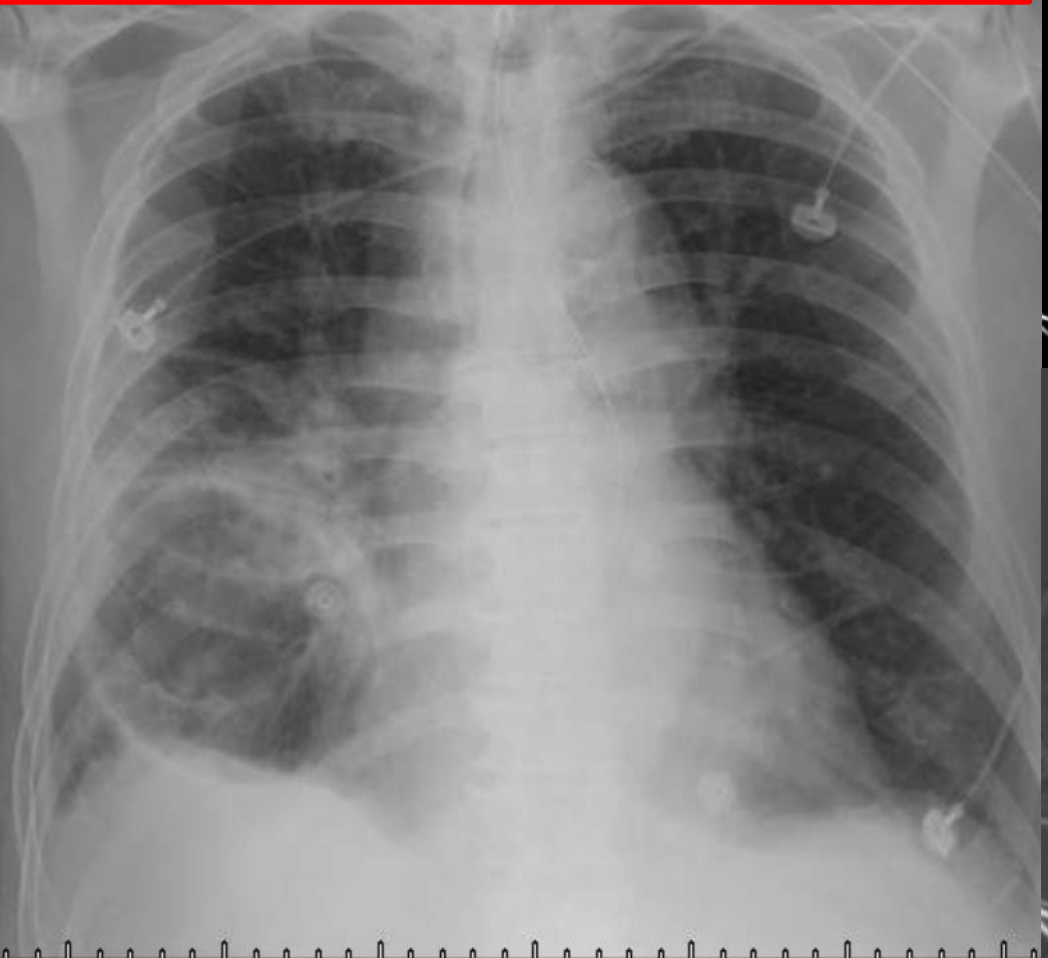
Special pattern
lucency within consolidation

5M later, resolved

51M, H1N1 ARDS,
with multiple pneumatocele, mimicking PTX

Special pattern
lucency within consolidation

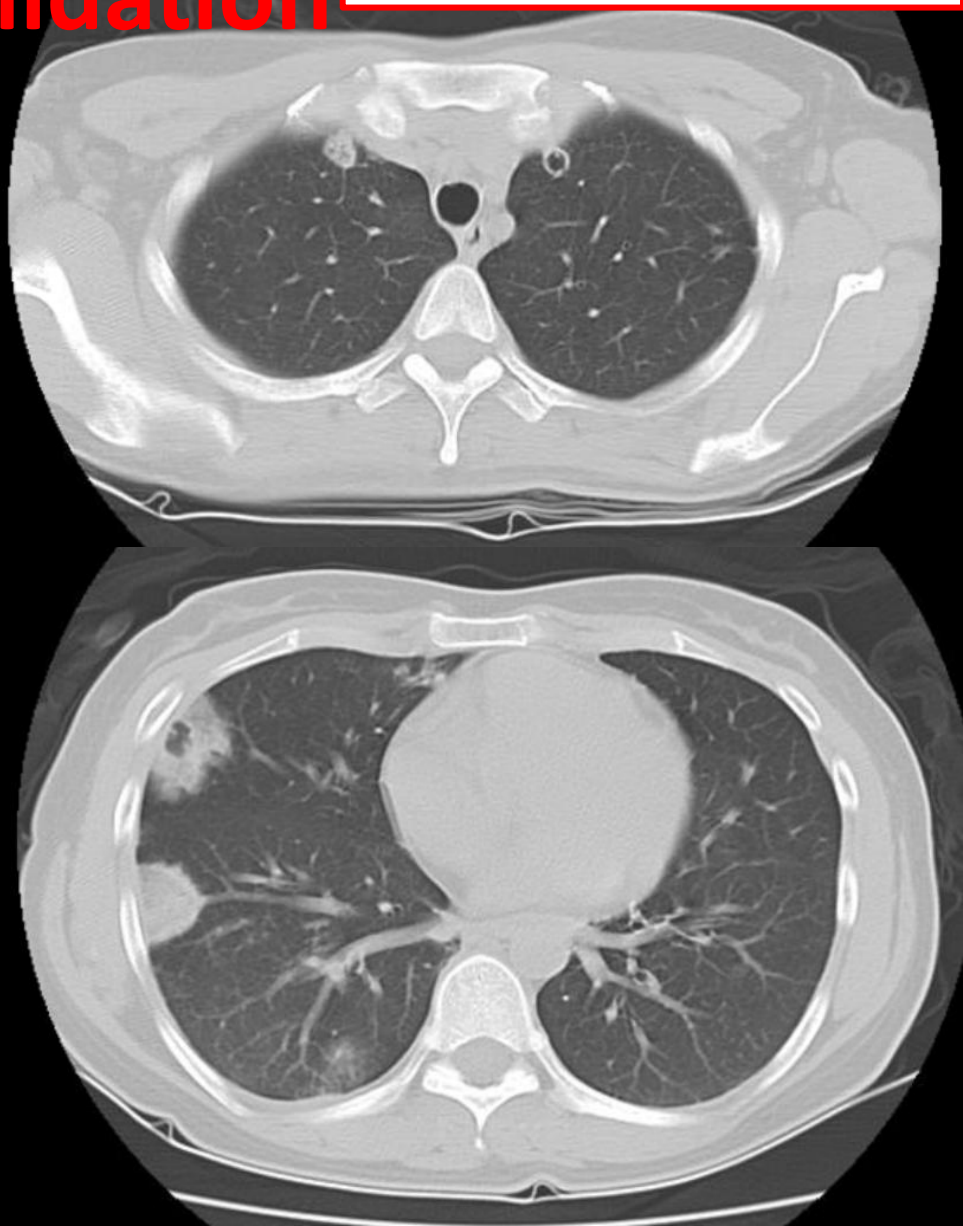
56M, RML PsA abscess with empyema



Special pattern
lucency within consolidation

1. 多發/雙側/周邊
2. 許多時期同時發生
3. 有時可見feeding vessel

38F, HIV/HCV with tricuspid IE,
with MSSA bacteremia and septic lung



Special pattern
predominant distribution

Disease	Comment
chronic eosinophilic pneumonia	upper and peripheral predominance. photographic negative of pulmonary edema
organizing pneumonia	non-upper and peripheral predominance

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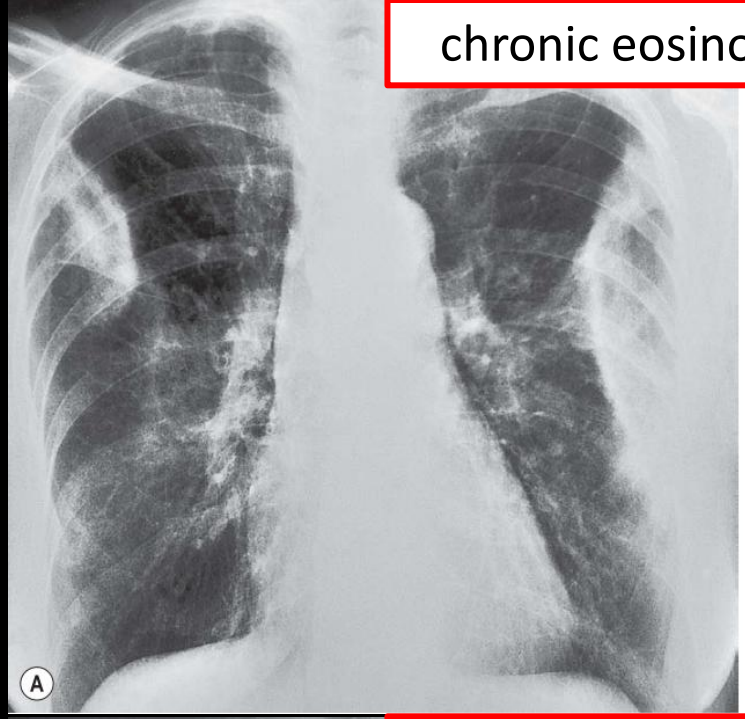
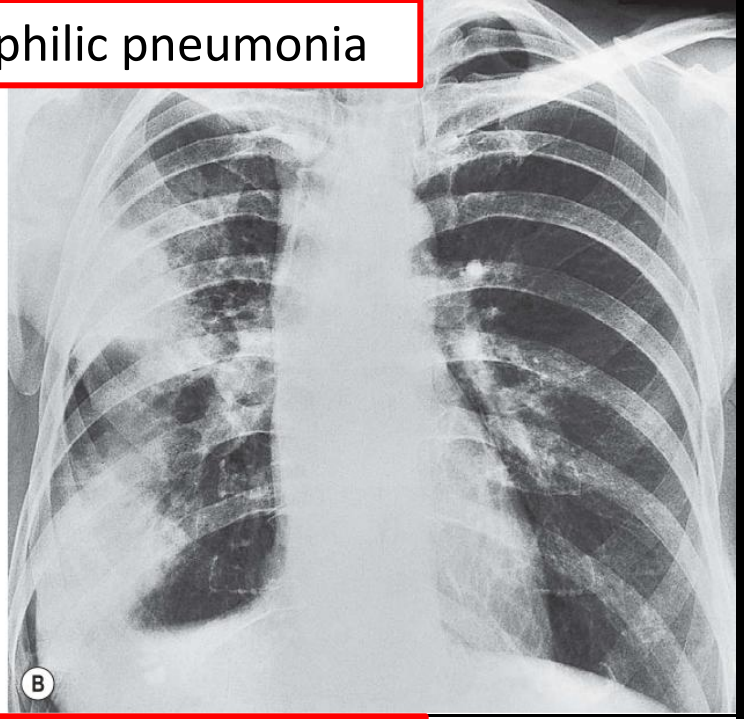
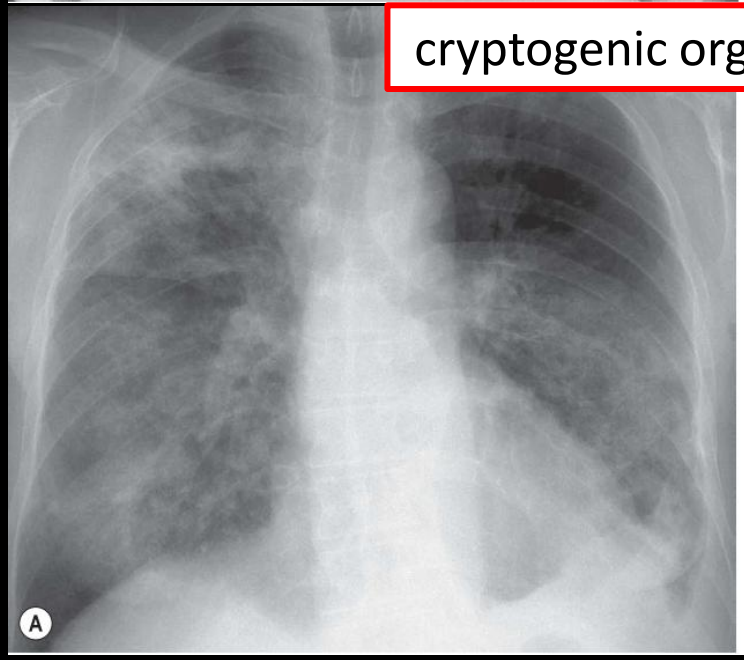
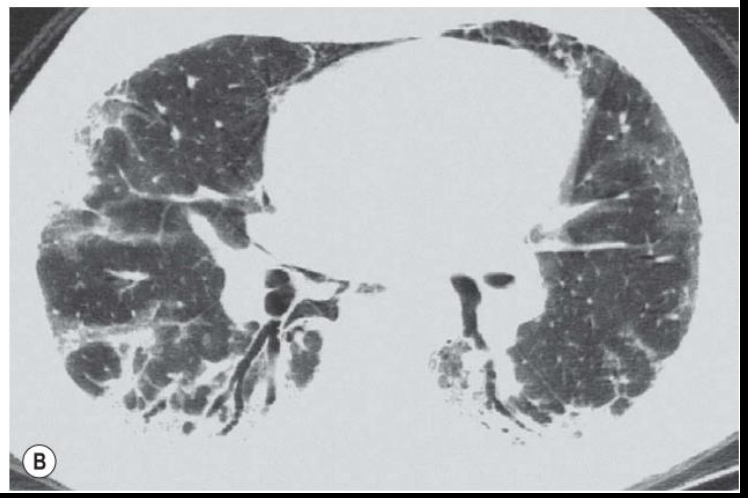
chronic eosinophilic pneumonia





cryptogenic organizing pneumonia





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Atelectasis (collapse)

Mechanism

Pattern

atelectasis

Pathophysiology.—Atelectasis is reduced inflation of all or part of the lung (20). One of the commonest mechanisms is resorption of air distal to airway obstruction (eg, an endobronchial neoplasm) (21). The synonym *collapse* is often used interchangeably with *atelectasis*, particularly when it is severe or accompanied by obvious increase in lung opacity.

Hansell DM et al. Radiology. 2008;246(3):697-722.

Cause of atelectasis

Mechanism	Comment
resorption	large or small airway obstruction
adhesive	surfactant deficiency -ARDS (diffuse), pulmonary embolism (local)
passive	extrapulmonary retraction -PTX, diaphragm palsy
compressive	intrathoracic or abdominal compression -lung/pleura, obesity/ascites
cicatraization	Fibrosis, traction BXSIS, granulomatous inf.

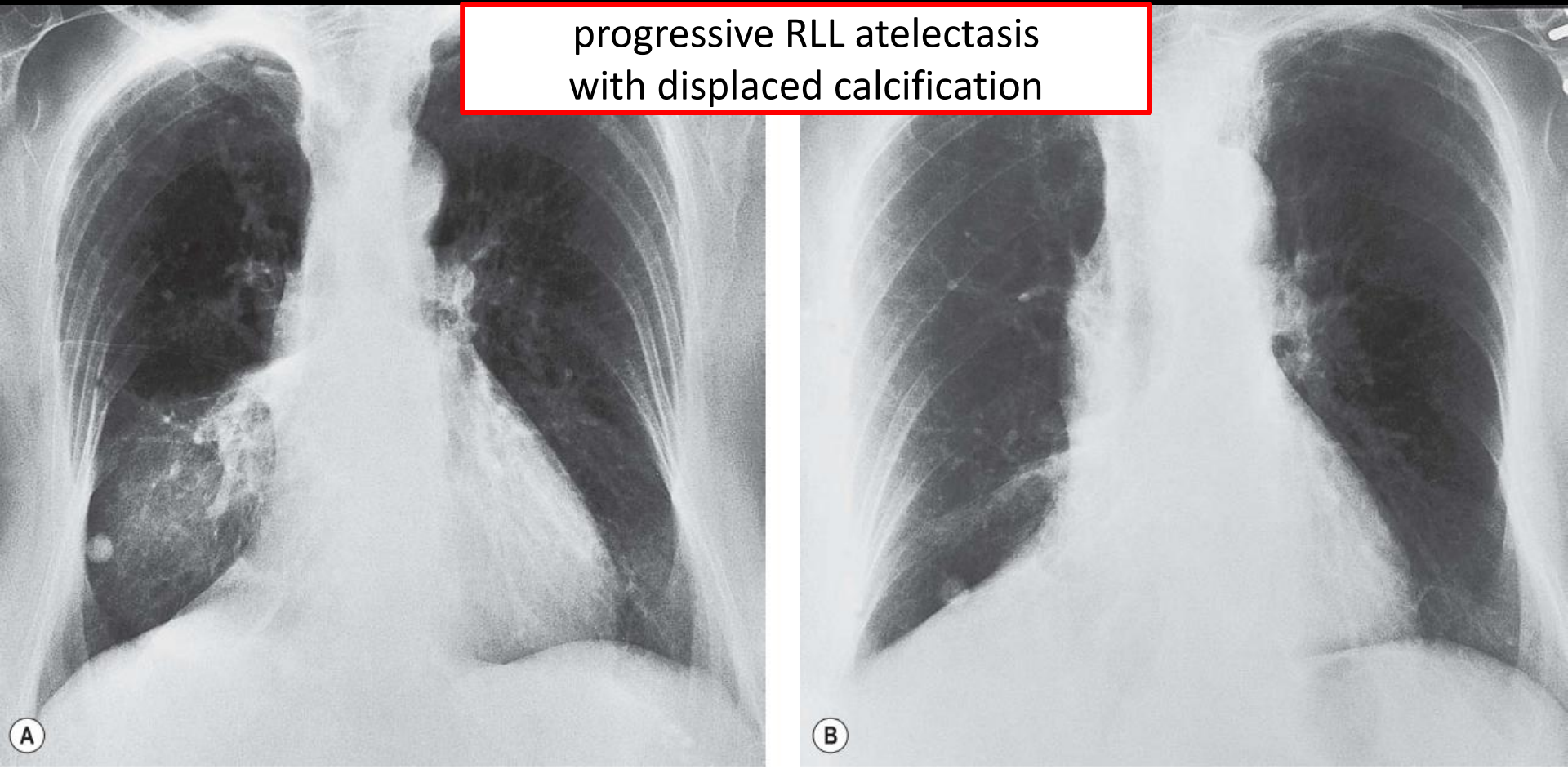
Woodring JH, Reed JC. J Thorac Imaging. 1996;11:92-108.

Signs of atelectasis

Direct	Indirect
fissure displacement	**pulmonary opacity**
crowed pulmonary vessels	diaphragm elevation
crowed air bronchograms	displacement of mediastinum, trachea, heart, hilum
	compensatory pulmonary expansion
	approximation of ribs
	shifting granuloma

Woodring JH, Reed JC. J Thorac Imaging. 1996;11:92-108.

progressive RLL atelectasis
with displaced calcification



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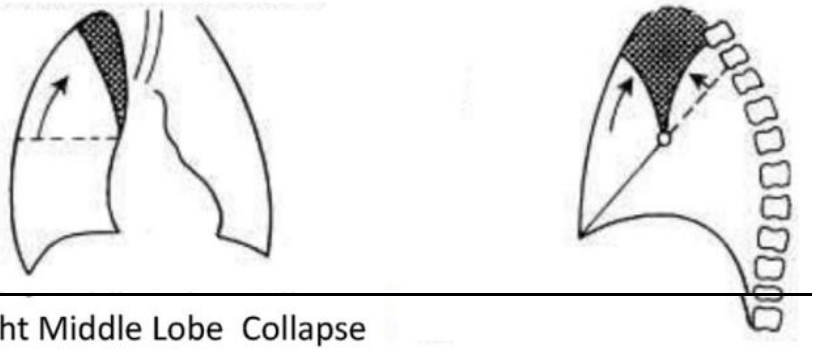
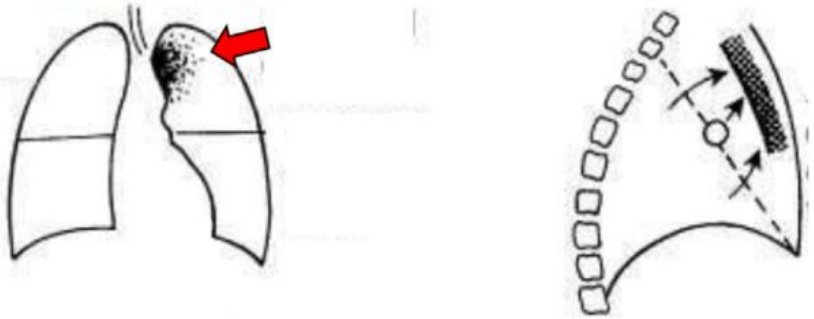
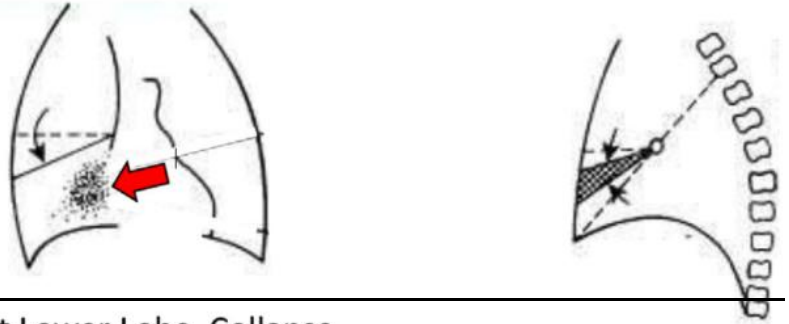
Right Upper Lobe Collapse



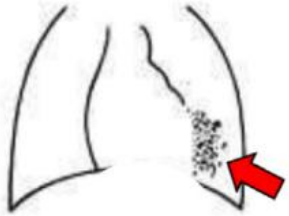
Left Upper Lobe Collapse



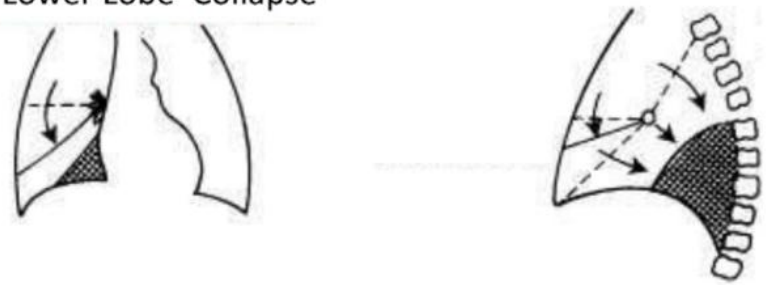
Right Middle Lobe Collapse



Lingular Collapse



Right Lower Lobe Collapse

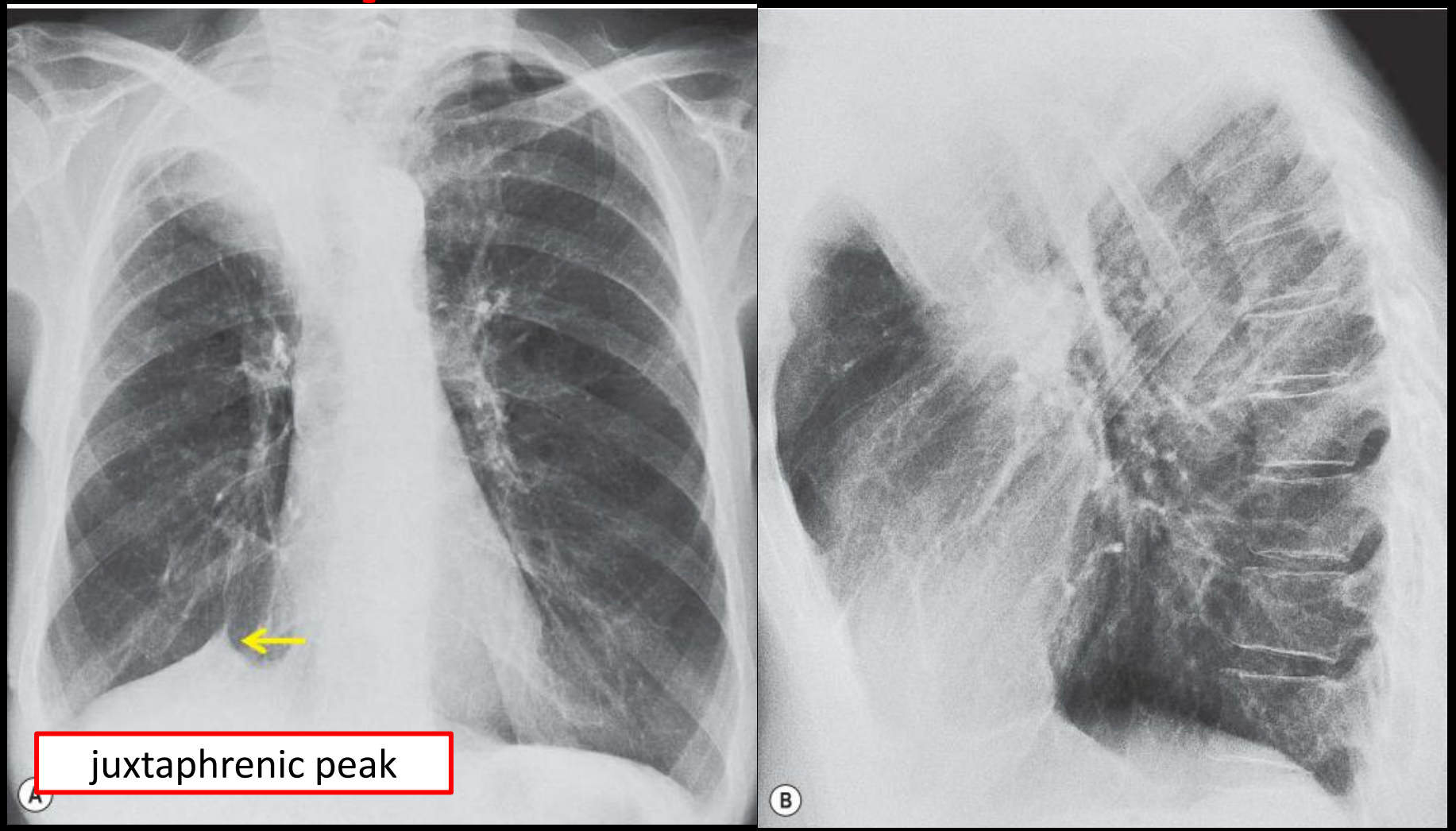


Left Lower Lobe Collapse

Marini JJ. Chest. 2019;155:1049-58.

RUL atelectasis

please look down



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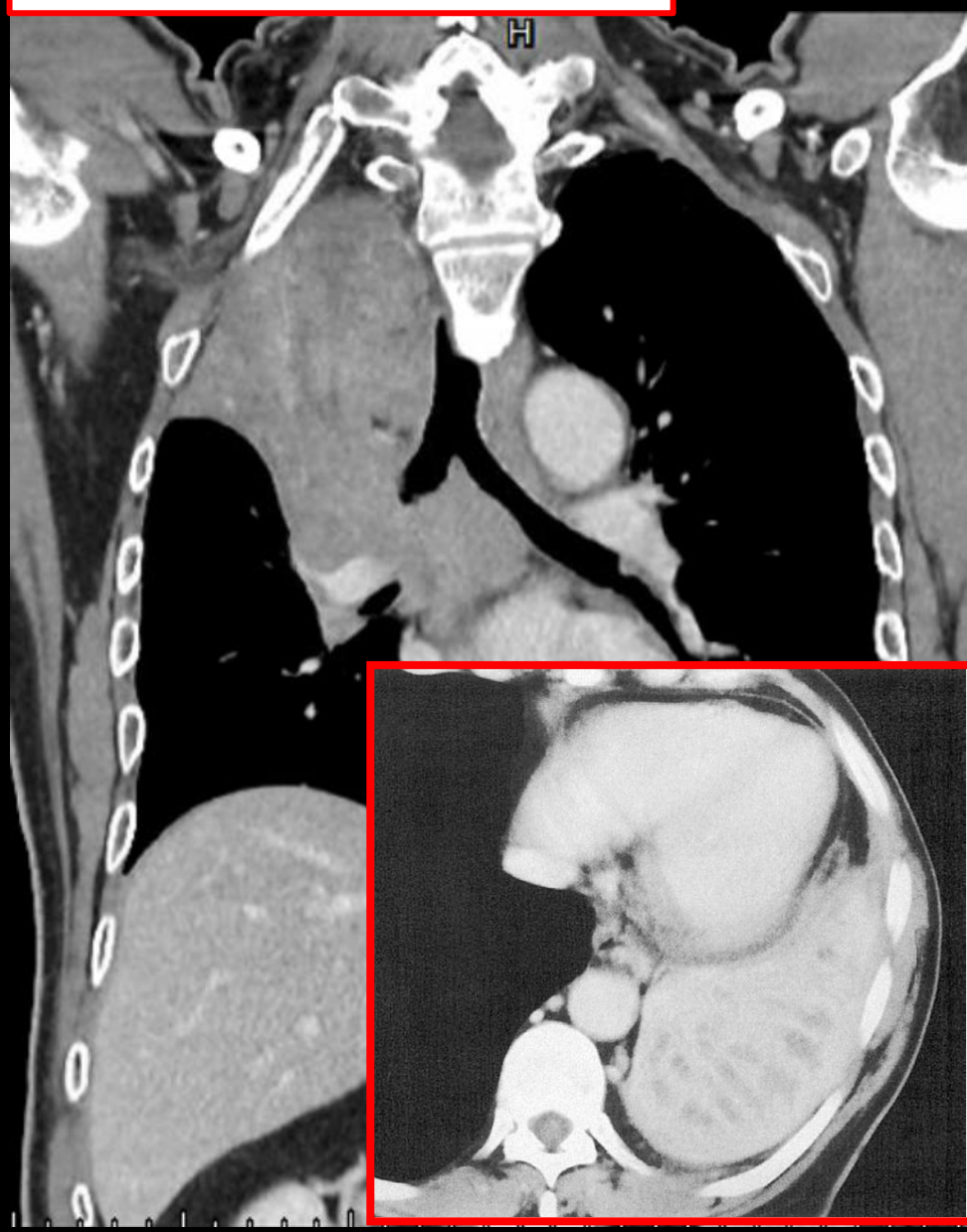
SCLC with RUL atelectasis
Golden S sign

fluid bronchogram sign
endobronchial invasion



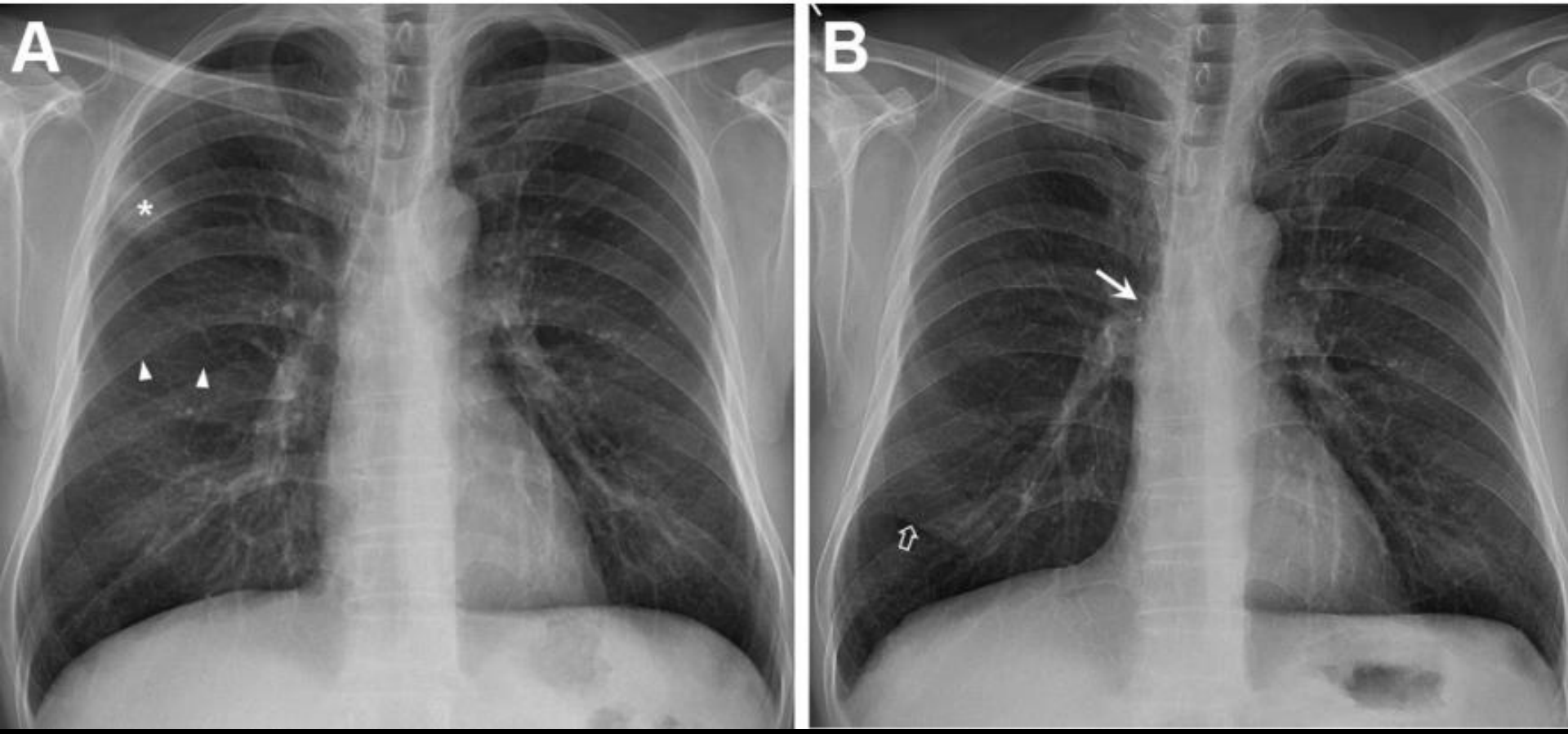
RUL atelectasis

extreme with fissure present

RUL atelectasis

extreme with fissure absent

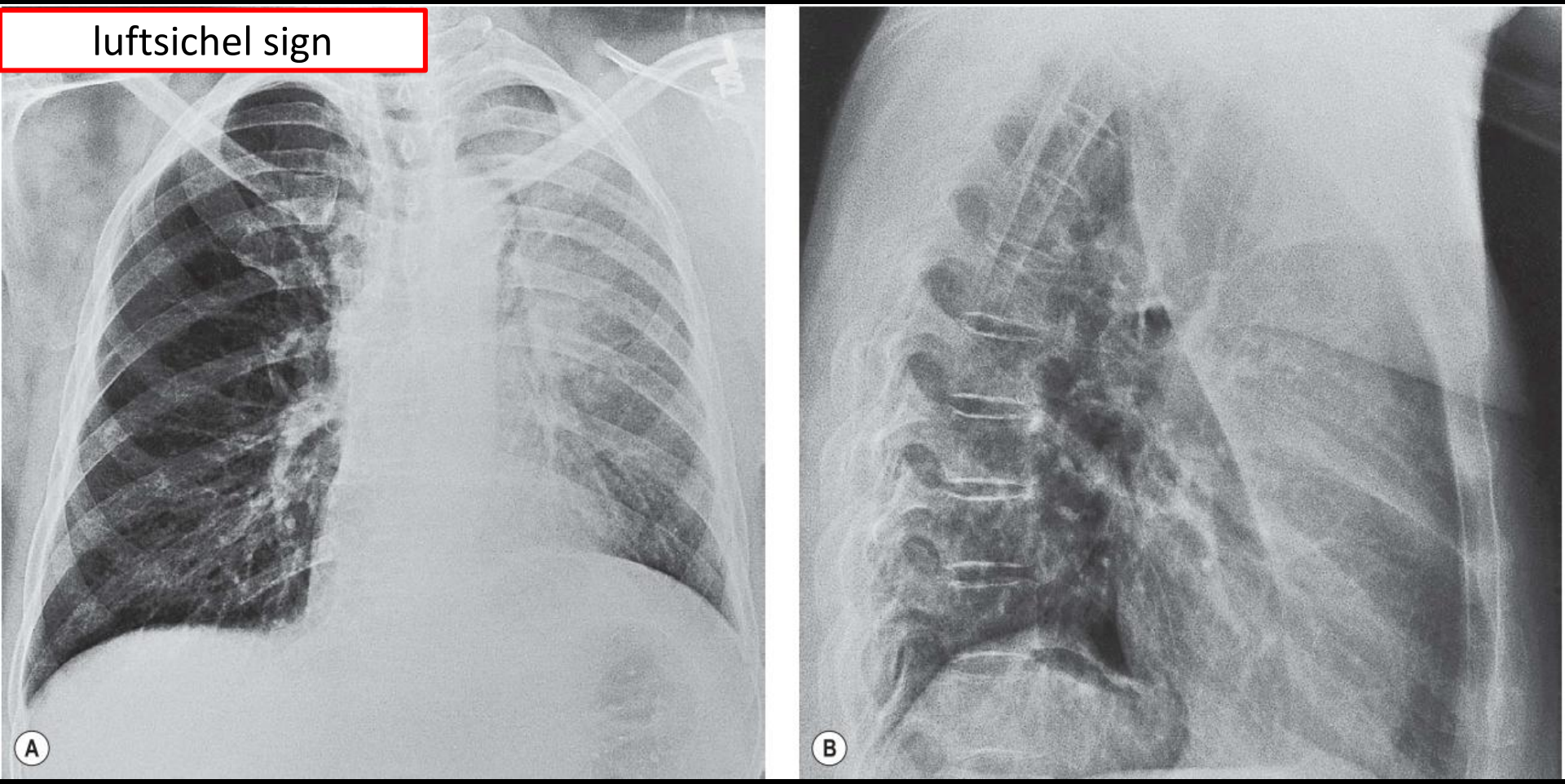
RUL lobectomy



Ko JM, et al. Chest. 2021;159:294-301.

LUL atelectasis

typical



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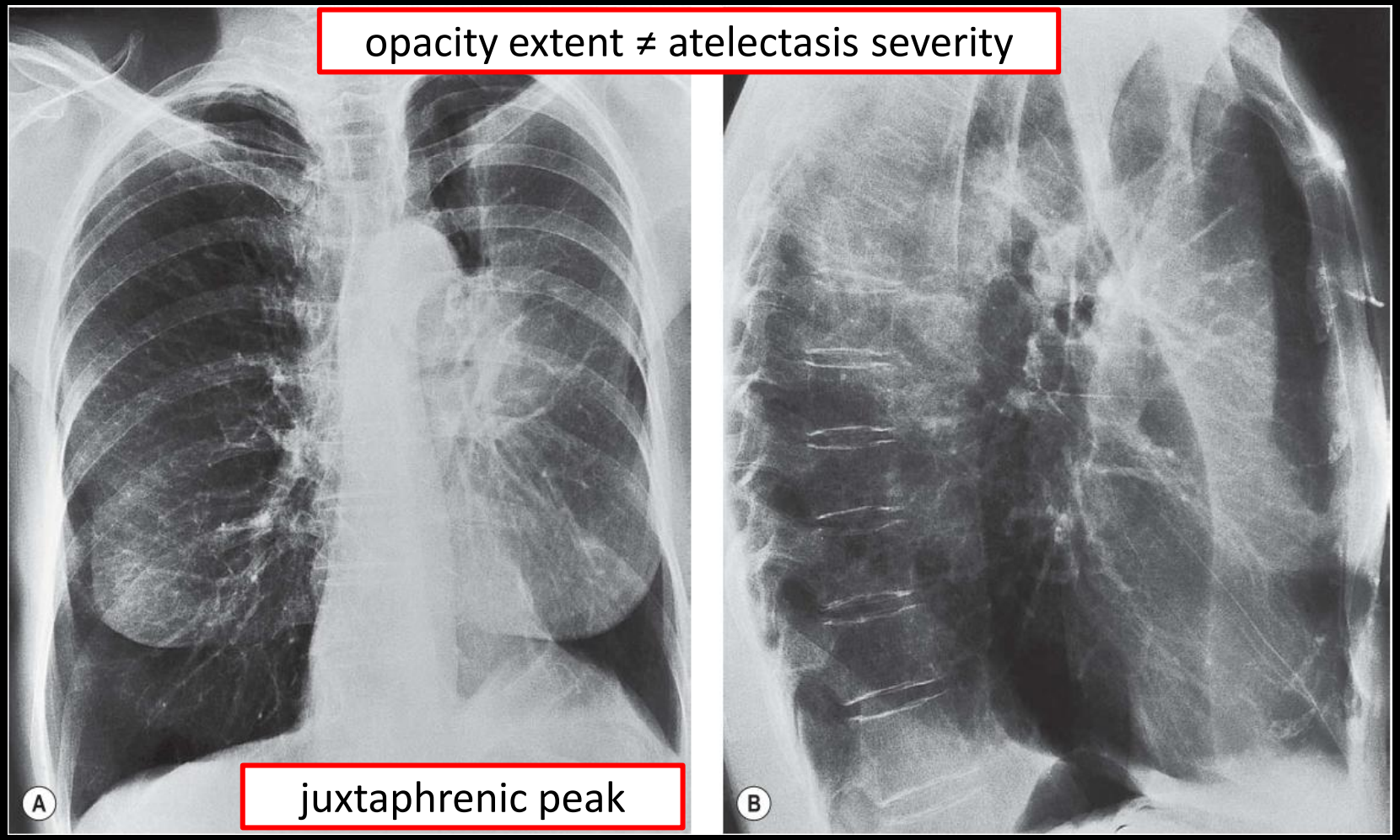
LUL atelectasis
further volume loss



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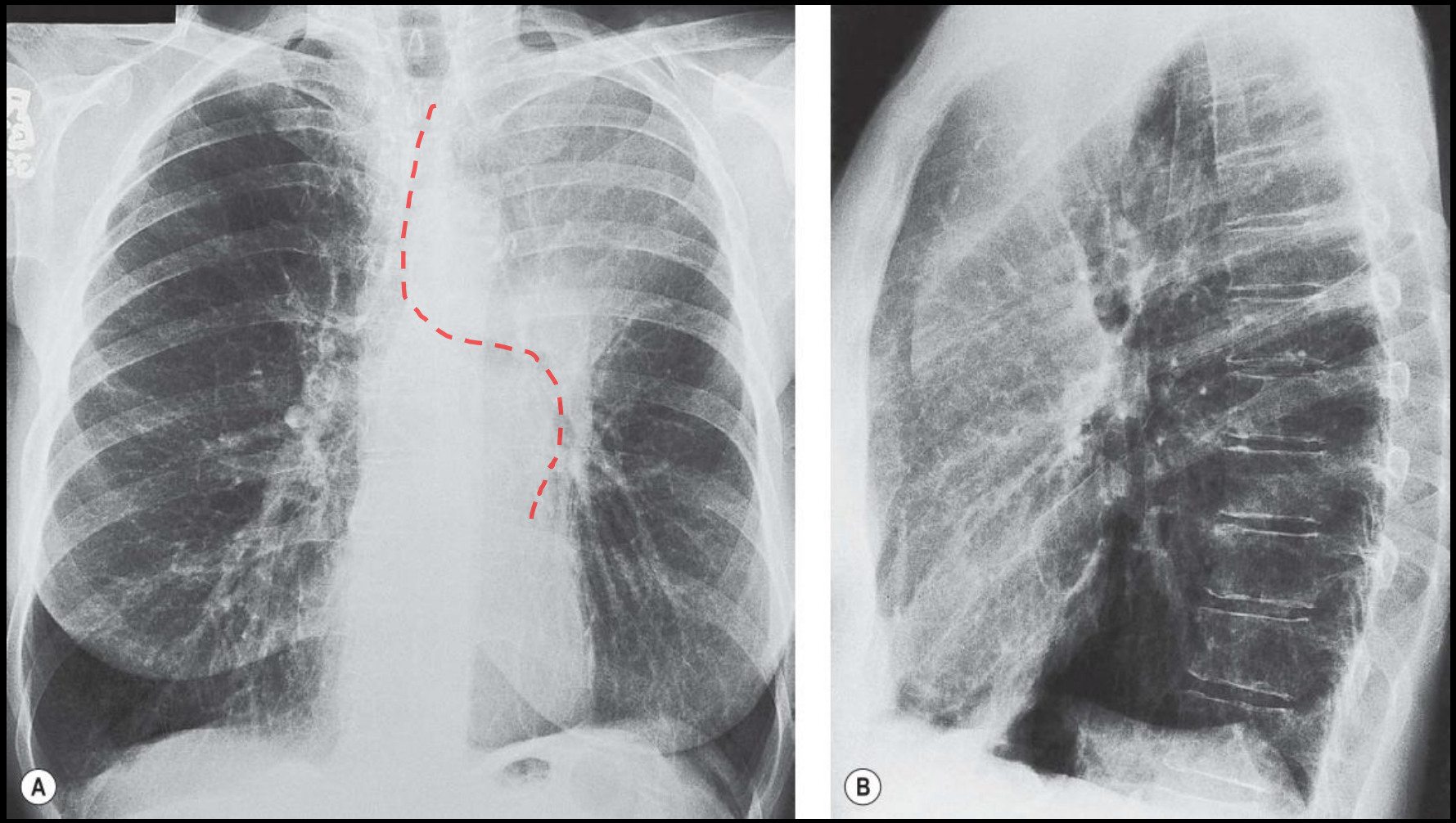
LUL atelectasis

S-shaped configuration



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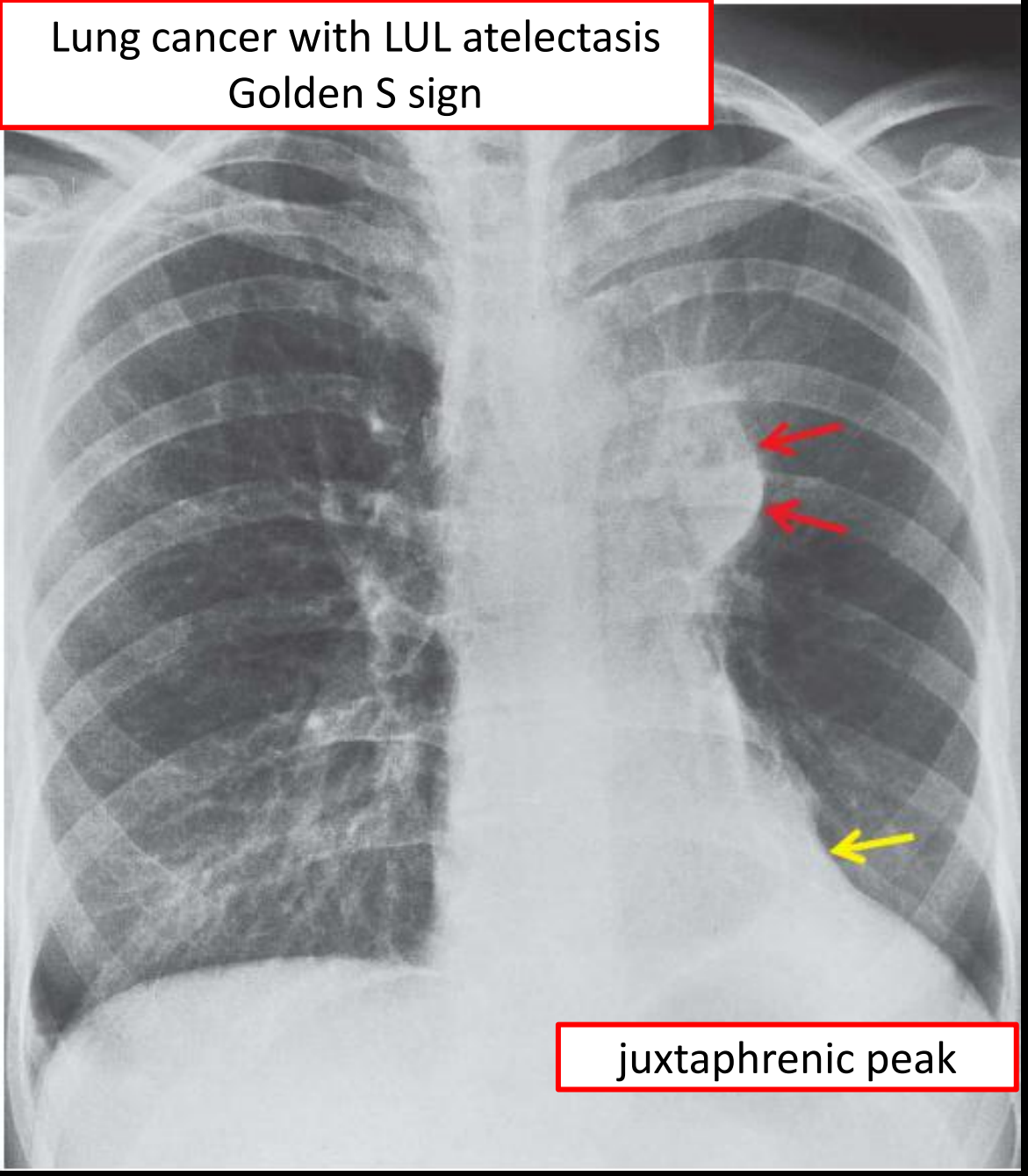
Lung cancer with LUL atelectasis
Golden S sign



juxtaphrenic peak

LUL atelectasis

with Golden S sign

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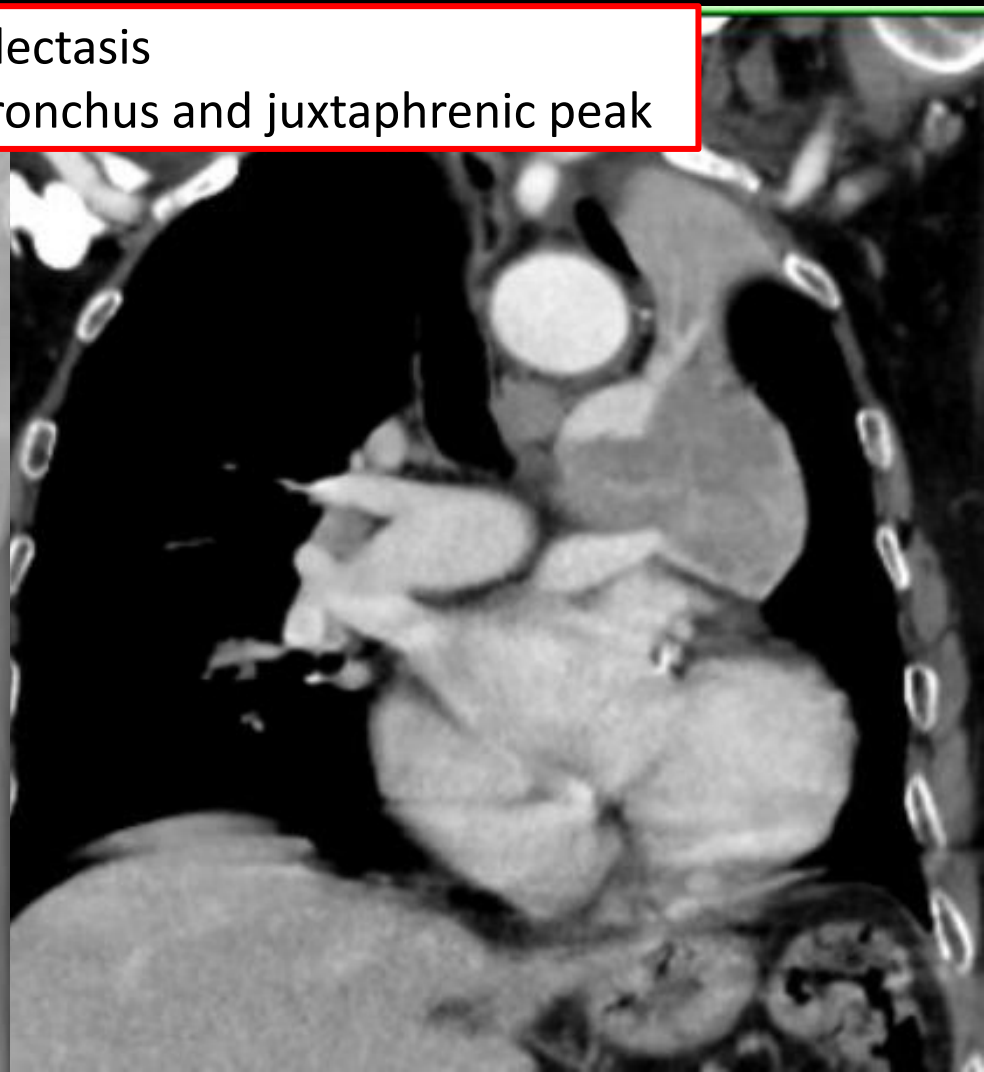
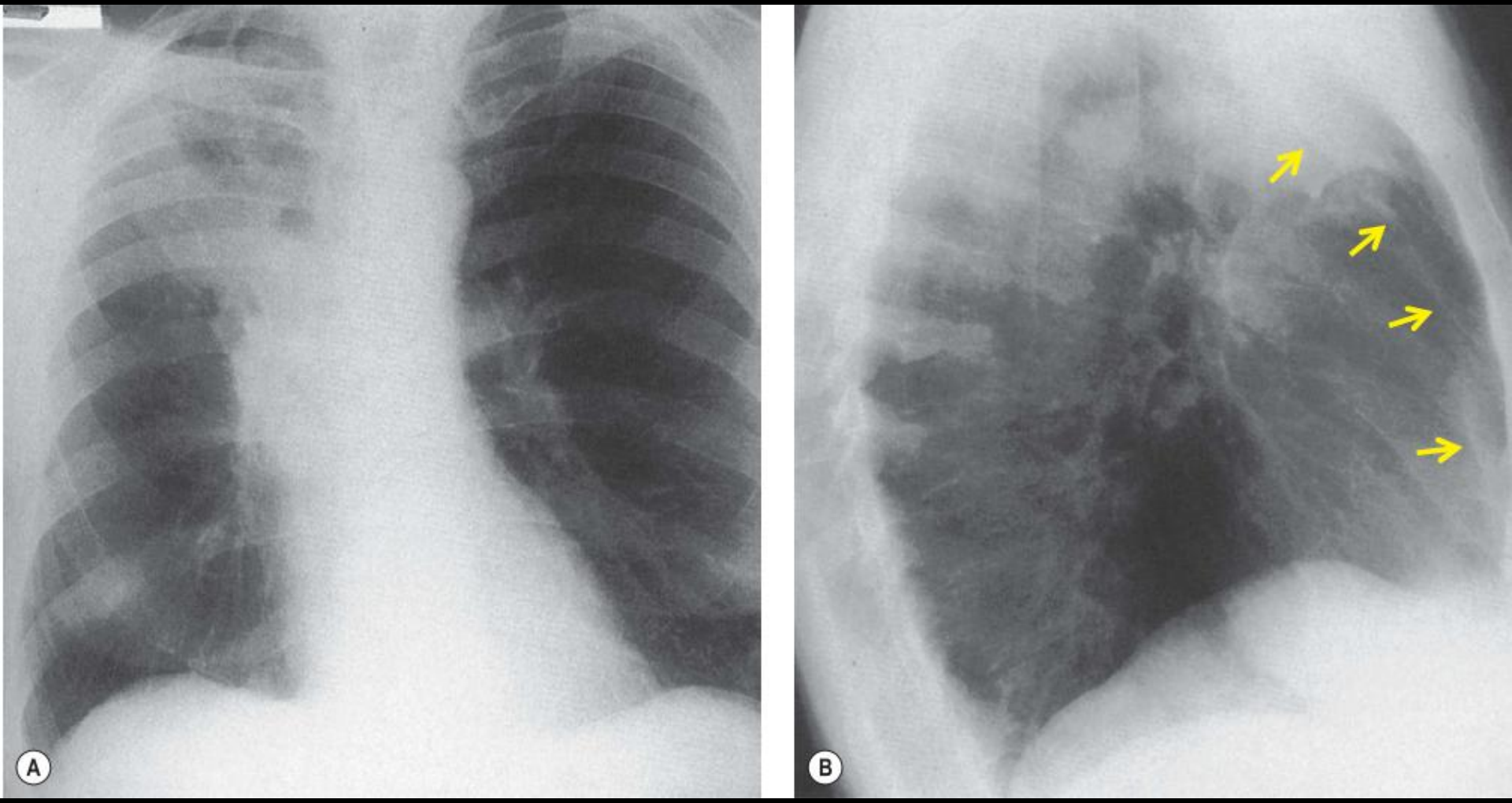
LUL atelectasis
ultimate play

SCLC with LUL atelectasis
Golden S sign, luftsichel sign, S-shaped bronchus and juxtaphrenic peak



RUL+RML atelectasis

mirror image of LUL atelectasis



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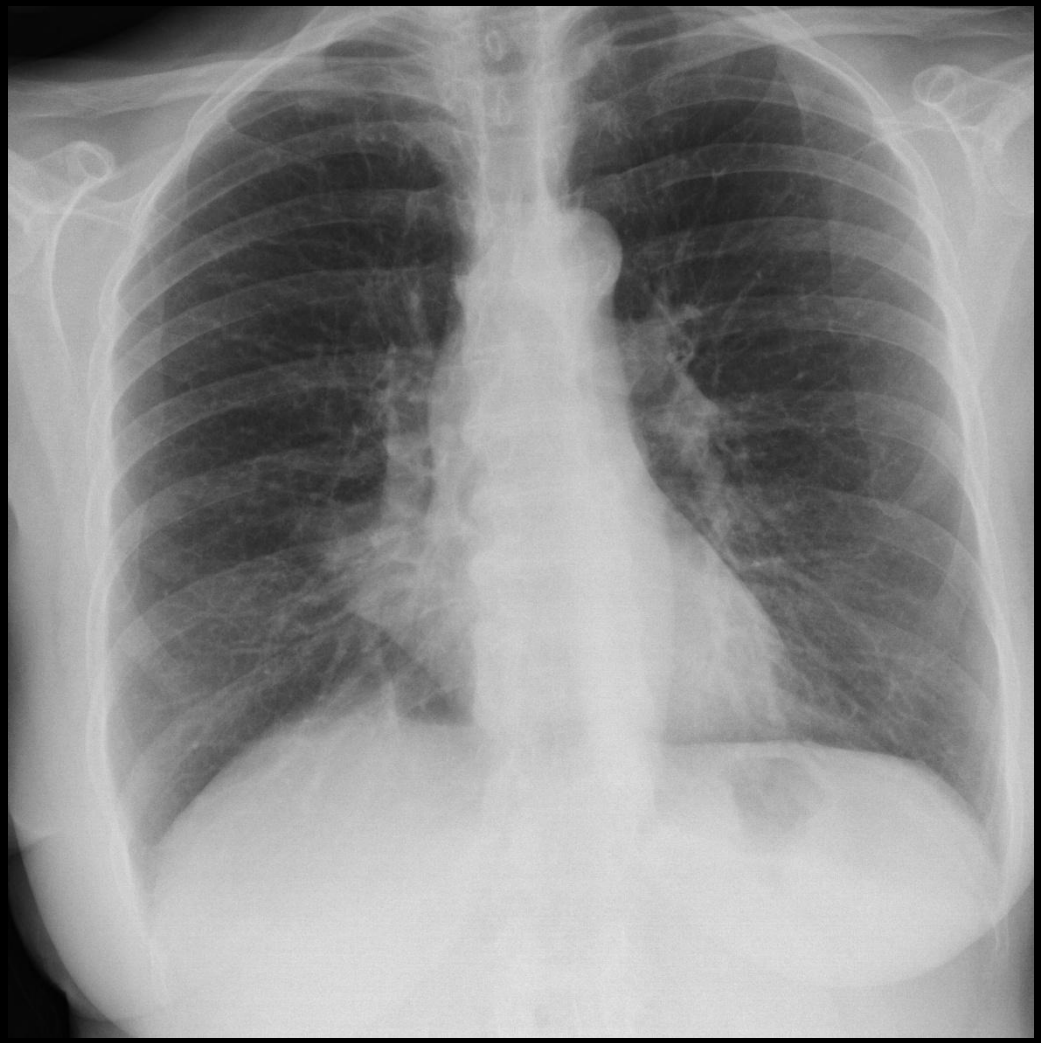
RML atelectasis

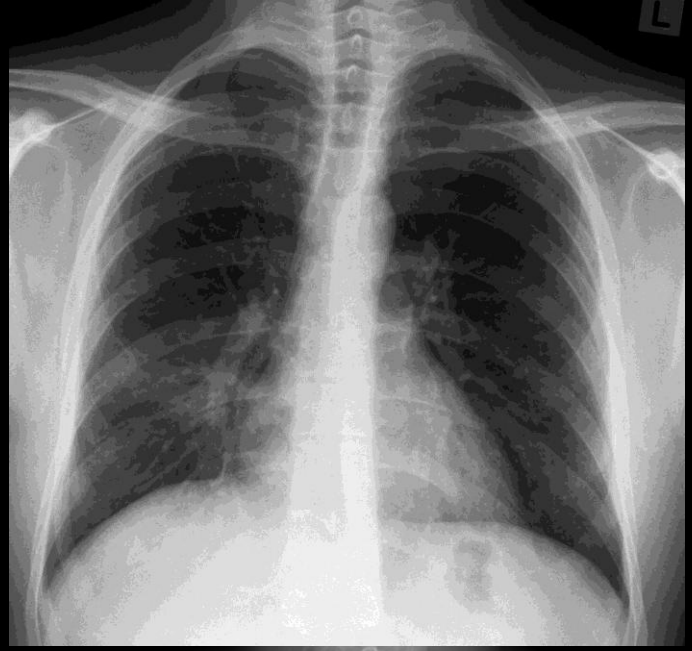
typical triangular

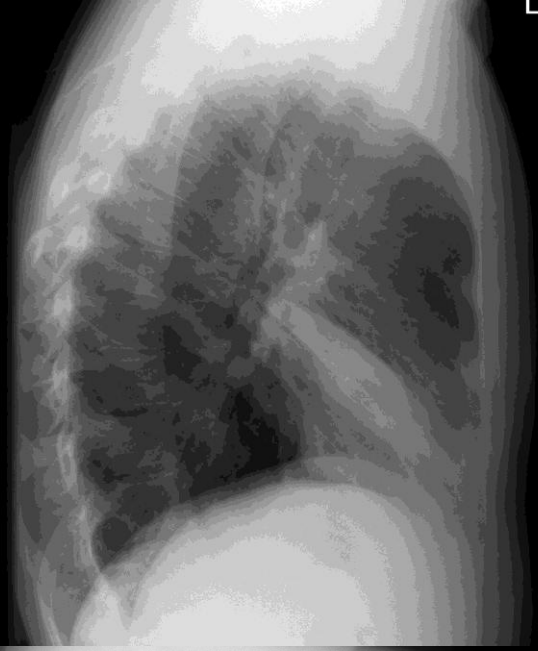


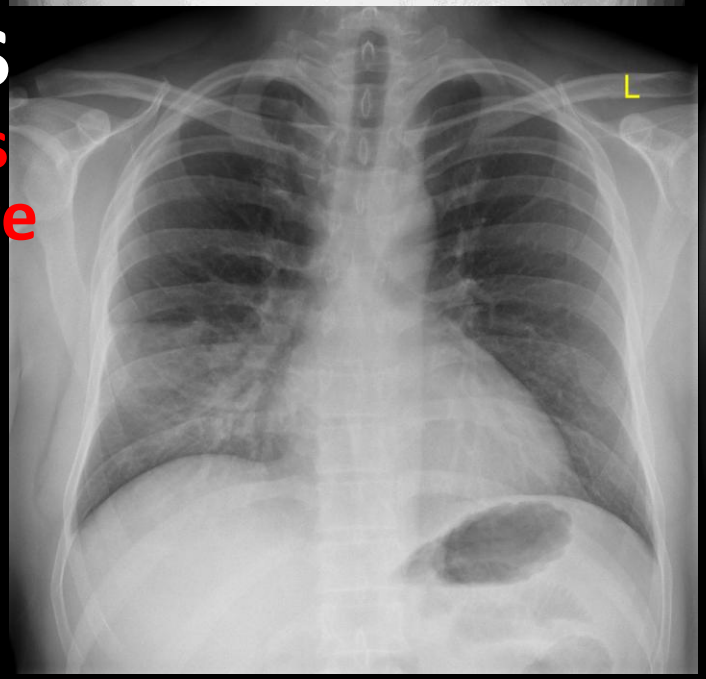
Case courtesy of Dr Ian Bickle, Radiopaedia.org, rID: 56428

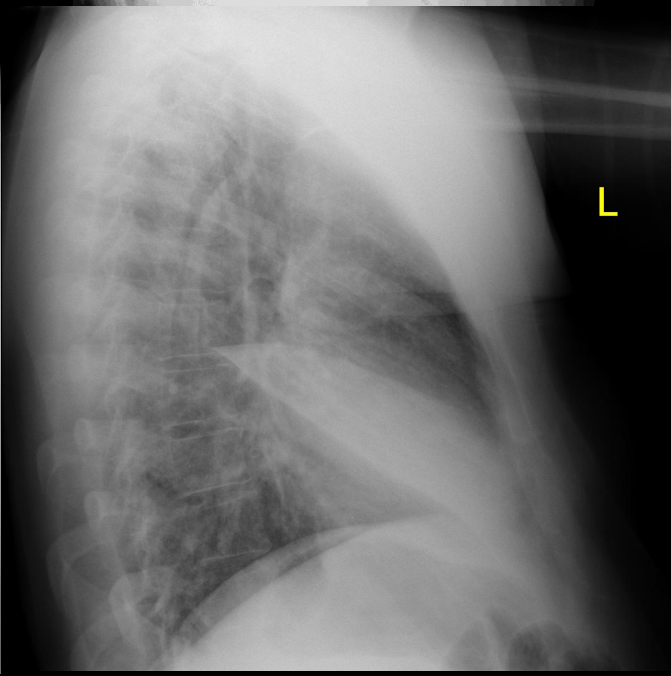
RML atelectasis

lateral view tells no volume change







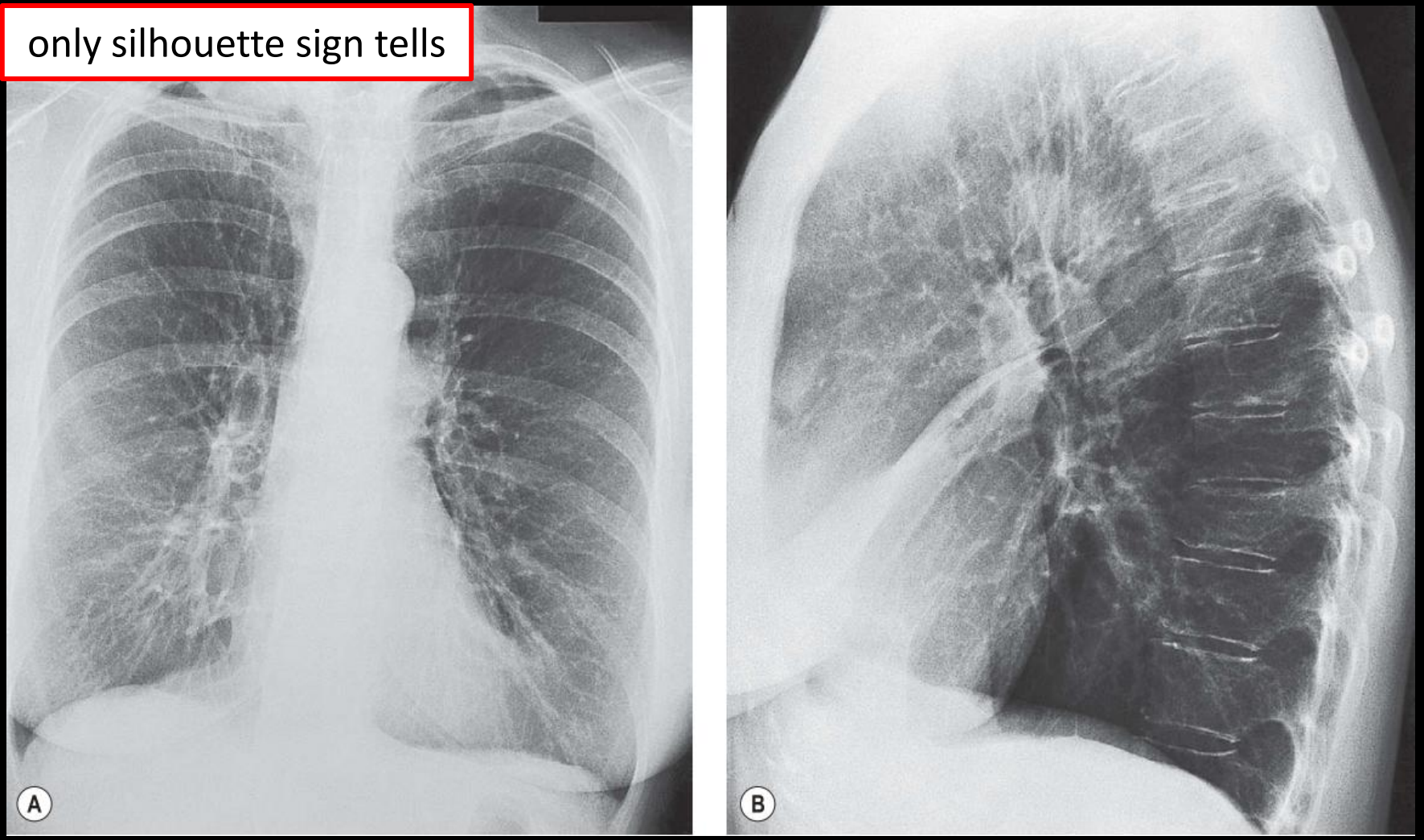


Case courtesy of Dr Henry Knipe, Radiopaedia.org, rID: 31087

Case courtesy of Assoc Prof Frank Gaillard, Radiopaedia.org, rID: 15329

RML atelectasis
further volume loss

only silhouette sign tells



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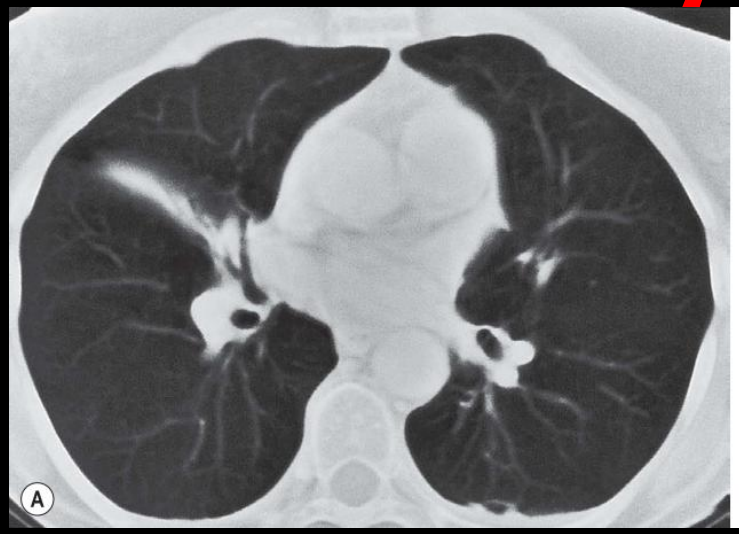
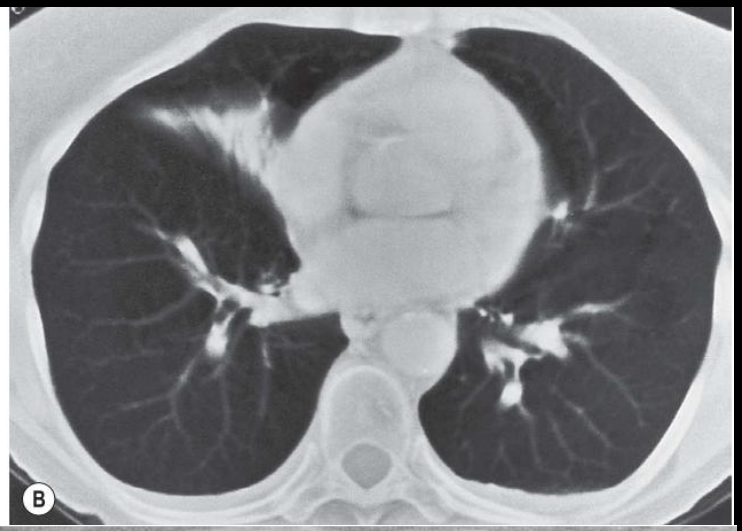
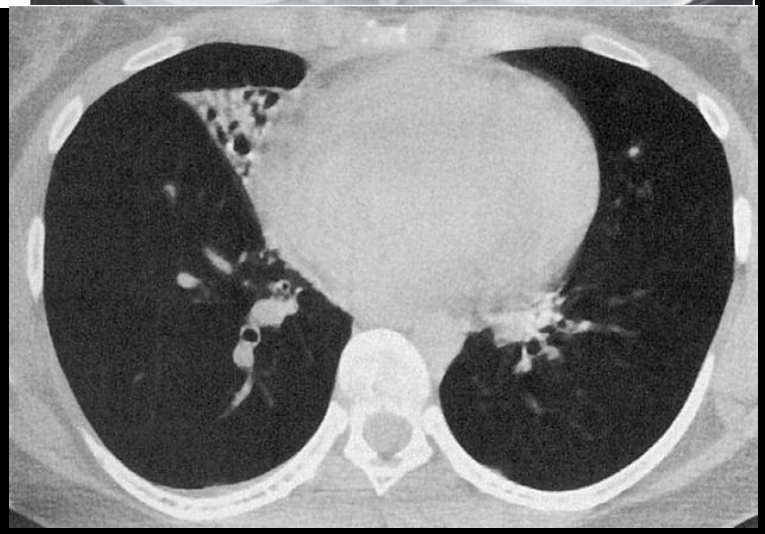
RML atelectasis

RML syndrome





non-obstructive RML atelectasis with BXSIS



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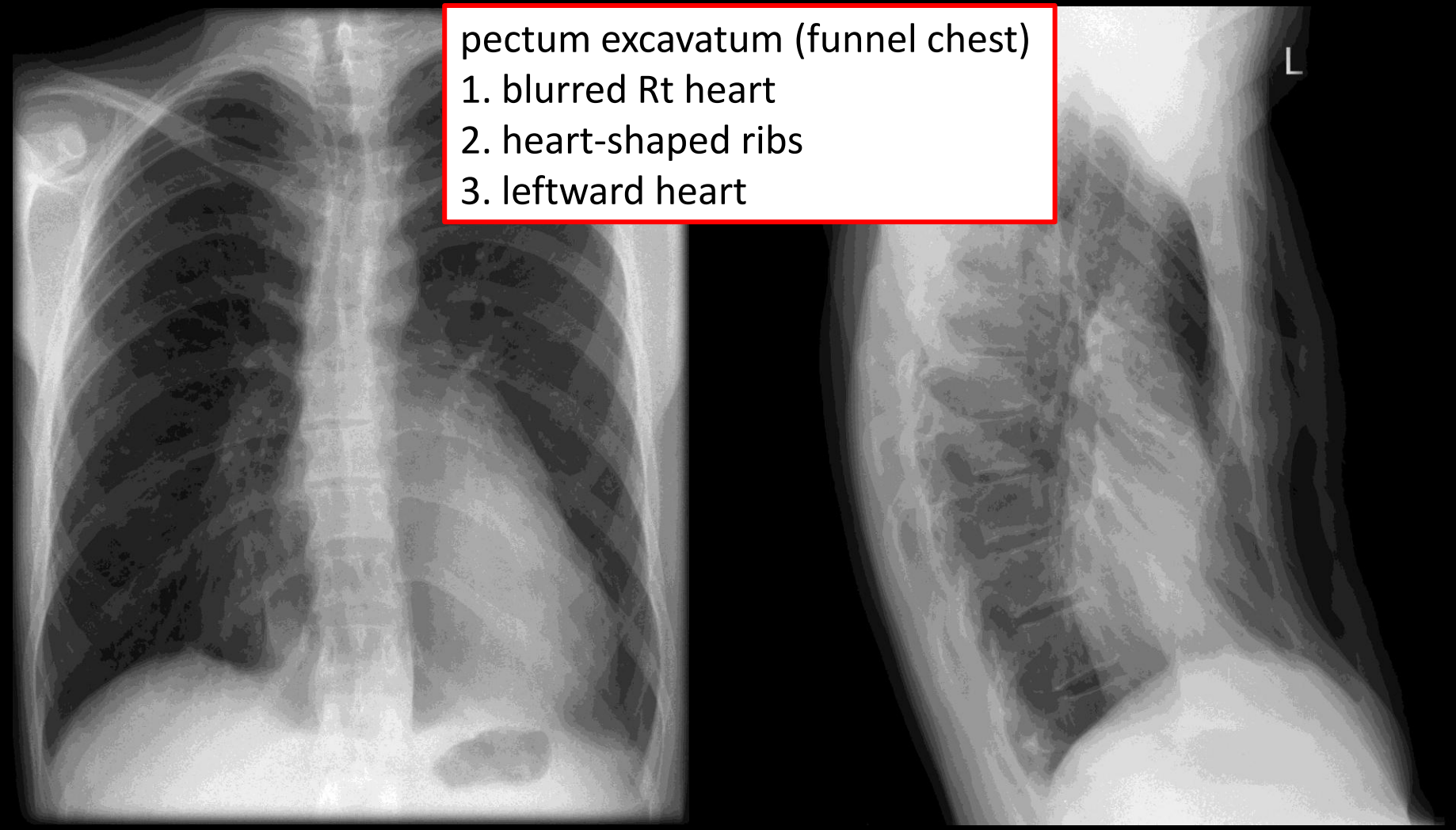
RML atelectasis

caveat

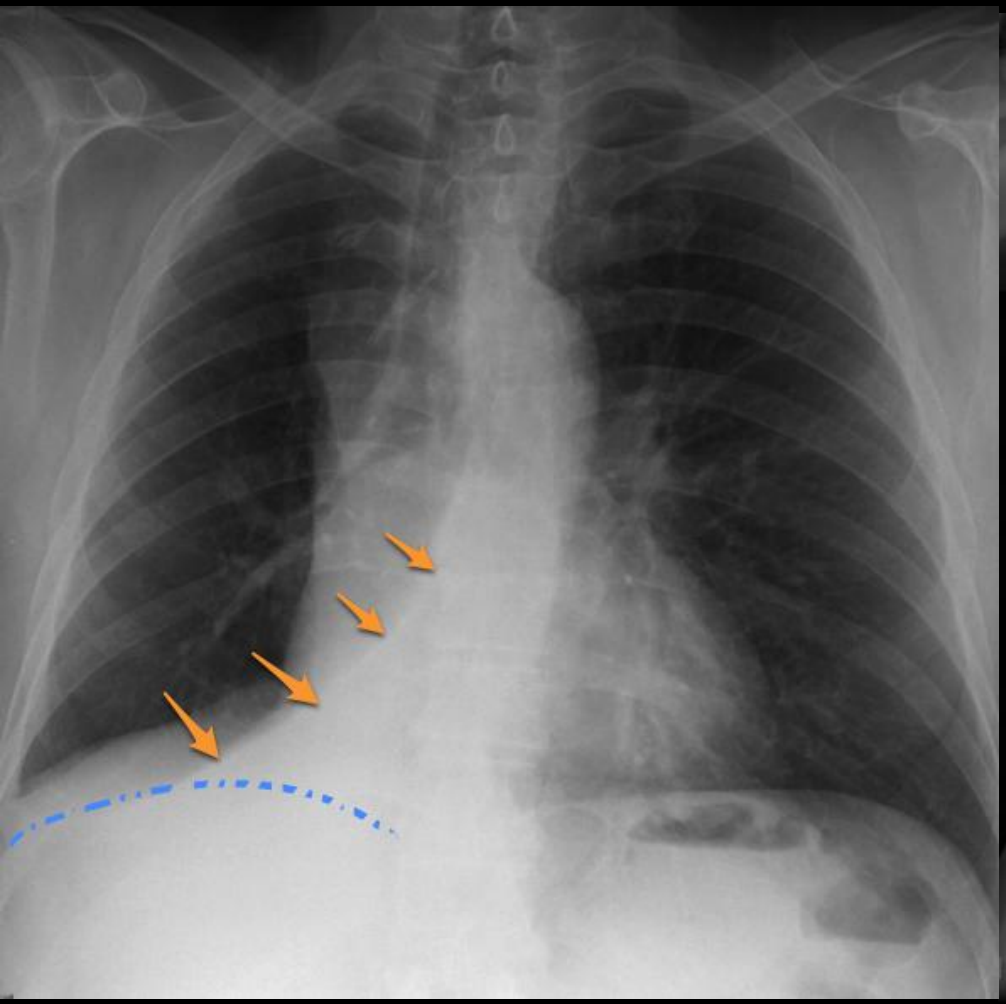
pectum excavatum (funnel chest)
1. blurred Rt heart
2. heart-shaped ribs
3. leftward heart

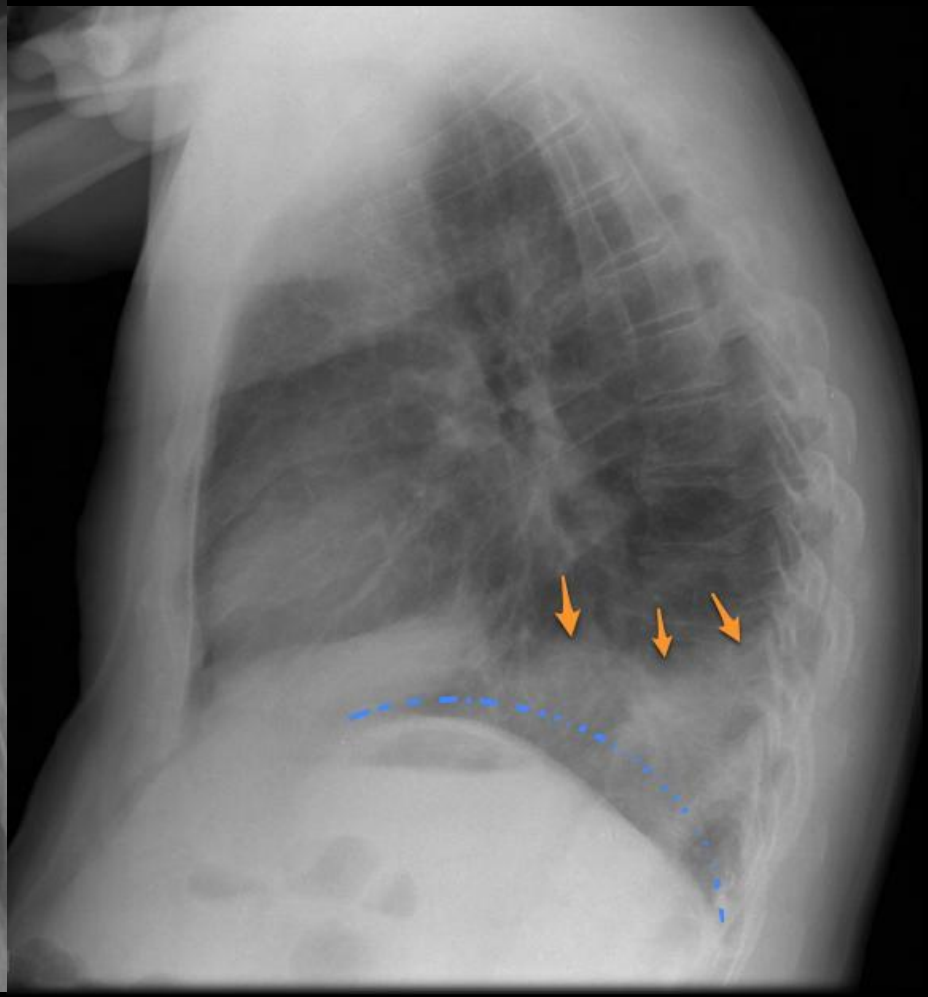


Case courtesy of Assoc Prof Frank Gaillard, Radiopaedia.org, rID: 15393

RLL atelectasis

typical triangular

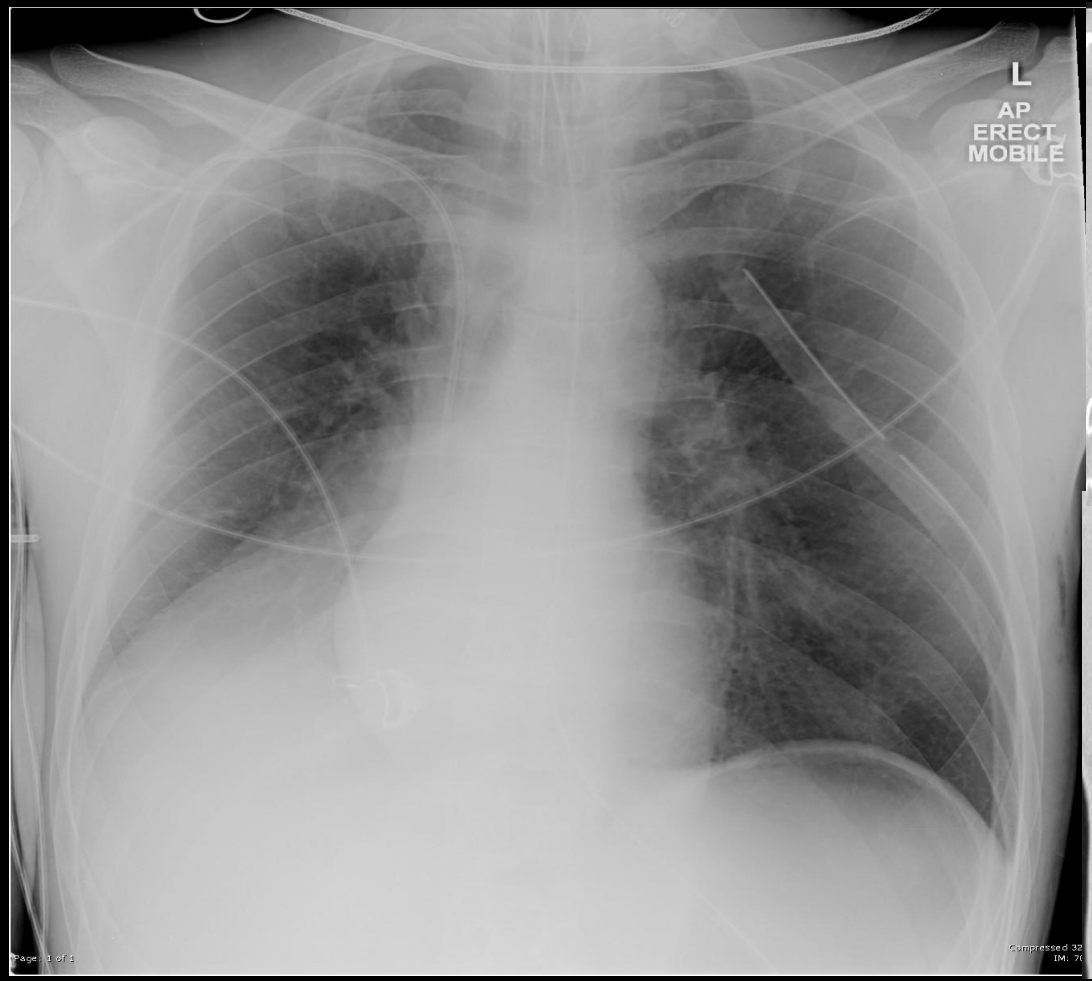


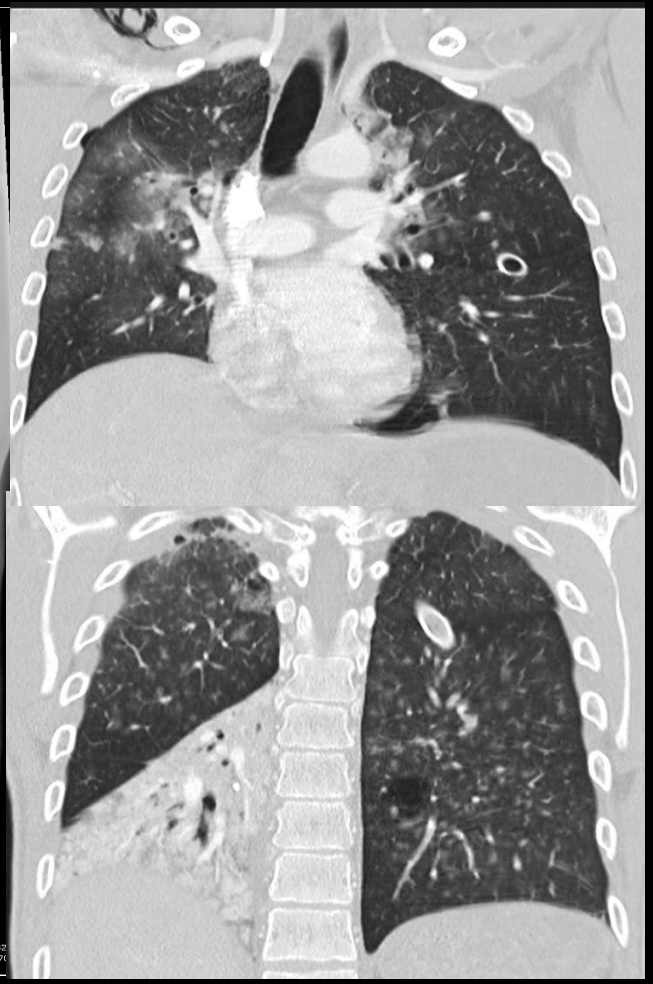


Case courtesy of Assoc Prof Frank Gaillard, Radiopaedia.org, rID: 15328

RLL atelectasis

my heart is clear

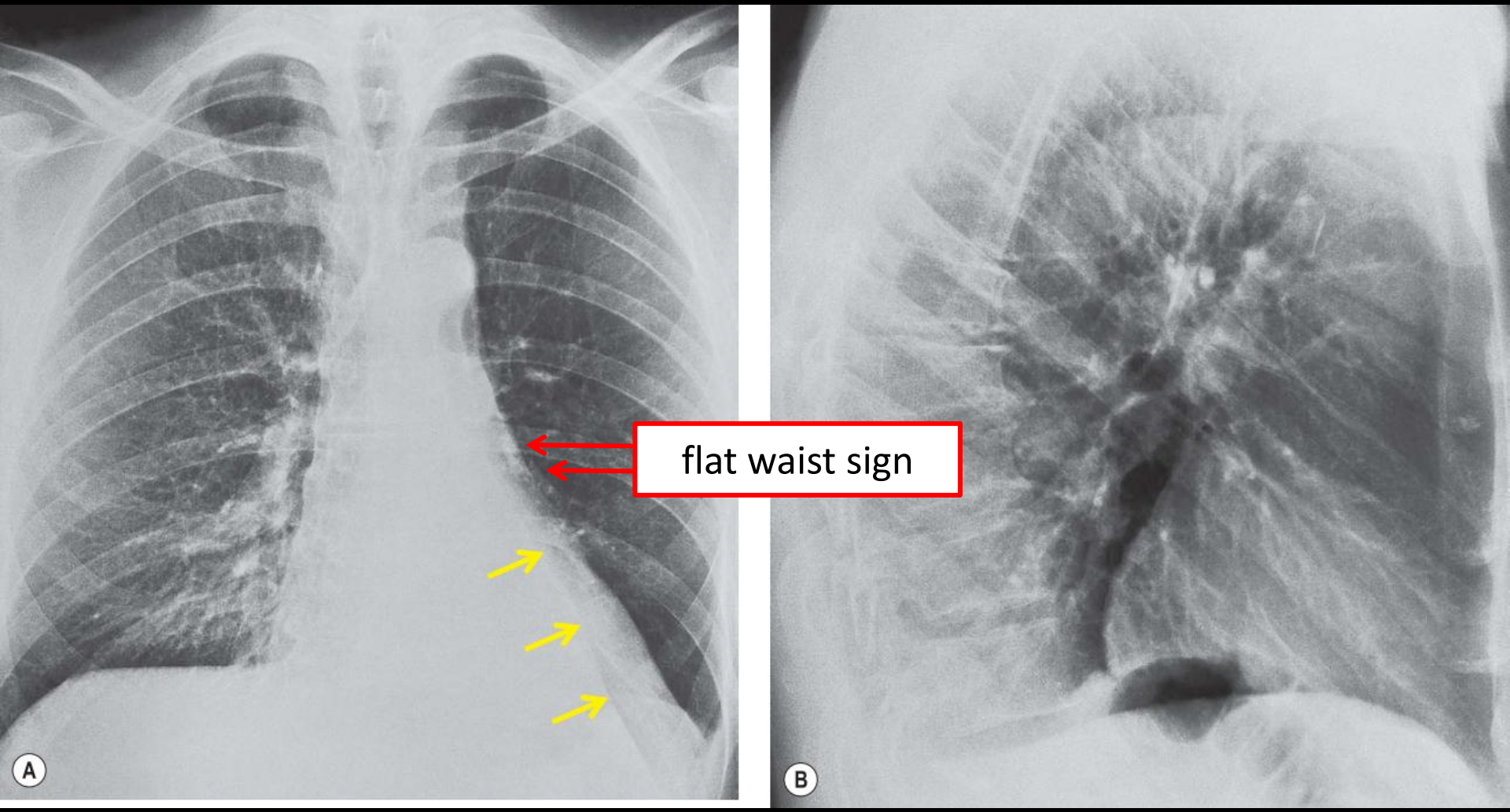




Case courtesy of Assoc Prof Frank Gaillard, Radiopaedia.org, rID: 13784

LLL atelectasis

typical sign



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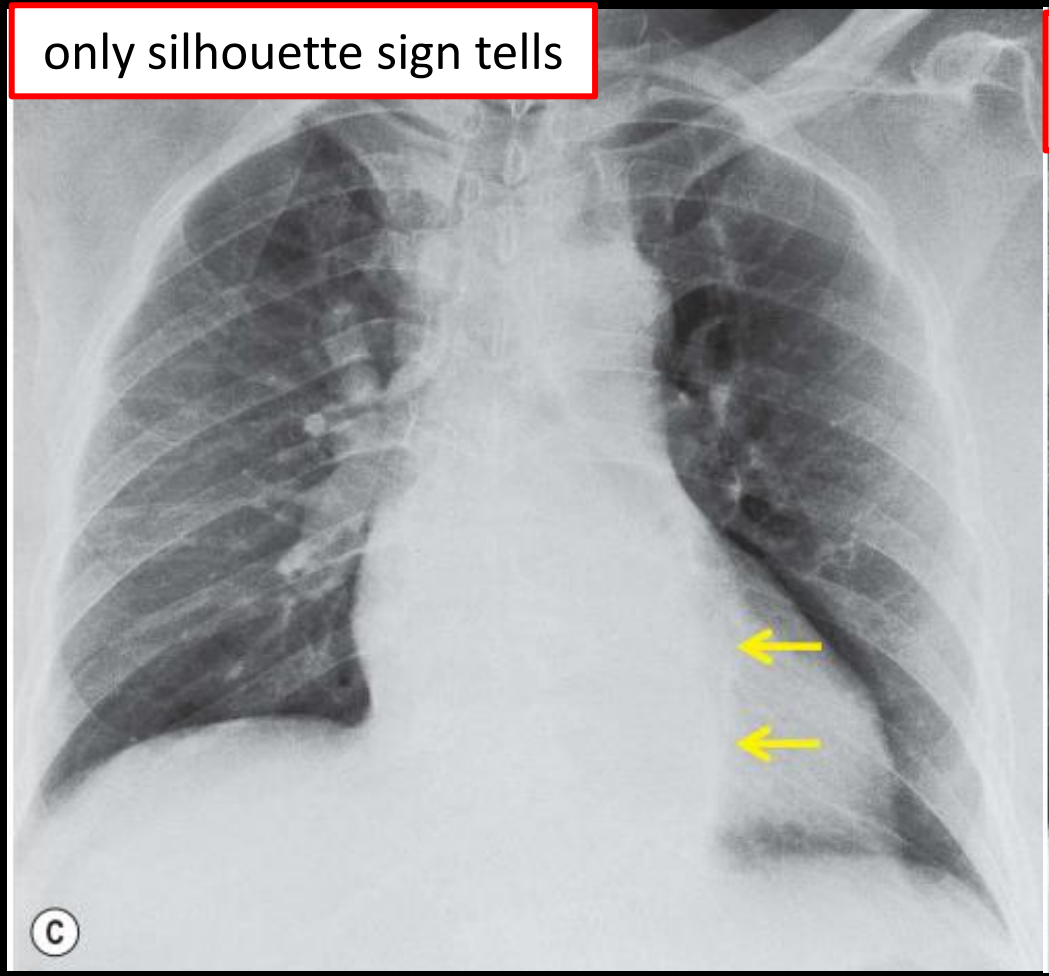
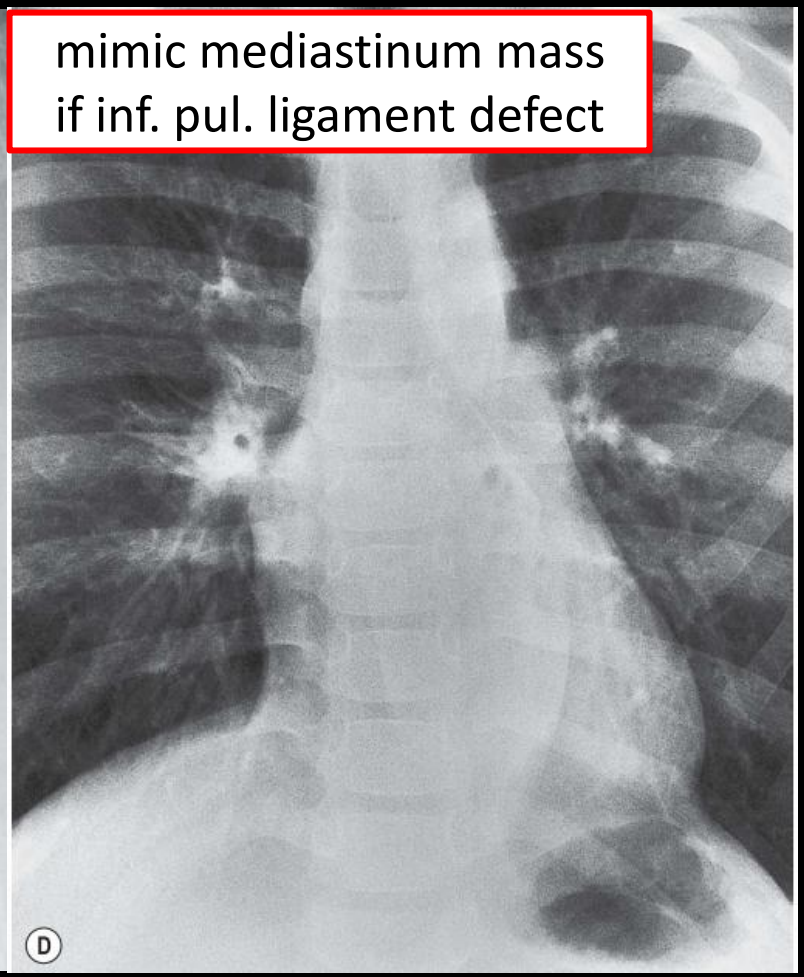
LLL atelectasis
further volume loss

only silhouette sign tells



mimic mediastinum mass
if inf. pul. ligament defect



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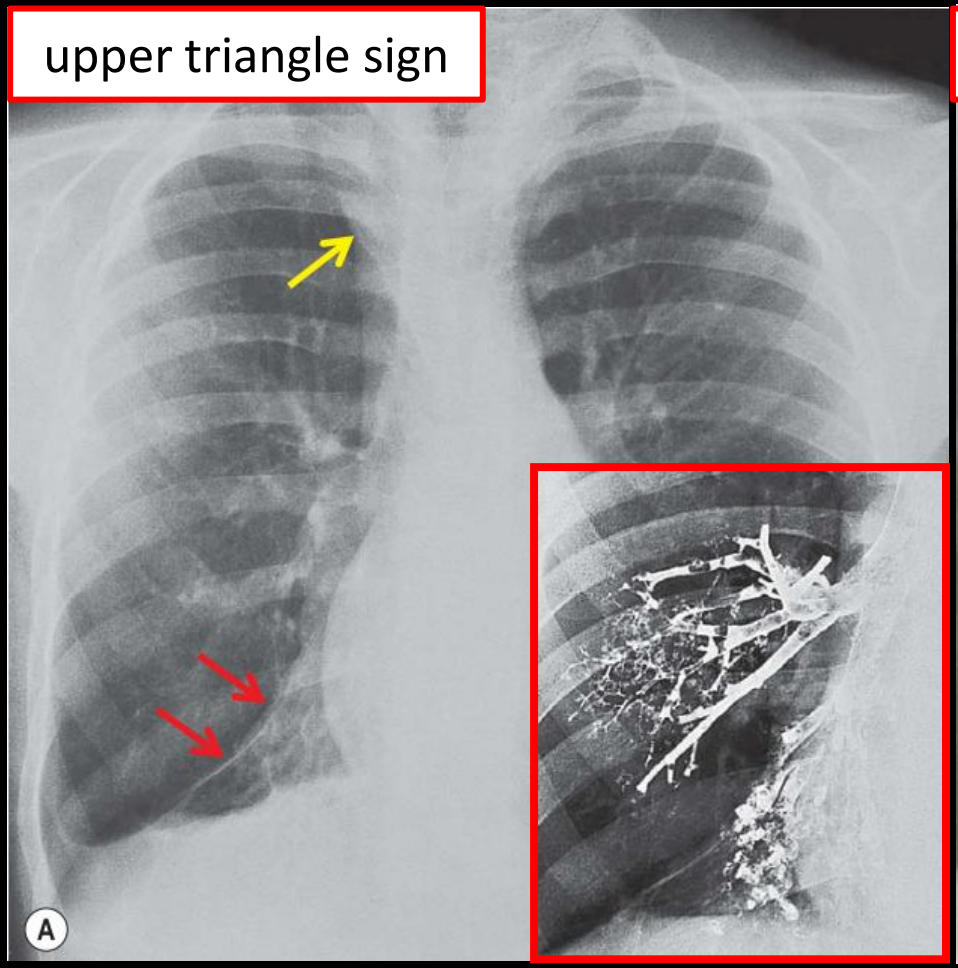
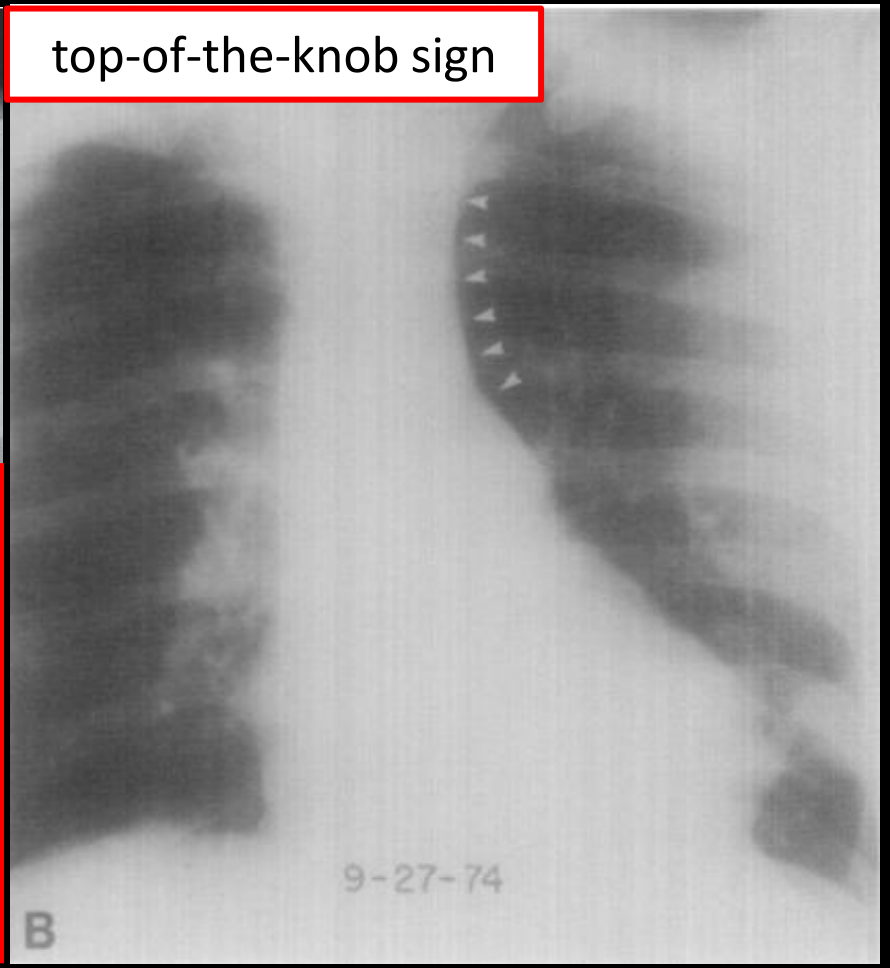
Lower lobes atelectasis

please look up (ant. junctional tissue)

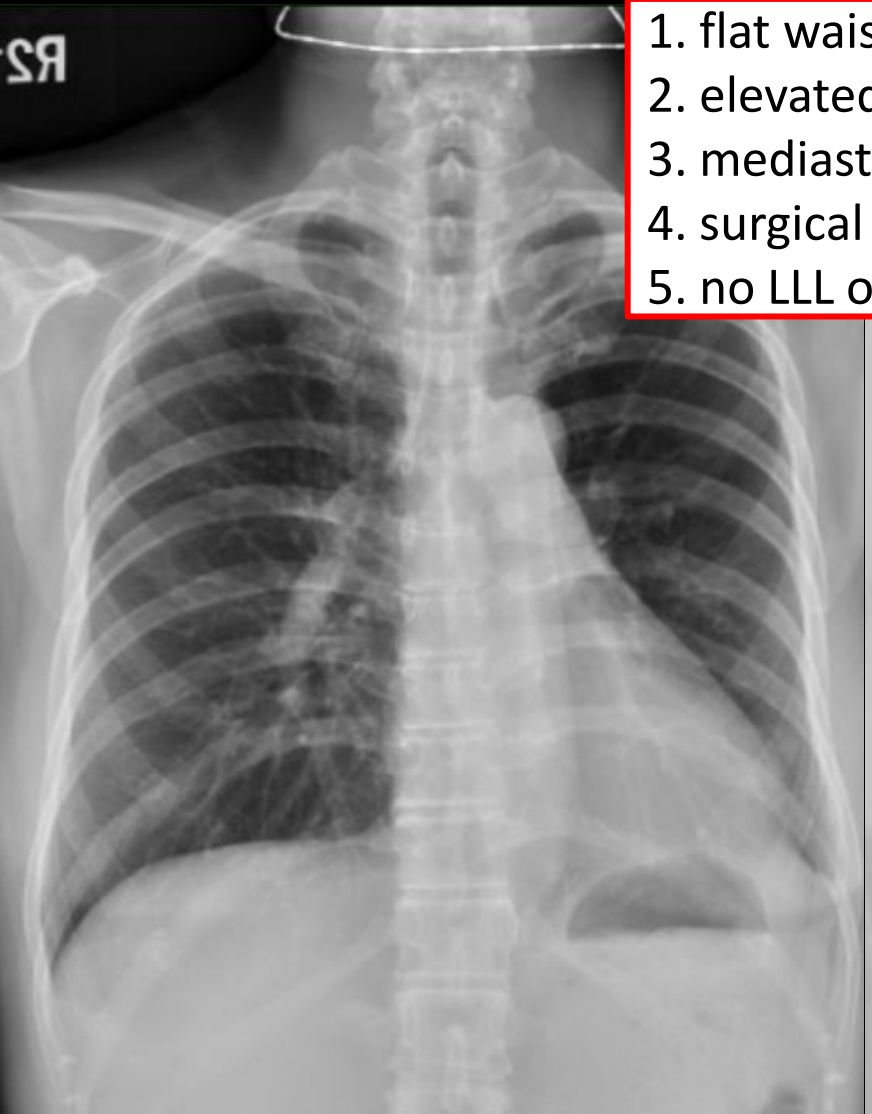


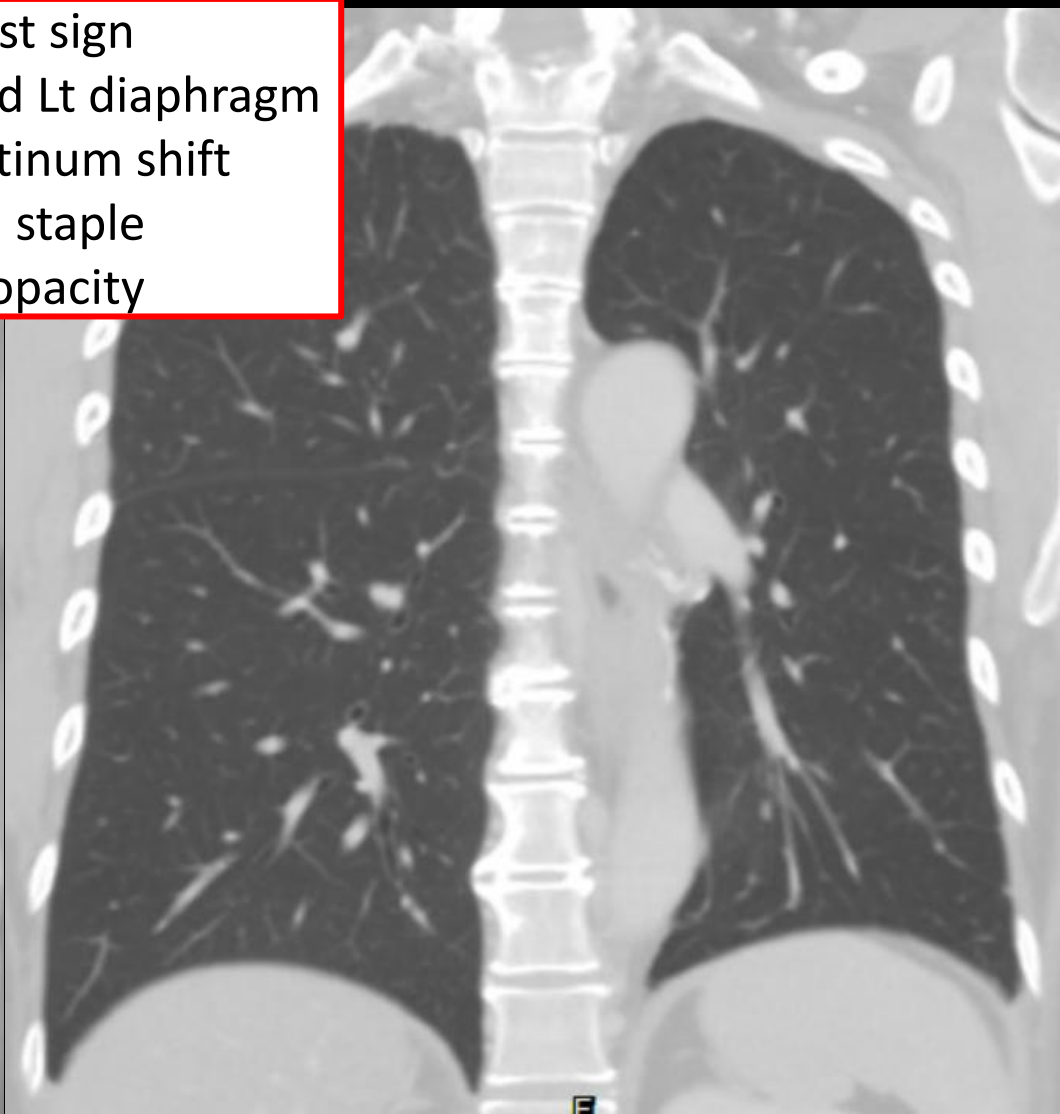


Kattan KR. Semin Roentgenol 1980;15:183–186.
Hansell DM et al. Imaging of Diseases of the Chest, 5th Edition

LLL lobectomy

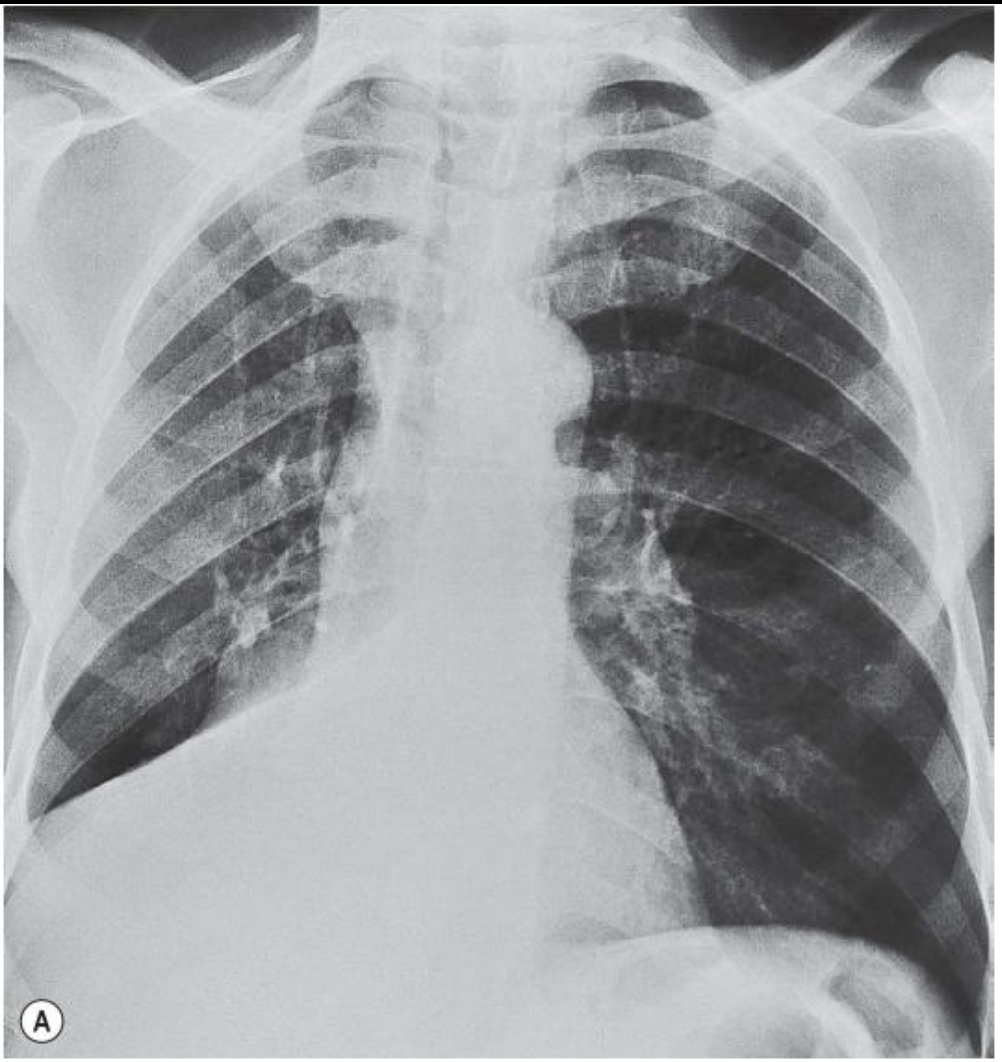
1. flat waist sign
2. elevated Lt diaphragm
3. mediastinum shift
4. surgical staple
5. no LLL opacity

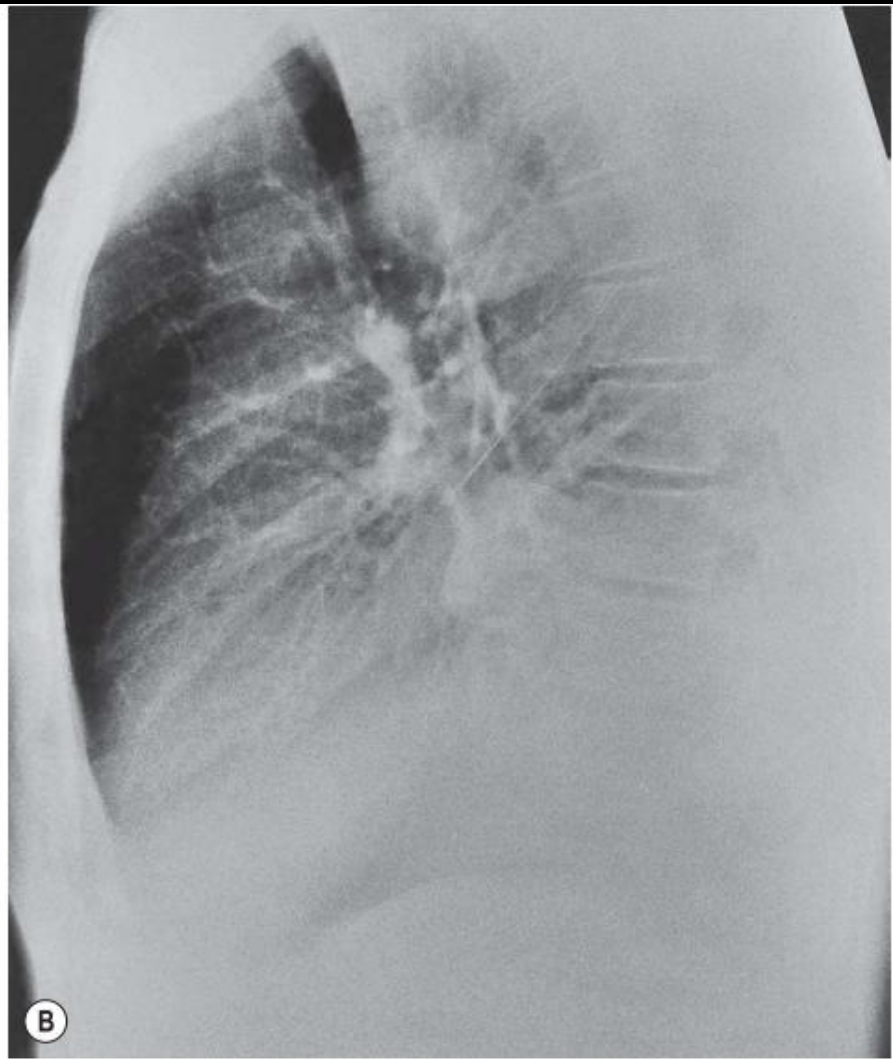




RML+RLL atelectasis

extended version of RLL atelectasis





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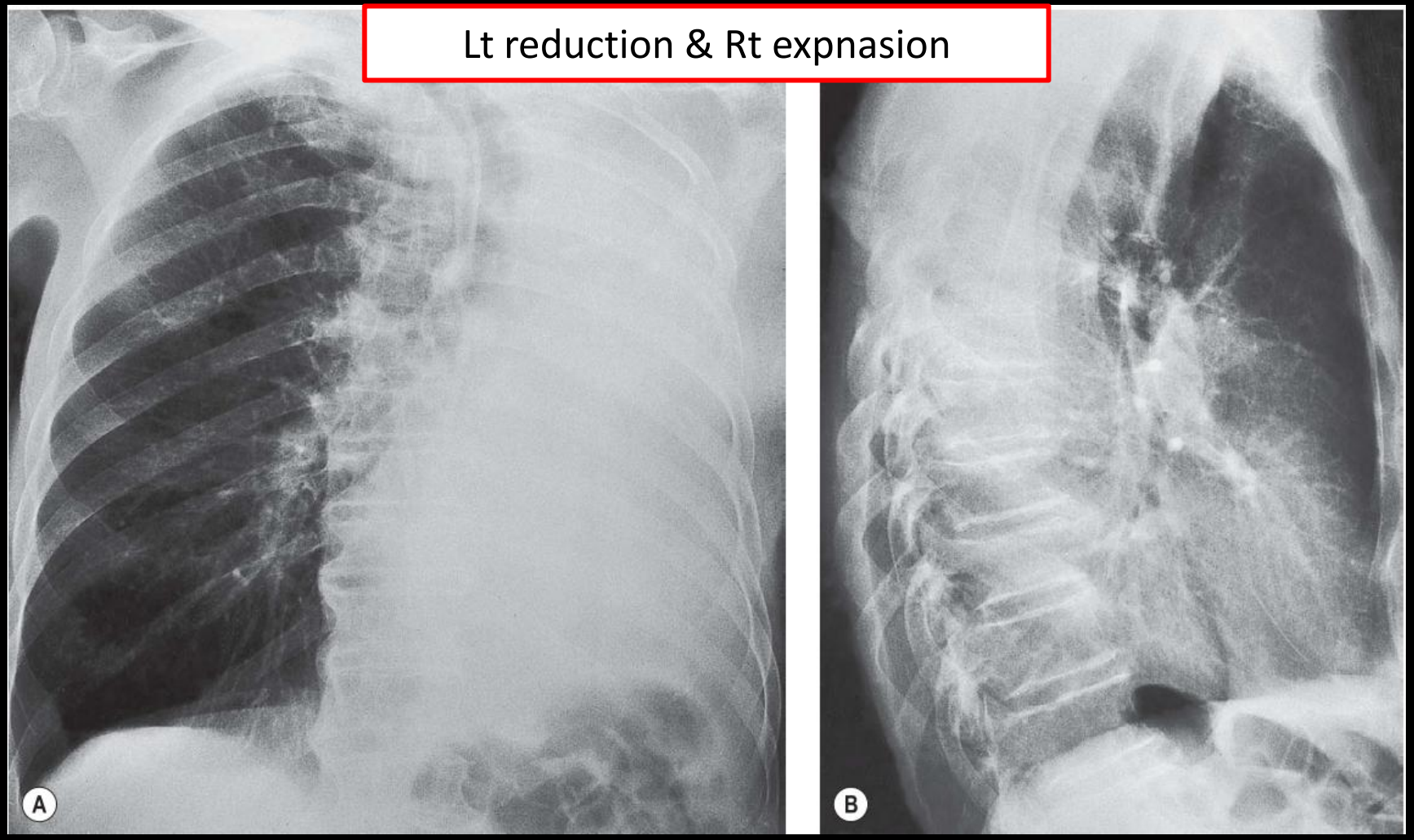
Whole lung atelectasis

Yin & Yang

Lt reduction & Rt expnasion



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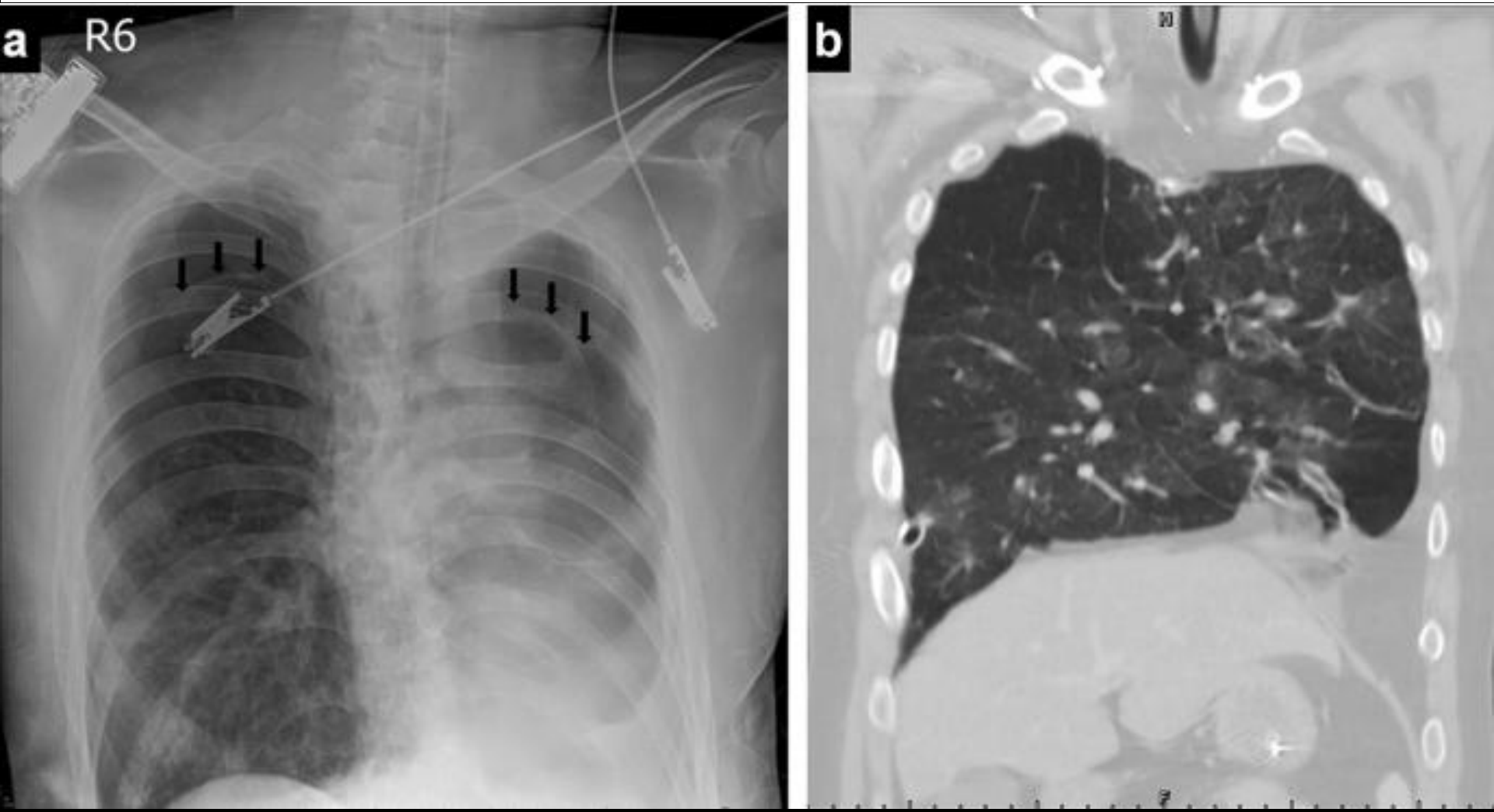
IMAGING IN INTENSIVE CARE MEDICINE

Single lung with bilateral pneumothorax

Li-Ta Keng* and Lih-Yu Chang

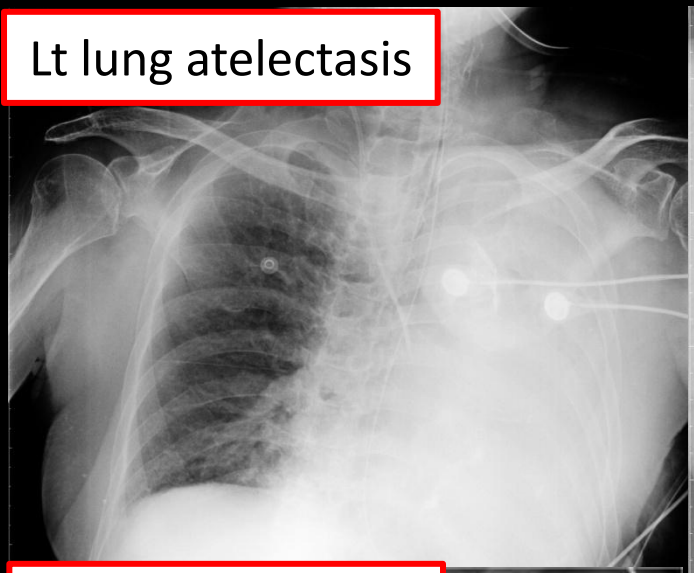


Keng LT, Chang LY. Intensive Care Med. 2020;46:1753-4.

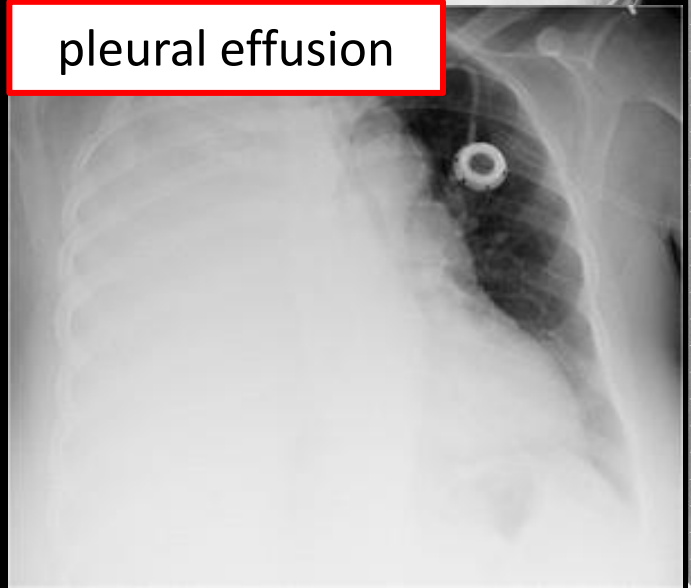
Hemithorax whiteout

the volume tells

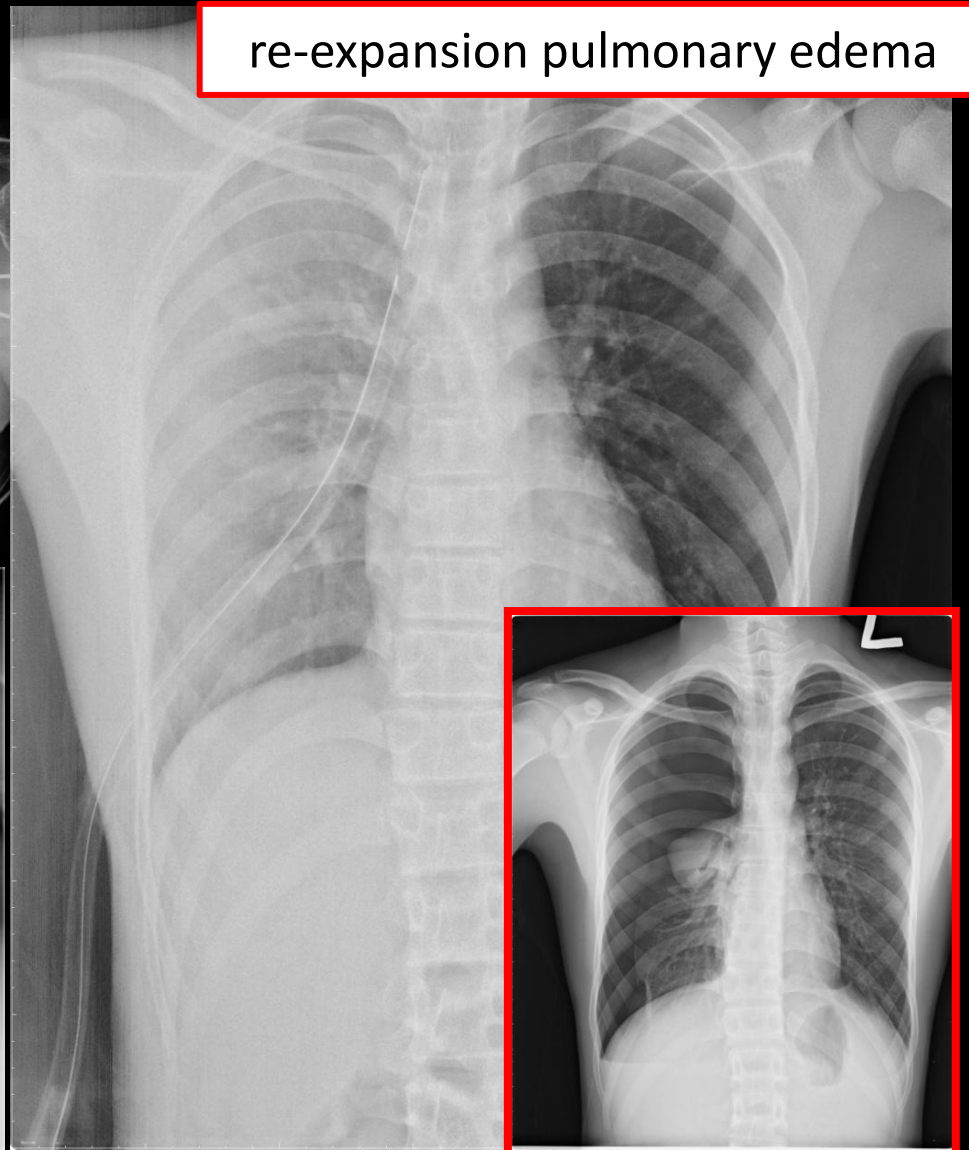
Lt lung atelectasis



pleural effusion

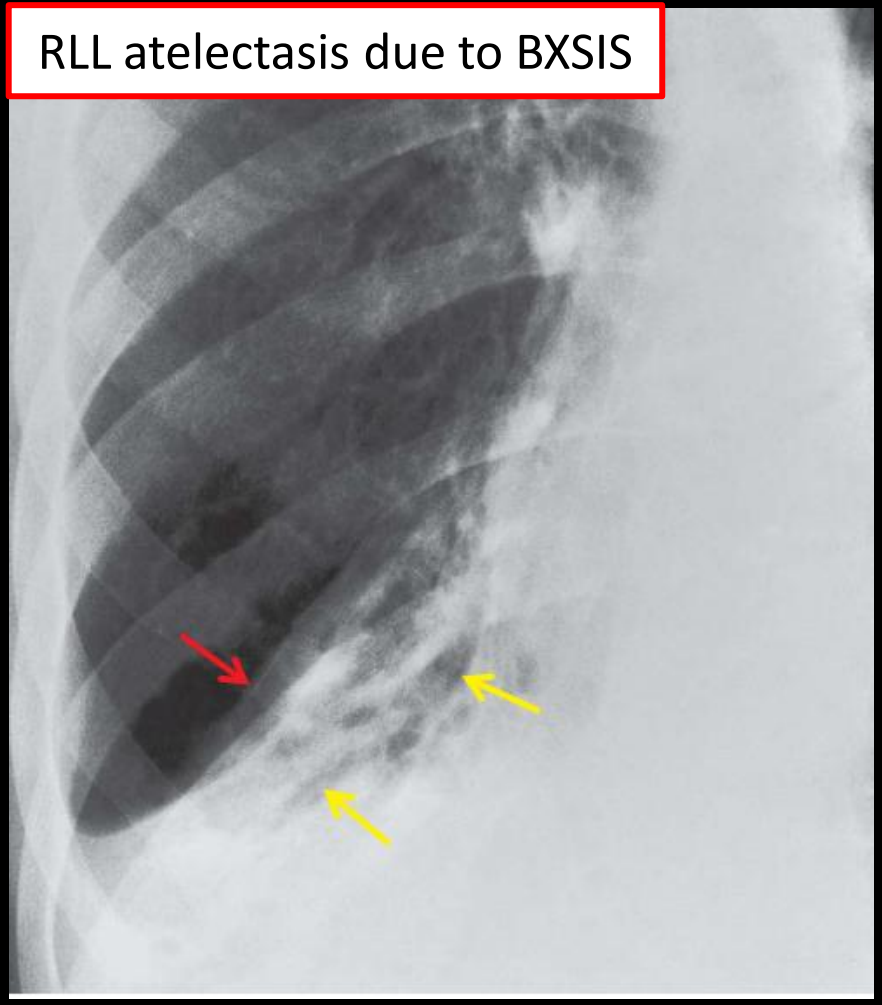


re-expansion pulmonary edema

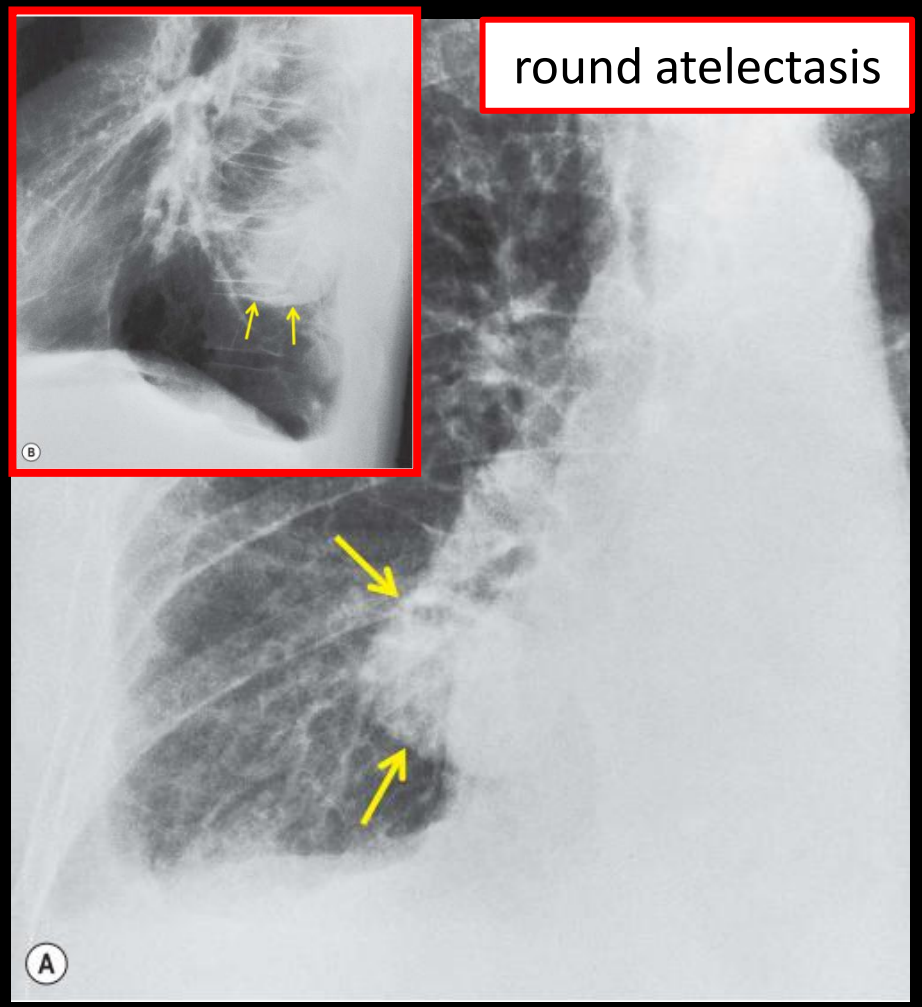


Other atelectasis

RLL atelectasis due to BXSIS



round atelectasis



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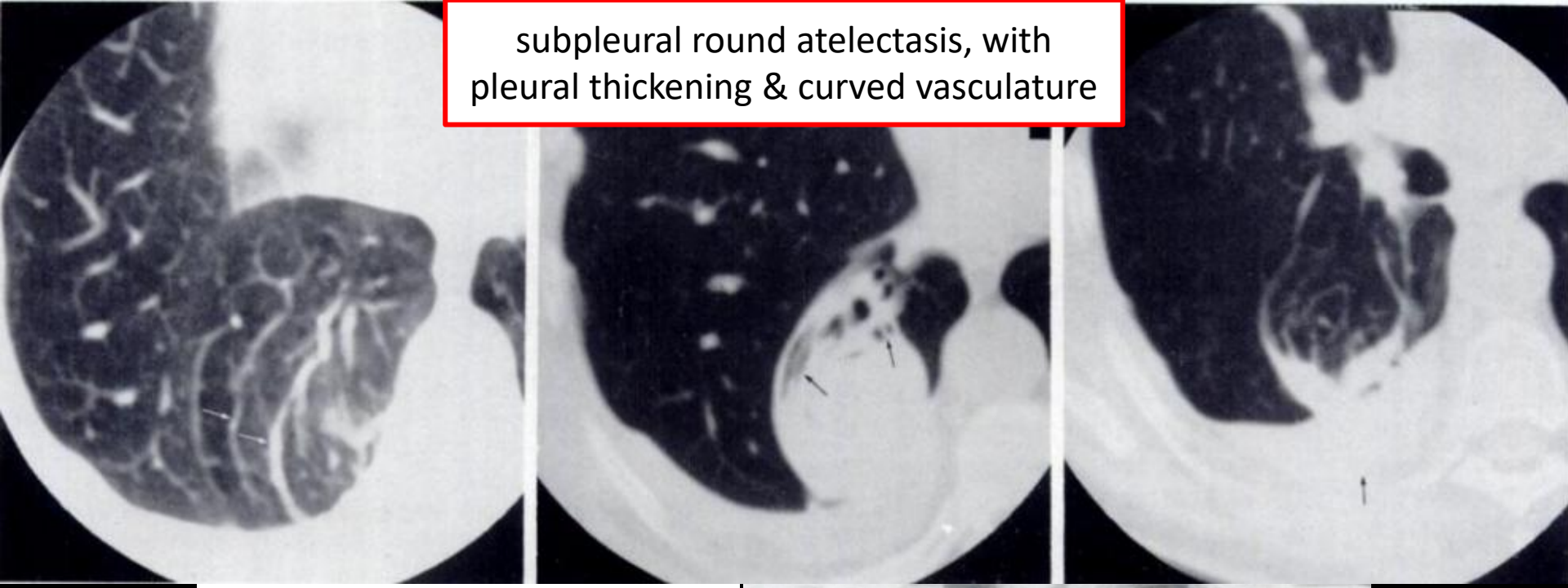
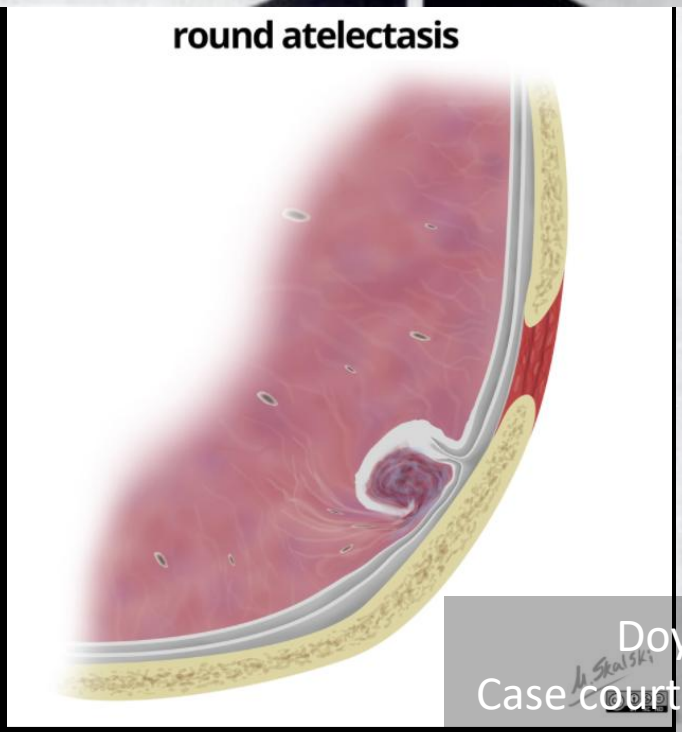
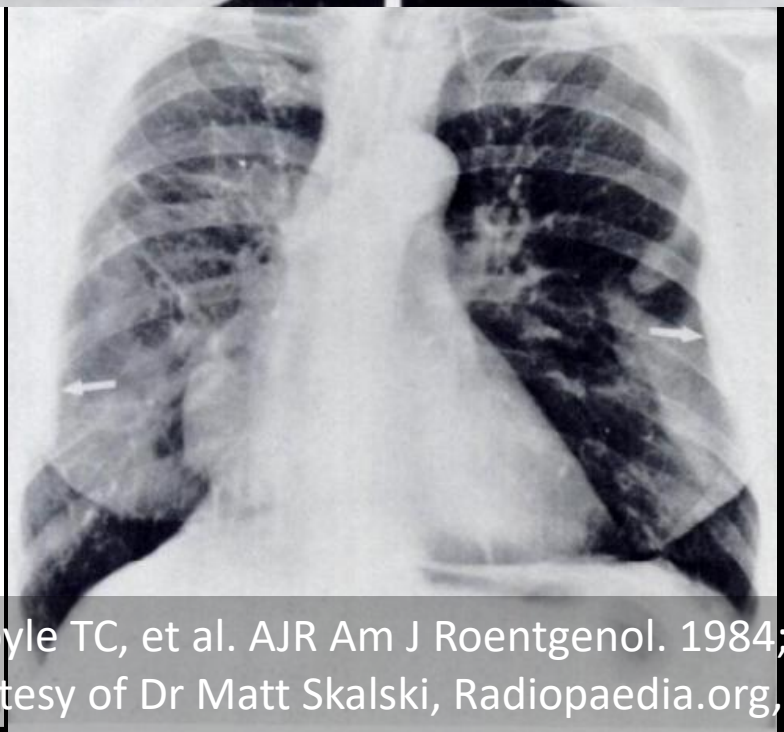
subpleural round atelectasis, with pleural thickening & curved vasculature



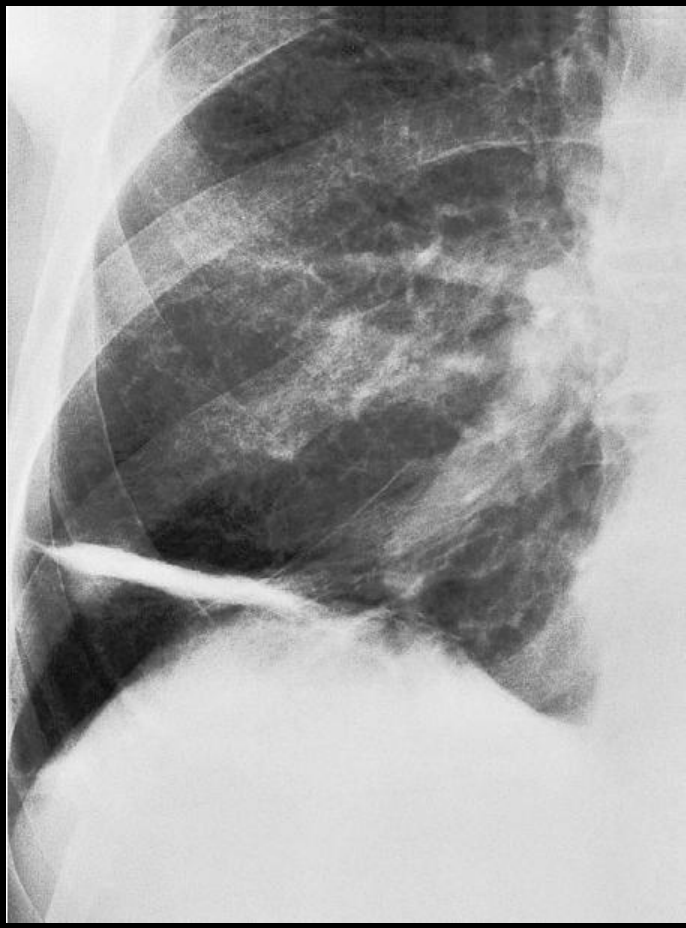




Doyle TC, et al. AJR Am J Roentgenol. 1984;143:225-8.
Case courtesy of Dr Matt Skalski, Radiopaedia.org, rID: 53333

Discoid atelectasis

Character	Comment
AKA	-platelike or linear atelectasis -Fleischner lines
cause	alveolar hypoventilation
image	-abuts the pleura -perpendicular to the pleura -from horizontal to vertical -line or bandlike



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Summary

General Principles

- Ideal interpretation
- Silhouette sign
- Basic 4 CXR patterns

Airspace Opacity

- Mimickers
- Radio-pathologic correlation
- Patterns/Spectrum

Dx of Airspace Opacity

- Diffuse/ID-GGO/Focal
- Fluid/Pus/Blood/Others
- Special pattern

Atelectasis/Collapse

- Mechanism
- Sings (Direct/Indirect)
- Patterns