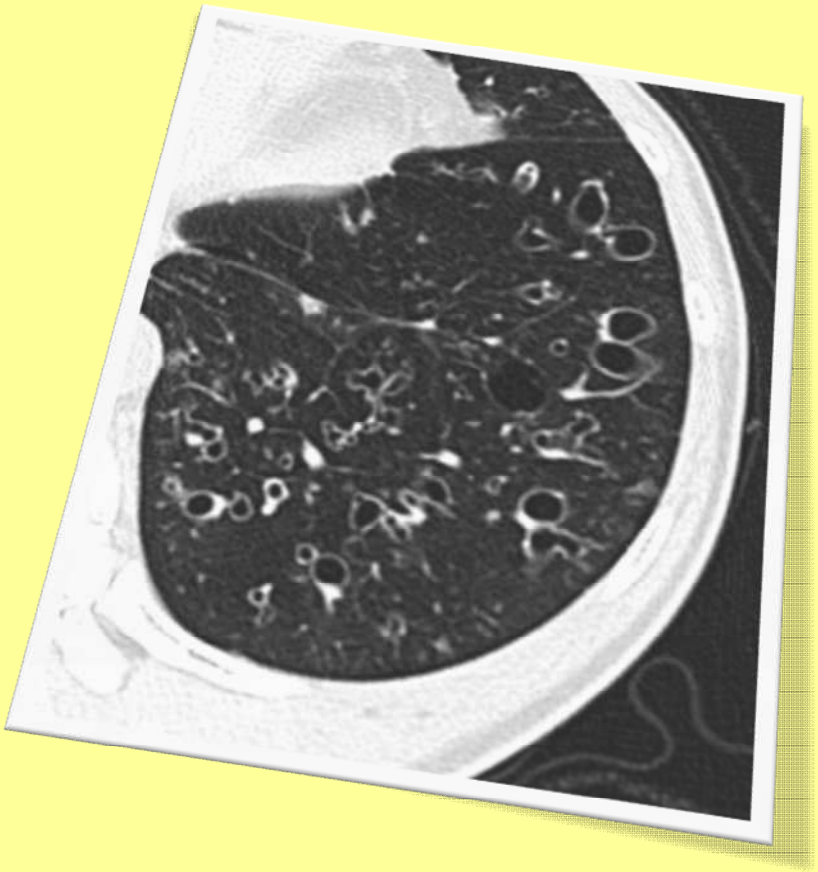
An Image Repository for Chest CT



Francesco Frajoli

for the Chest CT in
Antibody Deficiency Group

www.chest-CT-group.eu

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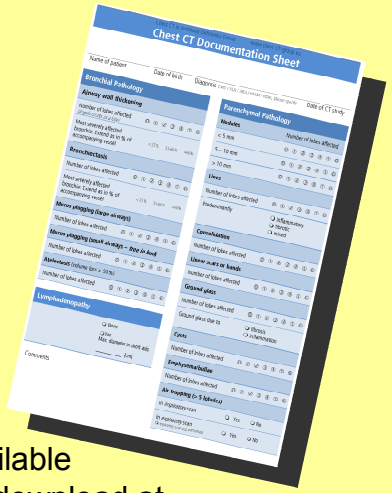

available
for download at
www.chest-ct-group.eu

The Chest CT in Antibody Deficiency Group is an international and interdisciplinary group that works together to improve pulmonary diagnostics in patients with antibody deficiency syndrome.

One of the projects of the Group is to uniformely document chest CT scans. A common list of pulmonary pathologies is rated according to the same criteria. The list of findings is available for download at the website of the group. Findings may be documented in the ESID registry, a national registry, or sent by fax to Ulrich Baumann (for details see docutmentation sheet).
The following collection of images and comments aims to standardise the rating of pulmonary CT findings and thus improve the quality of the data.

We are greatly indebted to **Francesco Frajoli**, MD, radiologist at Sapienza University, Rome, Italy, EU, who prepared and commented the following collection of CT images for this purpose.

Hanover, July 2012 Ulrich Baumann

Chest CT Documentation Sheet

Bronchial Pathology

Airway wall thickening

Number of lobes affected *(lingula counts as a lobe)*	⓪ ① ② ③ ④ ⑤ ⑥
Most severely affected bronchia: Extend as in % of accompanying vessel	< 33% 33-66% >66%

Bronchiectasis

Number of lobes affected	⓪ ① ② ③ ④ ⑤ ⑥
Most severely affected bronchia: Extend as in % of accompanying vessel	< 33% 33-66% >66%

Mucus plugging (large airways)

Number of lobes affected	⓪ ① ② ③ ④ ⑤ ⑥

Mucus plugging (small airways – *tree in bud*)

Number of lobes affected	⓪ ① ② ③ ④ ⑤ ⑥

Atelectasis (volume loss > 50%)

Number of lobes affected	⓪ ① ② ③ ④ ⑤ ⑥

Parenchymal Pathology

Nodules

Number of lobes affected	
< 5 mm	⓪ ① ② ③ ④ ⑤ ⑥
5 – 10 mm	⓪ ① ② ③ ④ ⑤ ⑥
> 10 mm	⓪ ① ② ③ ④ ⑤ ⑥

Lines

Number of lobes affected	⓪ ① ② ③ ④ ⑤ ⑥
Predominantly	❍ inflammatory ❍ fibrotic ❍ mixed

Consolidation

Number of lobes affected	⓪ ① ② ③ ④ ⑤ ⑥

Linear scars or bands

Number of lobes affected	⓪ ① ② ③ ④ ⑤ ⑥

Ground glass

Number of lobes affected	⓪ ① ② ③ ④ ⑤ ⑥
Ground glass due to	❍ fibrosis ❍ inflammation

Cysts

Number of lobes affected	⓪ ① ② ③ ④ ⑤ ⑥

Emphysema/bullae

Number of lobes affected	⓪ ① ② ③ ④ ⑤ ⑥

Air trapping (> 5 lobules)

in *inspiratory* scan	❍ Yes	❍ No
in *expiratory* scan ❍ expiratory scan not performed	❍ Yes	❍ No

Lymphadenopathy

❍ None

❍ Yes
Max. diameter in short axis

_____ [cm]

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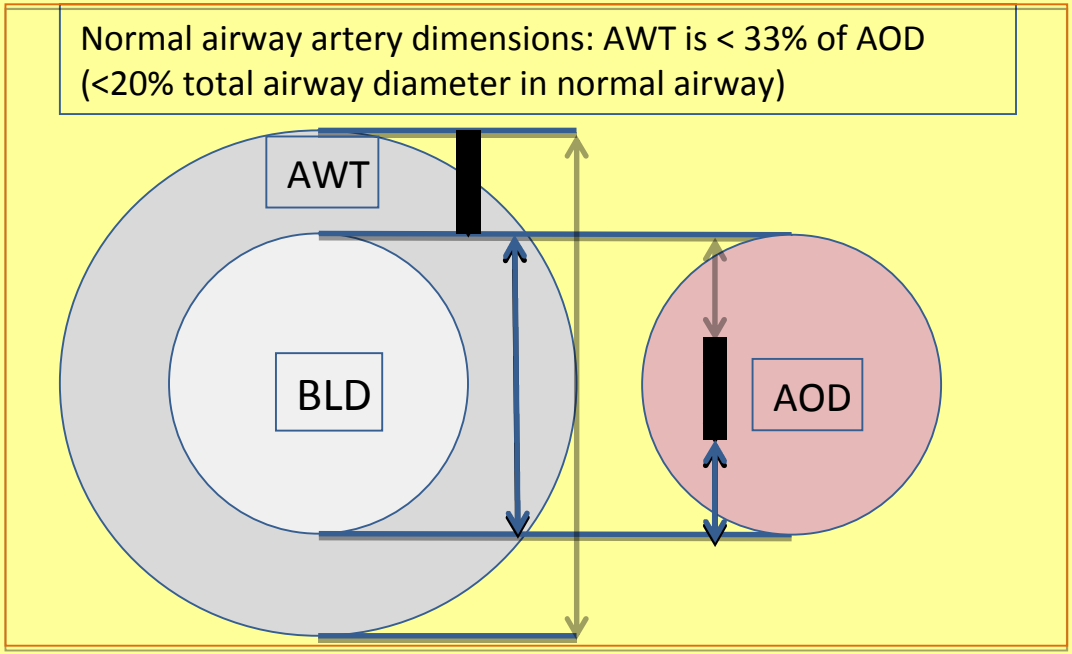
Air Wall Thickening

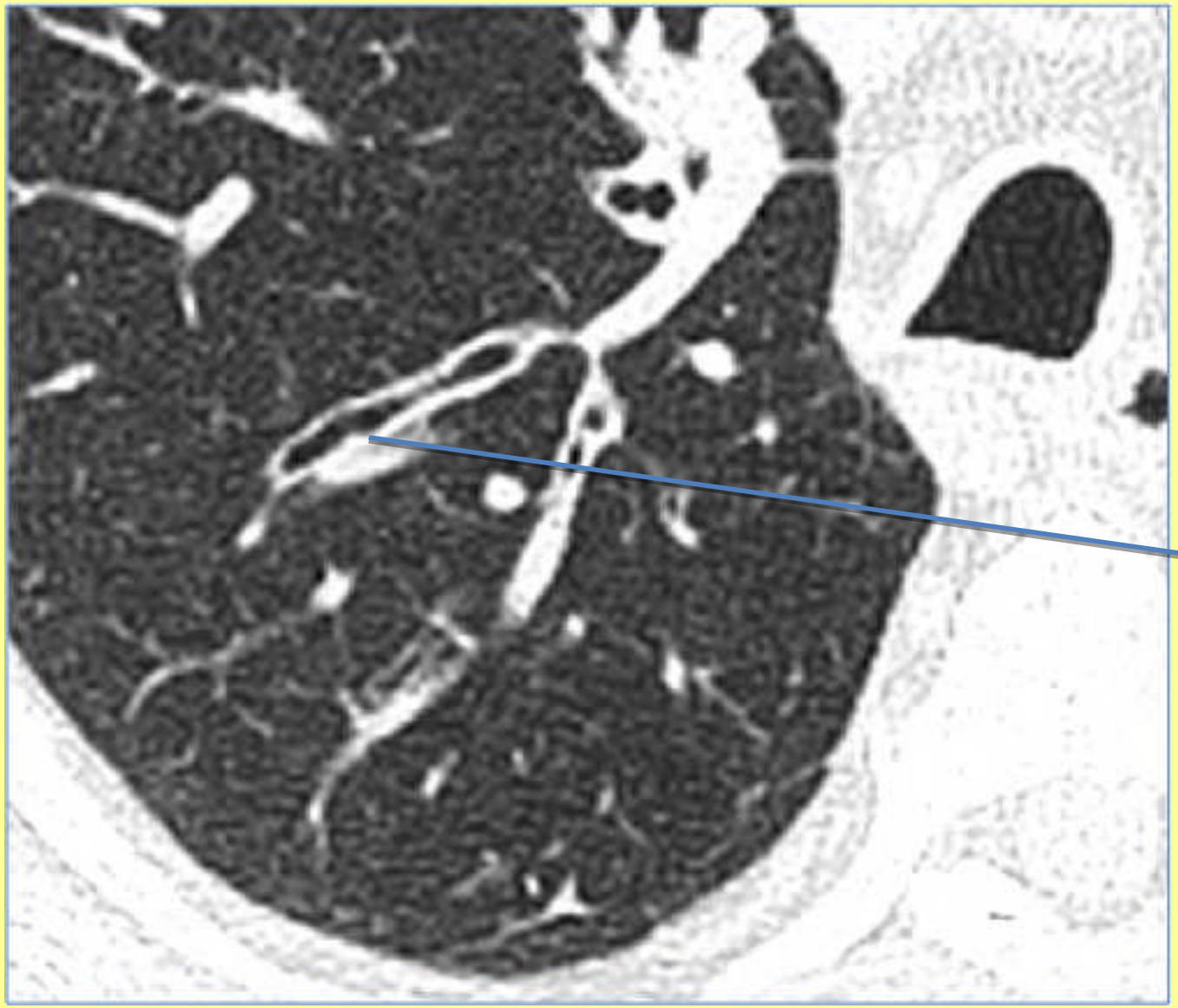
Bronchial Pathology							
Airway wall thickening							
Number of lobes affected	⓪	①	②	③	④	⑤	⑥
Most severely affected bronchia: Extend in % of accompanying vessel	< 33%		33-66%			>66%	

It's a morphological abnormality observed in chronic airway disease. On HRTC scans is only assessed subjectively. It may render airways visible in more distal areas of the lung than normally expected.

The severity of peribronchial thickening was designated as < 33 % if the thickness of the bronchial wall was equal to the diameter of the adjacent vessel; was designated as 33-66% if the thickness was greater than and up to twice the diameter of an adjacent vessel; and was designated > 66% if the thickness was greater than twice the diameter of an adjacent vessel.

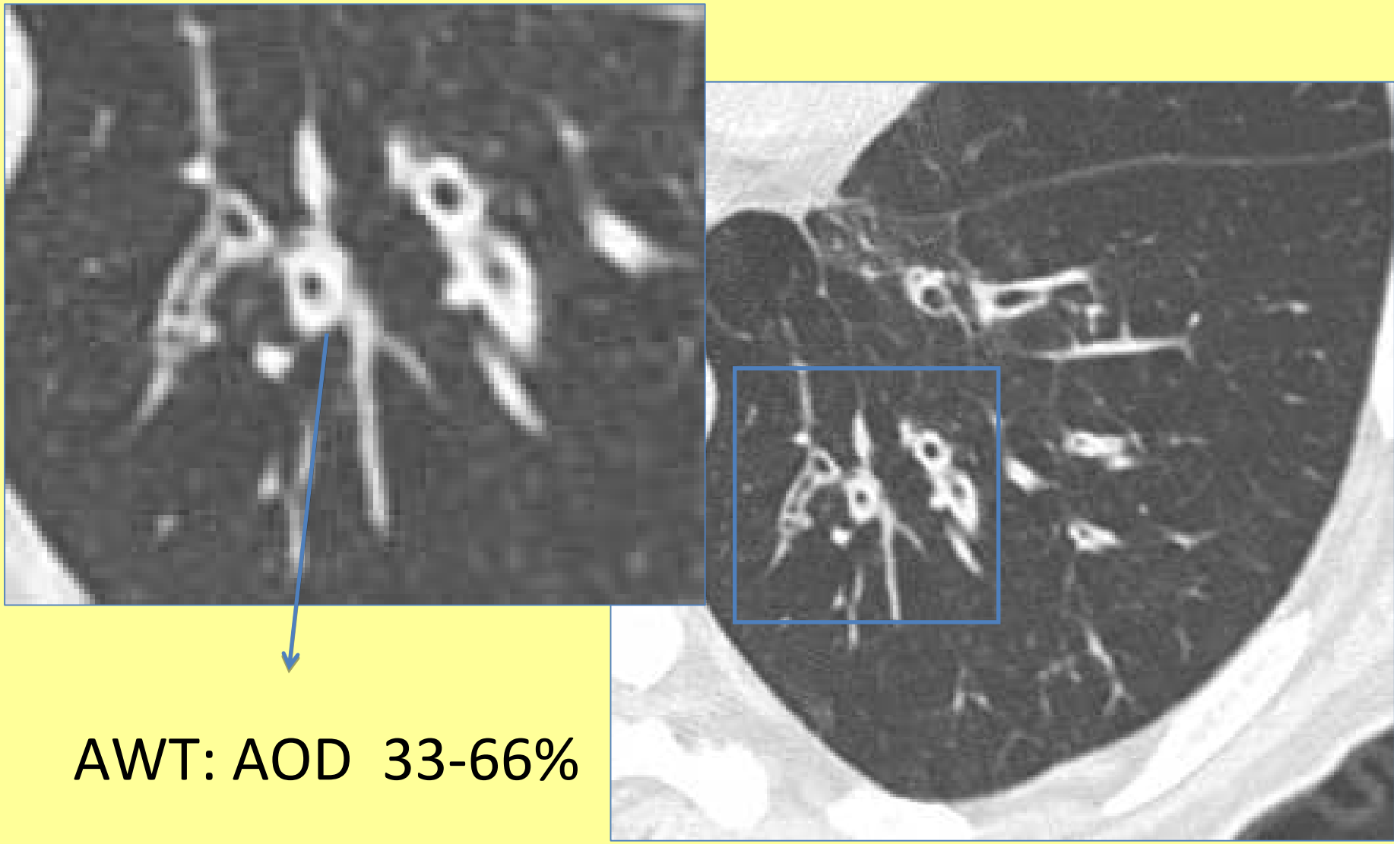


Most severely affected bronchi: Extend in % of accompany vessel



AWT: AOD < 33%

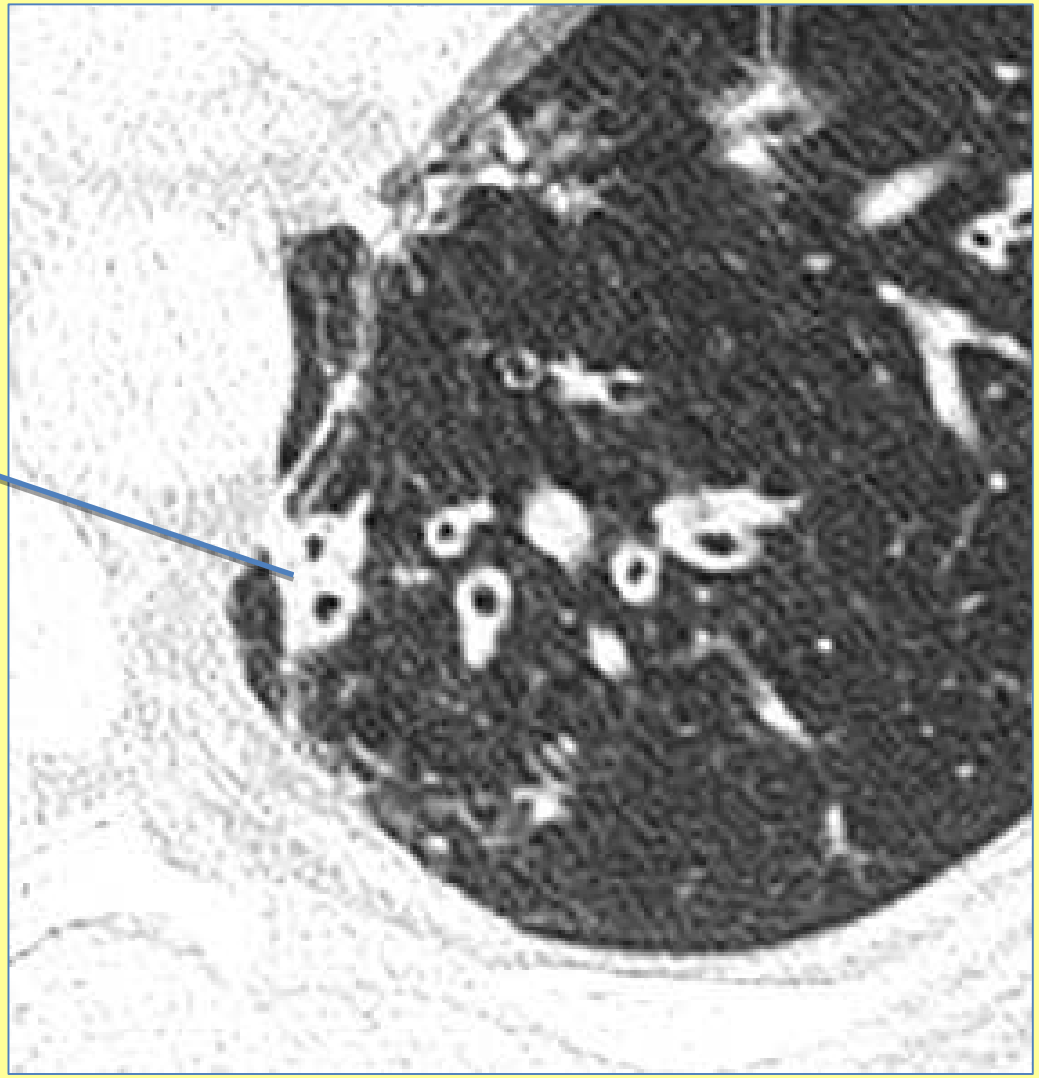
Most severely affected bronchi: Extend in % of accompany vessel



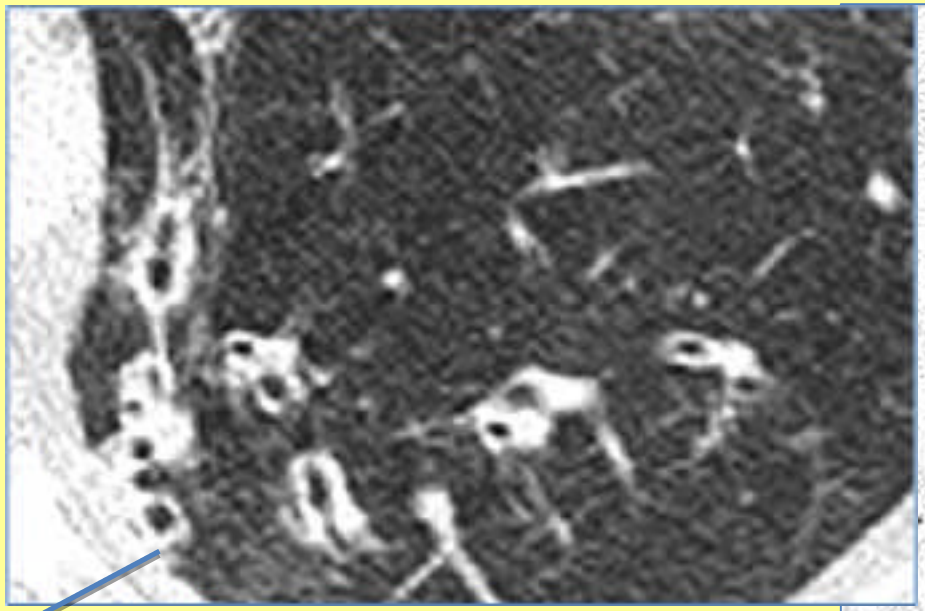
AWT: AOD 33-66%

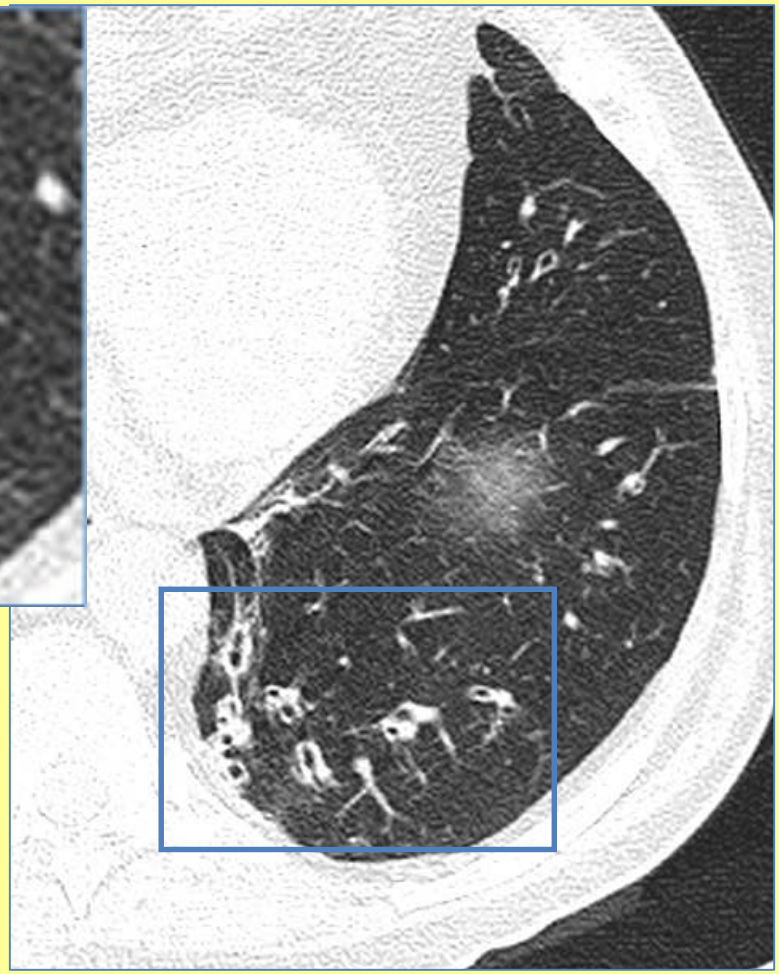
Most severely affected bronchia: Extend in % of accompanying vessel

AWT : AOD > 66%



Considerations
Peripheral air wall thickness





Most of the peripheral air wall thickening should be considered as >66 %

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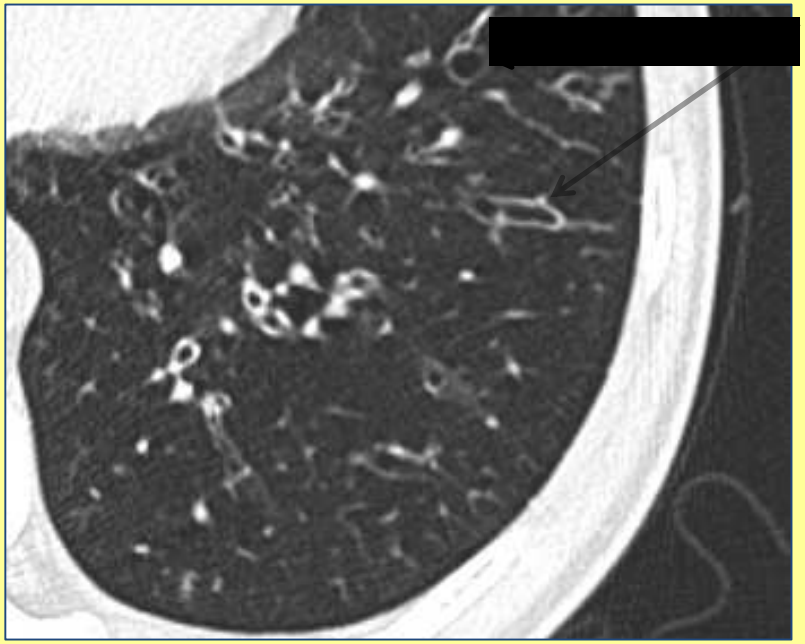
BRONCHIECTASIS

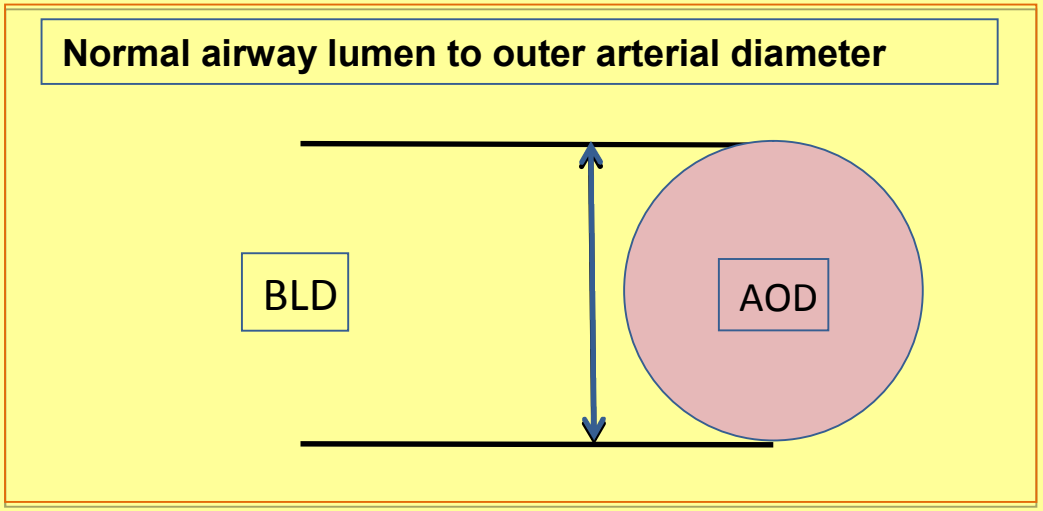
Pathology. — Bronchiectasis is irreversible localized or diffuse bronchial dilatation, usually resulting from chronic infection, proximal airway obstruction, or congenital bronchial abnormality.

Bronchial Pathology							
Bronchiectasis							
Number of lobes affected	⓪	①	②	③	④	⑤	⑥
Most severely affected bronchia: Extend in % of accompanying vessel		< 33%		33-66%		>66%	

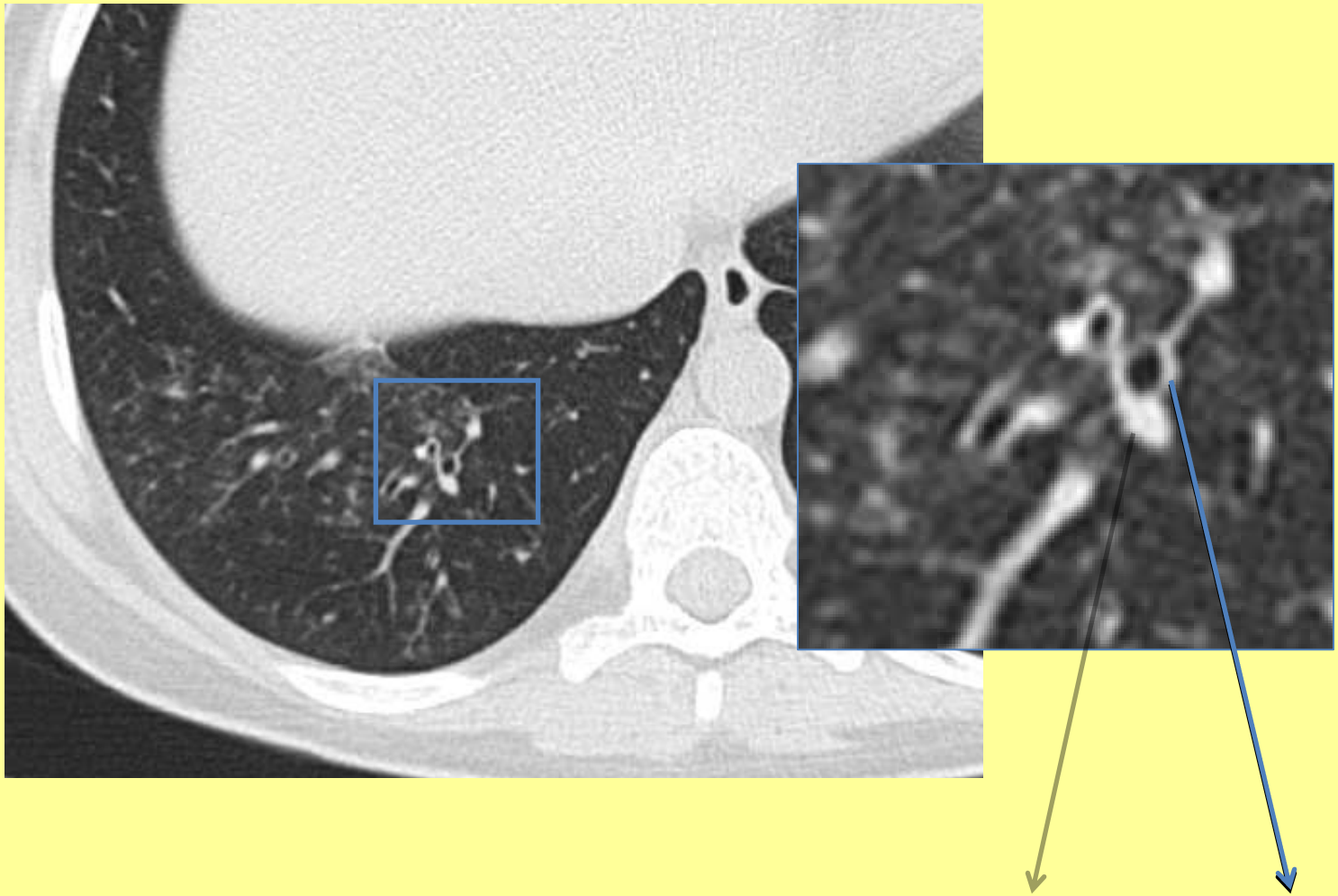
CT scans.— Morphologic criteria on thin-section CT scans include bronchial dilatation with respect to the accompanying pulmonary artery (signet ring sign), lack of tapering of bronchi, and identification of bronchi within 1 cm of the pleural surface. Bronchiectasis may be classified as cylindric, varicose, or cystic, depending on the appearance of the affected bronchi. It is often accompanied by bronchial wall thickening, mucoid impaction, and small-airways abnormalities.



Transverse CT scan shows varicose Bronchiectasis.

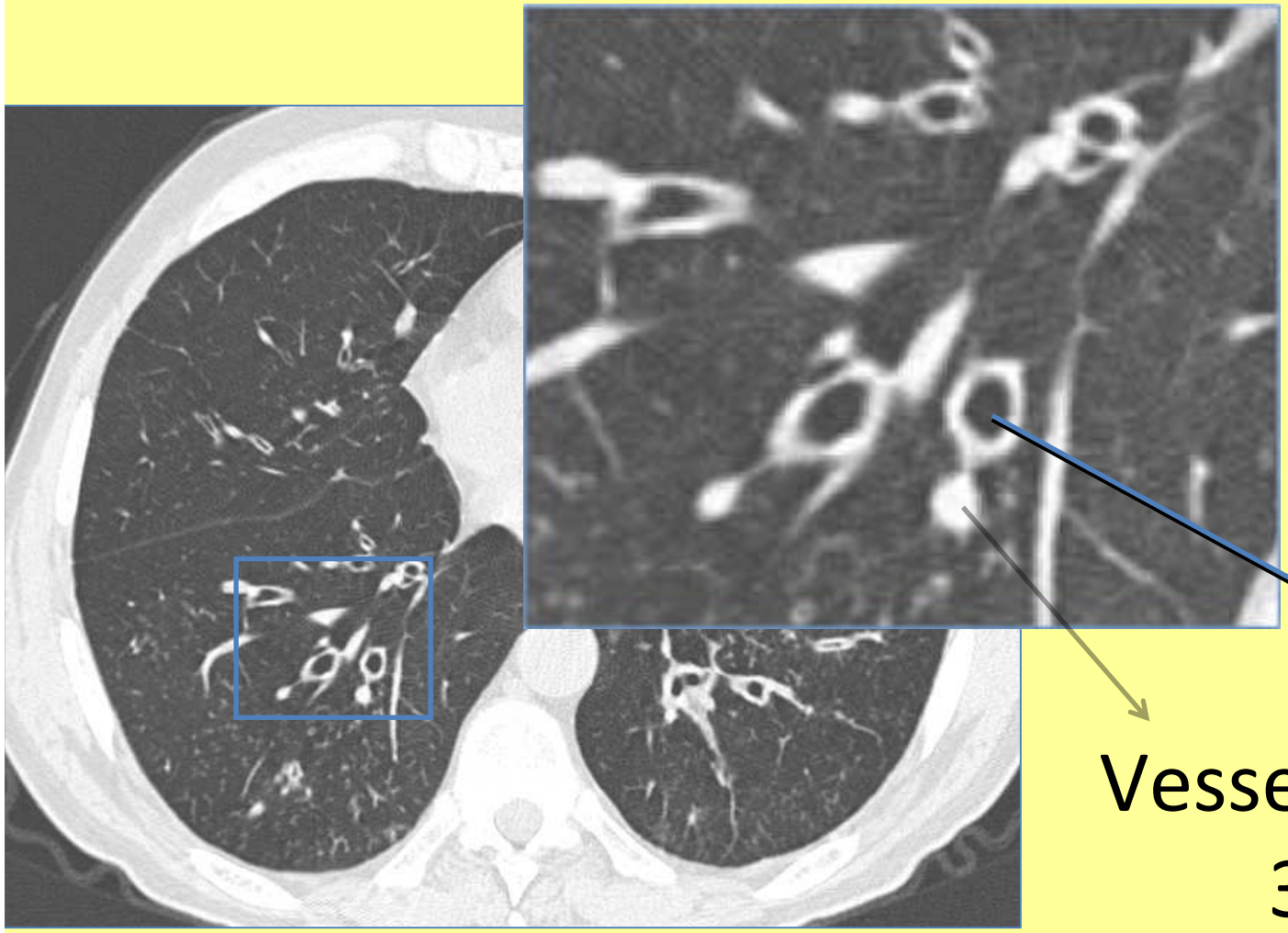


Most severely affected bronchia: Extend in % of accompany vessel



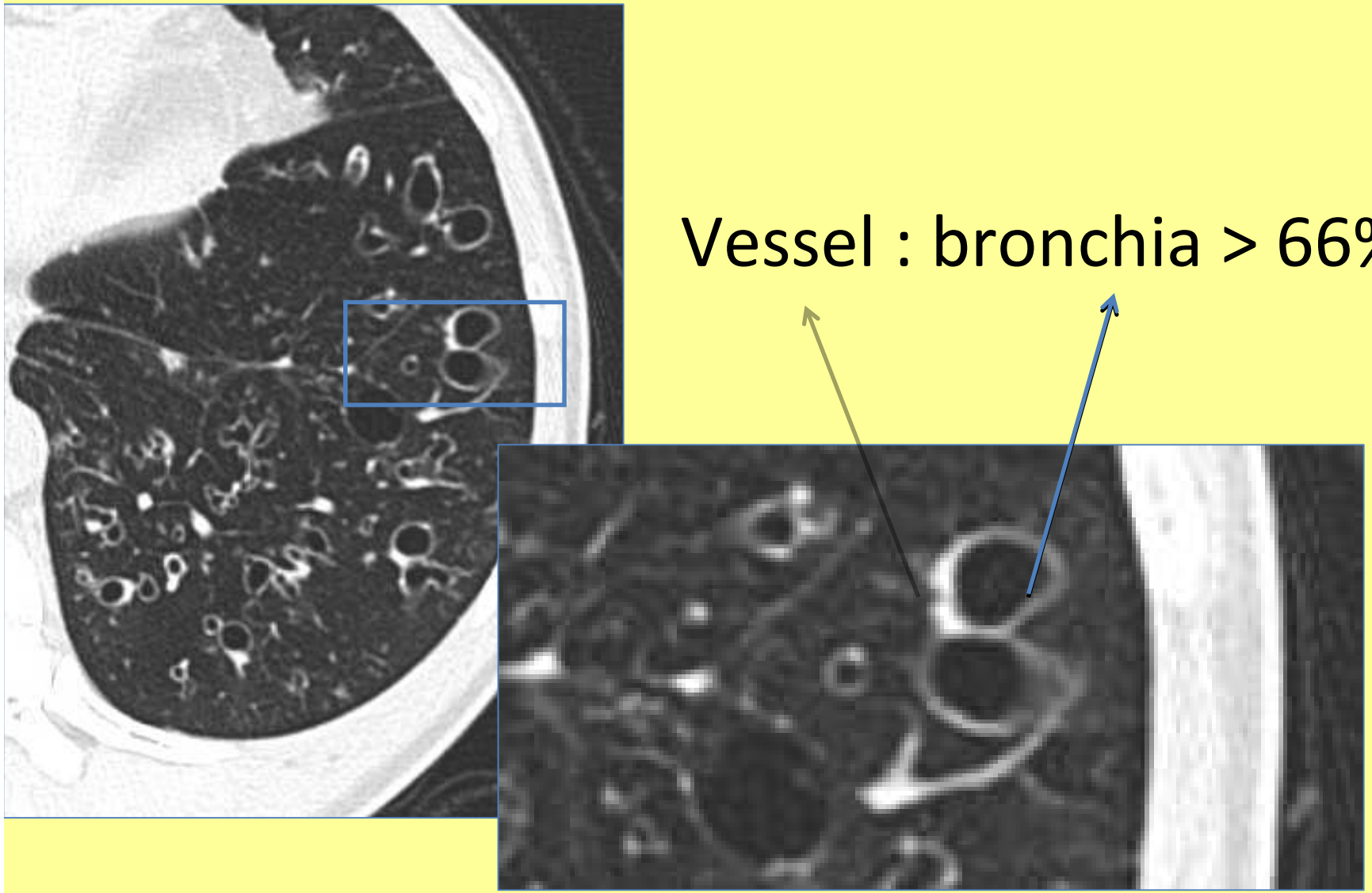
Vessel : bronchia < 33%

Most severely affected bronchia: Extend in % of accompany vessel



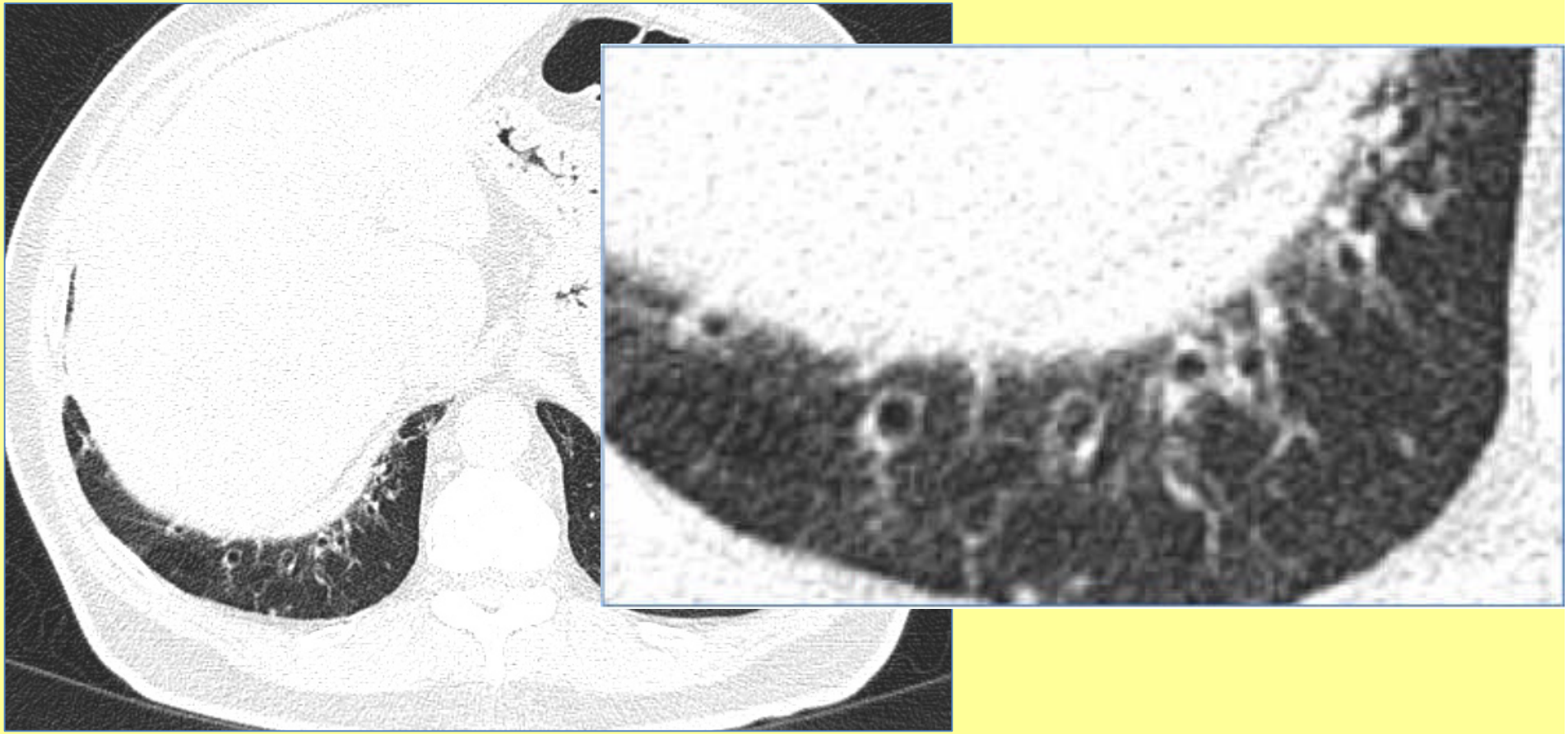
Vessel : bronchia
33-66 %

Most severely affected bronchia: Extend in % of accompany vassel



Considerations

Peripheral bronchiectasis



Most of the peripheral bronchiectasis should be considered as >66 %

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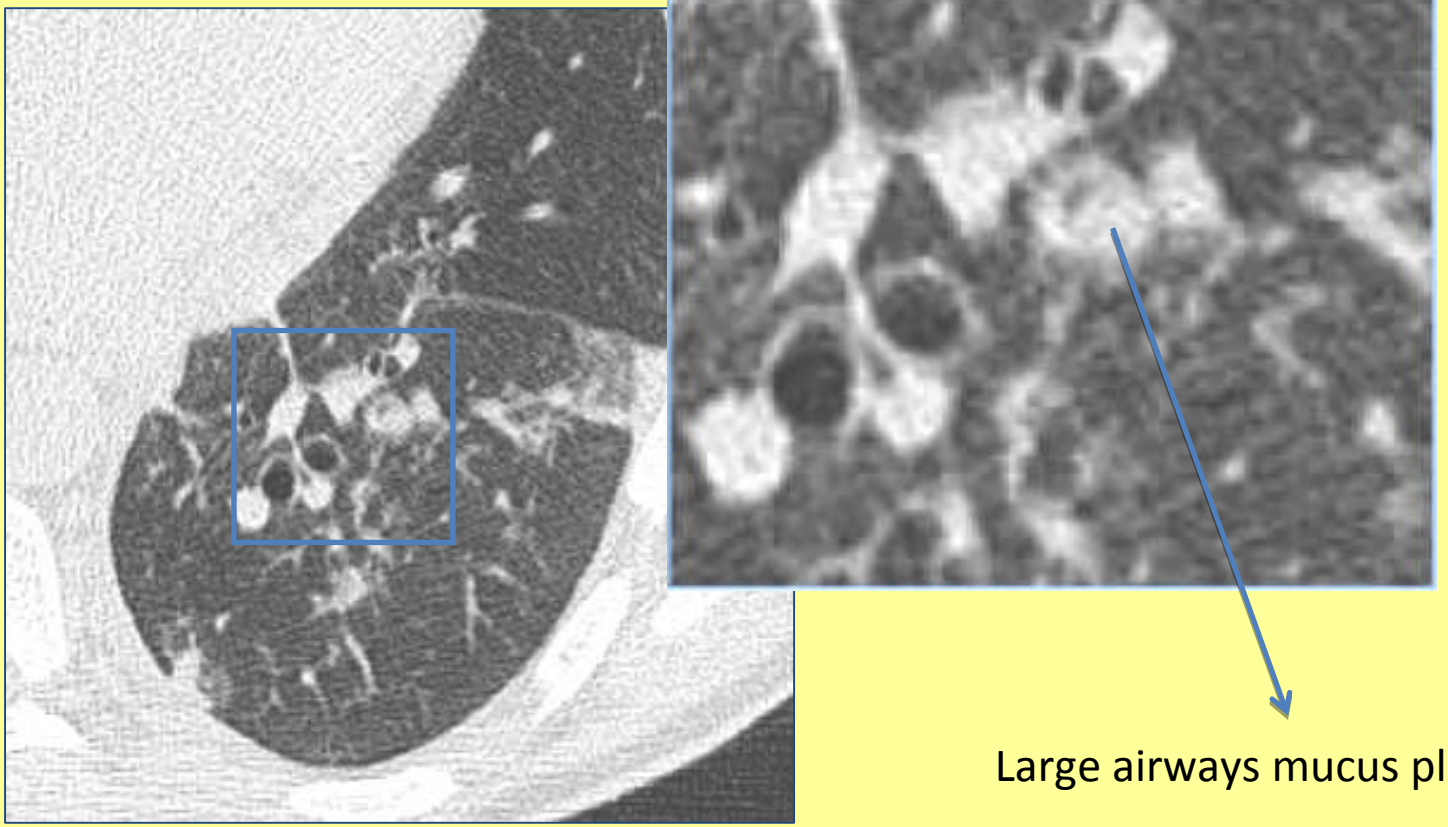
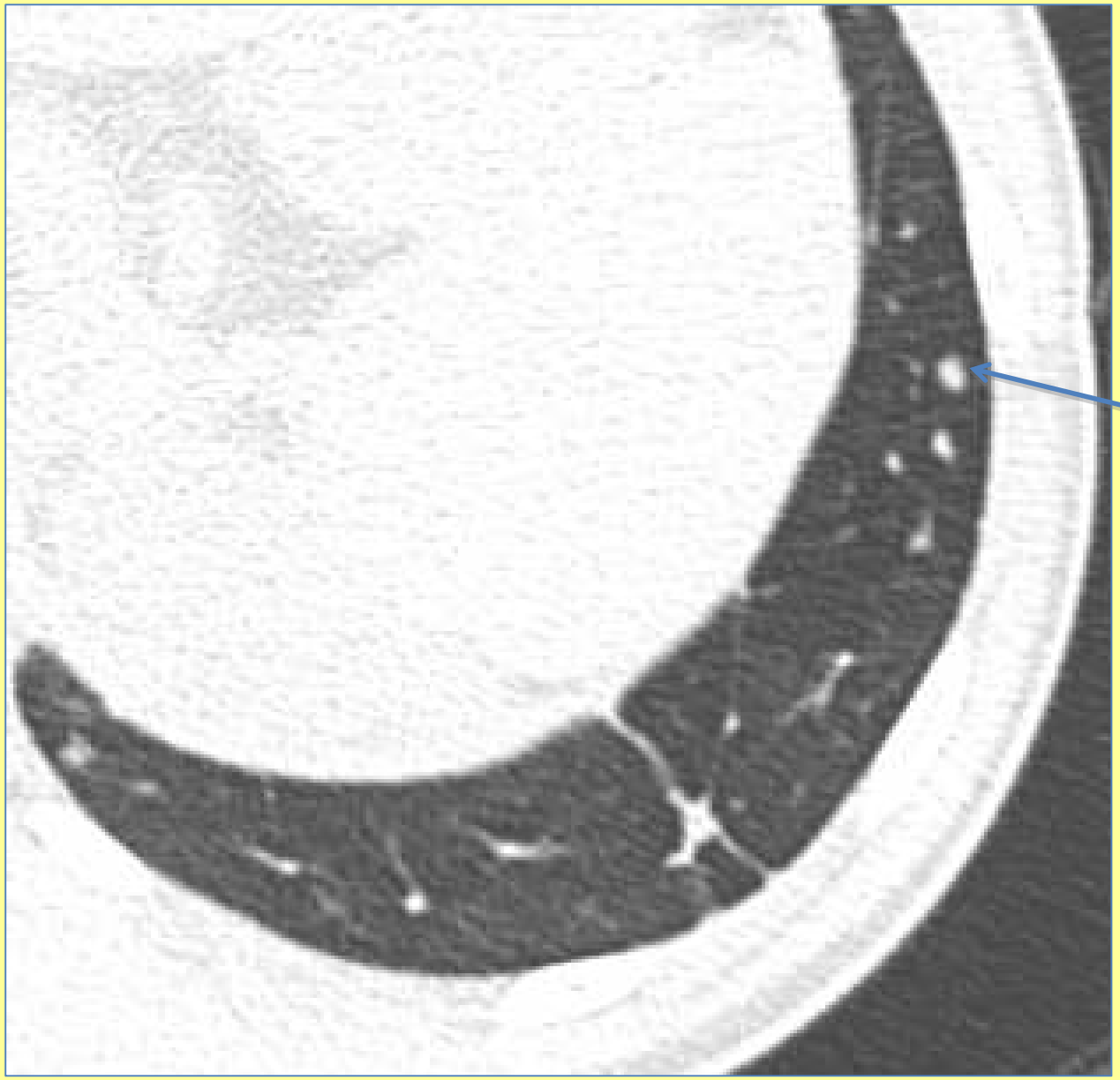
Mucus plugging

Mucus Plugging (large airways)							
Number of lobes affected	⓪	①	②	③	④	⑤	⑥
Mucus Plugging (small airways – *tree in bud*)							
Number of lobes affected	⓪	①	②	③	④	⑤	⑥

Central mucous plugging was defined as an opacity filling a defined bronchus, and peripheral mucous plugging was defined as the presence of either dilated bronchi or peripheral thin branching structures or centrilobular nodules in the peripheral lung.

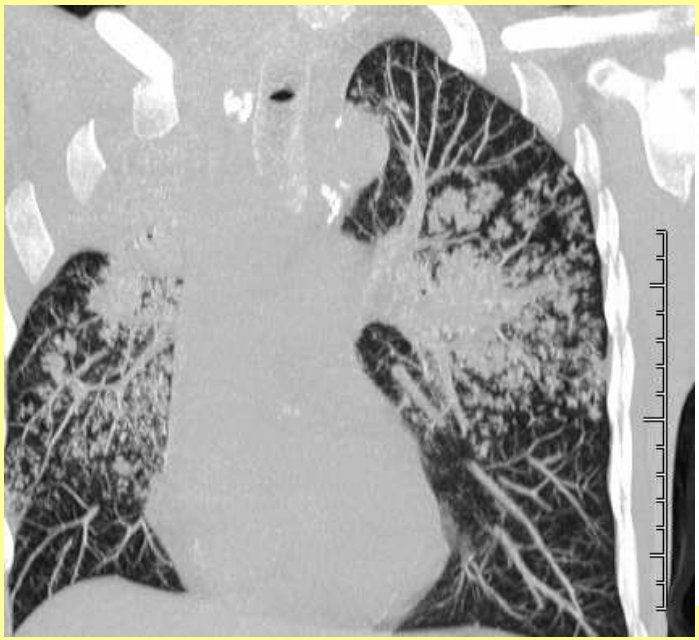


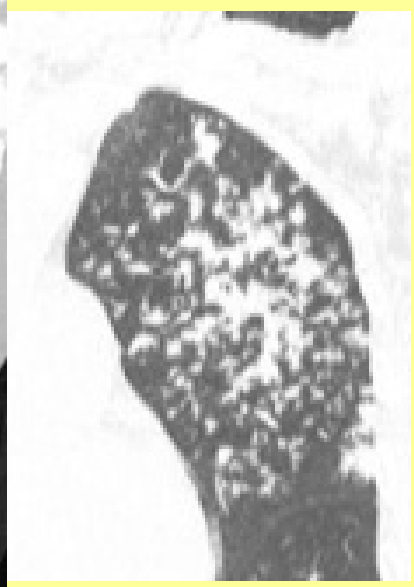
Large airways mucus plugging



Small airways mucus plugging

Tree in bud



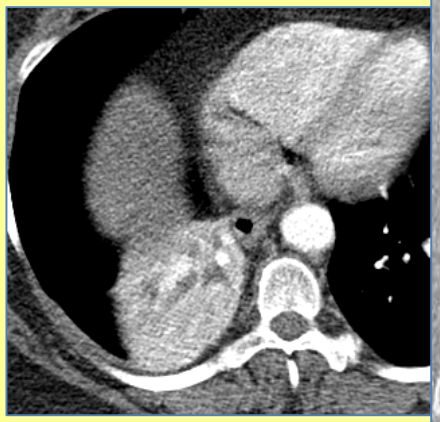


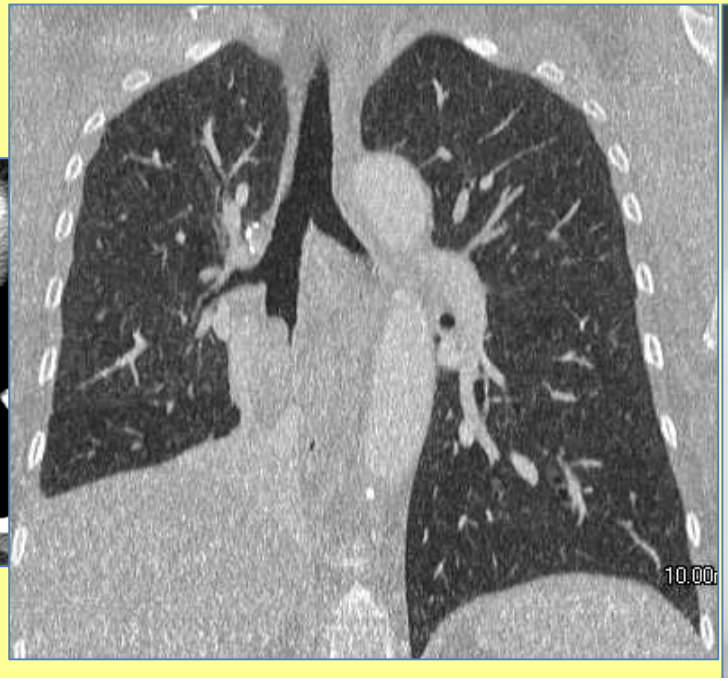
Small airways mucus plugging

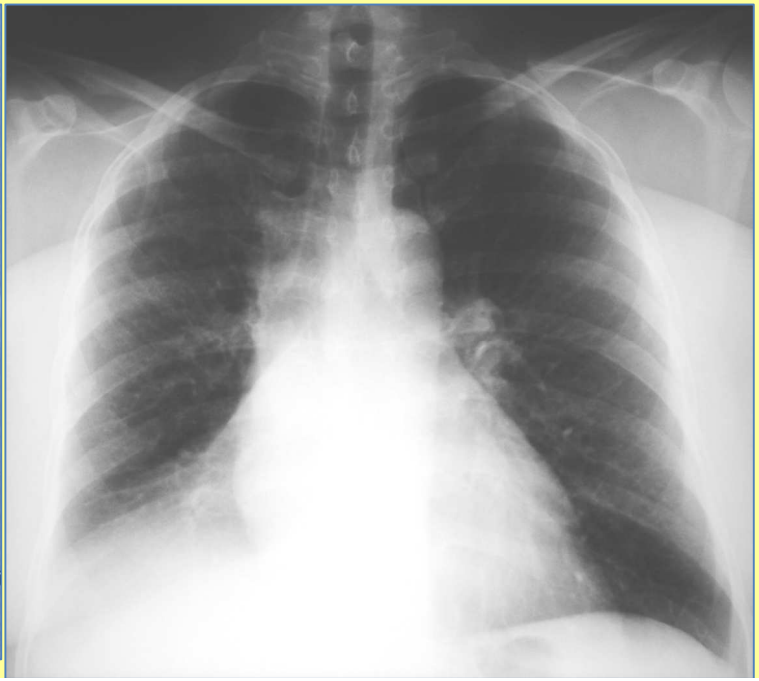
It consists of small centrilobular nodules of soft tissue attenuation connected to multiple branching linear structures of similar caliber that originate from as single stalk

Atelectasis

- *Pathophysiology.* —Atelectasis is reduced inflation of all or part of the lung. One of the commonest mechanisms is resorption of air distal to airway obstruction (eg, an endobronchial neoplasm). The synonym collapse is often used interchangeably with atelectasis, particularly when it is severe or accompanied by obvious increase in lung opacity.
- *CT scans*. — Reduced volume is seen, accompanied by increased attenuation in the affected part of the lung. Atelectasis is often associated with abnormal displacement of fissures, bronchi, vessels, diaphragm, heart, or mediastinum. The distribution can be lobar, segmental, or subsegmental. Atelectasis is often qualified by descriptors such as linear, discoid, or platelike.







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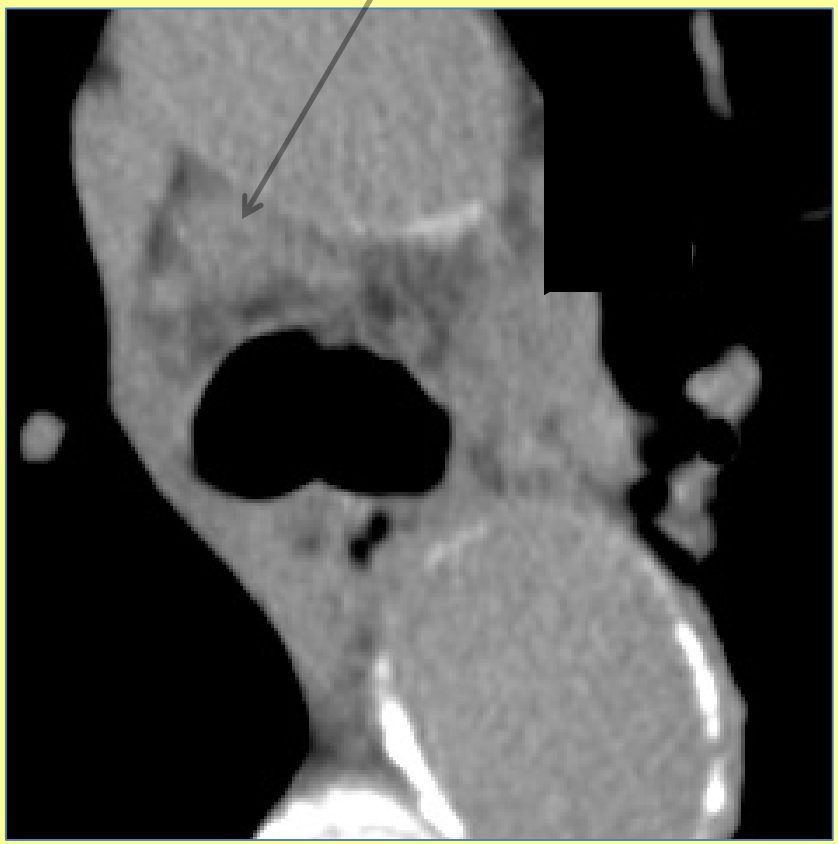
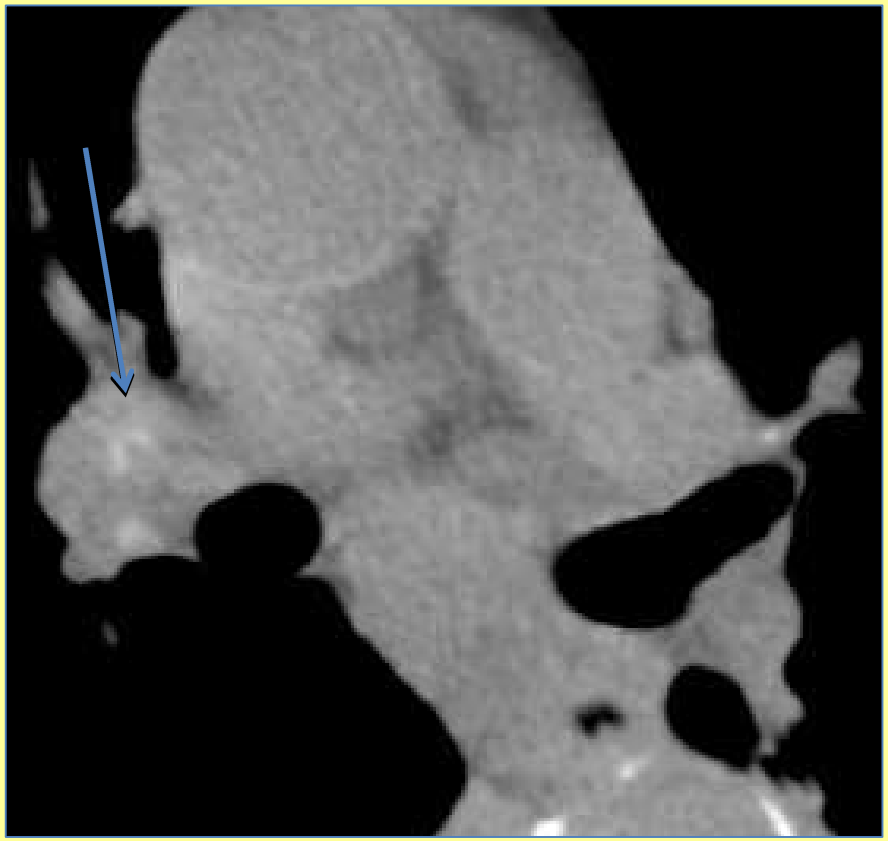
Lymphadenopathy

Pathology.—By common usage, the term lymphadenopathy is usually restricted to enlargement, due to any cause, of the lymph nodes. Synonyms include lymph node enlargement (preferred) and adenopathy.

CT scans.—There is a wide range in the size of normal lymph nodes. Mediastinal and hilar lymph nodes range in size from sub-CT resolution to 12 mm. Somewhat arbitrary thresholds for the upper limit of normal of 1 cm in short axis diameter for mediastinal nodes and 3 mm for most hilar nodes have been reported, but size criteria do not allow reliable differentiation between healthy and diseased lymph nodes .

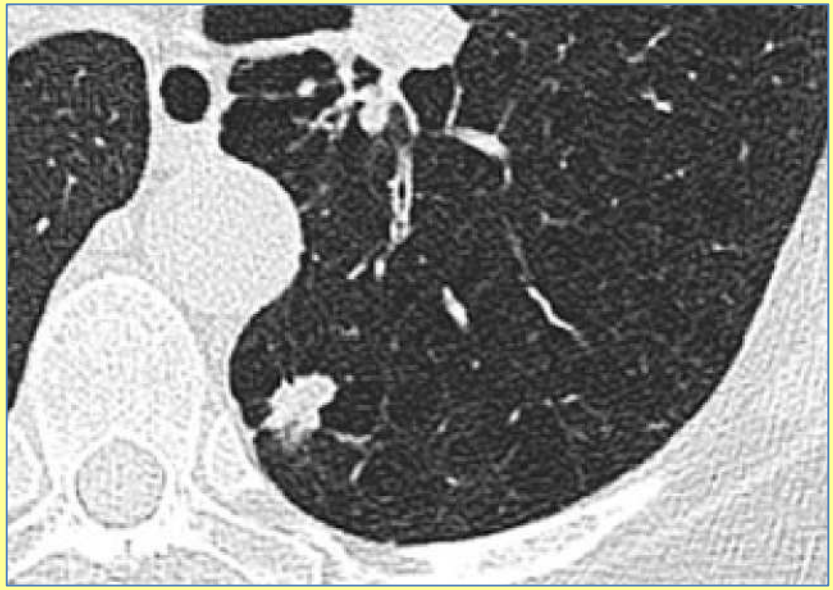




Nodule

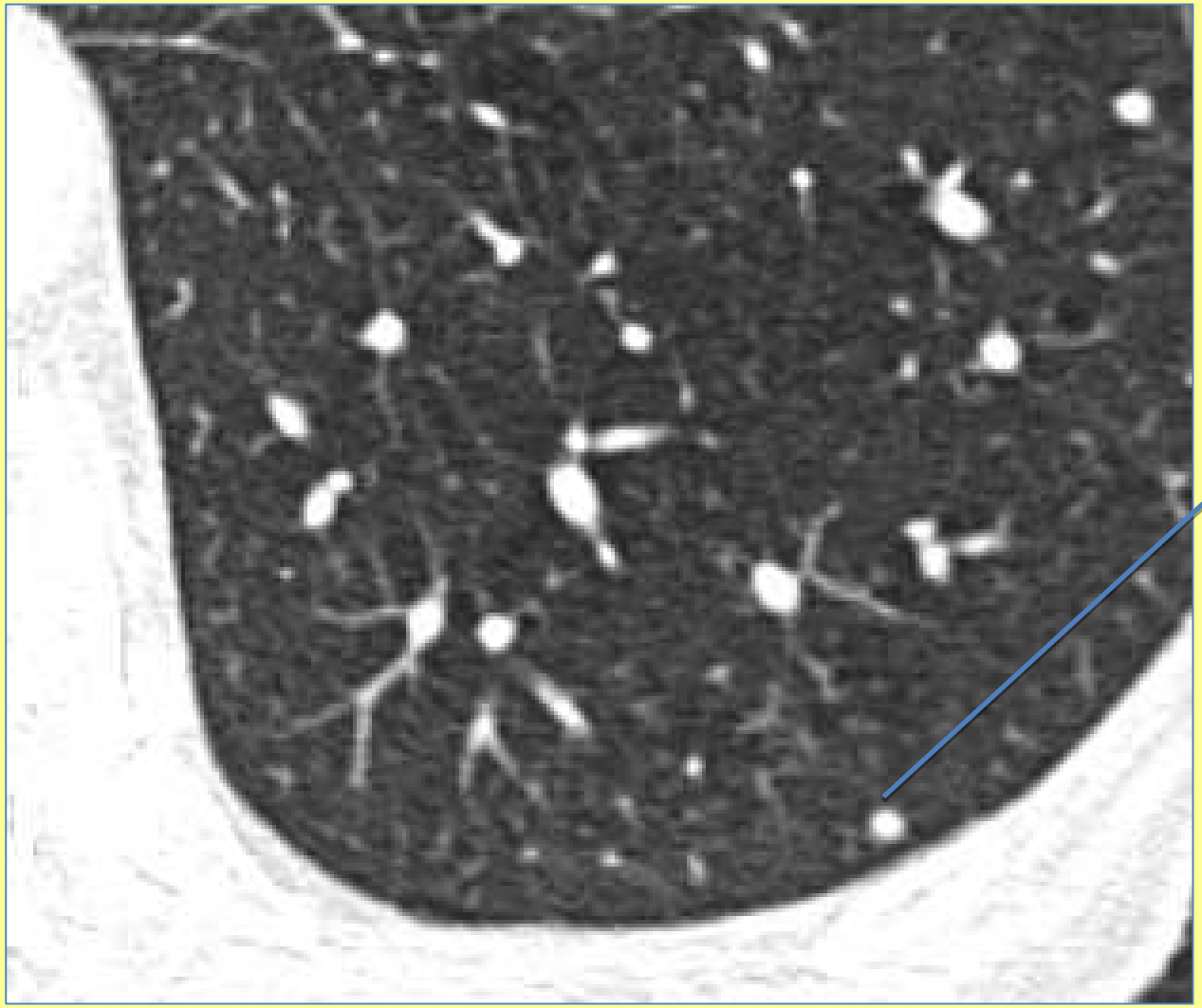
- On CT scans a nodule appears as a rounded or irregular opacity, well or poorly defined, measuring up to 3 cm in diameter.
- (a) Centrilobular nodules appear separated by several millimeters from the pleural surfaces, fissures, and interlobular septa. They may be of soft-tissue or ground-glass attenuation. Ranging in size from a few millimeters to a centimeter, centrilobular nodules are usually ill-defined.
- (b) A micronodule is less than 3 mm in diameter.
- (c) A ground-glass nodule (synonym, nonsolid nodule) manifests as hazy increased attenuation in the lung that does not obliterate the bronchial and vascular margins.
- (d) A solid nodule has homogenous soft-tissue attenuation.
- (e) A part-solid nodule (synonym, semisolid nodule) consists of both groundglass and solid soft-tissue attenuation components.

Parenchymal Pathology							
Nodules	Number of lobes affected						
< 5 mm	⓪	①	②	③	④	⑤	⑥
5 – 10 mm	⓪	①	②	③	④	⑤	⑥
> 10 mm	⓪	①	②	③	④	⑤	⑥



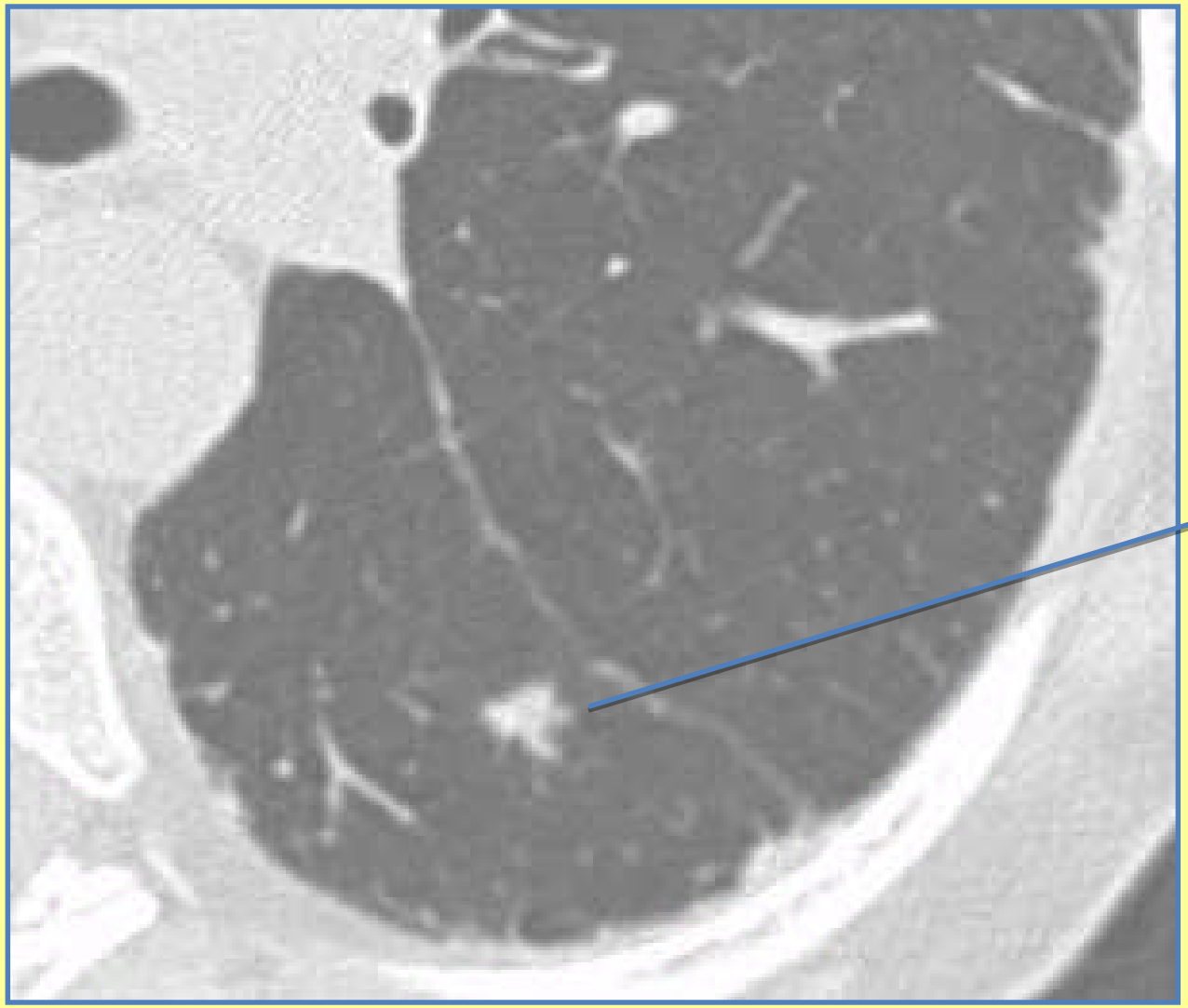
Transverse CT scan shows irregular nodule in left lower lobe.

Nodule



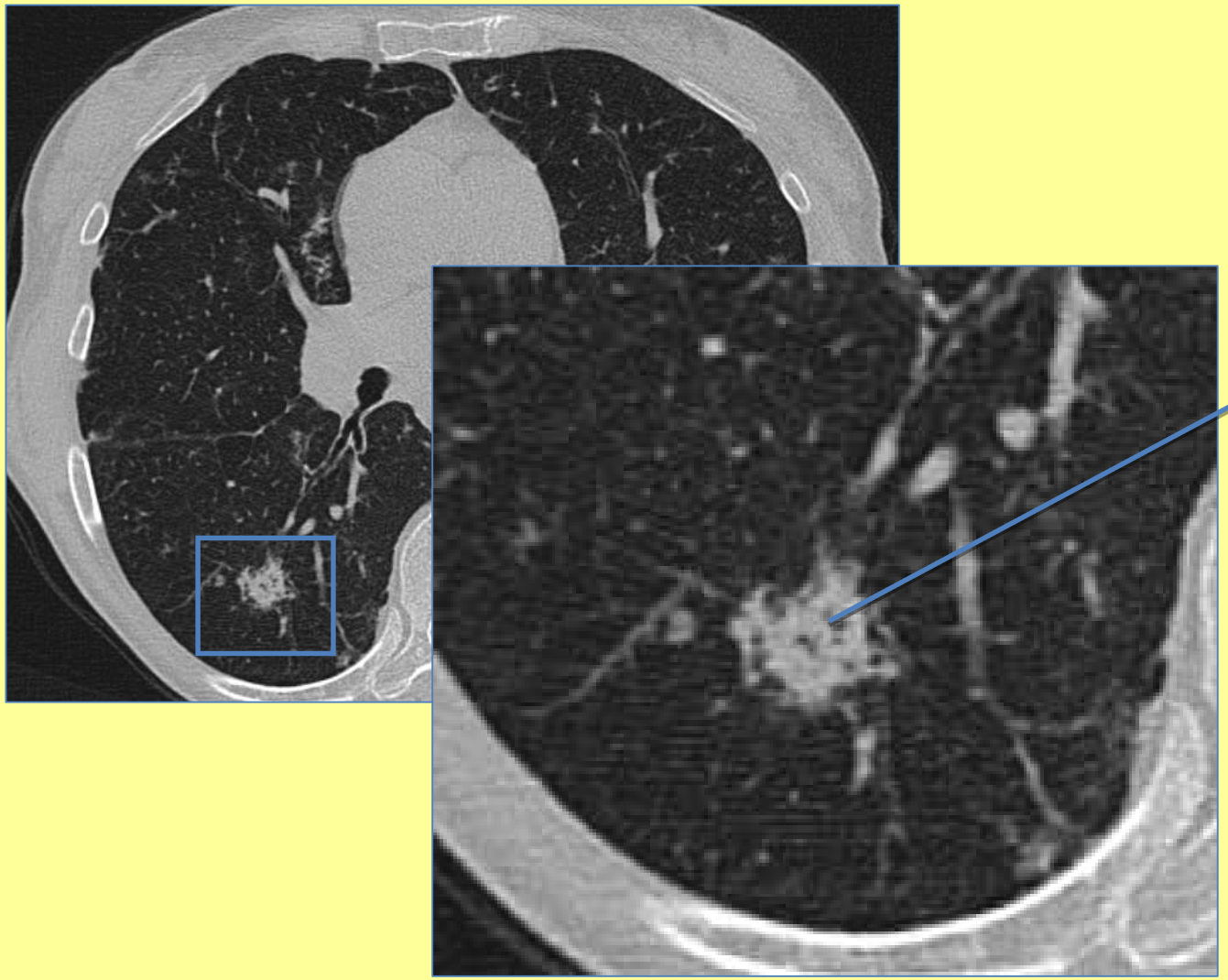
CT scan shows a nodule < 5 mm

Nodule



CT scan shows a
Nodule 5-10 mm

Nodule



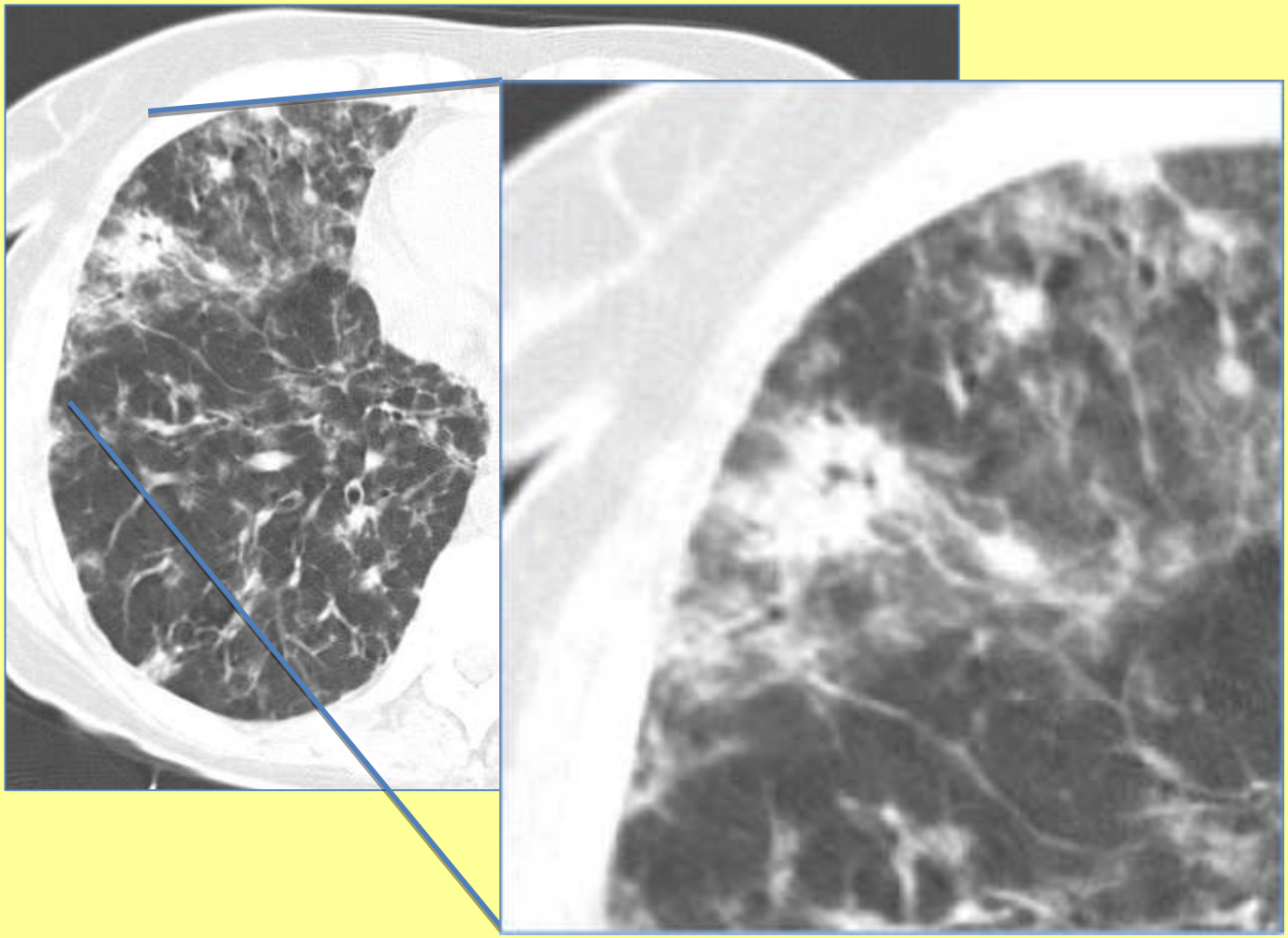
Tc scan shows a nodule
> 10 mm

Intralobular lines

CT scans.—Intralobular lines are visible as fine linear opacities in a lobule when the intralobular interstitial tissue is abnormally thickened. When numerous, they may appear as a fine reticular pattern. Intralobular lines may be seen in various conditions, including interstitial fibrosis and alveolar proteinosis

Lines	
Number of lobes affected	⓪ ① ② ③ ④ ⑤ ⑥
Is it a predominant	❍ inflammatory ❍ fibrotic ❍ mixed phenomenon?

Inflammatory Lines



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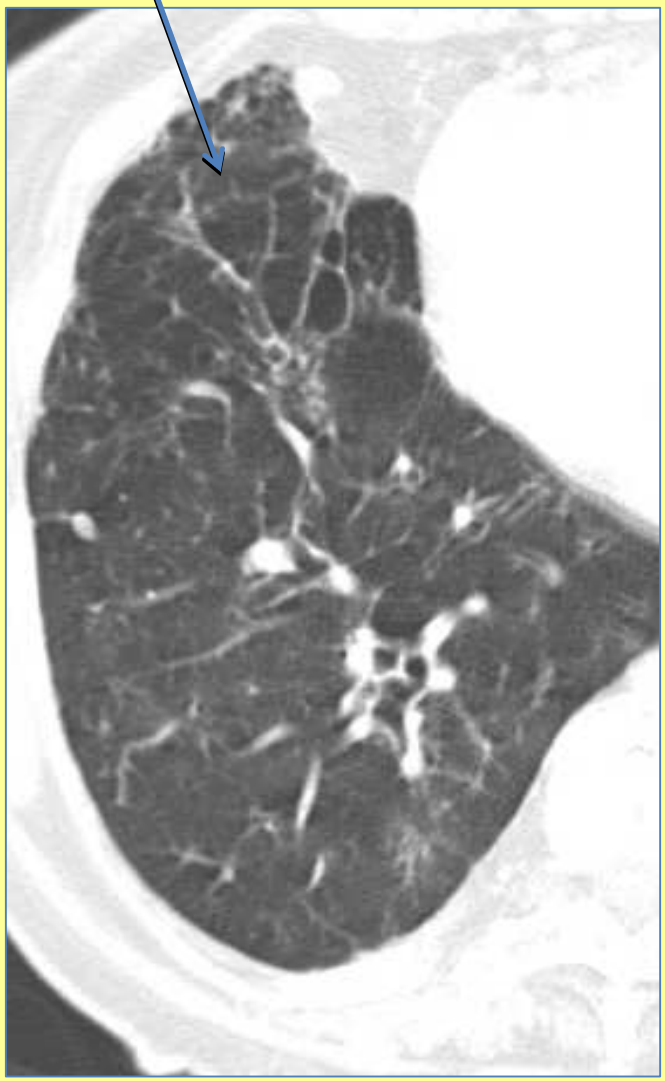
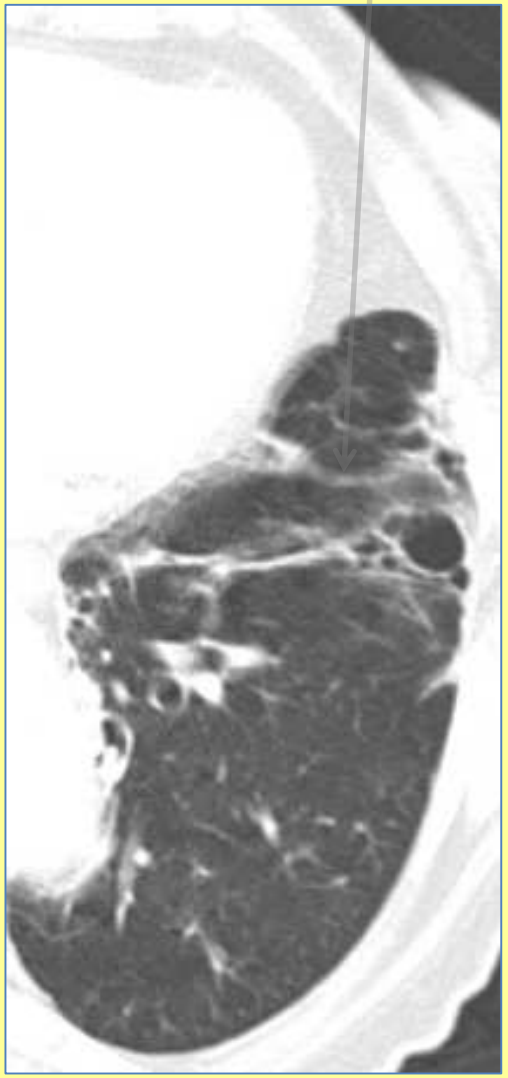
Fibrotic lines



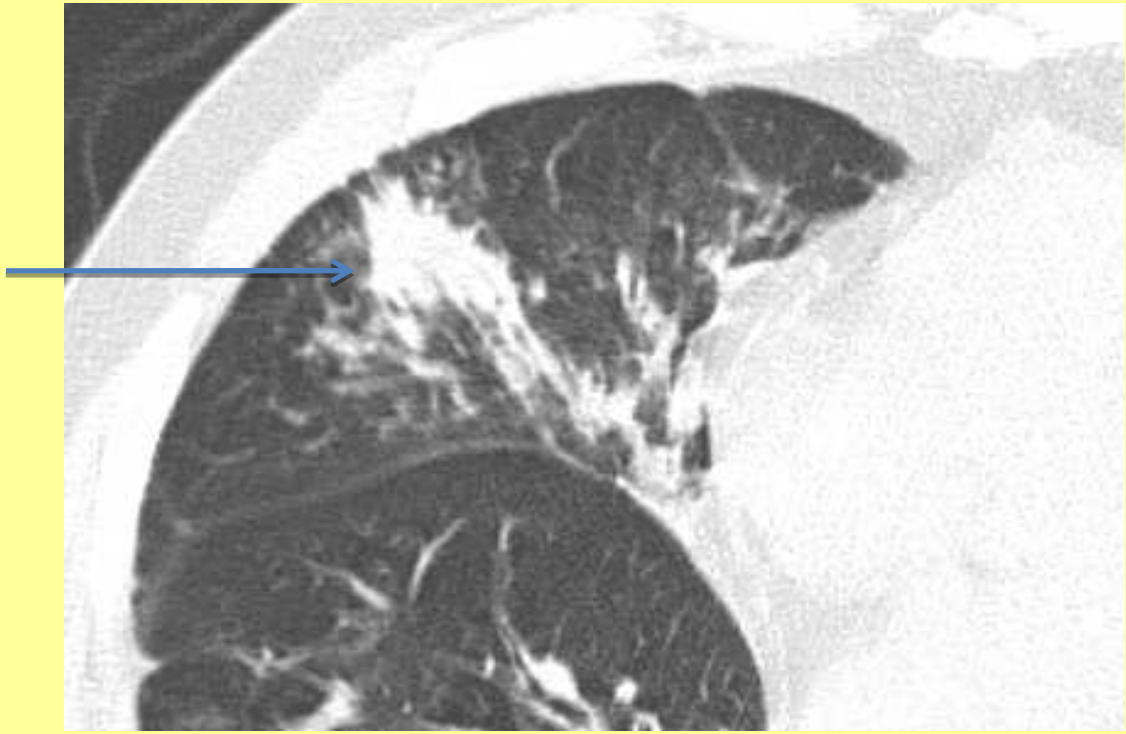
Mixed lines



Consolidation

- *Pathology.* —Consolidation refers to an exudate or other product of disease that replaces alveolar air, rendering the lung solid (as in infective pneumonia).
- *CT scans.* —Consolidation appears as a homogeneous increase in pulmonary parenchymal attenuation that obscures the margins of vessels and airway walls. An air bronchogram may be present. The attenuation characteristics of consolidated lung are only rarely helpful in differential diagnosis (eg, decreased attenuation in lipoid pneumonia and increased in amiodarone toxicity).

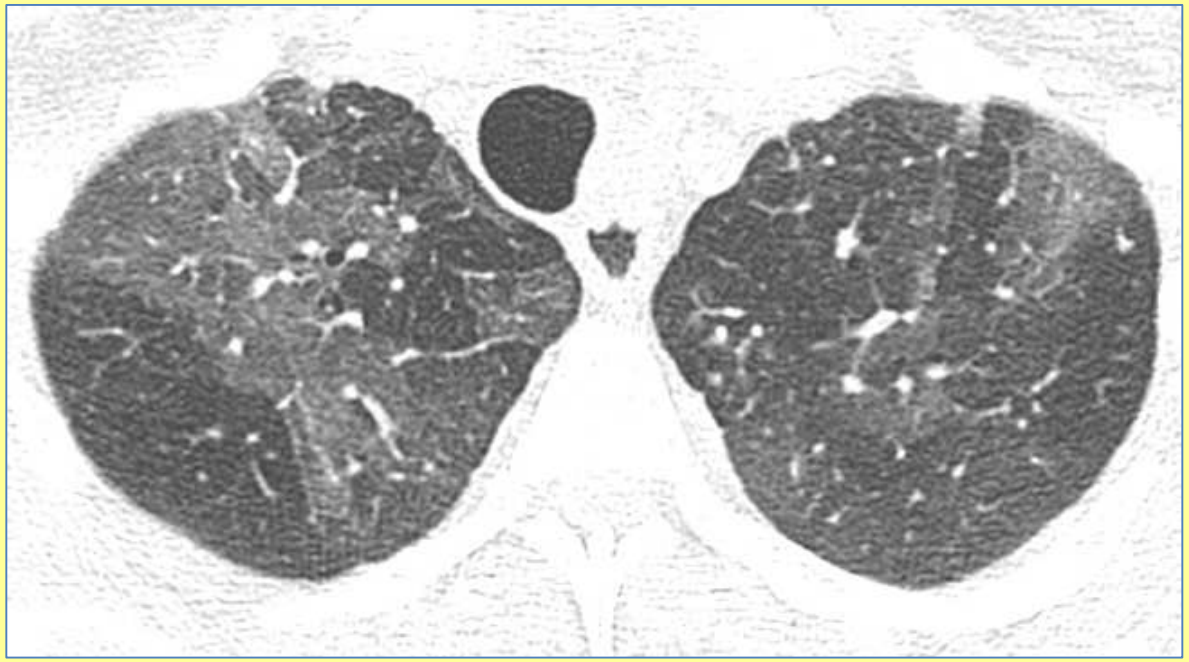
Transverse CT scan shows a consolidation in the middle lobe



Ground-glass opacity

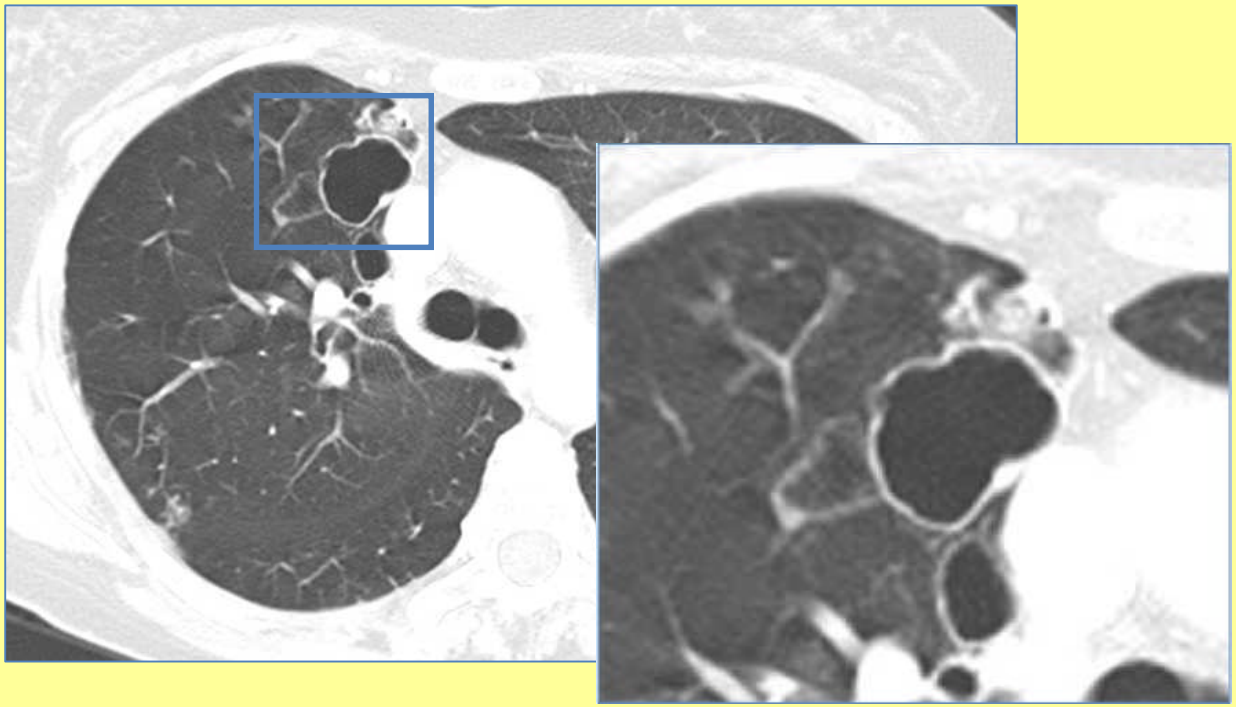
- On CT scans, it appears as hazy increased opacity of lung, with preservation of bronchial and vascular margins. It is caused by partial filling of airspaces, interstitial thickening (due to fluid, cells, and/or fibrosis), partial collapse of alveoli, increased capillary blood volume, or a combination of these, the common factor being the partial displacement of air.
- Ground-glass opacity is less opaque than consolidation, in which bronchovascular margins are obscured.

Transverse CT scan shows ground glass opacity



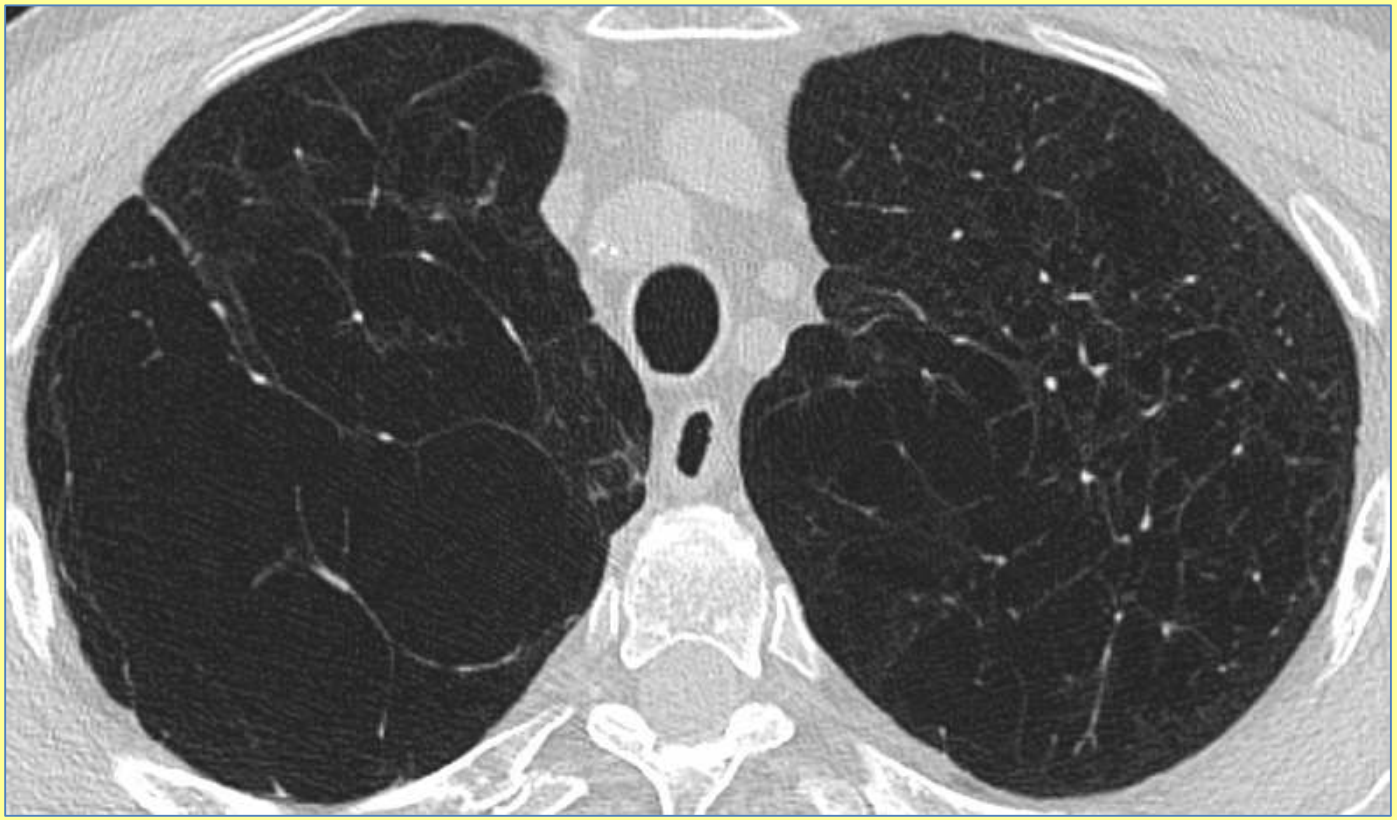
Cysts

- Pathology.—A cyst is any round circumscribed space that is surrounded by an epithelial or fibrous wall of variable thickness
- A cyst appears as a round parenchymal low-attenuating area with a well-defined interface with normal lung. Cysts have variable wall thickness but are usually thin-walled (<2 mm) and occur without associated pulmonary emphysema. Cysts in the lung usually contain air but occasionally contain fluid or solid material. The term is often used to describe enlarged thin walled airspaces in patients with lymphangioleiomyomatosis or Langerhans cell histiocytosis; thicker walled honeycomb cysts are seen in patients with end-stage fibrosis.



Emphysema

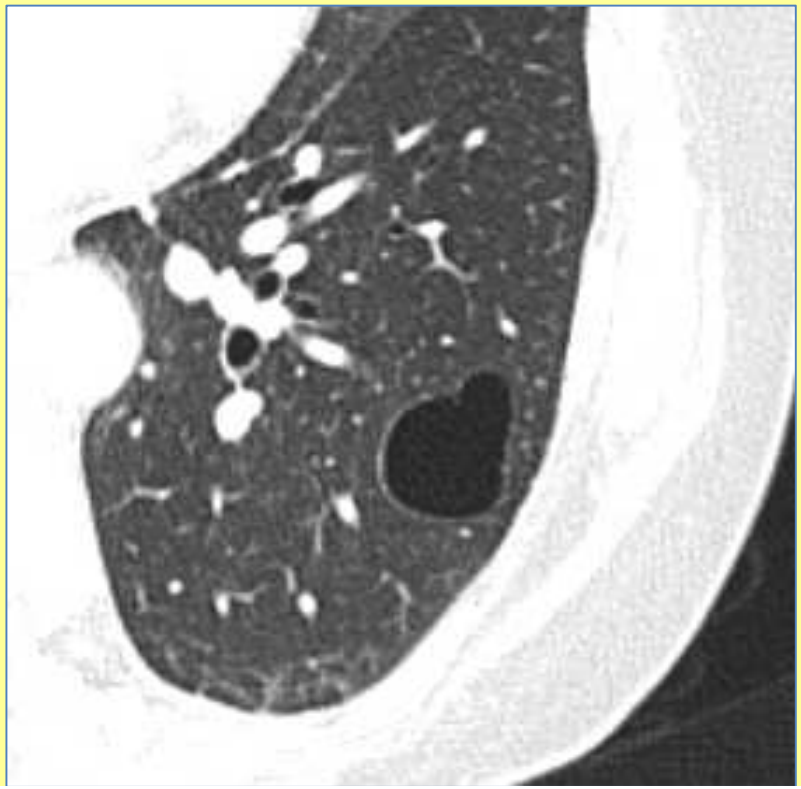
- Pathology.—Emphysema is characterized by permanently enlarged airspaces distal to the terminal bronchiole with destruction of alveolar walls. Absence of “obvious fibrosis” was historically regarded as an additional criterion, but the validity of that criterion has been questioned because some interstitial fibrosis may be present in emphysema secondary to cigarette smoking. Emphysema is usually classified in terms of the part of the acinus predominantly affected: proximal (centriacinar, more commonly termed centrilobular, emphysema), distal (paraseptal emphysema), or whole acinus (panacinar or, less commonly, panlobular emphysema).
- The CT appearance of emphysema consists of focal areas or regions of low attenuation, usually without visible walls. In the case of panacinar emphysema, decreased attenuation is more diffuse.



Transverse CT scan shows centrilobular emphysema.

Bulla

- Pathology. —An airspace measuring more than 1 cm—usually several centimeters—in diameter, sharply demarcated by a thin wall that is no greater than 1 mm in thickness. A bulla is usually accompanied by emphysematous changes in the adjacent lung.
- CT scans.—A bulla appears as a rounded focal area of decreased attenuation, 1 cm or more in diameter, bounded by a thin wall. Multiple bullae are often present and are associated with other signs of pulmonary emphysema (centrilobular and paraseptal).

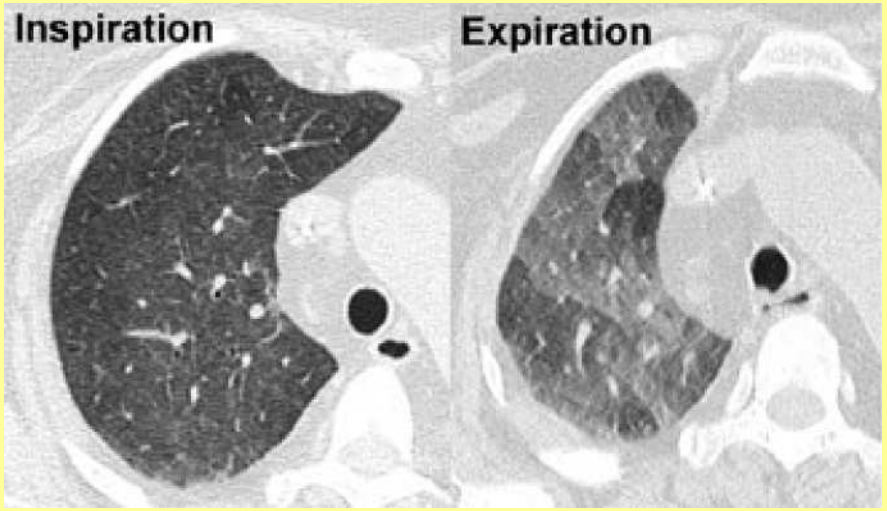


Axial CT scan shows large bulla in left lower lung zone.

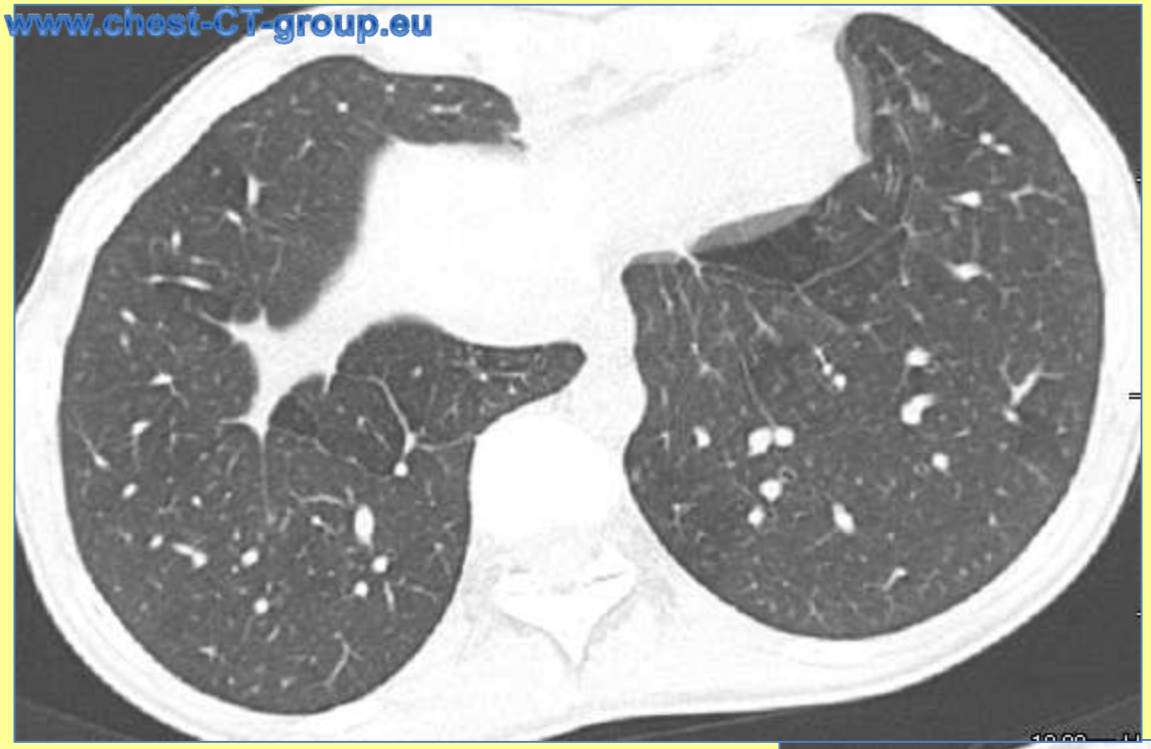
Air trapping

- Pathophysiology. —Air trapping is retention of air in the lung distal to an obstruction (usually partial).
- CT scans. —Air trapping is seen on end-expiration CT scans as parenchymal areas with less than normal increase in attenuation and lack of volume reduction. Comparison between inspiratory and expiratory CT scans can be helpful when air trapping is subtle or diffuse. Differentiation from areas of decreased attenuation resulting from hypoperfusion as a consequence of an occlusive vascular disorder (eg, chronic thromboembolism) may be problematic, but other findings of airways versus vascular disease are usually present.

Transverse CT scans at end inspiration and end expiration show air trapping.



Air trapping (> 5 lobules)		
in inspiratory scan	Yes	No
in expiratory scan	Yes	No



INSPIRATION

EXPIRATION