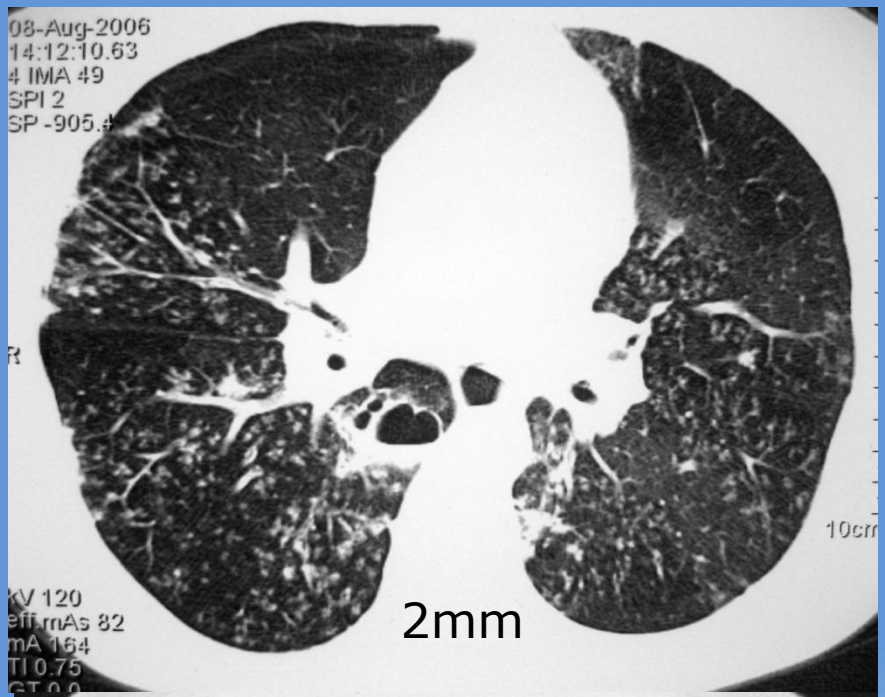
小气道病变的影像评价

首都医科大学附属北京友谊医院
放射科 贺文

2017-05-24


08-Aug-2006
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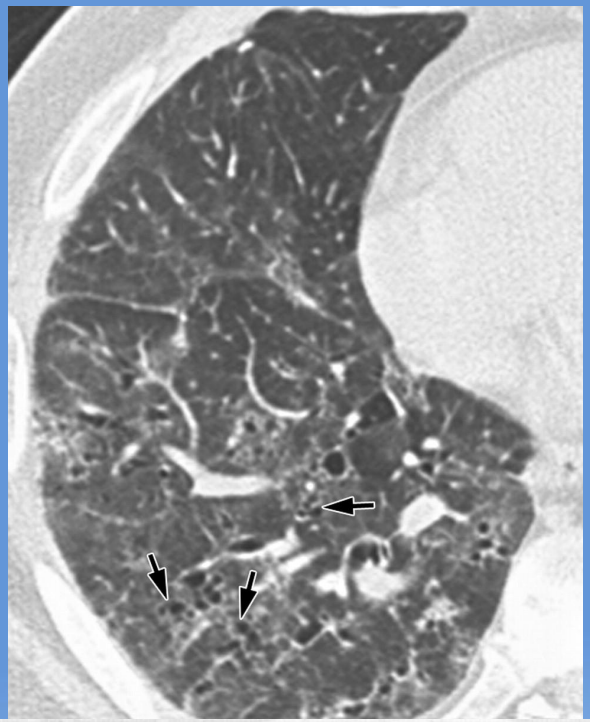
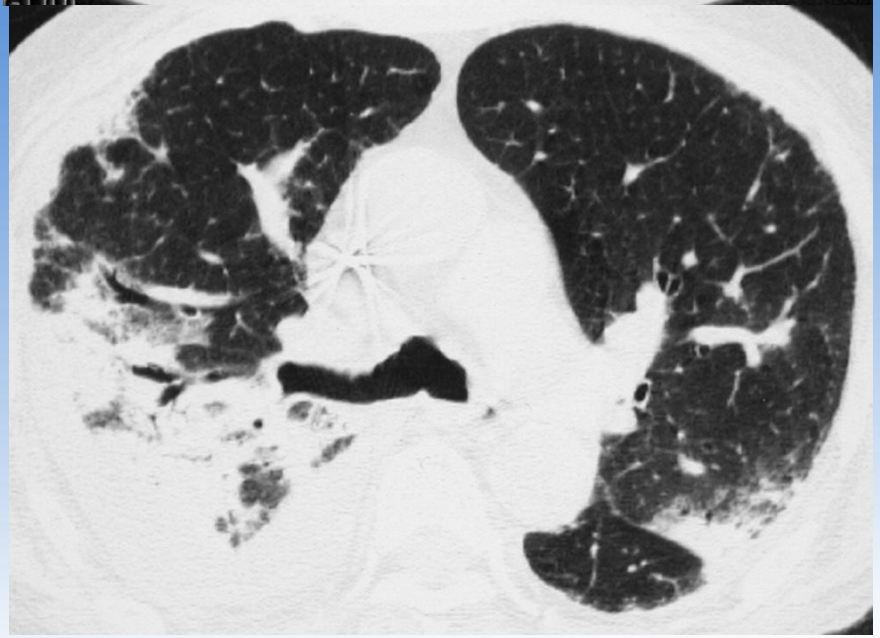
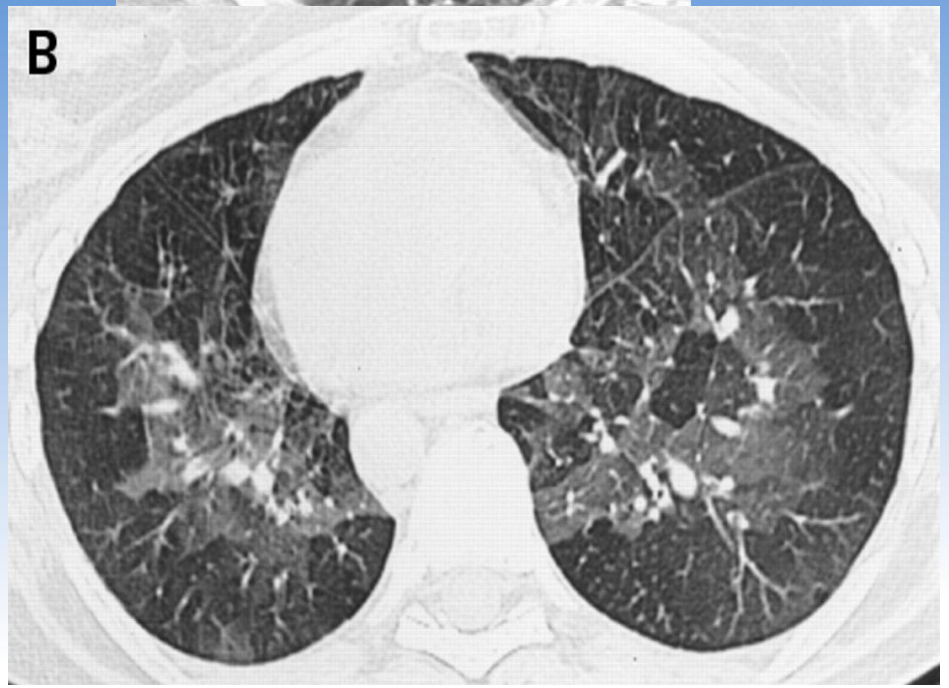
kV 120
eff.mAs 82
mA 164
TI 0.75
2mm



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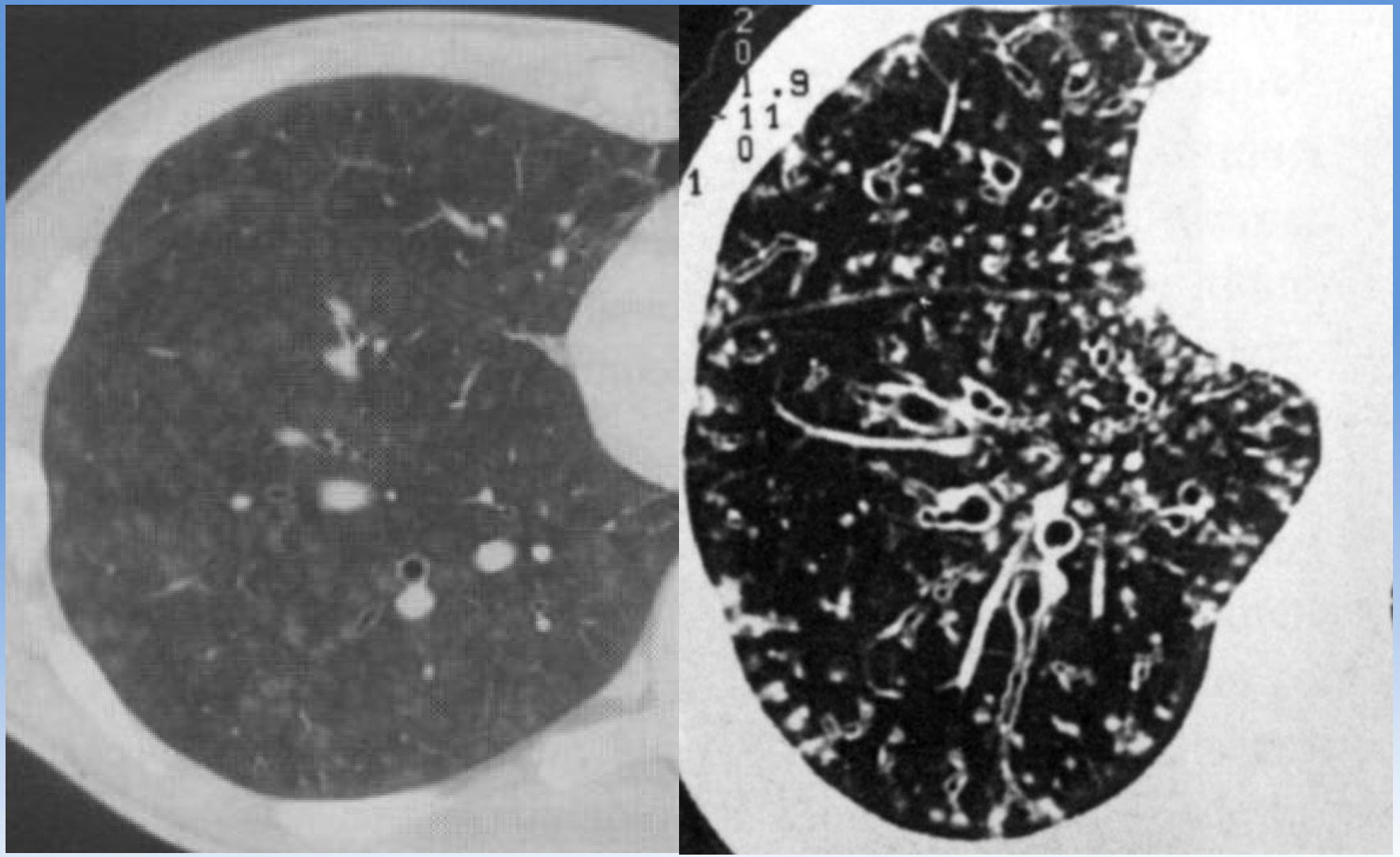

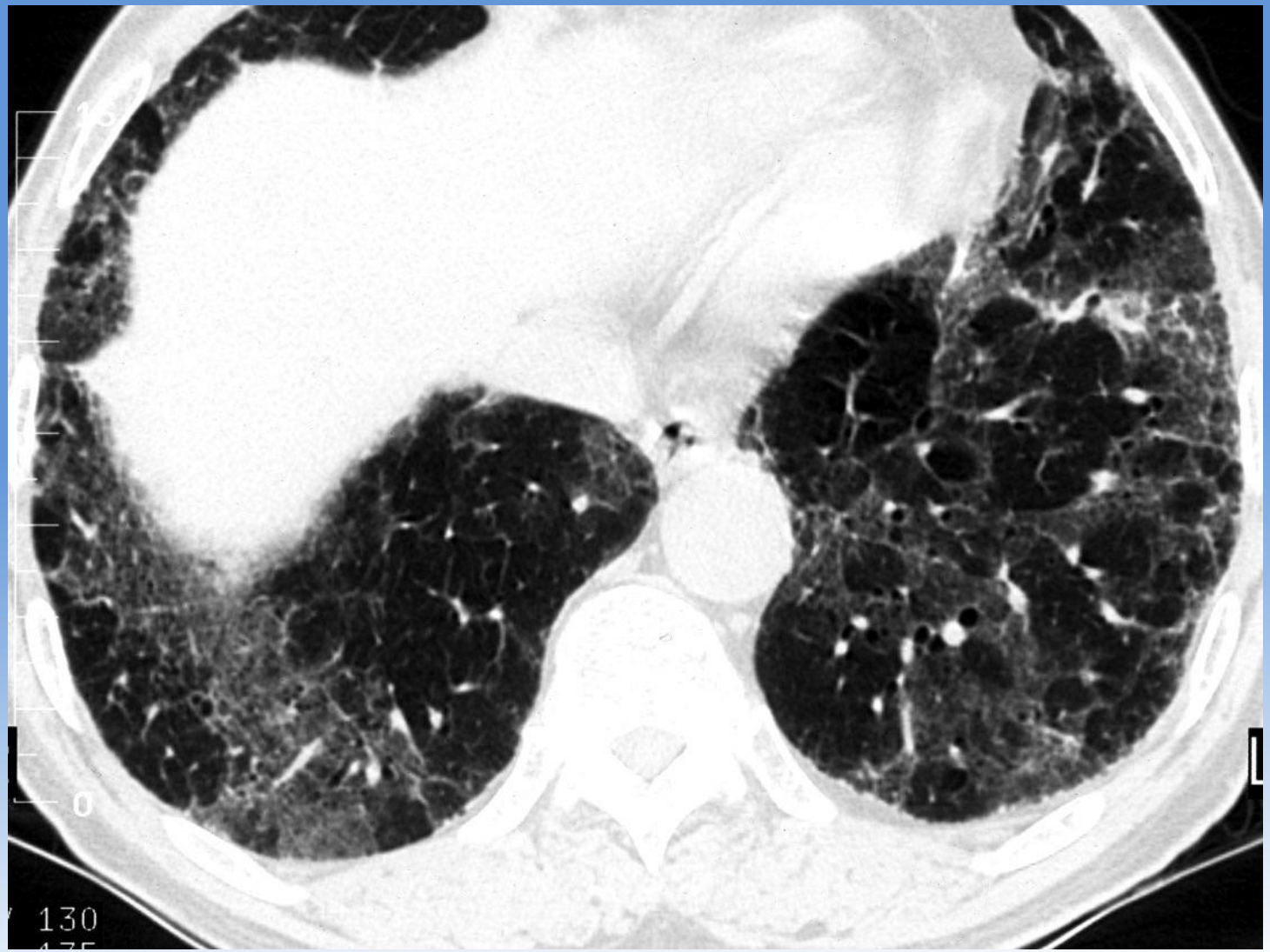
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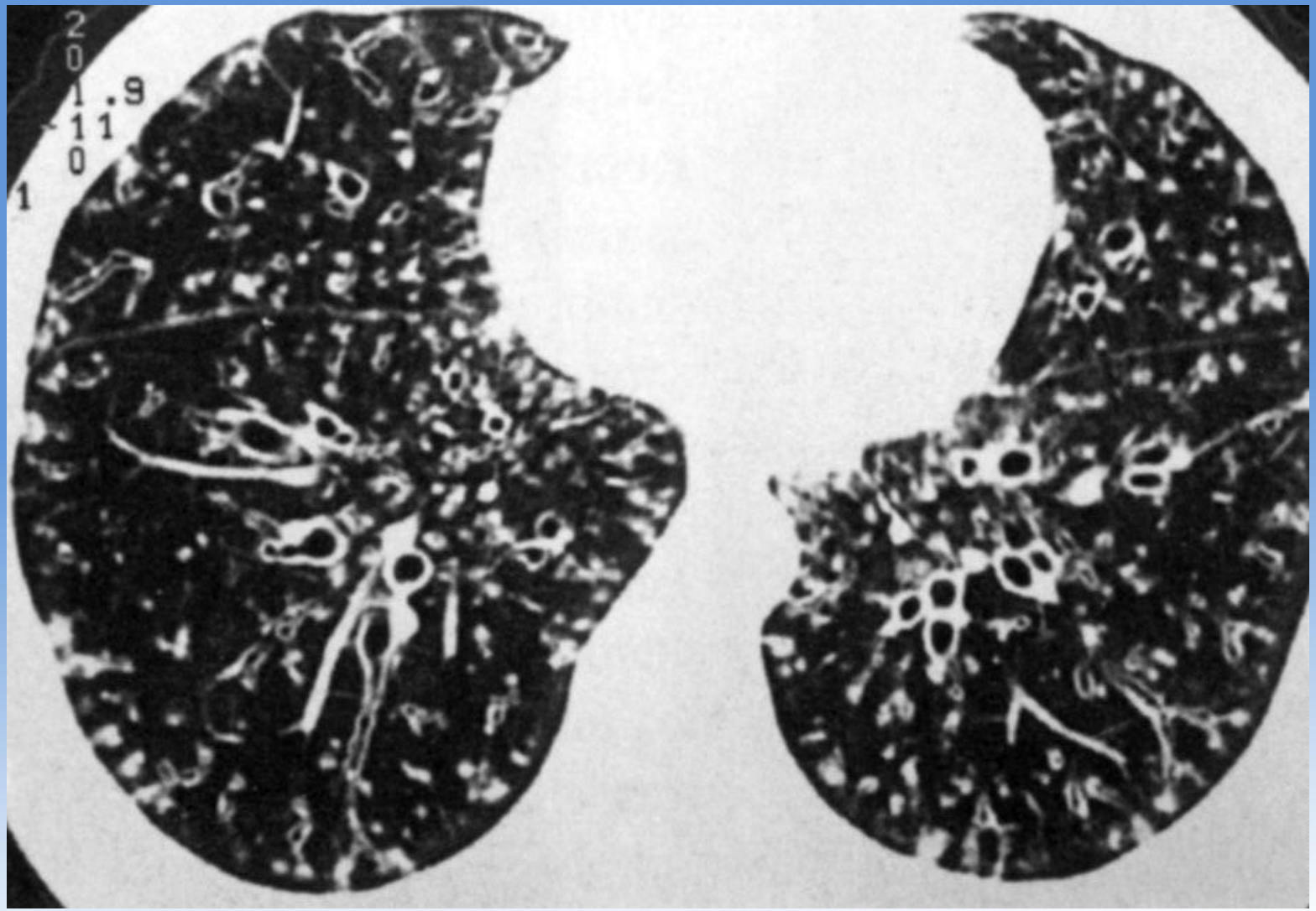
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0
1.9
11
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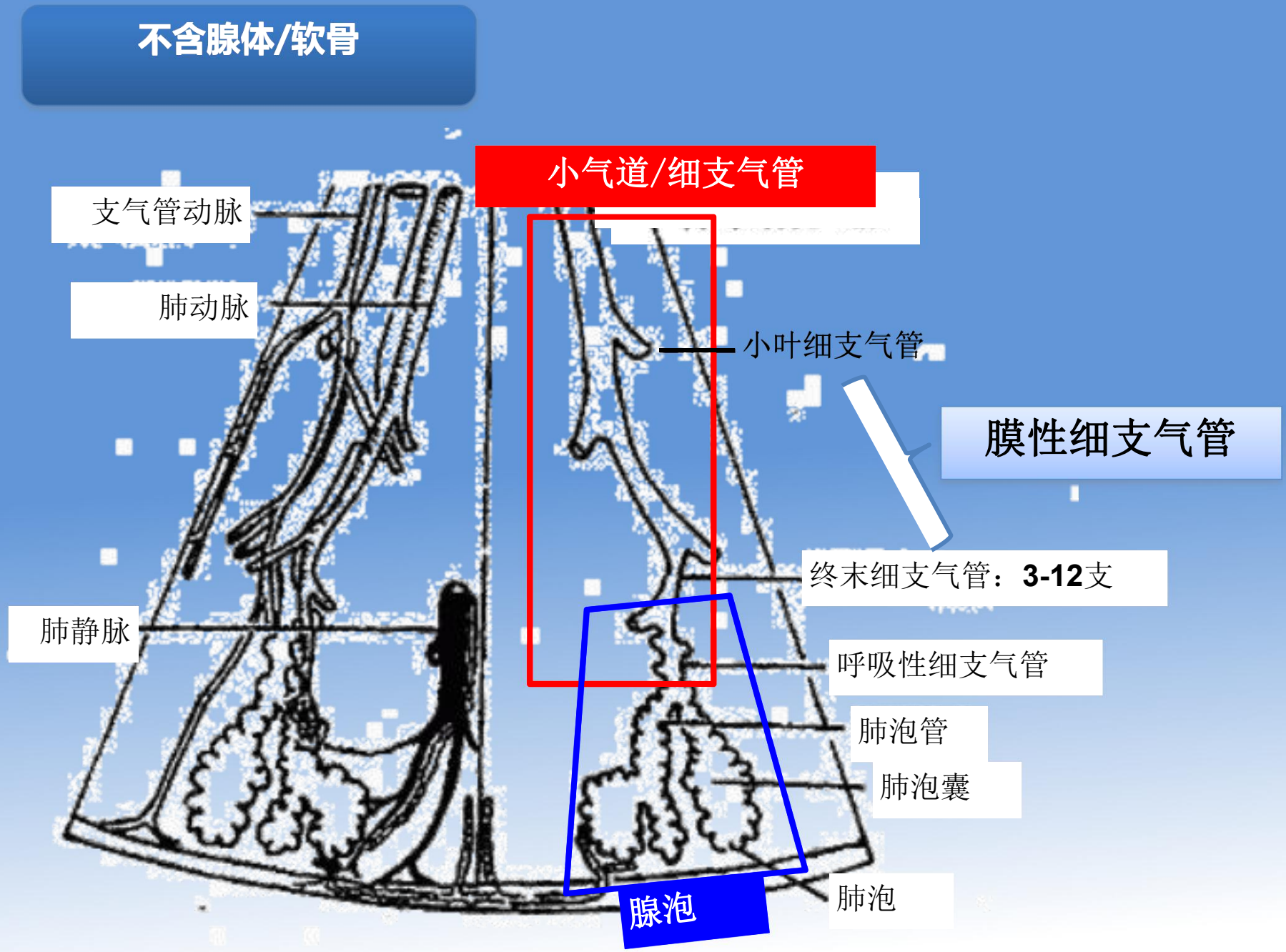
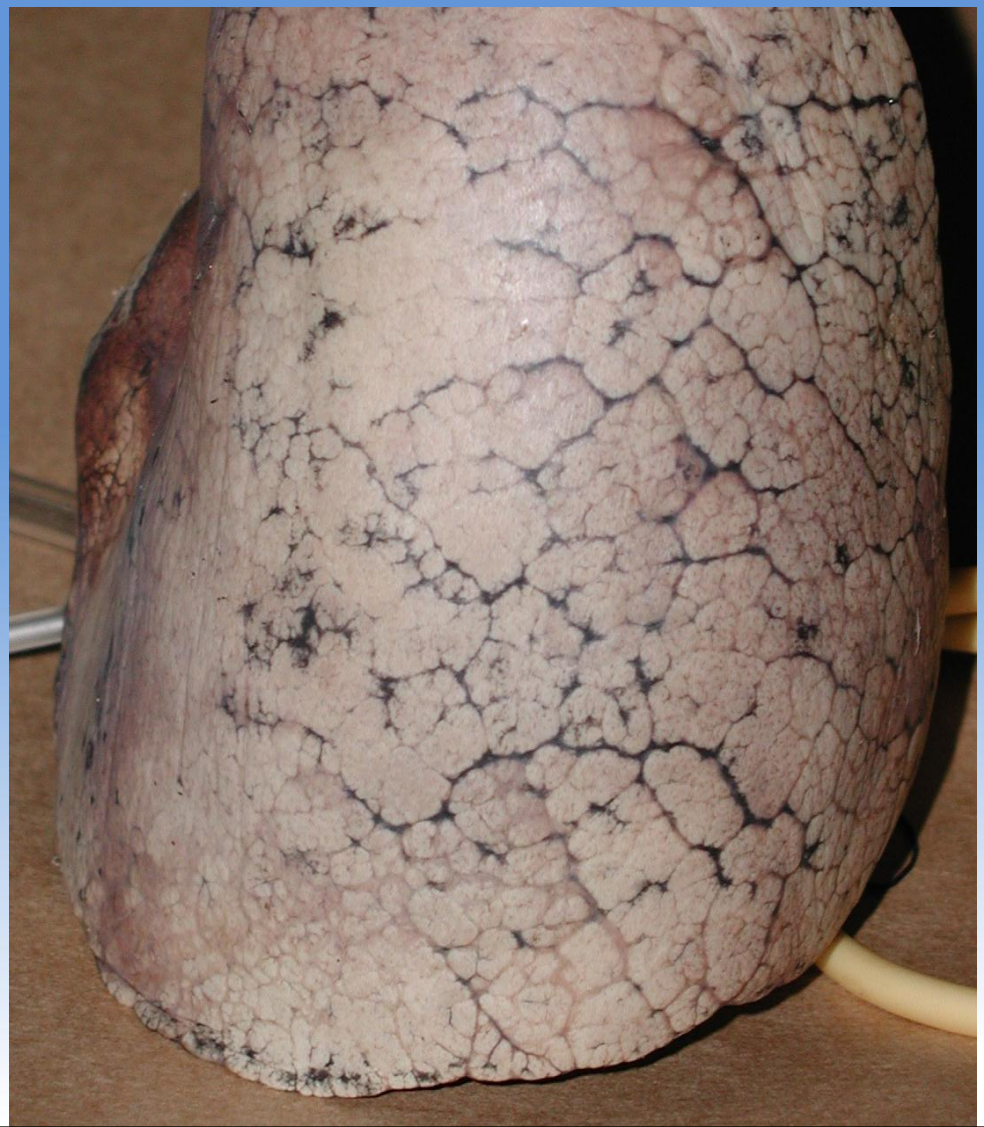
1

小气道病变的CT征象

- 直接征象：支气管－血管束、小结节、实变
- 间接征象：气体潴留
- 合并征象：气腔、间质


不含腺体/软骨
小气道/细支气管
支气管动脉
肺动脉
小叶细支气管
膜性细支气管
终末细支气管：3-12支
肺静脉
呼吸性细支气管
肺泡管
肺泡囊
肺泡
腺泡

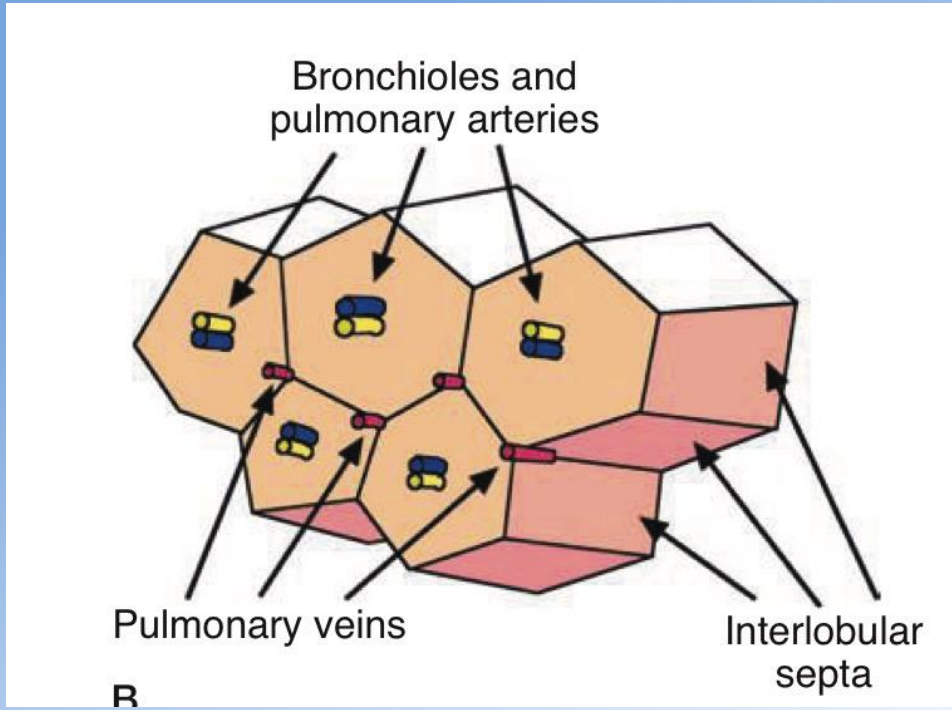
肺小气道的解剖

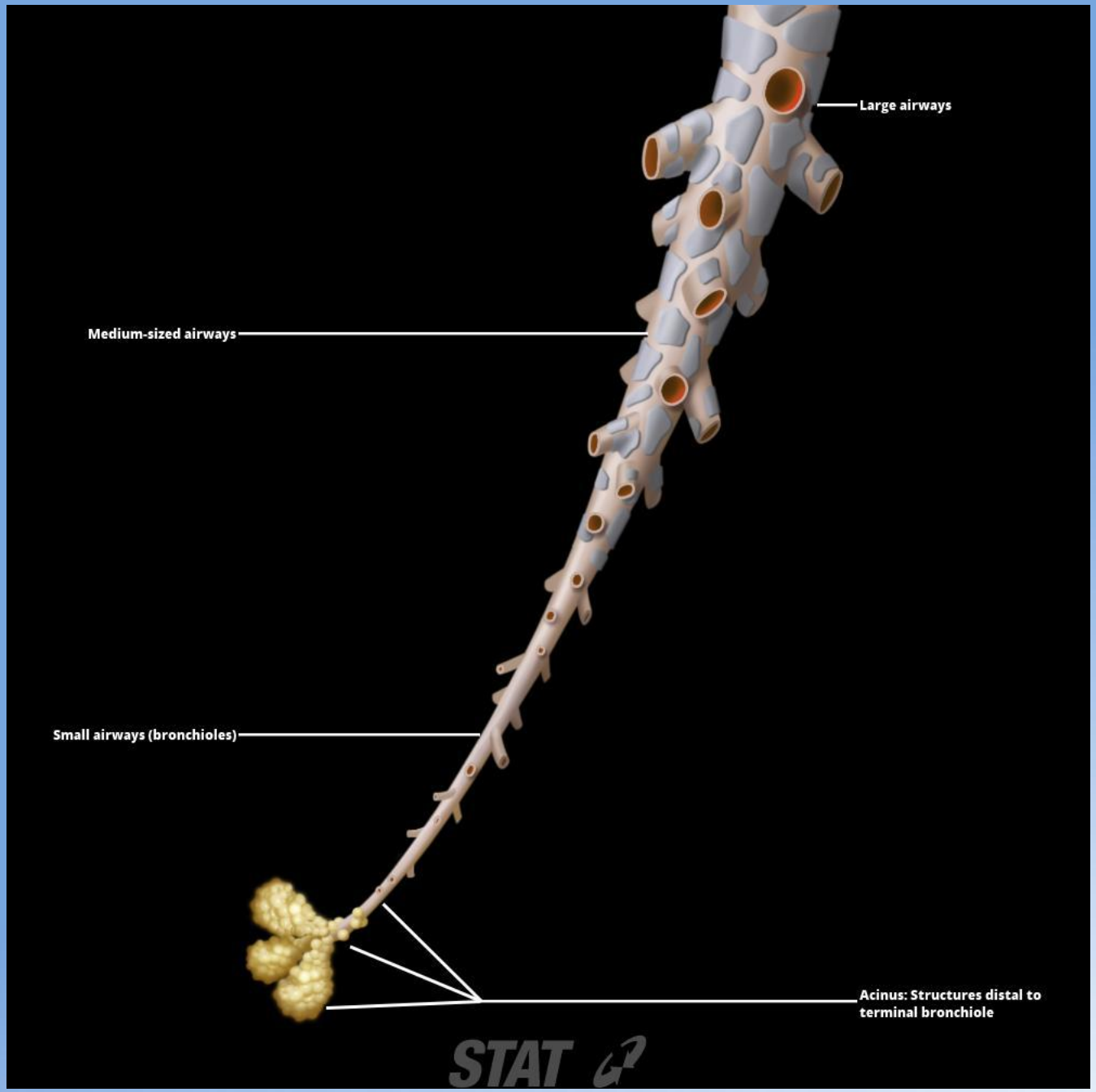


次级肺小叶（1-2.5cm）

最小的解剖结构

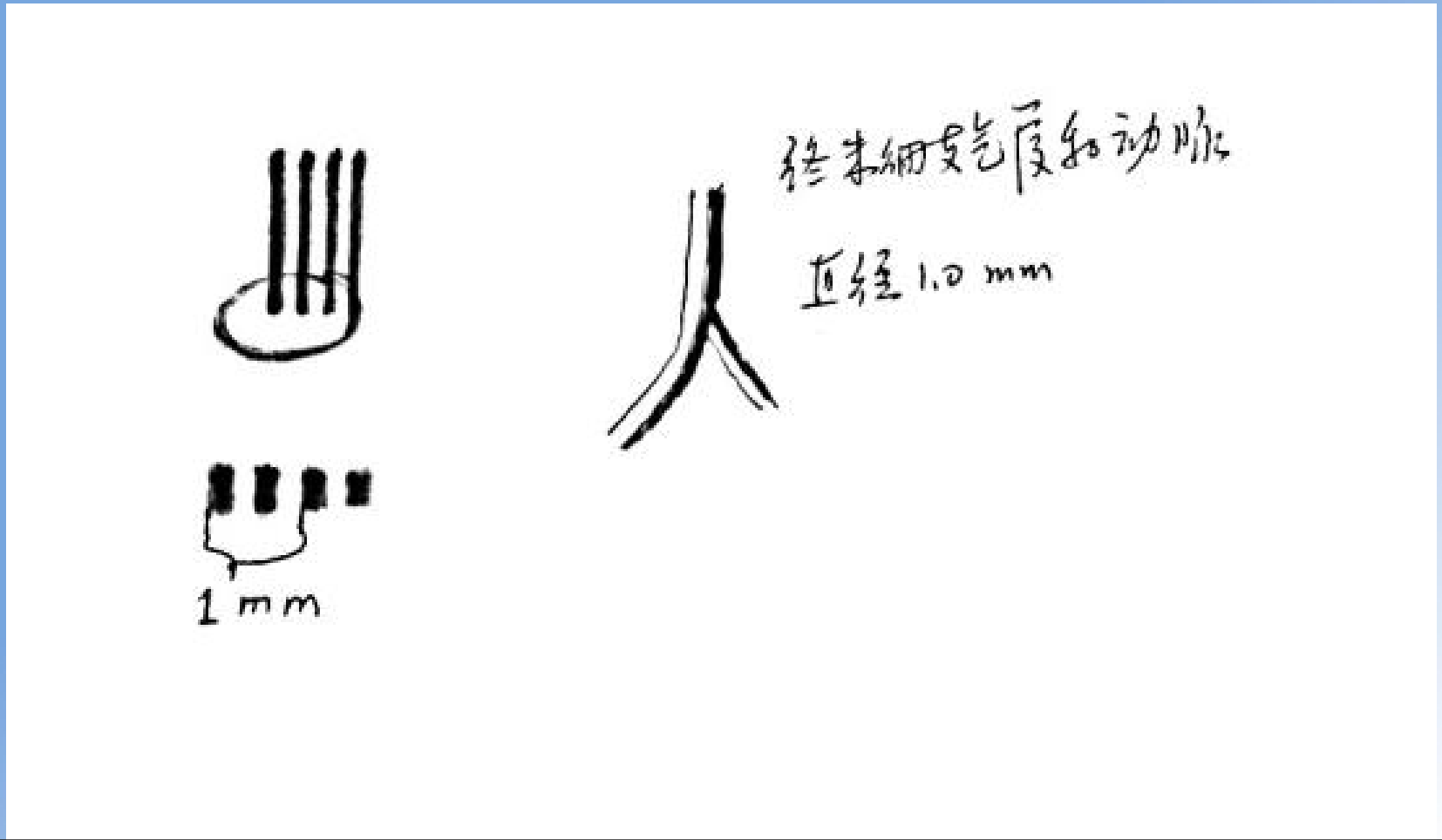
- 1.小叶间隔与胸膜下间质
- 2. 小叶中央结构
- 3. 小叶实质和腺泡




Large airways
Medium-sized airways
Small airways (bronchioles)
Acinus: Structures distal to terminal bronchiole
STAT

能看多远？胸部CT的分辨率

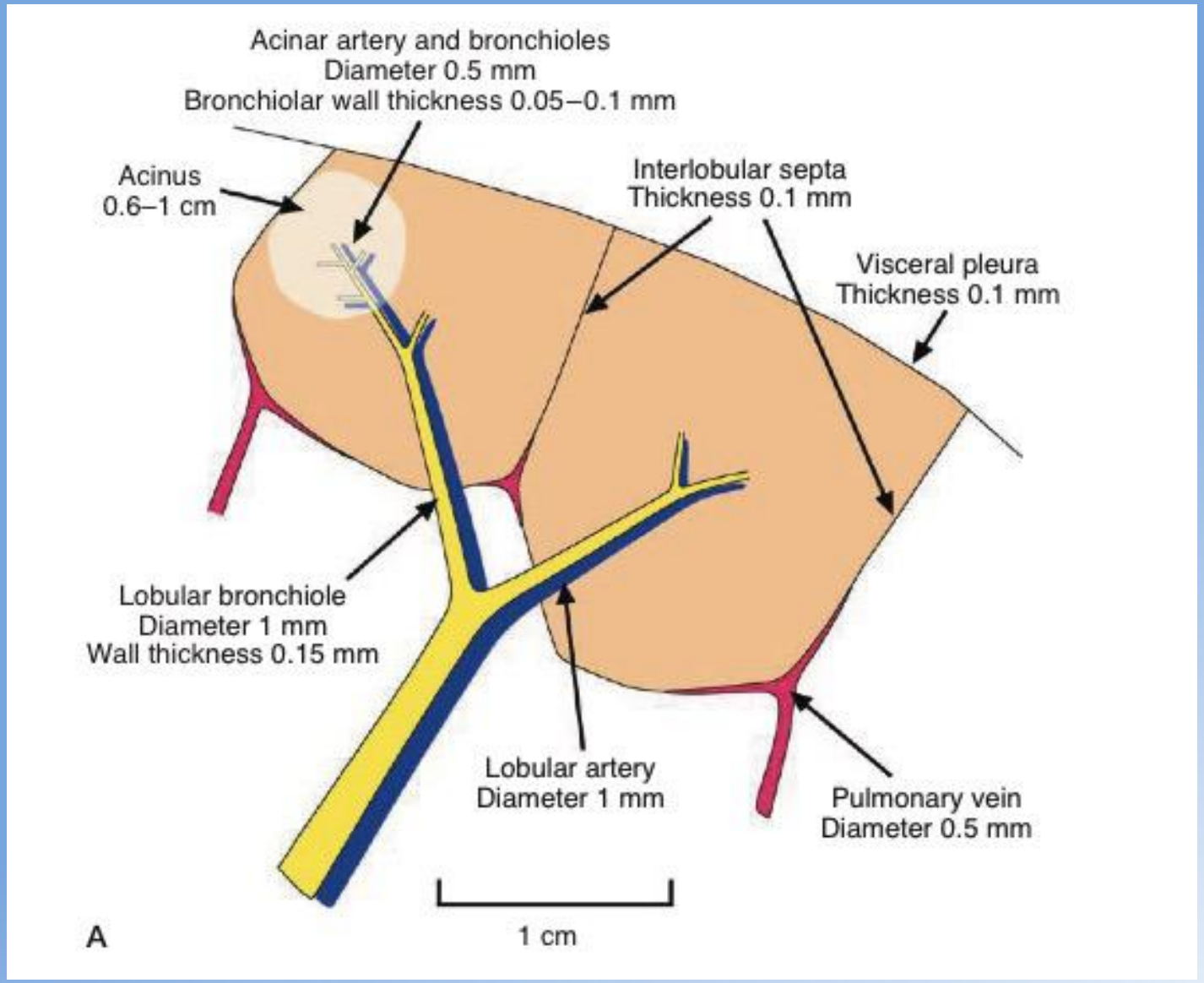
- 20线对/cm=2线对/mm，像素：0.25mm

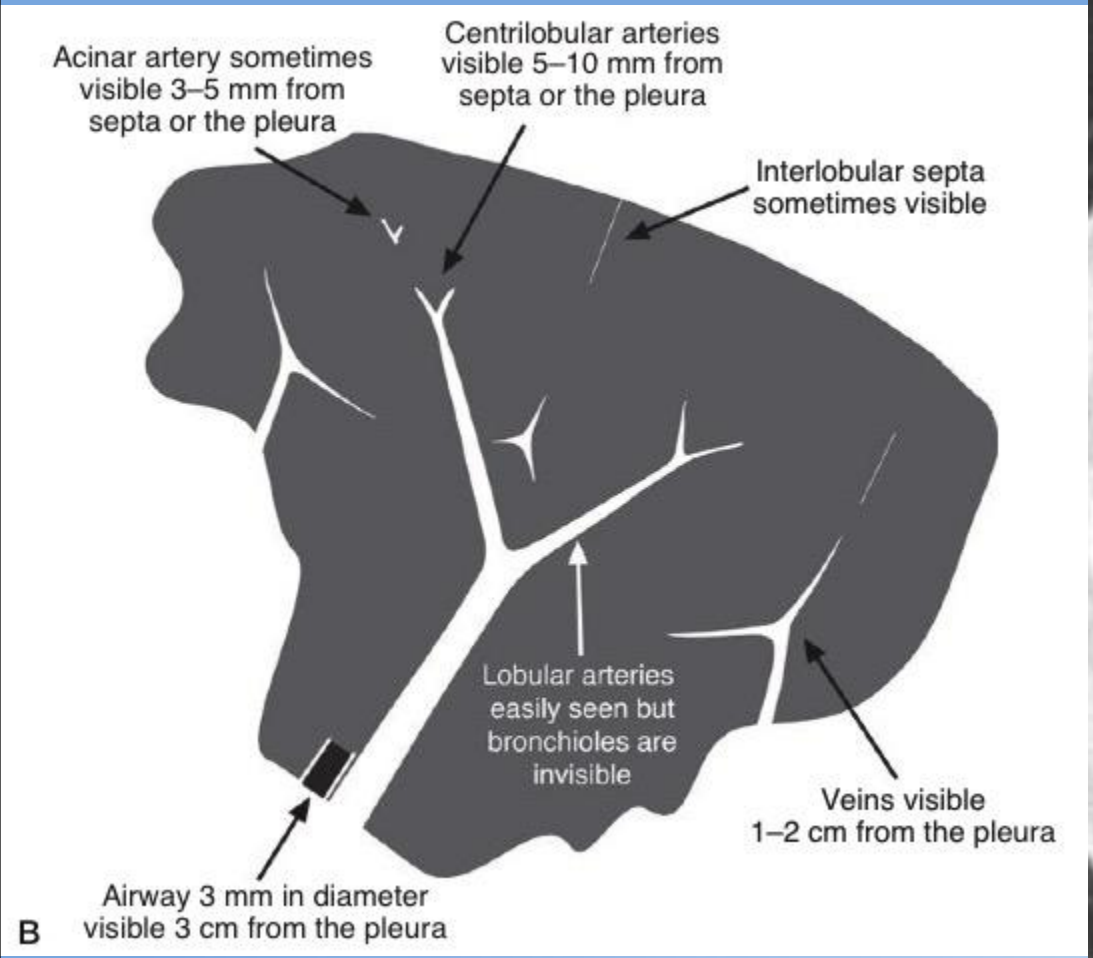


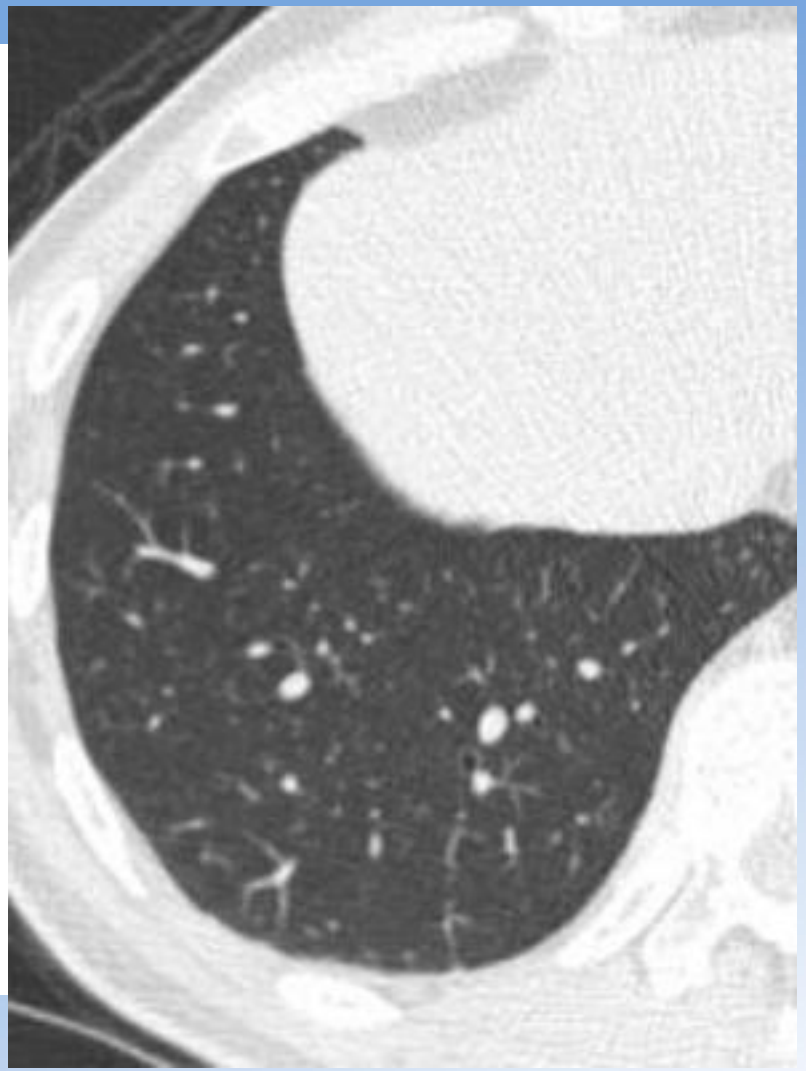
支气管、肺血管的显示级别

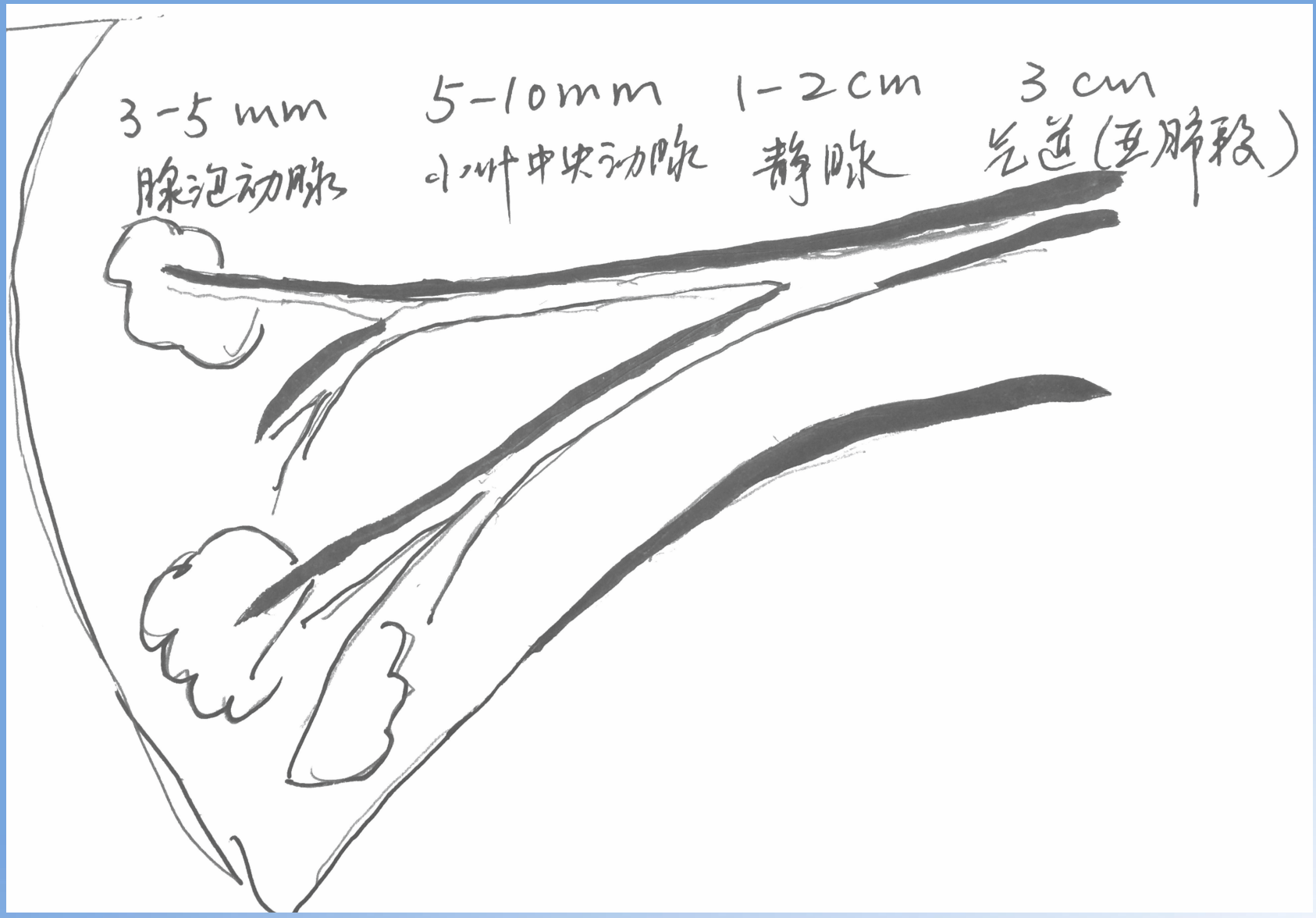
TABLE 2-1 Relation of Airway Diameter to Wall Thickness

Airway	Diameter (mm)	Wall thickness (mm)
Lobular and segmental bronchi	5–8	1.5
Subsegmental bronchi/ bronchiole	1.5–3.0	0.2–0.3
Lobular bronchiole	1	0.15
Terminal bronchiole	0.7	0.1
Acinar bronchiole	0.5	0.05

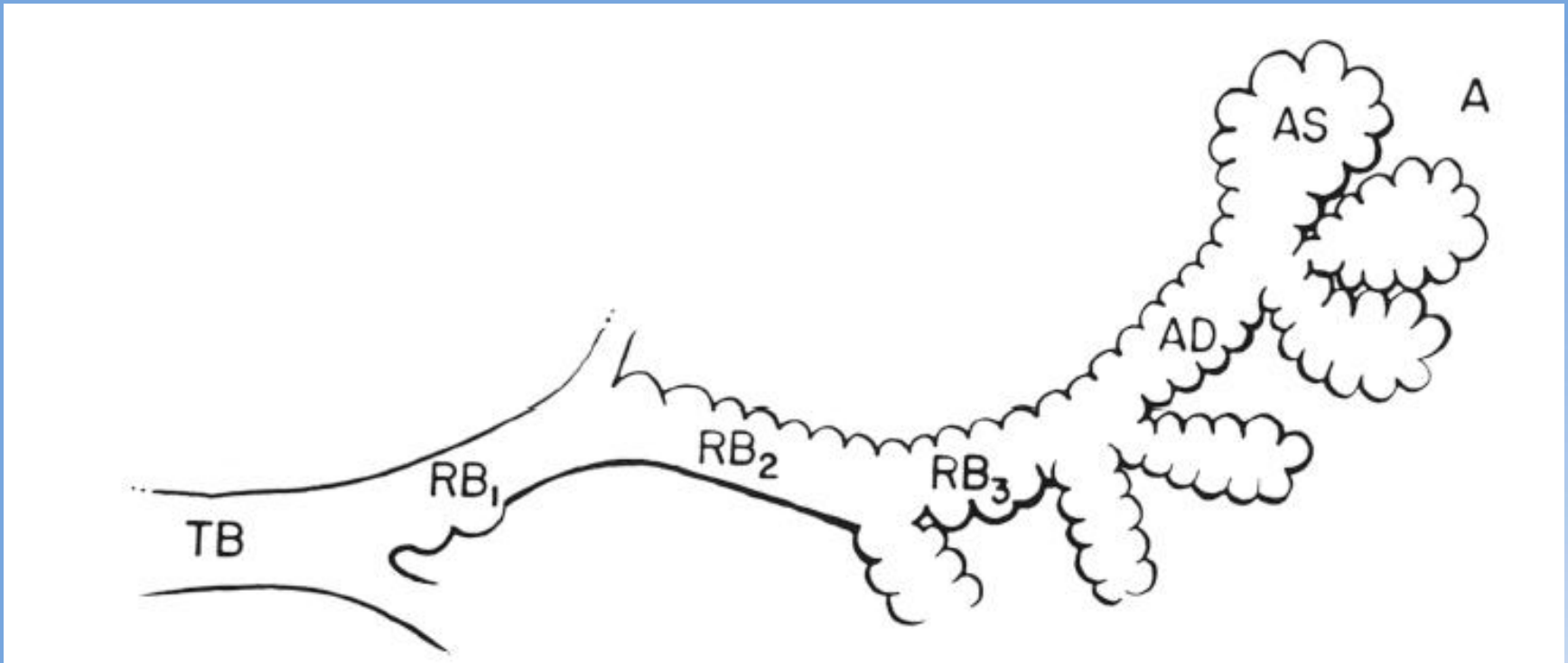

Acinar artery and bronchioles
Diameter 0.5 mm
Bronchiolar wall thickness 0.05–0.1 mm
Acinus
0.6–1 cm
Interlobular septa
Thickness 0.1 mm
Visceral pleura
Thickness 0.1 mm
Lobular bronchiole
Diameter 1 mm
Wall thickness 0.15 mm
Lobular artery
Diameter 1 mm
Pulmonary vein
Diameter 0.5 mm
1 cm
A


Acinar artery sometimes visible 3–5 mm from septa or the pleura
Centrilobular arteries visible 5–10 mm from septa or the pleura
Interlobular septa sometimes visible
Lobular arteries easily seen but bronchioles are invisible
Veins visible 1–2 cm from the pleura
Airway 3 mm in diameter visible 3 cm from the pleura
B

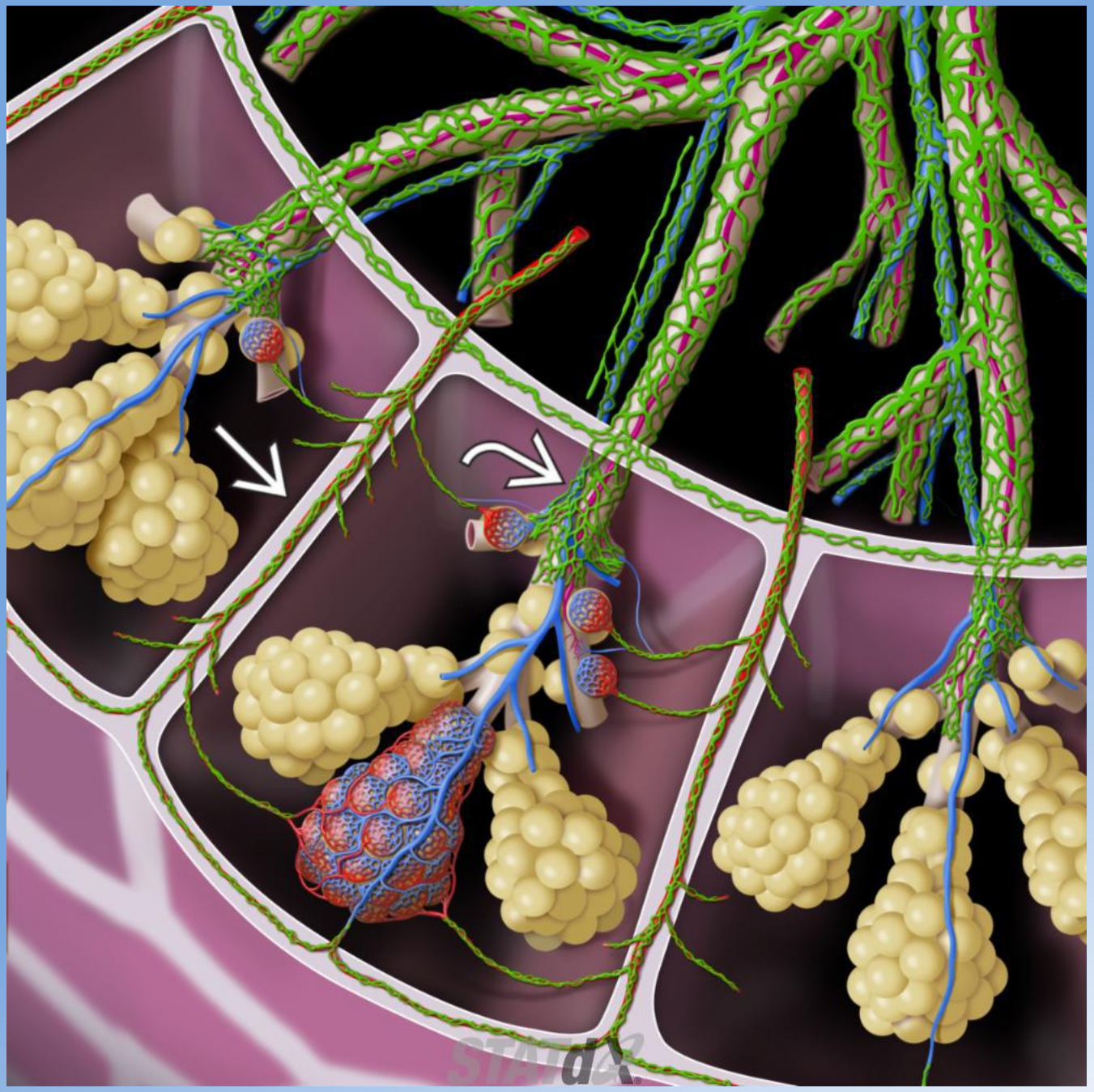


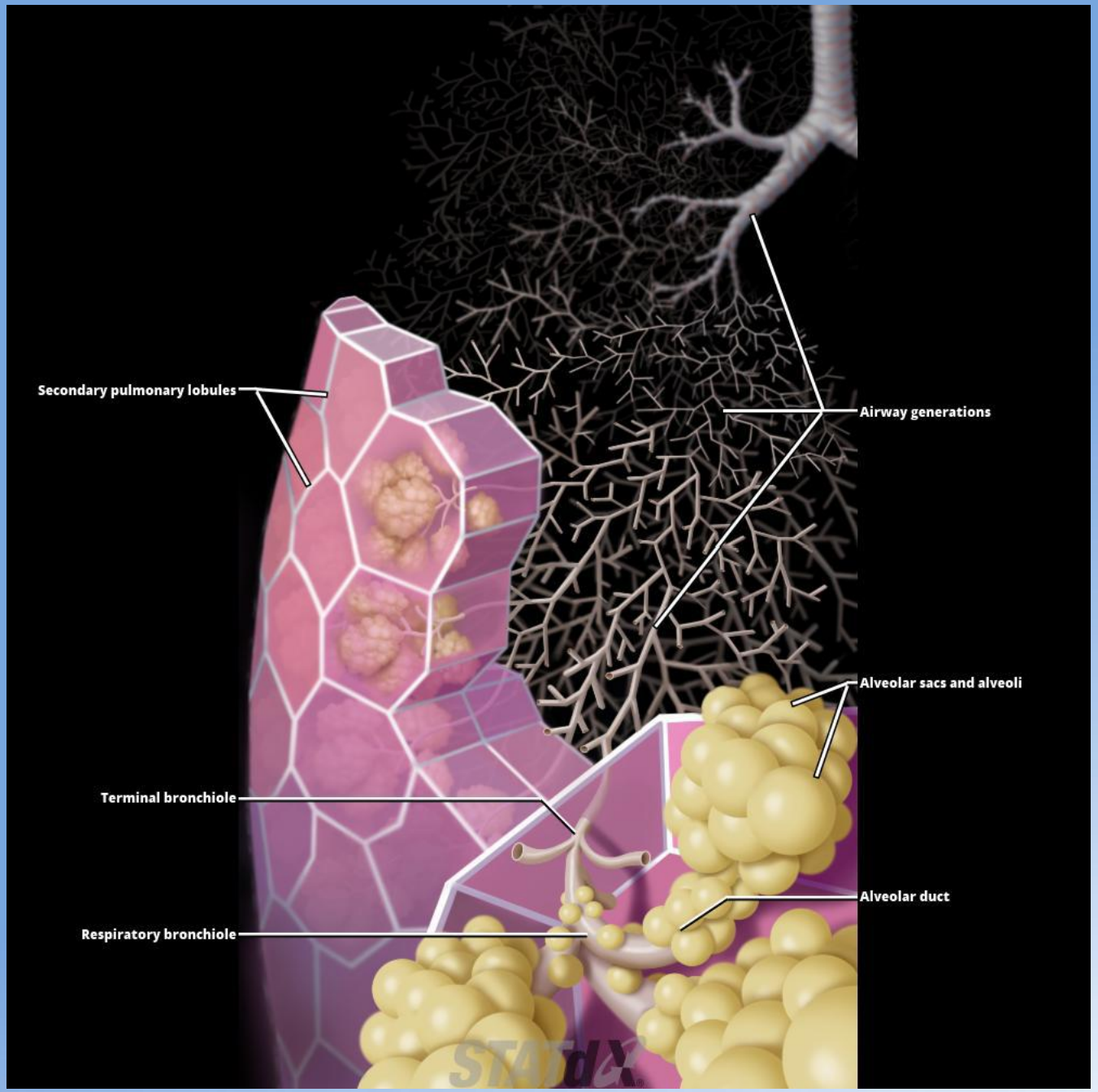

3-5 mm
腺泡动脉
5-10mm
小叶中央动脉
1-2cm
静脉
3 cm
气道(五肺段)

腺泡(6-10mm)

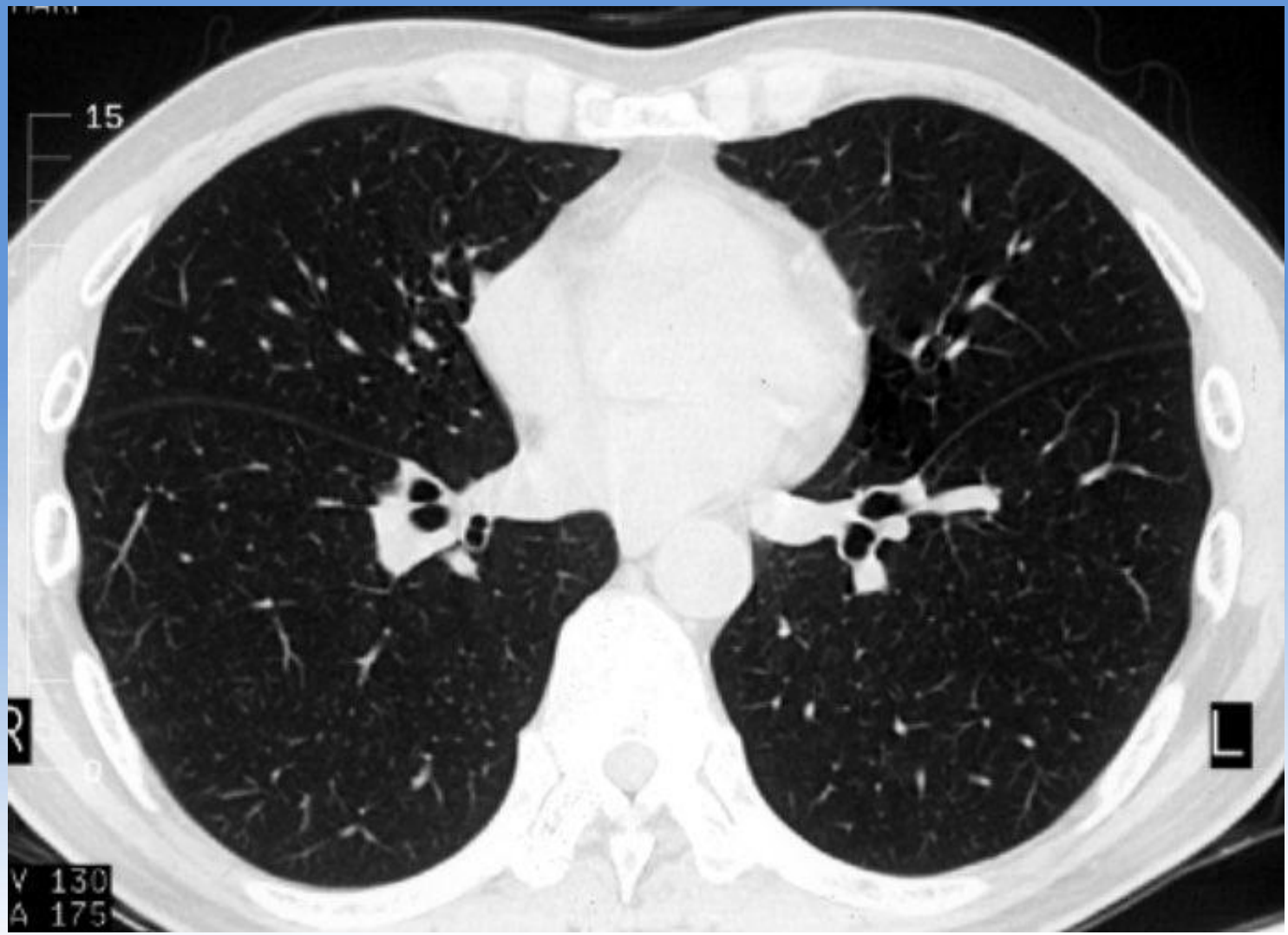


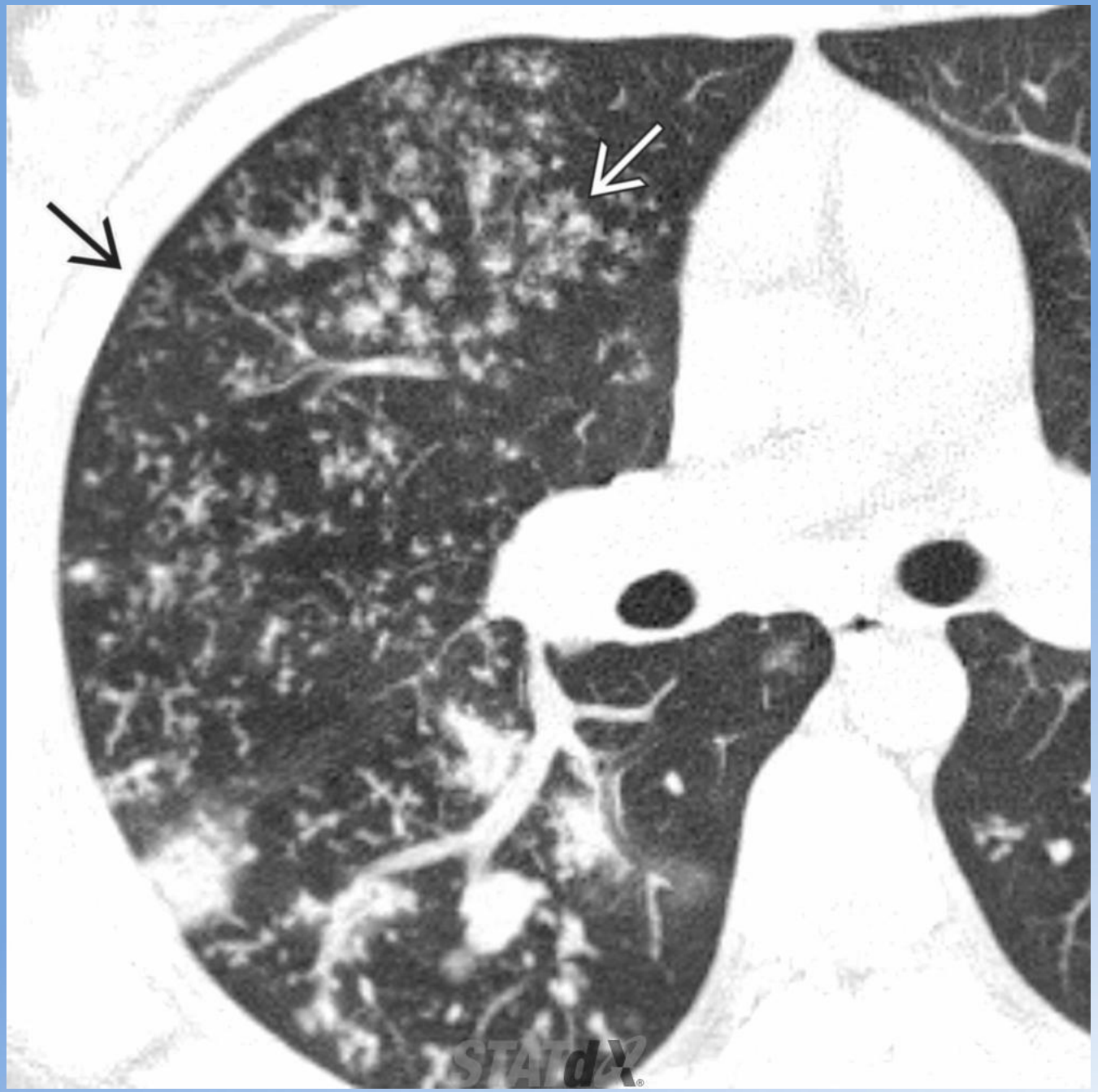
终末毛细支气管远端的解剖单位，由呼吸性毛细支气管、肺泡管、肺泡囊和所属的肺泡组成。



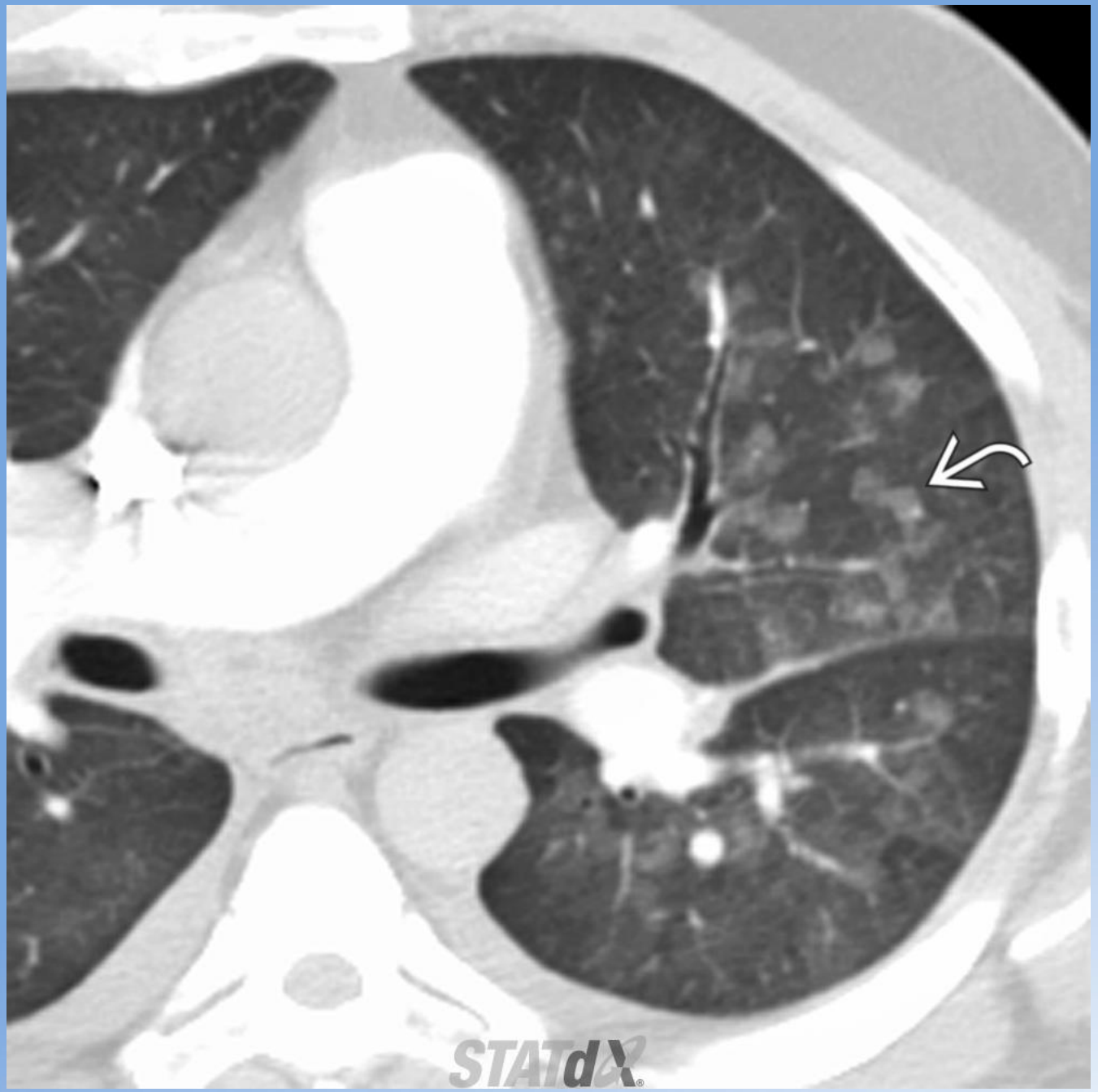

Secondary pulmonary lobules
Airway generations
Alveolar sacs and alveoli
Terminal bronchiole
Alveolar duct
Respiratory bronchiole
STATdx

肺小气道的影像表现

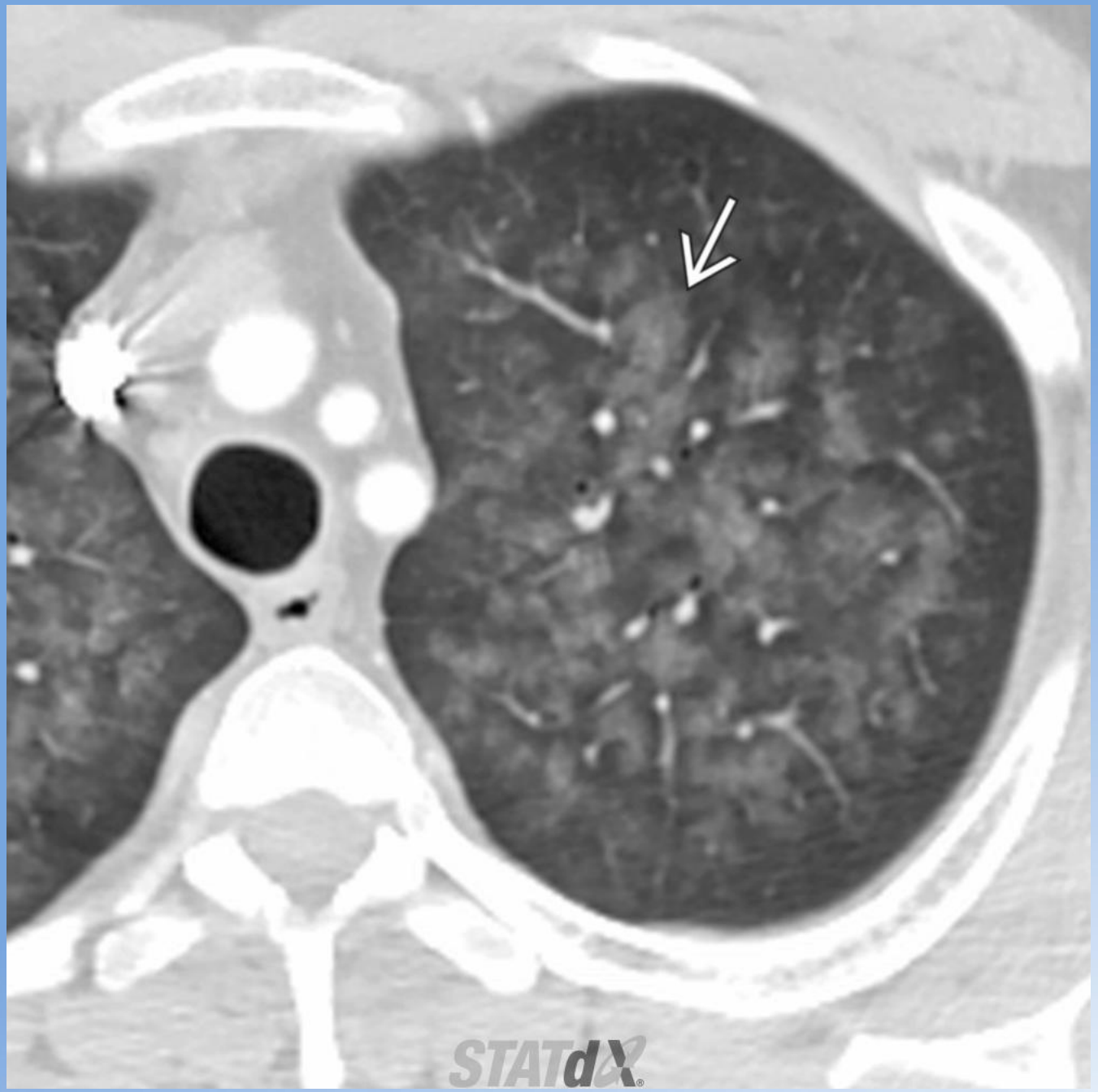




Axial NECT of a patient with active tuberculosis shows multifocal clustered acinar nodules (white solid arrow) and scattered tree-in-bud opacities (black solid arrow) due to endobronchial spread of tuberculosis.



Axial CECT of a patient with postpartum pulmonary edema shows edema fluid manifesting as multiple acinar nodules (white curved arrow) of ground-glass attenuation without associated interlobular septal thickening. Note associated small bilateral pleural effusions.

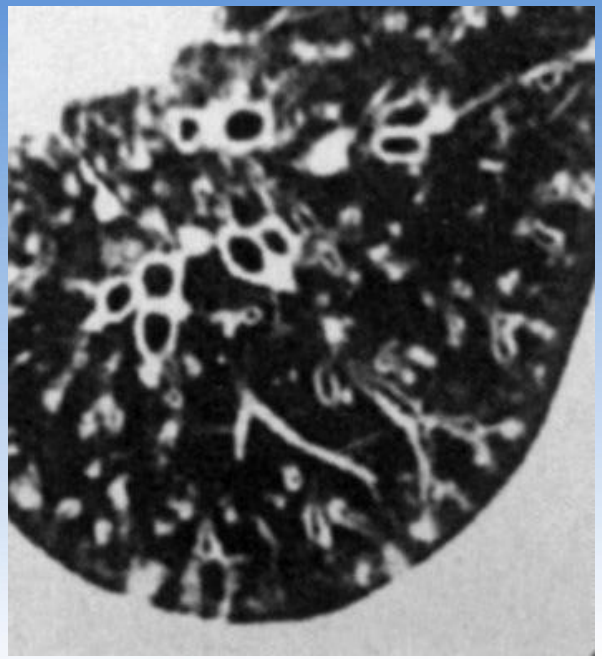

STATdx

小气道病变的CT征象

- 直接征象：支气管－血管束、小结节、实变
- 间接征象：气体潴留
- 合并征象：气腔、间质

小叶中心结节

- 无树芽征
  - 血管炎等
  - 细支气管病变
- 树芽征
  - 细支气管病变



感染、DPB、FB、DIP/RBILD
过敏性肺炎、BOOP/COP
BO、哮喘、结节病、LCH等

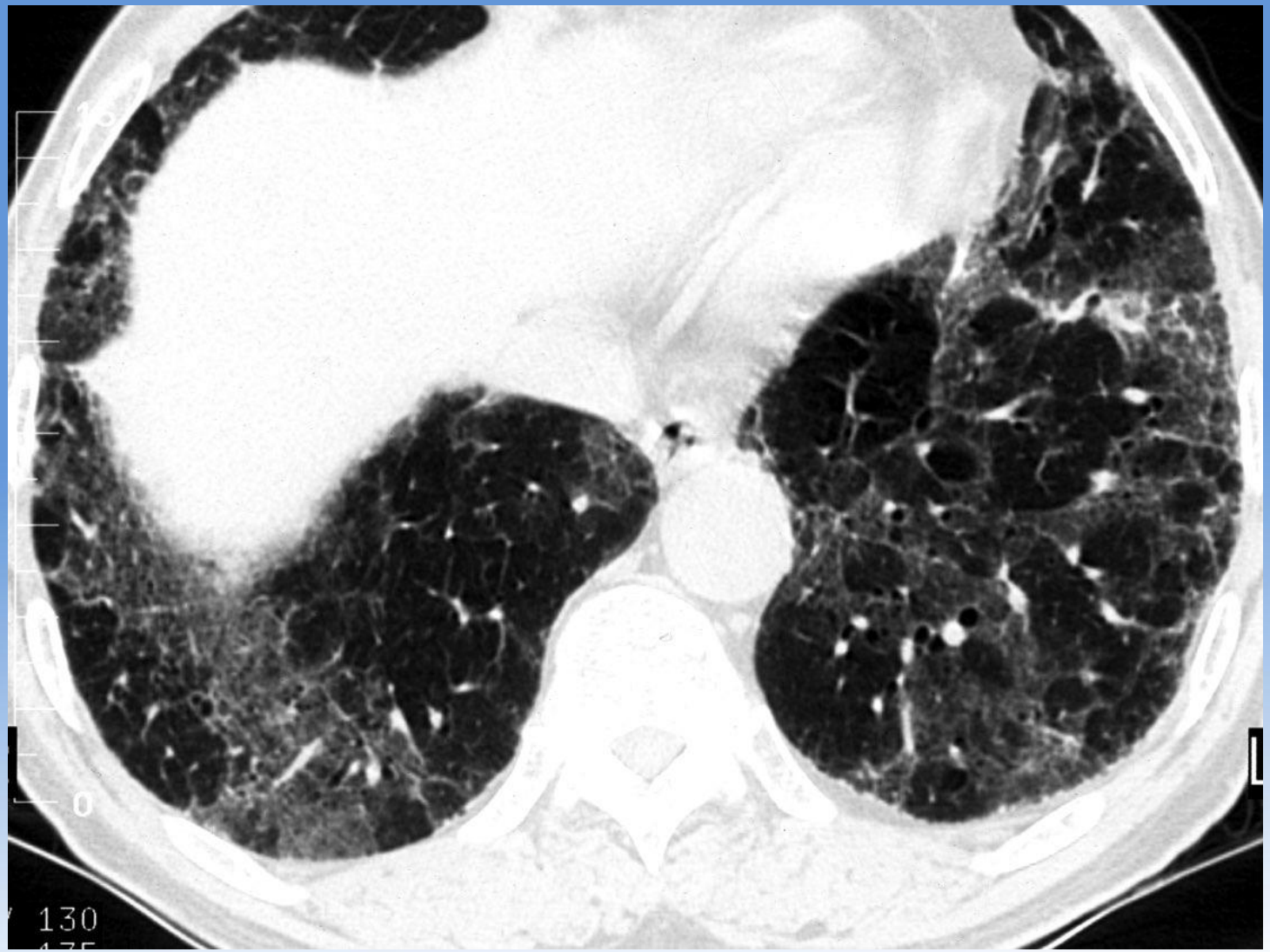
肺密度减低影

马赛克征

- 密度减低区内血管影变细、稀疏
- 密度增高区内血管增粗

空气潴留

- 吸气相：正常
- 呼气相：局限性密度减低，界限清晰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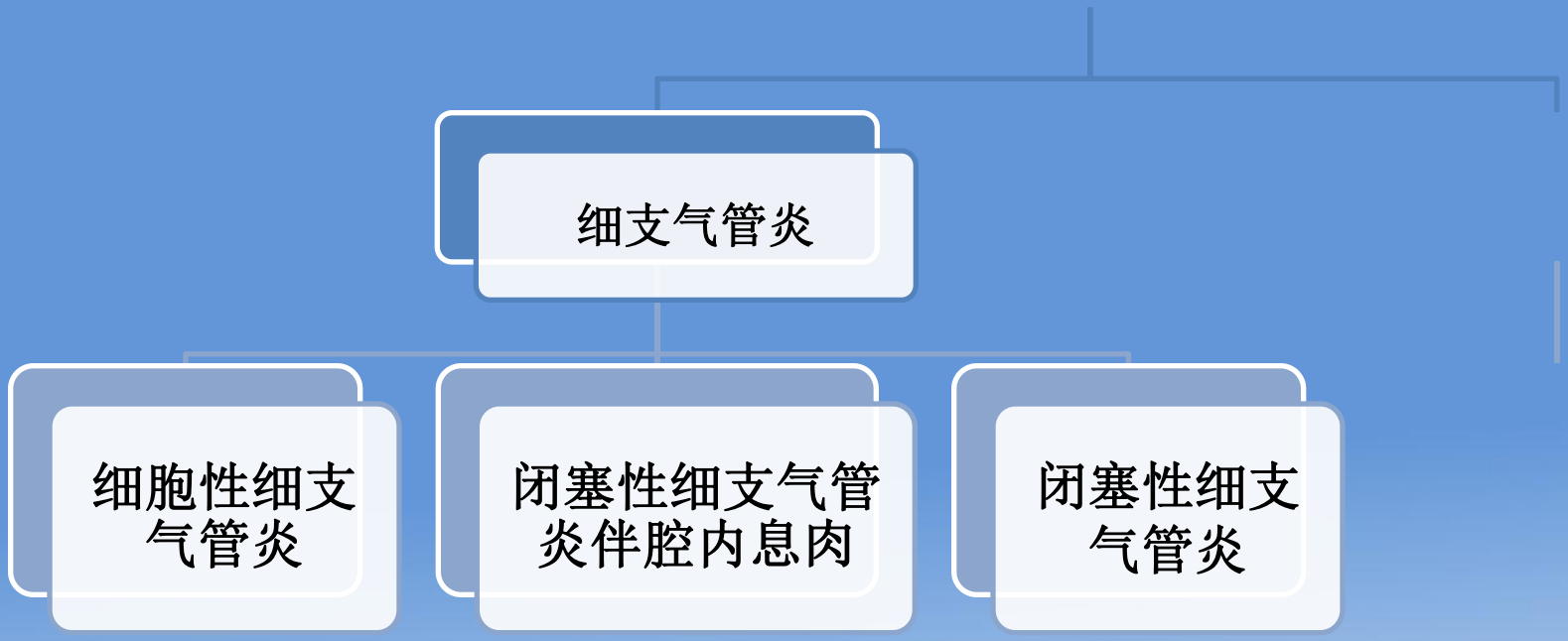
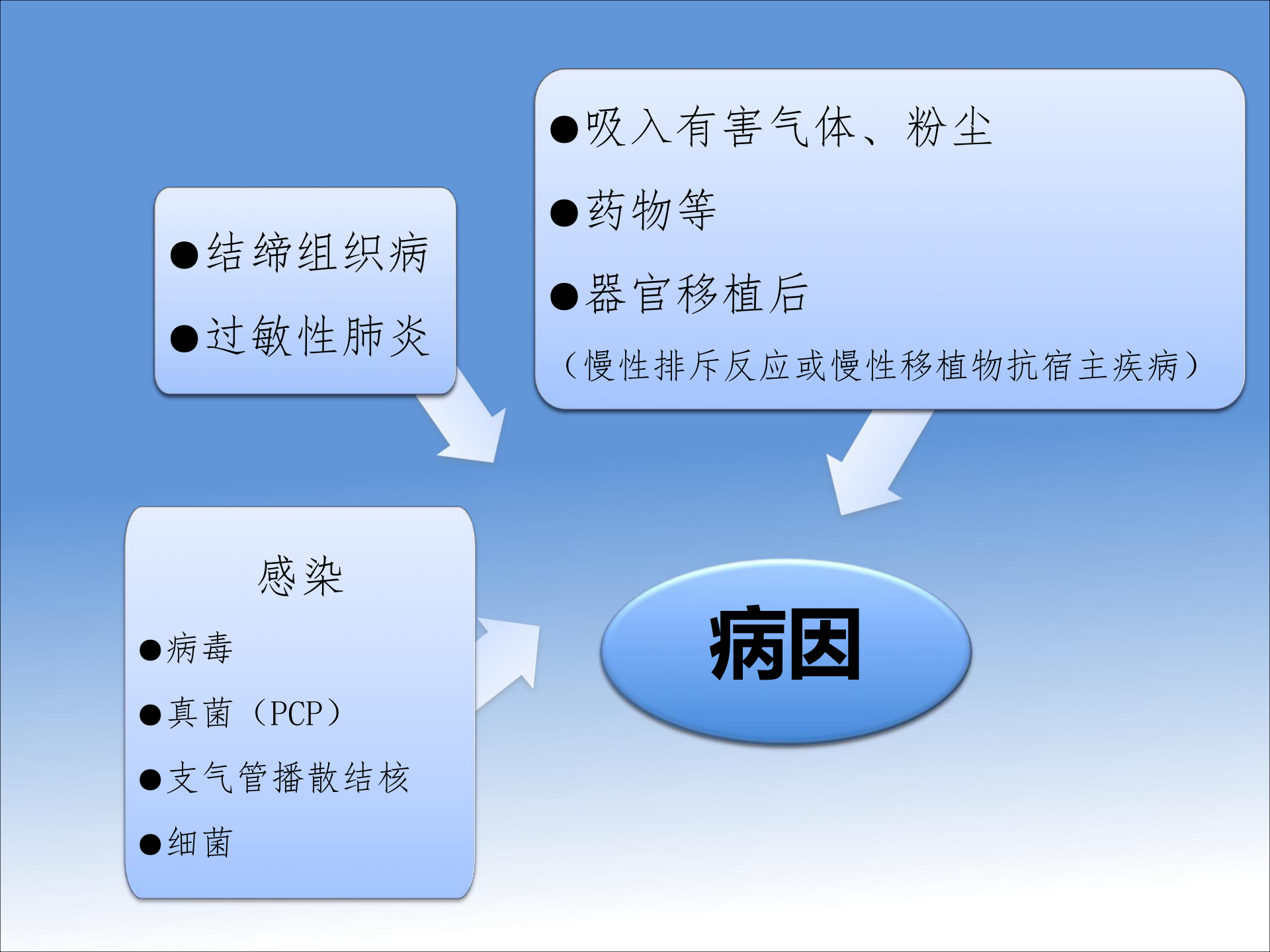
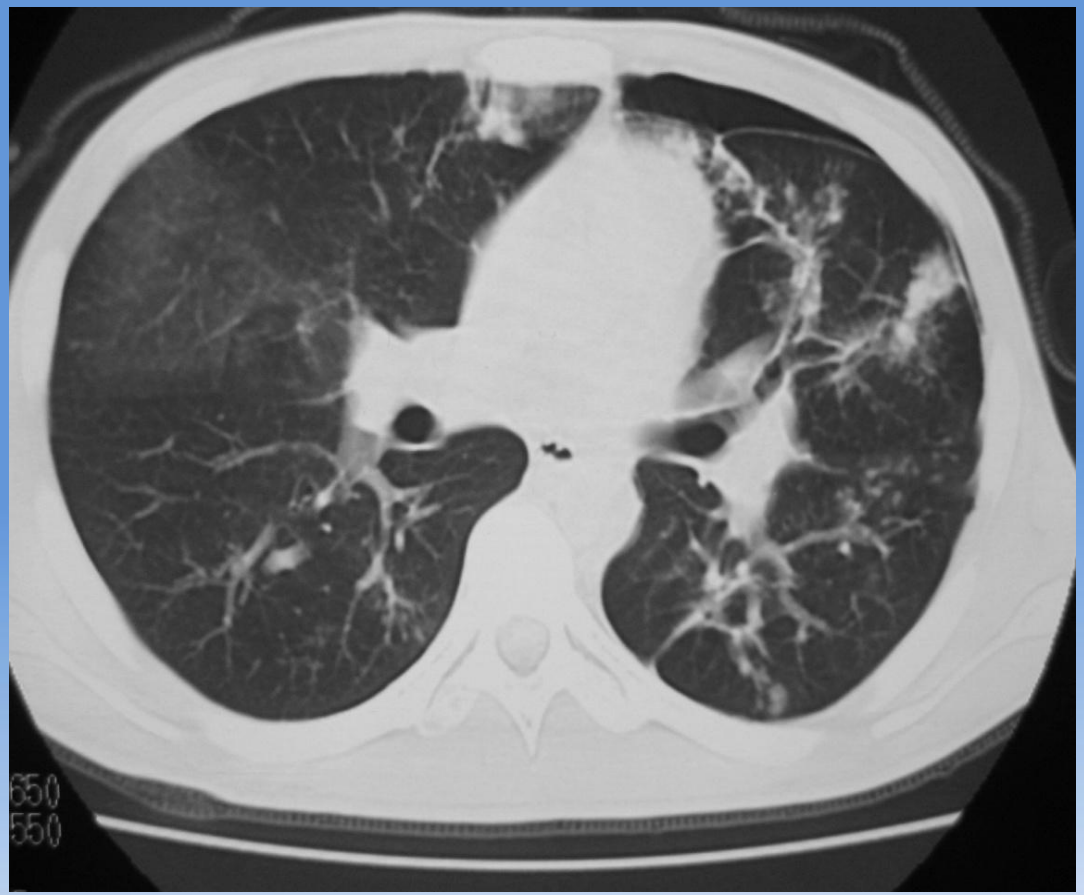


- 急性：上皮坏死/脱屑，伴渗出、炎性细胞浸润及肉芽肿
- 慢性：单核细胞浸润伴纤维化


●结缔组织病
●过敏性肺炎
●吸入有害气体、粉尘
●药物等
●器官移植后
（慢性排斥反应或慢性移植物抗宿主疾病）
感染
●病毒
●真菌（PCP）
●支气管播散结核
●细菌
病因

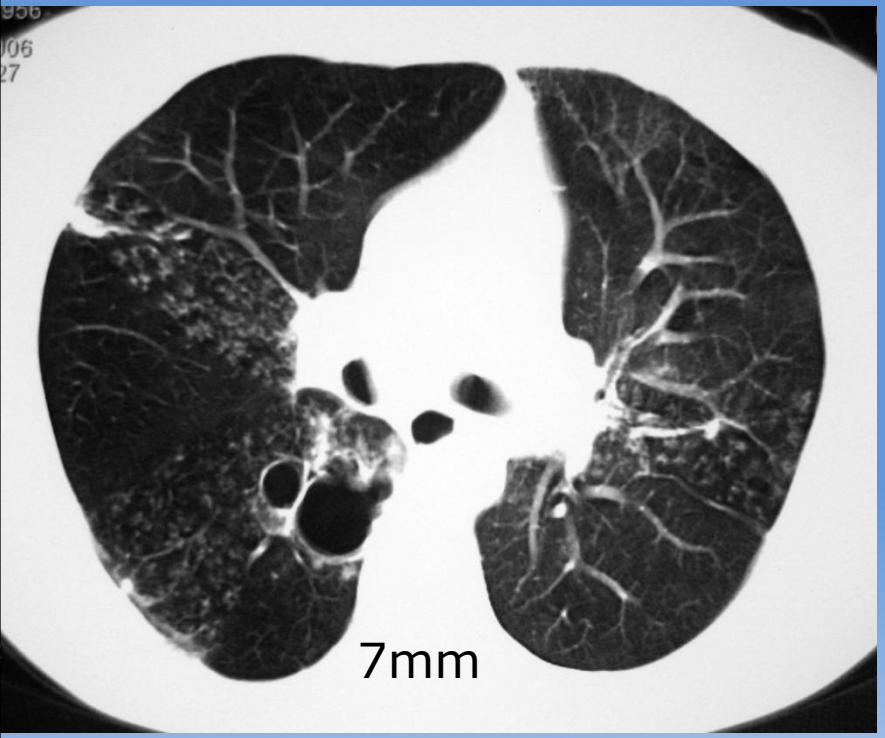
- 细支-感染性
- 吸入
- CB（原发和继发）
- HP
- DPB
- FB
- RB（DIP）
- 气道中心纤维化
- 原发性弥漫神经内分泌细胞增生

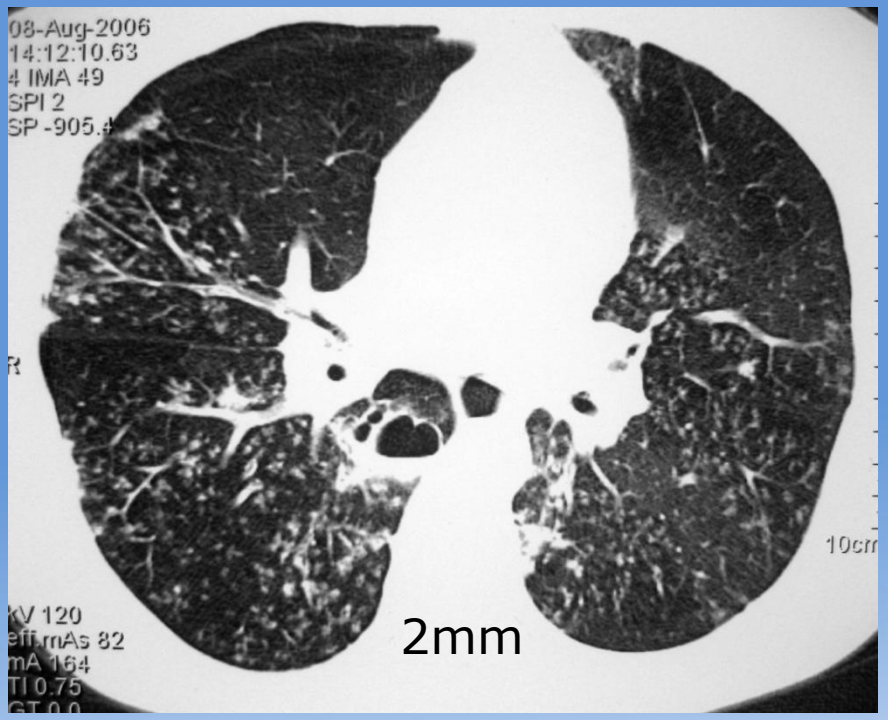
M,22岁,白血病化疗 发热、咳嗽、咳痰20天



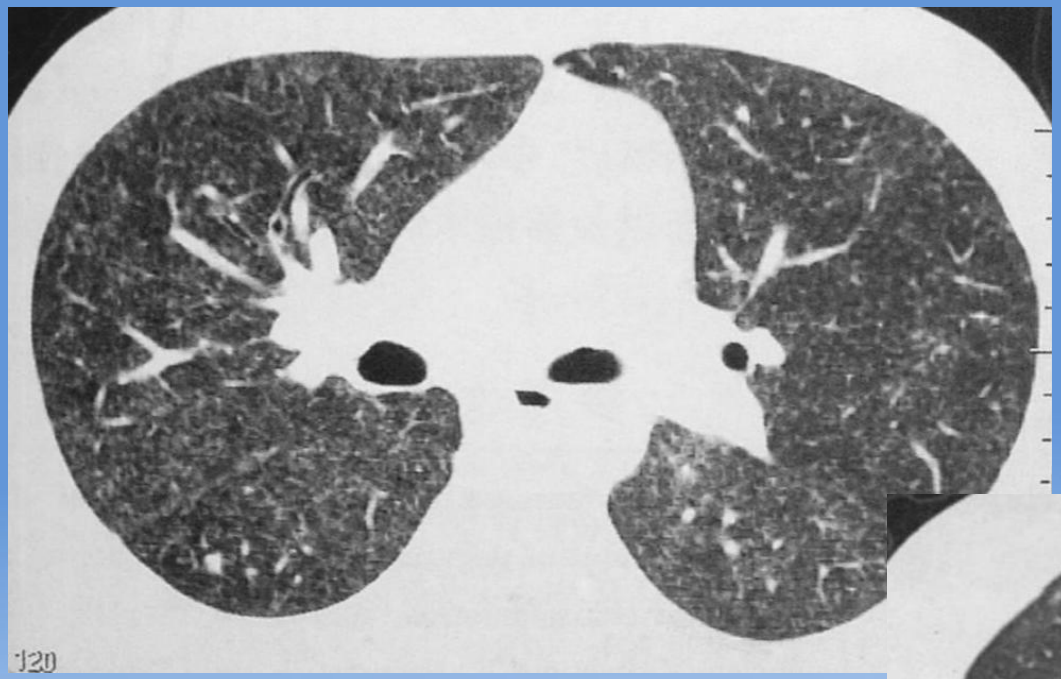
气道侵袭性曲霉菌病

F ，50岁，咳嗽半年

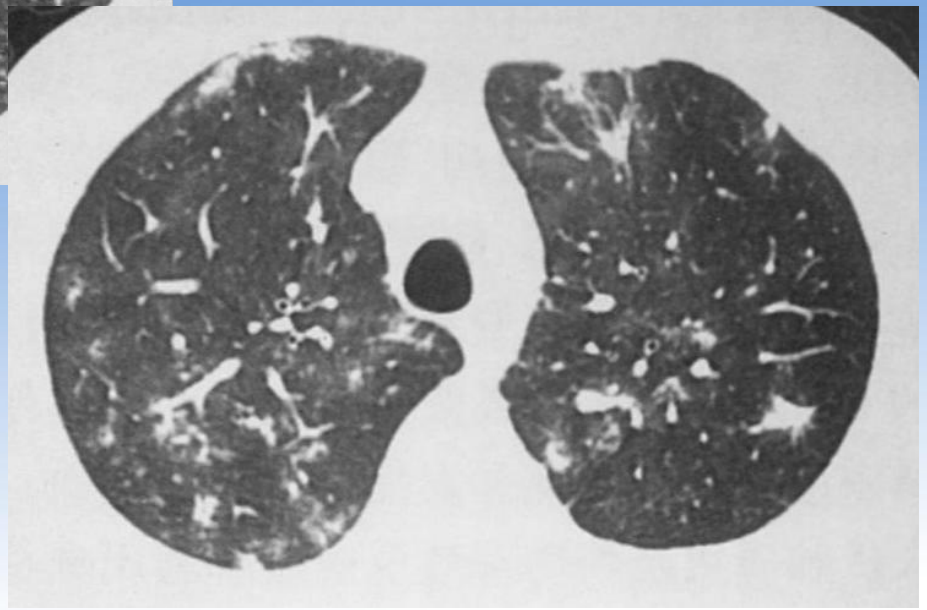




巨细胞病毒肺炎-小叶中心性结节



大小不等的结节,实变，形态不一，



弥漫分布的结节状或粟粒状影

急性感染性

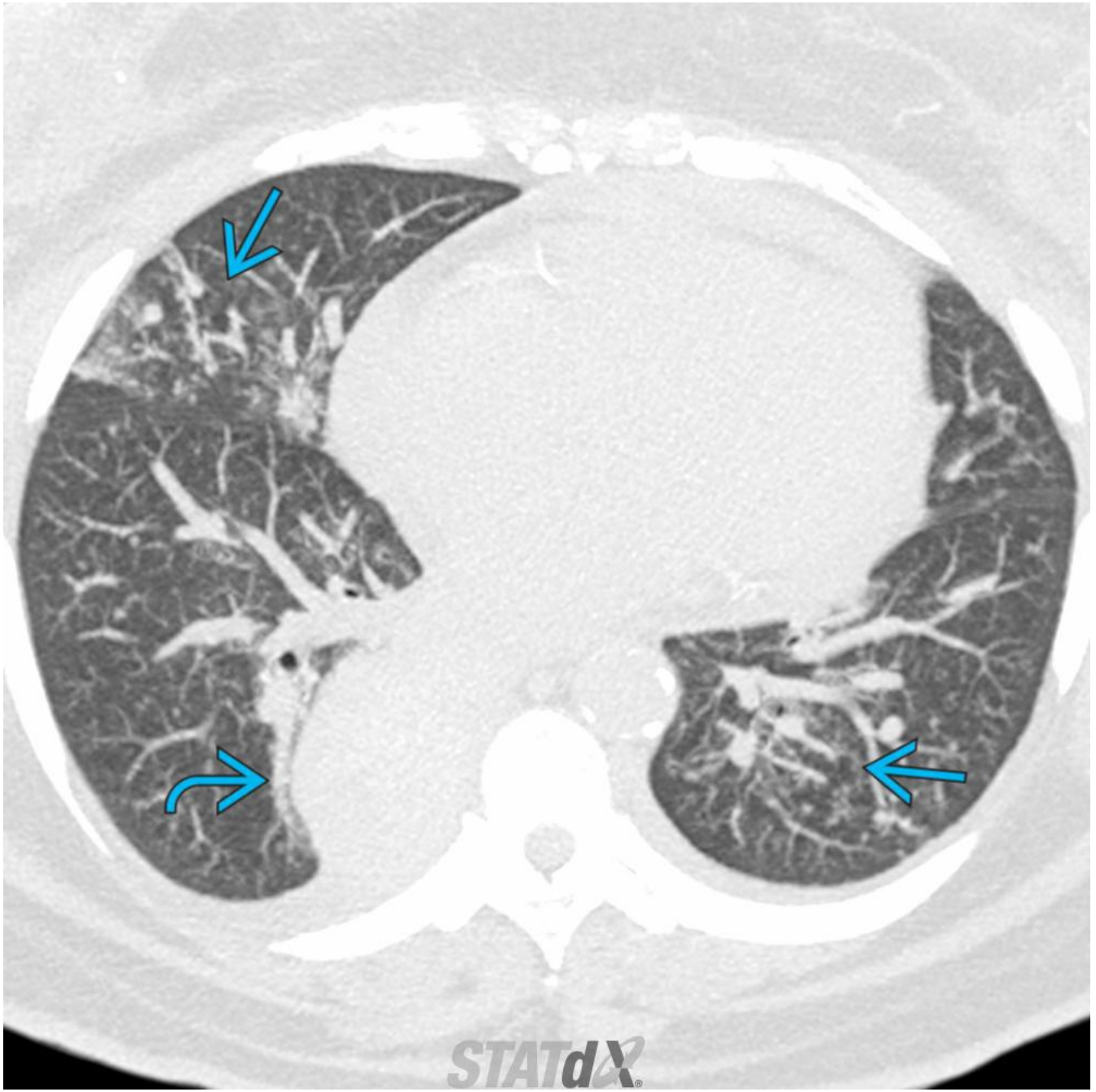
- 细菌、病毒
- 支原体/衣原体
- 支气管播散结核
- 气道侵袭性曲霉菌病

婴儿/儿童
慢性气道疾病/免疫损伤成人

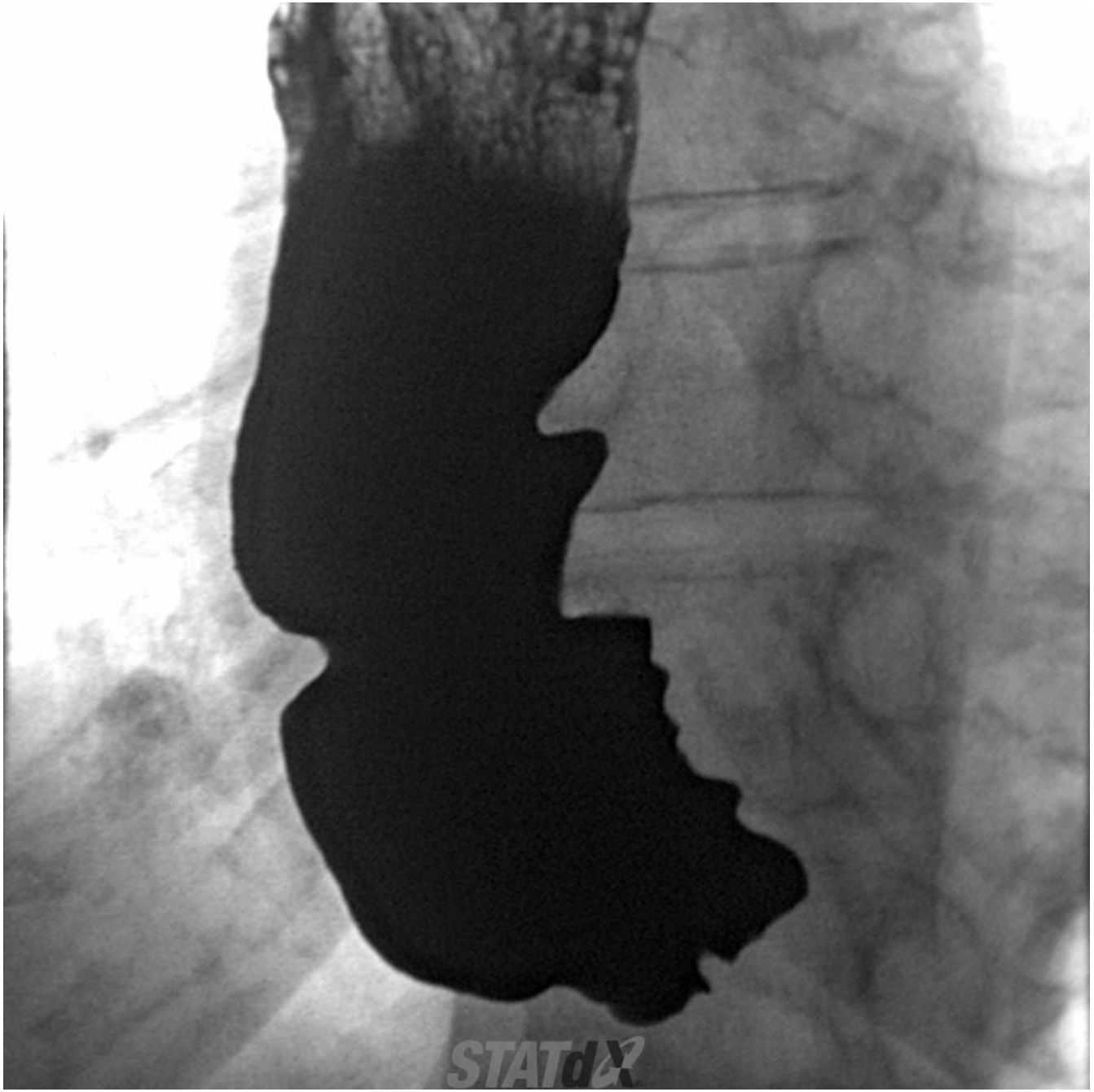
- 树芽征
  - 弥漫均匀分布
  - 斑片状分布
- 局灶性GGO/实变
  - 小叶性分布
  - 斑片状分布

- 细支-感染性
- 吸入
- CB（原发和继发）
- HP
- DPB
- FB
- RB（DIP）
- 气道中心纤维化
- 原发性弥漫神经内分泌细胞增生

吸入

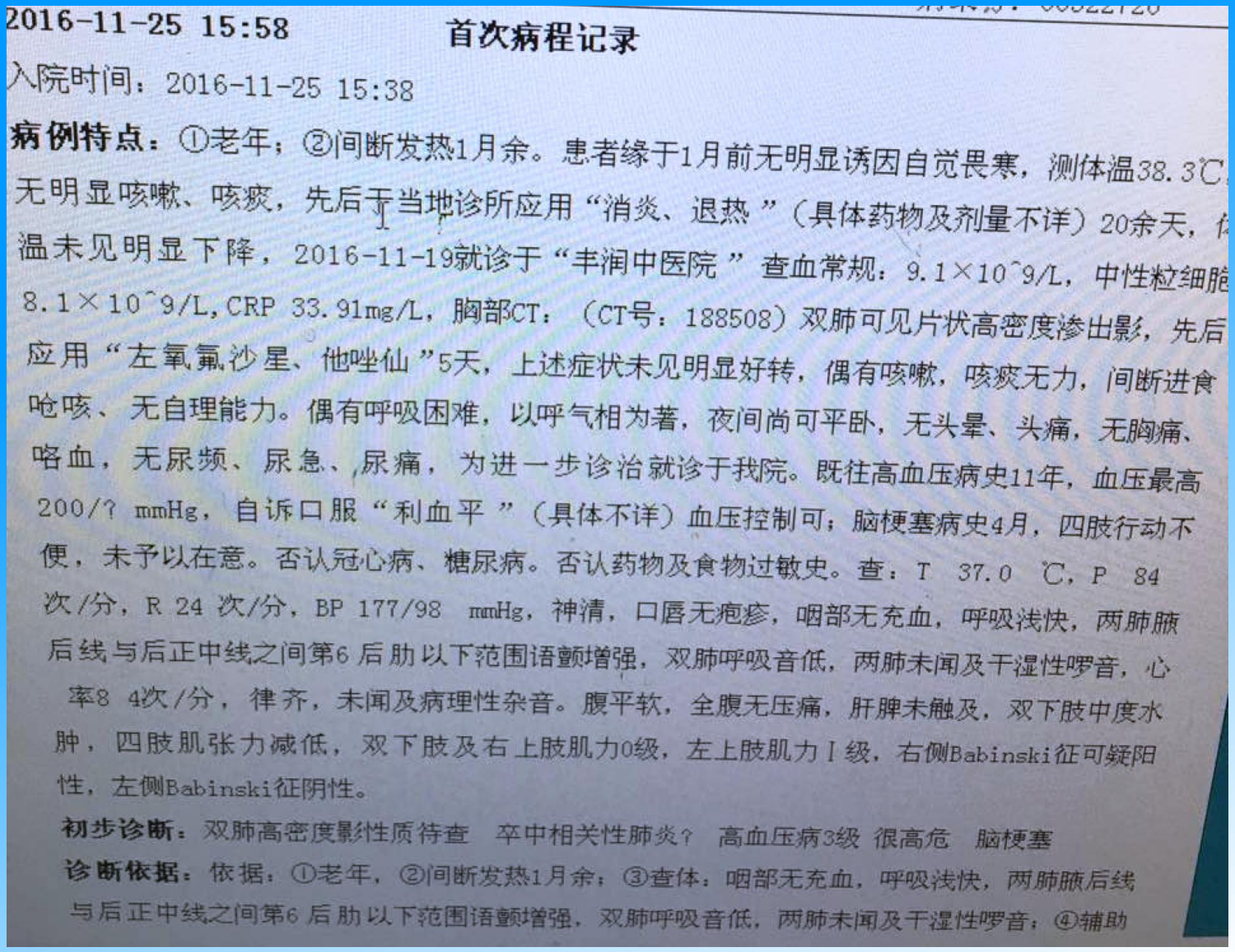


Axial NECT MIP reformation of the same patient shows bilateral tree-in-bud nodules (cyan solid arrow) in the dependent and nondependent lung and marked esophageal dilatation (cyan curved arrow). MIP reformation images increase the conspicuity of small nodules. Esophageal dilatation should suggest the diagnosis of



Barium esophagram of a patient with diffuse aspiration bronchiolitis secondary to achalasia shows marked dilatation of the esophagus and failure of antegrade flow of contrast.

病例 男性 74岁



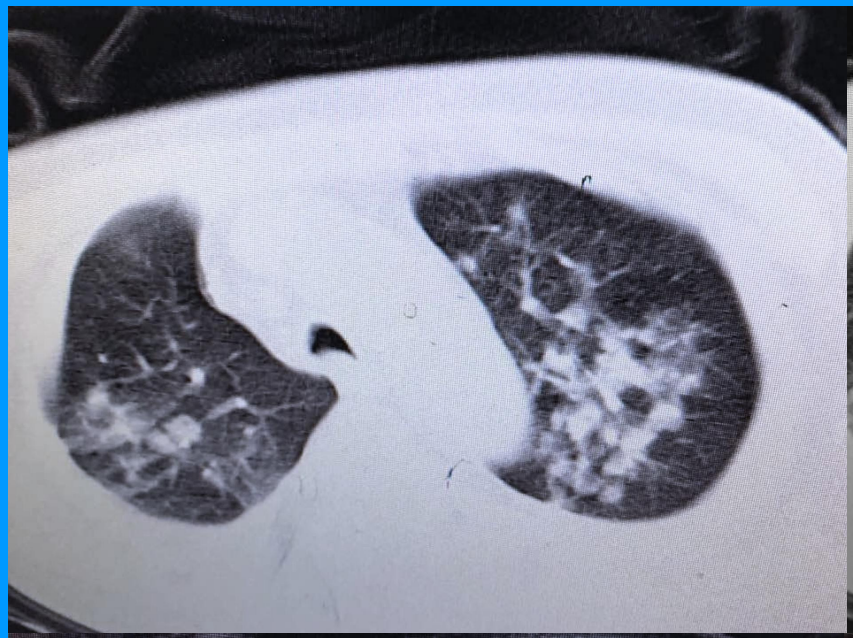
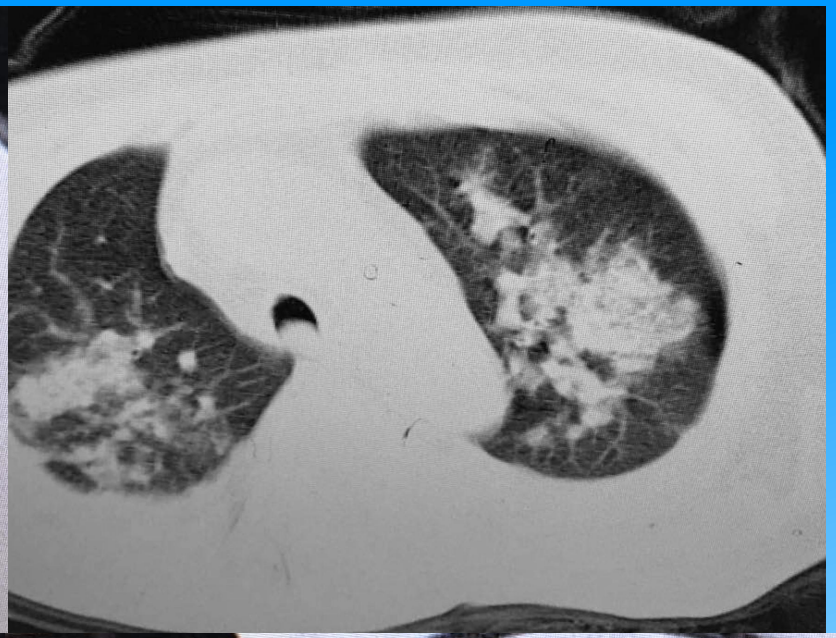
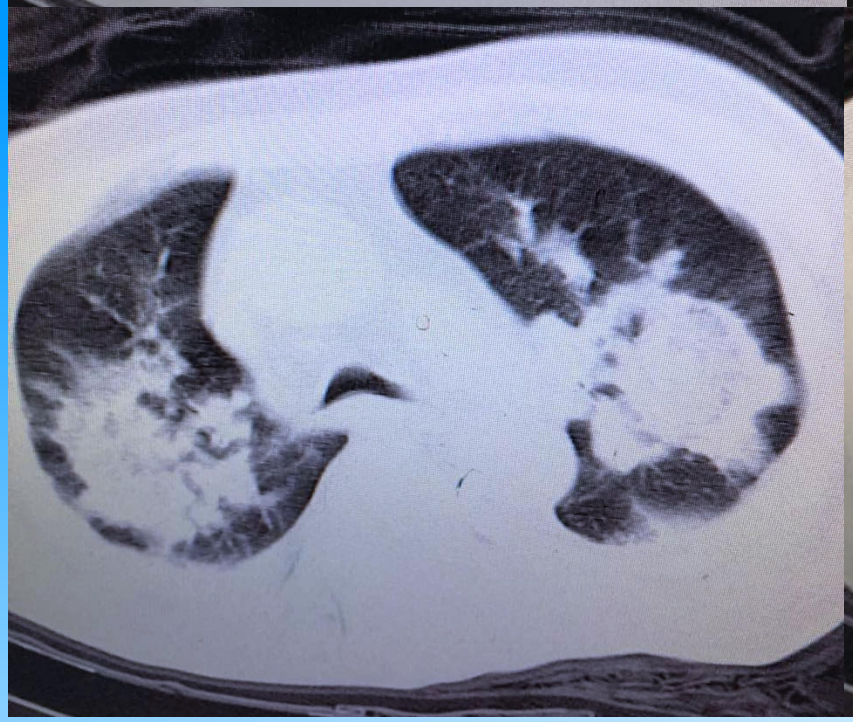
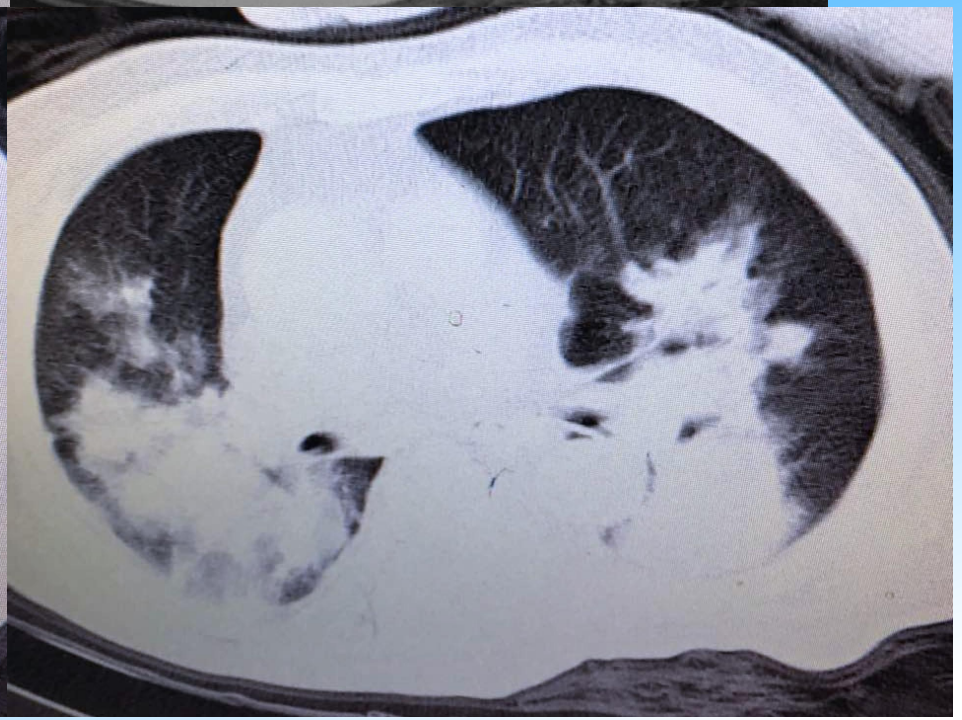
2016-11-25 15:58 首次病程记录

入院时间：2016-11-25 15:38

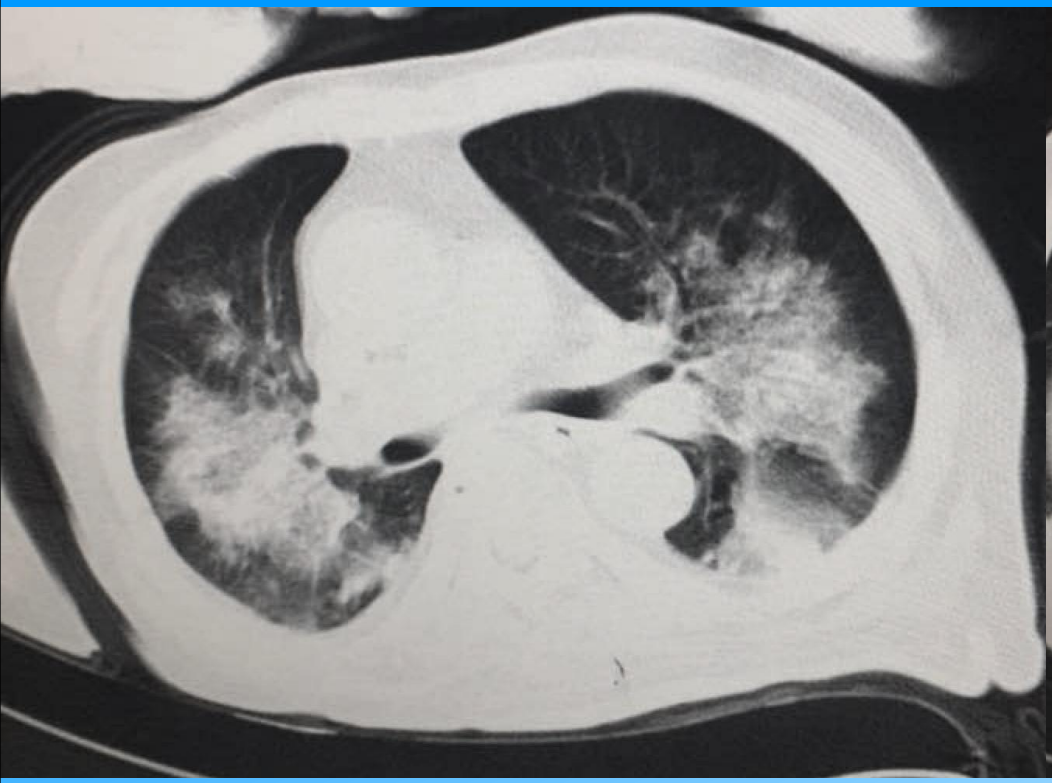
病例特点：①老年；②间断发热1月余。患者缘于1月前无明显诱因自觉畏寒，测体温38.3℃，无明显咳嗽、咳痰，先后于当地诊所应用“消炎、退热”（具体药物及剂量不详）20余天，体温未见明显下降，2016-11-19就诊于“丰润中医院”查血常规：9.1×10^9/L，中性粒细胞8.1×10^9/L，CRP 33.91mg/L，胸部CT：（CT号：188508）双肺可见片状高密度渗出影，先后应用“左氧氟沙星、他唑仙”5天，上述症状未见明显好转，偶有咳嗽，咳痰无力，间断进食呛咳、无自理能力。偶有呼吸困难，以呼气相为著，夜间尚可平卧，无头晕、头痛，无胸痛、咯血，无尿频、尿急、尿痛，为进一步诊治就诊于我院。既往高血压病史11年，血压最高200/? mmHg，自诉口服“利血平”（具体不详）血压控制可；脑梗塞病史4月，四肢行动不便，未予以在意。否认冠心病、糖尿病。否认药物及食物过敏史。查：T 37.0 ℃，P 84次/分，R 24 次/分，BP 177/98 mmHg，神清，口唇无疱疹，咽部无充血，呼吸浅快，两肺腋后线与后正中线之间第6 后肋以下范围语颤增强，双肺呼吸音低，两肺未闻及干湿性啰音，心率8 4次/分，律齐，未闻及病理性杂音。腹平软，全腹无压痛，肝脾未触及，双下肢中度水肿，四肢肌张力减低，双下肢及右上肢肌力0级，左上肢肌力Ⅰ级，右侧Babinski征可疑阳性，左侧Babinski征阴性。

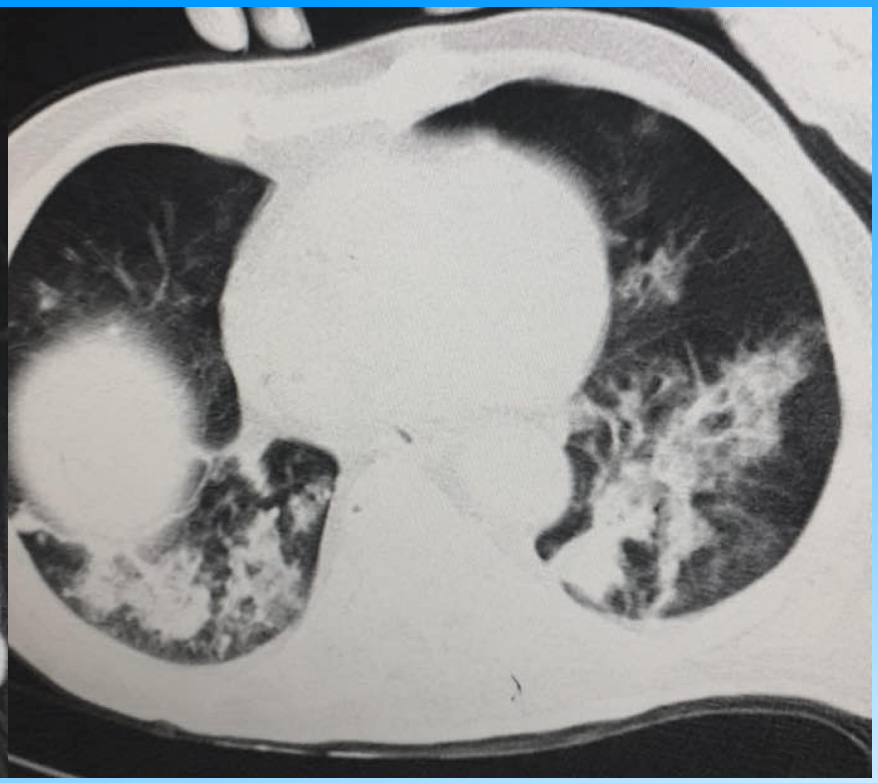
初步诊断：双肺高密度影性质待查 卒中相关性肺炎？ 高血压病3级 很高危 脑梗塞

诊断依据：依据：①老年，②间断发热1月余；③查体：咽部无充血，呼吸浅快，两肺腋后线与后正中线之间第6 后肋以下范围语颤增强，双肺呼吸音低，两肺未闻及干湿性啰音；④辅助

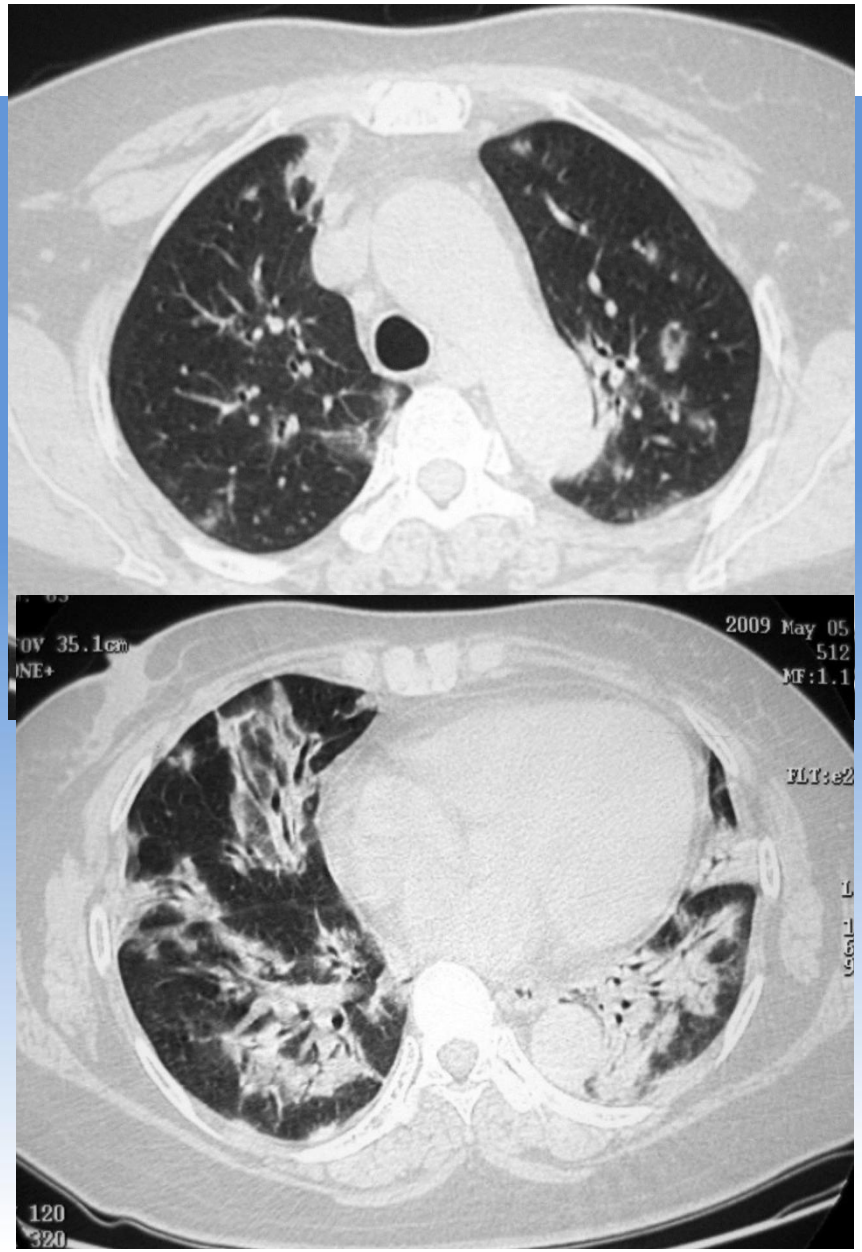
抗感染＋激素治疗2周





- 细支-感染性
- 吸入
- CB（原发和继发）
- HP
- DPB
- FB
- RB（DIP）
- 气道中心纤维化
- 原发性弥漫神经内分泌细胞增生

女，59岁，干燥综合征12年间断咳嗽7年，加重5月，无发热/咯血



- 小气道壁及周围慢性炎性细胞浸润，细支气管呈慢性炎
- 小气道瘢痕
- 偶有BO

结缔组织病、移植后、哮喘等

肺密度减低/空气潴留

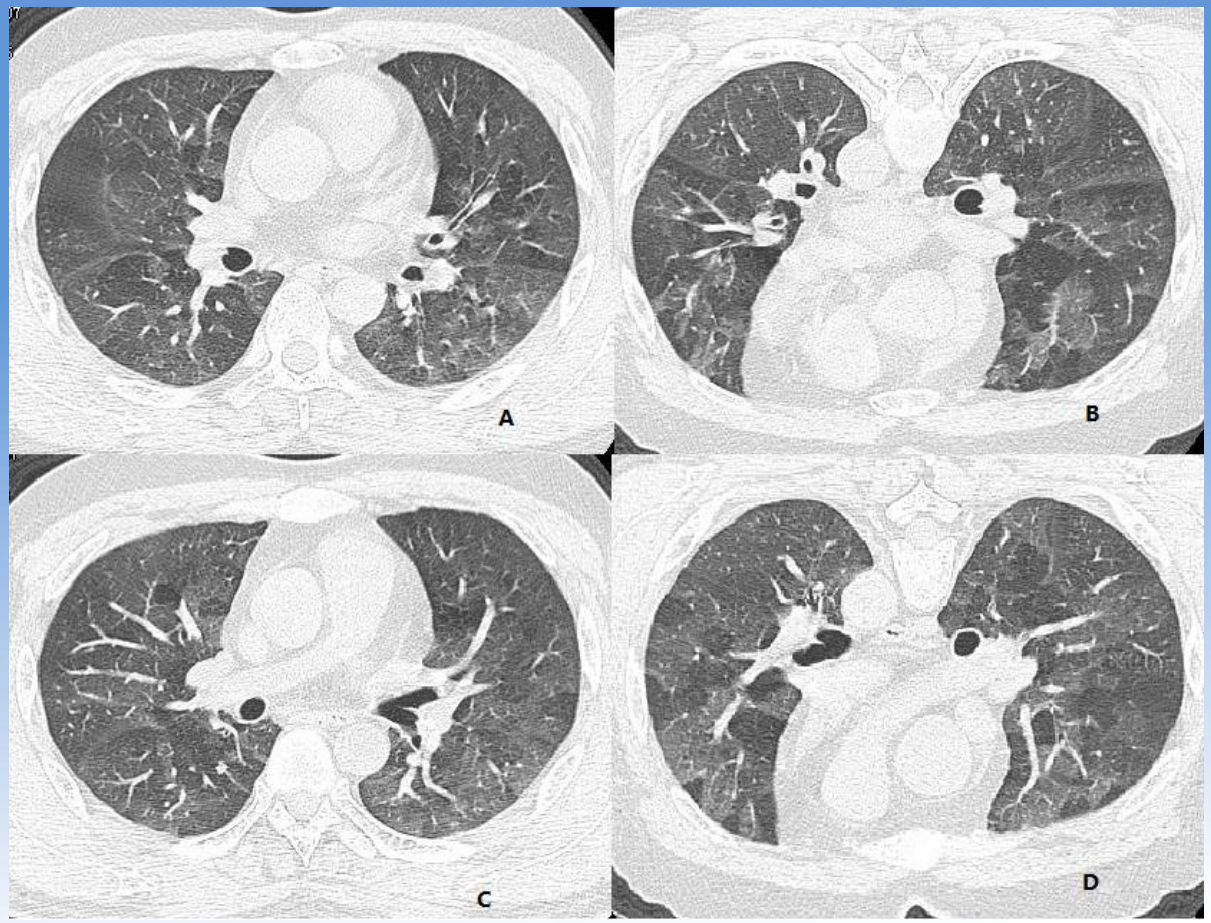
小叶中心结节

实变/GGO

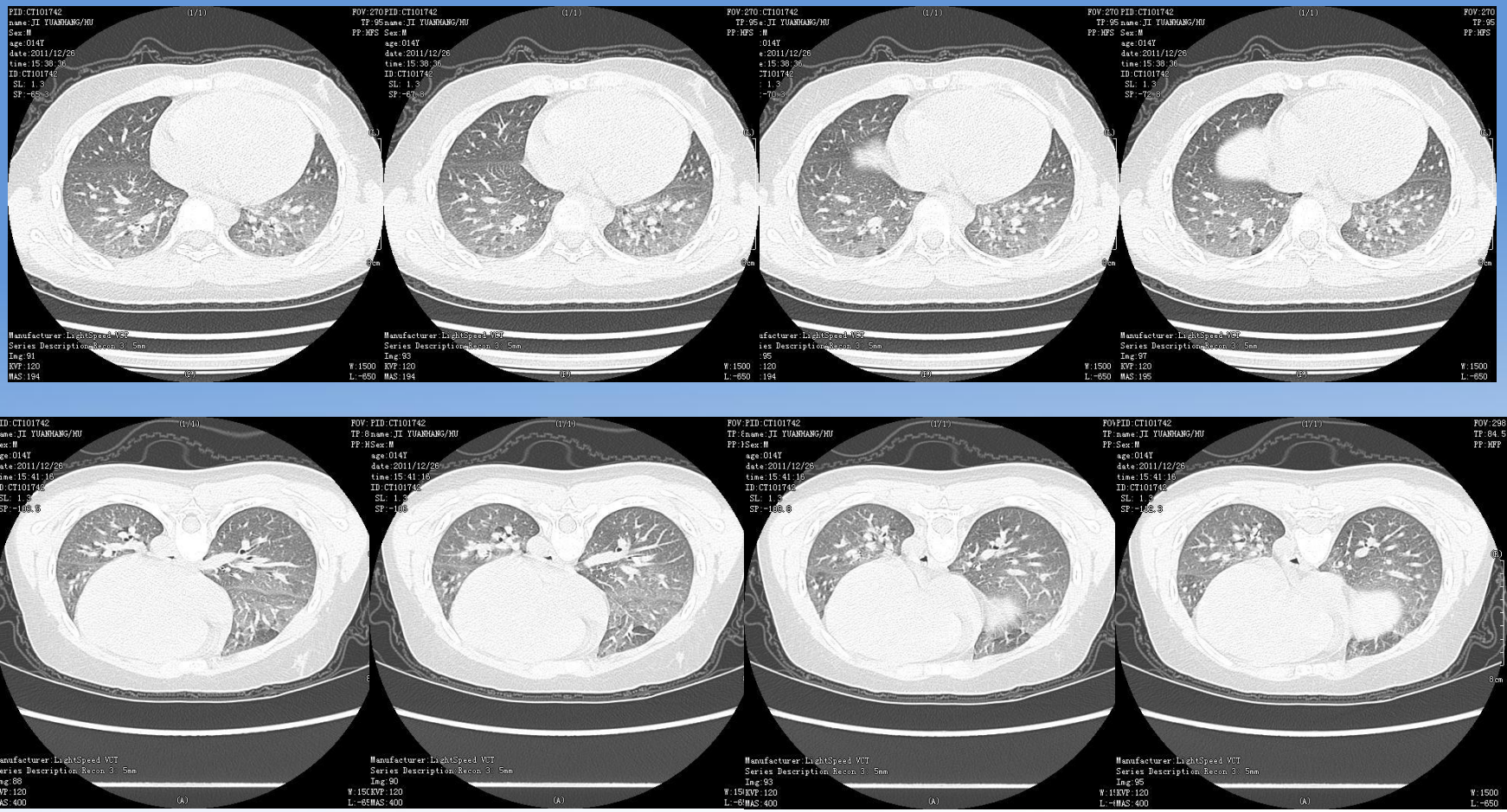
沿小气道斑片状分布

BO

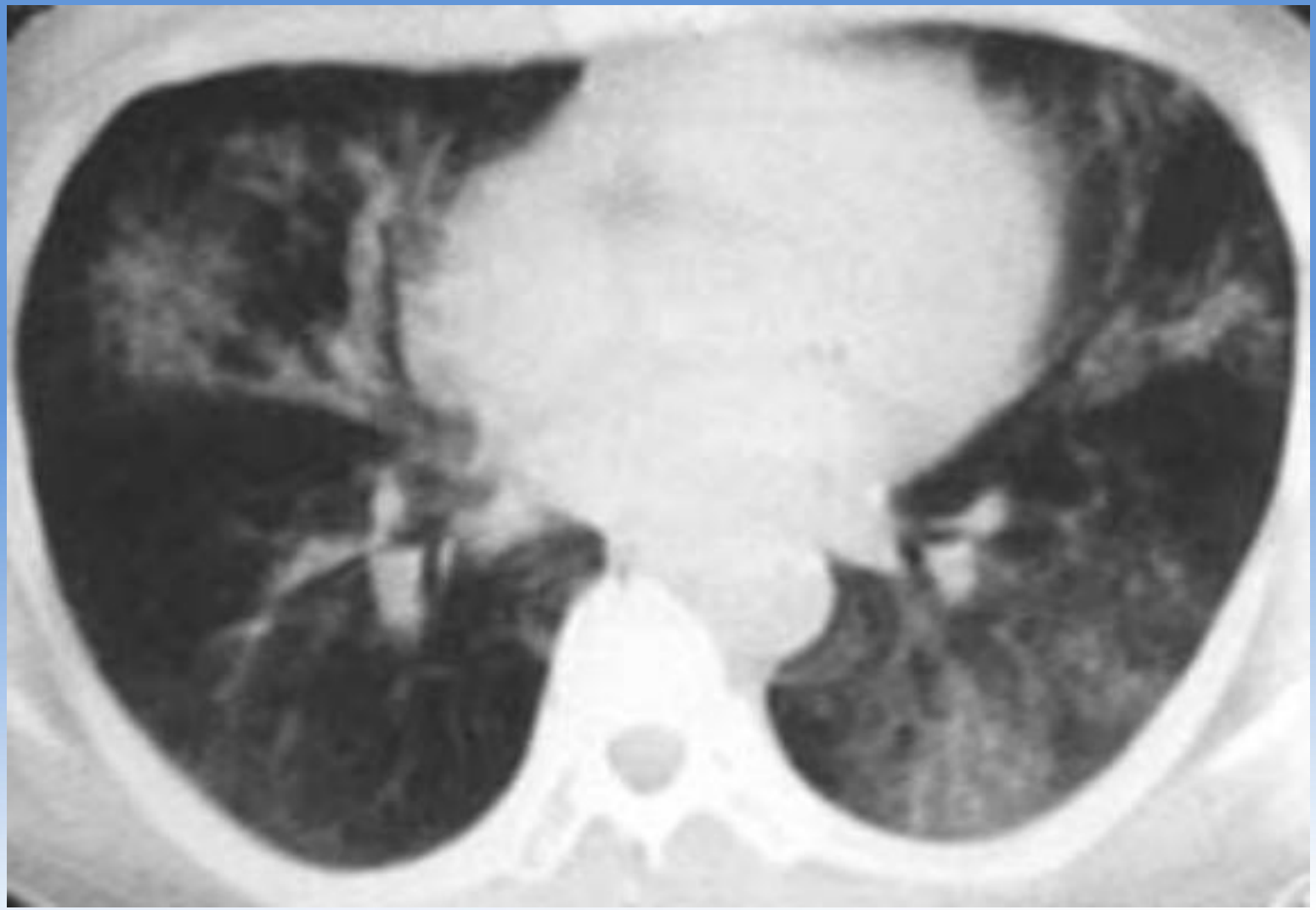
- 俯卧位能够检出更多阻塞性细支气管炎气体潴留，或病变显示更加清晰。



- 两种体位扫描病变无明显变化，可认为小气道阻塞更为严重，

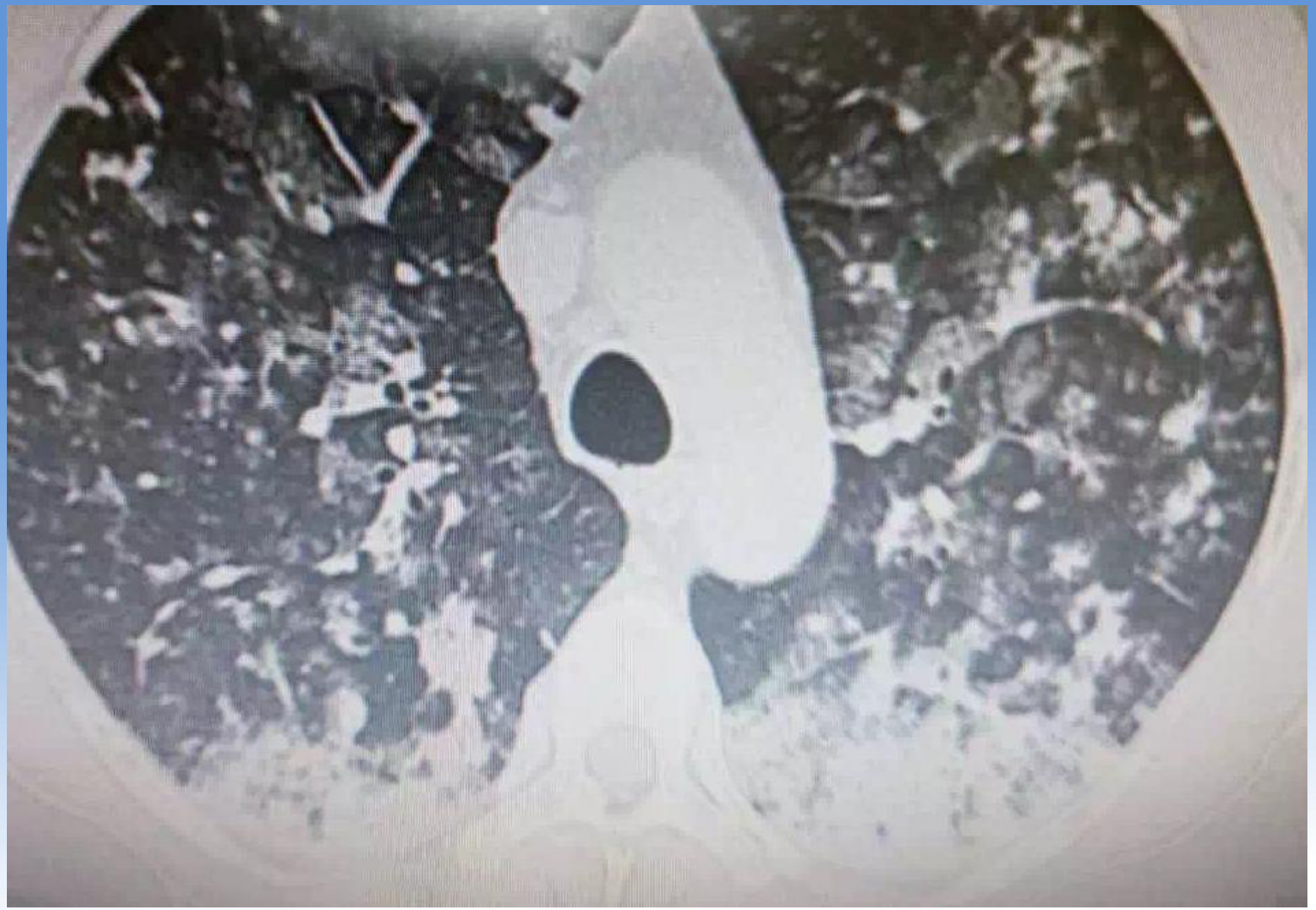


阻塞性细支气管肺炎并机化性肺炎



男，10岁；肺炎后咳喘2月。

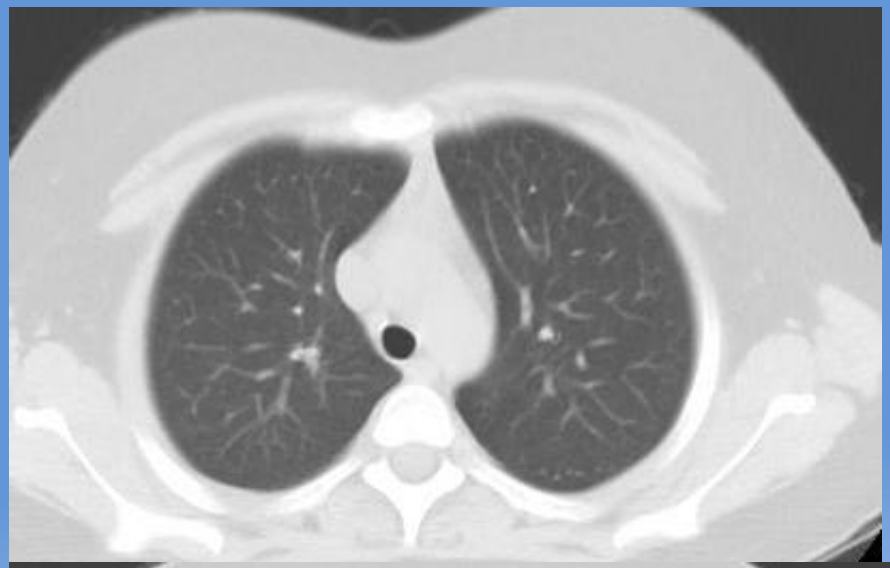
患者，男，40岁，二氧化氮和硝酸混合气体暴露

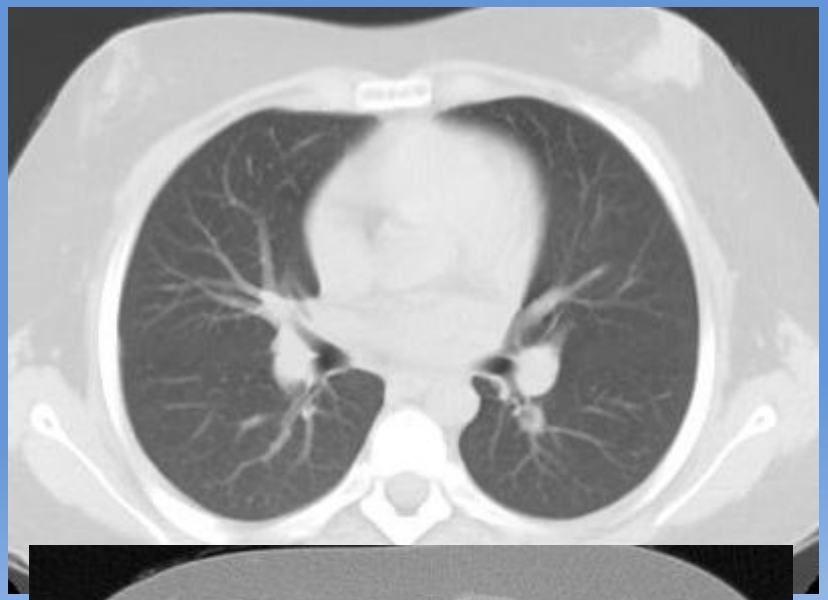


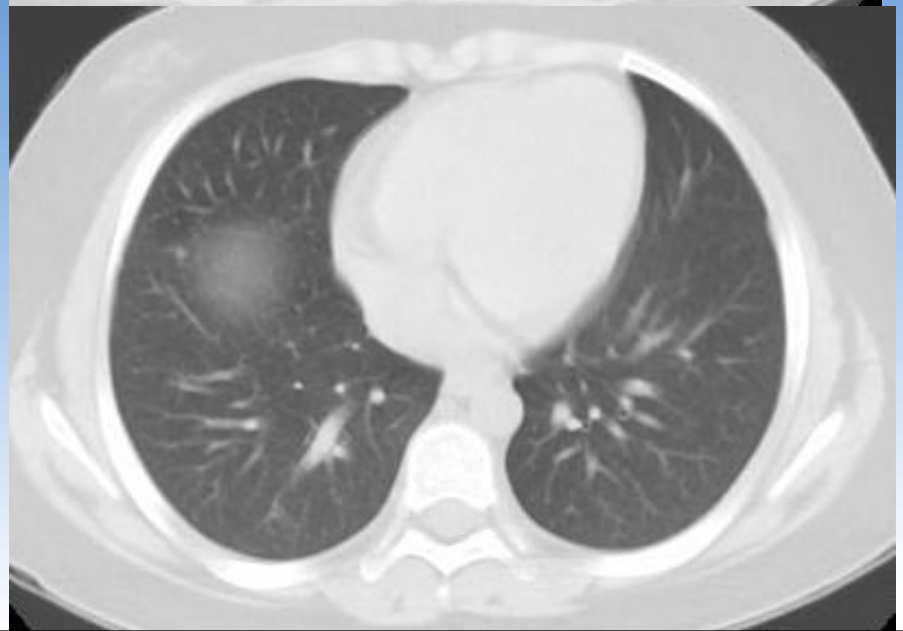
病例

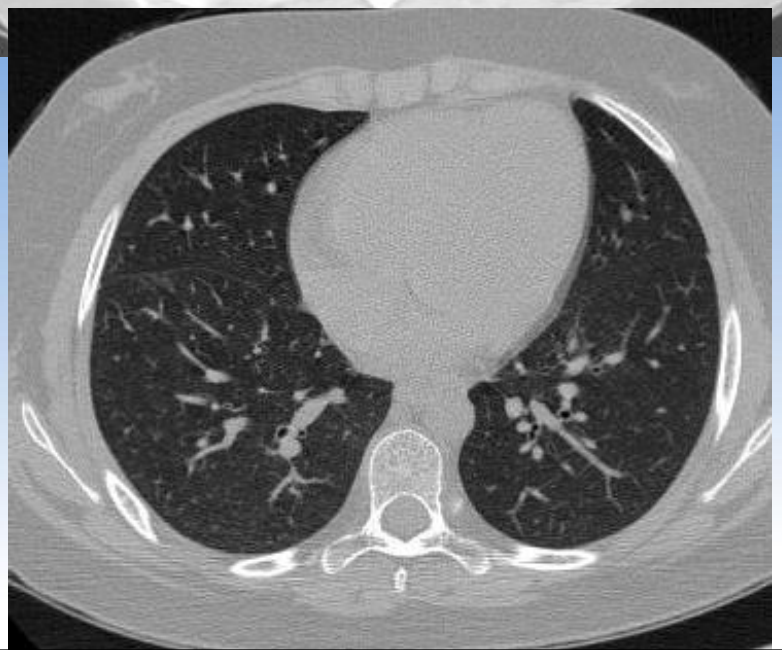
- 女性，13岁，非急淋M2。
- 父供体，半合，移植束后8个月。
- 抗排异治疗中，停用激素2个月。
- 近期发热，轻咳，轻度憋气，皮疹。
- 胸部CT，平扫、HRCT.

肺部CT（激素冲击治疗一周后）





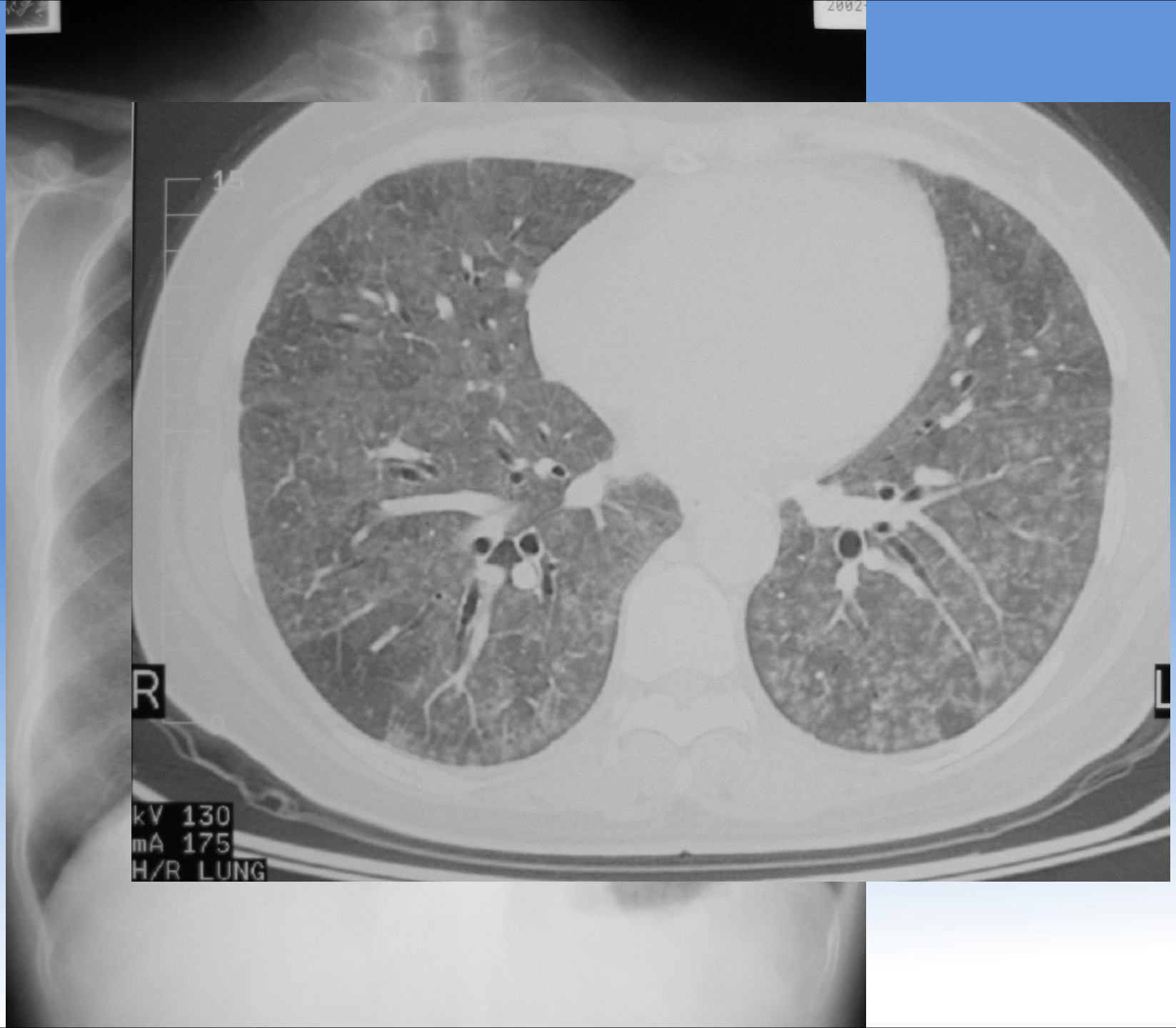




- 细支-感染性
- 吸入
- CB（原发和继发）
- HP
- DPB
- FB
- RB（DIP）
- 气道中心纤维化
- 原发性弥漫神经内分泌细胞增生

case

- 男性，50岁
- 干咳6个月，白痰。


R
kV 130
mA 175
H/R LUNG

过敏性肺炎

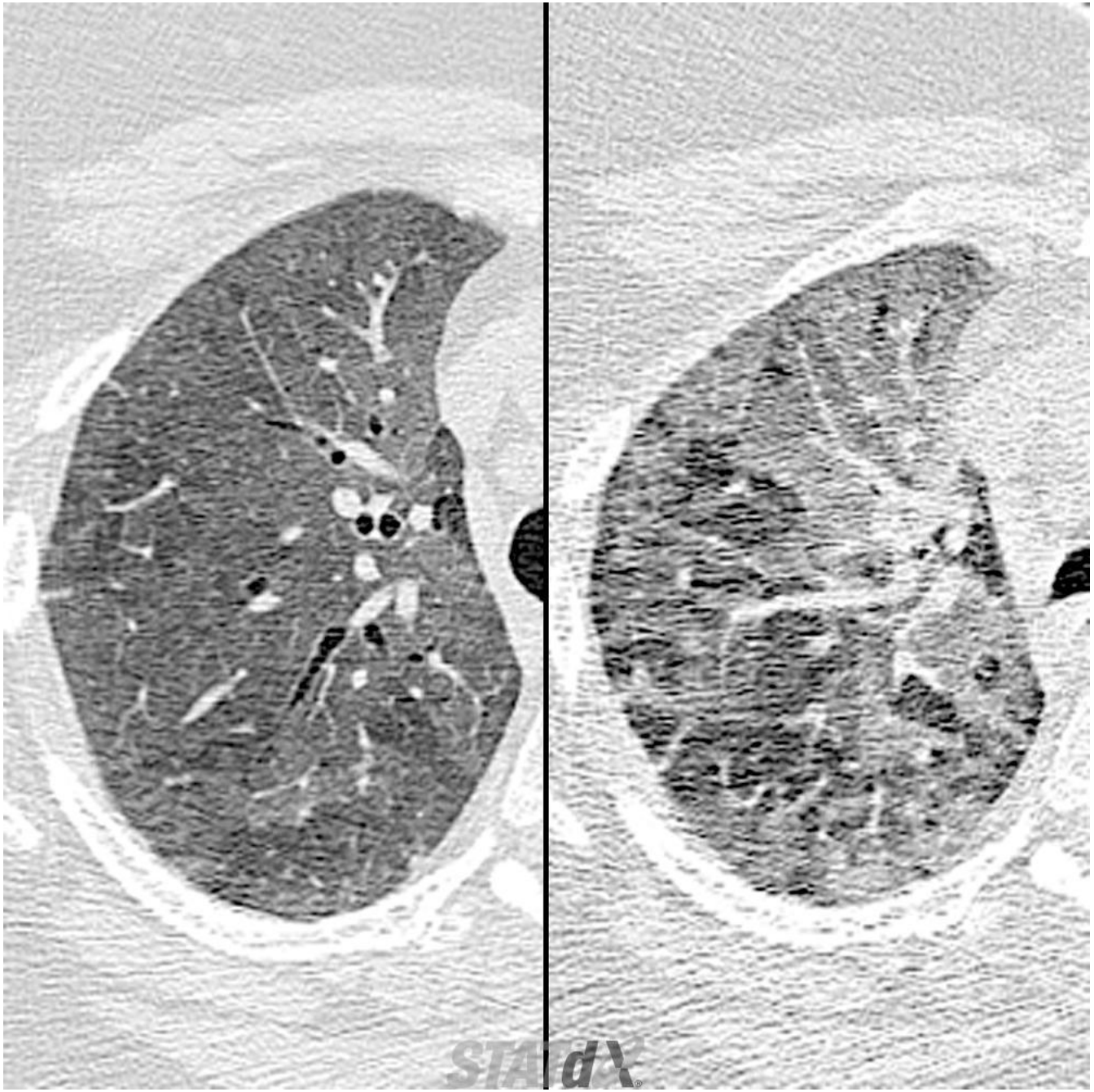
- 急性：肺泡、呼吸性细支气管中性粒细胞浸润，呈急性细支气管炎，实相单一
- 亚急性：细支气管为中心，间质淋巴细胞浸润，非坏死肉芽肿（似BOOP或DIP样）
- 慢性：纤维化+亚急性表现（似NSIP或UIP）

小叶中心结节
弥漫GGO/实变

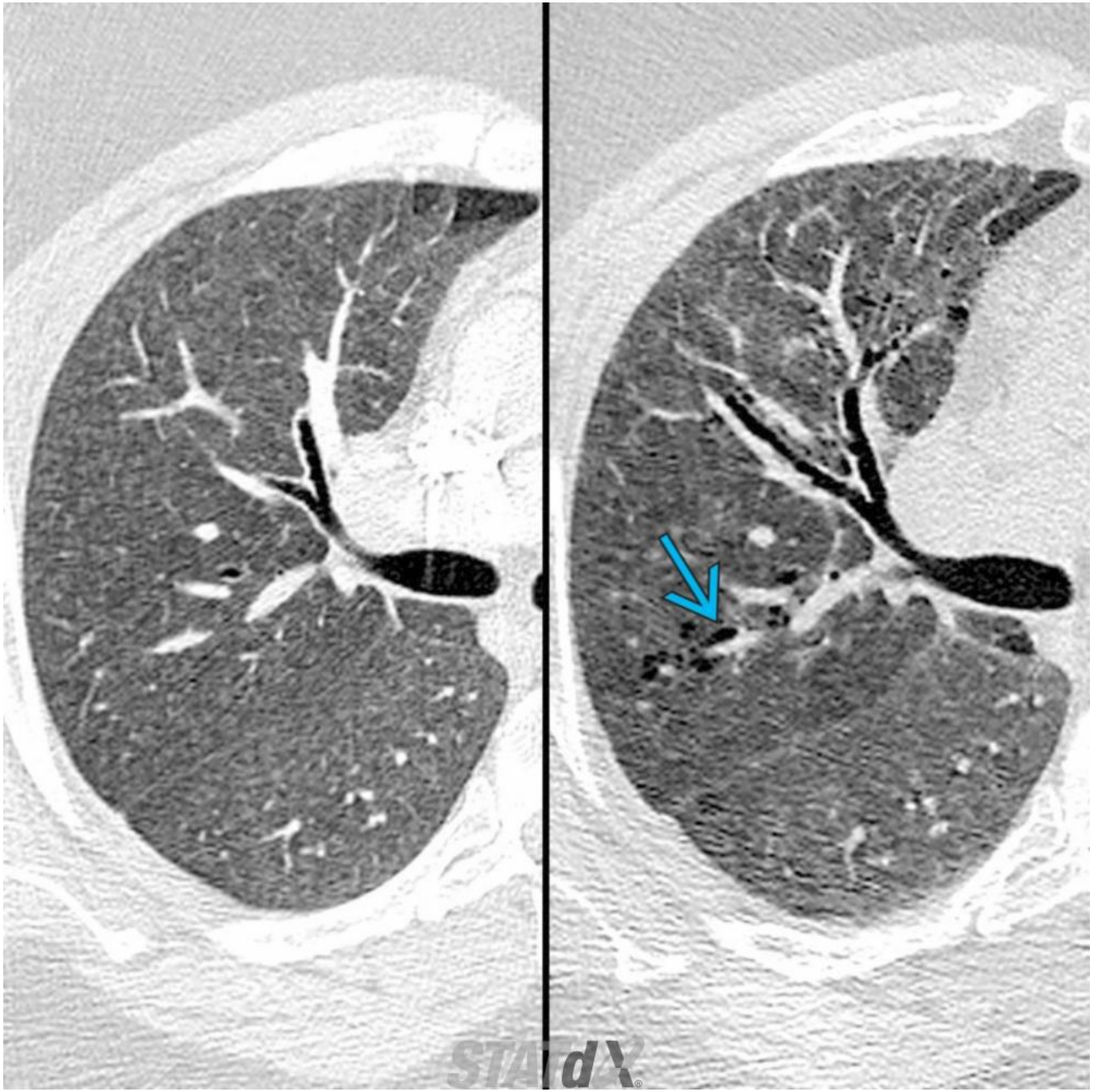
模糊小叶中心结节
弥漫气腔实变/GGO
空气潴留/薄壁囊肿

网状影
蜂窝征

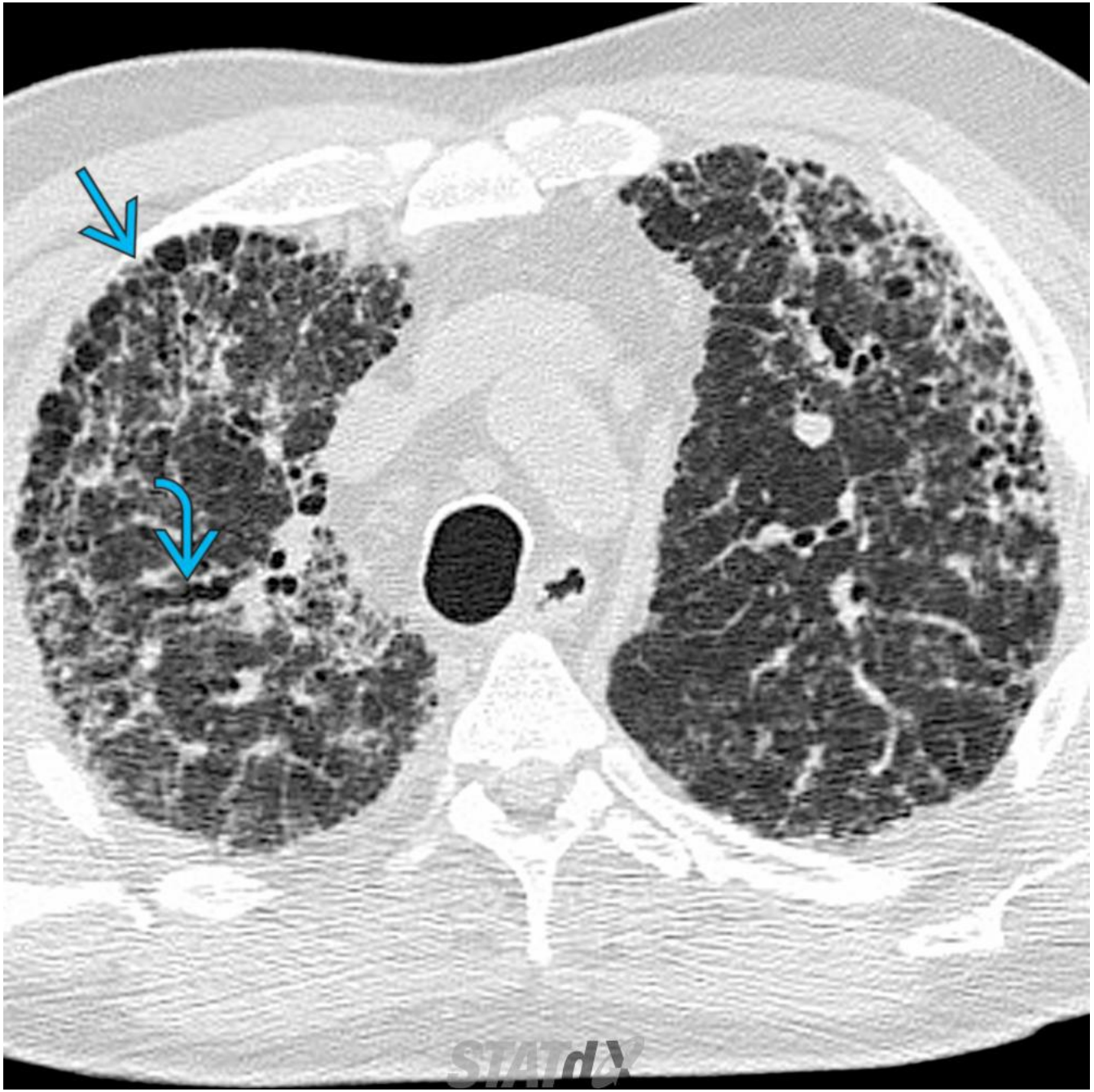
免疫介导：农民肺/饲鸟者肺
CO弥散功能下降/限制性通气障碍



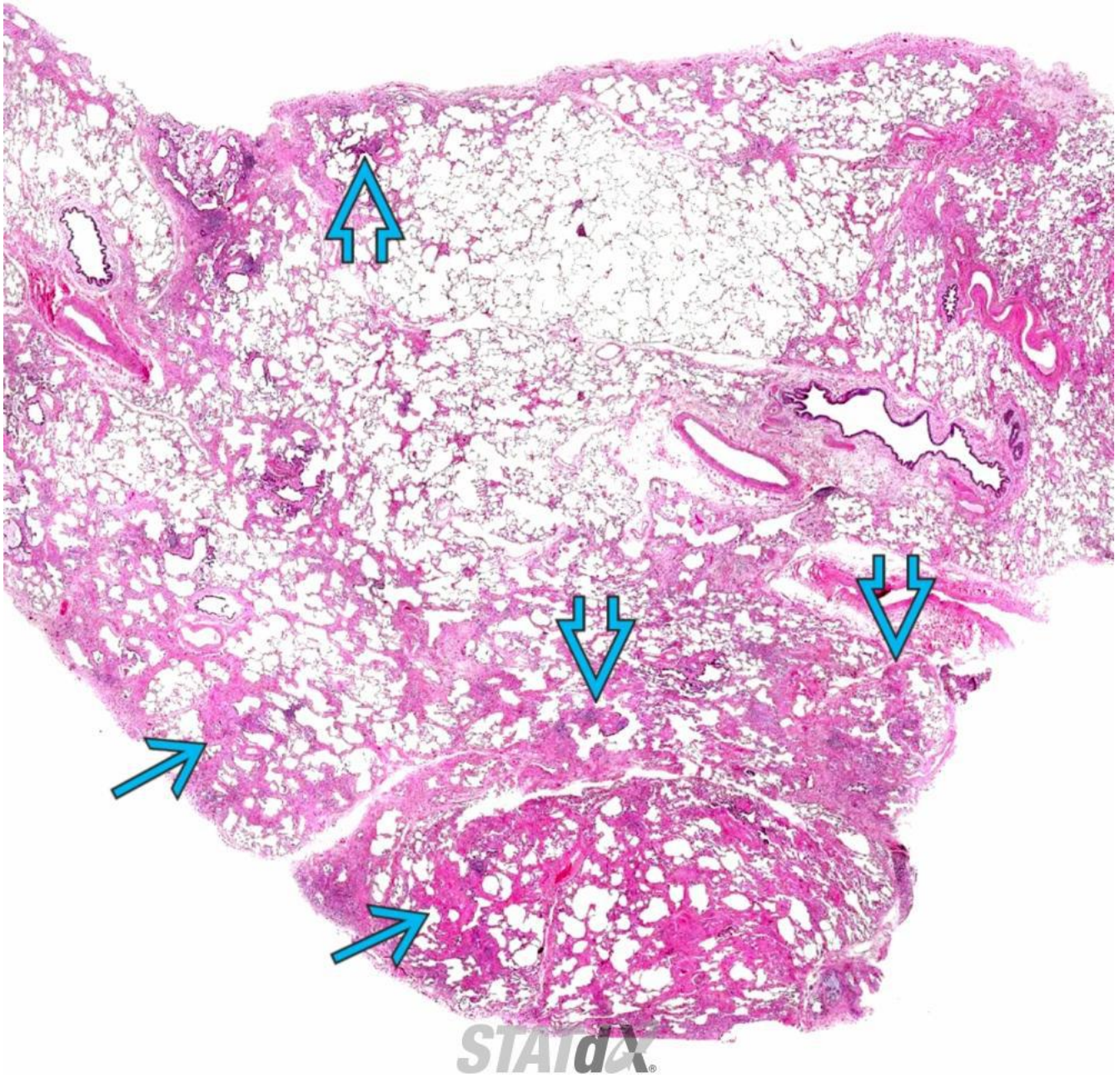
Composite image with axial inspiratory (left) and expiratory (right) HRCT of a patient with cluster 1 hypersensitivity pneumonitis demonstrates mosaic attenuation and head cheese pattern. While nonspecific, the latter is a common CT finding of hypersensitivity pneumonitis.



Composite image with axial HRCT at baseline (left) and 4 years later (right) of a patient with hypersensitivity pneumonitis shows evolution from diffuse ground-glass opacities to peribronchovascular fibrosis with traction bronchiectasis (cyan solid arrow).



Axial HRCT of a patient with cluster 2 hypersensitivity pneumonitis demonstrates upper lobe predominant peribronchovascular and subpleural reticular opacities (cyan solid arrow) and honeycombing as well as scattered traction bronchiectasis (cyan curved arrow).



Low-power photomicrograph (H&E stain) of a specimen of cluster 2 hypersensitivity pneumonitis shows areas of interstitial pulmonary fibrosis (cyan solid arrow) with temporal homogeneity. Also note loose peribronchiolar granulomas (cyan open arrow).

- 细支-感染性
- 吸入
- CB（原发和继发）
- HP
- DPB
- FB
- RB（DIP）
- 气道中心纤维化
- 原发性弥漫神经内分泌细胞增生

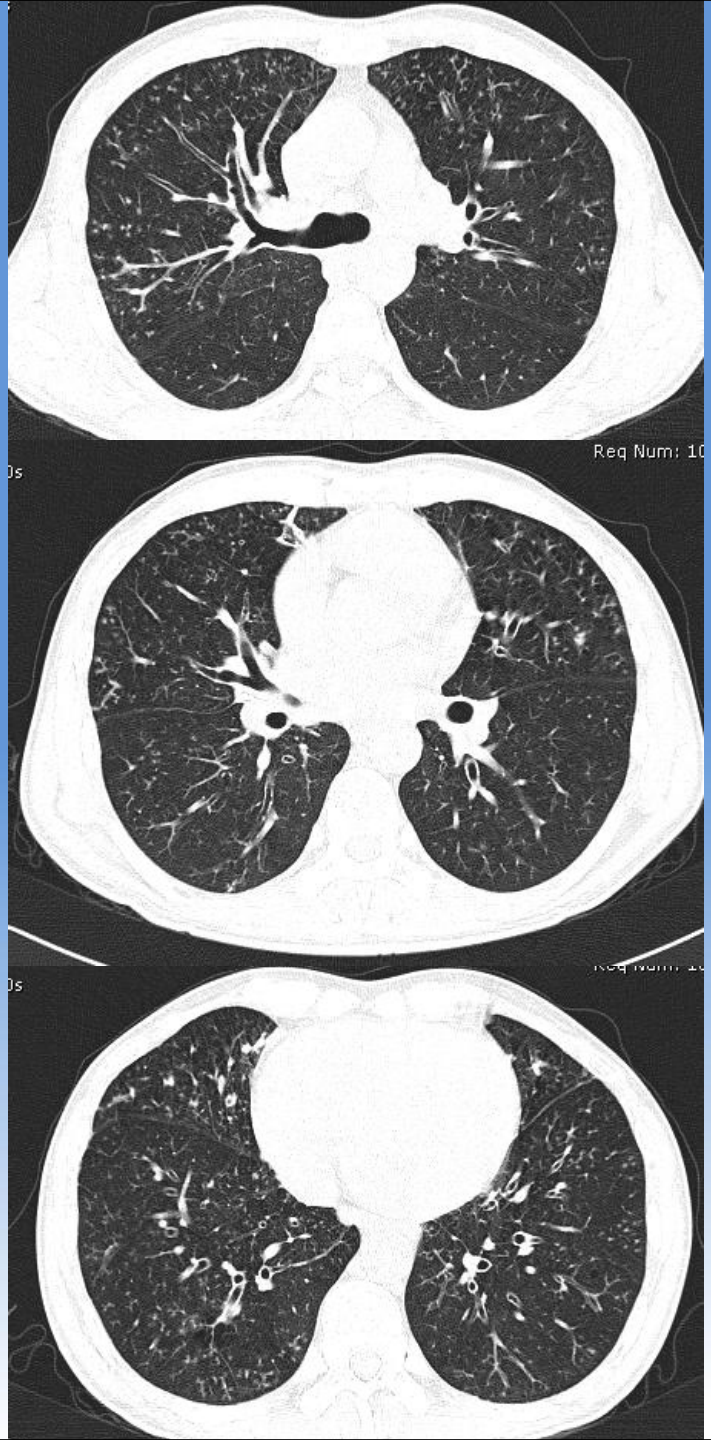
- 呼吸性细支气管管壁、肺泡腔单核炎性细胞聚集
- 气道内粘液及中性粒细胞聚集
- 呼吸性细支气管扩张

小叶中心结节/树芽征
空气潴留/马赛克征
小支气管扩张

红霉素治疗有效

鼻窦慢性炎症
明显阻塞性/轻微限制性通气障碍

DPB

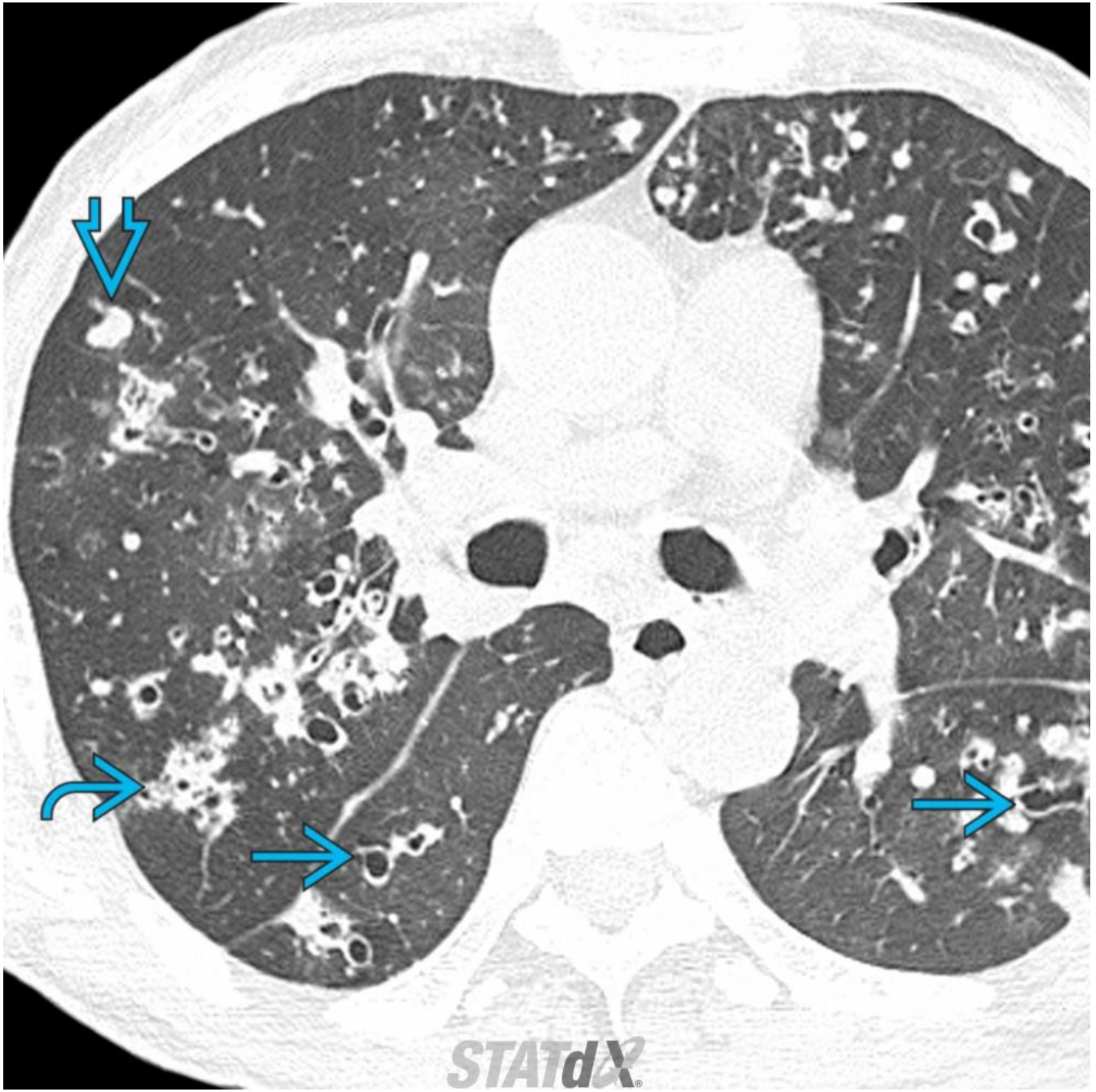


男，40岁，反复咳嗽/咳痰10年，间断发热、喘憋2年

- 小叶中心结节/树芽征
- 小支扩
- 局部透亮度增高

阻塞性通气功能障碍

DPB

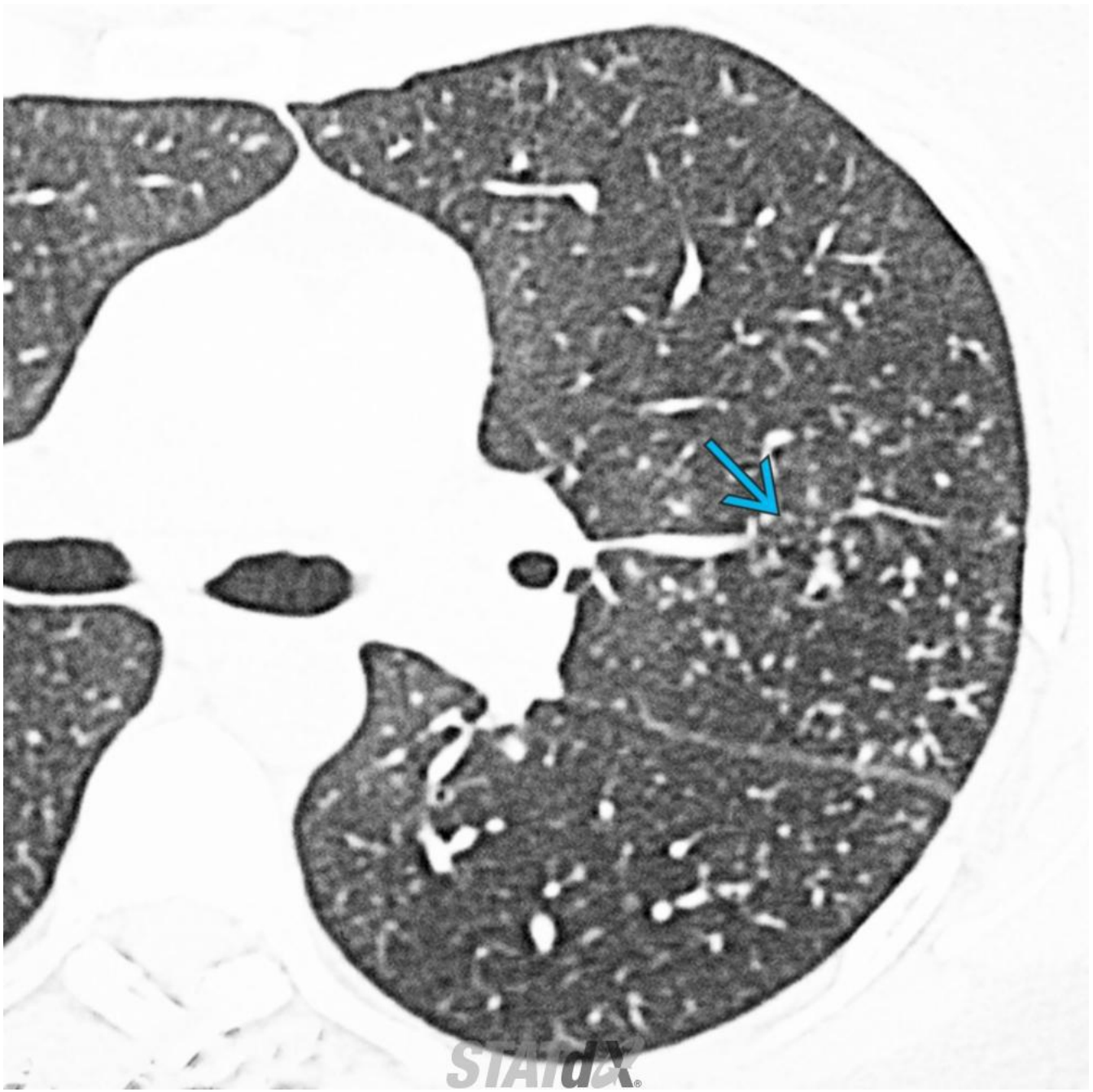


Axial CECT of a 56-year-old Korean man with diffuse panbronchiolitis shows bilateral multifocal bronchiectasis (cyan solid arrow), bronchial wall thickening, mucus plugging (cyan open arrow), peribronchial consolidation (cyan curved arrow), and mild mosaic attenuation. Sputum culture grew Pseudomonas aeruginosa.

- 细支-感染性
- 吸入
- CB（原发和继发）
- HP
- DPB
- FB
- RB（DIP）
- 气道中心纤维化
- 原发性弥漫神经内分泌细胞增生

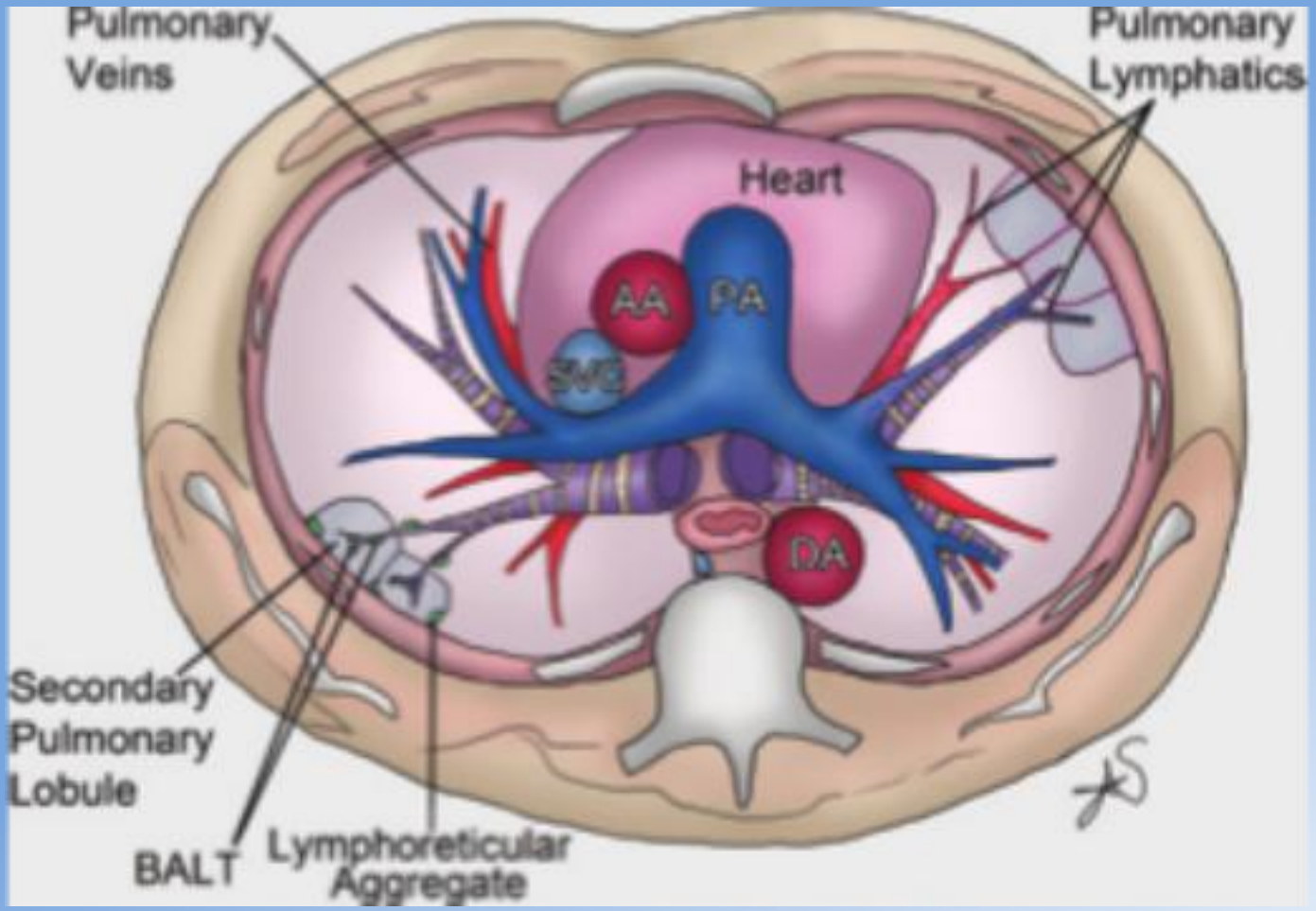
Primary or idiopathic FB

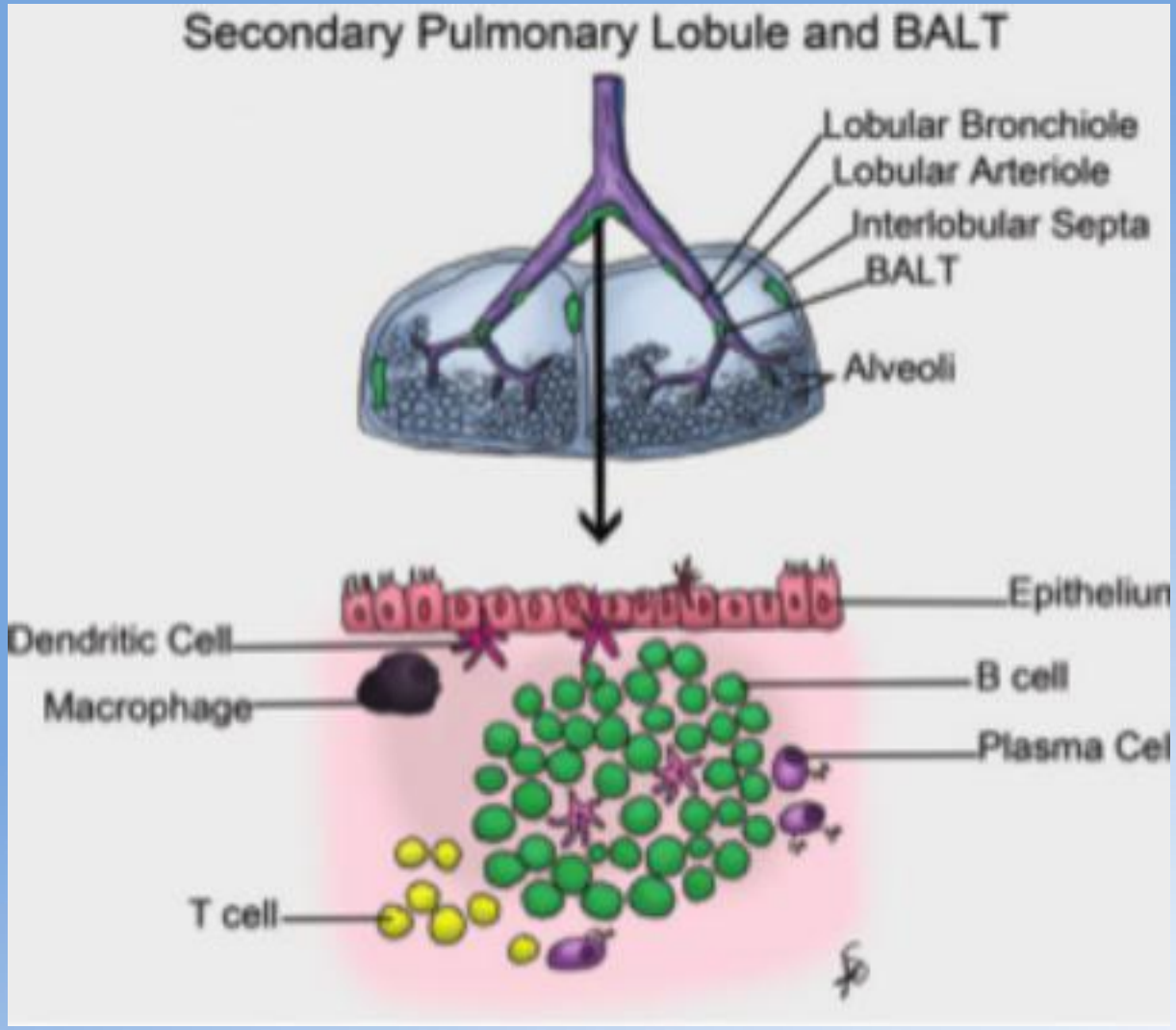
- Secondary FB more common and may be associated with
  - Connective tissue diseases
  - Immunodeficiency
  - Hypersensitivity reactions
  - Infections

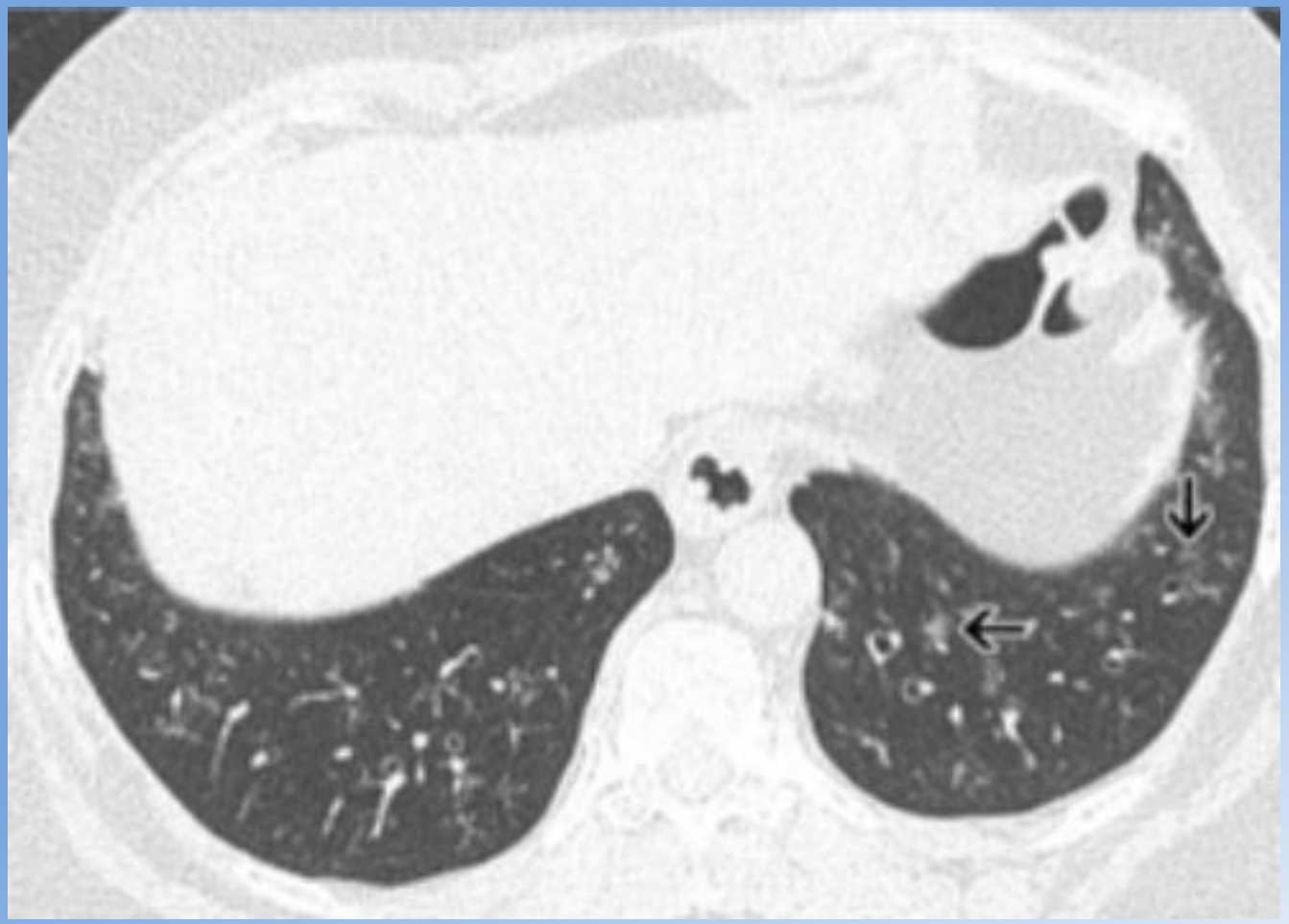


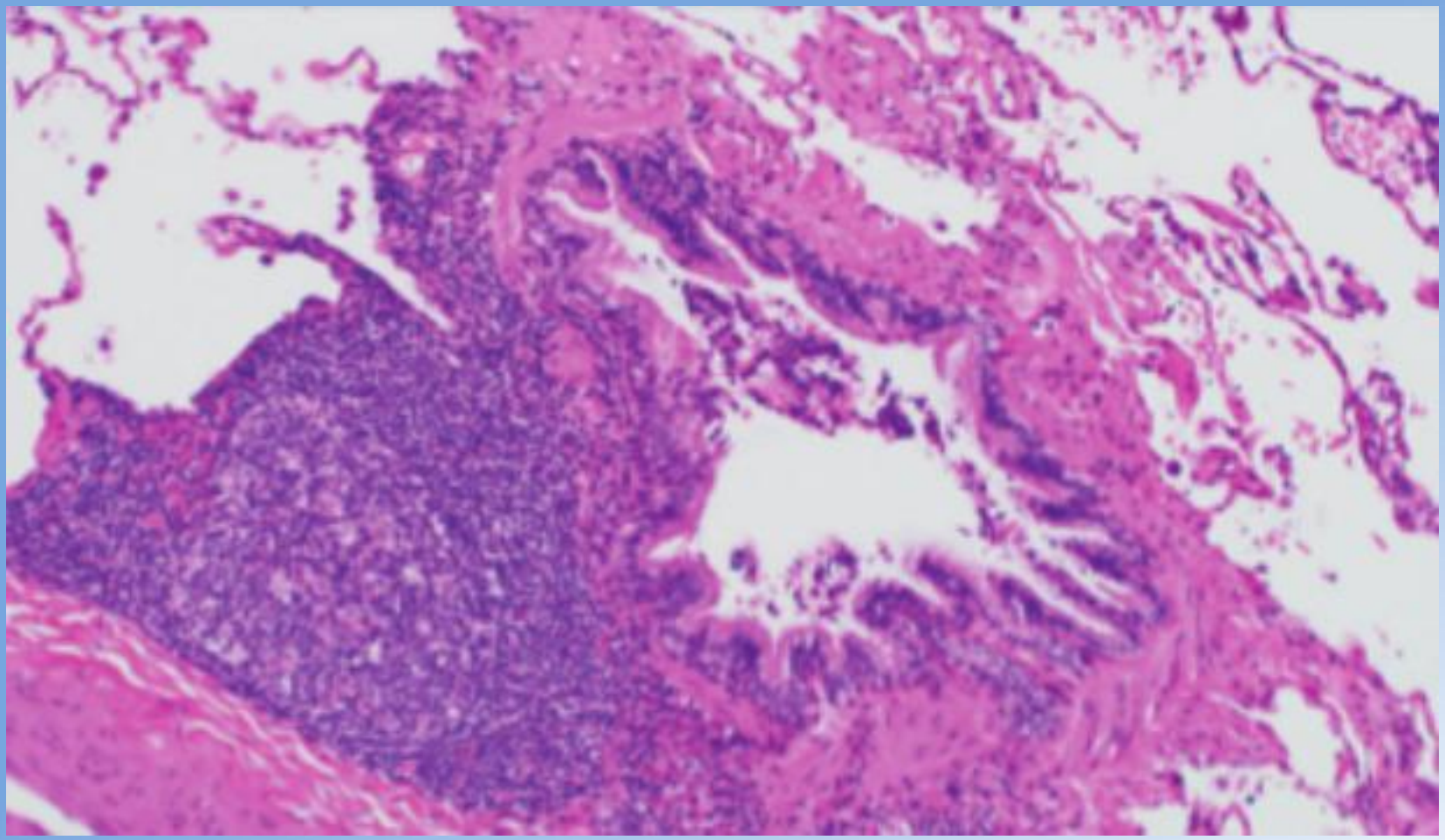
Axial HRCT of the same patient shows left upper lobe centrilobular micronodules (cyan solid arrow). While imaging manifestations of follicular bronchiolitis are nonspecific, the presence of centrilobular micronodules in the absence of symptoms of pulmonary infection should raise suspicion for follicular bronchiolitis.

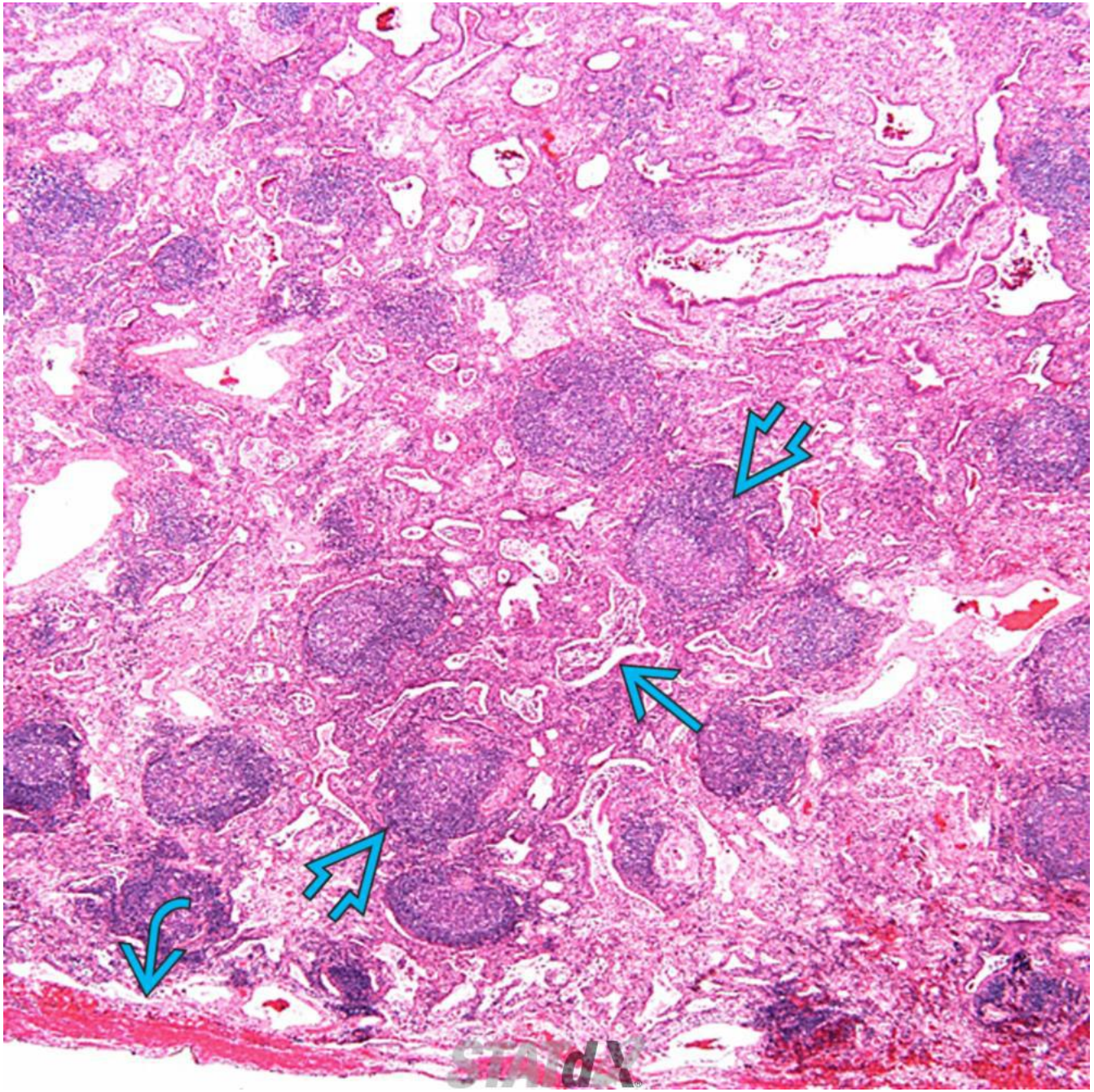
肺实质淋巴组织


Pulmonary
Veins
Pulmonary
Lymphatics
Heart
AA
PA
SVC
DA
Secondary
Pulmonary
Lobule
BALT
Lymphoreticular
Aggregate

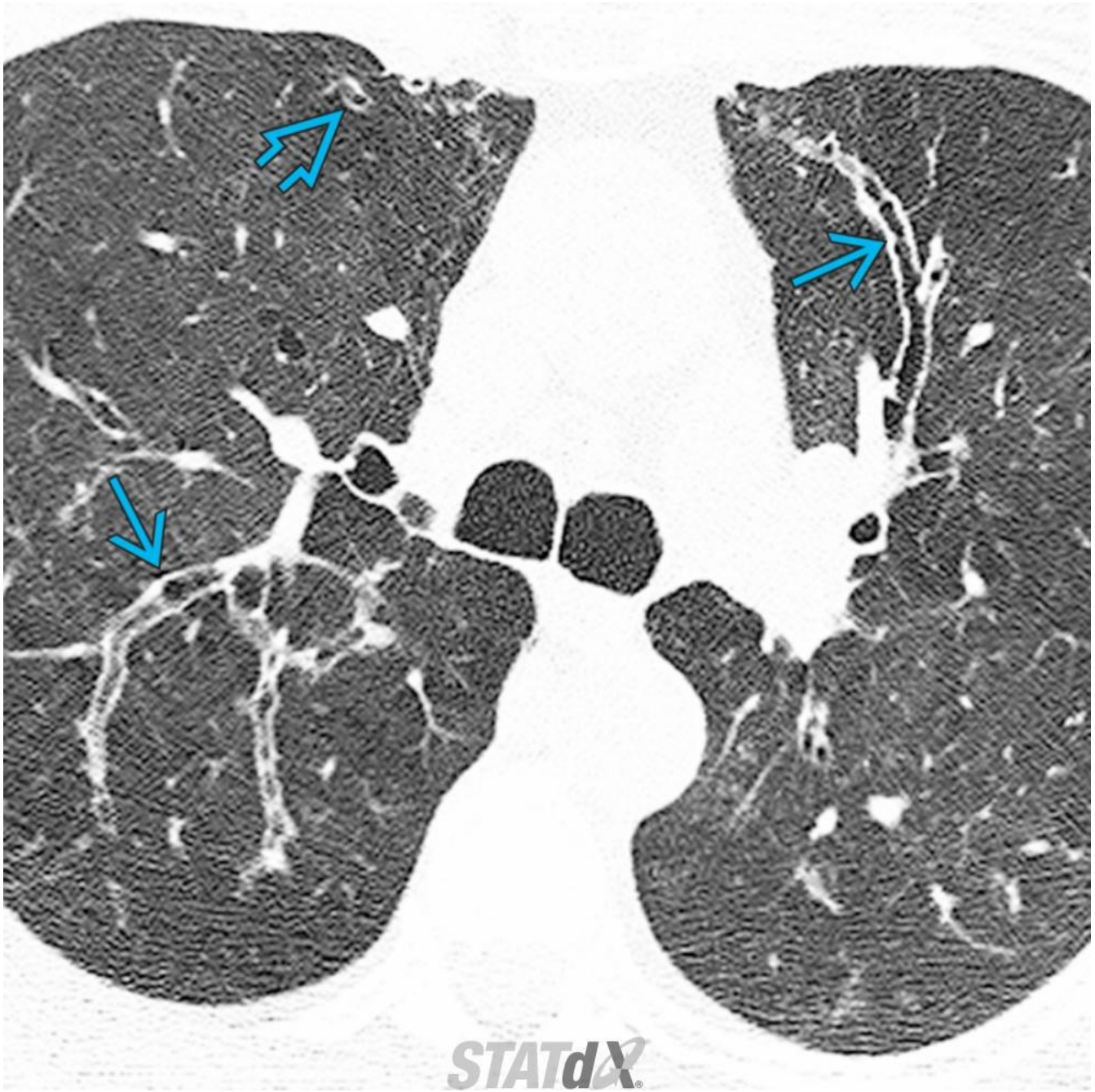

Secondary Pulmonary Lobule and BALT
Lobular Bronchiole
Lobular Arteriole
Interlobular Septa
BALT
Alveoli
Epithelium
Dendritic Cell
B cell
Macrophage
Plasma Cel
T cell



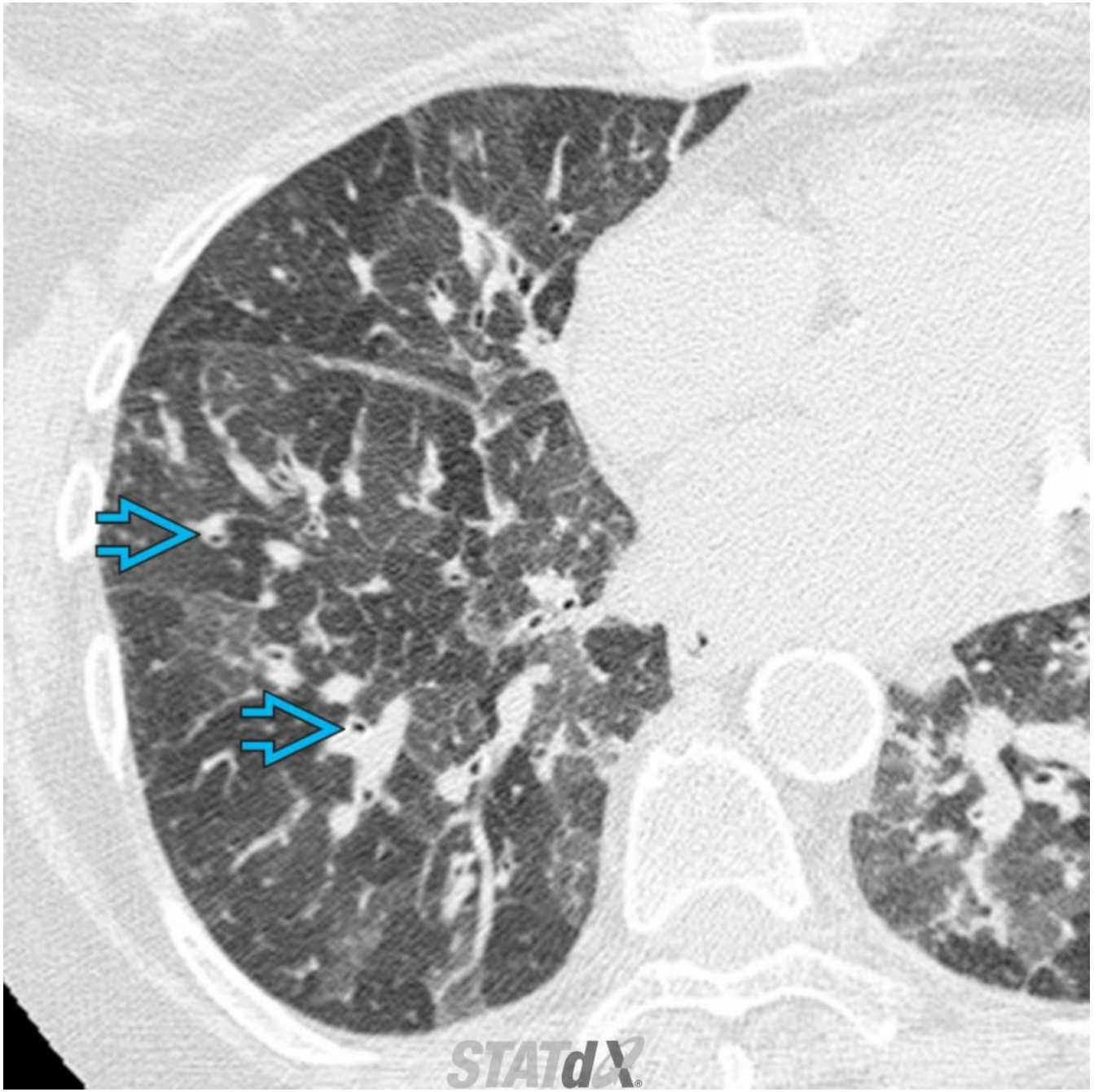




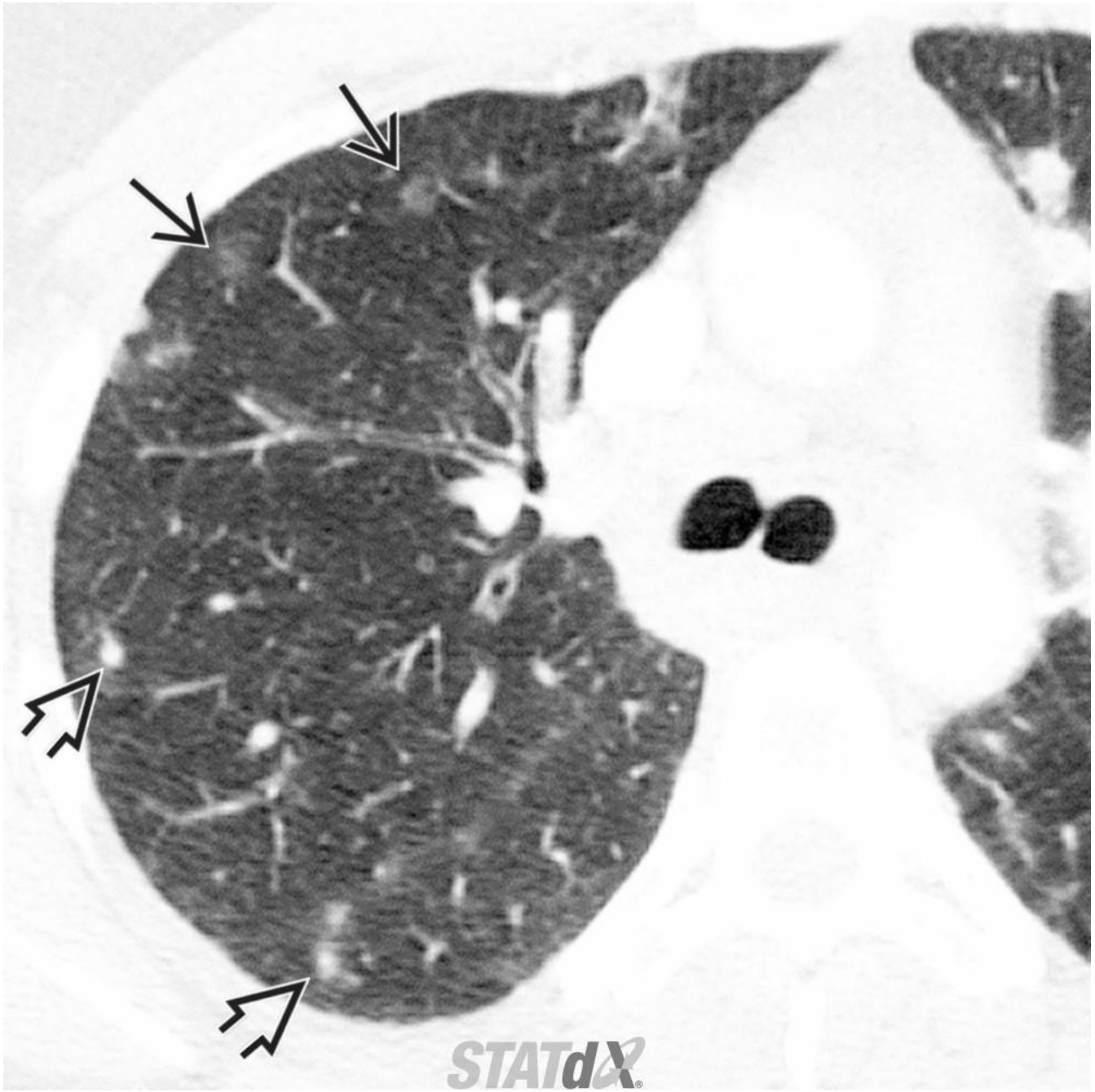
Low-power photomicrograph (H&E stain) shows follicular bronchiolitis characterized by germinal centers (cyan open arrow) surrounding bronchioles (cyan solid arrow). These germinal centers correlate with centrilobular micronodules on HRCT. Note sparing of the pleura (cyan curved arrow) typical of a centrilobular process.



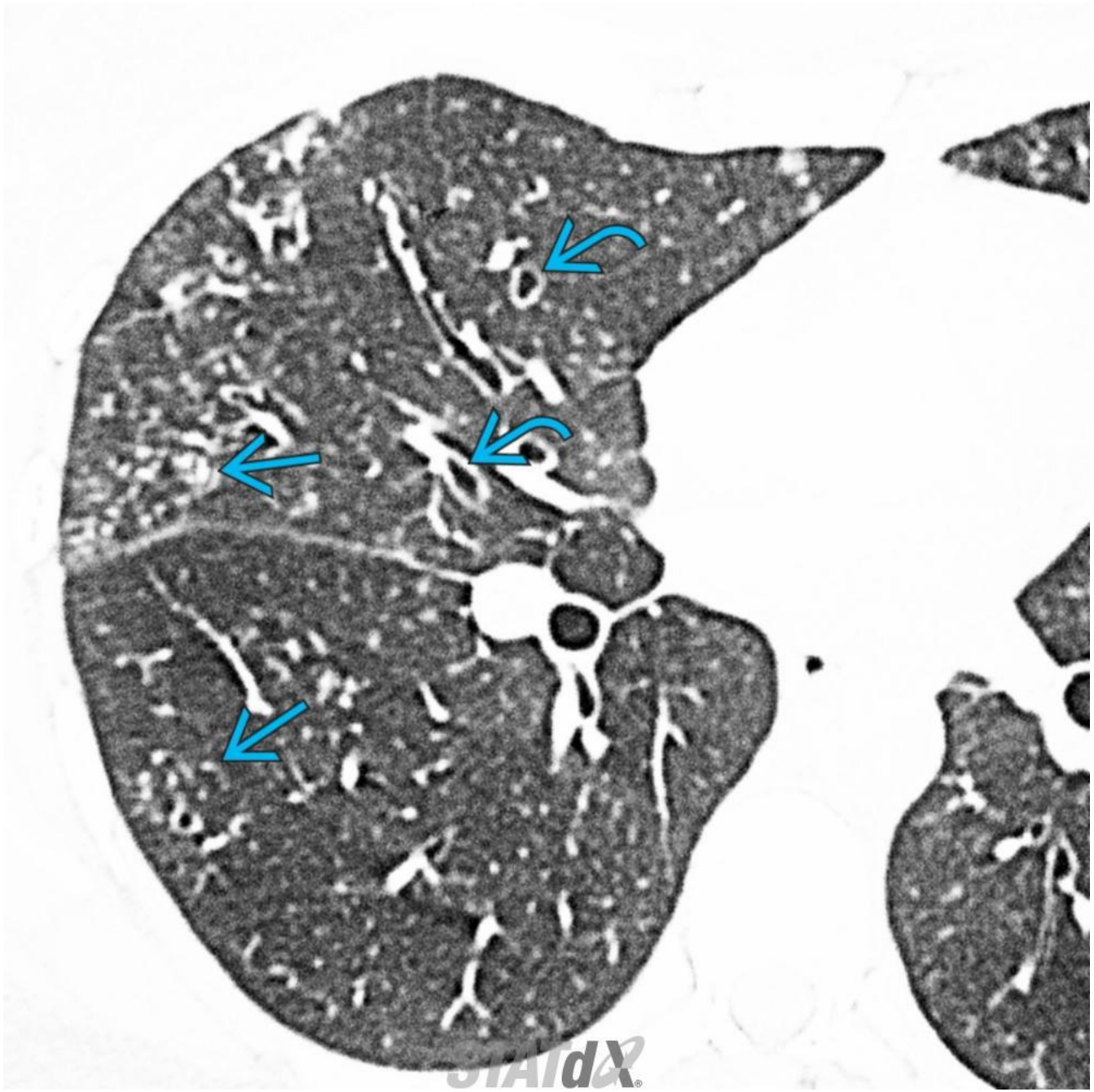
Axial HRCT of a 50-year-old man with follicular bronchiolitis shows bronchiectasis (cyan solid arrow) and bronchiolectasis (cyan open arrow) in the bilateral upper lobes. While centrilobular micronodules are a common imaging abnormality in patients with follicular bronchiolitis, bronchial wall thickening and bronchiectasis are



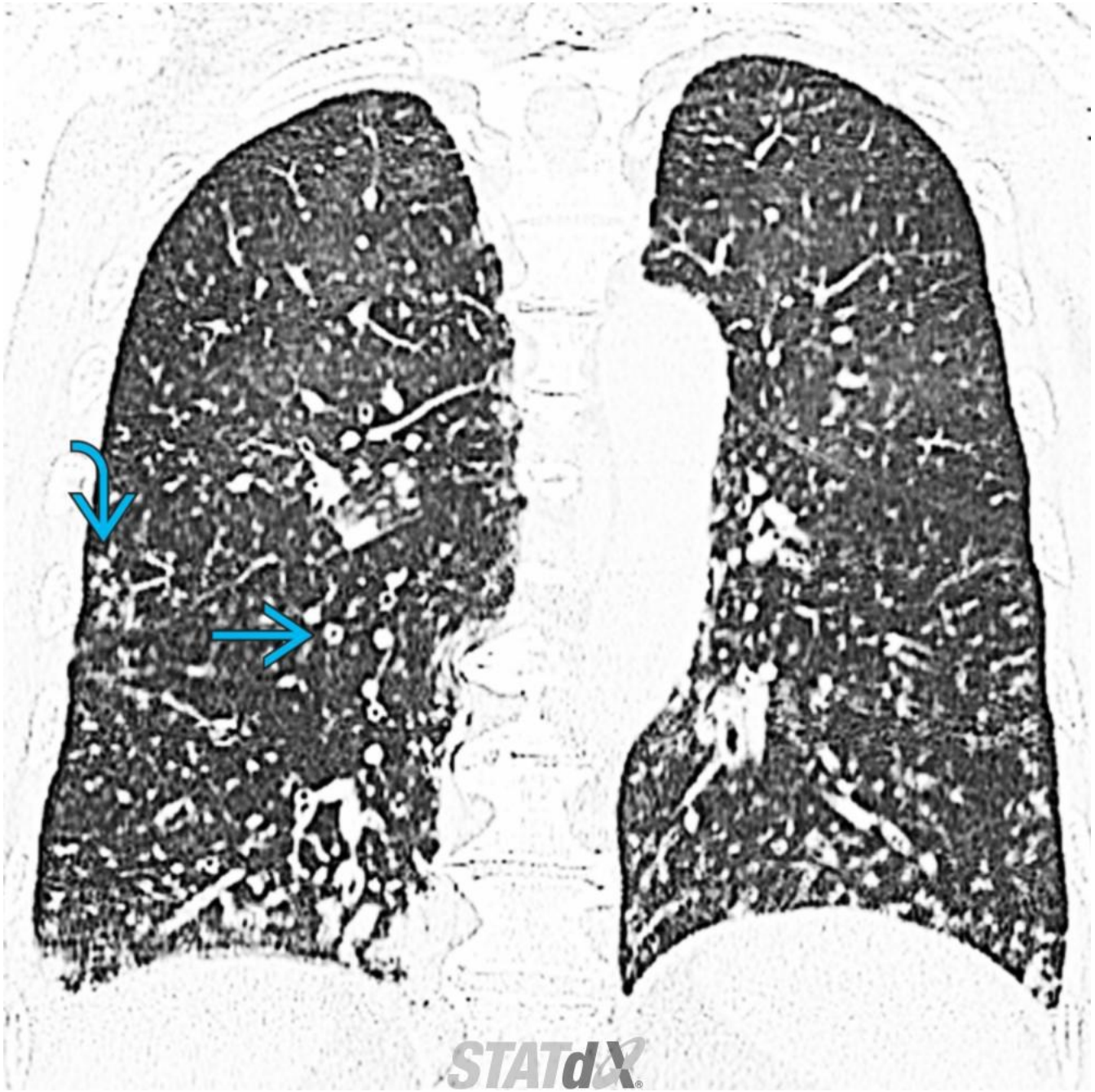
Axial HRCT of 42-year-old woman with follicular bronchiolitis shows bronchial wall thickening (cyan open arrow) and air-trapping with a lobular pattern. As any other bronchiolitis, follicular bronchiolitis is often associated with mosaic attenuation on inspiratory HRCT and air-trapping on expiratory HRCT.



Axial HRCT of a middle-aged man with follicular bronchiolitis and organizing pneumonia pattern shows small solid (black open arrow) and ground-glass opacity nodules (black solid arrow) in the right upper lobe.



Axial HRCT of a 50-year-old man with rheumatoid arthritis and follicular bronchiolitis shows centrilobular nodules with a tree-in-bud configuration (cyan solid arrow) and bronchial wall thickening (cyan curved arrow).



Coronal HRCT of the same patient shows bilateral centrilobular micronodules, tree-in-bud opacities (cyan curved arrow), and bronchial wall thickening (cyan solid arrow). This constellation of findings should suggest the diagnosis of follicular bronchiolitis particularly in patients with rheumatoid arthritis with cellular bronchiolitis

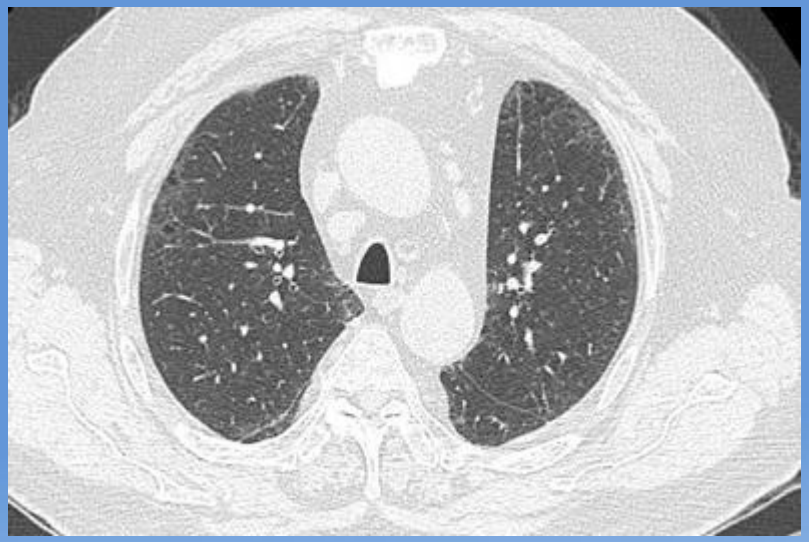
- 细支-感染性
- 吸入
- CB（原发和继发）
- HP
- DPB
- FB
- RB（DIP）
- 气道中心纤维化
- 原发性弥漫神经内分泌细胞增生

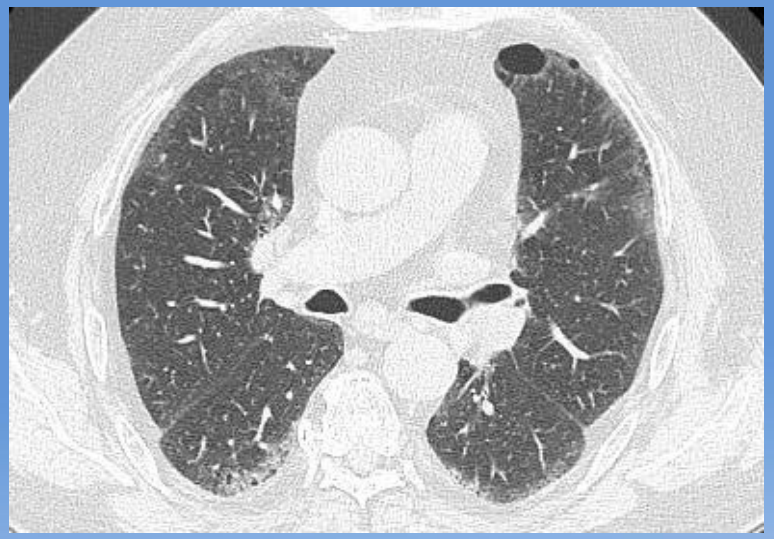
- 男性，62岁, 2011-12入院
- 间断咳嗽、咳痰5年，加重伴喘憋1月
- 既往糖尿病史4年，吸烟40包年
- 查体：杵状指，双下肺可闻及爆裂音

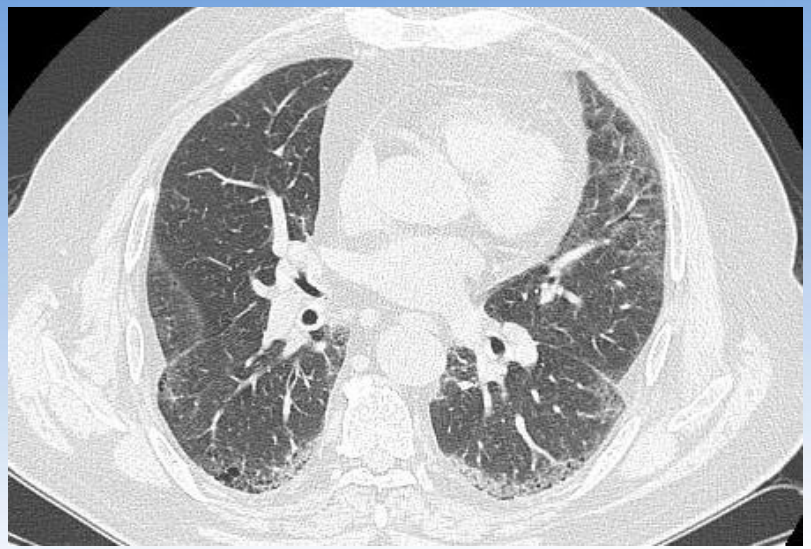
辅助检查

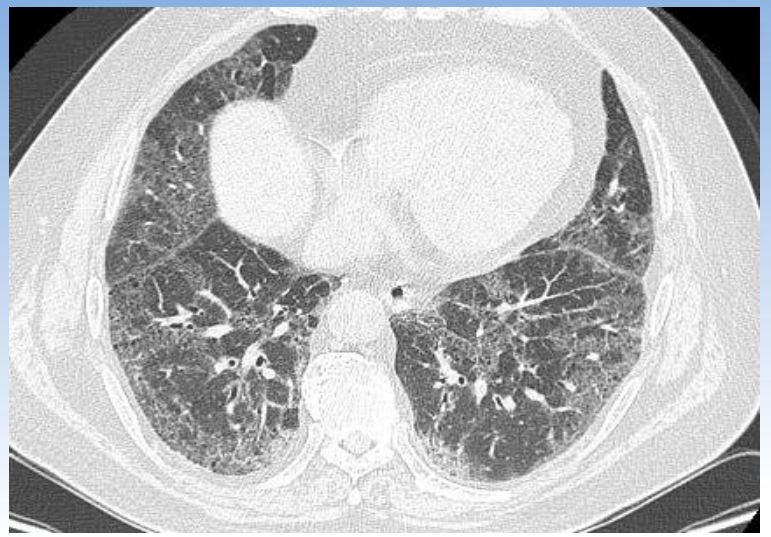
- 肺功能：混合性通气功能障碍伴弥散障碍。
- 超声心动、腹部超声均未见异常。

肺部CT

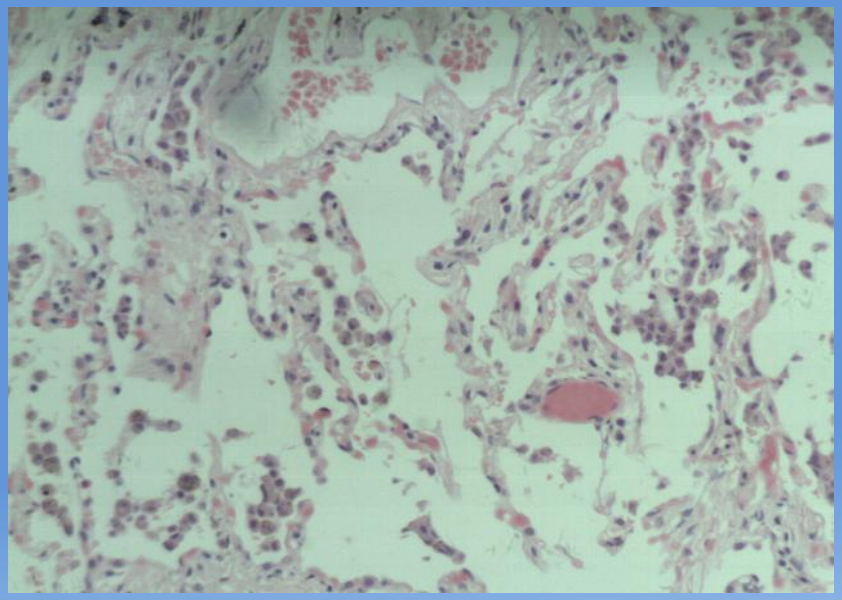
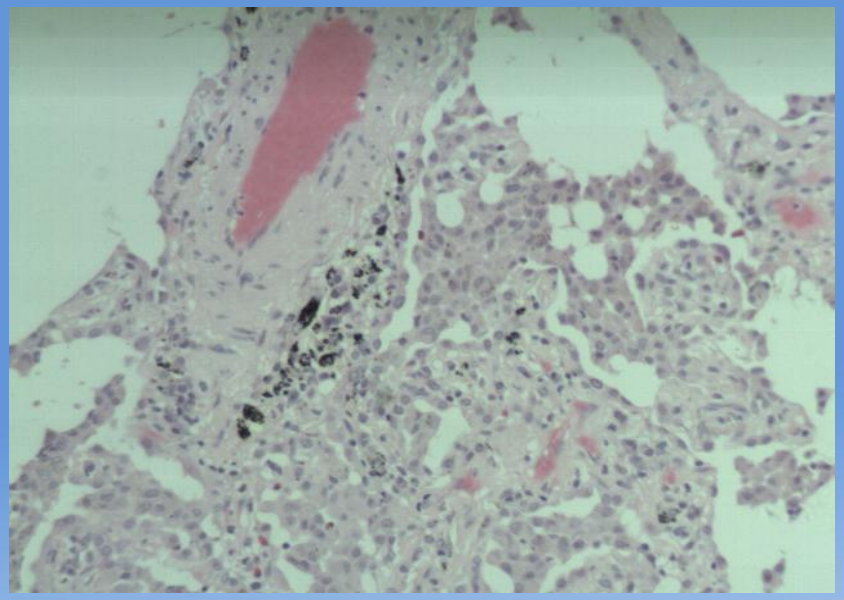
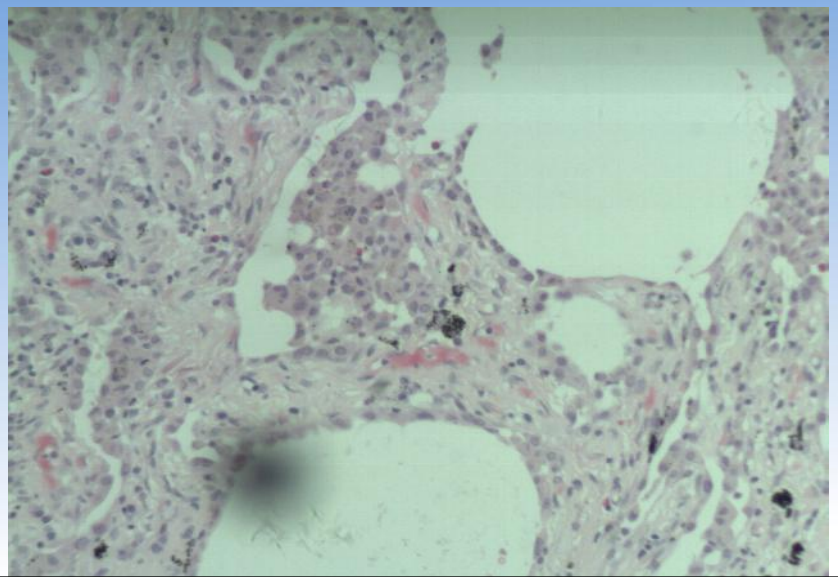
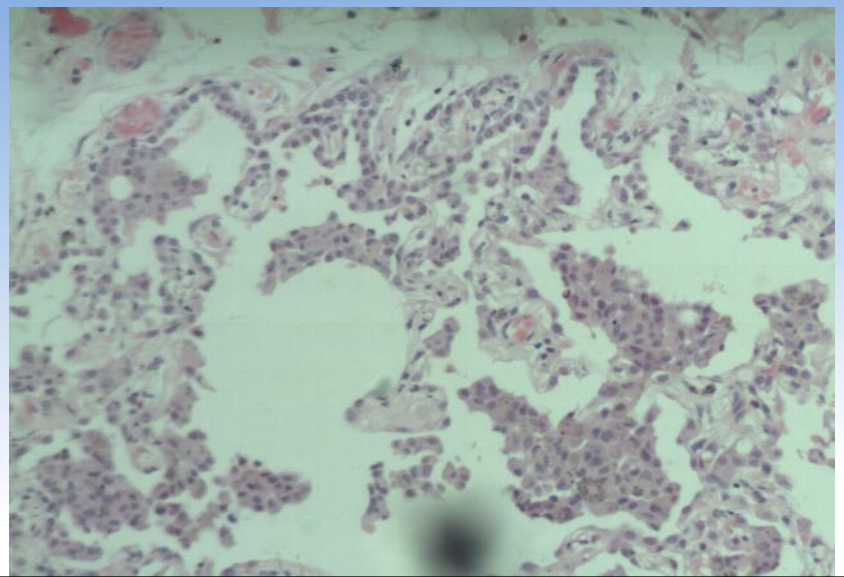


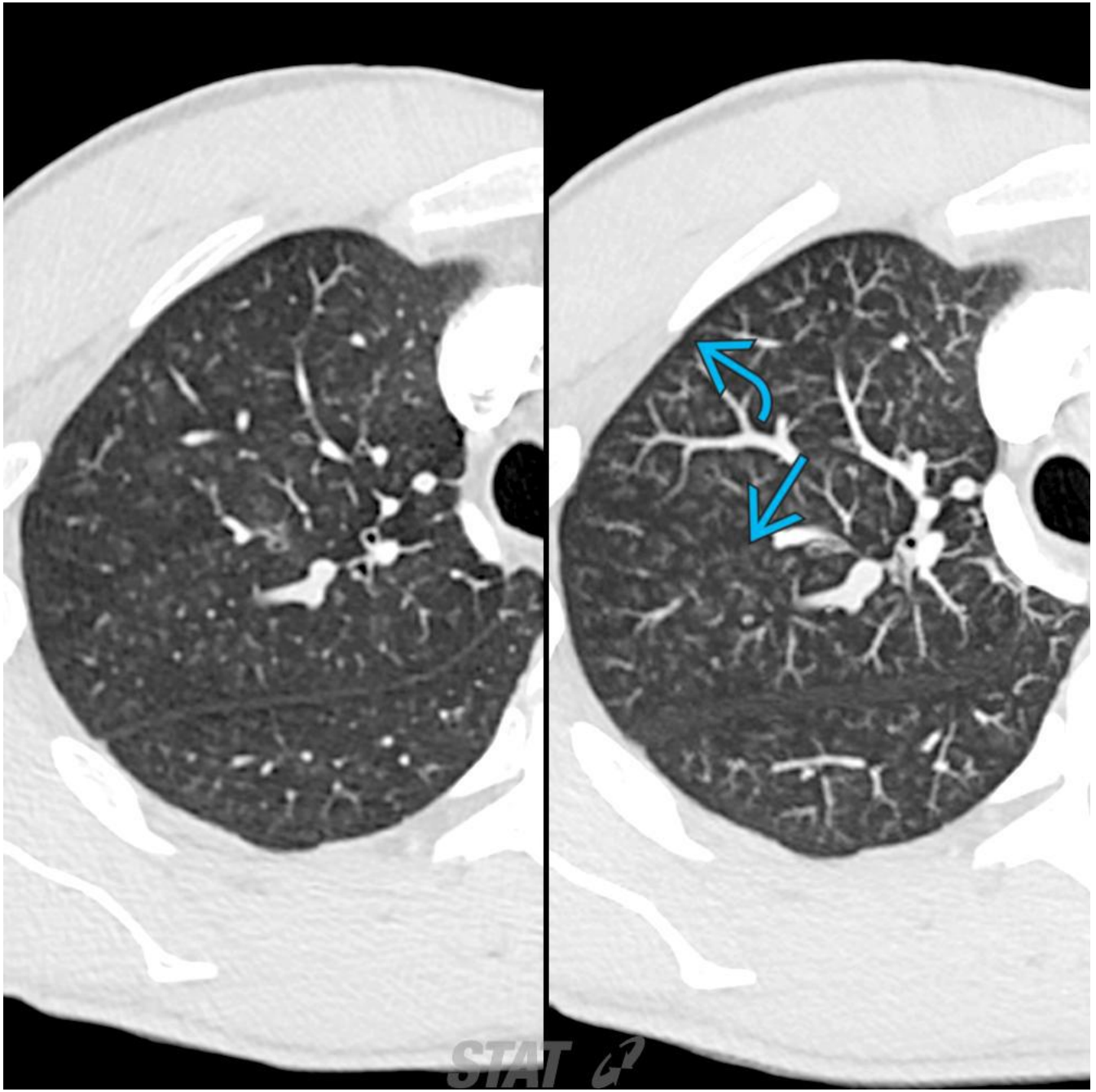




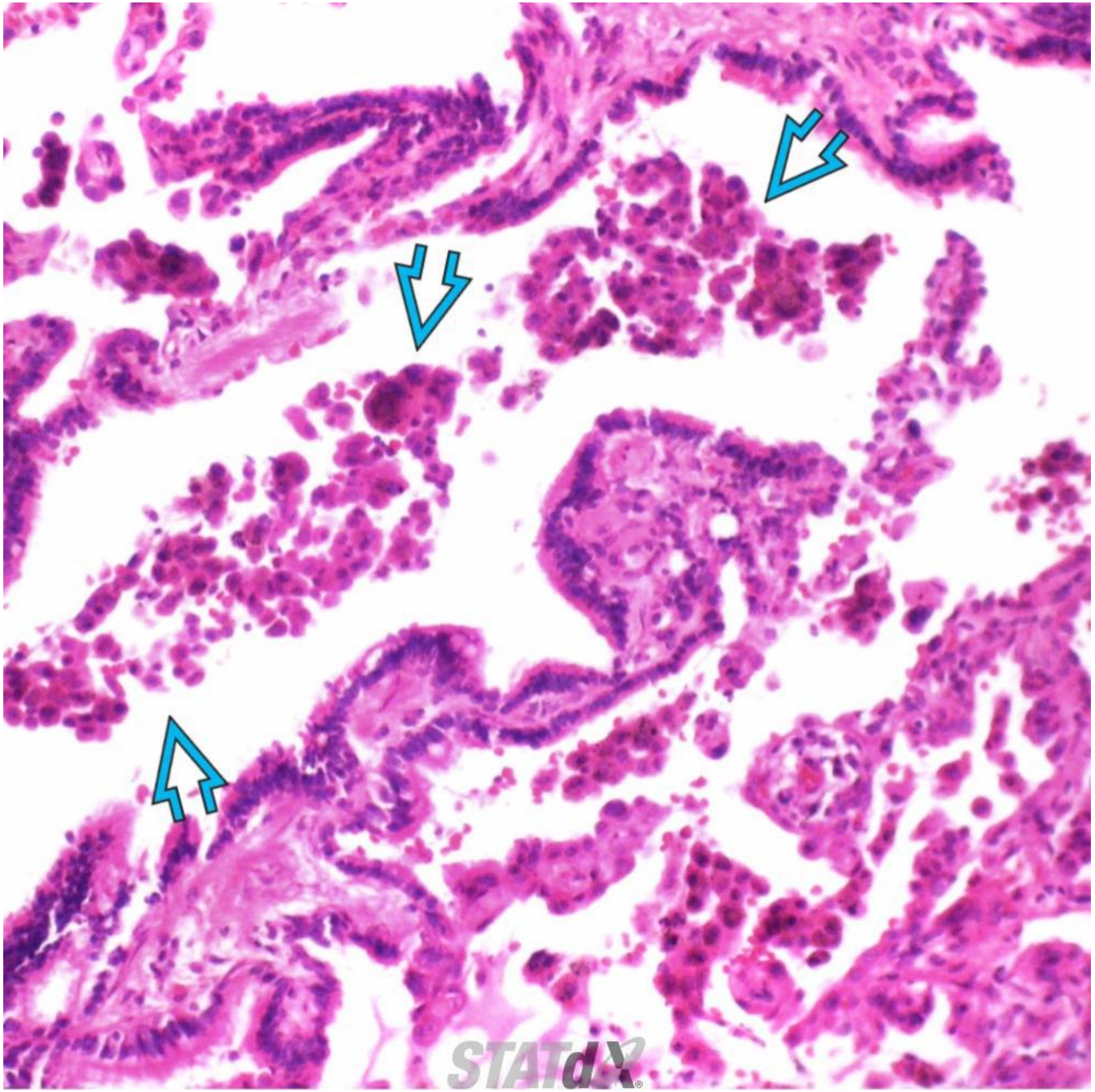


开胸肺活检病理：RB—ILD

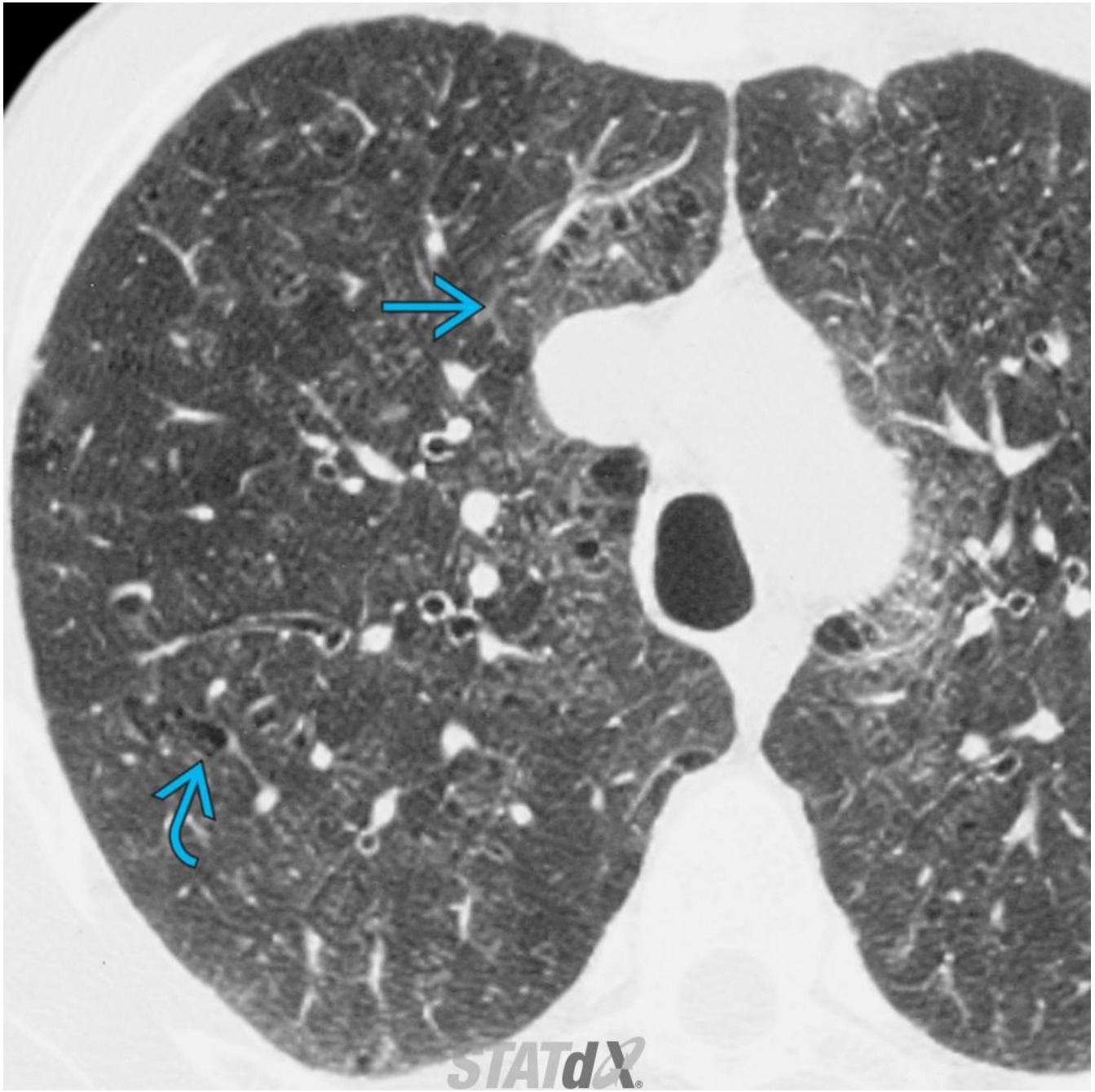







Composite image with axial CECT (left) and axial MIP reformation CECT (right) of a patient with respiratory bronchiolitis shows centrilobular ground-glass nodules (cyan solid arrow), more conspicuous on the MIP reformation. Note that these nodules spare the subpleural lung (cyan curved arrow), indicating their centrilobular

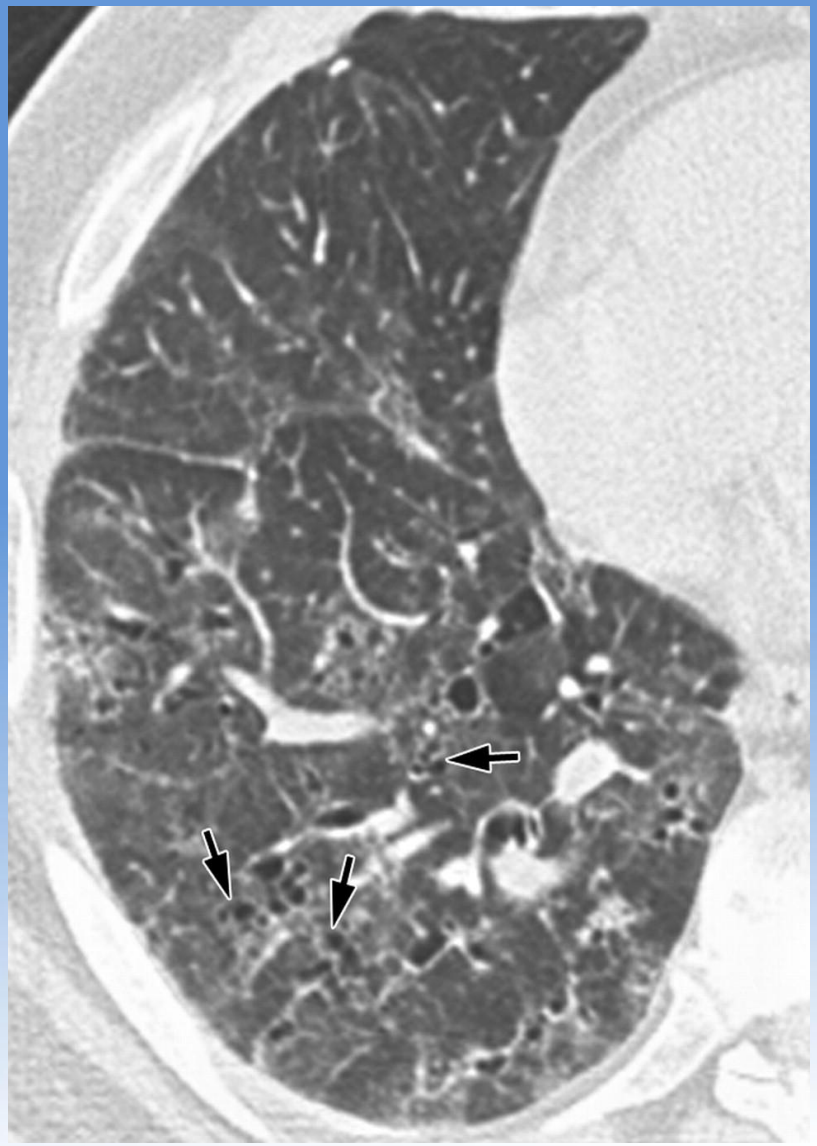


Low-power photomicrograph (H&E stain) shows respiratory bronchiolitis characterized by collections of lightly pigmented macrophages (cyan open arrow) within a bronchiole and adjacent alveolar spaces. Chronic bronchiolar and alveolar duct inflammation, interstitial inflammation, and fibrosis are common on histology.



Axial HRCT of a 35-year-old male smoker with respiratory bronchiolitis shows centrilobular nodules, ground-glass opacities (cyan solid arrow), bronchial wall thickening and centrilobular emphysema (cyan curved arrow). Typically respiratory bronchiolitis occurs in an asymptomatic patient.

男，62岁， 气短1年



- GGO
  - 斑片状分布
- 细网状影
- 囊状气腔
  - 牵拉支扩？
  - 小叶中心型肺气肿？

限制性/阻塞性通气功能障碍

DIP

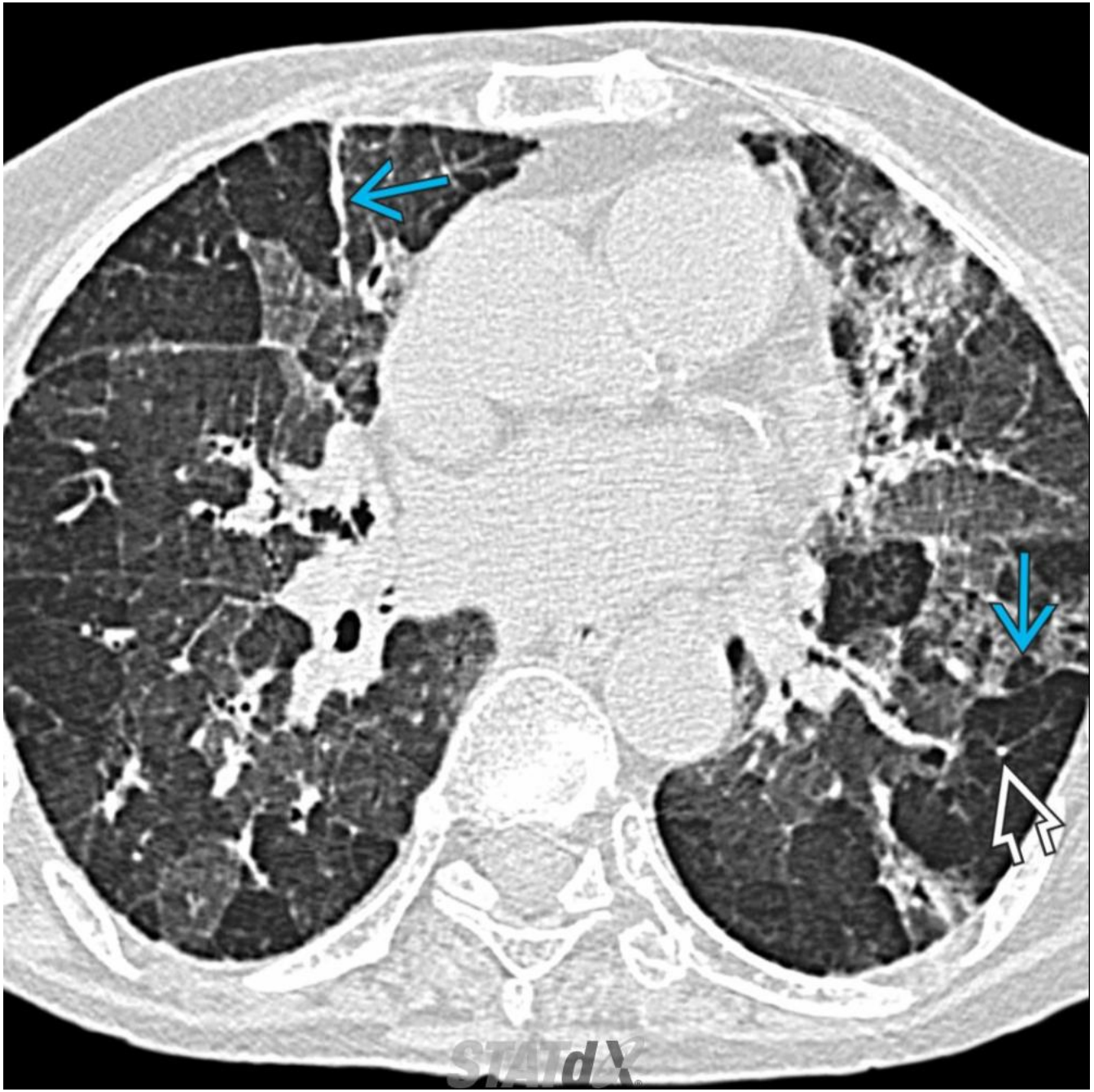
呼吸性细支气管炎/RBILD/DIP

- 呼吸性细支气管管壁慢性炎性细胞浸润
- 呼吸性细支气管及肺泡腔内含棕色色素的巨噬细胞聚集

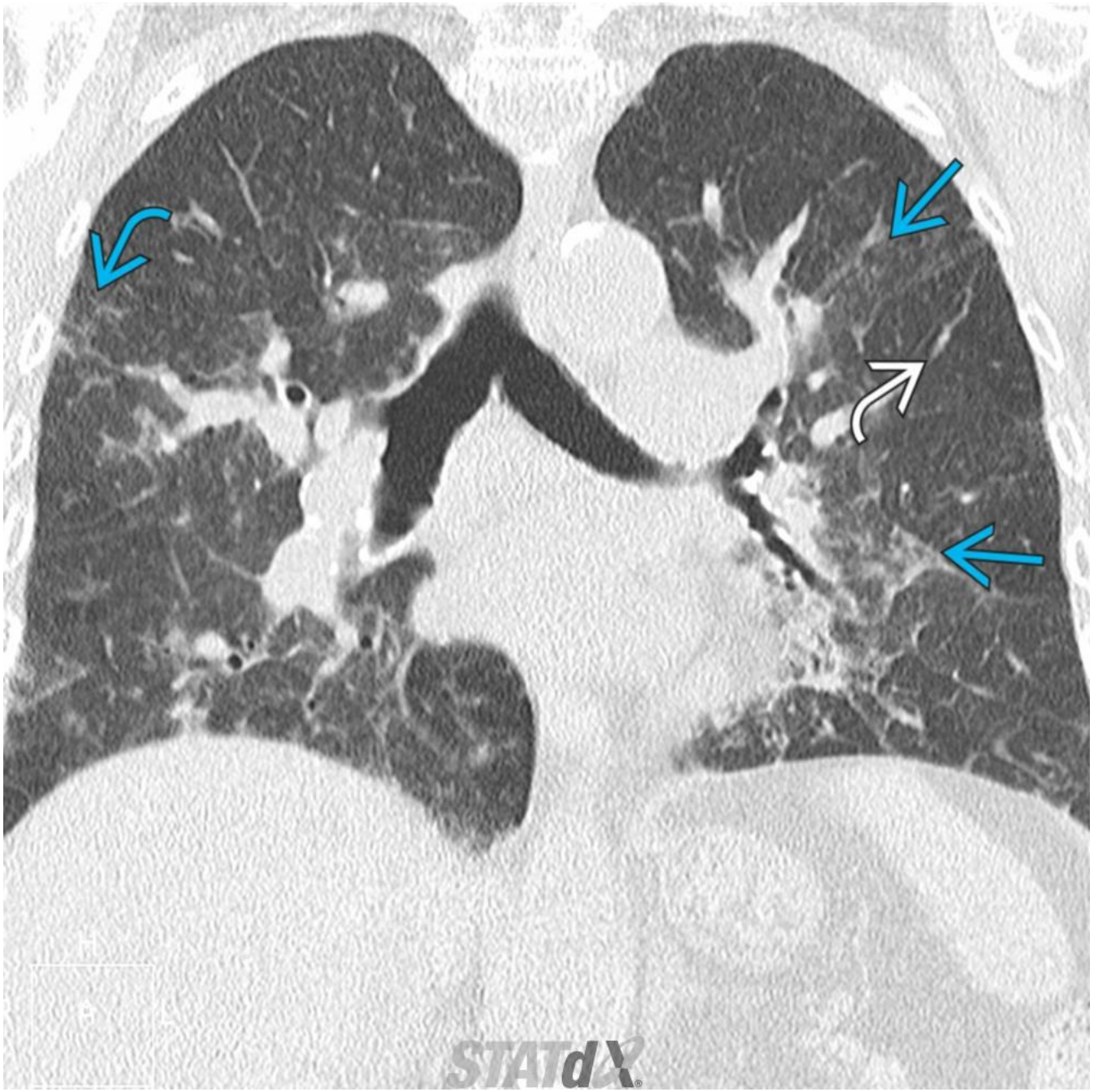
(普鲁士蓝染色+)

	RB	RBILD	DIP
纤维化		√	√
分布/形态	沿小气道斑片状	沿小气道斑片状	弥漫
GGO	√	√	√
小叶中心结节	√	√	√
细网状影		√	√

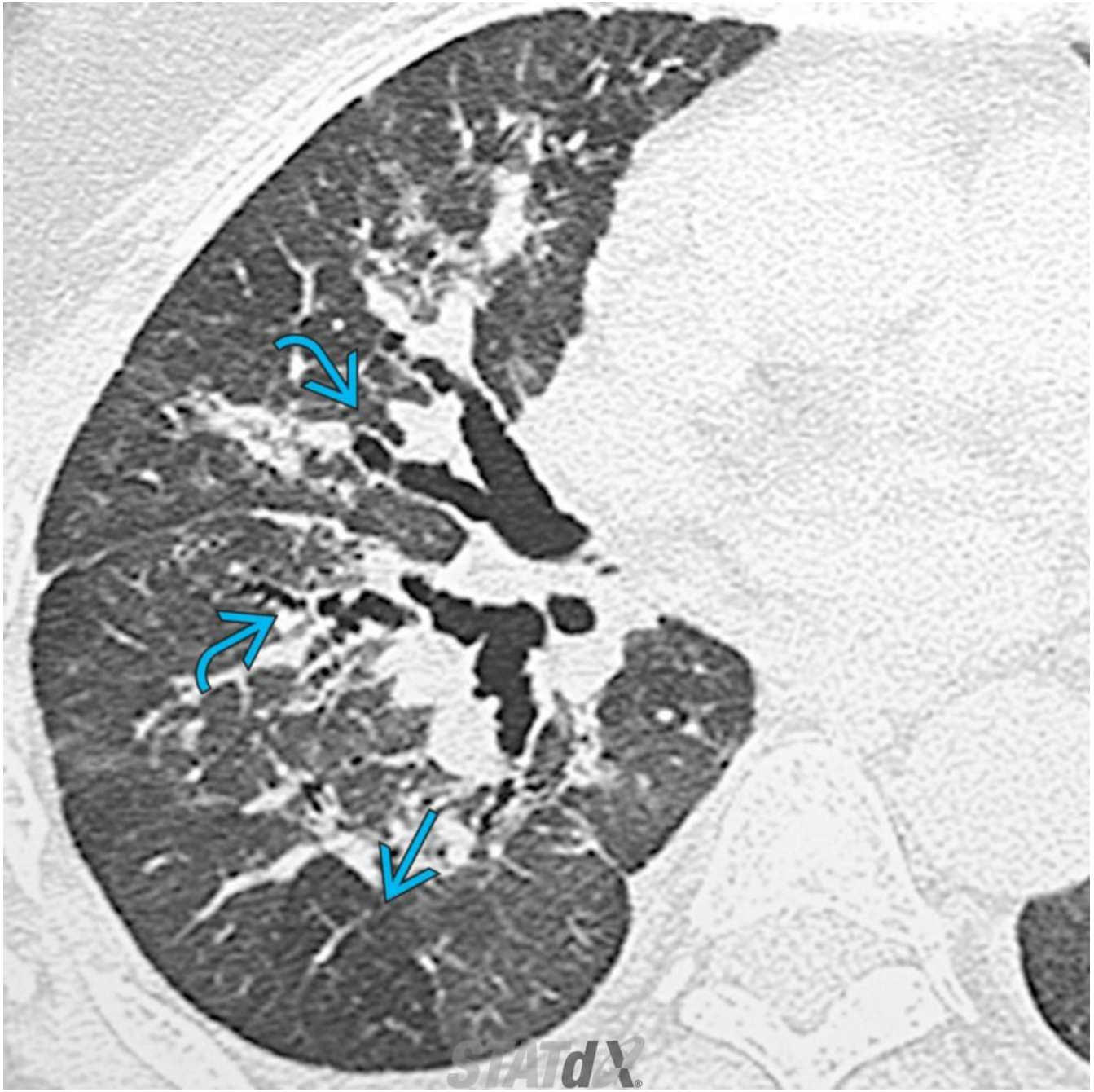
- 细支-感染性
- 吸入
- CB（原发和继发）
- HP
- DPB
- FB
- RB（DIP）
- 气道中心纤维化
- 原发性弥漫神经内分泌细胞增生



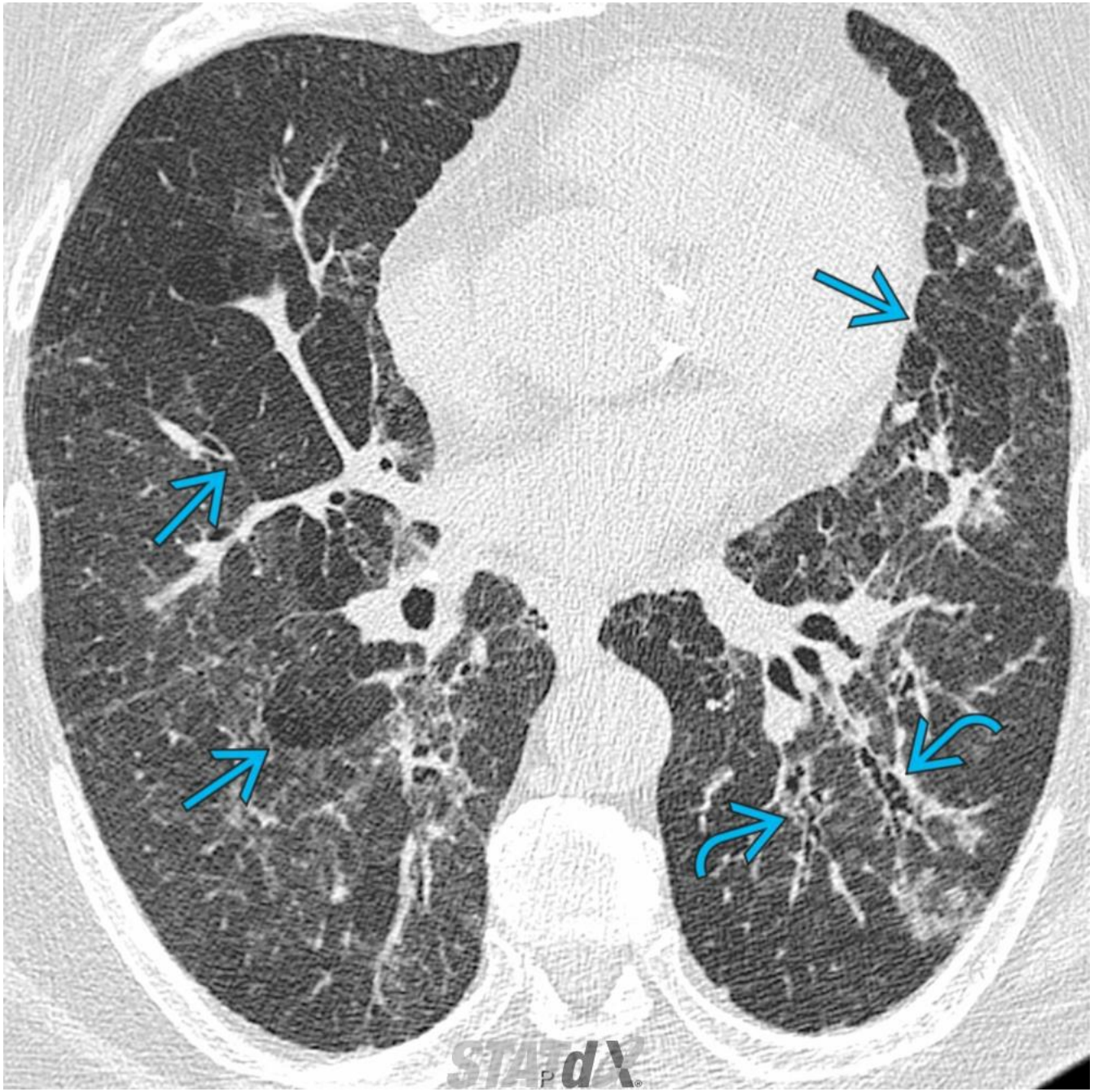
Axial expiratory HRCT of the same patient shows geographic mosaic attenuation (cyan solid arrow) due to small airways disease. Note small caliber of pulmonary vessels in areas of decreased attenuation (white open arrow). The most common etiologies of ACIF are hypersensitivity pneumonitis and gastroesophageal reflux



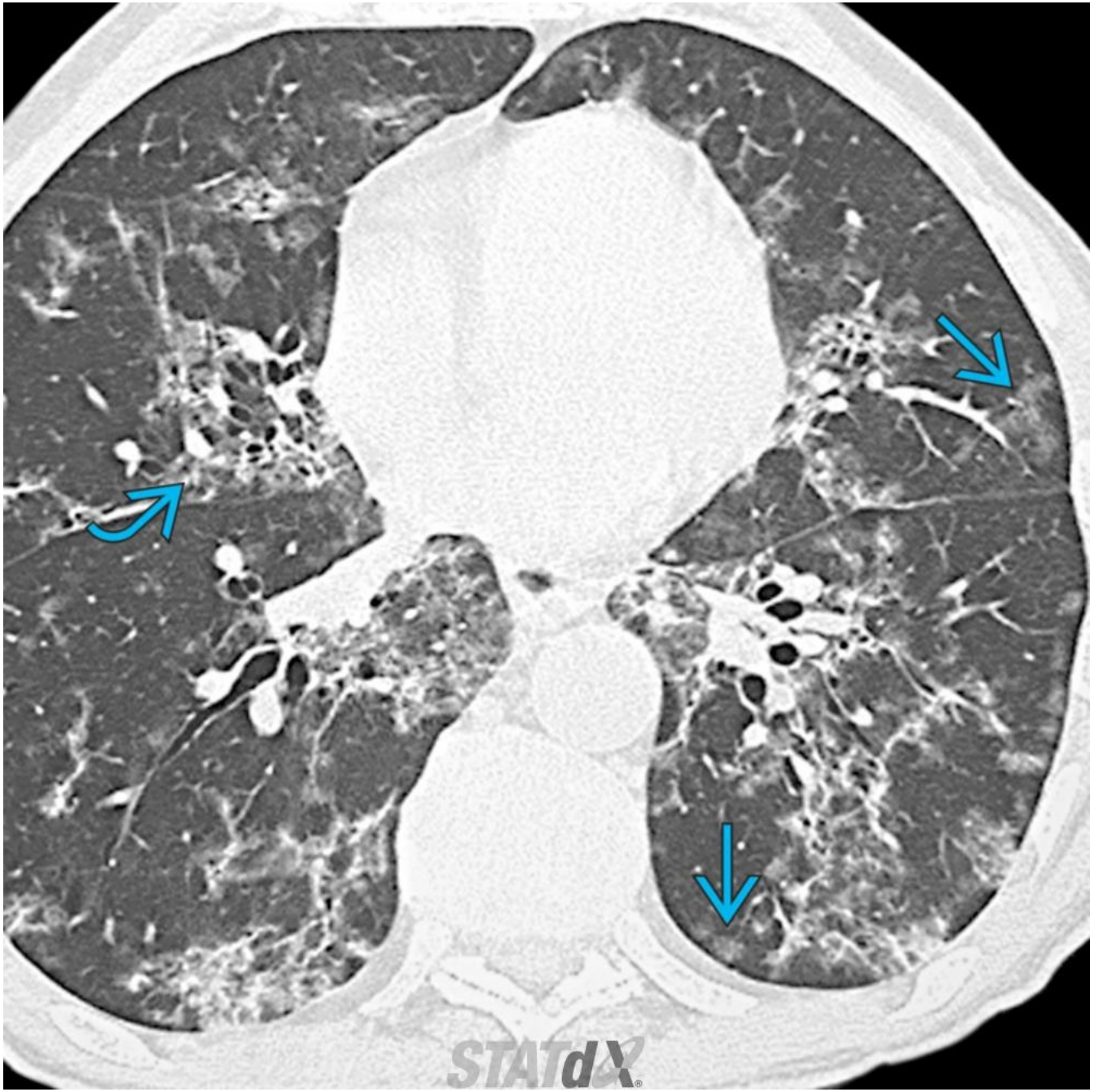
Coronal NECT of the same patient shows multifocal ground-glass opacities (cyan solid arrow) mostly in a peribronchovascular distribution. Note an asymmetric mosaic attenuation pattern (white curved arrow) and right upper lobe focal tree-in-bud opacities (cyan curved arrow).



Axial NECT of a patient with airway-centered interstitial fibrosis shows peribronchovascular thickening and traction bronchiectasis (cyan curved arrow) and air-trapping (cyan solid arrow). Cryobiopsy confirmed the diagnosis of airway-centered interstitial fibrosis.

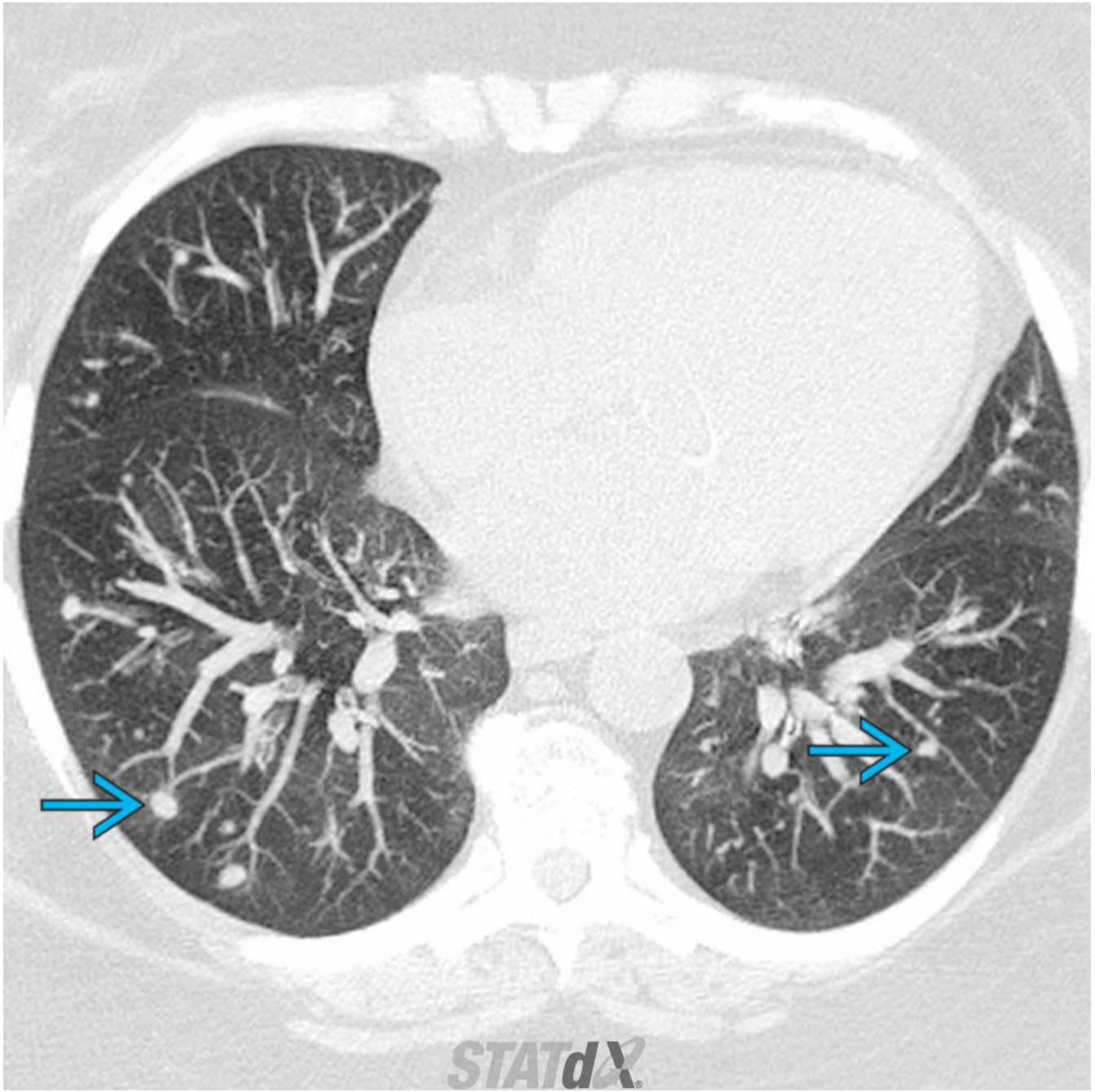


Axial HRCT of a patient with airway-centered interstitial fibrosis shows peribronchovascular thickening and irregular airway dilatation secondary to traction bronchiectasis consistent with mild interstitial fibrosis (cyan curved arrow). Note scattered areas of air-trapping (cyan solid arrow).

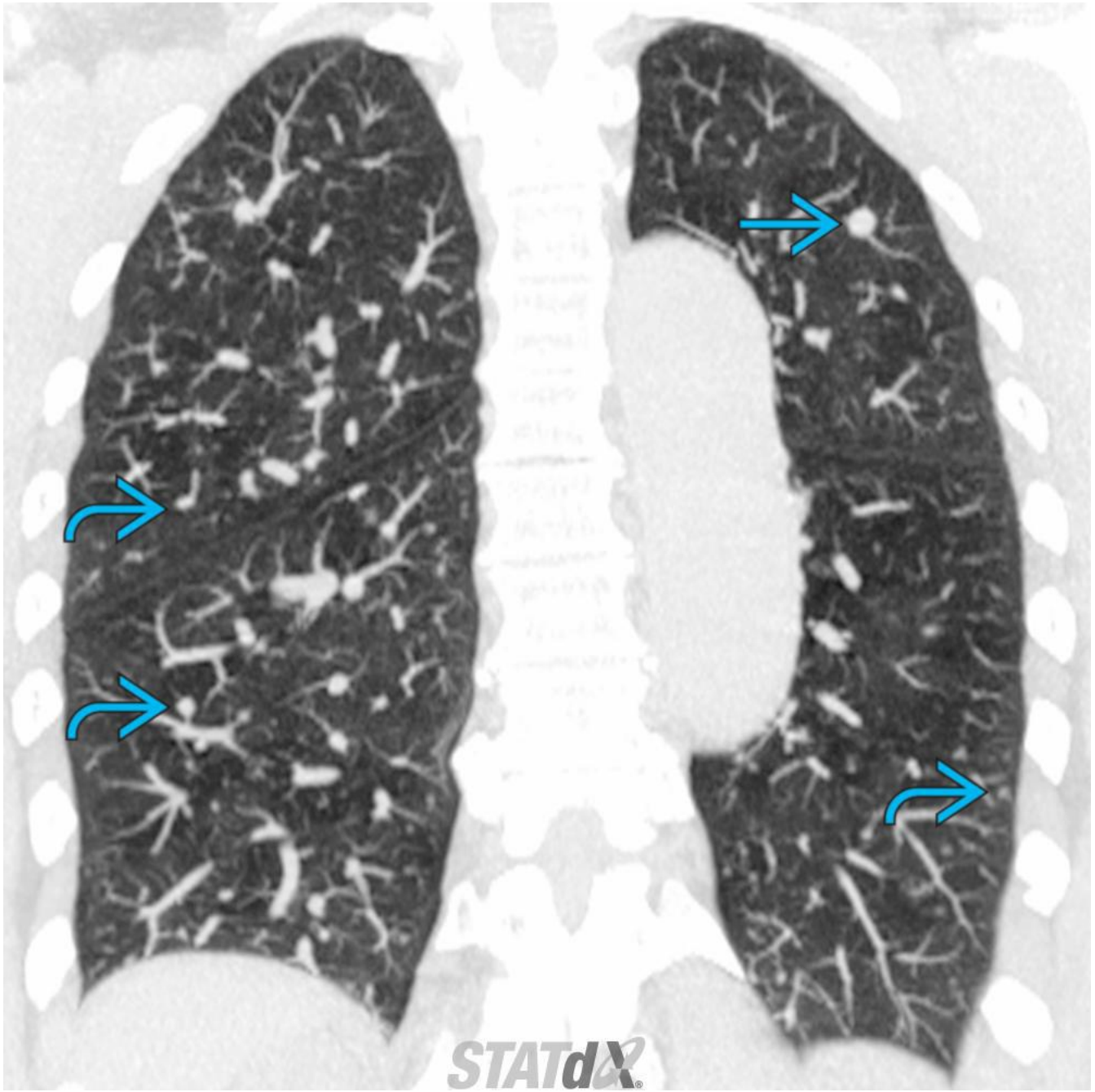


Axial HRCT of a patient with ACIF shows multifocal bilateral, asymmetric, peribronchovascular ground-glass opacities with central and peripheral reticular opacities (cyan curved arrow). When fibrosis is present, findings of architectural distortion are usually mild. Ill-defined centrilobular nodules (cyan solid arrow) are visible in the

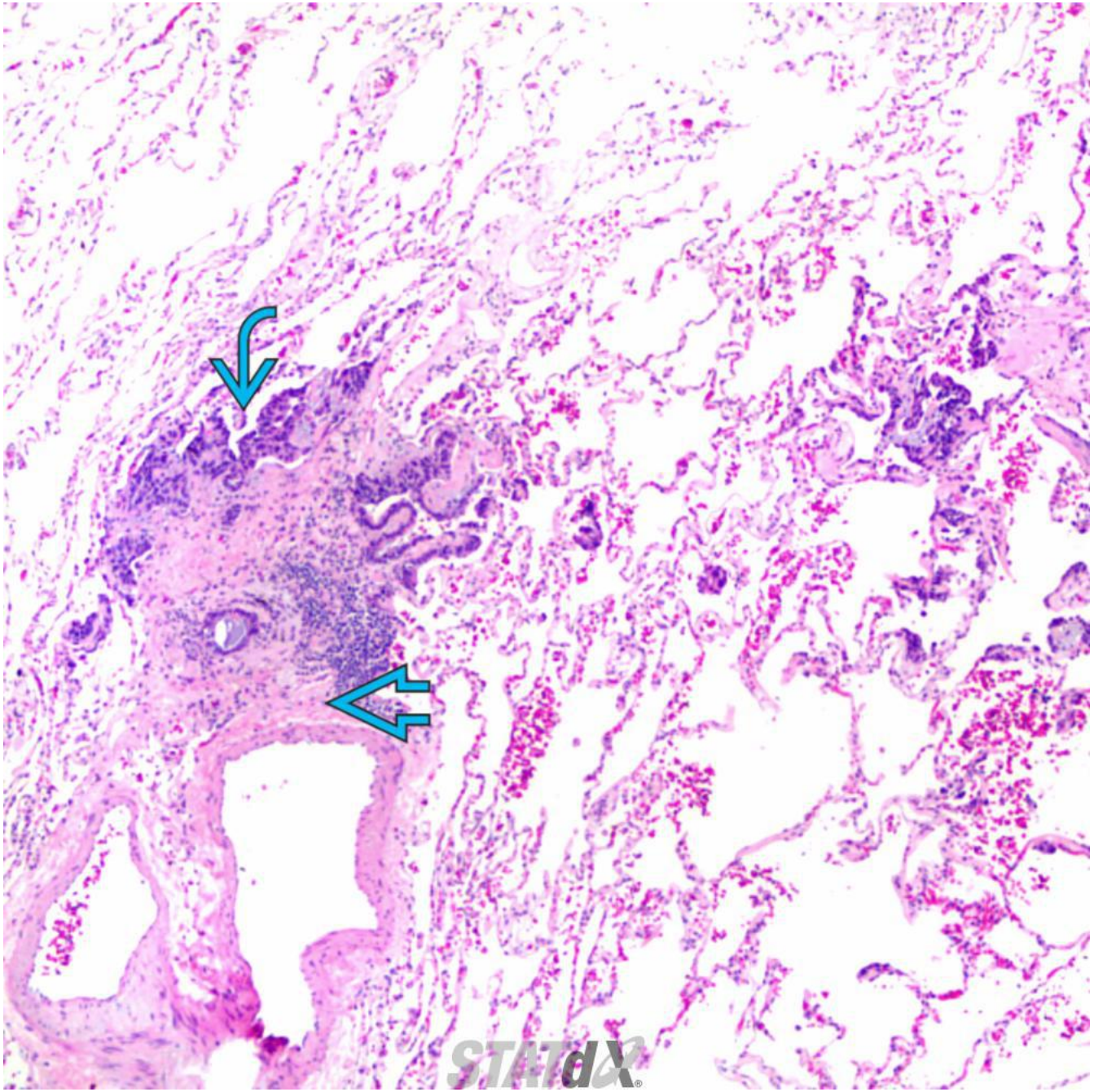
- 细支-感染性
- 吸入
- CB（原发和继发）
- HP
- DPB
- FB
- RB（DIP）
- 气道中心纤维化
- 原发性弥漫神经内分泌细胞增生



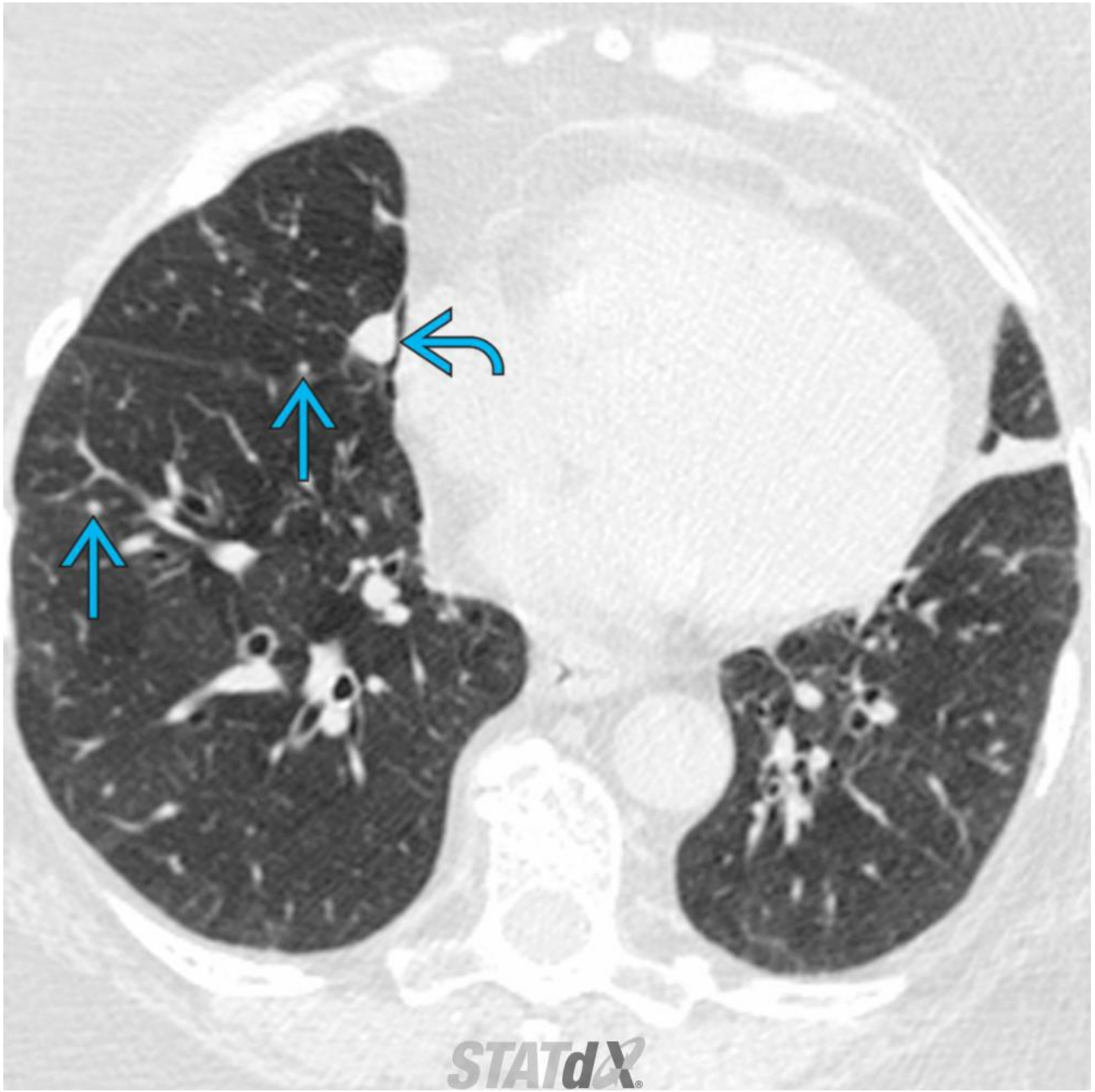
Axial NECT MIP reformation of the same patient shows multifocal bilateral pulmonary nodules (cyan solid arrow) to better advantage. MIP reformation highlights high-attenuation structures, such as nodules and blood vessels. Mosaic attenuation is still apparent on this image.



Coronal NECT MIP reformation shows the dominant left upper lobe nodule (cyan solid arrow) to better advantage. Multiple smaller lung nodules (cyan curved arrow) are visible in every lung lobe. These nodules correlate with neuroendocrine cell proliferations and tumorlets.



Low-power photomicrograph (H&E stain) of a specimen of diffuse idiopathic pulmonary neuroendocrine cell hyperplasia shows patchy lung involvement by neuroendocrine cell hyperplasia (cyan curved arrow) associated with slight bronchiolar metaplasia and fibrosis (cyan open arrow).



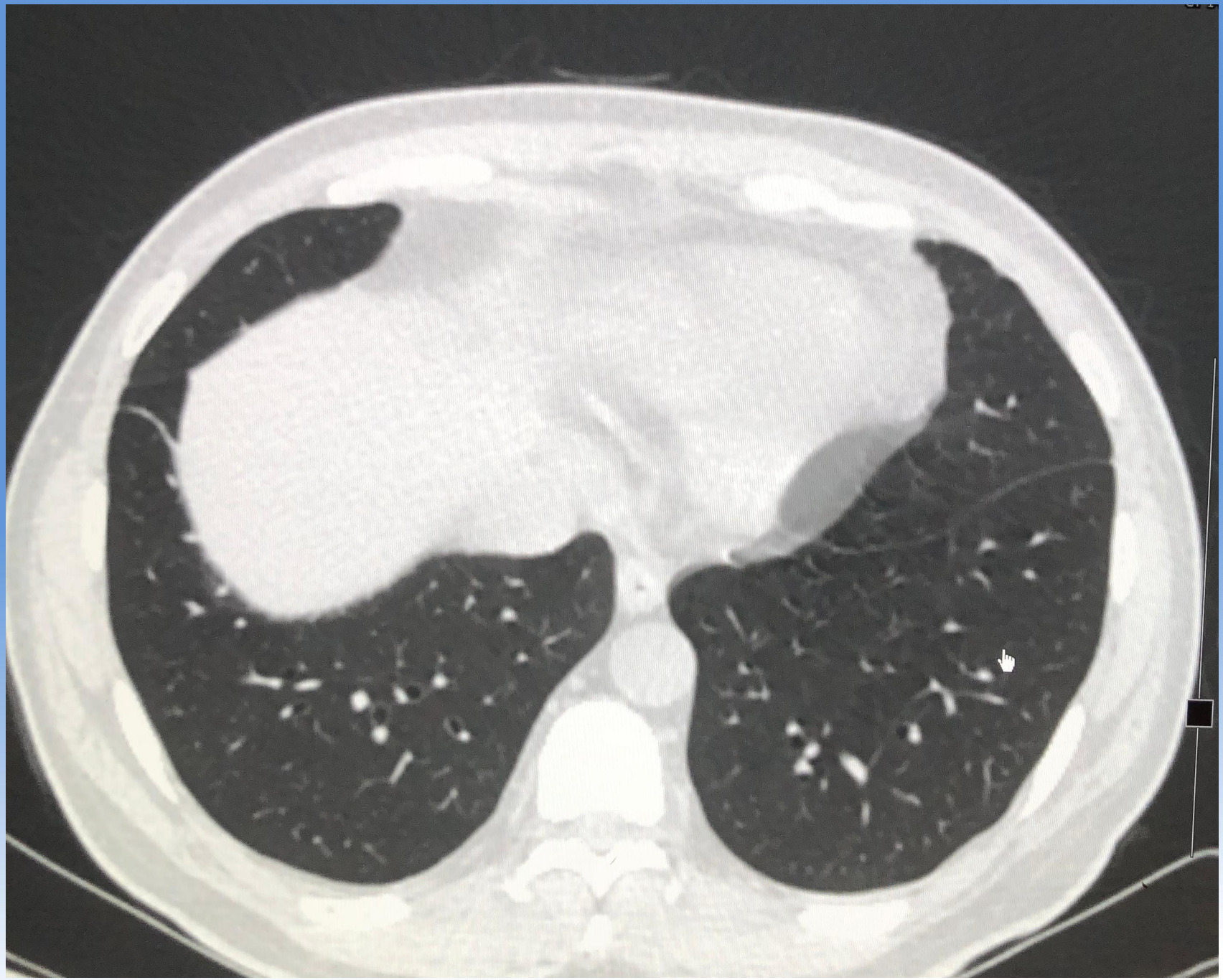
Axial NECT of a 78-year-old woman with diffuse idiopathic pulmonary neuroendocrine cell hyperplasia shows mosaic attenuation, multiple small nodules (cyan solid arrow), and a larger middle lobe nodule (cyan curved arrow), suspicious for carcinoid tumor given its size.

小气道病变的CT征象

- 直接征象：支气管－血管束、小结节、实变
- 间接征象：气体潴留
- 合并征象：气腔、间质

复习病例

- 男性，56，乏力，血氧降低8个月。
- 游走性红斑
- 血嗜酸细胞增高



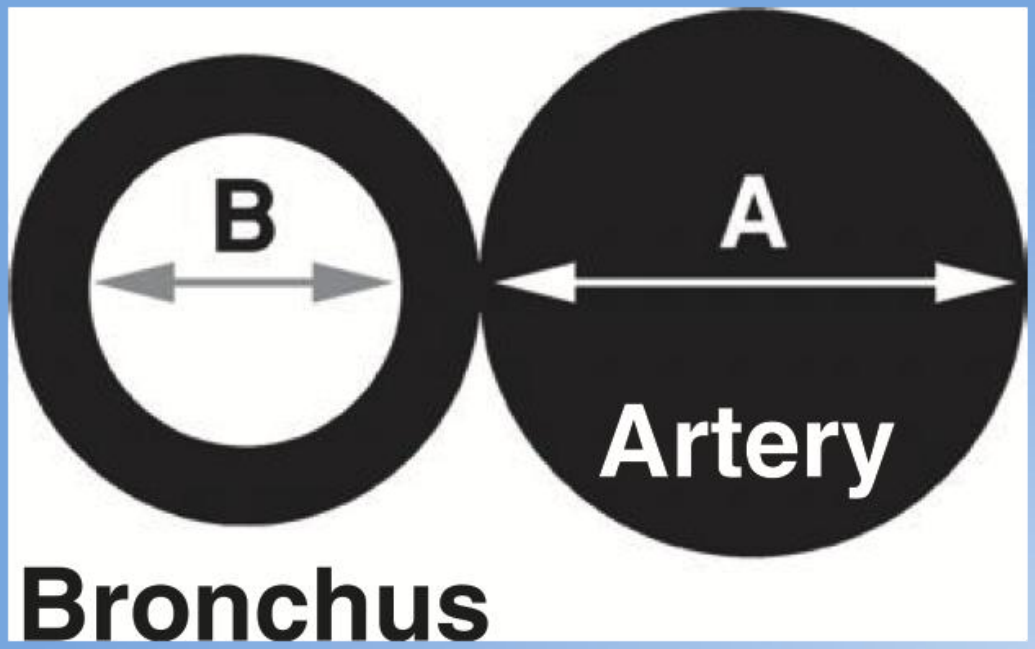
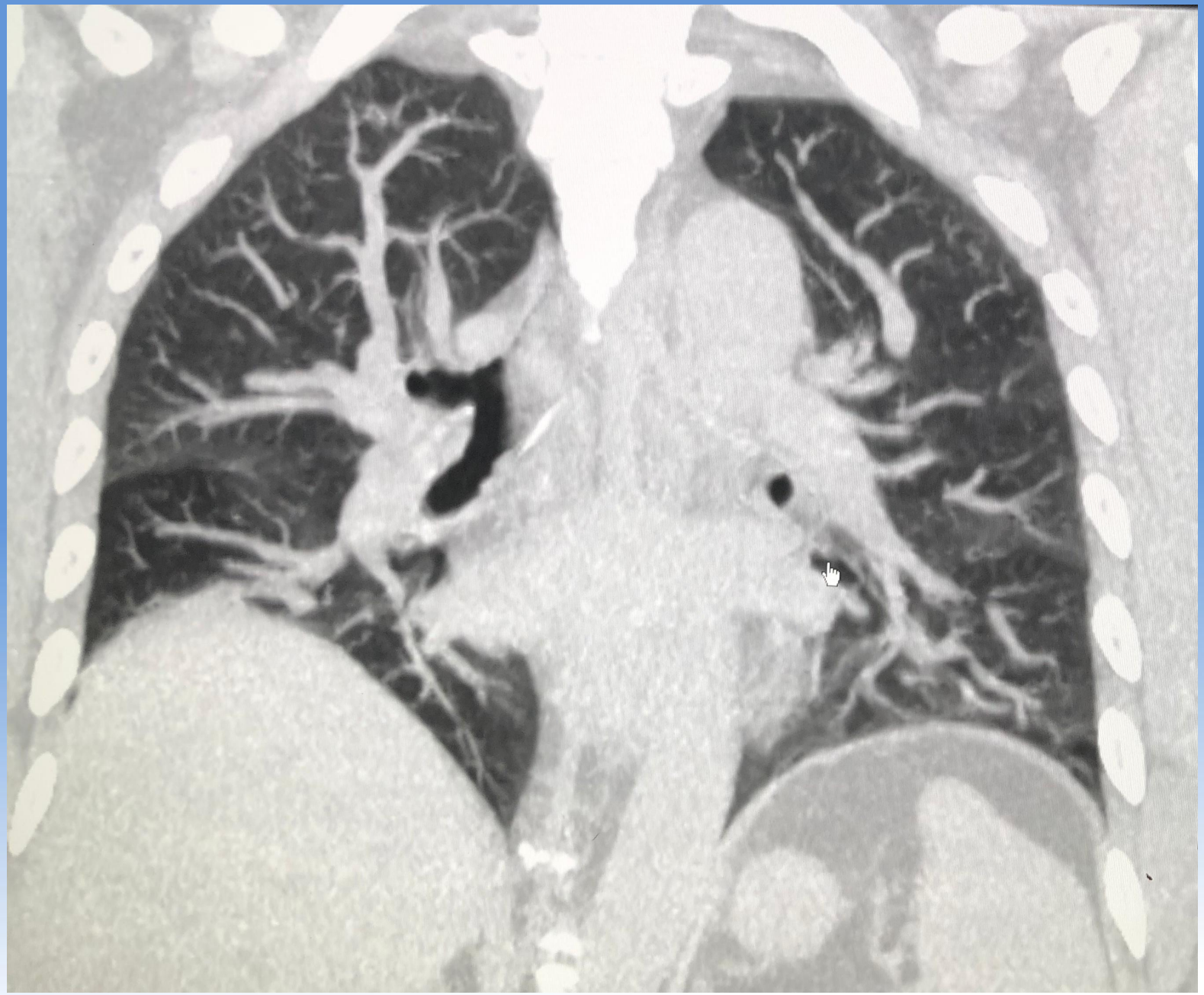
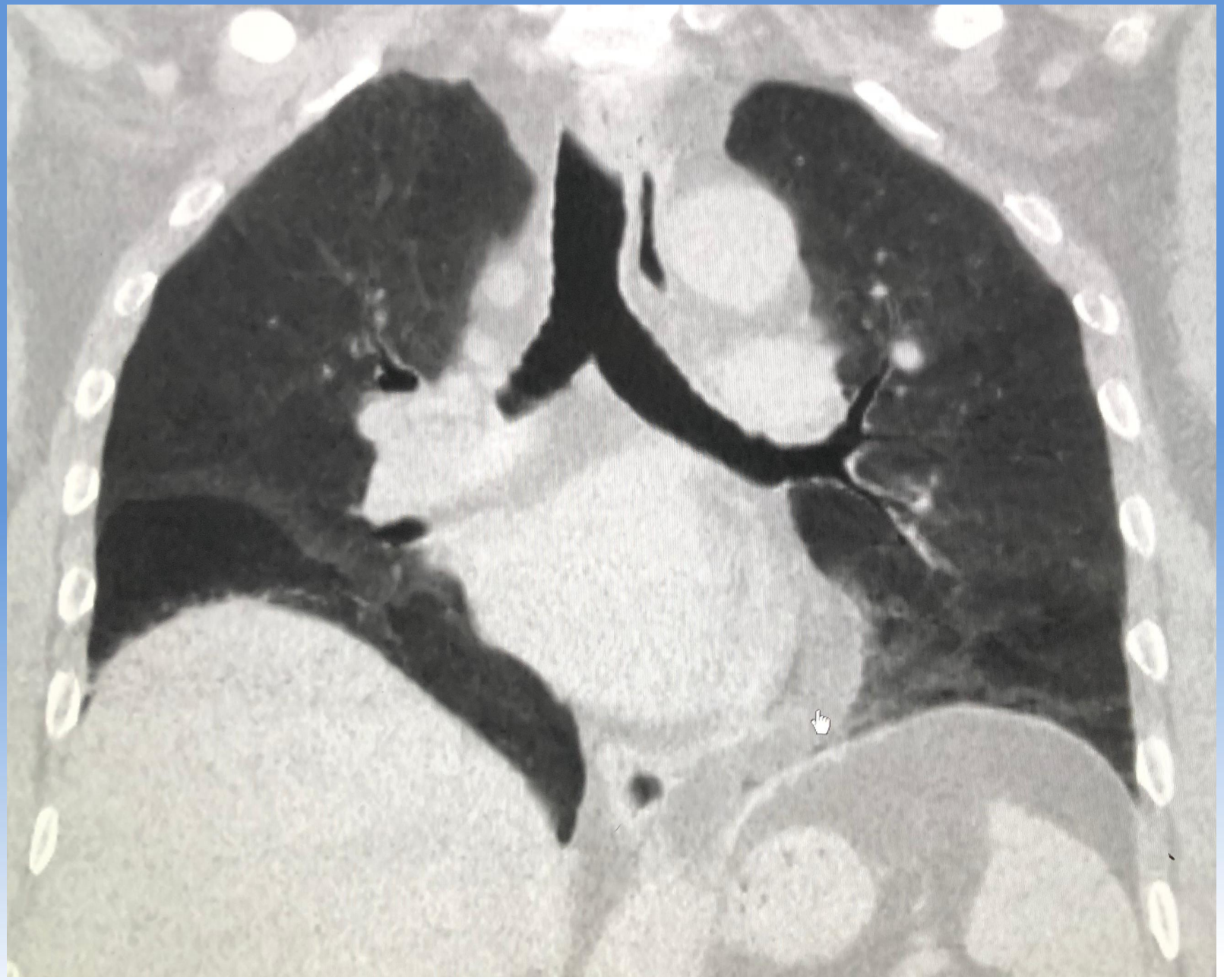


FIGURE 2-4 B/A ratio. The B/A ratio is calculated by dividing the internal diameter (i.e., luminal diameter) of the bronchus (*B*) by the diameter of the adjacent pulmonary artery (*A*). It averages 0.65 to 0.70 in normal subjects.





- 谢谢！
- 2018-05-24