

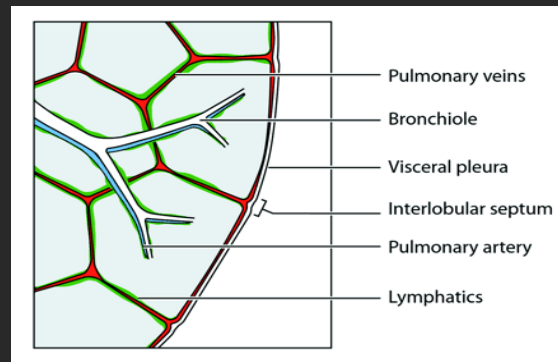
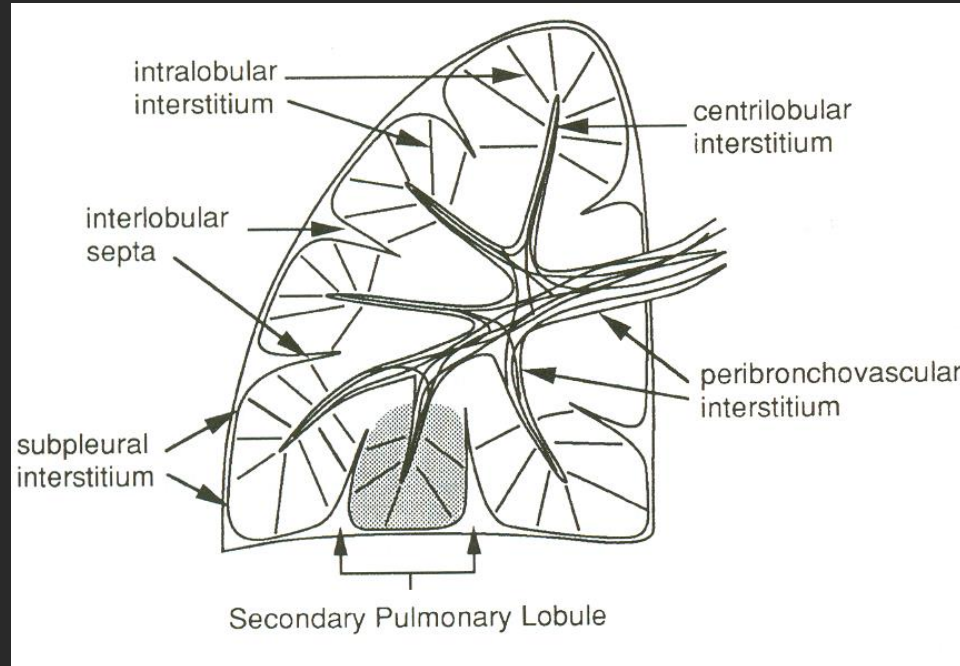
間質性肺病之影像判讀

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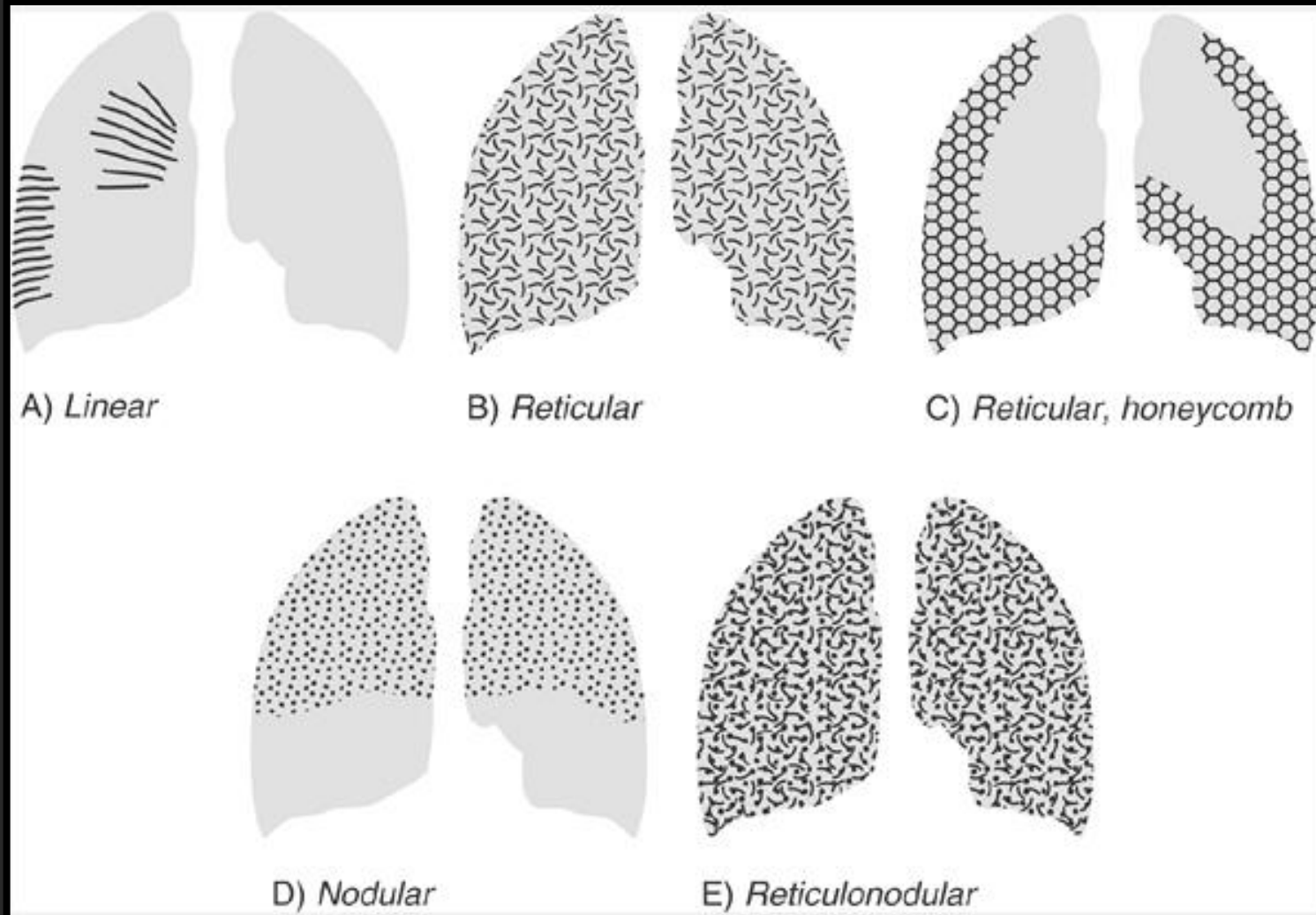
影像醫學部

Secondary Pulmonary Lobule



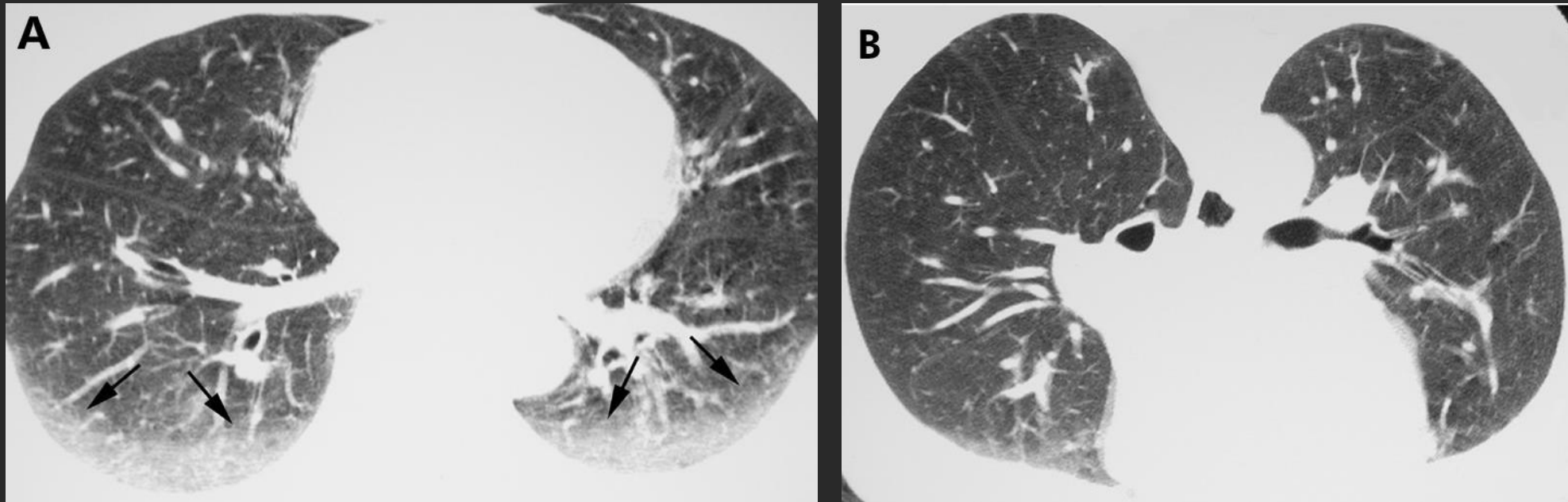
- **Axial interstitium**
Bronchiovascular bundle
(artery, bronchiol)
connective tissue, lymph
vessels, central core
- **Peripheral interstitium**
 - * **Interlobular septum**
- vein, connective tissue
lymph vessels
 - * **Intralobular septum**

Patterns of Interstitial Lung Disease



CT Technique

- Contiguous thin sections (≤ 2.5 mm but usually 1–1.5 mm) of the lung parenchyma on HRCT
- Prone imaging through the lung bases



Paired CT images



Paired inspiratory (left) and expiratory (right) HRCT



Paired HRCT without contrast (left) and with contrast (right)

Pattern of Diffuse Interstitial Lung Disease on CT

- 1. Predominantly reticular pattern
- 2. Multiple small pulmonary nodules
- 3. Decreased lung density
- 4. Heterogeneous or diffuse increase lung attenuation

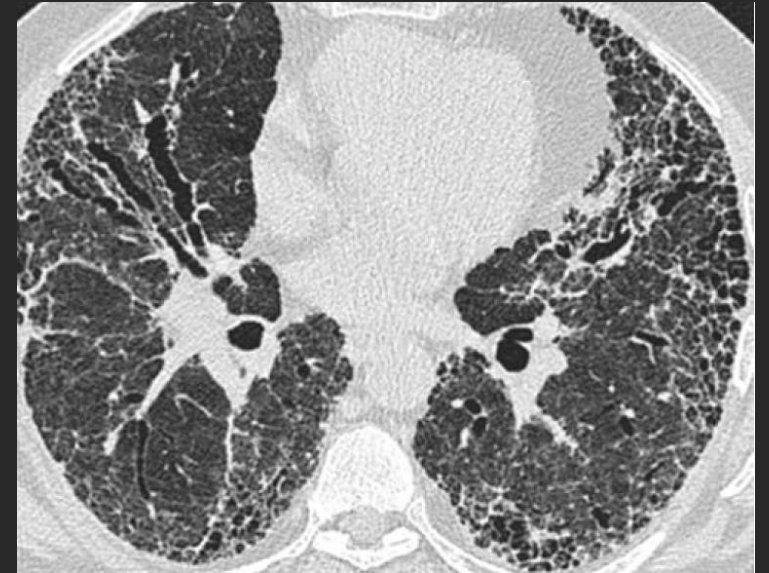
The HRCT signs of fibrosing lung disease

Reliability of individual HRCT signs of fibrotic lung disease

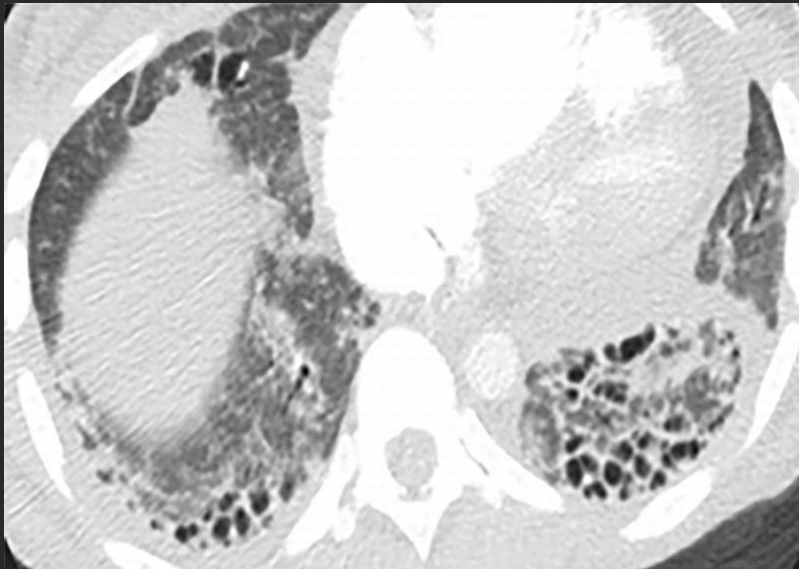
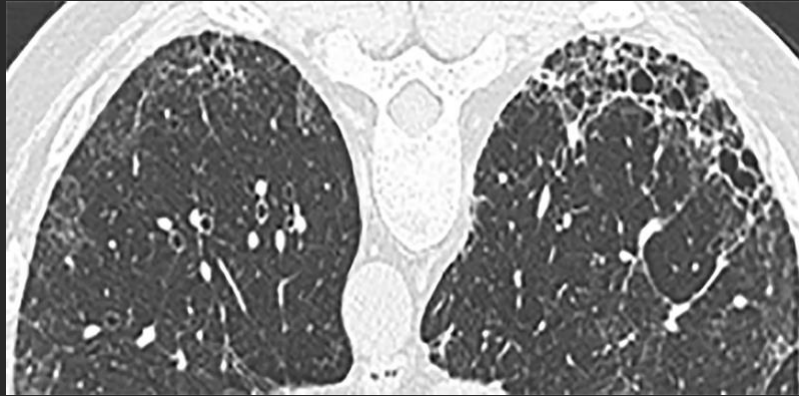
Honeycomb pattern	★	★	★	★
Traction bronchiectasis	★	★	★	★
Volume loss	★	★	★	★
All three signs present	★	★	★	★

Traction bronchiectasis/bronchiolectasis

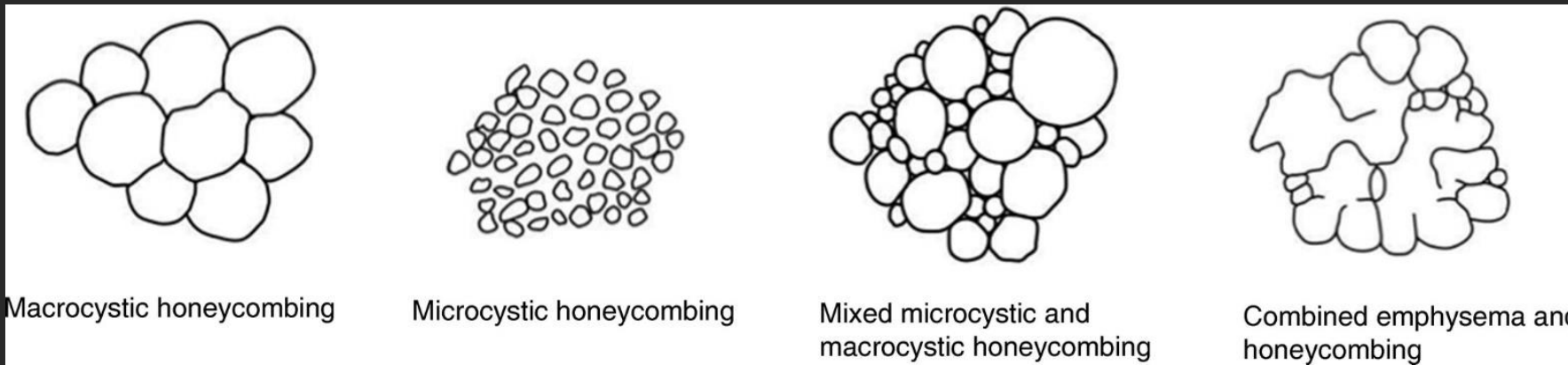
- Bronchial/bronchiolar dilatation without thick bronchial/bronchiolar wall in the abnormal background lung , either ground glass or reticular pattern



Honeycomb cysts



- An advanced and late-stage finding in fibrotic lung disease
- * HRCT
 - Clustered cystic airspaces (3–10 mm)
 - Subpleural (≥ 2 layers) and well-defined walls



Macrocytic honeycombing

Microcystic honeycombing

Mixed microcystic and macrocystic honeycombing

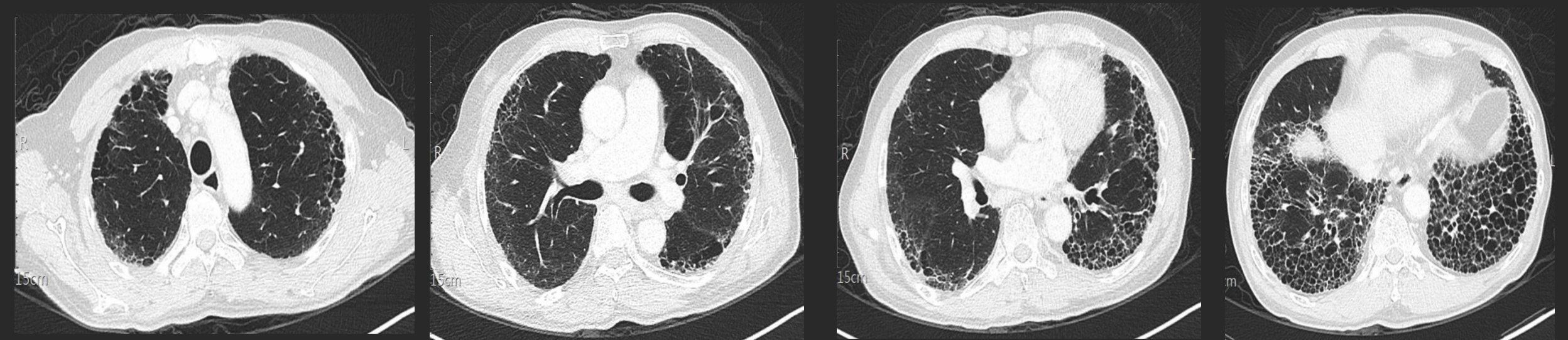
Combined emphysema and honeycombing

Macrocytic Honeycombing	Microcystic Honeycombing	Mixed Microcystic and Macrocytic Honeycombing	Combined Emphysema and Honeycombing
UIP	Early UIP	UIP	CPFE
Clustered bronchiectasis	Long-standing NSIP	CVD-IP (UIP pattern)	Sarcoidosis
CVD-IP	CVD-IP		UIP
Sarcoidosis			
Long-standing NSIP			

Definition of abbreviations: CPFE = combined pulmonary fibrosis and emphysema; CVD = collagen vascular disease; CVD-IP = CVD-associated interstitial pneumonia; NSIP = nonspecific interstitial pneumonia; UIP = usual interstitial pneumonia.

Predominantly **Reticular Pattern** **with** Traction Bronchiolectasis/Honeycombing

- With **UIP/IPF or Probable UIP/IPF**
 - Subpleural lower zone predominant (especially CP angles), heterogeneous reticulation, honeycombing or traction bronchiectasis, some upper lobe peripheral reticulation
 - DD: IPF. UIP (asbestosis; rheumatoid arthritis)



CTD-ILD



Anterior upper lobe sign



The straight-edge sign



Exuberant honeycombing sign

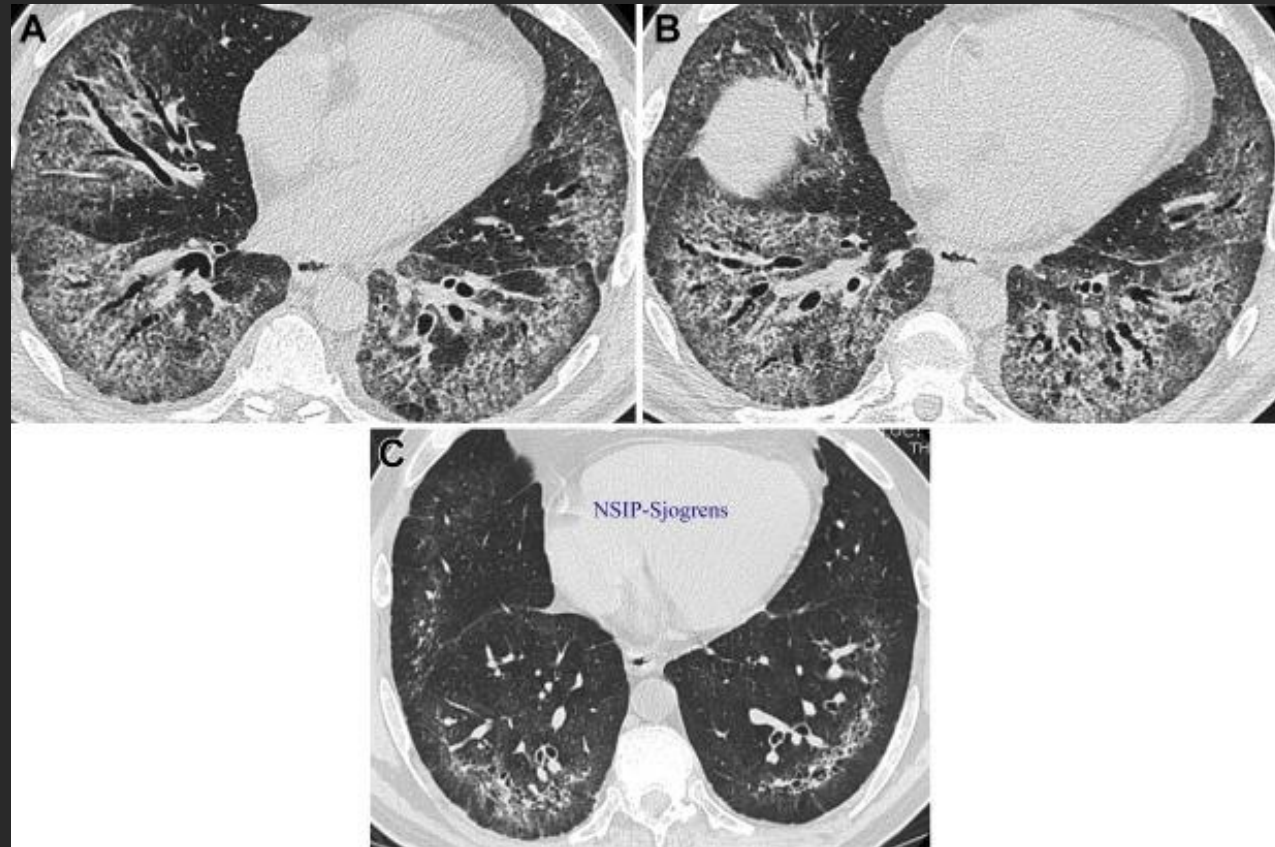
Predominantly **Reticular Pattern** **with** Traction Bronchiolectasis/Honeycombing

- **Without features diagnostic of UIP**

- Not lower zone/CP angle predominant, absent upper lobe peripheral reticulation, homogeneous appearance, traction bronchiectasis (with or without bronchiolectasis), septal thickening with lobular distortion, prominent intralobular lines, variable ground-glass attenuation/consolidation
- DD: fibrotic interstitial lung disease (indeterminate UIP, fibrotic NSIP, fibrotic HP, organizing pneumonia, chronic gastric acid aspiration)

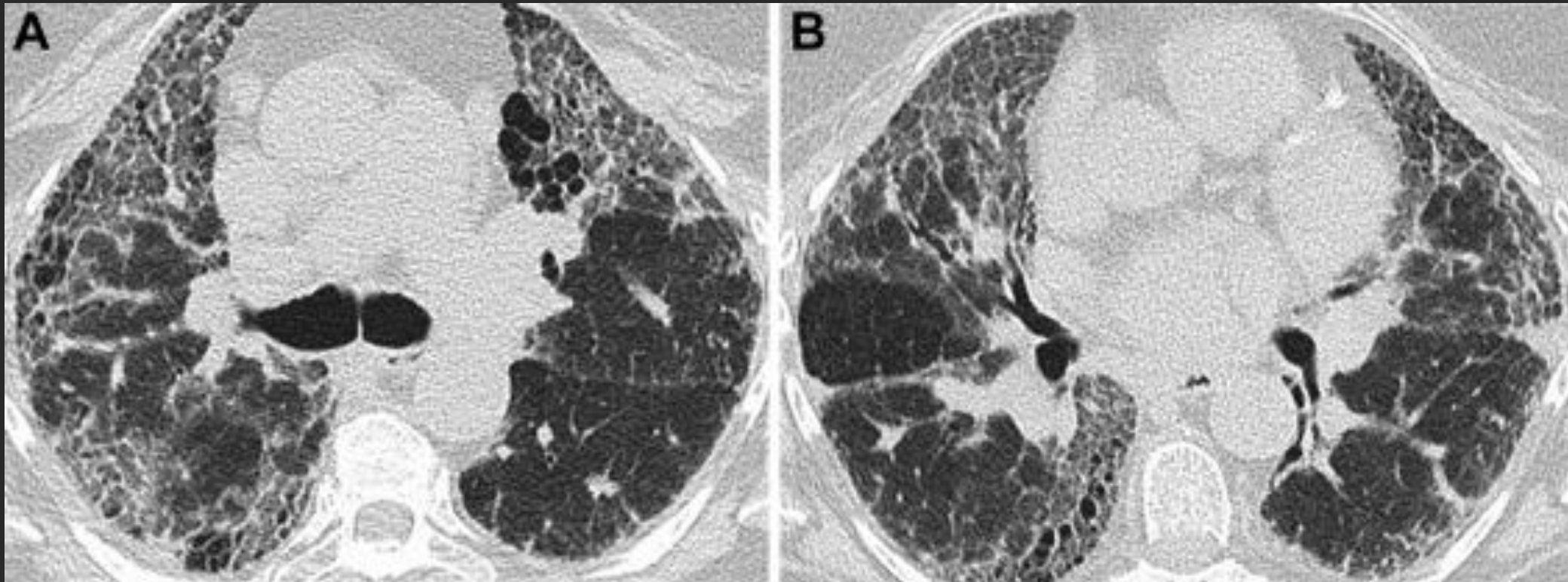
Nonspecific interstitial pneumonia (NSIP)

Widespread, bilateral ground-glass opacities, which may be associated with peripheral irregular linear or reticular opacities, subpleural sparing.



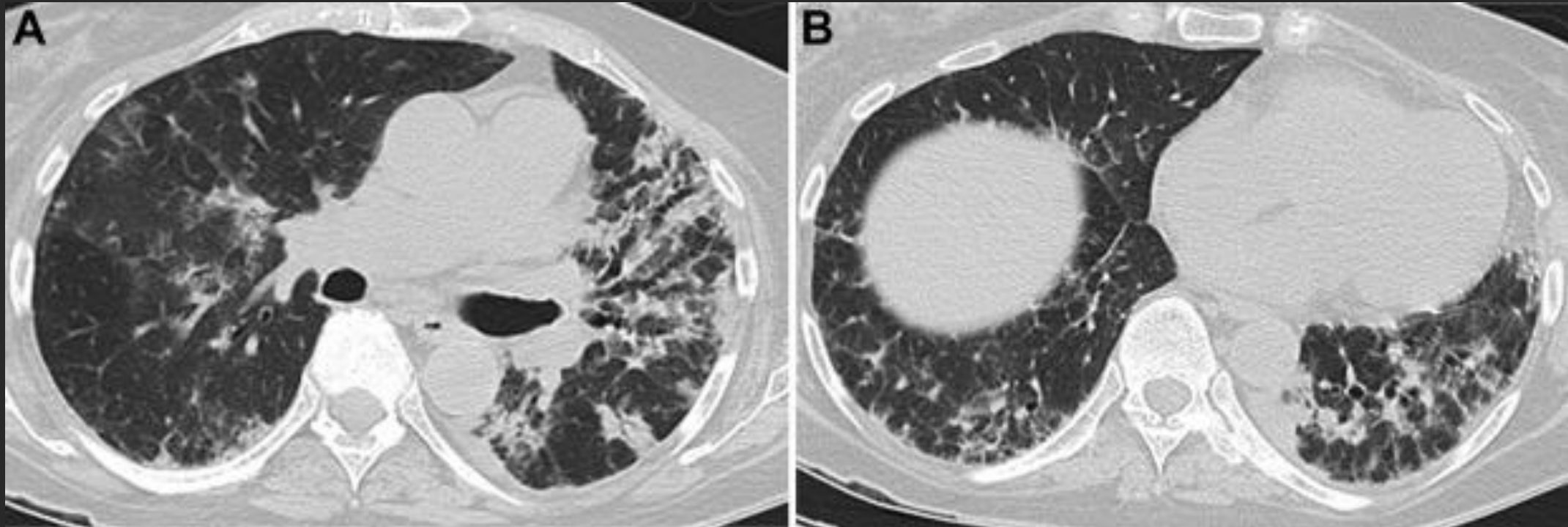
Chronic hypersensitivity pneumonitis (CHP)

Middle and upper zone predominant, lobular areas with air trapping, centrilobular nodules



Cryptogenic organizing pneumonia (COP)

- Typical, lower zone predominance, peripheral unilateral or bilateral peribronchovascular interstitial thickening and subpleural sparing
- Atypical appearance is perilobular pattern, GGOs with “reversed halo” sign, masses, migration on follow-up

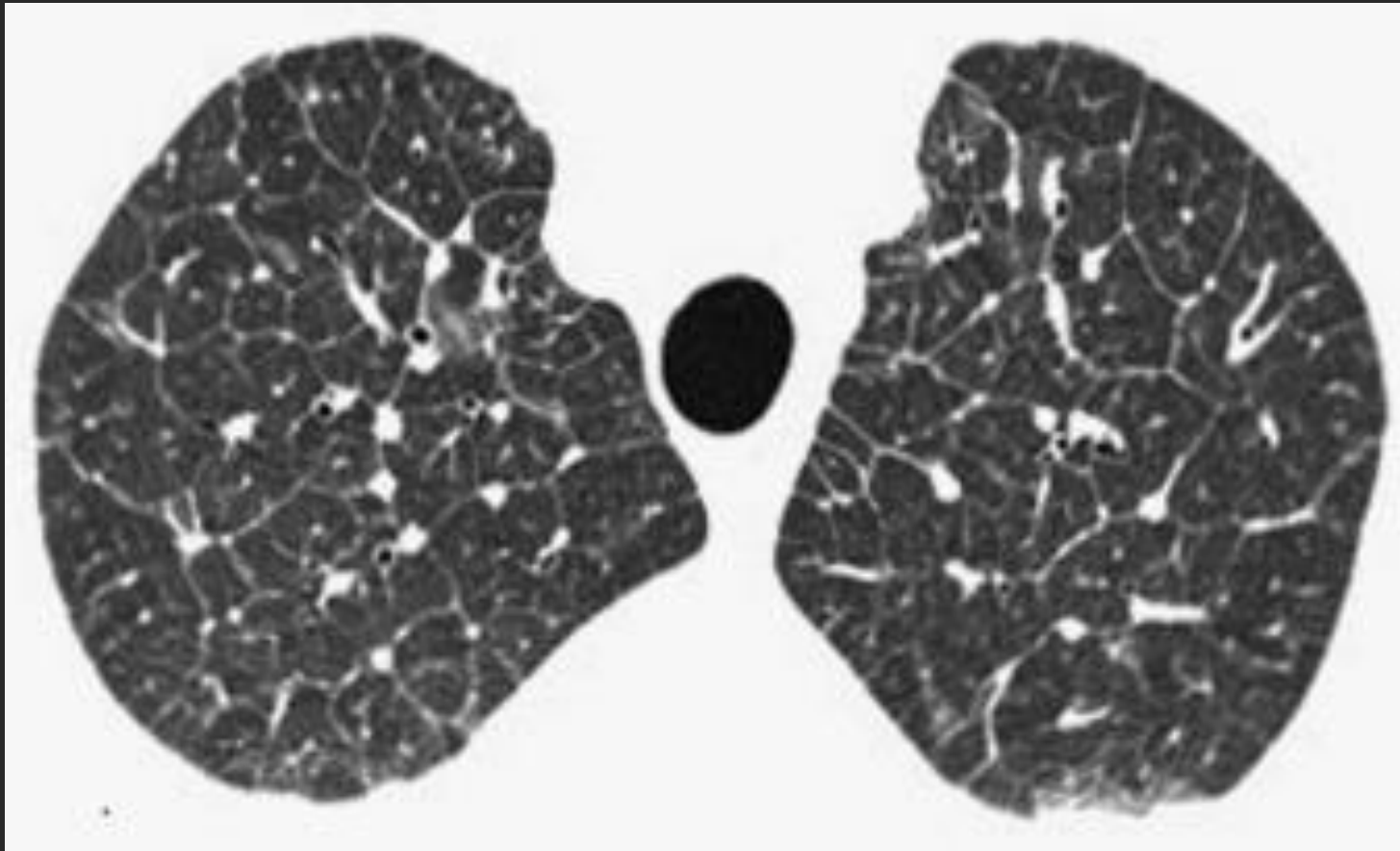


Predominantly Reticular Pattern without Traction Bronchiolectasis/Honeycombing

- CT finding:
 - Interlobular septal thickening with visible secondary lobules, minimal or no lobular distortion or intralobular lines, \pm discrete septal nodules, variable GGO
- Key Differentials
 - Interstitial pulmonary edema, lymphangitic carcinomatosis, lymphoproliferative disease, dendriform pulmonary ossification (DPO) (nodular, some ossified), septal amyloidosis (rare)

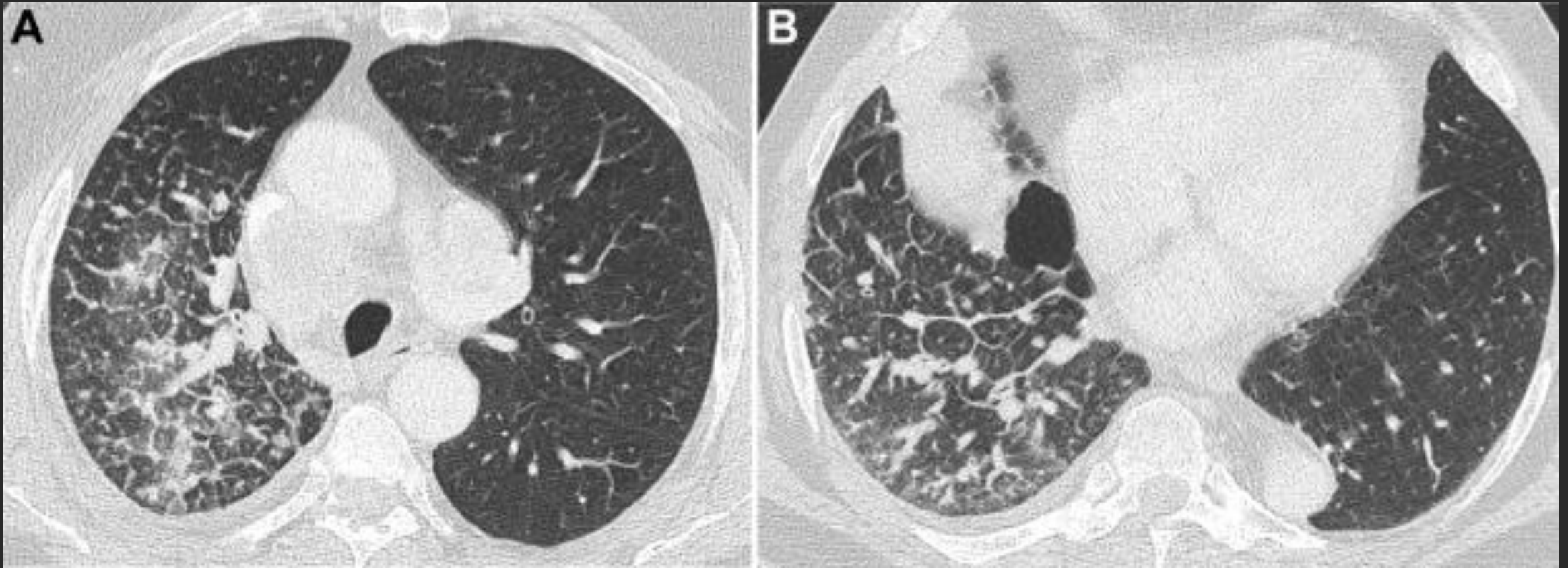
Interstitial pulmonary edema

Long-standing congestive heart failure, smoothly thickened interlobular septa



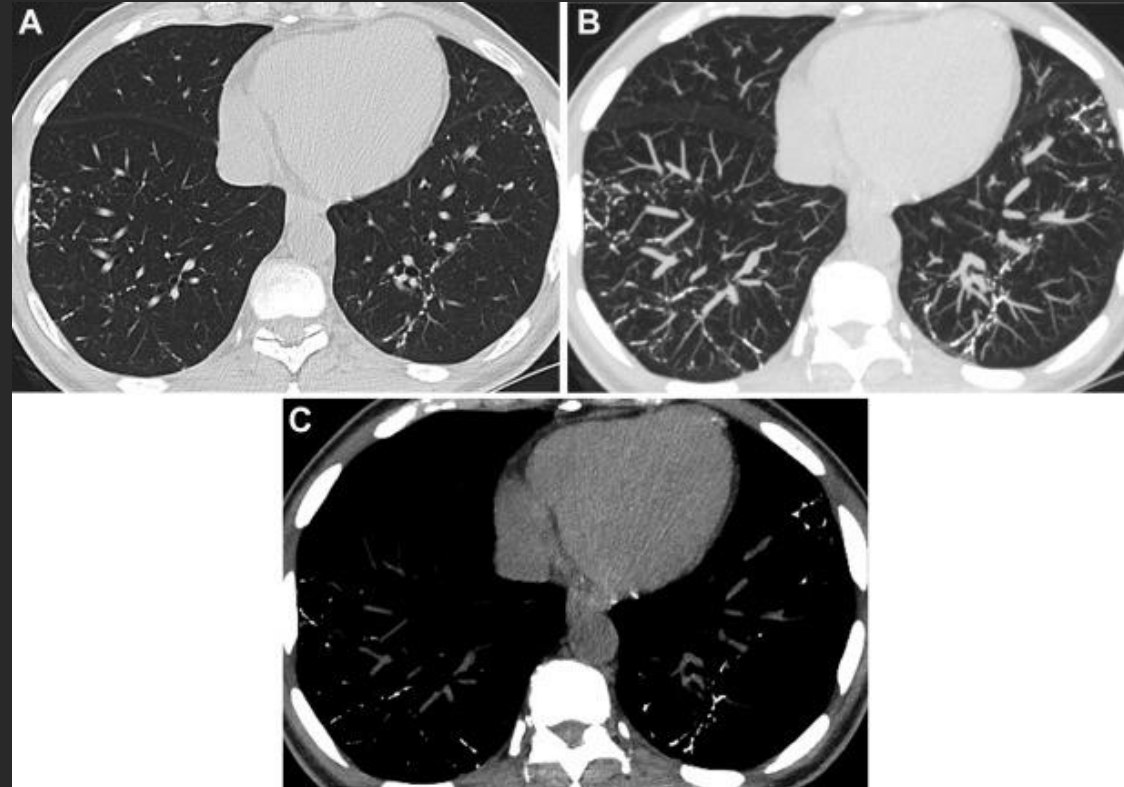
Lymphangitic cancer

Nodular thickening of interlobular septae



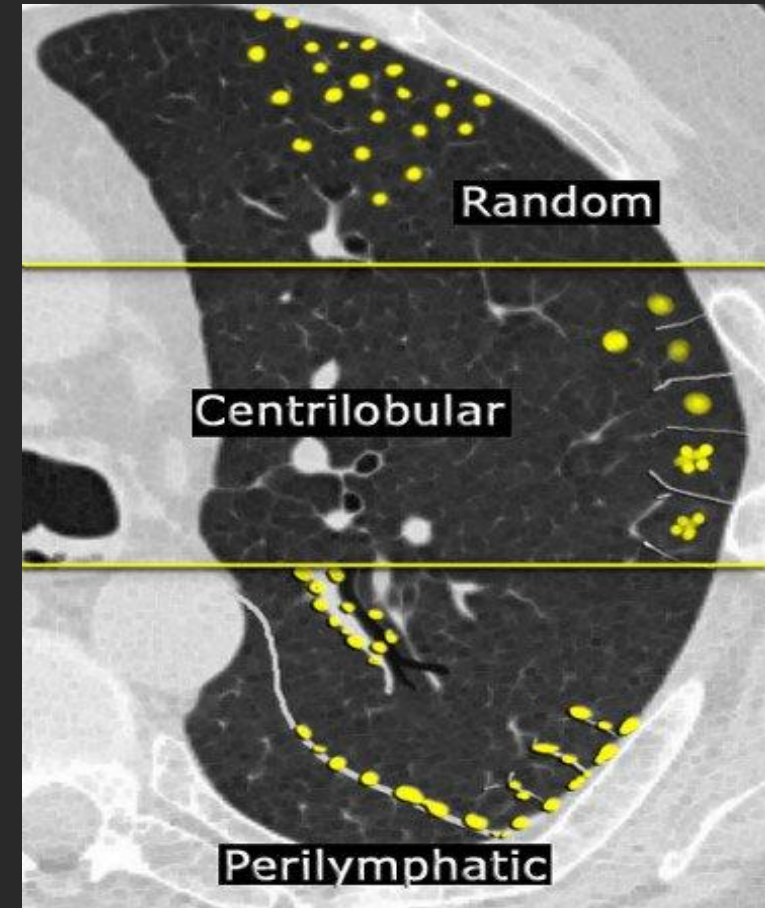
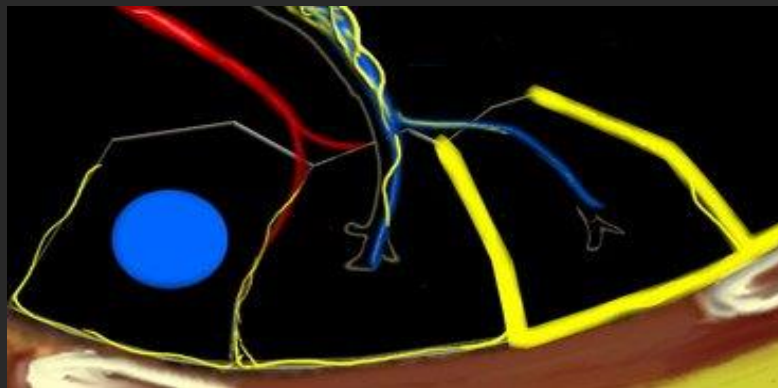
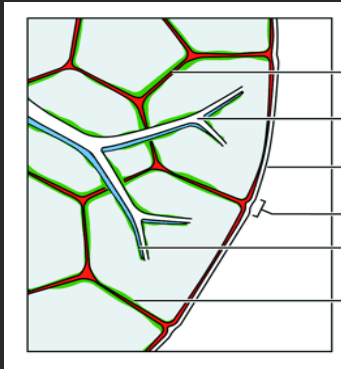
Dendriform pulmonary ossification(DPO)

Elderly patients (usually men) recurrent gastric acid aspiration, nodular septae (dendriform ,“tree-like”) (with some nodules appearing calcified), , the posterior and lateral basilar segments of the lower lobes



Diseases Associated With Multiple Small Nodules

- Centrilobular distribution
- Perilymphaitic distribution
- Random distribution

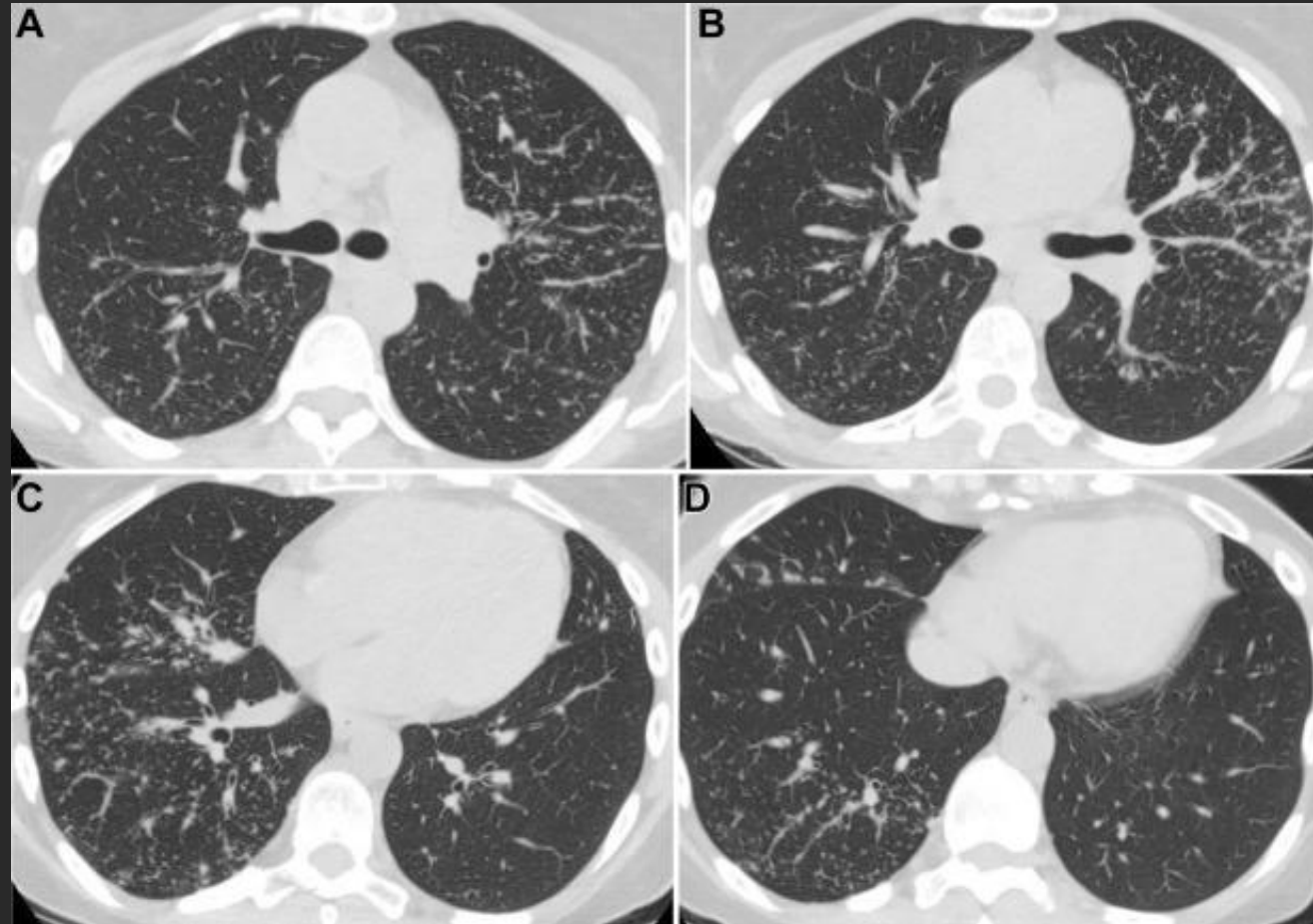


Distribution: **Pleural and/or Fissural Surfaces Involved**

- **Perilymphatic (interstitial) nodules**
 - * CT : small, clustered (“galaxysign”); “Beading of bronchovascular bundles
 - * Key Differentials: sarcoidosis; pneumoconiosis (silicosis; coal workers)
- **Random (hematogenous, miliary) nodules**
 - * CT: Well-defined; peripheral, lower, posterior zone; prominent feeding vessel (70%)
 - * Key differentials: metastases, miliary Infection, silicosis

Perilymphatic (interstitial) nodules due to sarcoidosis

Nodules along the fissure and bronchovascular bundle



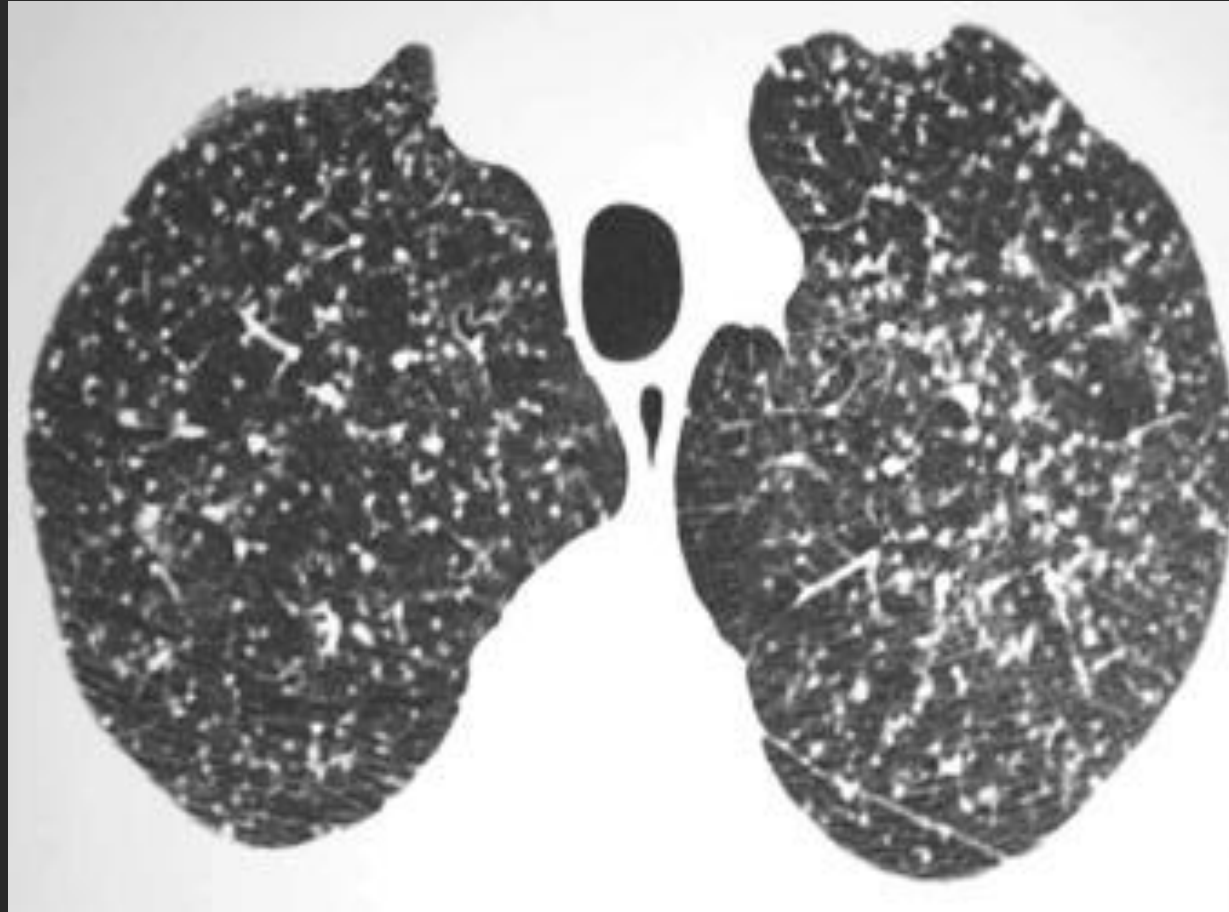
Hematogenous metastases

Random distribution nodules



Miliary TB

Random micronodules (<5mm) distribution

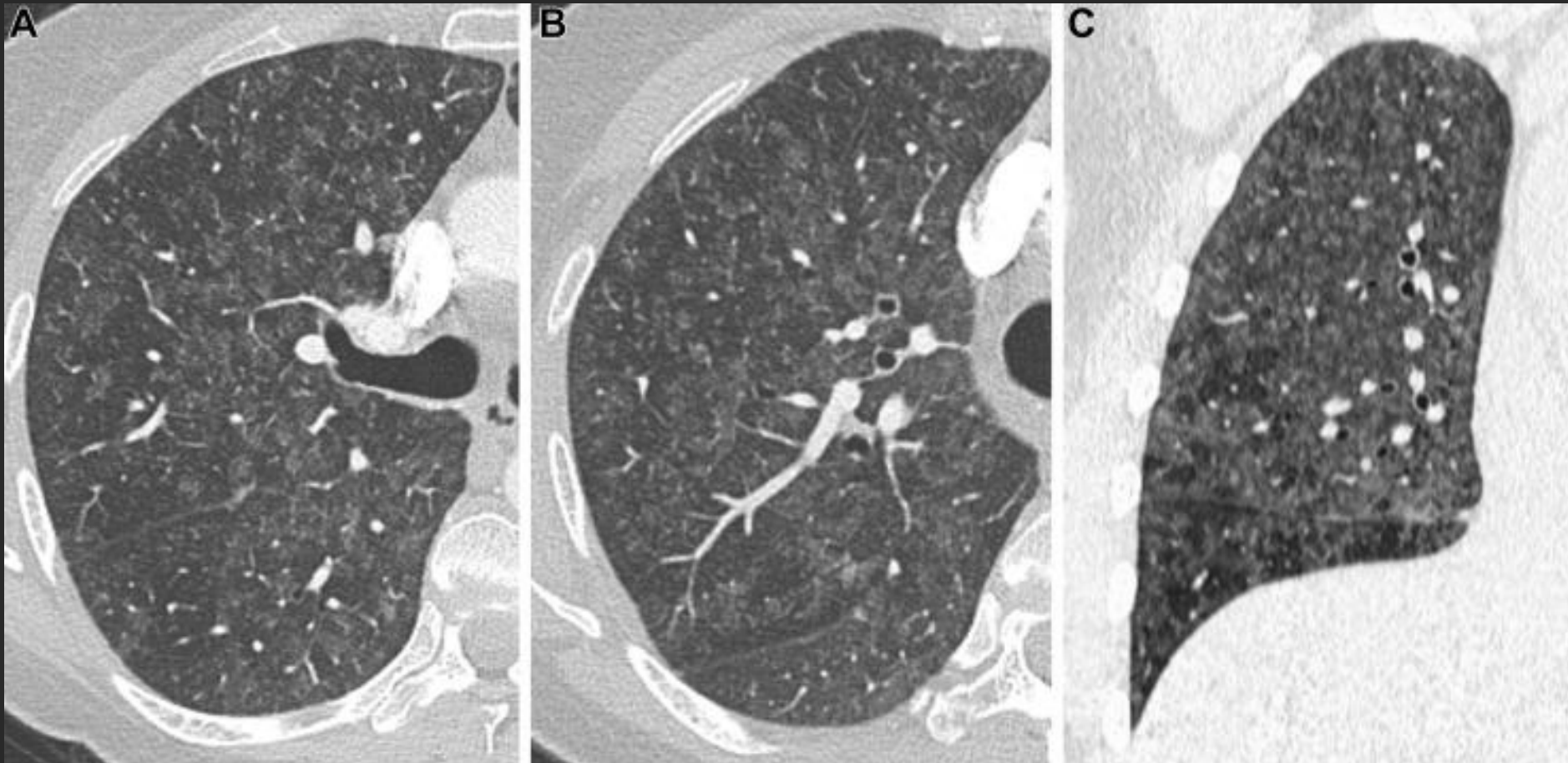


Pleural and Fissural Surfaces Spared

- Centrilobular, poorly defined GG nodules
- Key Differentials: hypersensitivity pneumonitis (cellular HP); respiratory bronchiolitis; vasculitis; hemorrhage.
- “Tree-in-Bud” or “Jacks”
- Key Differentials: infectious bronchiolitis, aspiration; tumor emboli (intravascular); perilymphatic nodules confined to the axial interstitium

Hypersensitivity pneumonitis

- Poorly defined centrilobular ground-glass attenuation and spare the pleural and fissural surfaces



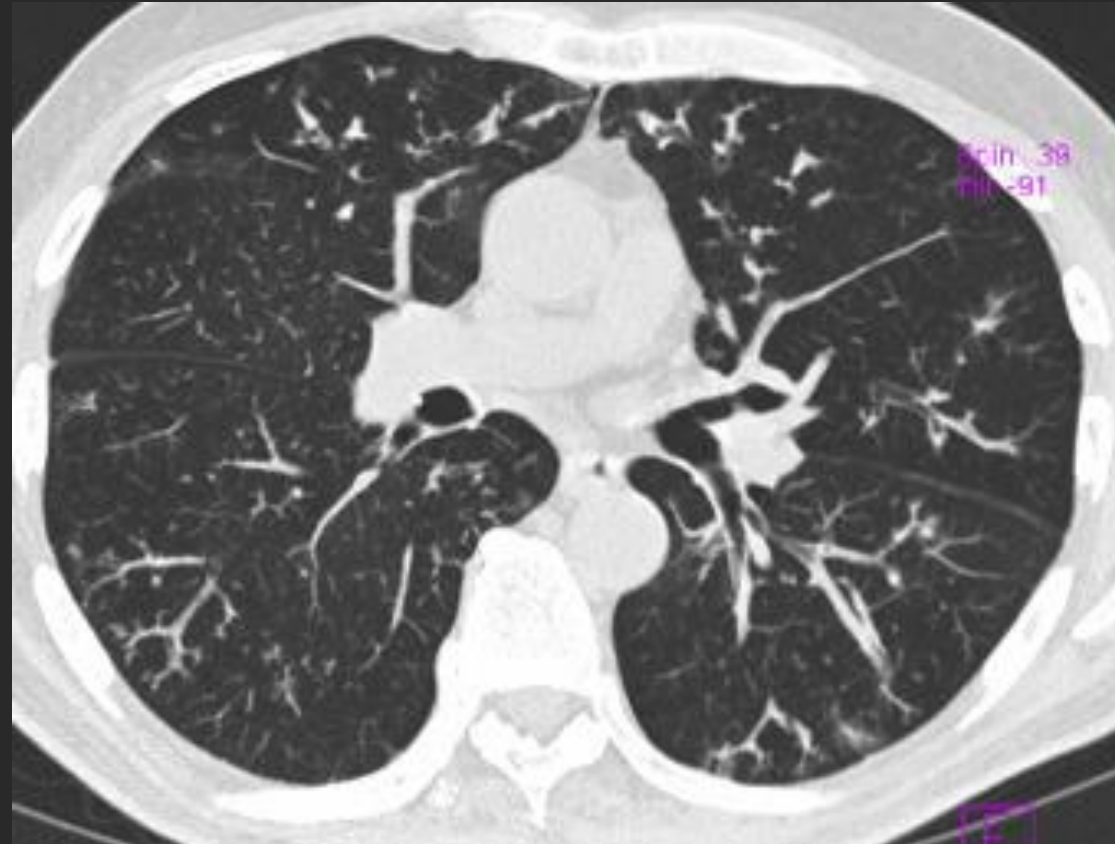
Respiratory bronchiolitis

Cigarette smokers, upper lobe , fuzzy centrilobular nodules of ground-glass attenuation sparing the pleural and fissural surfaces



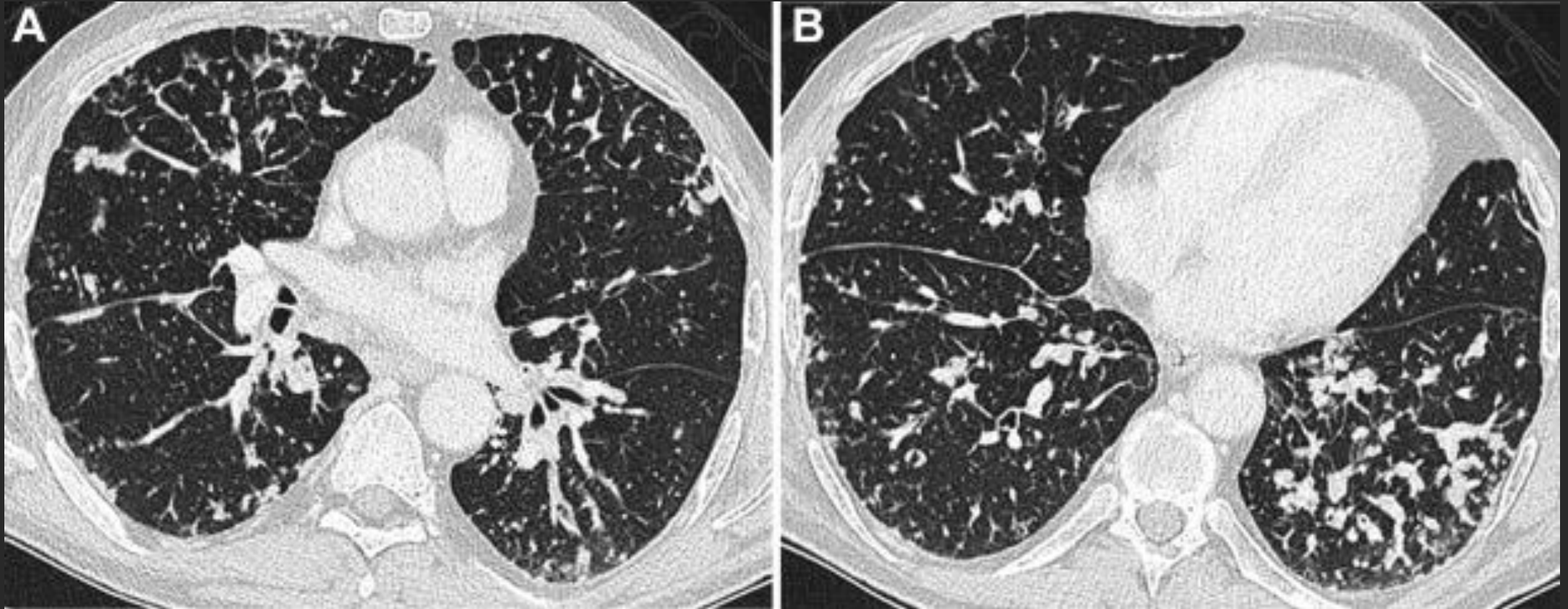
Infectious airway disease

- “tree-in-bud” configuration due to mucoid impacted peripheral small airways/bronchiole ,sparing of the pleural and fissural surfaces
- “tree-in-bud” opacities nearly always is secondary to infection



Metastatic cancer

Thickened interlobular septa, intravascular tumor emboli (tree-in-bud)



Miscellaneous Nodules

- Peribronchovascular Nodules
- Random Nodules (no specific localization)
 - Cavitory Nodules
 - "Halo Sign" or partial solid nodule
 - "Reverse Halo" (Atoll) Sign

Peribronchovascular Nodules

- CT: Peribronchovascular nodular or mass-like consolidation; Focal airbronchograms; irregular interfaces along bronchovascular bundles
- Key Differentials:
 - Organizing pneumonia
 - Lymphoproliferative disease
 - Lymphoma
 - Kaposi's sarcoma
 - Granulomatosis with polyangiitis

Random Nodules (no specific localization)

- **Cavitary nodules**

DD: septic emboli, infection, metastases, Langerhans cell histiocytosis, autoimmune disease

- **"Halo Sign" or partial solid nodule**

DD: invasive fungal infection, primary lung neoplasms, hemorrhagic metastases

- **"Reverse Halo" (Atoll) Sign**

DD: Hemorrhagic infarction (pulmonary embolism, invasive fungal infection, post ablation) , organizing pneumonia, lymphoma, sarcoidosis, radiation pneumonitis

Peribronchovascular consolidation

Sarcoidosis
(perifissural
nodularity)



Cryptogenic organizing
pneumonia



Immunoglobulin G-4
related vasculitis

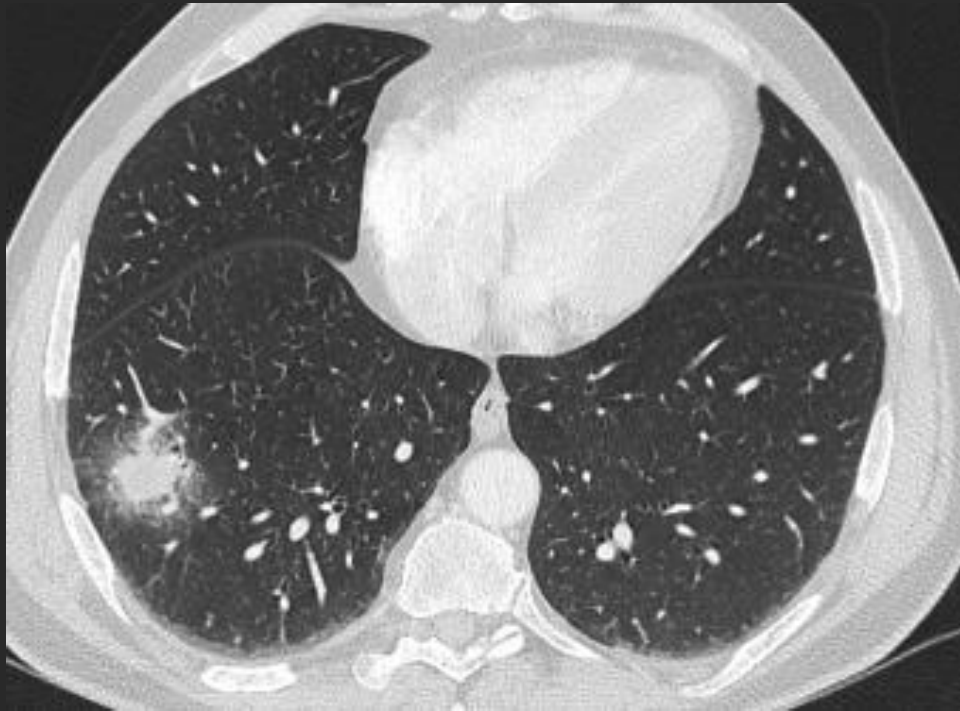
Septic emboli

Multiple peripheral nodules and cavitary nodules



“halo sign”

A dense nodule surrounded by a “halo” of ground-glass attenuation



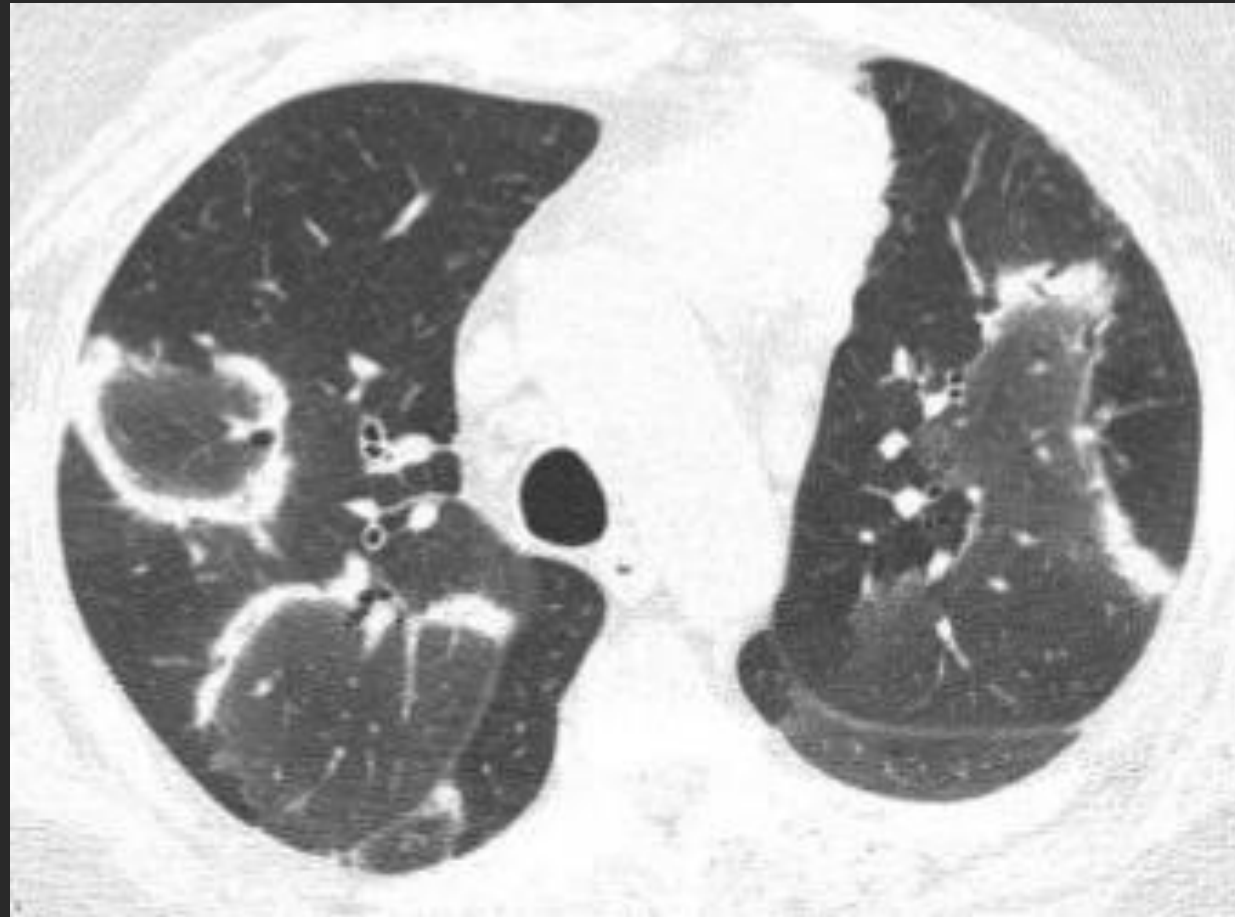
Granulomatous polyangiitis



Metastatic choriocarcinoma

“Reverse halo” sign (atoll sign)

A ground-glass dense nodule surrounded by fibrous capsule



Organizing pneumonia

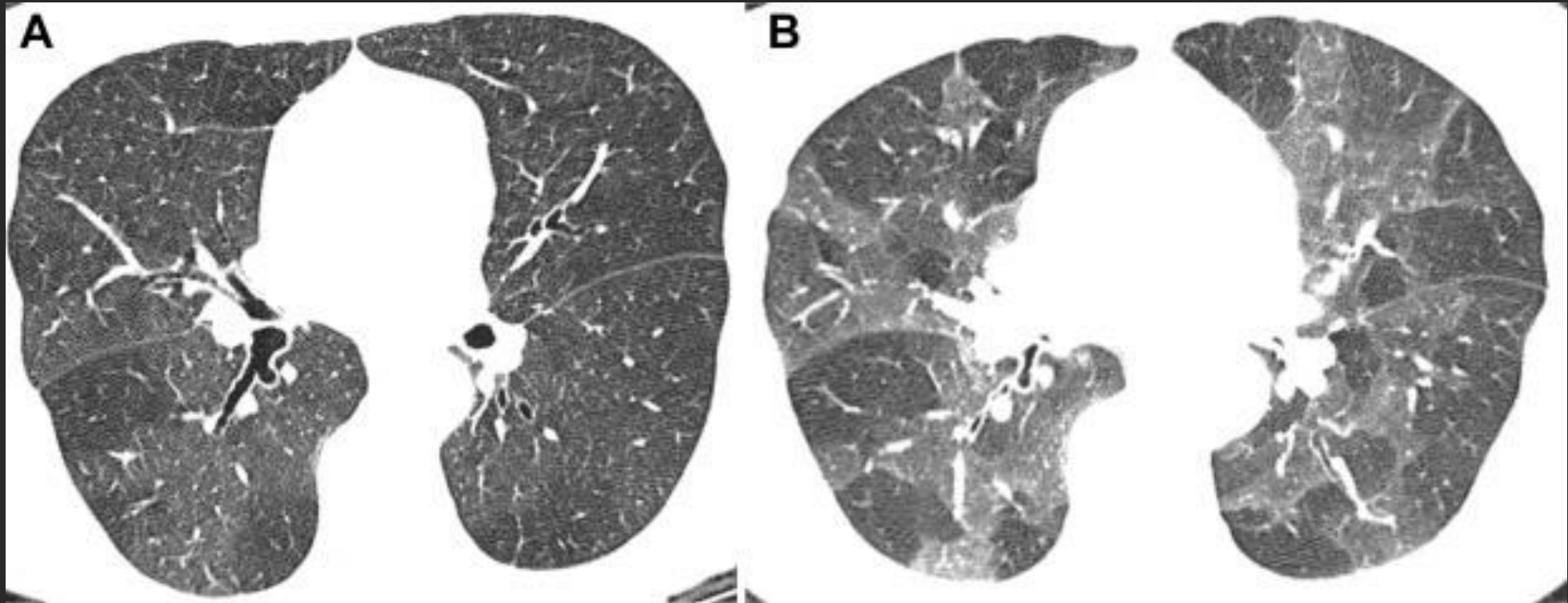
Decreased Lung Density

Diffuse low attenuation

- Small airway disease are often associated airway thickening or dilatation, air trapping.
- DD: Bronchiolitis obliterans, allogenic BMT (GVHD), CTD-ILD, toxic fume inhalation, rejection of lung transplant, drug toxicity (rare), idiopathic

Bronchiolitis obliterans

Extensive multifocal air-trapping



Focal areas of low attenuation

- No clear wall (emphysema)

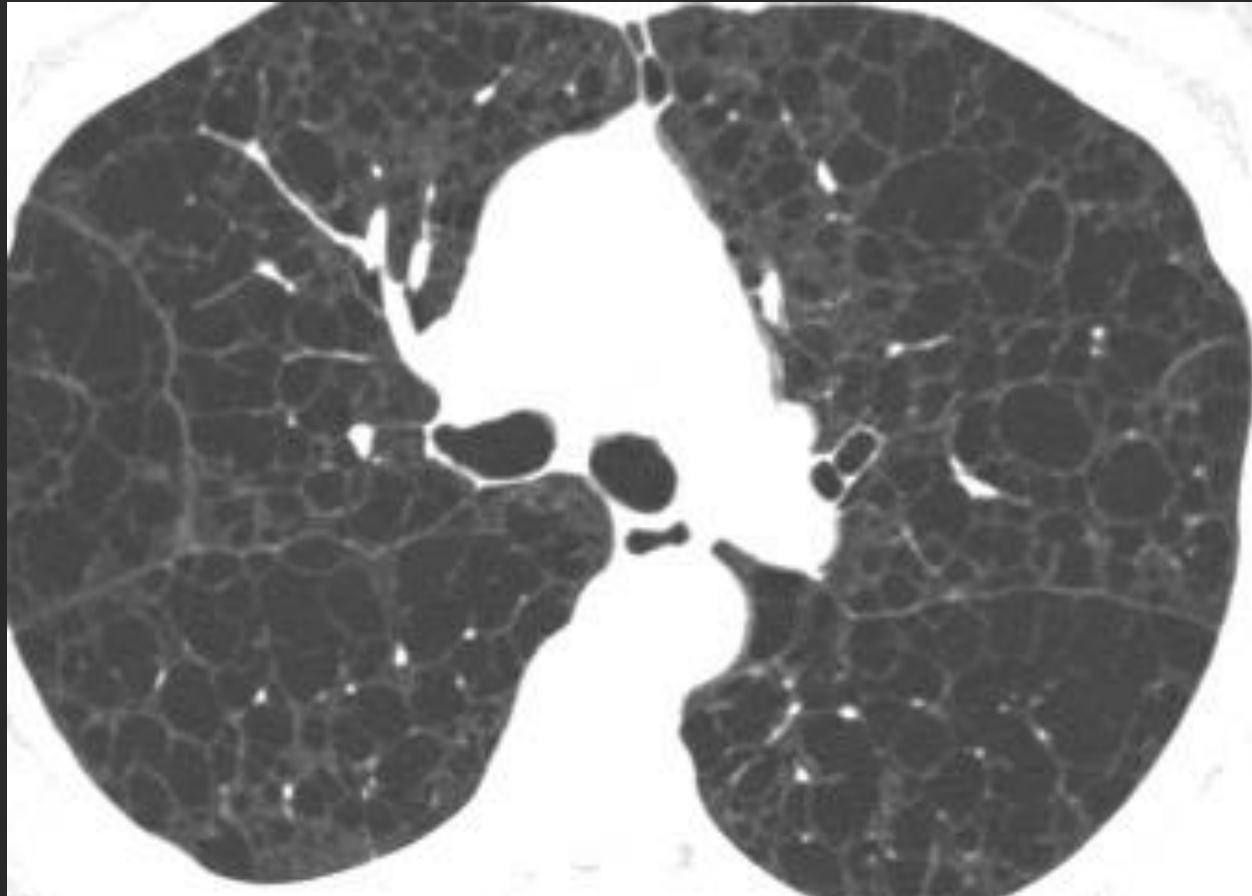
DD: centrilobular emphysema, end-stage LCH

- Visible wall (cyst)

DD: LAM/tuberous sclerosis, LIP, light chain deposition disease, amyloidosis, paraseptal emphysema/bullae with associated subpleural, perifissural lines

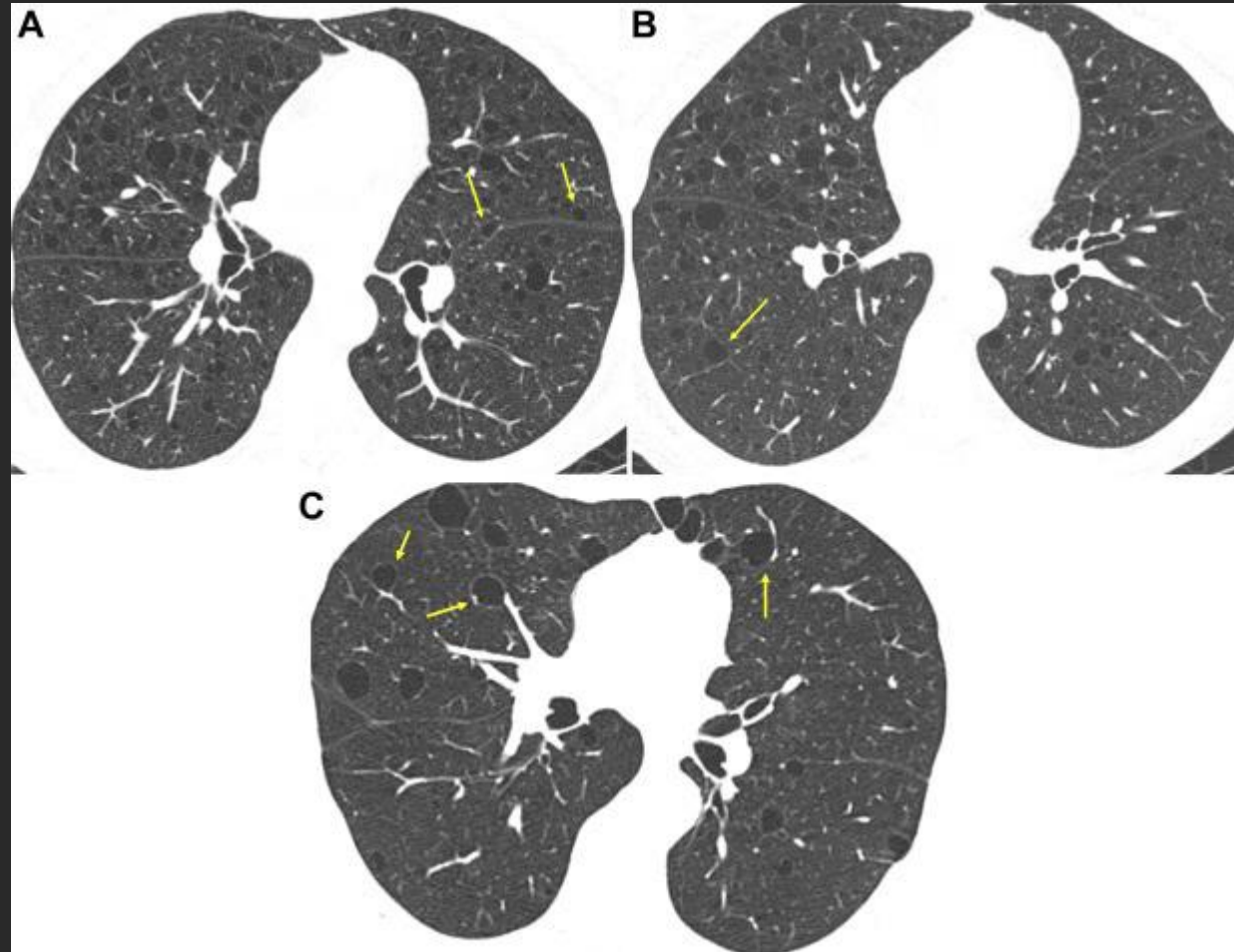
Severe emphysema

Abnormal low attenuation areas coalesce in the absence of definable walls



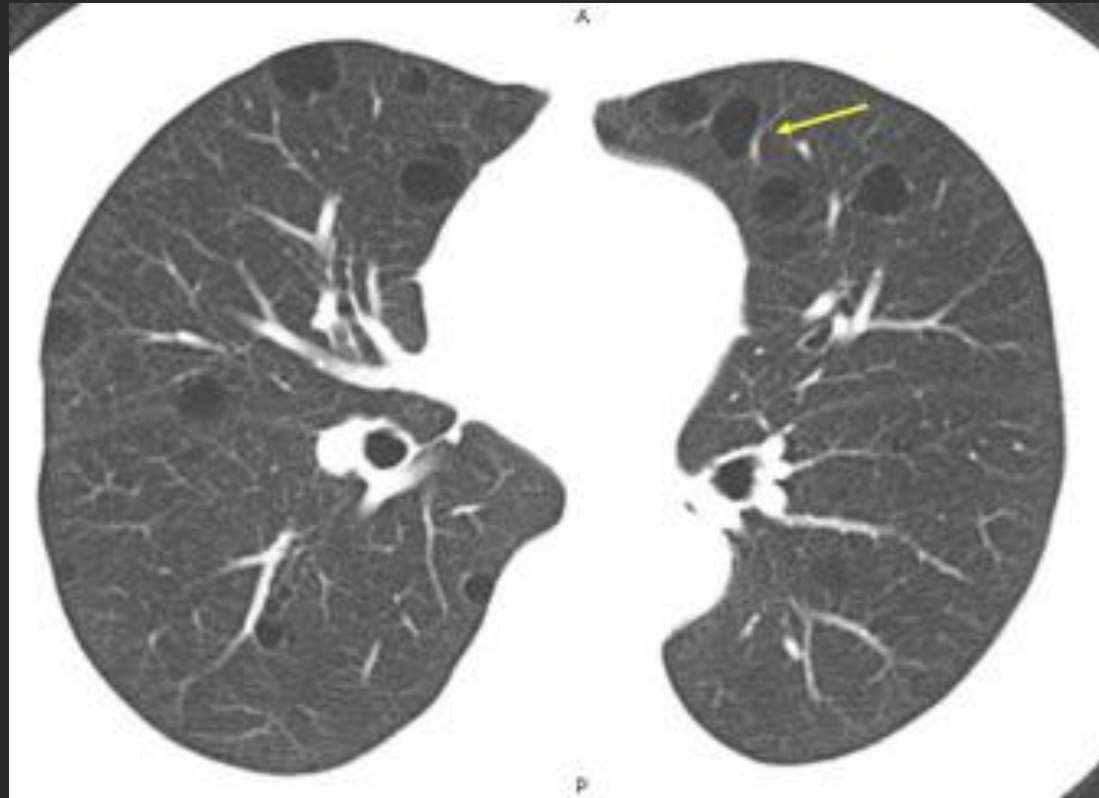
Lymphangiomyomatosis (LAM)

Female, lower lobe, round cysts in a perilymphatic distribution



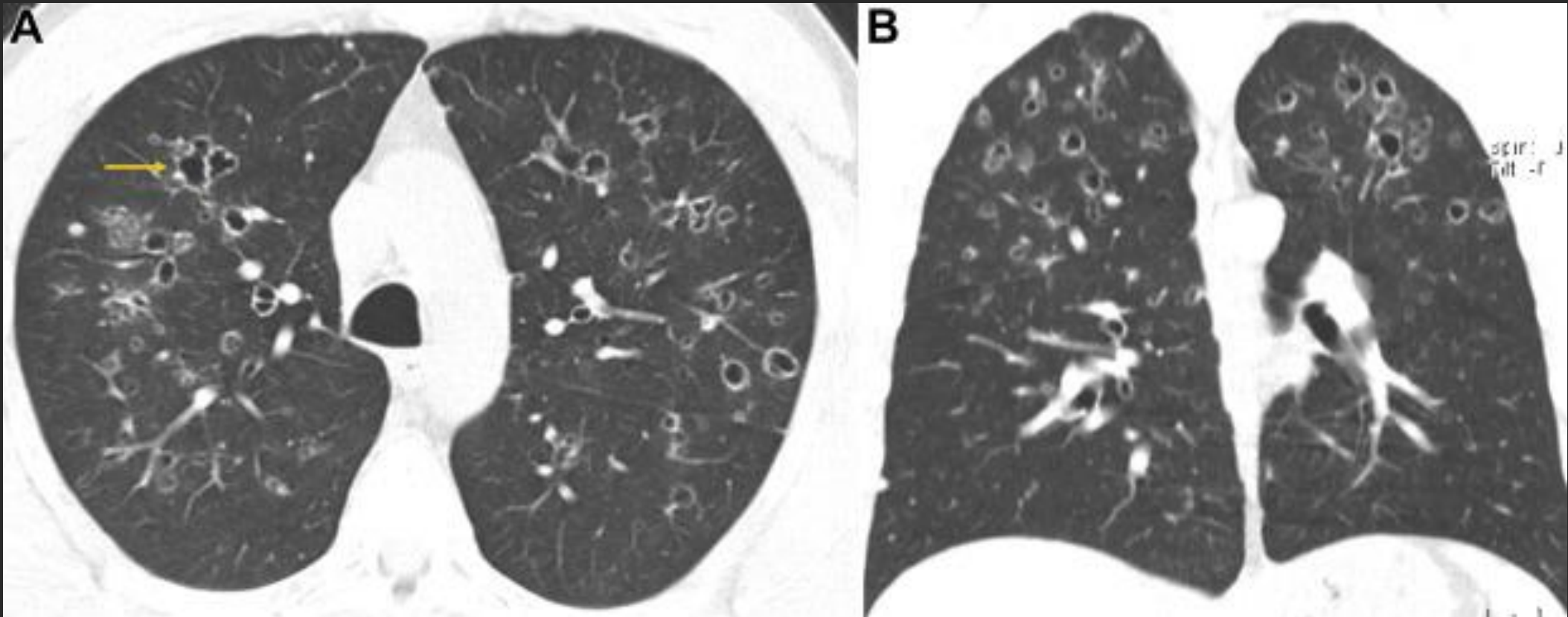
Sjögren syndrome and lymphocytic interstitial pneumonia

Scattered cysts in a perilymphatic distribution



Langerhans cell histiocytosis (LCH)

Male, smoker, upper lobe, bizarre-shaped cystic or cavitory lesions, costophrenic angles spared



Heterogenous Lung Attenuation (Mosaic Attenuation)

- **Small Airway Disease**

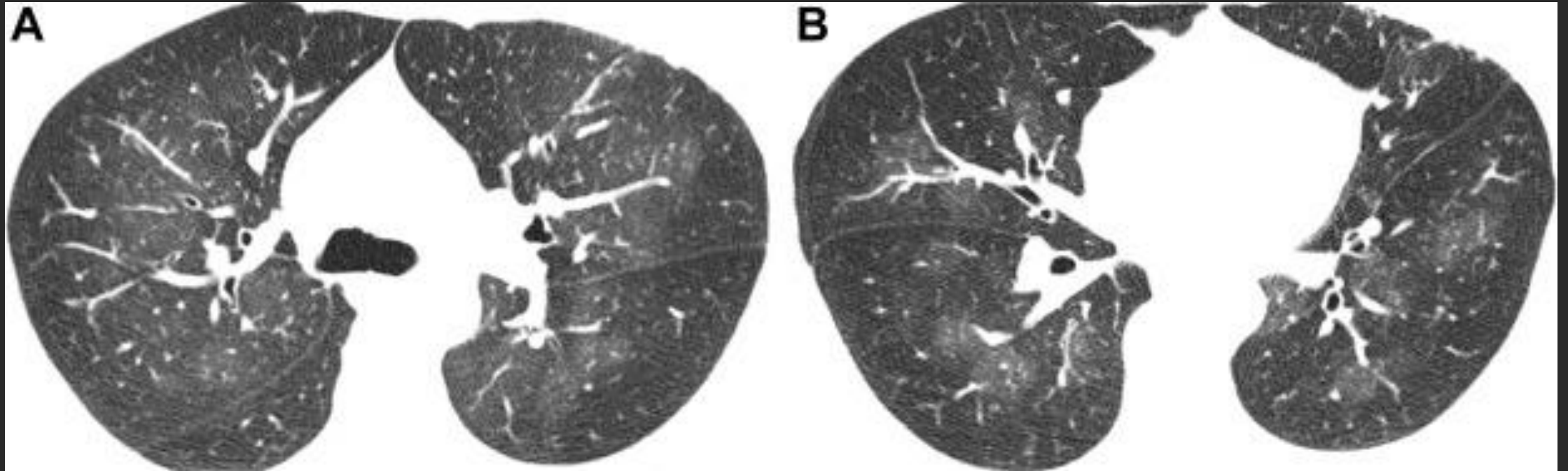
- Usually associated with central airway thickening, dilatation, and/or bronchiolectasis accentuated on expiratory scans
- DD: postviral bronchiolitis obliterans (Swyer-James syndrome), diffuse pulmonary neuroendocrine cell hyperplasia (DIPNECH), HP

- **Mosaic Perfusion**

- Vascular (arteries or veins) caliber larger in areas of increased lung attenuation than in low-density areas No or minimal air-trapping
- DD: chronic thromboembolic pulmonary hypertension (CTEPH), pulmonary venous hypertension

Bronchiolitis obliterans and graft-versus-host disease

Allogeneic transplant , mosaic attenuation, air trapping



Chronic hypersensitivity pneumonia

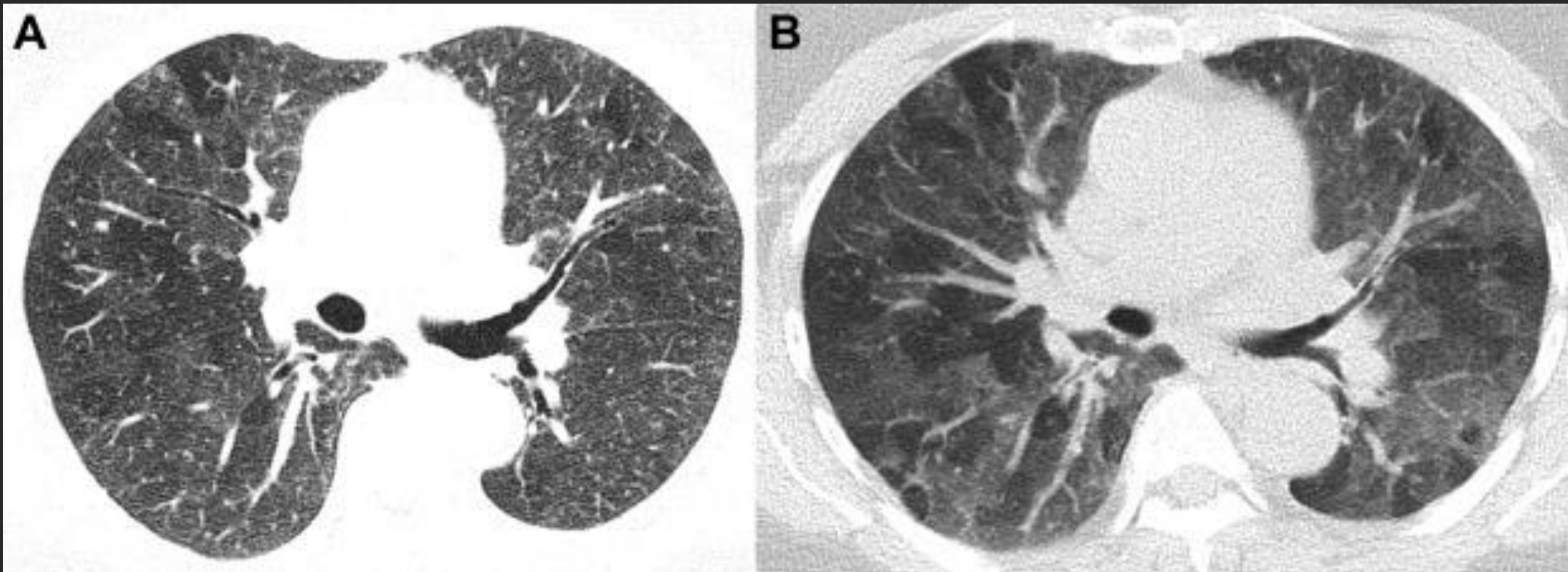
“head cheese sign”: hyperlucent parenchyma with peribronchovascular fibrosis, intralobular lines, and traction bronchiectasis and bronchiolectasis



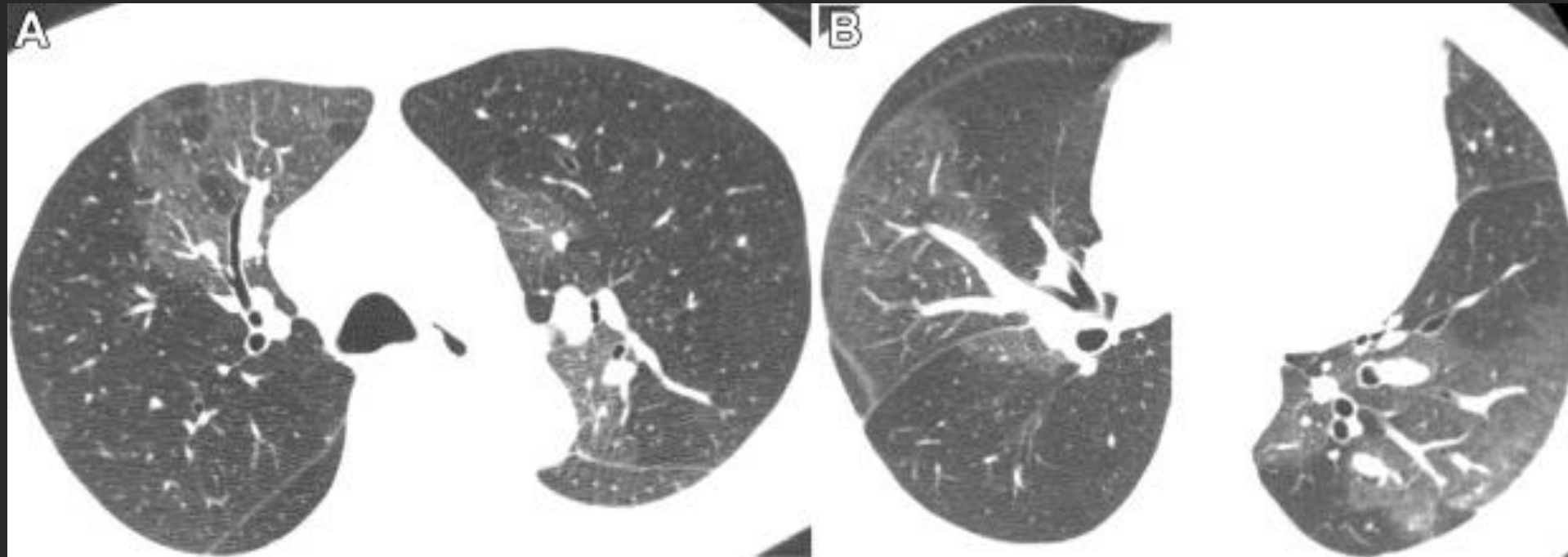
https://www.researchgate.net/figure/The-headcheese-sign-in-chronic-hypersensitivity-pneumonitis-Ground-glass-opacities_fig4_320508337

<https://radiopaedia.org/articles/head-cheese-sign-lungs>

Mosaic attenuation with small nodules in diffuse pulmonary neuroendocrine cell hyperplasia



Chronic thromboembolic pulmonary hypertension (CTEPH)

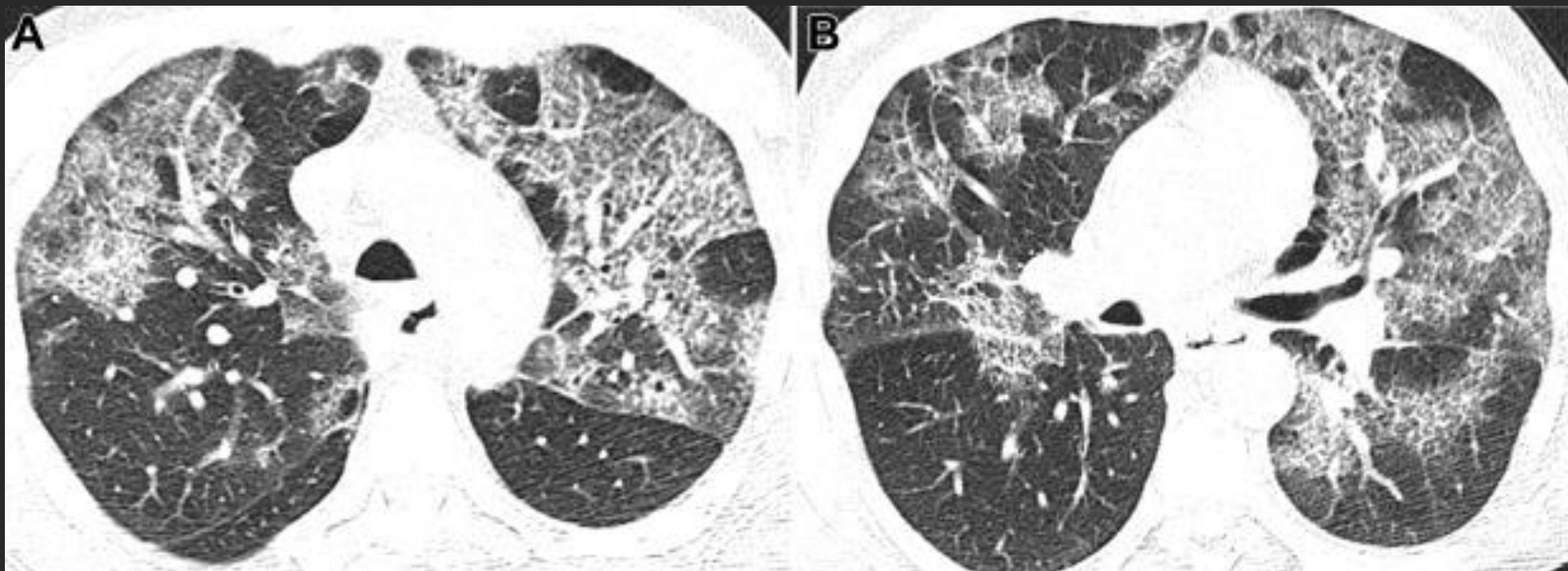


Diffusely Increased Lung Attenuation

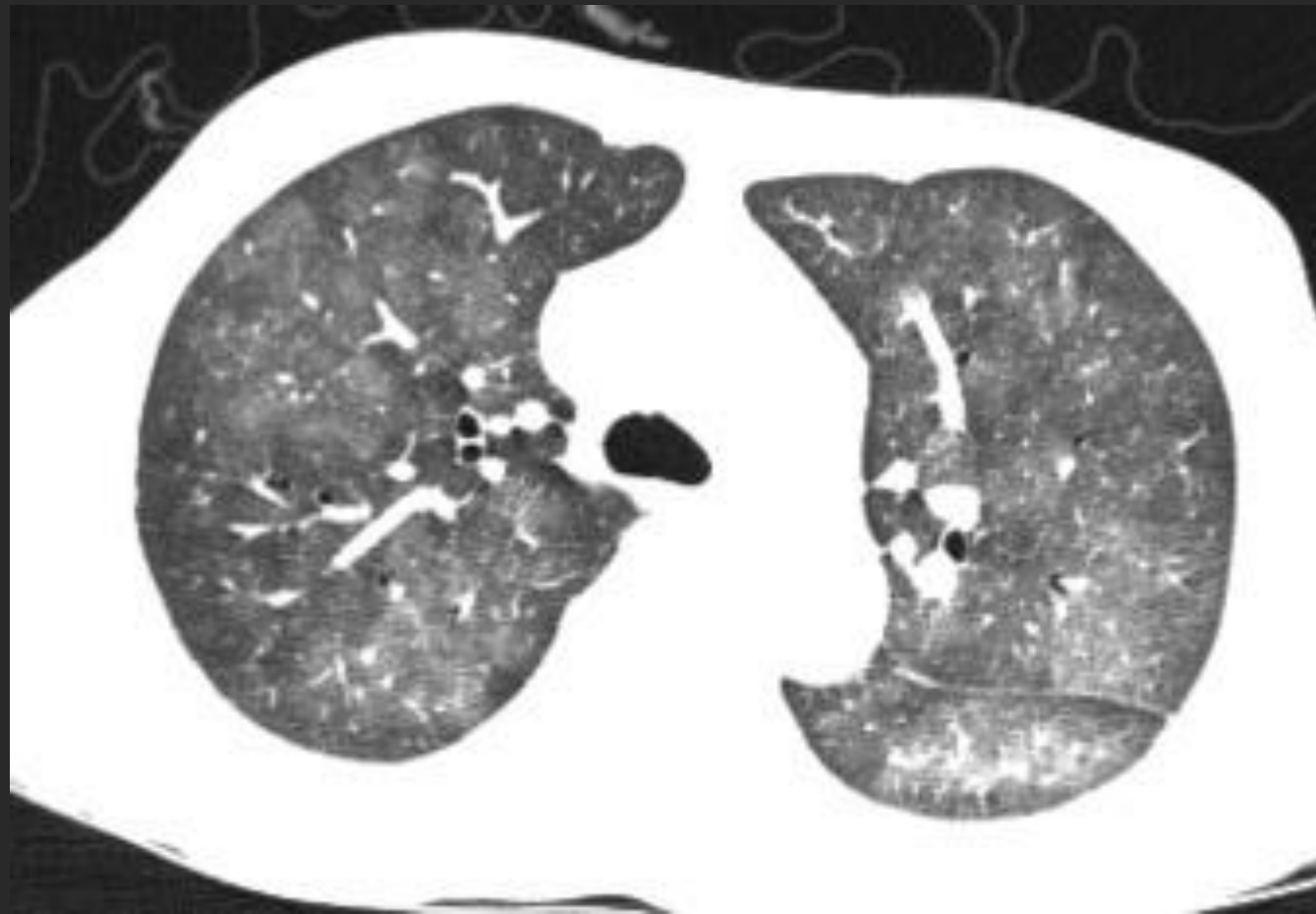
- “Crazy Paving”
 - GGO superimposed on prominent intralobular lines, frequent interlobular septal thickening patchy areas of normal lung
 - DD: PJP pneumonia, subacute diffuse alveolar damage, cellular NSIP, alveolar proteinosis (PAP),
- Diffuse GGO Attenuation/ Diffuse Consolidation
 - DD: multifocal pneumonia, diffuse hemorrhage, edema, diffuse aspiration (near drowning), acute interstitial pneumonia (AIP) , acute lung injury, ARDS, Vaping

Interstitial edema

Abnormal ground-glass attenuation superimposed on dilated pulmonary veins and prominent intralobular septal thickening in the absence of anatomic distortion or findings of fibrosis.



Diffuse pulmonary hemorrhage

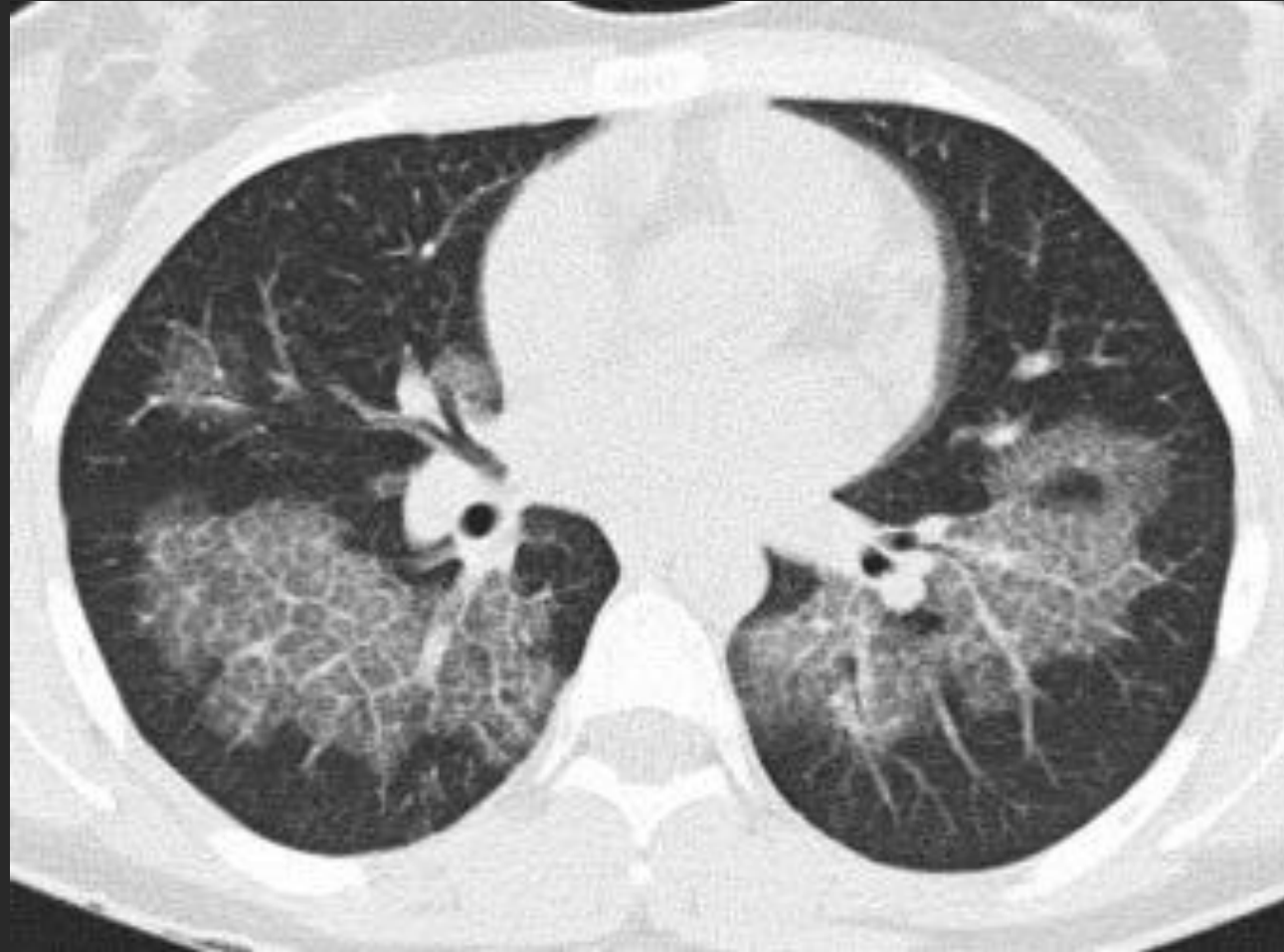


Heterogenous Lung Attenuation (Mosaic Attenuation)

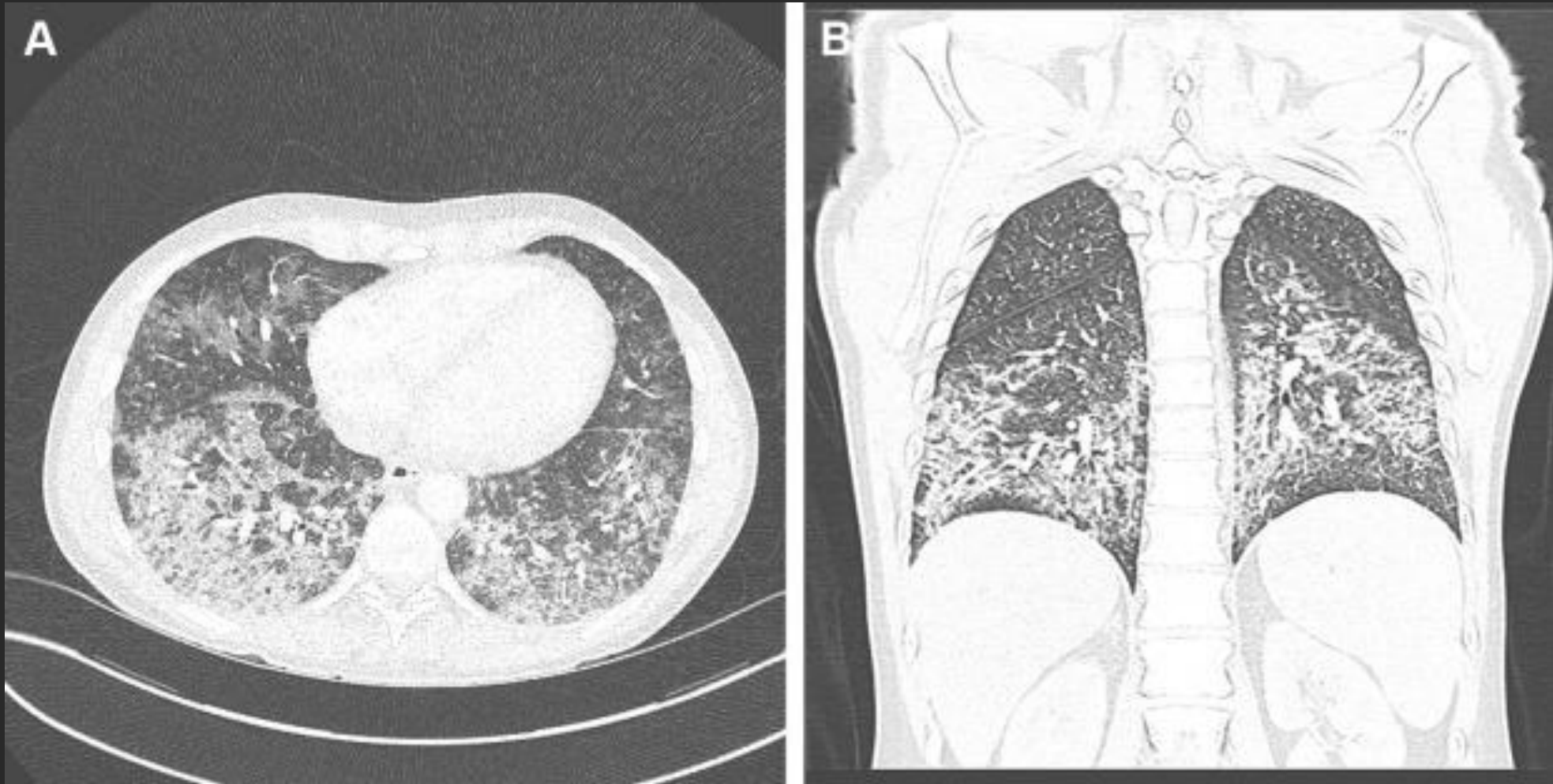
- Patchy Lung Infiltrates

- Geographic foci of GGO in the absence of extensive air trapping on expiratory imaging
- DD: Infection (Mycobacterial, PJP, viral); eosinophilic pneumonia/OP, HP, desquamative interstitial pneumonia (DIP), ARDS, drug reaction, vaping

Crazy paving in alveolar proteinosis



Electronic-cigarette or vaping associated lung injury



Take home message

- Familiar with the correlation between the concept of the 2nd pulmonary lobe and pathophysiology of the interstitial disease to approach interstitial disease on imaging.

Thanks for your attention