

SÉMIOLOGIE SCANOGRAPHIQUE DES MALADIES DIFFUSES DU POUMON

LE VERRE DÉPOLI

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Service de Radiologie

Cliniques Universitaires St-Luc

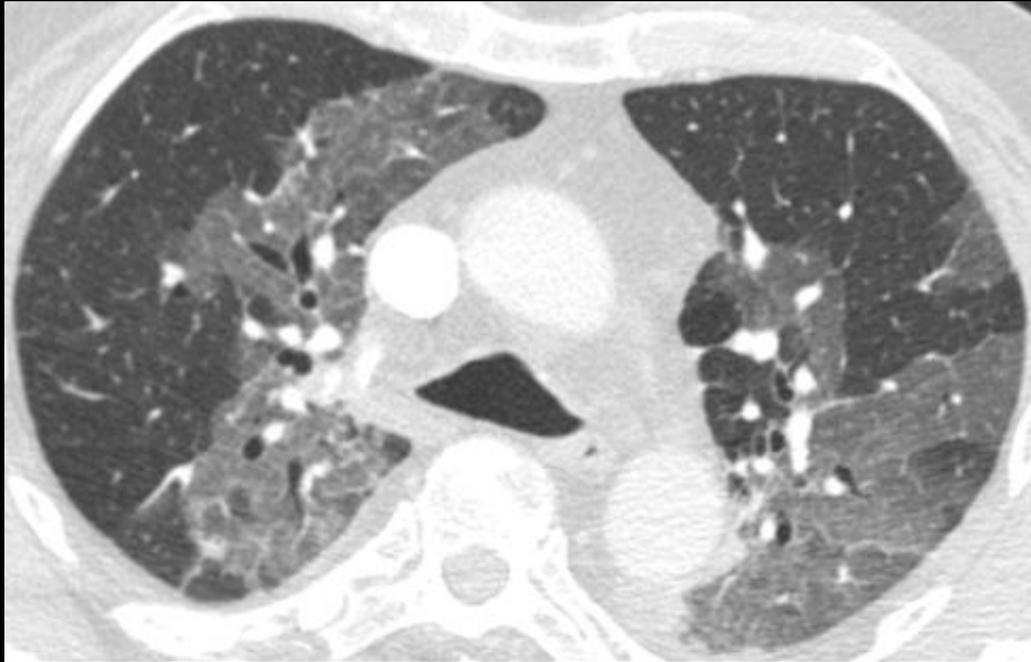
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DES 23 Avril 2021

CT ground glass opacification is characterized by :

- Increase of density or attenuation of lung parenchyma
- No alteration of vessels and bronchi visibility



Organised pneumonia
after viral infection

GGO

Definition

CT \neq X-ray

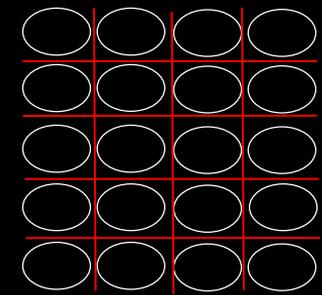


GGO

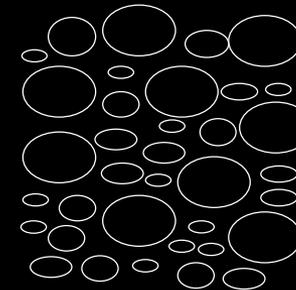
Pathologic substratum (1)

Any pathology → partial filling / collapse of alveolar lumen :

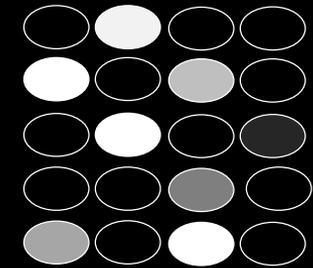
- **Collapse / partial alveolar filling by :**
 - *Cells*
 - *Liquid: edema, blood, bronchoalveolar lavage*
- **Thickening of the intralobular interstitium by :**
 - *Cells*
 - *Liquid: interstitial edema*
 - *Connective tissue: fibrosis*
- **Increase in pulmonary capillary blood volume**
- **Combination**



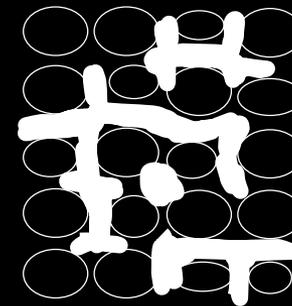
Normal lung



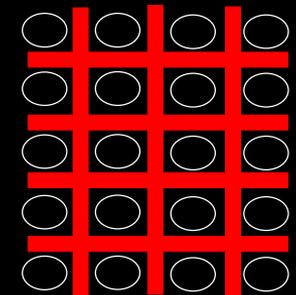
Alveolar collapse



Alveolar filling



Interstitial thickening



Blood volume increase



80% of GGO → active or early stage process
potentially reversible on treatment

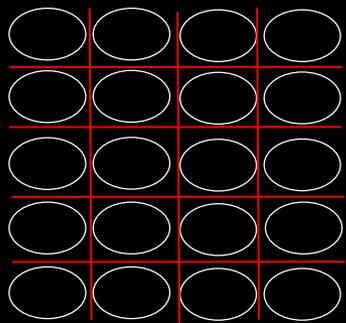
GGO

Pathologic substratum (2)

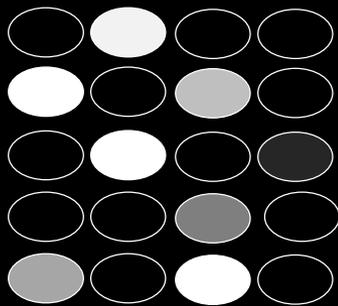
- At CT, some pathological process may present as GGO (-400 to -200 HU) or consolidation (40-60 HU)



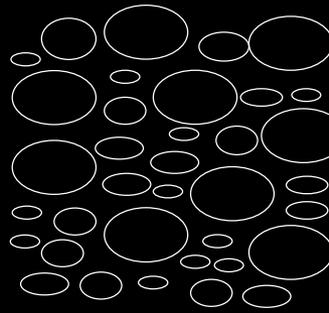
The key is a lower quantification of the pathological process per volume unit in the GGO with persistence of some quantity of air in the alveoli



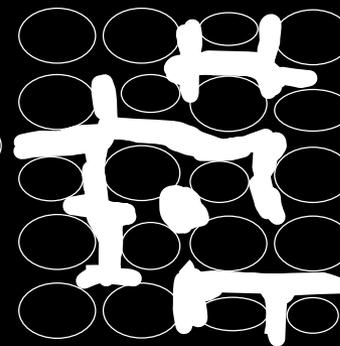
Normal lung



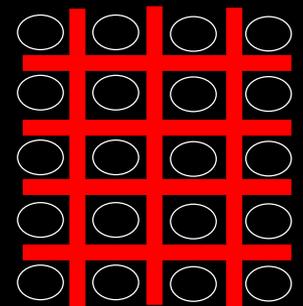
Alveolar filling



Alveolar collapse



Interstitial thickening



Blood volume increase

Technical and other factors responsible for false negatives and positives of GGO :

Soft room lighting

Windows setting

Level of inspiration

CM Injection

Sharp/soft kernel

Position of the patient

Morphology of the patient

Partial volume averaging

Artifacts



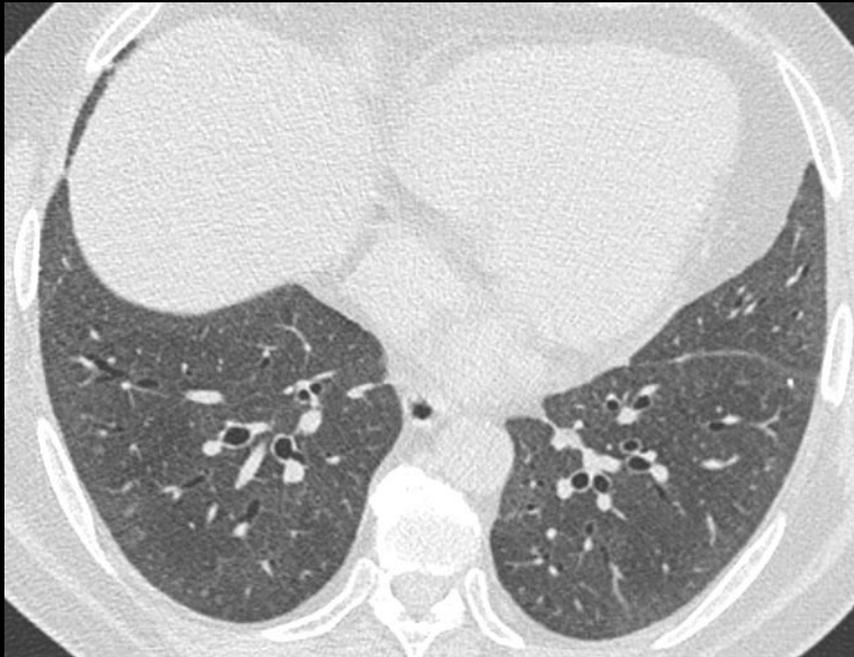
Do not overcall

GGO

Drawbacks (1)

Windows setting

A width of 1500 to 1600 UH and a mean (or center) of -600 UH are recommended



WW 1600 HU, L -600 HU



WW 1000 HU, L -600 HU

GGO

Drawbacks (2)

Level of inspiration

Images must be acquired in deep inspiration

A weak inspiration (and *a fortiori* an acquisition in expiration) is responsible for a pseudo-GGO



Inspiration



Poor inspiration



Hypersensitivity pneumonitis

GGO

Drawbacks (3)

CM injection

Increase of mean lung density by 15-40 HU



14/05/2018



22/05/2018

GGO

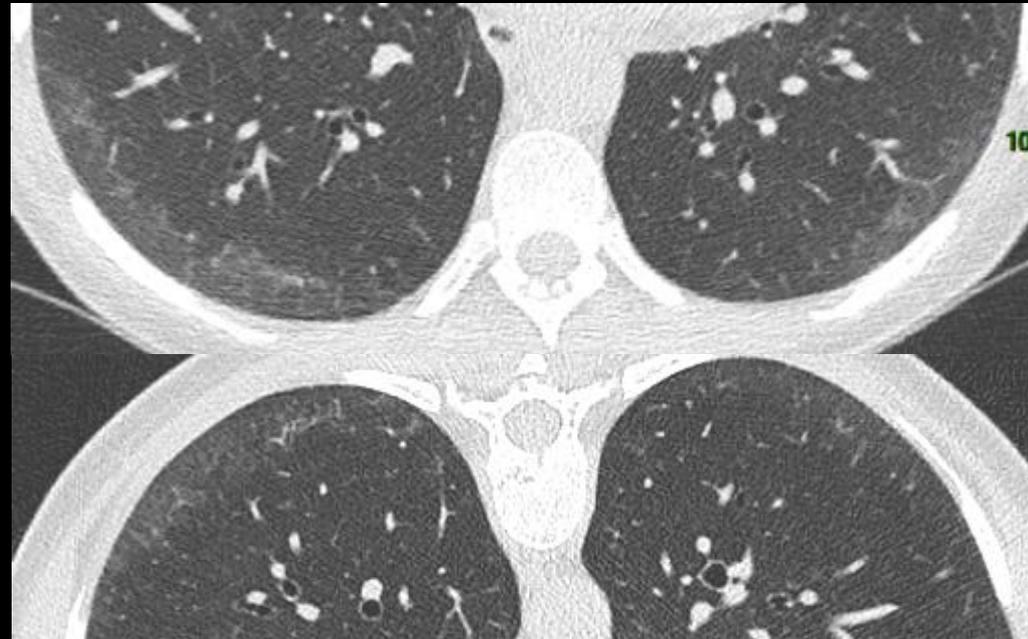
Drawbacks (4)

Position of the patient

Pseudo-GGO against the posterior thoracic wall disappears in procubitus in contrast to true GGO



Recumbent hypoventilation



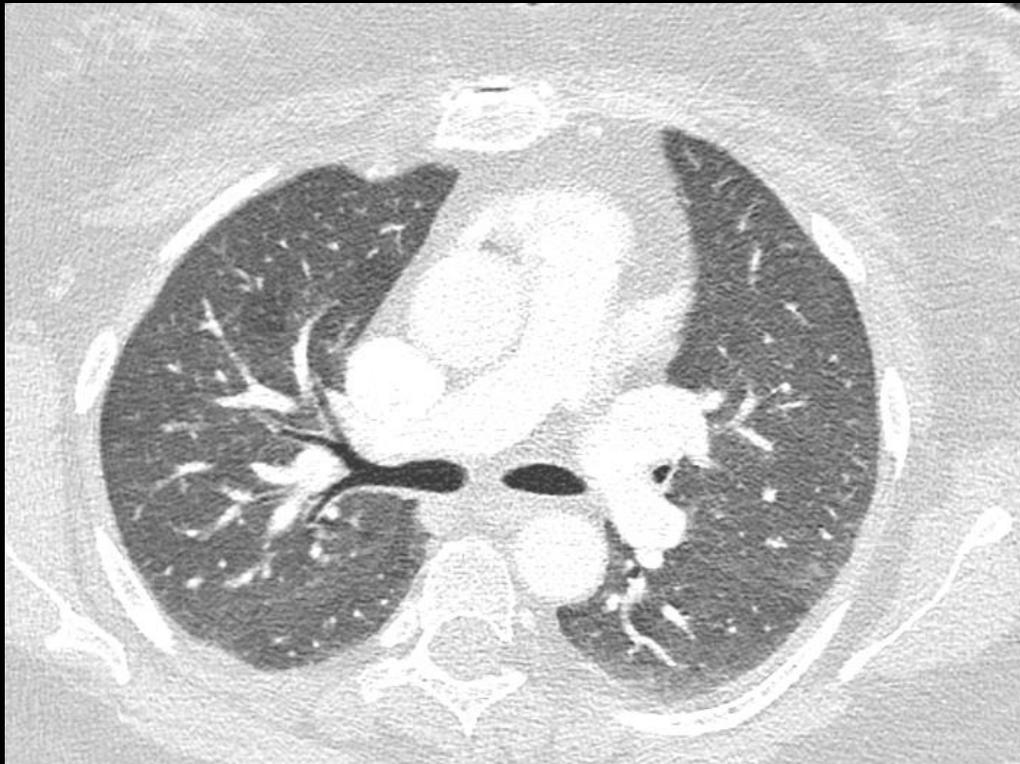
NSIP in mixed connectivitis

GGO

Drawbacks (5)

Morphology of the patient

Obesity may be responsible for an increase in lung density



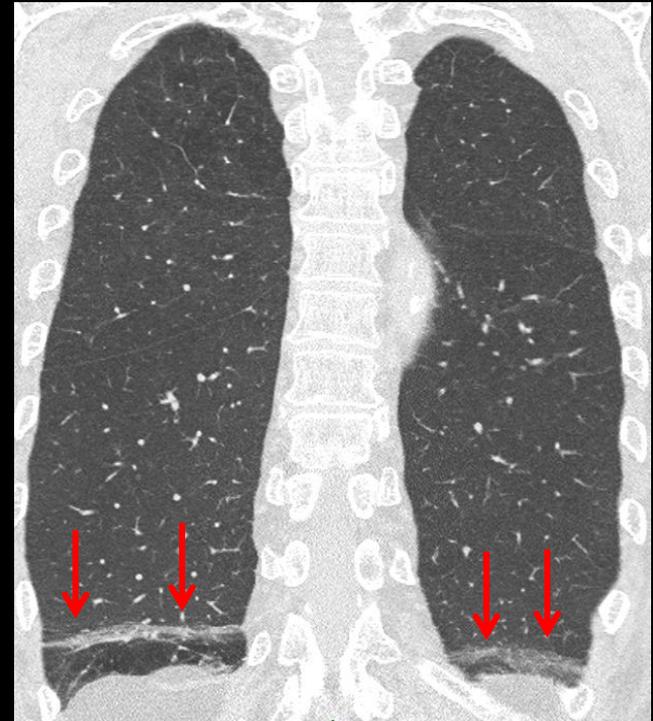
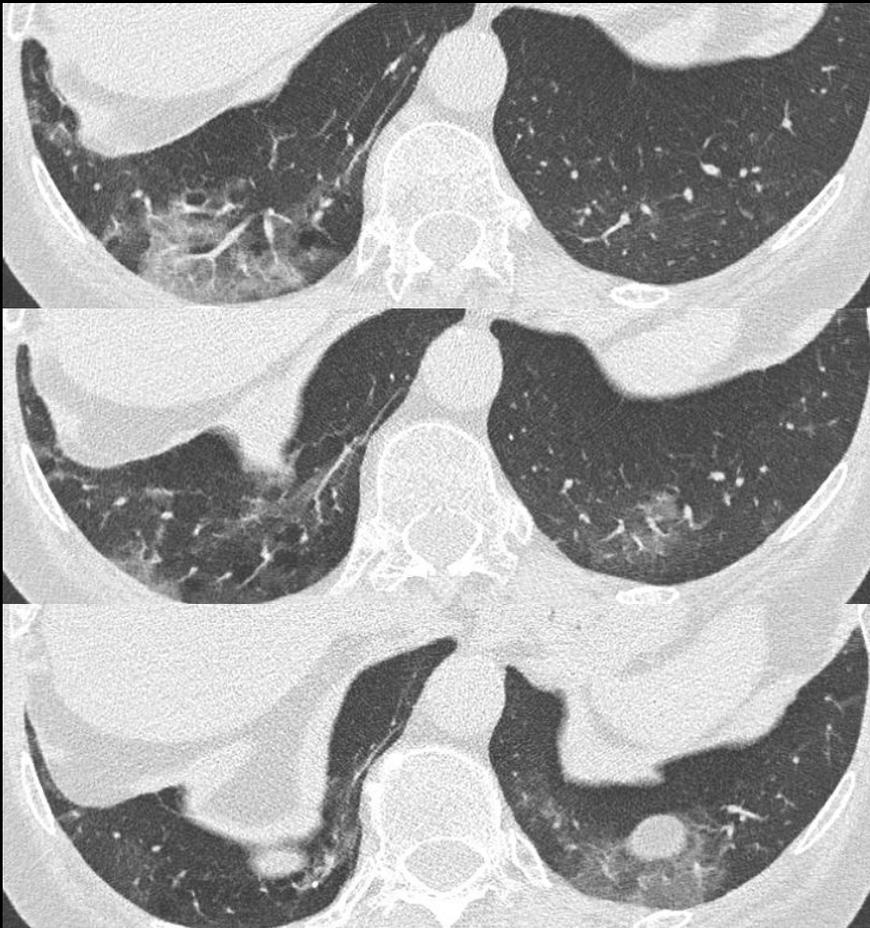
GGO

Drawbacks (6)

Partial volume averaging

Platelike atelectasis

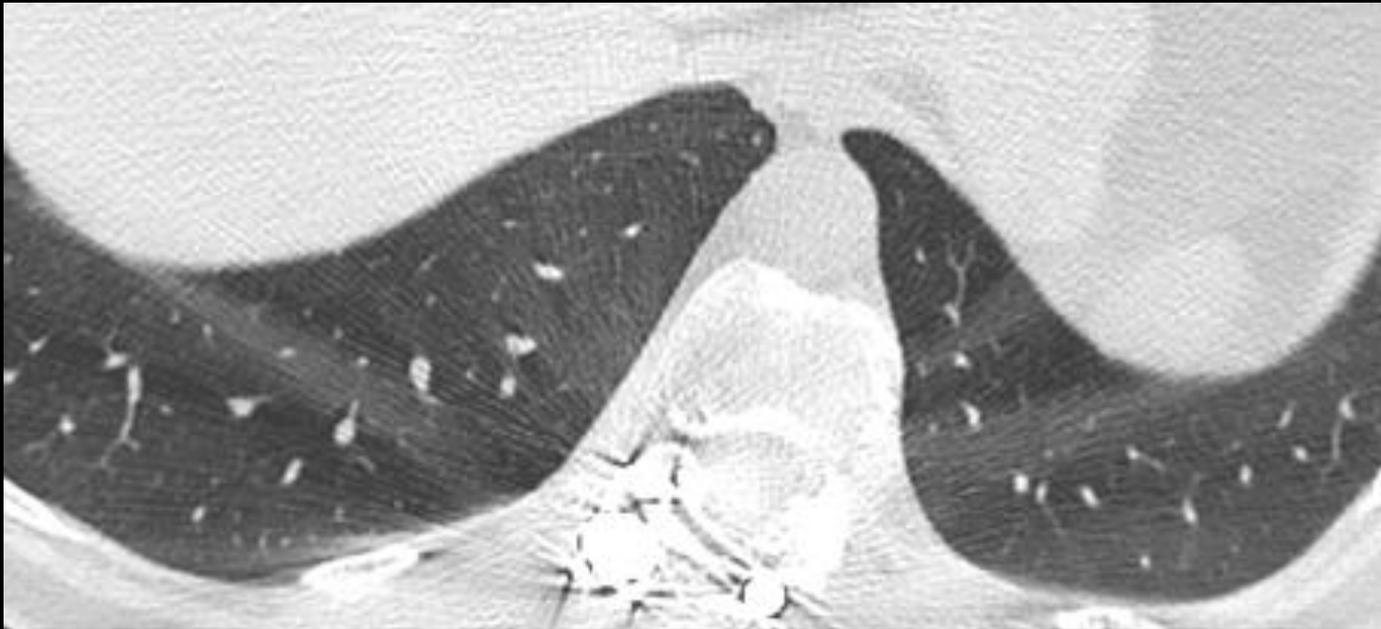
Use 2D-reformat !



GGO

Drawbacks (7)

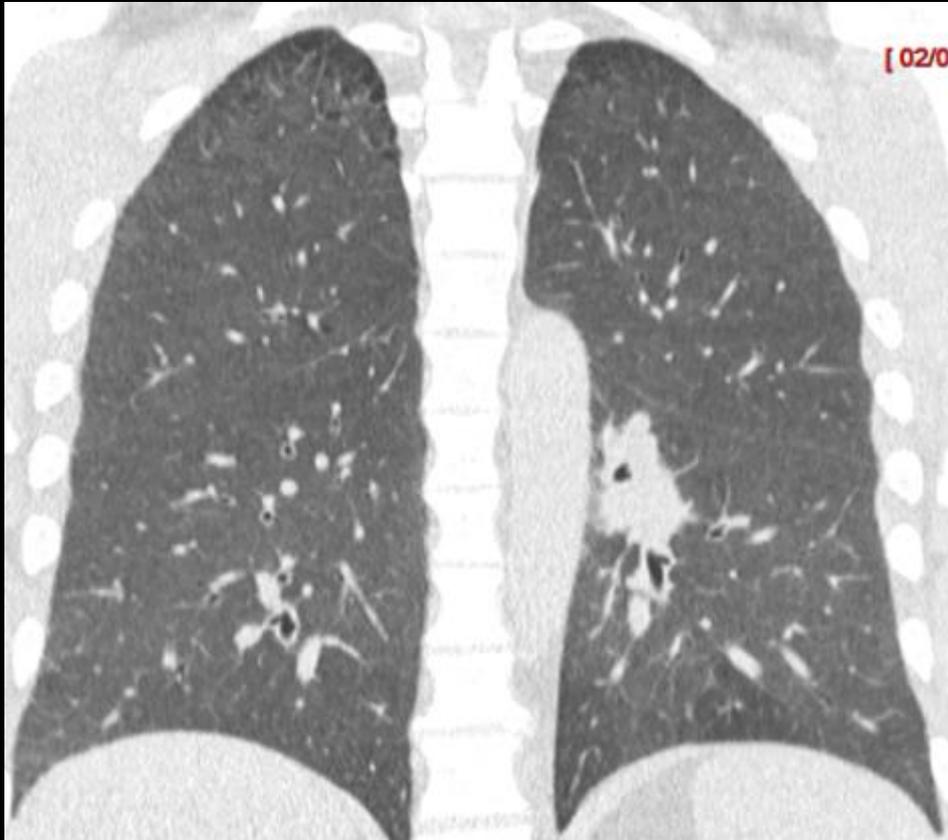
Artifacts (e.g. metal) can increase the density of the parenchyma



GGO

Diagnostic problems (1)

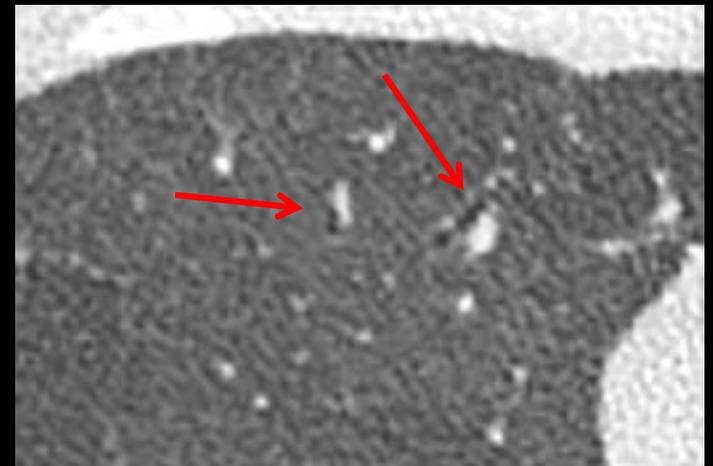
Diffuse and homogeneous GGO



Severe macrophagic alveolitis



Sharp demarcation of mild emphysema

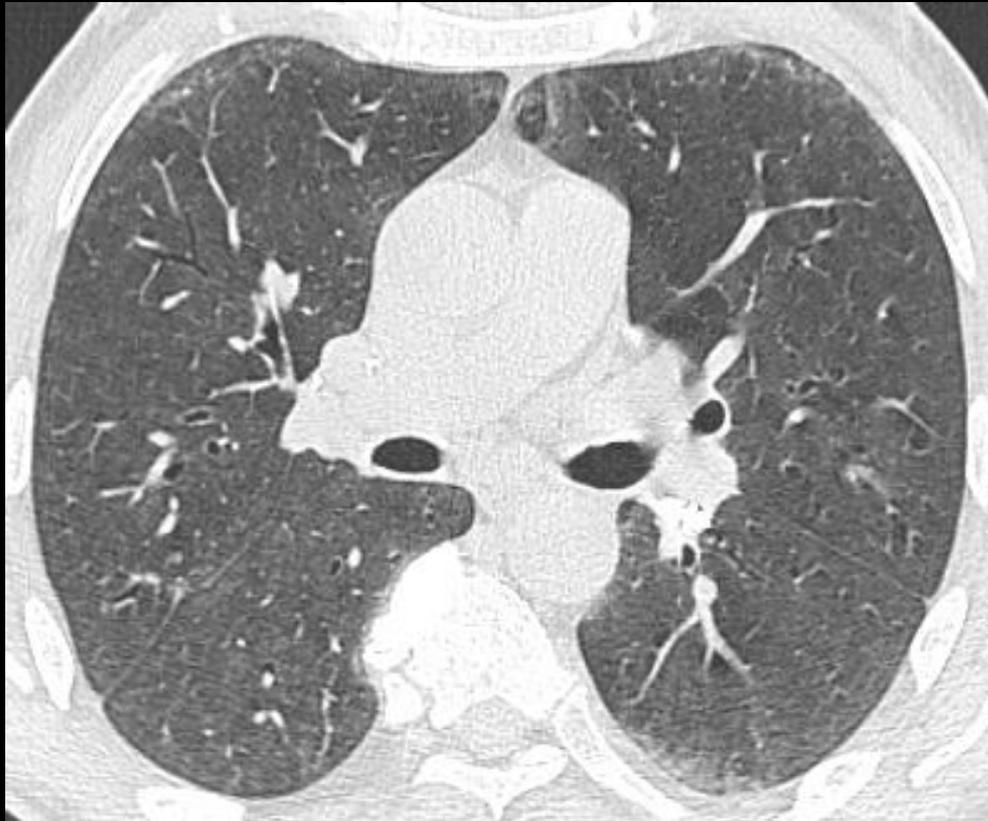


Dark bronchus sign

GGO

Diagnostic problems (1)

Diffuse and homogeneous GGO



Hypersensitivity pneumonitis



Dark bronchus sign

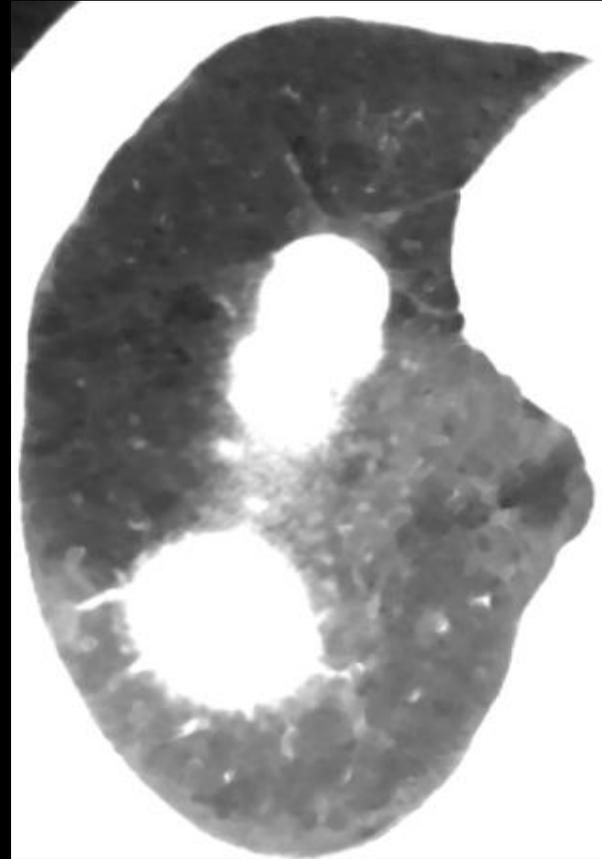
GGO

Diagnostic problems (2)

Slight and heterogeneous GGO



Cellular NSIP (systemic sclerosis)



Given its varied pathological substratum, GGO is **non-specific**

The diagnostic work-up is based on the conjunction of :

- **Morphology and distribution** of GGO
- **Associated findings** : intra- and interlobular lines, fibrosis, cyst, air trapping, ...
- **Acute, subacute or chronic** clinical presentation
- **Context** : smoking, occupation, medication, immunity, environment, history, ...

Pure GGO is mainly of acute/subacute origin

- **Pulmonary edema**
- **Pulmonary hemorrhage**
- **Infectious pneumonia**
 - *Mycoplasma pneumoniae*
 - *Pneumocystis Jirovecii* (PJP)
 - Viral infection (Herpes, CMV, Influenza, Covid-19, ...)
- **Acute / subacute hypersensitivity pneumonitis**
- **Drugs**
- **Organized pneumonia (OP)**
- **Acute interstitial pneumonia (AIP)**
- **Acute eosinophilic pneumonia**
- **Acute radiation pneumonitis**
- **Diffuse alveolar damage (DAD), ARDS**
- **Exacerbation of fibrotic infiltrative pneumonia**

GGO

Acute/subacute pneumonitis (1)

Pulmonary oedema



Courtoisie de Catherine Beigelman, Lausanne

GGO

Acute/subacute pneumonitis (1)

Pulmonary oedema



Acute myocardial infarct



Post-laryngeal obstruction

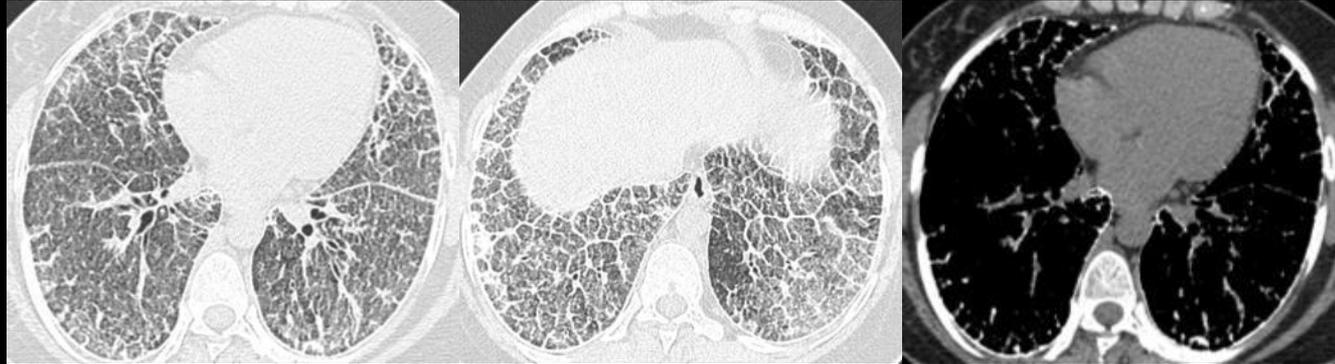


Reexpansion oedema

GGO

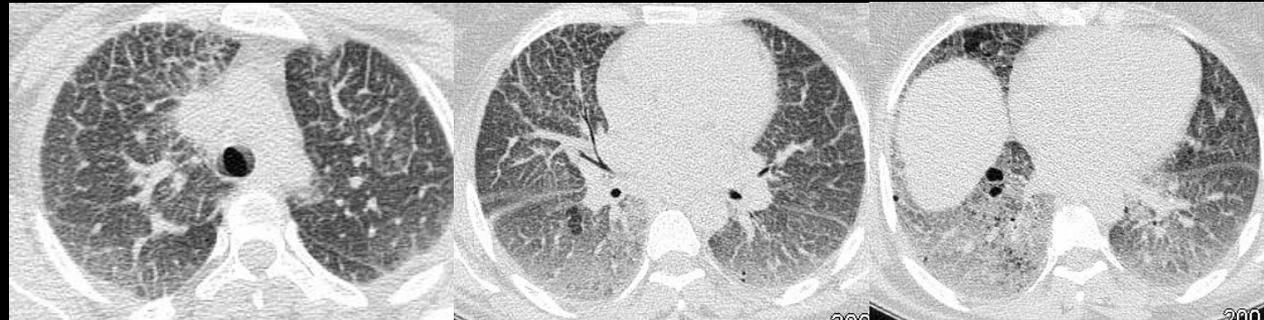
Acute/subacute pneumonitis (1)

Pulmonary oedema

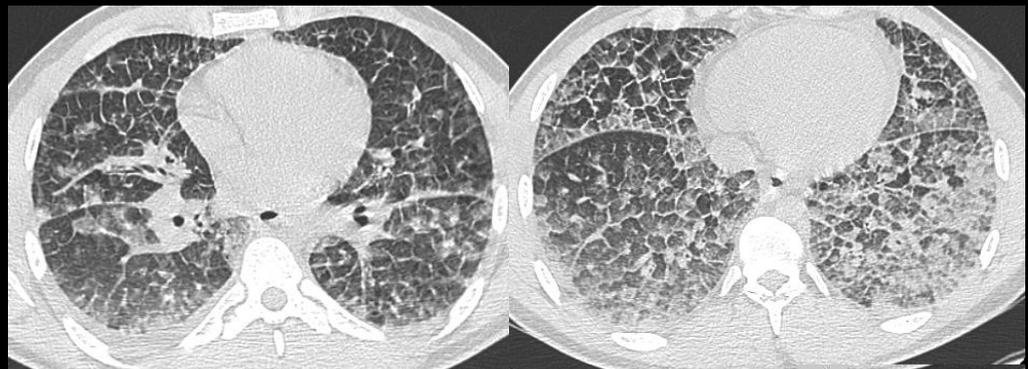


Alveolar microlithiasis

≠



Niemann- Pick type B disease



Acute eosinophilic pneumonia

GGO

Acute/subacute pneumonitis (2)

Pulmonary hemorrhage



Goodpasture disease



Goodpasture disease



Microscopic polyangeitis

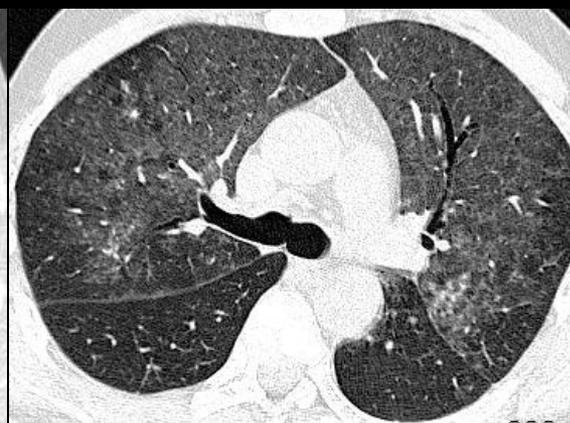
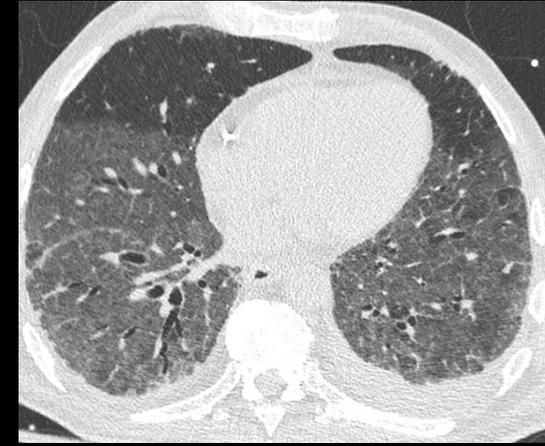
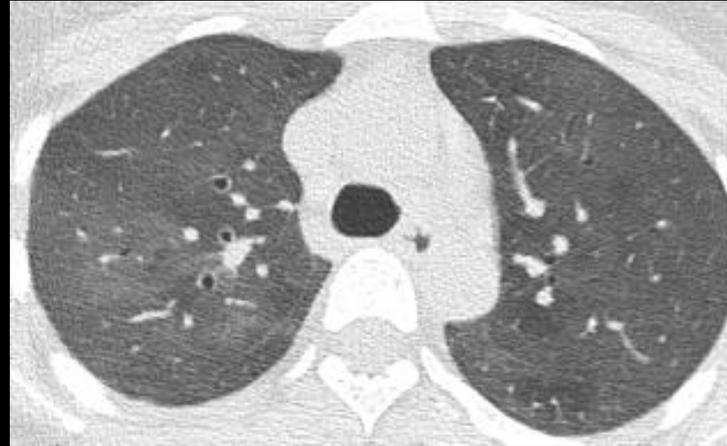


GGO

Acute/subacute pneumonitis (3)

Pneumonia

Pneumocystis Jirovenci pneumonia (PJP)



GGO

Acute/subacute pneumonitis (3)

Pneumonia

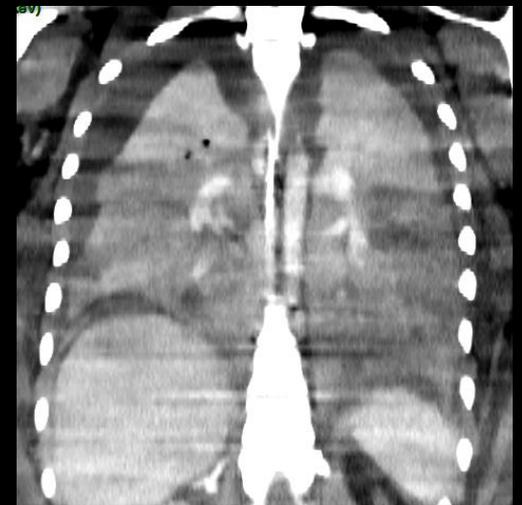
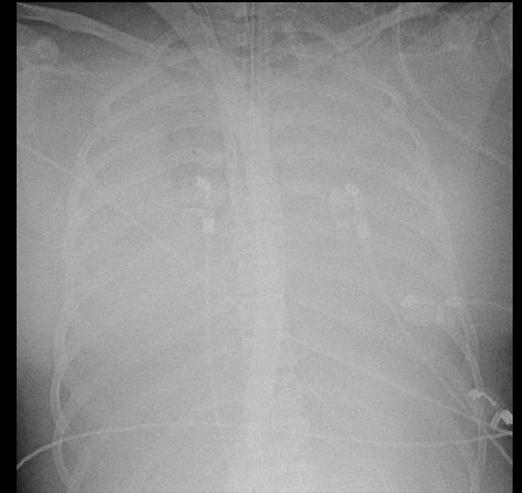
Viral pneumonia



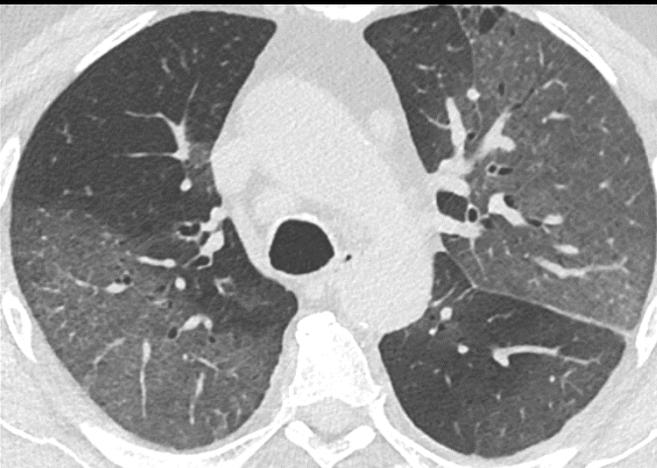
Influenza 36 YO



Herpes 16 YO



Influenza 15 YO



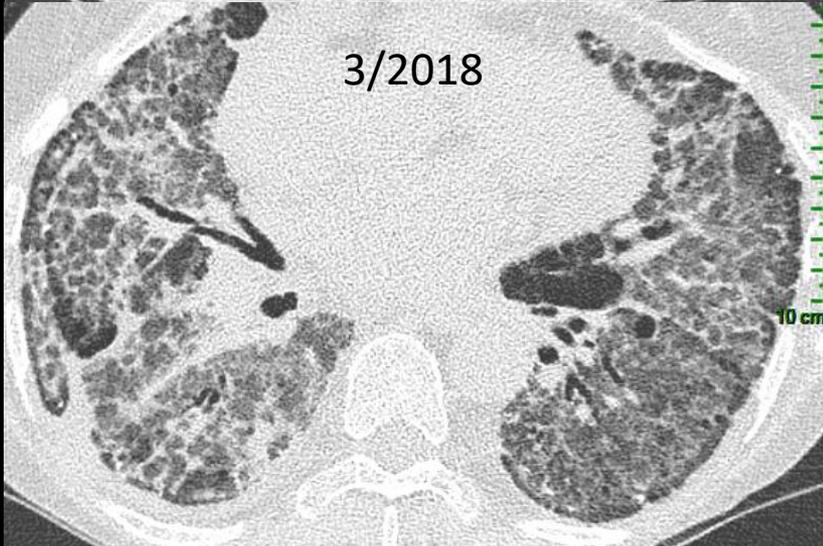
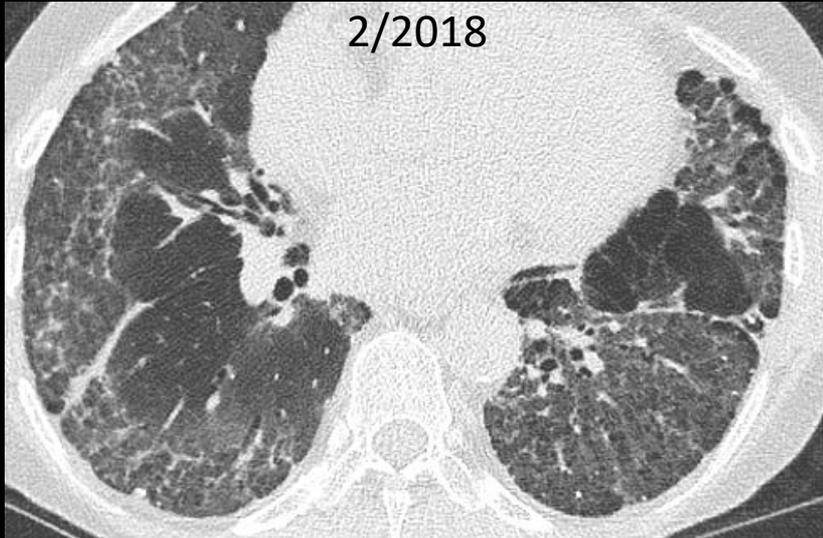
Covid-19 74 YO



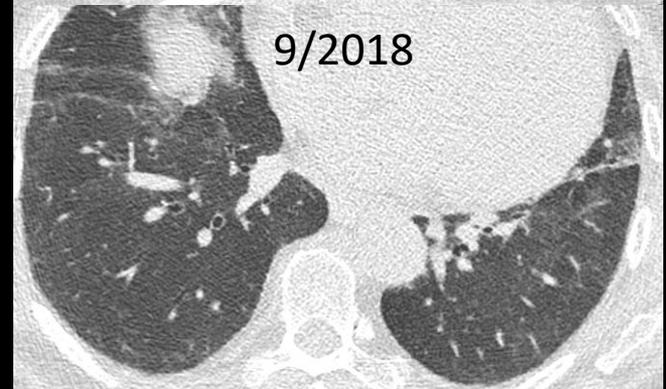
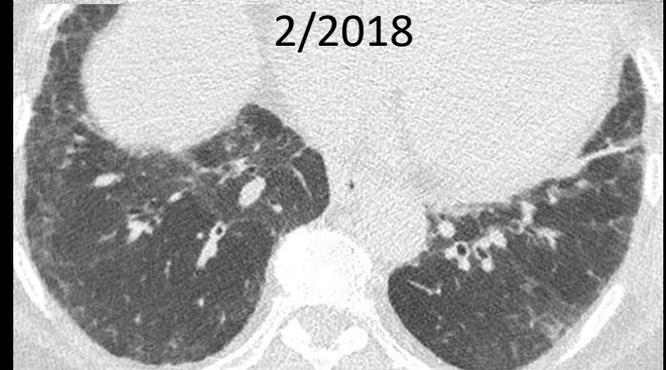
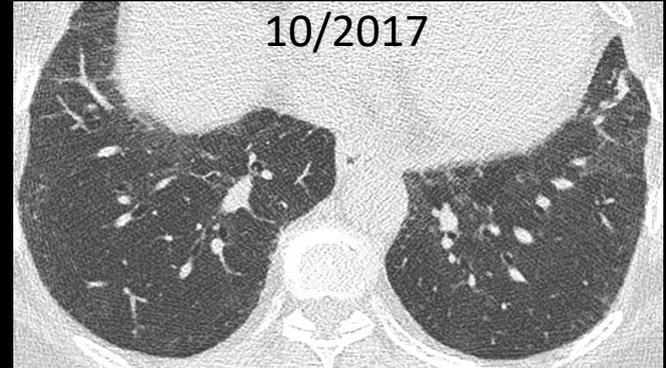
GGO

Acute/subacute pneumonitis (3)

Pneumonia



NSIP and Influenza



Sclerodermia and Influenza

GGO

Acute/subacute pneumonitis (3)

Pneumonia



12/11/2020



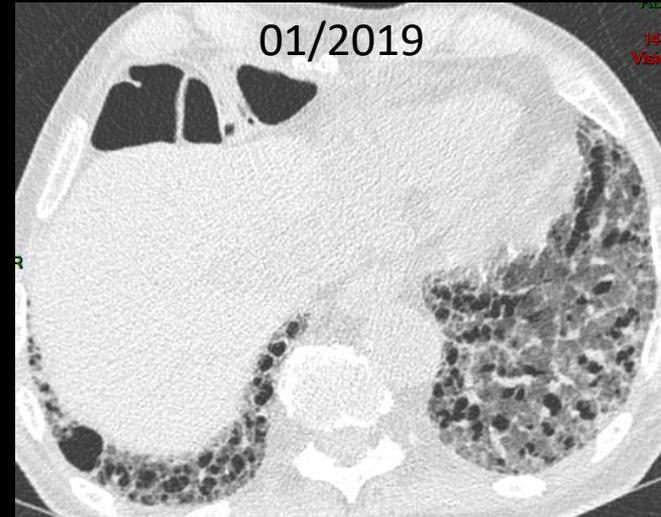
02/03/2021

Covid-19 and organizing pneumonia

GGO

Acute/subacute pneumonitis (4)

Fibrotic disease exacerbation



UIP inflammatory exacerbation

GGO

Acute/subacute pneumonitis (5)

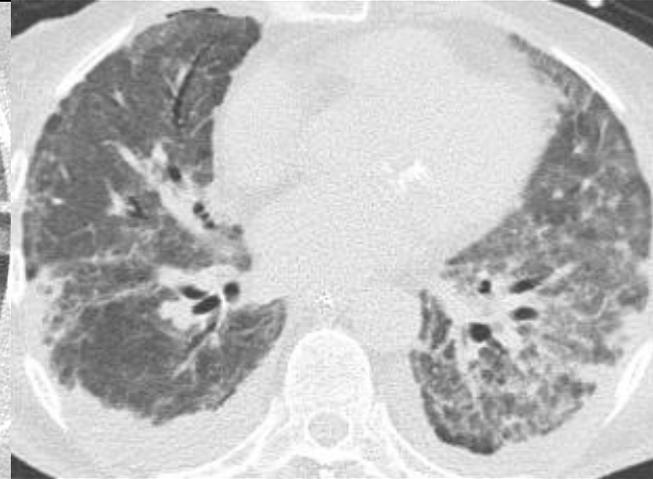
Diffuse alveolar damage



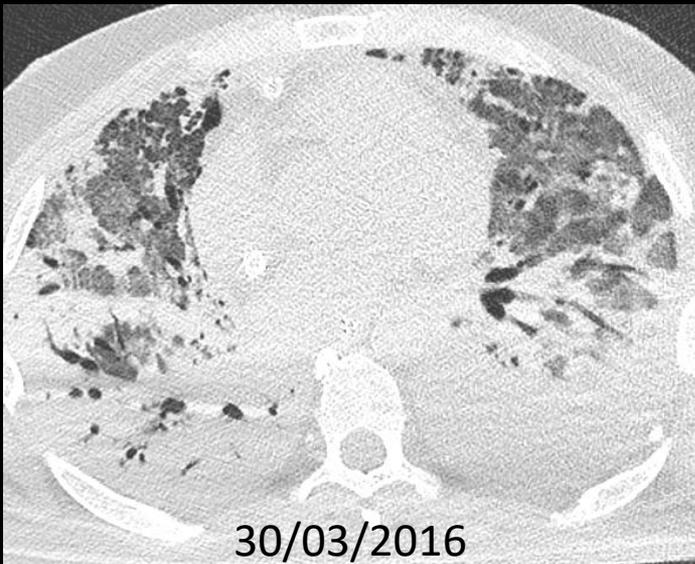
ARDS post CABG



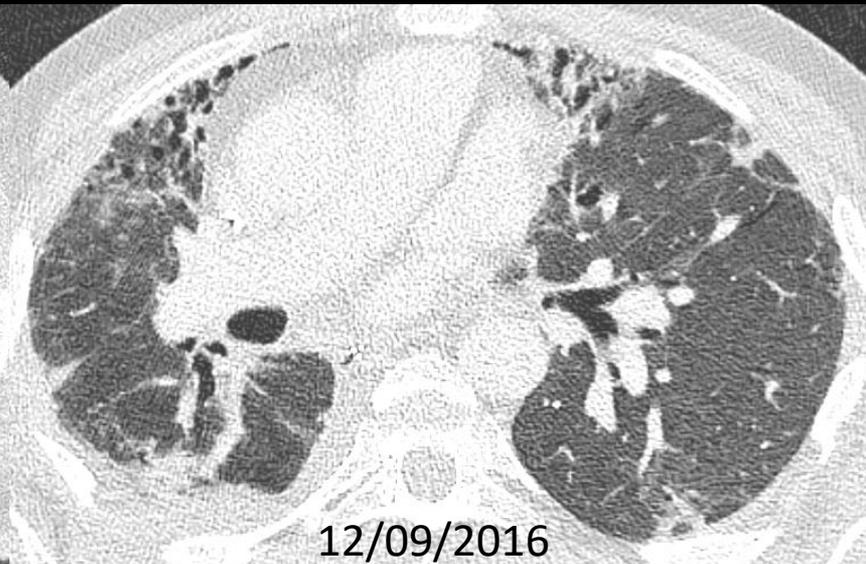
ARDS post peritonitis



AIP



30/03/2016



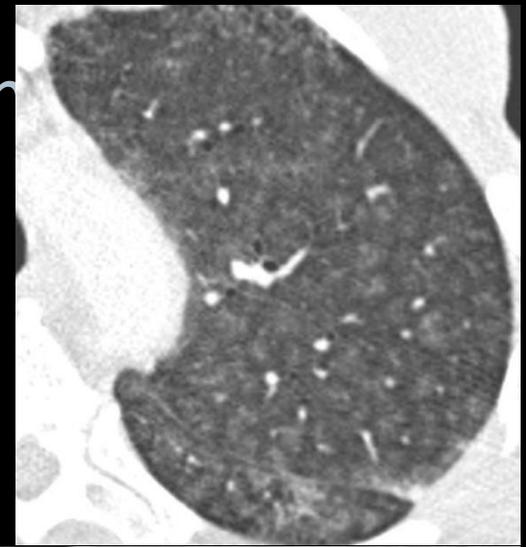
12/09/2016

ARDS Influenza

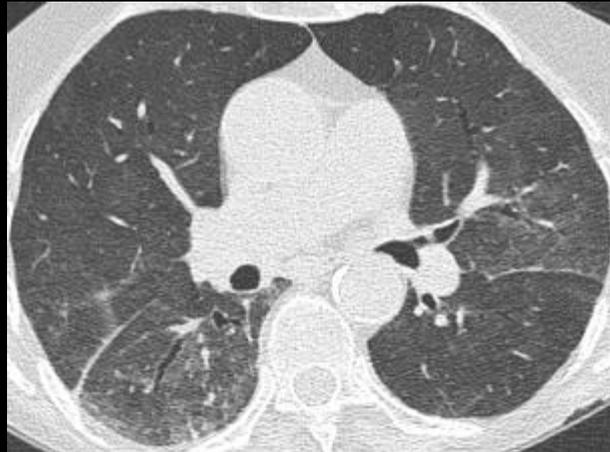
GGO

Acute/subacute pneumonitis

Hypersensitivity pneumonitis



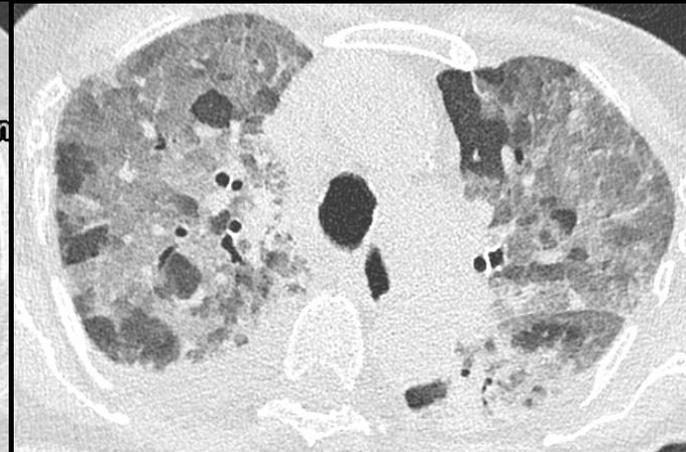
Drug diseases



Amiodarone



Am



Amiodarone



Exp: 97.0 mAs
KVP: 120

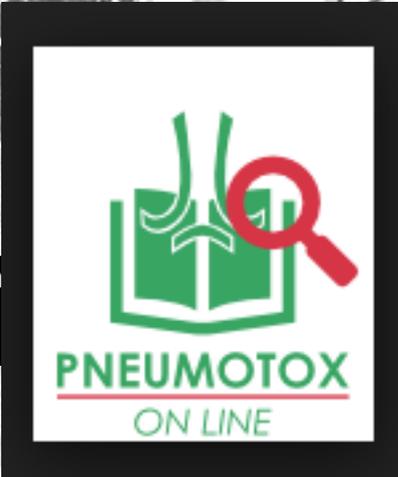


Exp: 97.0 mAs
KVP: 120



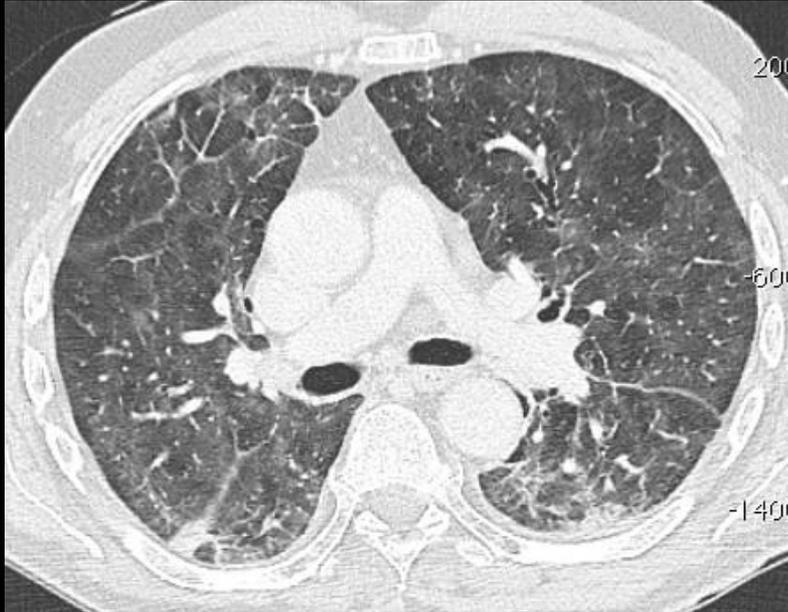
SEX: M
Im: 24/23

Exp: 97.0 mAs
KVP: 120
Tilt: 0
FoV: 391



Amiodarone : OP

Drug diseases



LBA : Lymphocytes 70 %

Composition: pine essential oil and turpentine

Respiratory consequences:

Toxic pneumonia

Pneumatocele

Pneumothorax and pleuritis

Bronchopleural fistula

Pulmonary edema and ARDS



2° interrogatoire: inhalations multiples du
« bol d'air jacquier »

- 3 fois /jour depuis 1 mois avec séances prolongées (30 mn)

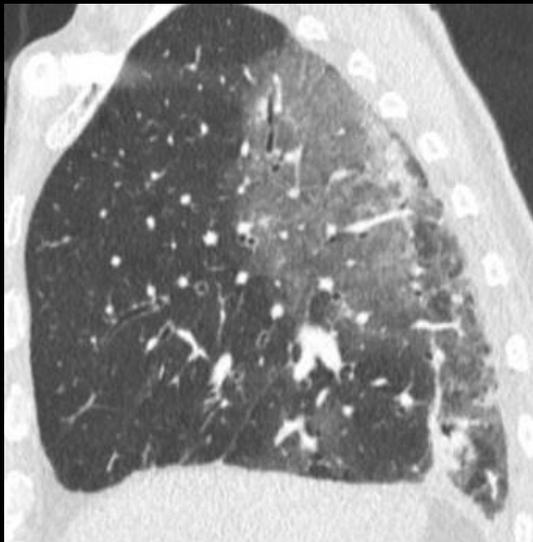
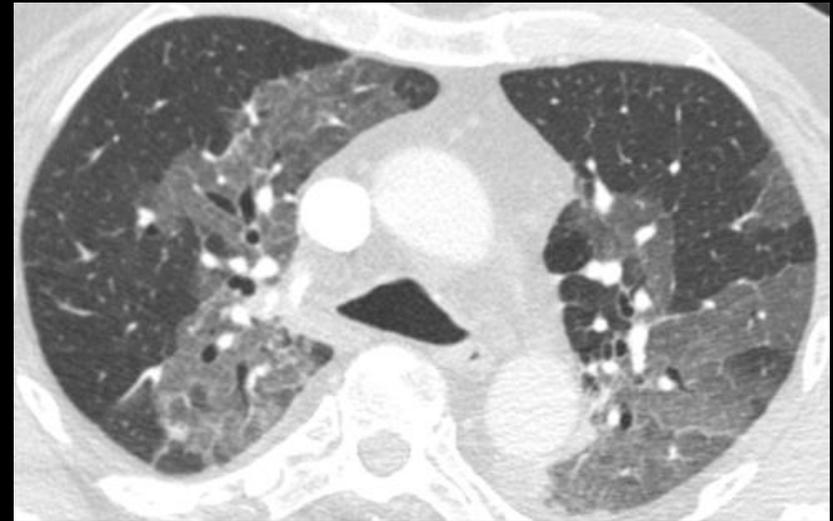
Le Bol d'air Jacquier®, une **oxygénation sans risque radicalaire**, en accord avec la **nature**.

Une **attitude responsable** pour prendre en main notre **état général** et préserver notre **vitalité**. Avec le Bol d'air Jacquier®, respirons la santé !

GGO

Acute/subacute pneumonitis (8)

Organizing pneumonia



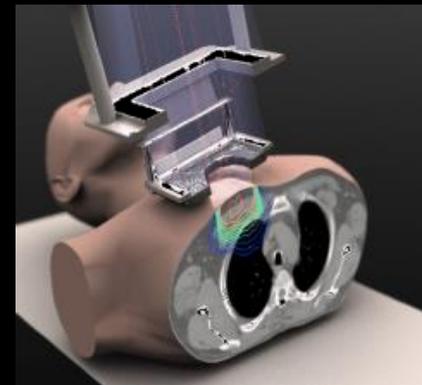
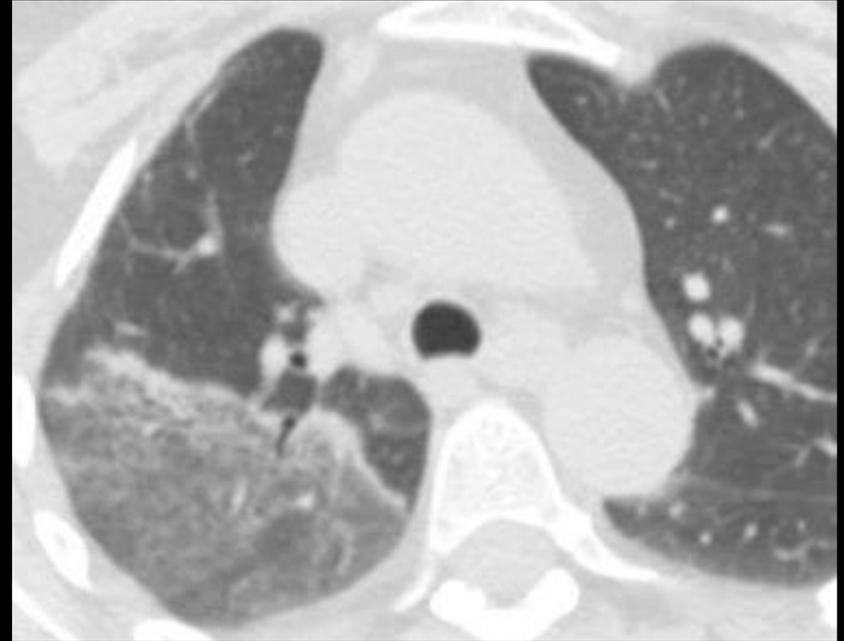
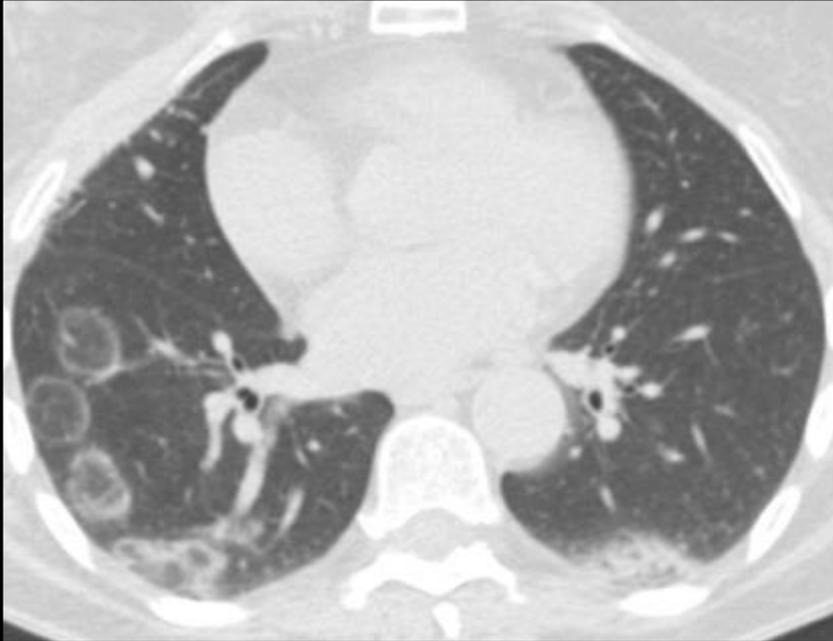
Reversed halo sign

Atoll sign

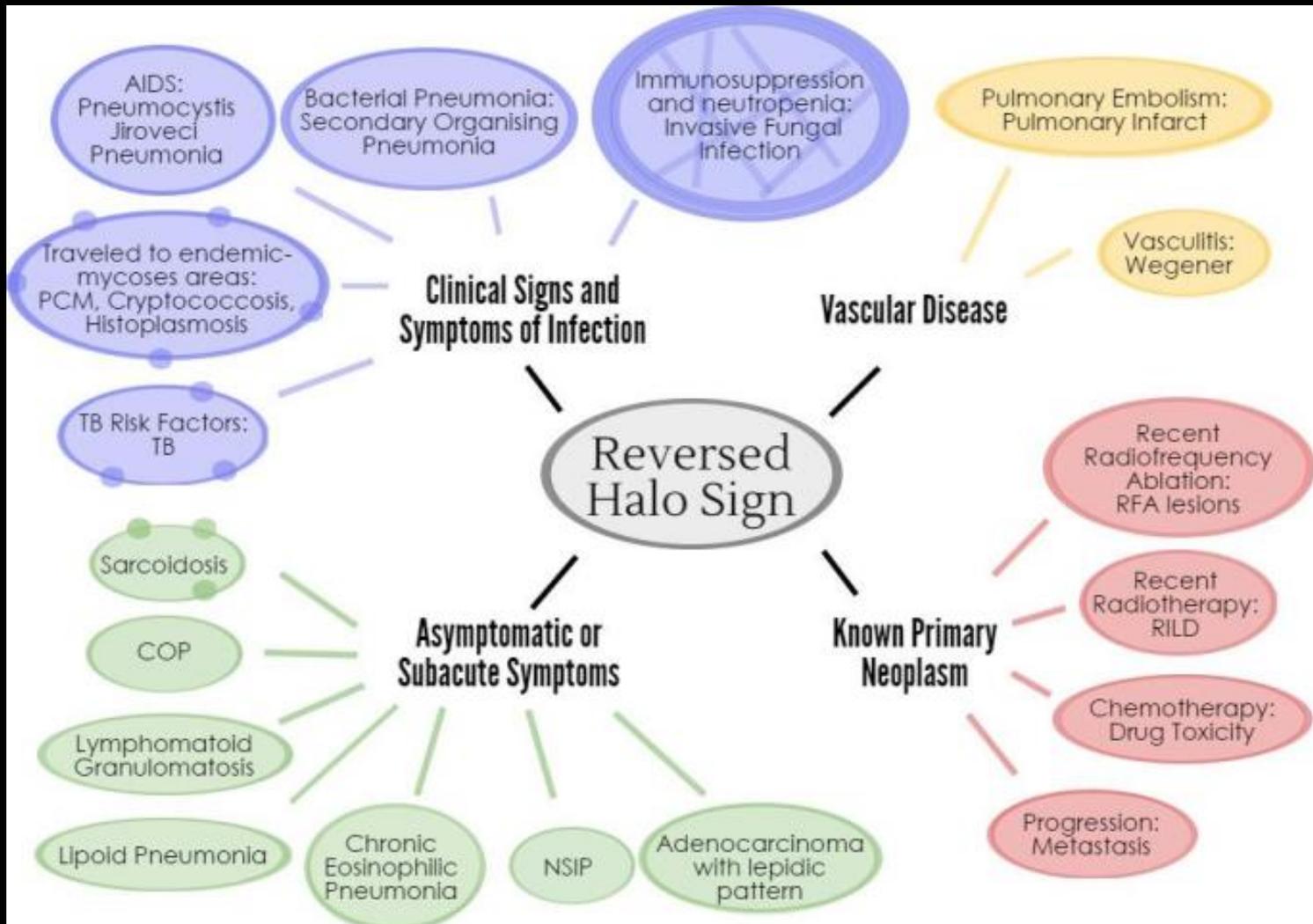
GGO

Acute/subacute pneumonitis (8)

Organizing pneumonia

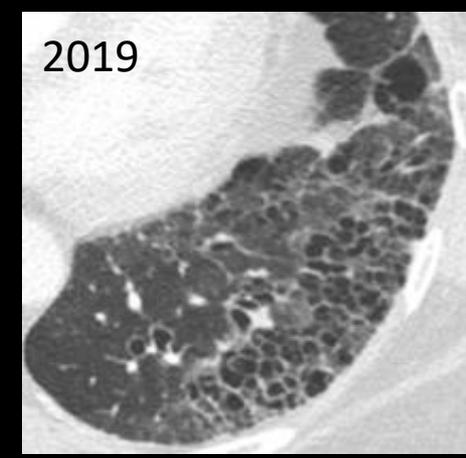
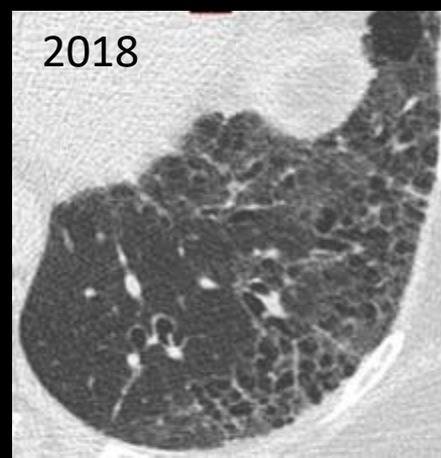
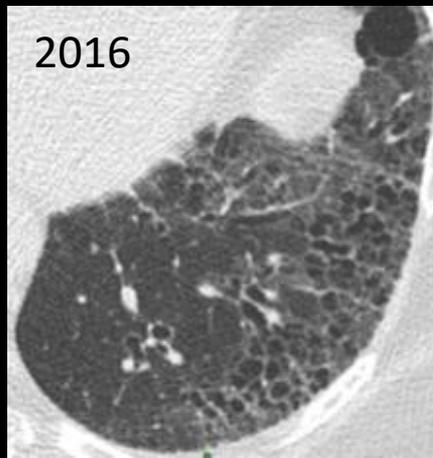
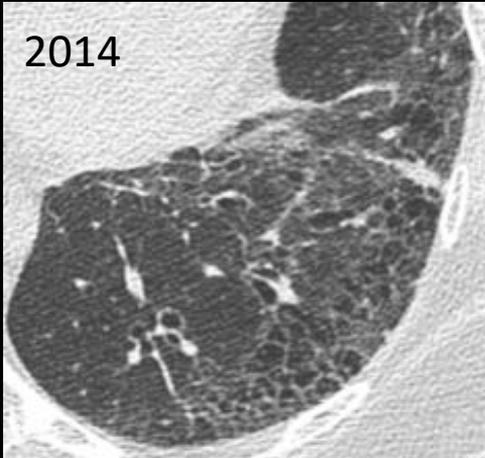
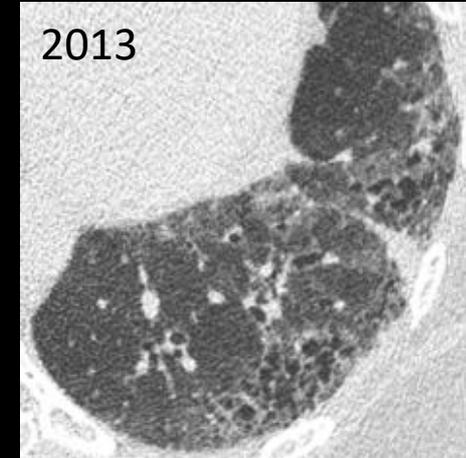
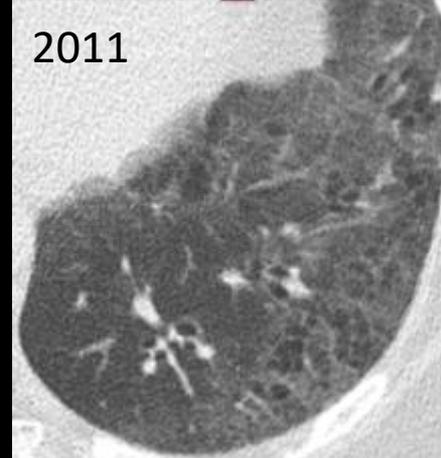
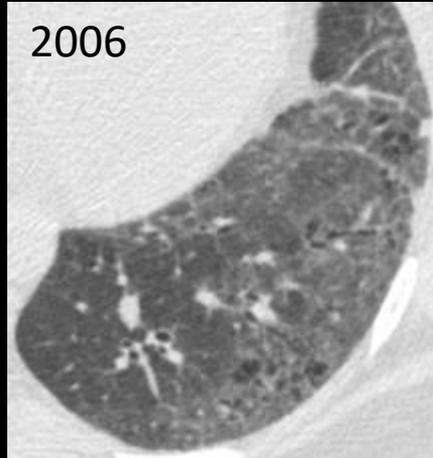


Courtoisie de Anne-Sophie Claes, Nîmes



GGO

Acute/subacute pneumonitis (9)



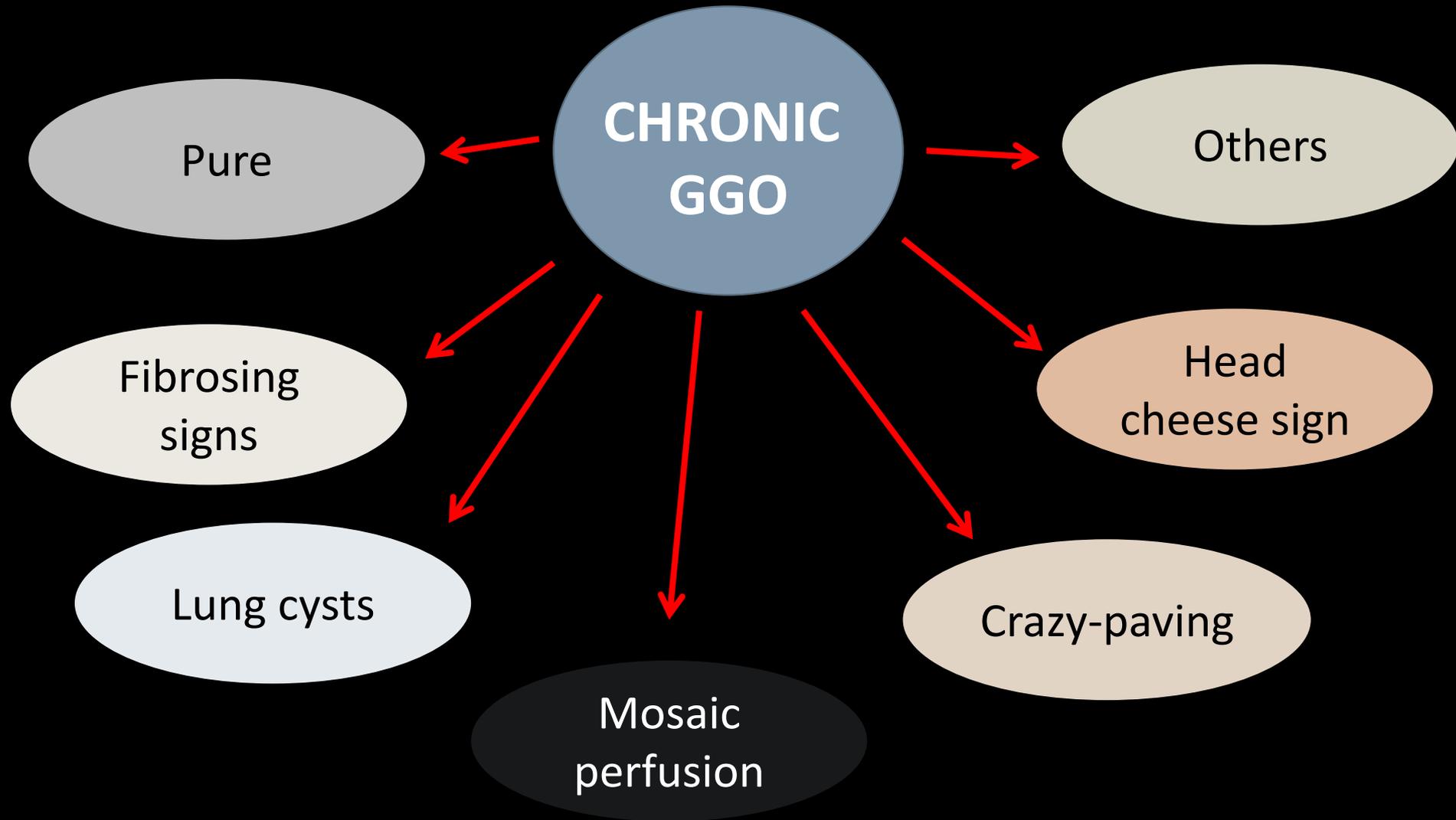
Lupus fibrosing pneumonitis

GGO = usually active-component areas of the process, although it may also be pure fibrosis

- Non-specific interstitial pneumonitis (NSIP)
- Interstitial pneumonia associated with smoking
 - Respiratory bronchiolitis with interstitial pneumonitis (RB-ILD)
 - Interstitial desquamative pneumonia (DIP)
- Lymphocytic interstitial pneumonia (LIP)
- Hypersensitivity pneumonia
- Chronic eosinophilic pneumonia
- Sarcoidosis
- Vasculitis
- Metastatic calcifications
- Exogenous lipoid pneumonia
- Organized pneumonia in immunocompromised patients
- Neoplasia
 - Atypical adenomatous hyperplasia
 - Adenocarcinoma in situ, minimally invasive, lepidic
 - Pulmonary lymphoma

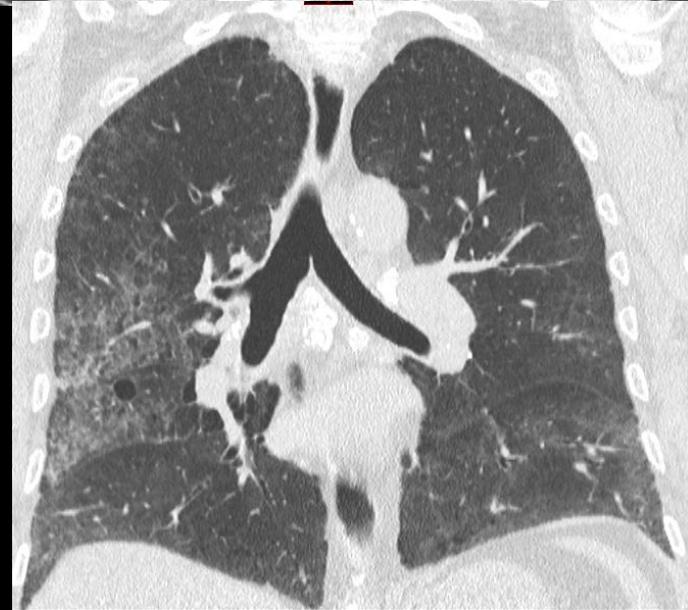
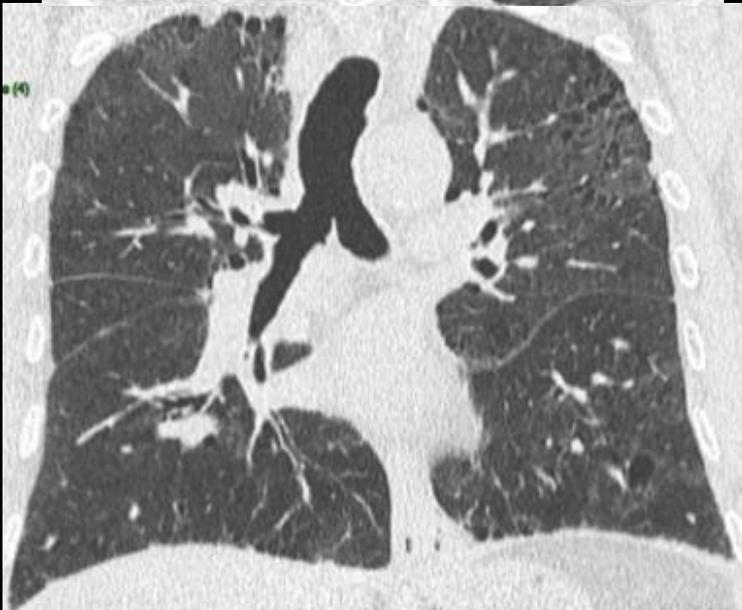
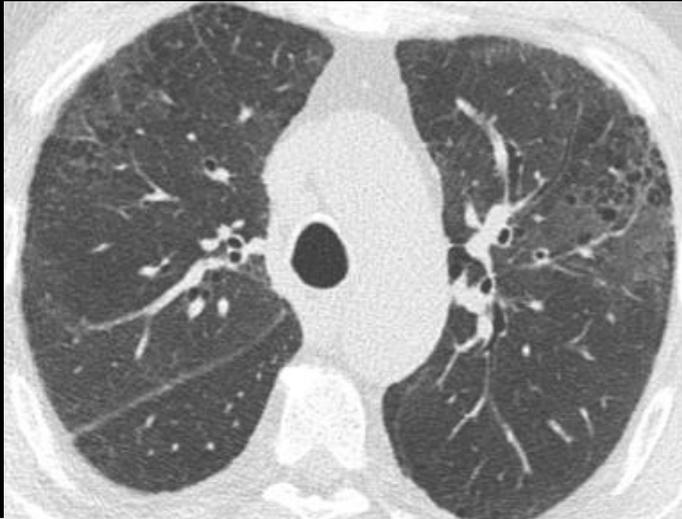
GGO

Chronic pneumonitis



GGO

Chronic pneumonitis (1)

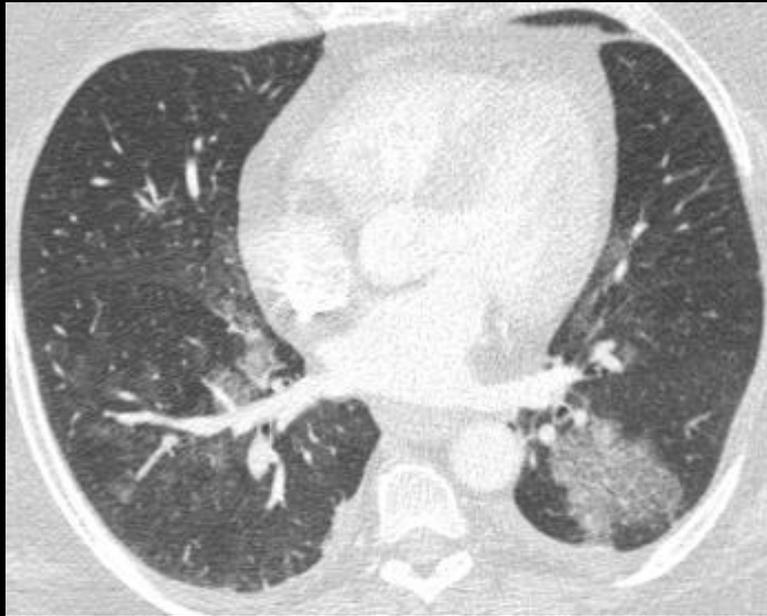


RB-ILD in a 63 YO male with 45 PYU

DIP in a 55 YO male with 40 PYU

GGO

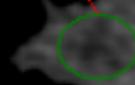
Chronic pneumonitis (2)



Exogenous lipid pneumonia



Zone : 53.1 mm²
Moy. : -53.9
Épaisseur : 15.0
Plage : -93 - -13
Rayon : 6.4 mm

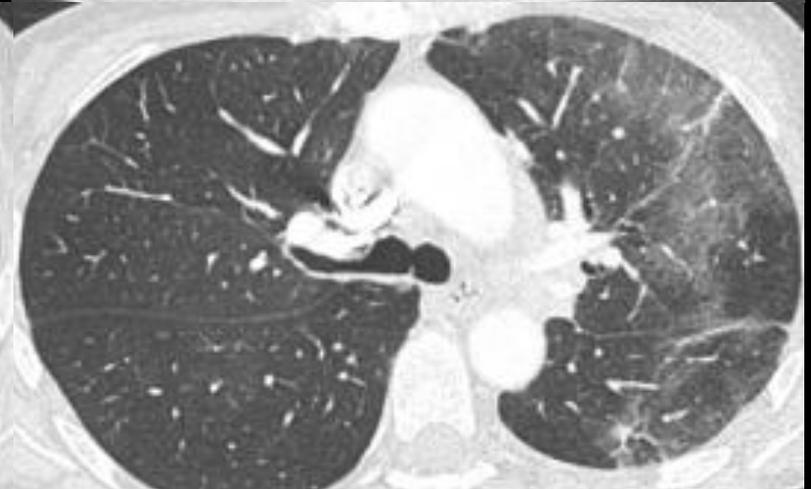


GGO

Chronic pneumonitis (3)



Chronic eosinophilic pneumonia



GGO

Chronic pneumonitis (4)



Metastatic calcifications

- GGO
- Respect for interlobular septa
- No zonal distribution
- Variable density of opacities
- No fibrosis
- No tree-in-bud
- Tracheobronchial calcifications



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Chronic pneumonitis (4)

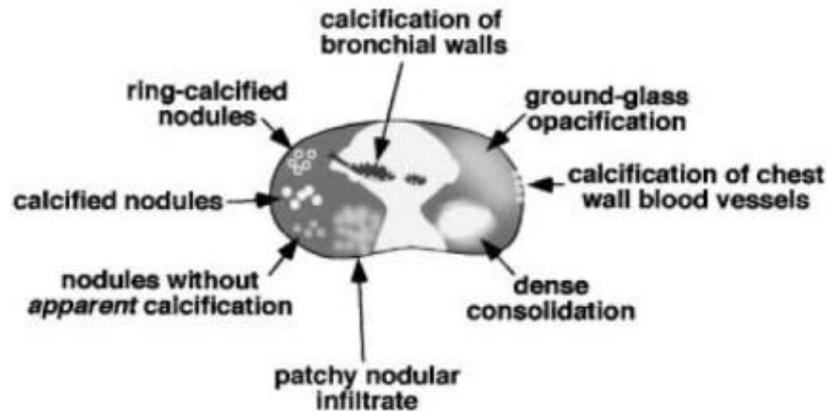


TABLE 1. CAUSES OF PULMONARY CALCIFICATION*

I. Metastatic

A. Benign causes

1. Chronic renal insufficiency on hemodialysis
2. Orthotopic liver transplantation
3. Primary hyperparathyroidism
4. Excess exogenous administration of calcium and vitamin D (milk-alkali syndrome)
5. Hypervitaminosis D
6. Osteopetrosis
7. Osteitis deformans (Paget's disease)

B. Malignant causes

1. Parathyroid carcinoma
2. Multiple myeloma
3. Lymphoma/leukemia
4. Hypopharyngeal squamous cell carcinoma
5. Synovial sarcoma
6. Breast carcinoma
7. Choriocarcinoma

II. Dystrophic calcification

A. Granulomatous disorders

1. Histoplasmosis
2. Coccidioidomycosis
3. Tuberculosis
4. Sarcoidosis

B. Viral infections

1. Postvaricella pneumonia
2. Smallpox handler's lung

C. Parasitic infections

1. Paragonimiasis
2. Pneumocystosis

D. Amyloidosis

E. Pulmonary vascular calcifications

1. Vascular grafts
2. Pulmonary hypertension
3. Congenital high flow
4. Hemosiderosis

F. Coal worker's pneumoconiosis

G. Silicosis

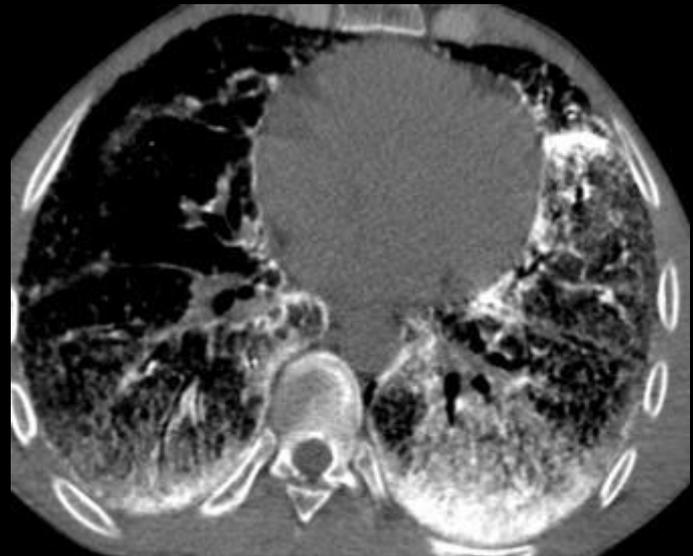
III. Idiopathic

A. Pulmonary alveolar microlithiasis

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Chronic pneumonitis (5)

Pulmonary alveolar microlithiasis



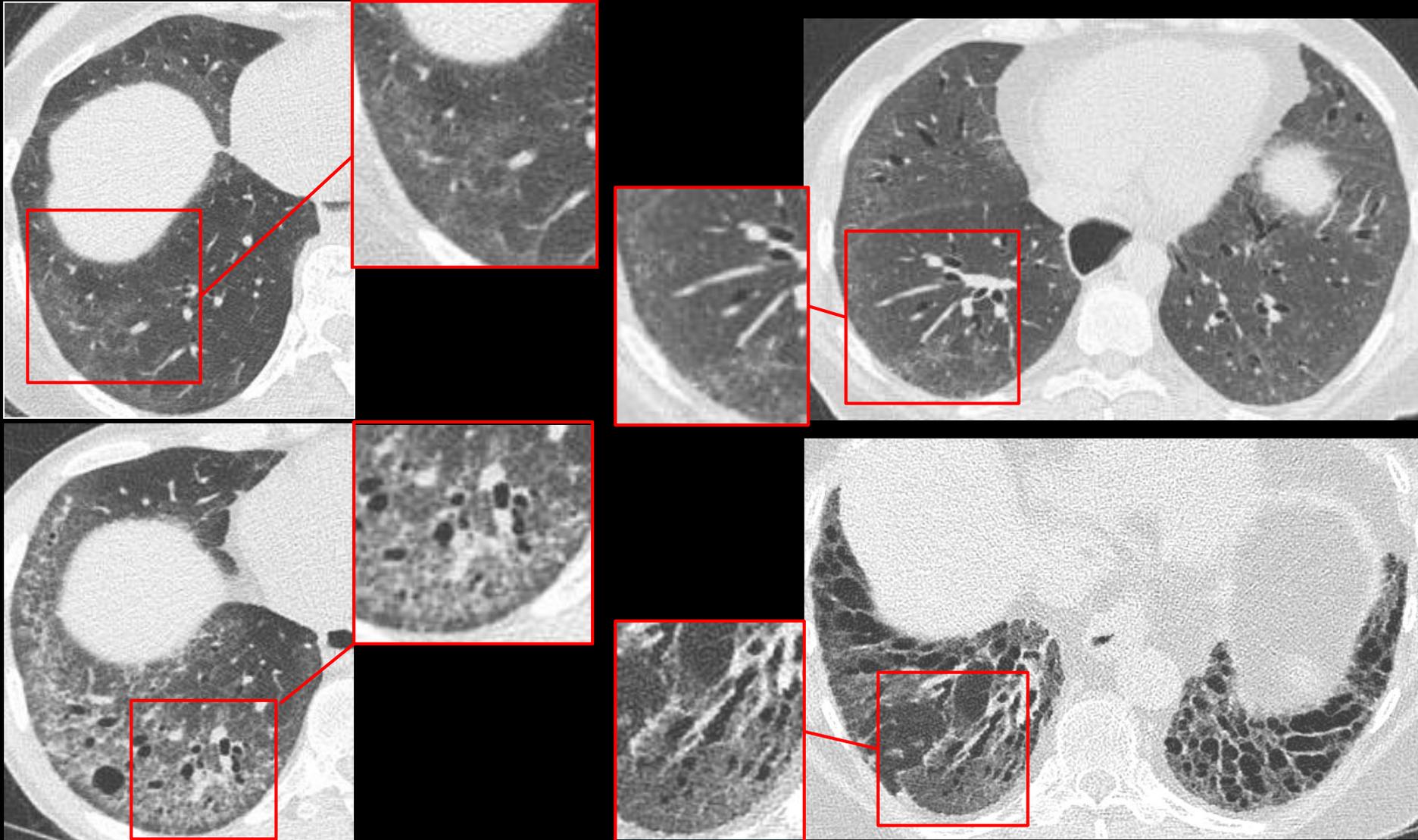
Intralobular reticulations, bronchiectasis / traction bronchiolectasis, loss of volume, architectural distortion

- Fibrotic non-specific interstitial pneumonitis (NSIP) (idiopathic, collagenosis, drugs)
- Hypersensitivity pneumonitis (chronic form)
- Atypical usual interstitial pneumonia (UIP)
- Sarcoidosis with fibrosis
- Lymphocytic interstitial pneumonia (LIP)

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Chronic pneumonitis with fibrosis signs

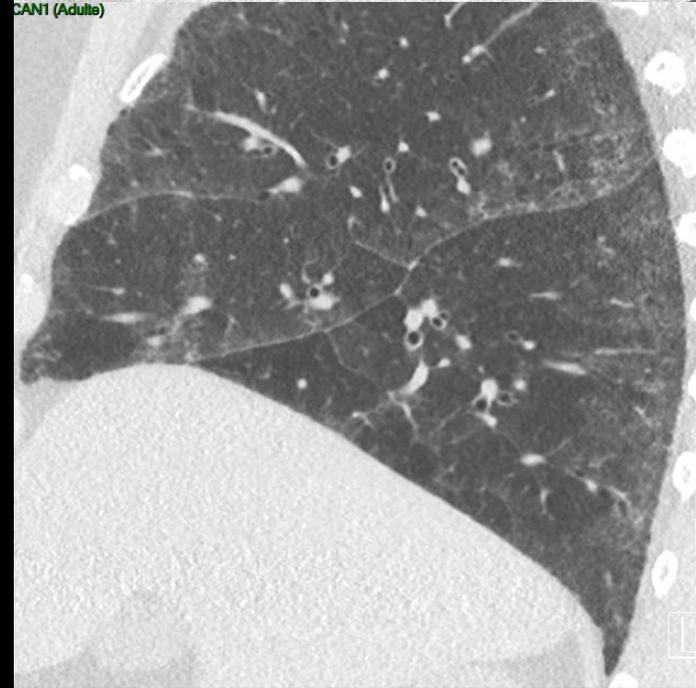
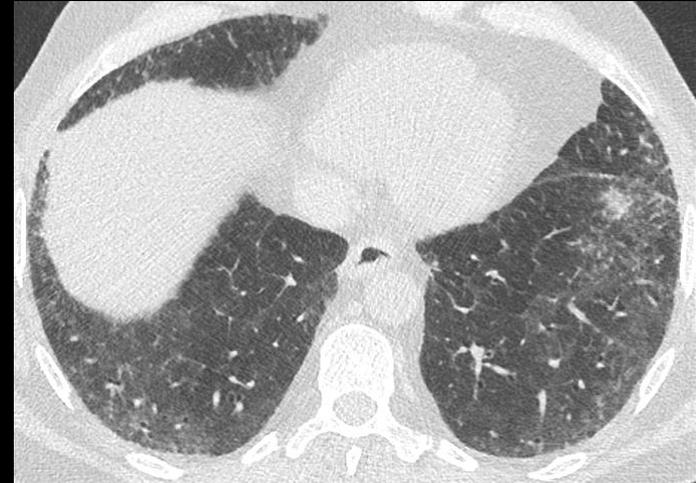
Four patients with various patterns of NSIP in systemic sclerosis



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Chronic pneumonitis with fibrosis signs

Typical UIP at surgical biopsy



Ryoko Egashira, MD, PhD
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Anne-Laure Brun, MD
Alexandra Rice, MB, BChir, FRCPath
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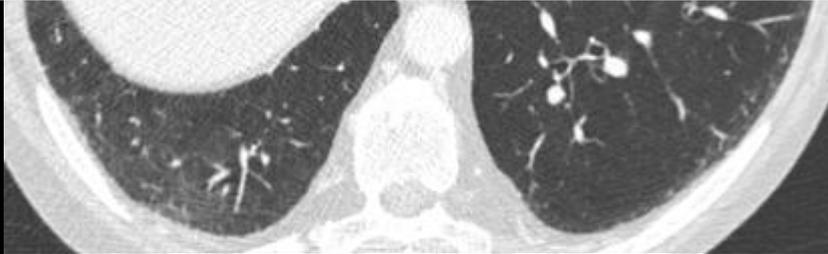
Radiology 2017; 284:255–263

Diffuse Pulmonary Ossification in Fibrosing Interstitial Lung Diseases: Prevalence and Associations¹

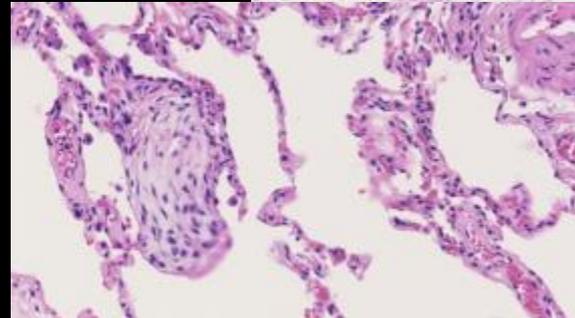
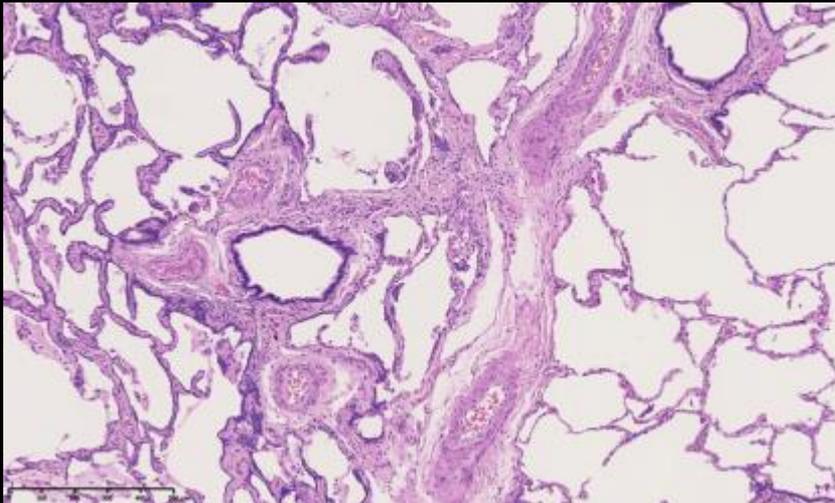
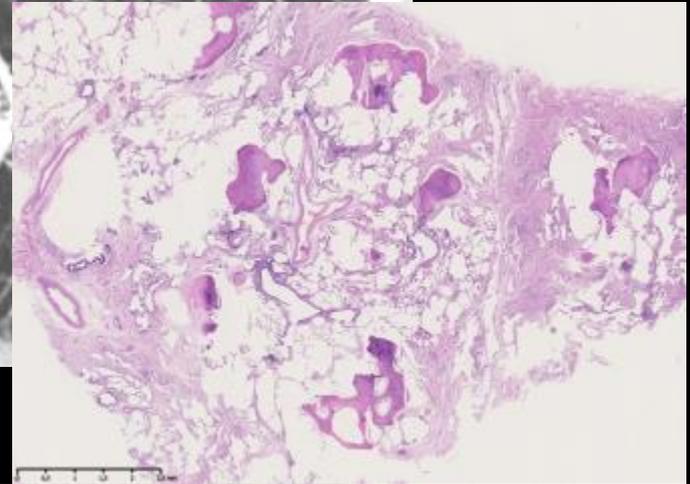
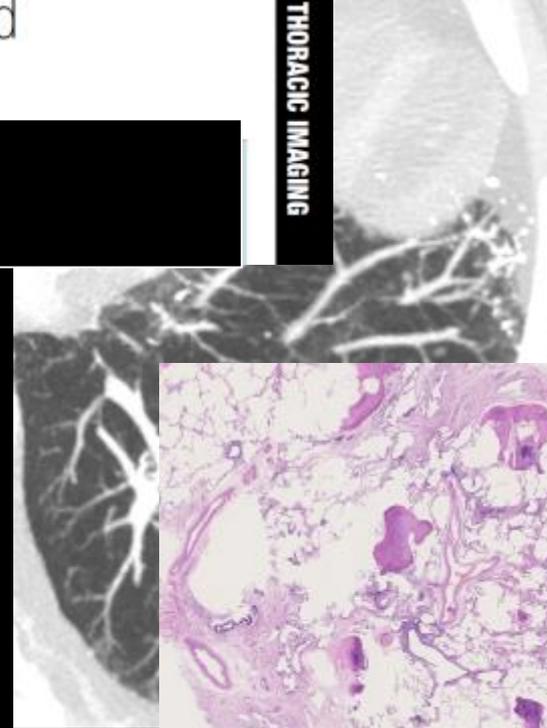
ORIGINAL RESEARCH ■ THORACIC IMAGING

↳ fibrosis signs

>10, in infiltrative areas
UIP (28,5%) vs. others (8,3%) (NSIP, HP,...)



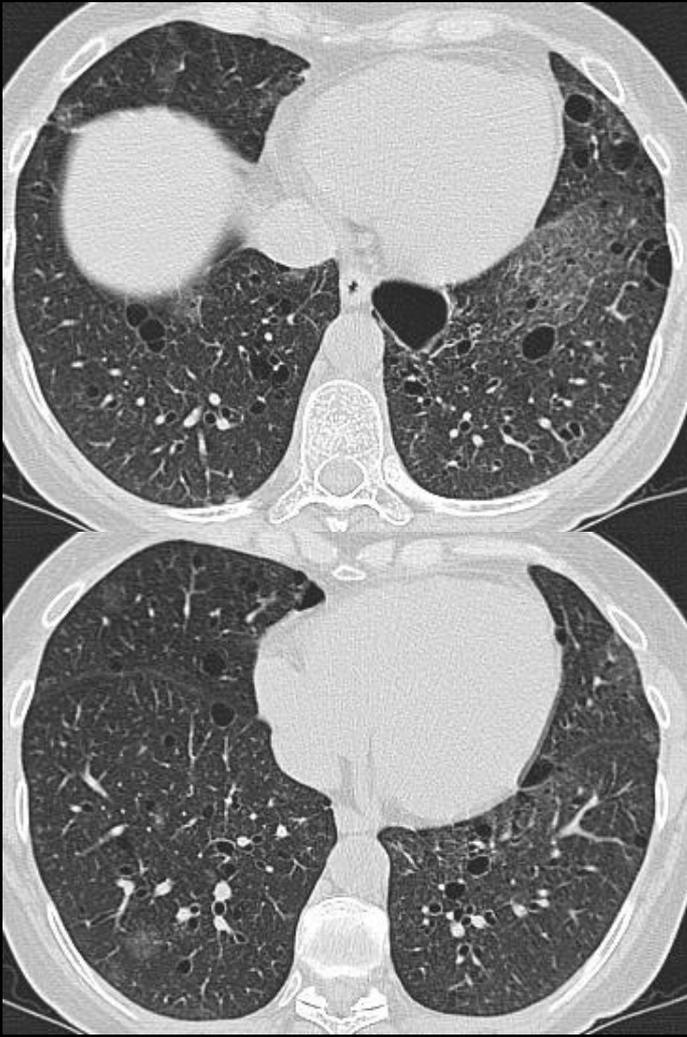
Typical UIP at surgical biopsy



- Lymphocytic interstitial pneumonia (LIP)
- Desquamative interstitial pneumonia (DIP)
- Pneumocystis Jirovecii pneumonia (PJP)
- Chronic hypersensitivity pneumonitis
- Usual interstitial pneumonia with honeycombing (UIP)

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Chronic pneumonitis with pulmonary cysts



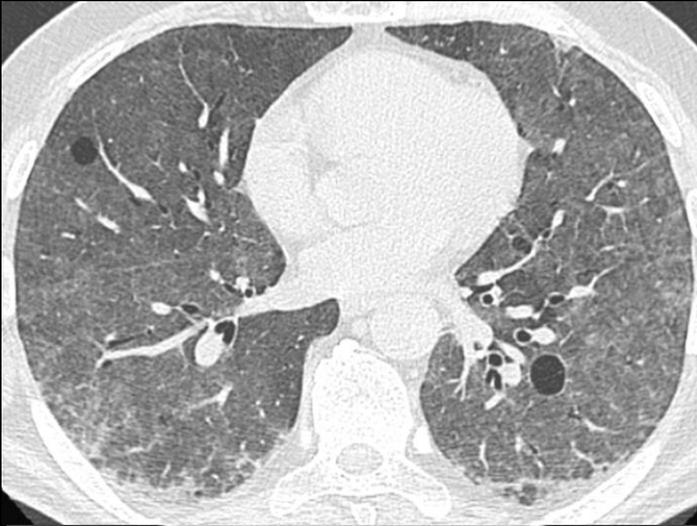
LIP in Sjögren syndrome



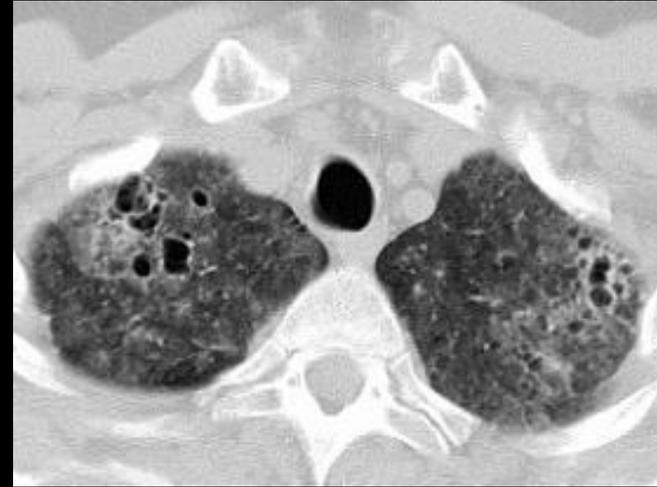
LIP in rheumatoid arthritis
Hypoxia at 58 mm Hg

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Pneumonitis with pulmonary cysts



Farmers lung HP



Pneumocystis Jirovecii Pneumonia

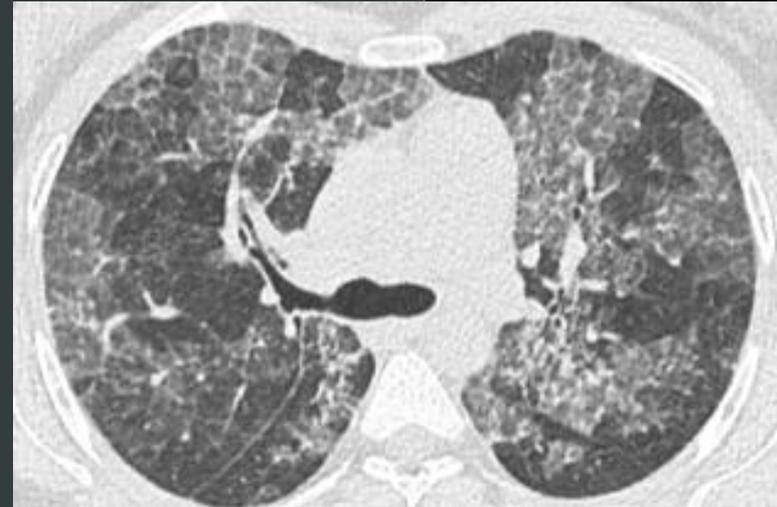
Pneumonitis with « crazy-paving »

Acute/subacute :

- Pulmonary edema
- Pulmonary hemorrhage
- Acute interstitial pneumonia (AIP), DAD, ARDS
- Acute eosinophilic pneumonia
- Hypersensitivity pneumonitis
- Pneumonia (bacterial, viral (**Covid**), PJP, mycoplasma, ...)
- Drugs
- Acute radiation pneumonitis

Chronic :

- **Alveolar proteinosis**
- Non-specific interstitial pneumonia (NSIP)
- **Exogenous lipoid pneumonia**
- Chronic eosinophilic pneumonia
- Adenocarcinoma (invasive mucinous)
- Lymphoma



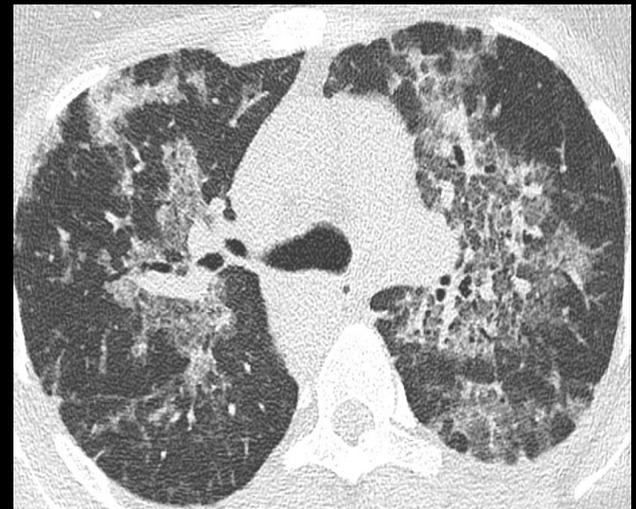
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Chronic pneumonitis with crazy-paving

The typical crazy-paving with mosaic or pseudo-mosaic GGO and thickening of inter- and intralobular lines is very suggestive of alveolar proteinosis and to a lesser extent of lipid pneumonitis. The term is, however, often misused in many other pathologies.



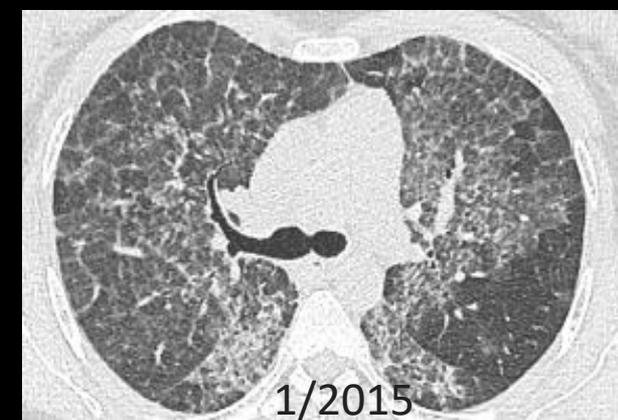
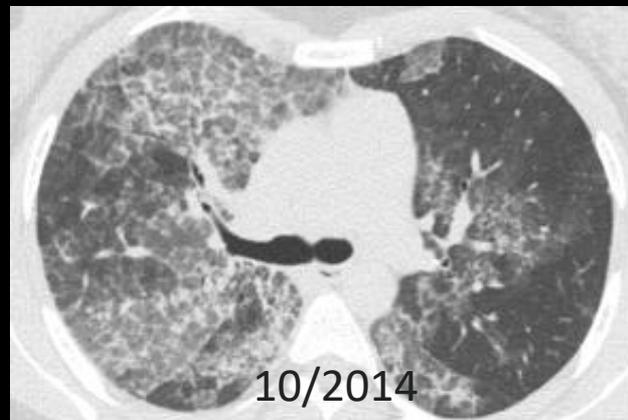
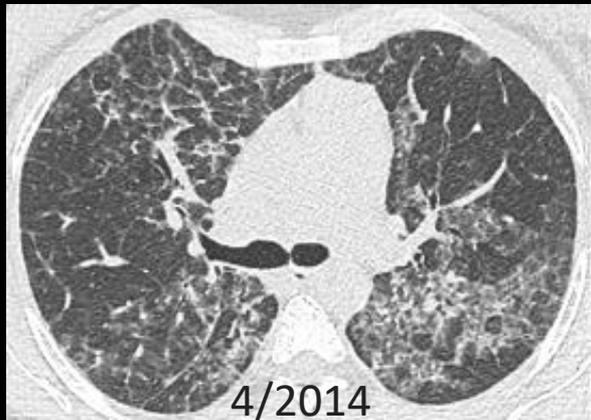
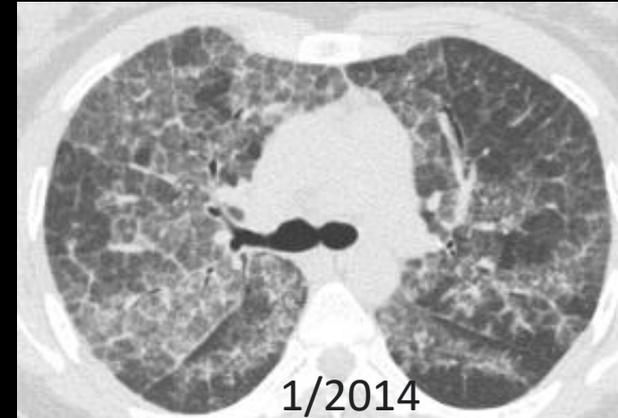
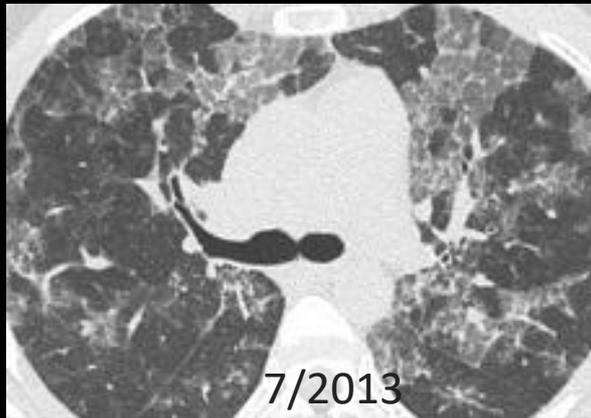
Alveolar proteinosis



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Chronic pneumonitis with crazy-paving

The typical crazy-paving with mosaic or pseudo-mosaic GGO and thickening of inter- and intralobular lines is very suggestive of alveolar proteinosis and to a lesser extent of lipid pneumonitis. The term is, however, often misused in many other pathologies.



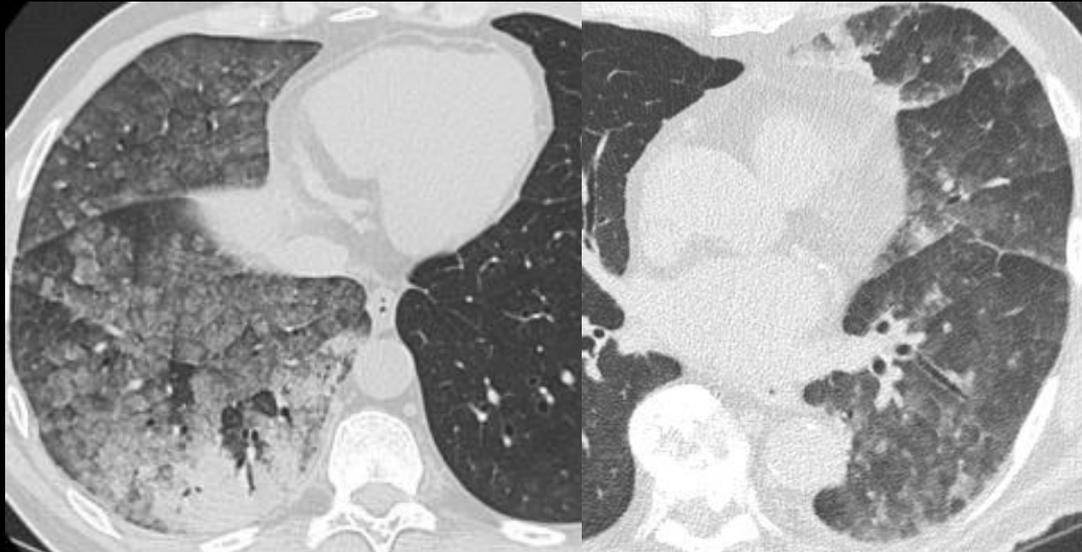
Evolution of alveolar proteinosis after LBA

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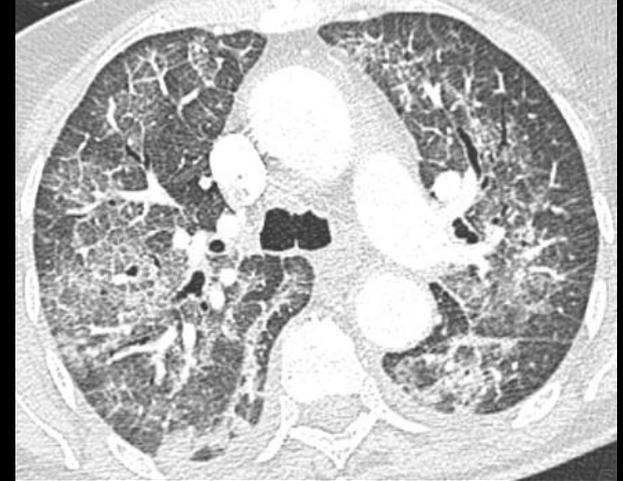
Chronic pneumonitis with « crazy-paving »



Amiodarone



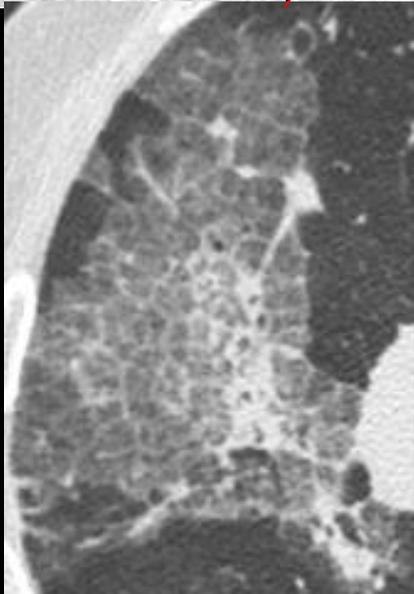
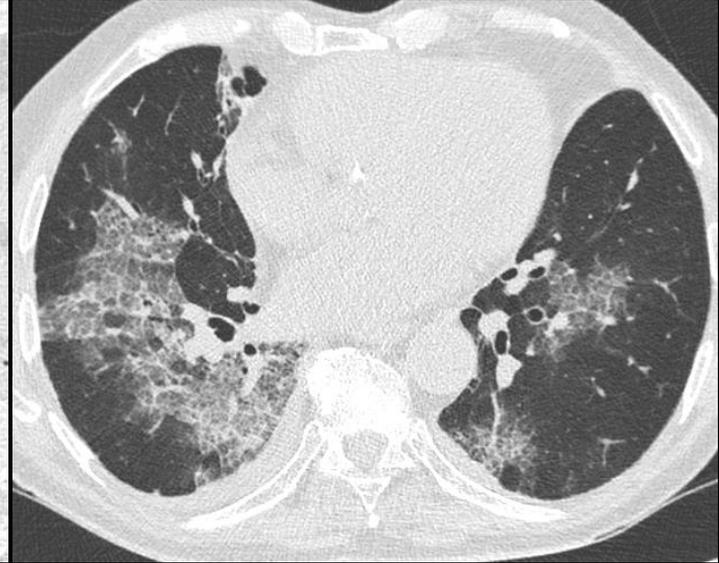
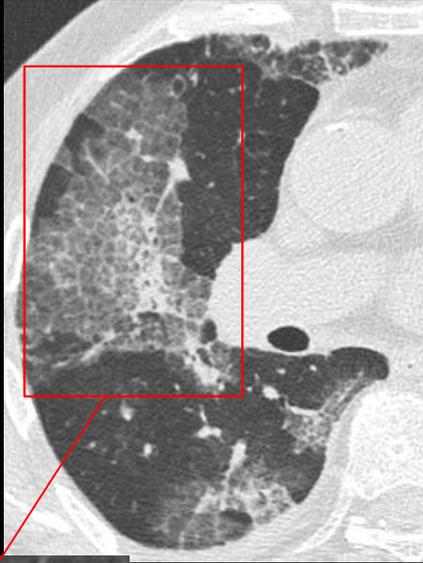
Adenocarcinoma



PJP

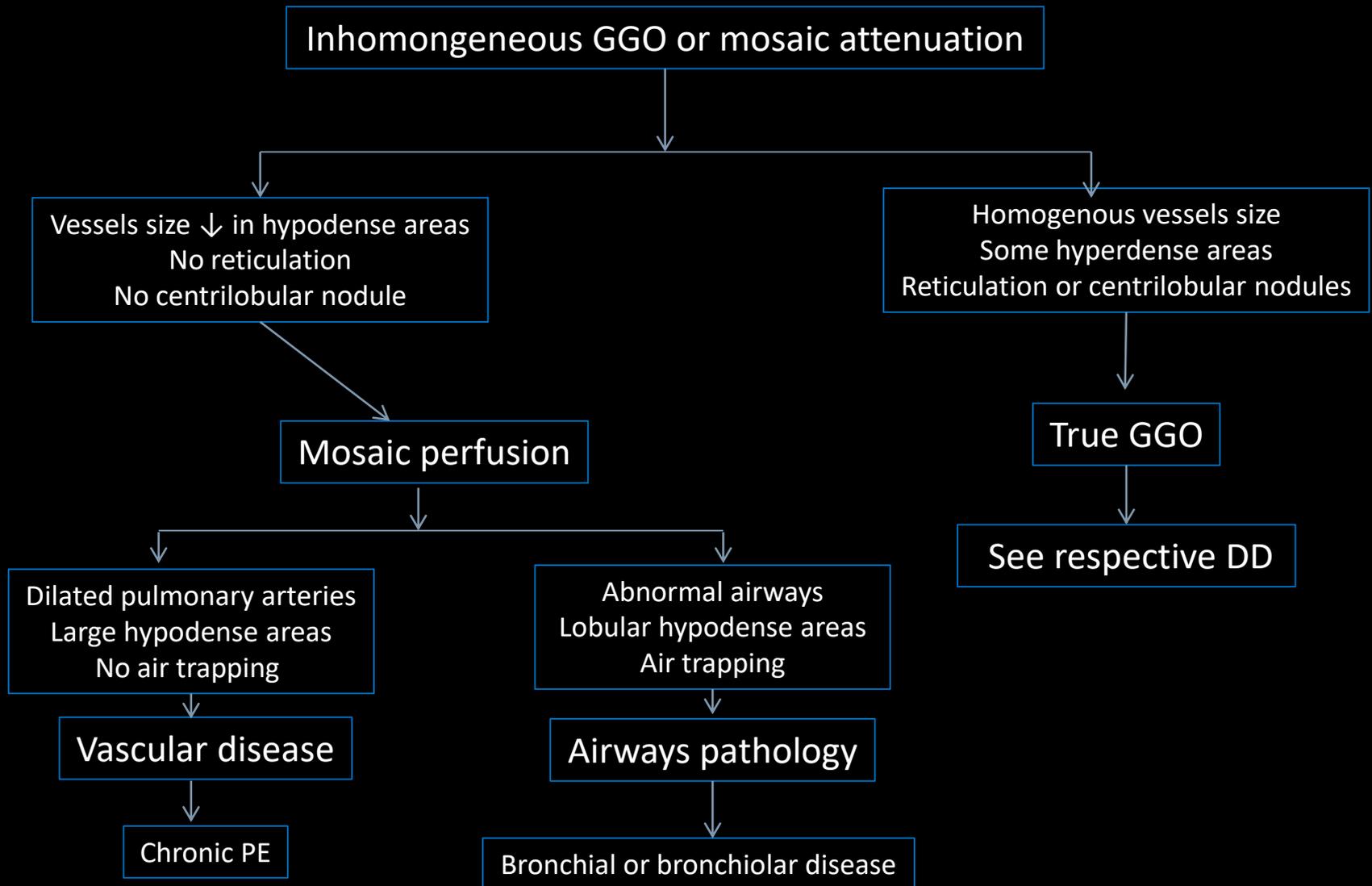
GGO

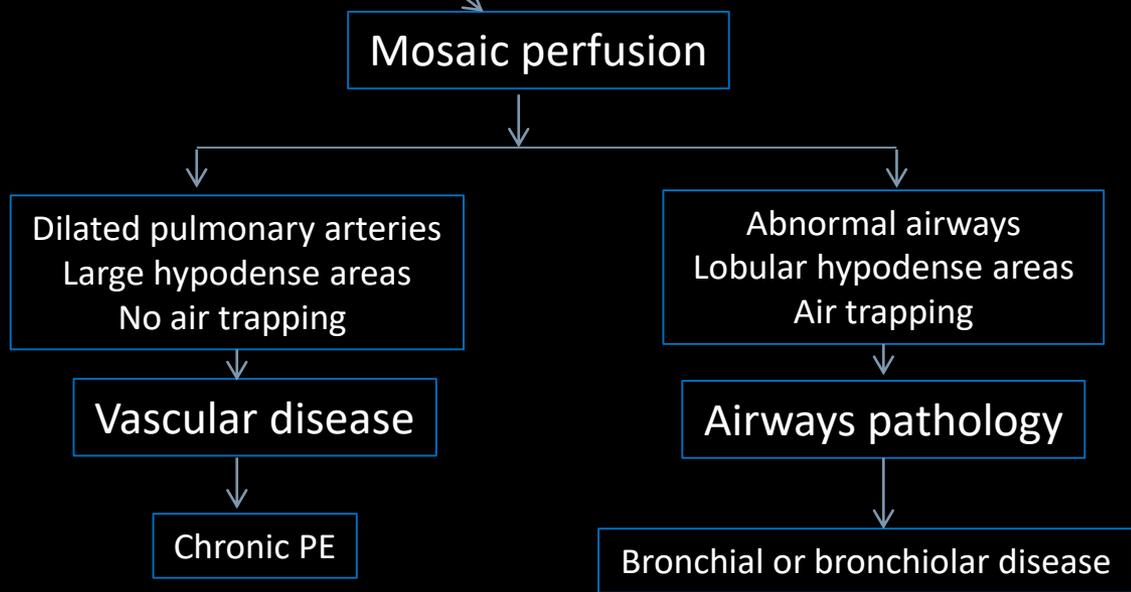
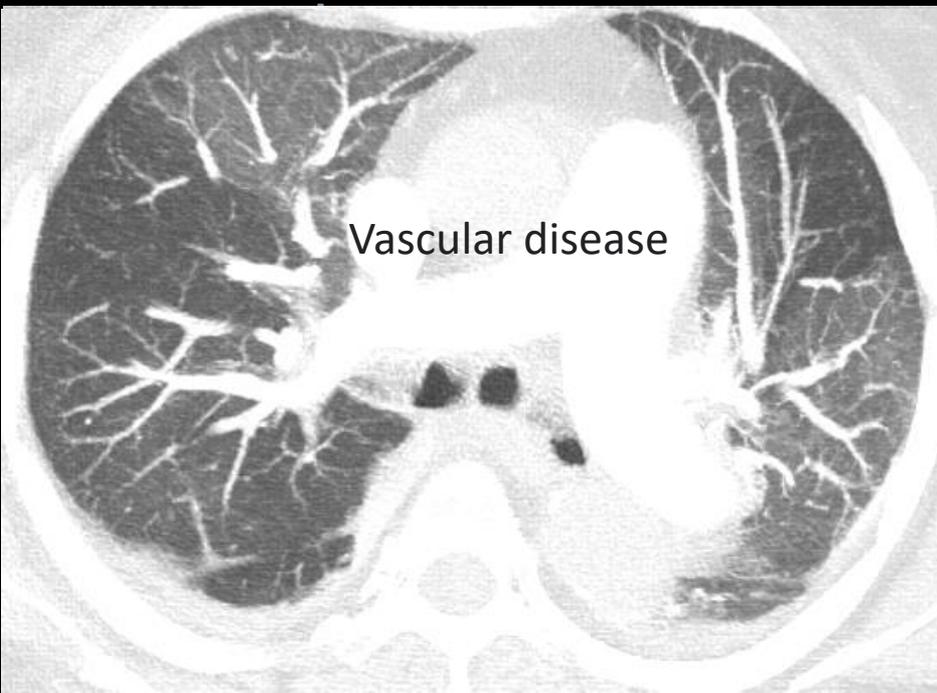
~~Acute~~
Chronic pneumonitis with « crazy-paving »



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Pneumonitis with mosaic pattern





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Pneumonitis with mosaic pa



Inhomogeneous GGO or mosaic attenuation

Vessels size ↓ in hypodense areas
No reticulation
No centrilobular nodule

Mosaic perfusion

Dilated pulmonary arteries
Large hypodense areas
No air trapping

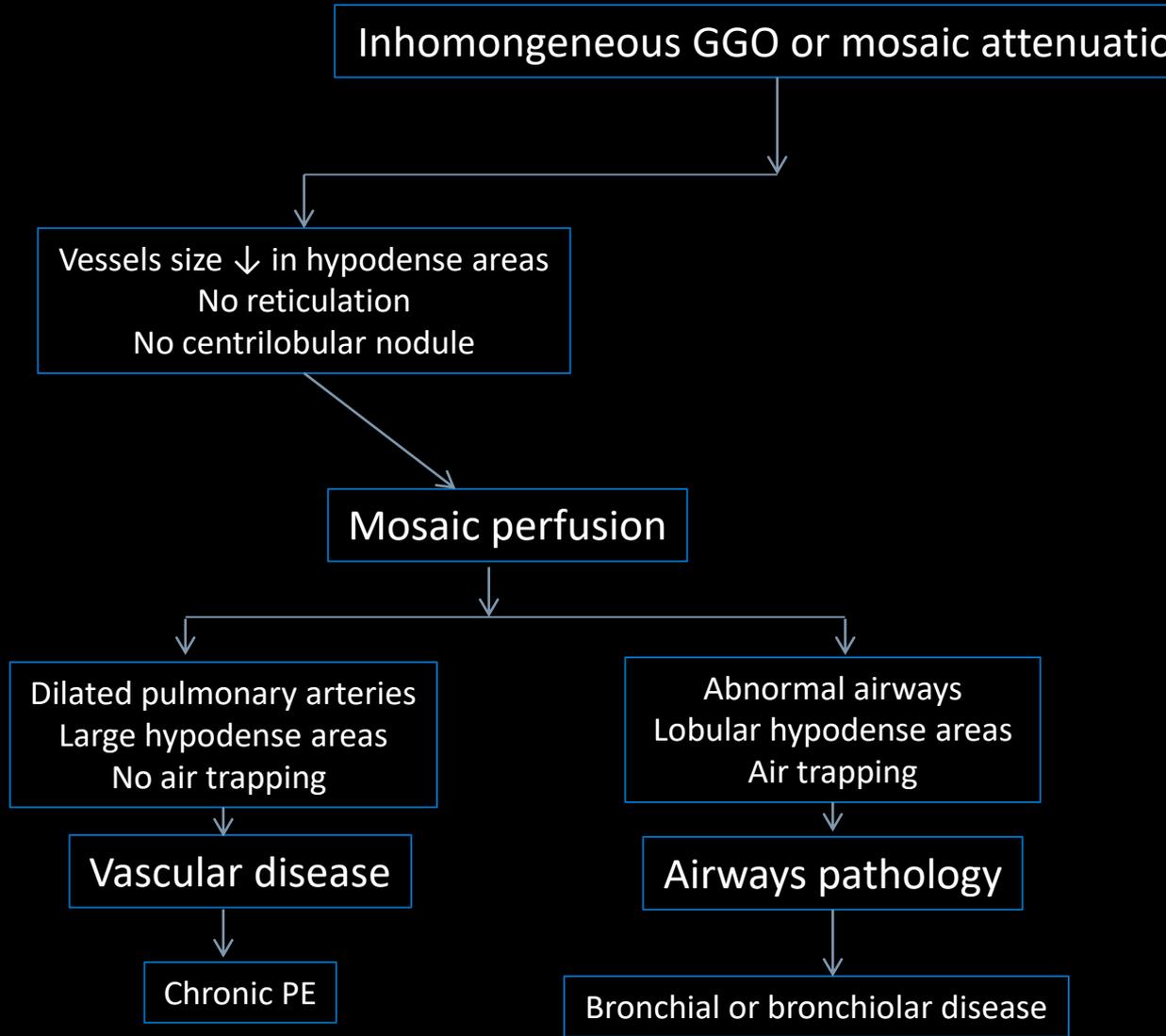
Abnormal airways
Lobular hypodense areas
Air trapping

Vascular disease

Airways pathology

Chronic PE

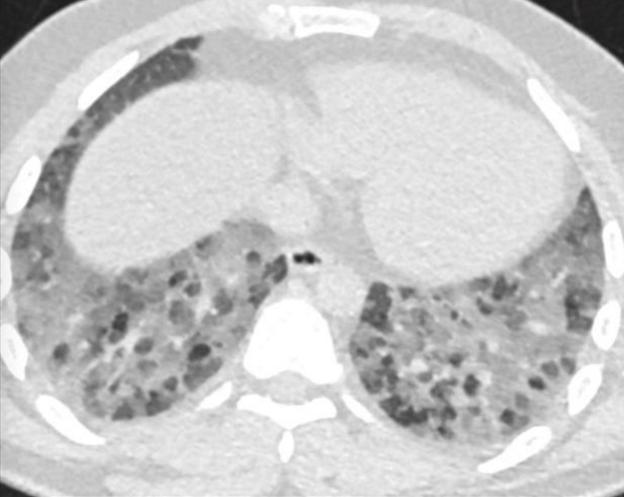
Bronchial or bronchiolar disease



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Pneumonitis with mosaic pattern

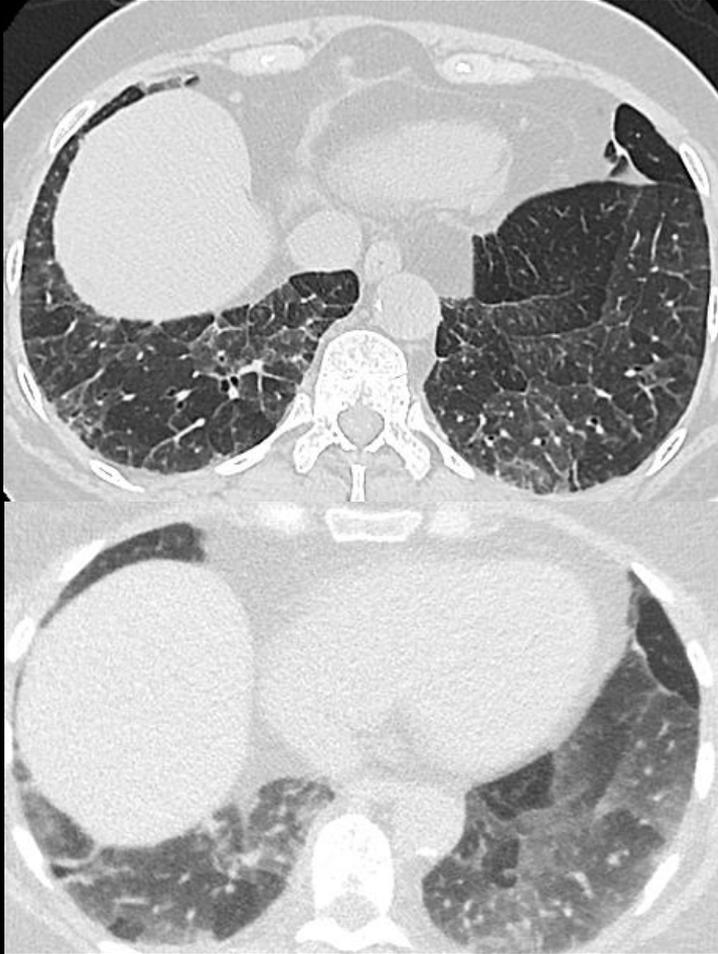
Various examples of hypersensitivity pneumonitis



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Pneumonitis with head cheese sign

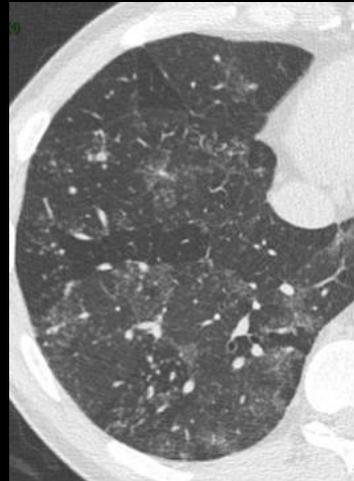
= infiltrative lung disease with bronchiolar obstruction



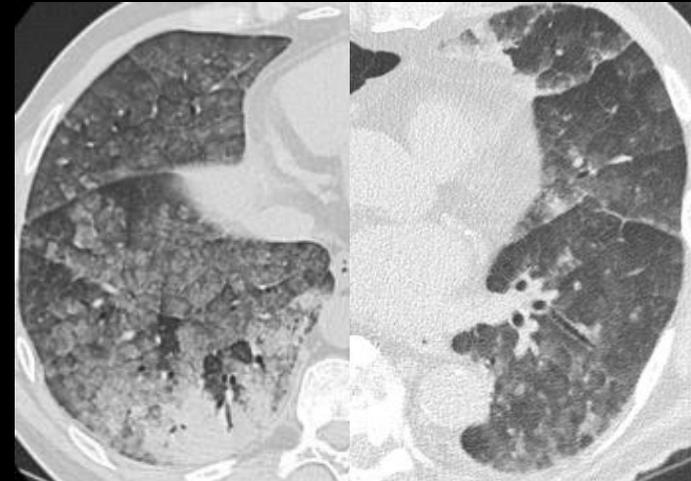
Hypersensitivity pneumonitis

✓ Hypersensitivity pneumonitis

- ✓ Sarcoidosis
- ✓ Atypical infections (mycoplasma, chlamydia)
- ✓ RB-ILD
- ✓ Adenocarcinoma



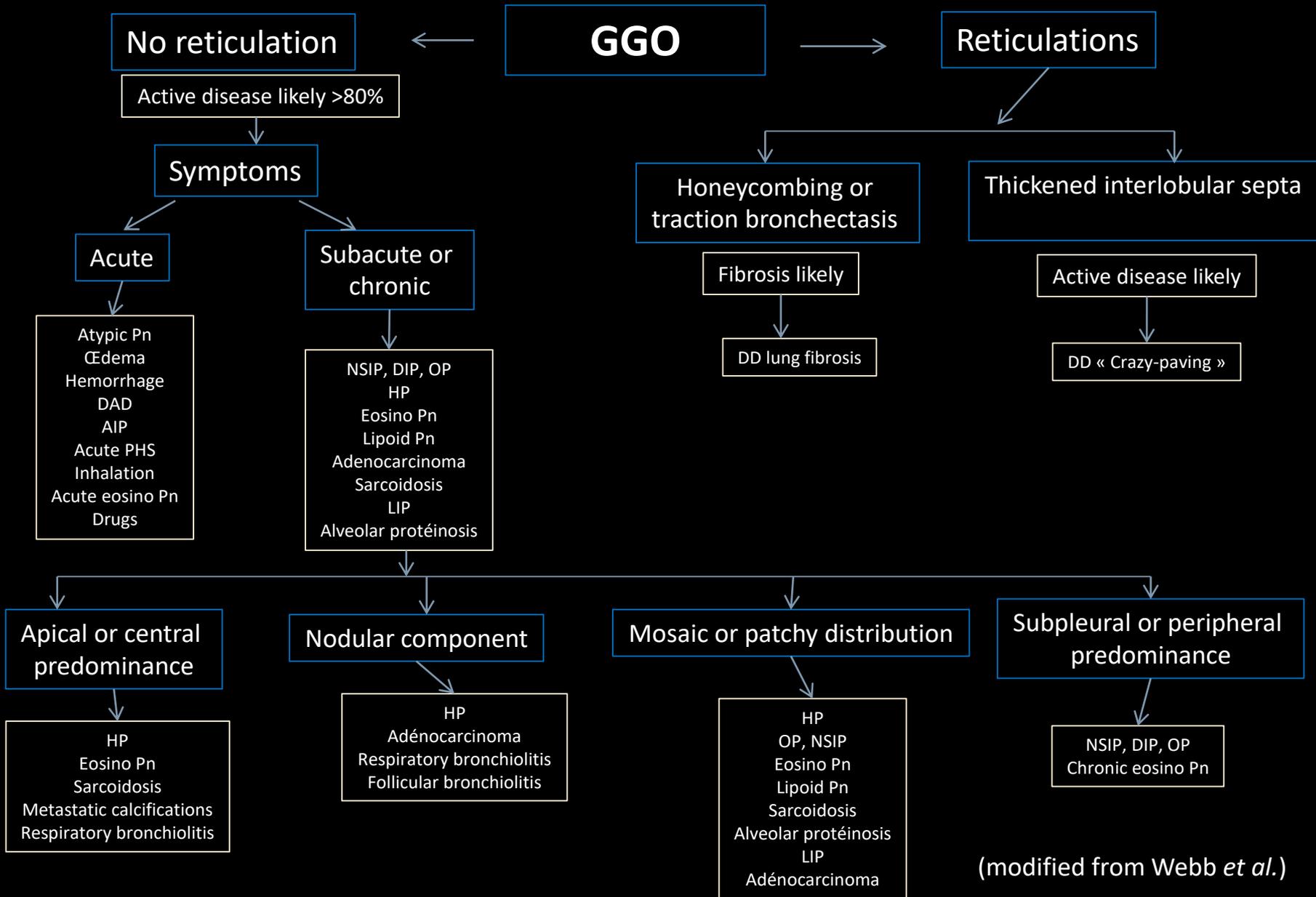
Sarcoidosis



Adenocarcinoma

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Diagnostic Algorithm



(modified from Webb *et al.*)

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Summary

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+

Isolated (no reticulation or fibrosis sign)



Edema/hemorrhage
Active inflammation/infection

Reticulations (honeycombing)
Traction bronchiectasies



DD fibrosing pathologies

Thickened inter/intra lobular septa



DD crazy-paving

Thickened intralobular interstitium
No bronchiectasis/bronchiolectasis



Pulmonary infiltration
Inflammation
Mild fibrosis



Some forms of adenocarcinoma may be included in most of those categories



CONGRÈS

Imagerie Appliquée à la Pratique Pneumologique



17&18

SEPTEMBRE
TOULOUSE

Comité d'organisation :
Docteur Sébastien Bommart
Docteur Gérard Durand

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