Coronavirus Disease 2019 (COVID-19): A Systematic Review of Imaging Findings in 162 Iranian Patients.

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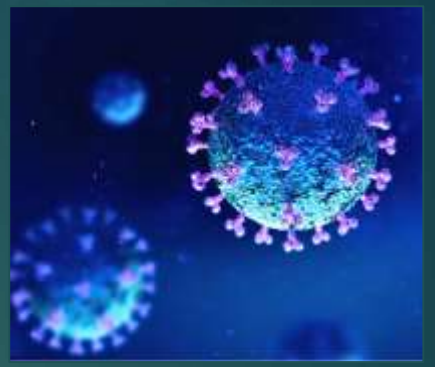
Intruduction

- December 2019, a lower respiratory tract febrile illness of unknown origin in a cluster of patients in Wuhan City, Hubei Province, China.
- Jan 7, 2020, a novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), later designated coronavirus disease 2019 (COVID-19) in February, 2020, by WHO.
- the outbreak started from a zoonotic transmission event associated with a large seafood market, became clear that efficient person-to-person transmission was also occurring.
- The wide clinical spectrum of infection : asymptomatic infection, mild upper respiratory tract illness, and severe viral pneumonia with respiratory failure and even death.

SARS-CoV-2 (2019-nCoV)



- Enveloped non-segmented positive sense RNA viruses belonging to the family Coronaviridae.
- SARS-CoV-1.
- MERS- CoV.

Novel Coronavirus (COVID-19) Situation WHO

China :**81416** cases

Italy :**47021** cases

Spain :**19980** cases

Iran (Islamic Republic of) :**19644** cases

Germany :**18323** cases

United States of America :**15219** cases

France :**12475** cases

Republic of Korea :**8799** cases

Switzerland :**4840** cases

The United Kingdom :**3983** cases

Netherlands :**2994** cases

Austria :**2649** cases

Belgium :**2257** cases

Norway :**1742** cases

Sweden :**1623** cases

Denmark :**1255** cases

Australia :**1081** cases

Malaysia :**1030** cases

Portugal :**1020** cases

Japan :**1007** cases

Czechia :**904** cases

Canada :**846** cases

267,013
confirmed cases

11,201
deaths

184
countries, areas or territories with cases

Role of Chest CT in Diagnosis and Management

- Early diagnosis of COVID-19 is crucial for disease treatment and control.
- Chest CT had a low rate of missed diagnosis of COVID-19 (3.9%).

- Useful as a standard method for the rapid diagnosis of COVID-19 to optimize the management of patient.
- Expert radiologists can distinguish COVID-19 from viral pneumonia with high specificity, 93 to 100% .

Coronavirus Disease 2019 (COVID-19): Role of Chest CT in Diagnosis and Management. AJR, Feb 11 2020
Performance of radiologists in differentiating COVID-19 from viral pneumonia on chest CT, Radiology, In press.

Correlation of chest CT and RT-PCR in COVID-19

- Chest CT is a more reliable, practical, and rapid method to diagnose and assess COVID-19, especially in epidemic area.
- The sensitivity, specificity, accuracy of chest CT in indicating COVID-19 infection: 97% ,25% ,and 68% ,respectively.
- The positive predictive value and negative predictive value: 65% and 83% respectively,
- Chest CT scan has higher sensitivity for diagnosis of COVID-19 as compared with initial RT-PCR from swab samples.

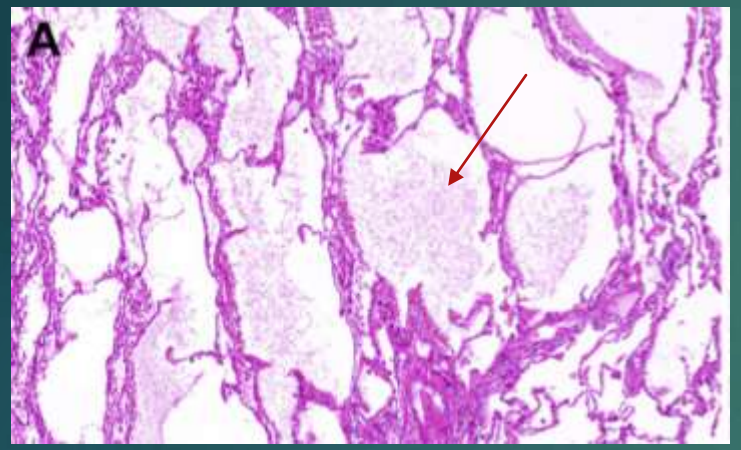
Correlation of Chest CT and RT-PCR Testing in Coronavirus Disease 2019 (COVID-19) in China: A Report of 1014 Cases , Radiology, In press.

Histopathologic findings

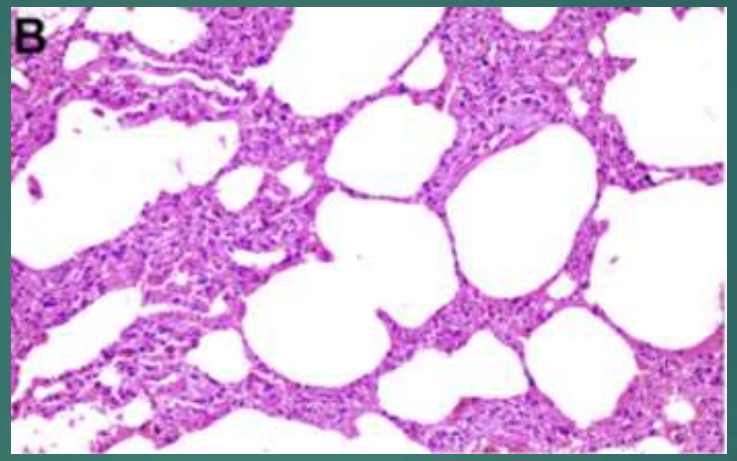
- Anecdotal pathology has been reported.
- The pathological features of COVID-19 greatly resemble those seen in SARS and Middle Eastern respiratory syndrome (MERS) coronavirus infection.
- DAD/ALI.
- Organizing pneumonia.
- AFOP (Acute fibrinous and Organizing pneumonia).
- Combination of all above findings?.

Journal of thoracic oncology , Article in press.
Lancet Respir Med 2020, Feb 17.2020.

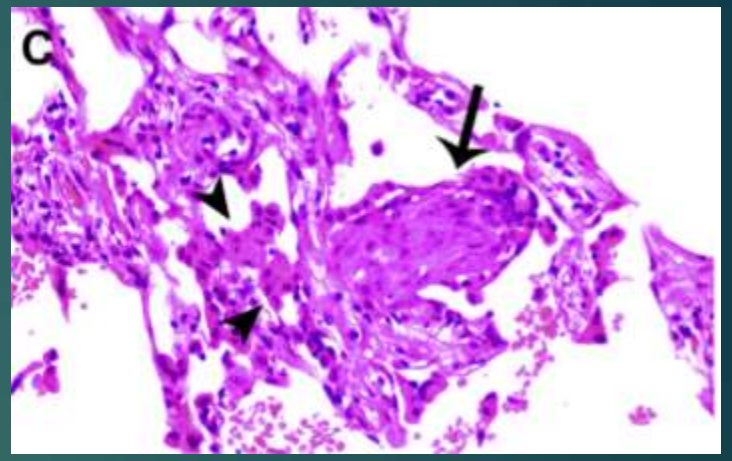
Radiology-Pathology Correlation



Evident proteinaceous and fibrin exudate



Diffuse expansion of alveolar walls and septa due to fibroblastic proliferations and type II pneumocyte hyperplasia



plugs of proliferating fibroblasts or "fibroblast balls" in the interstitium (arrows)

Cases from the Babak Imaging Center (Tehran, Iran) with Coronavirus Disease 2019 (COVID-19)

- During 20 Feb 2020 to 21 march 2020 We had 172 patients with COVID-19 pneumonia.
- M/F: 1.95/1
- Age: 15 to 93 , mean age: 47 year.
- Mortality rate: 4%.

Type of abnormalities on CT scan

- Ground glass opacity (most common).

1. Pure GGO.
2. GGO with interlobular septal thickening (crazy-paving pattern).
3. Irregular lines and interfaces with architectural distortion(Fibrosis) superimposed on GGO. Tractional bronchiectasis.

- Air-space consolidation (second most common).
- Mixed air-space consolidation and GGO (85% in first 2 weeks).
- Organizing pneumonia pattern.
- Centrilobular nodules.
- Pleural effusion<1%.
- Lymphadenopathy<1%.

Pattern of lesions

- Peripheral and subpleural distribution (most common:75%).
- Peribronchovascular distribution (second most common:15%).
- Multiple lesions: 75%.
- Bilateral involvement: 80%.
- Lower lobe: 78%.
- Right lower lobe>Left lower lobe.

Temporal change of CT findings

- First week after onset of symptoms.

1. Ground glass opacity.
2. Air-space consolidation.

- Second week after onset of symptoms,

1. Mixed GGO and air-space consolidation.
2. Air-space Consolidation and OP .
3. GGO

- Third week after onset of symptoms.

1. OP.
2. Irregular lines and interfaces with architectural distortion superimposed on GGO.

A

B

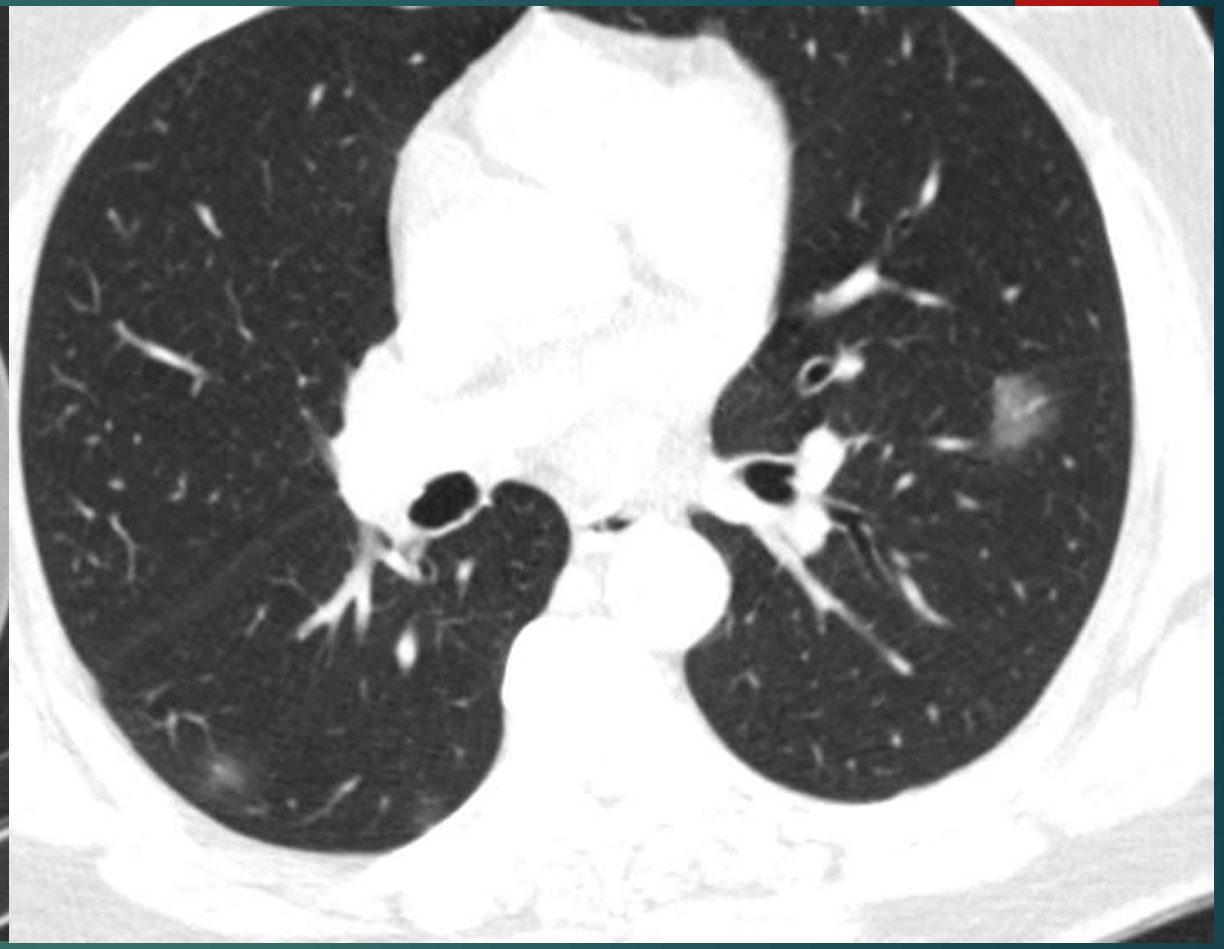
Early phase: Patchy GGO.

A: 29 y/o man with 3 days mild SOB and positive test.

B: 33 y/o women with 2 days fatigue and mild fever .

A

B



Early phase with pure Patchy GGO

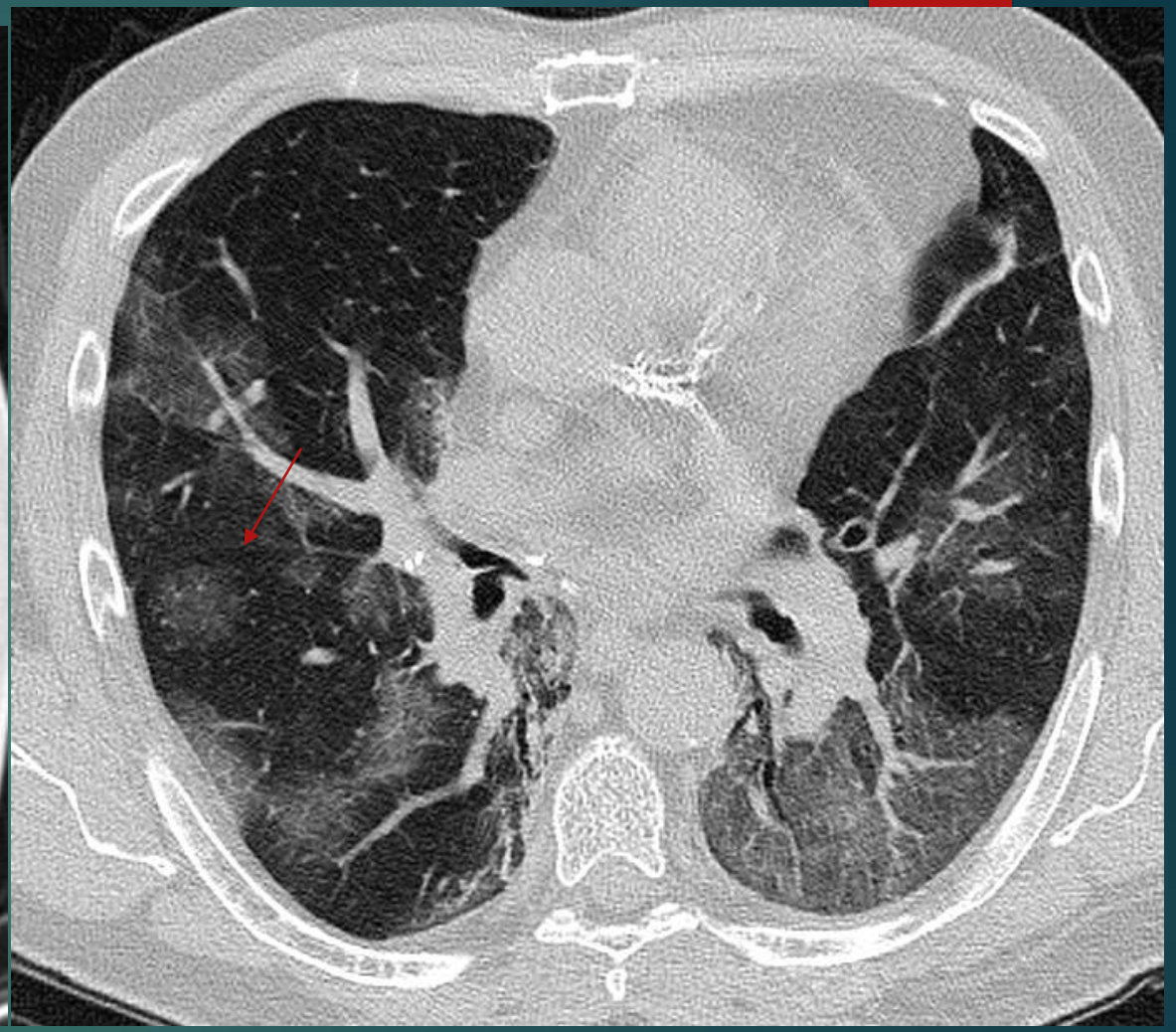
A:44 y/o man with 3 days Hx of dry cough and myalgia
B:59 y/o man with 4 days Hx of cough and fever.

Evolution of GGO to Mixed type lesions

A: 2019/03/02, B: 2019/03/06.

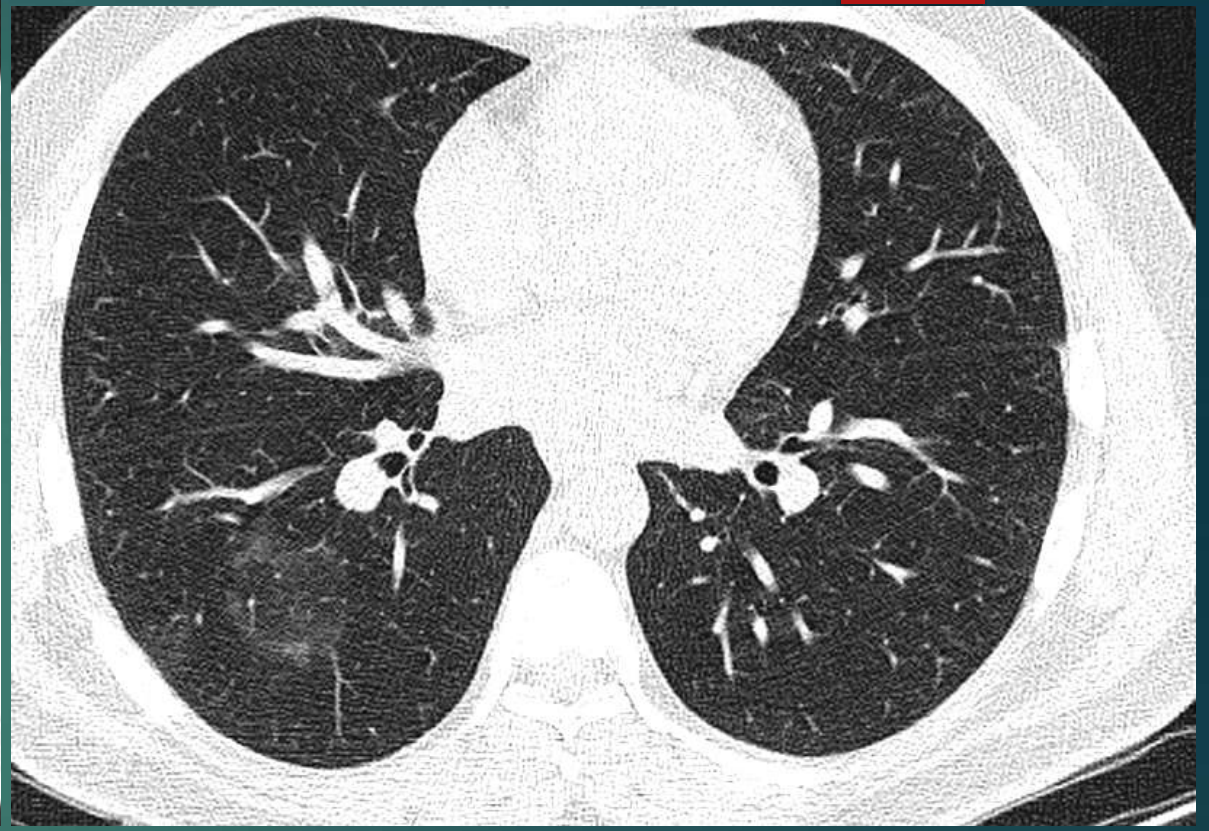
35 y/o ICU nurse, Hx of contact with COVID-19 case, presented with mild myalgia and headache and fever. Progressive worsening of symptoms.

B



Nodular GGO

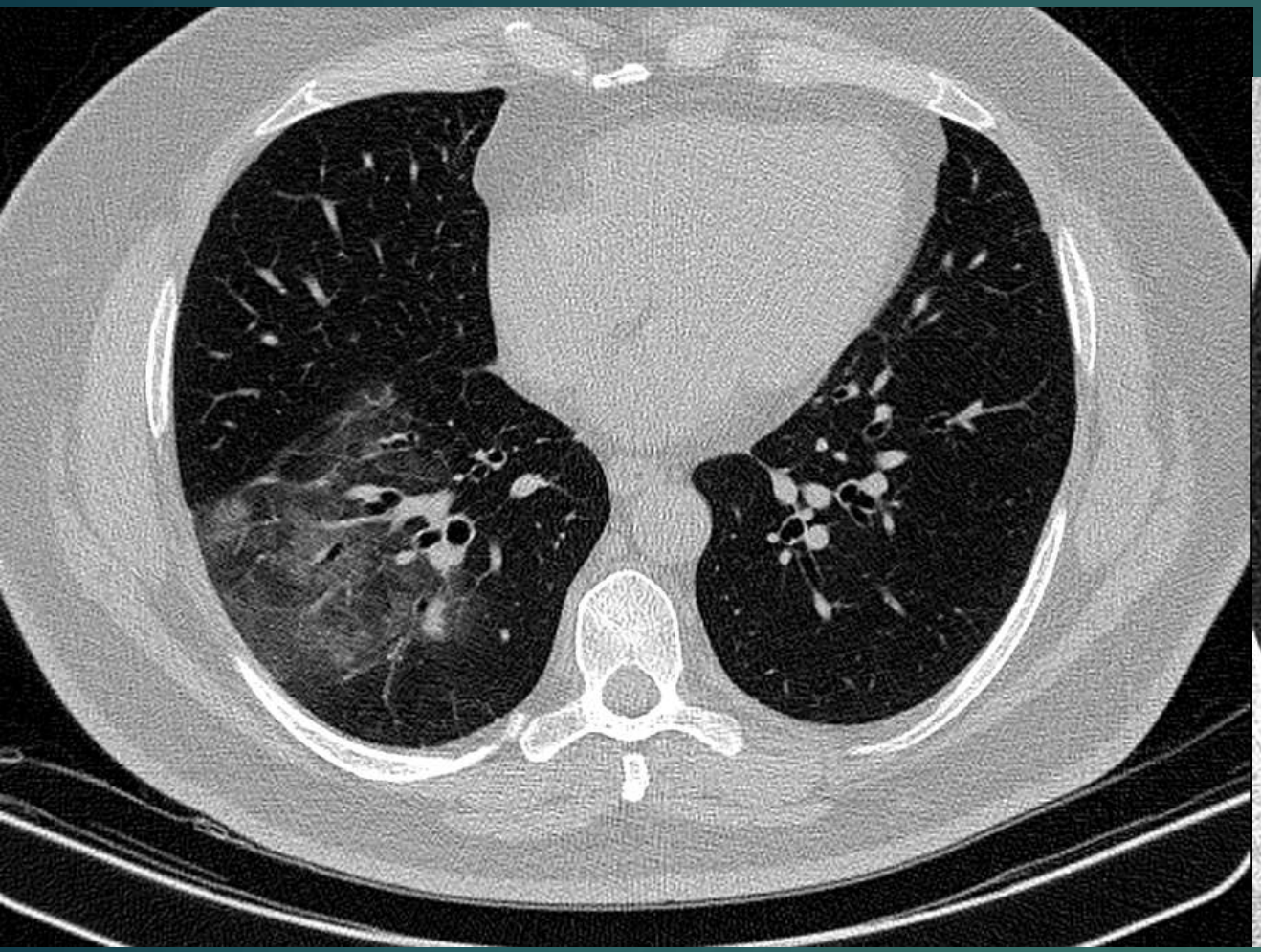
A: 39 y/o man with 5 days Hx of fever and cough.
B:55 y/o man with10 days Hx of fever, cough and fatigue.



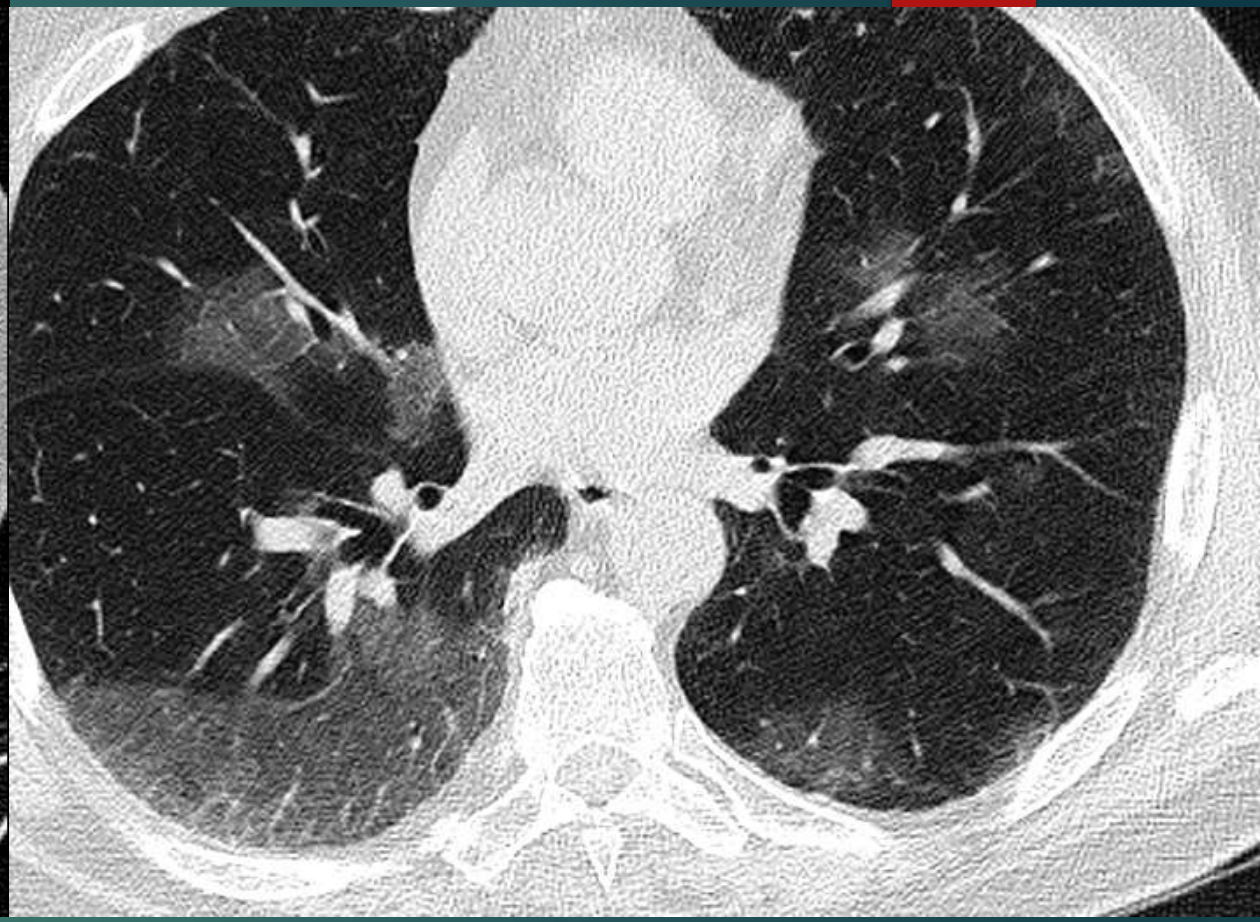
Nodular GGO

35 y/o man with cough, myalgia and fever.

A



B

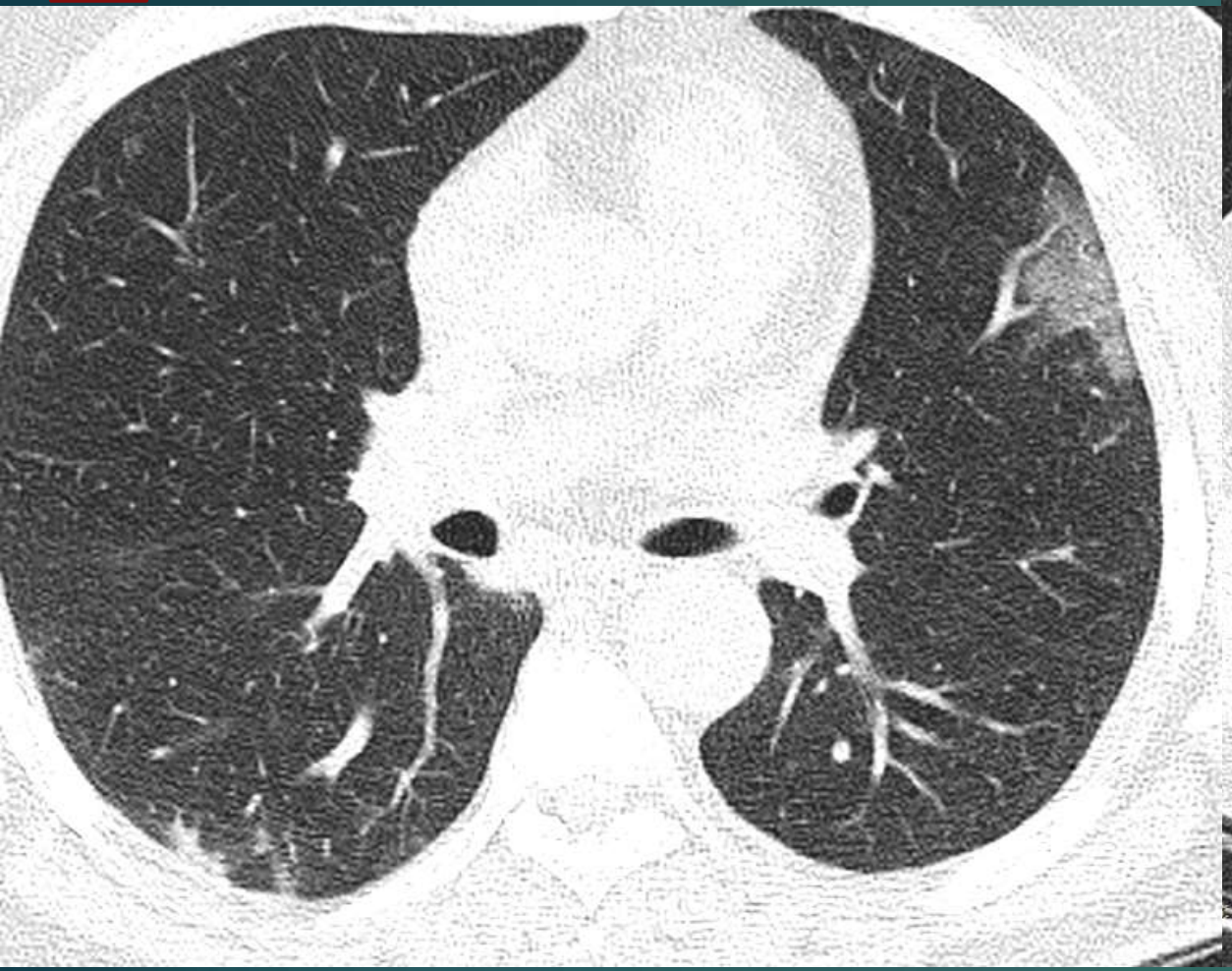


GGO , thickening of interlobular septae ,

A: 54 y/o man, Fever and chills, Dry cough.

B: 48 y/o man with cough, fever and headache, PCR positive

A



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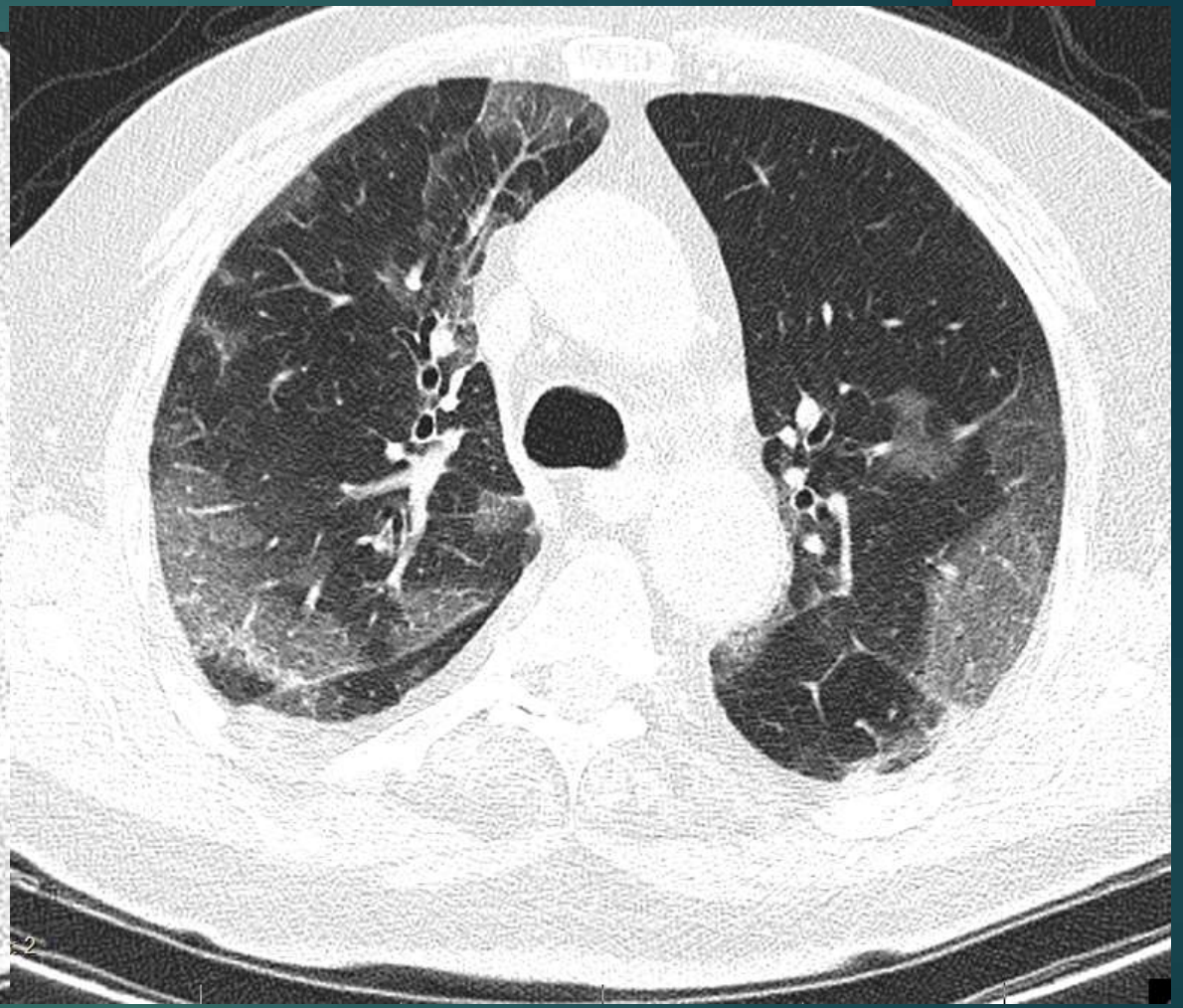
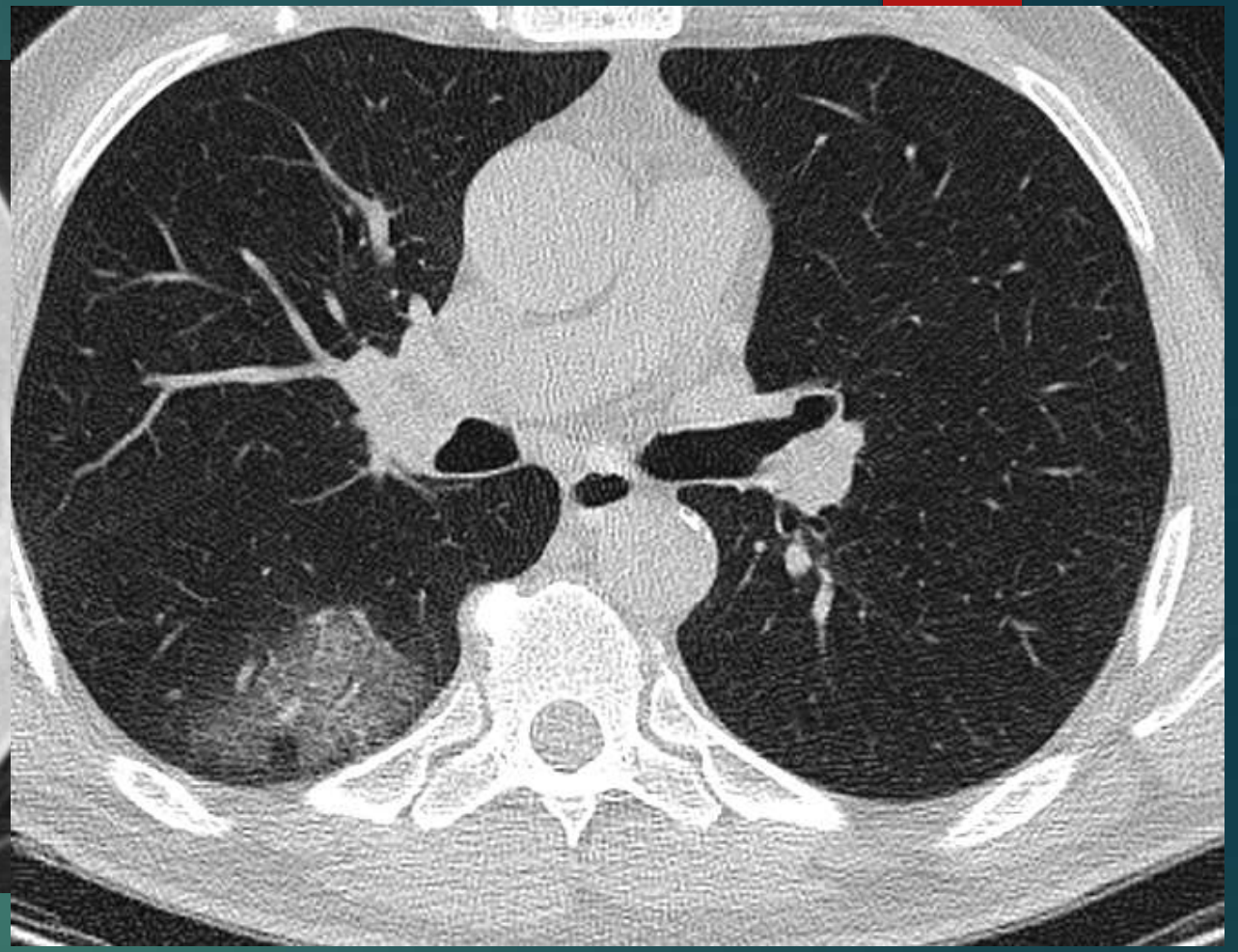


GGO , thickening of interlobular septae

A

B



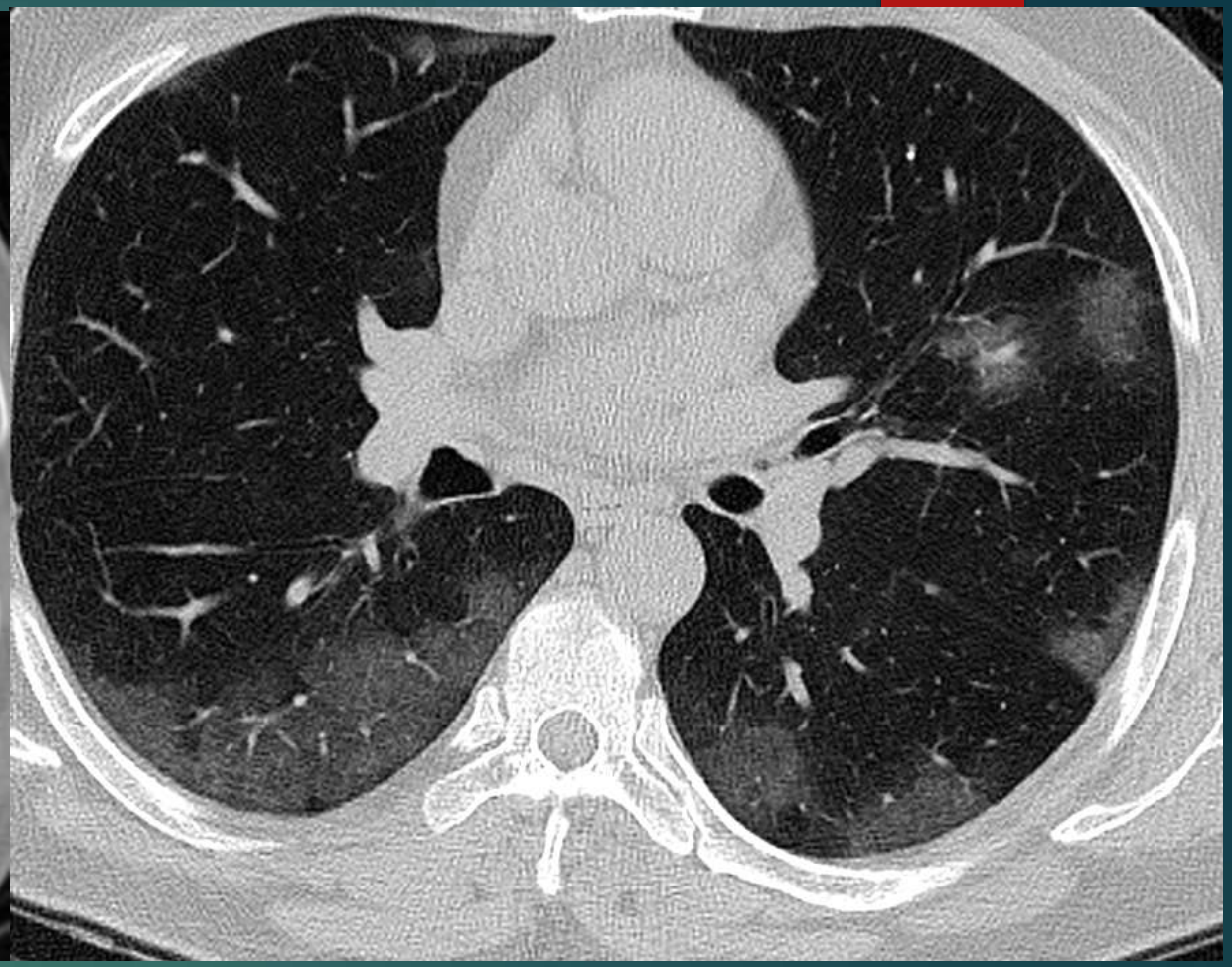
Early phase with pure GGO

35 y/o man known case of lymphoma with 5 days Hx of fever, diarrhea and myalgia,

65y/o man with fever and cough.

A

B

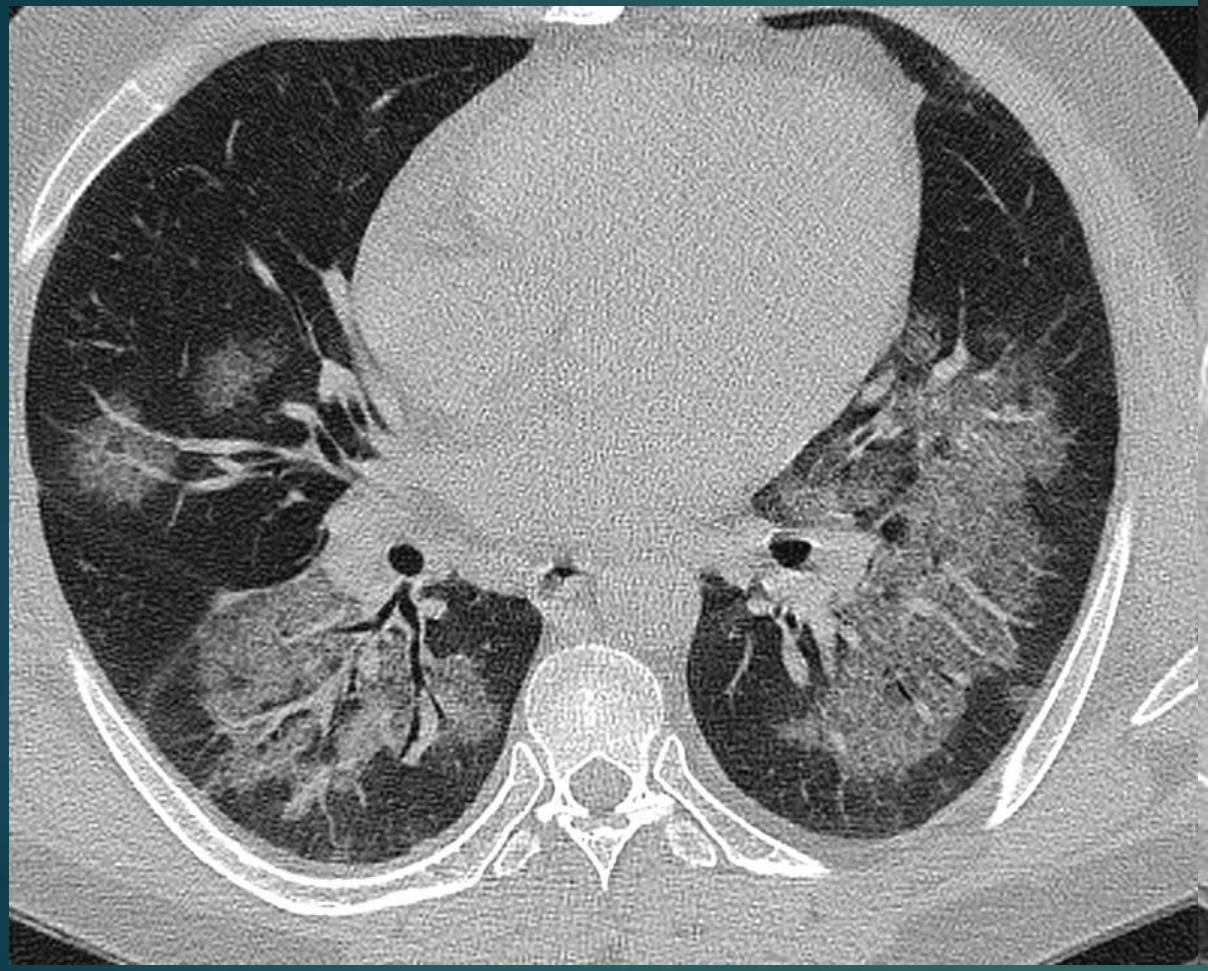


GGO , thickening of interlobular septae(Crazy-paving), Enlarged vessels.

A: 46 y/o man, Fever and chills,

B: 48 y/o man with cough, fever and headache, PCR positive

A



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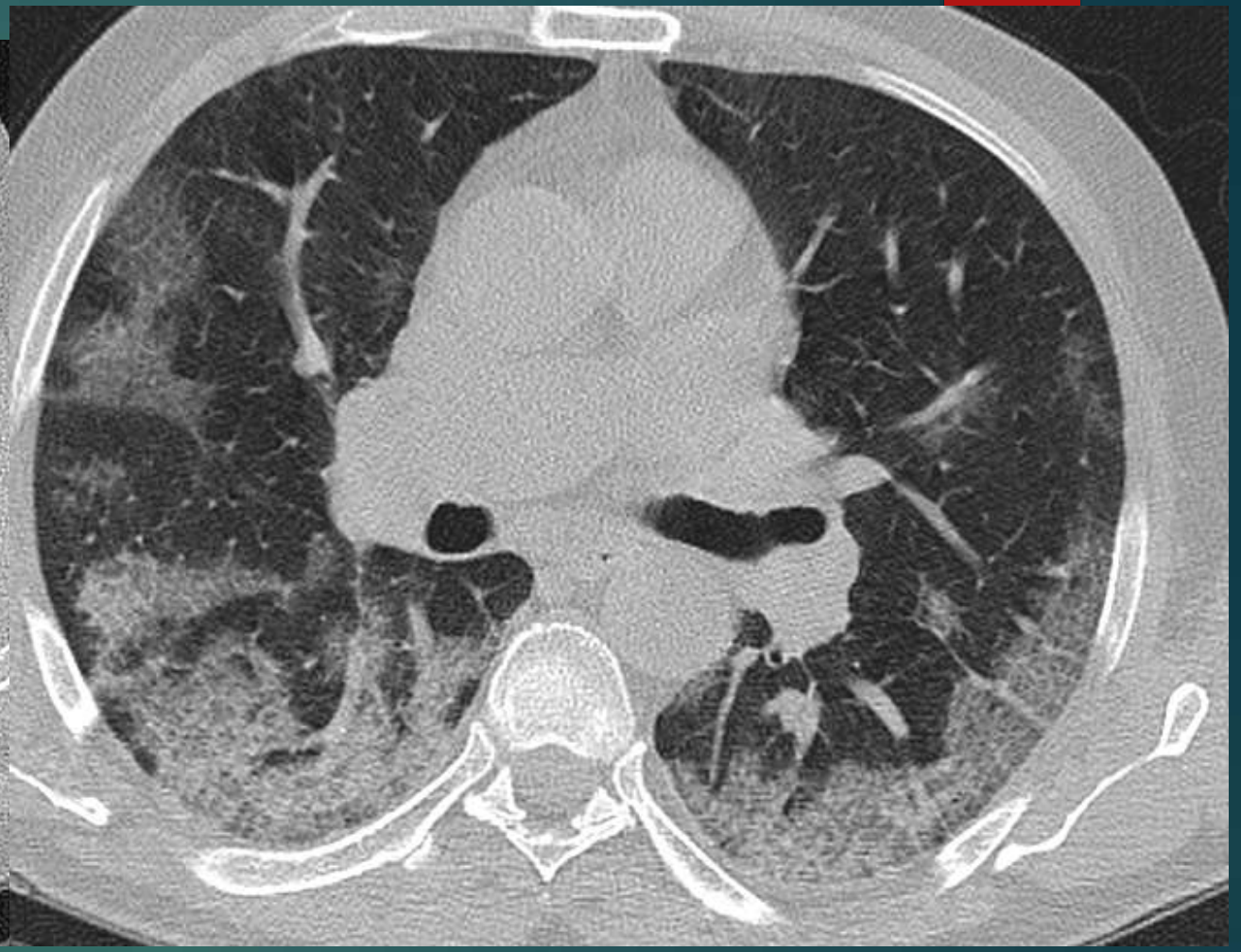


GGO and thickening of interlobular septate (Crazy-paving),Enlarged vessels

44 Y/O man with fever, cough and SOB. PCR positive

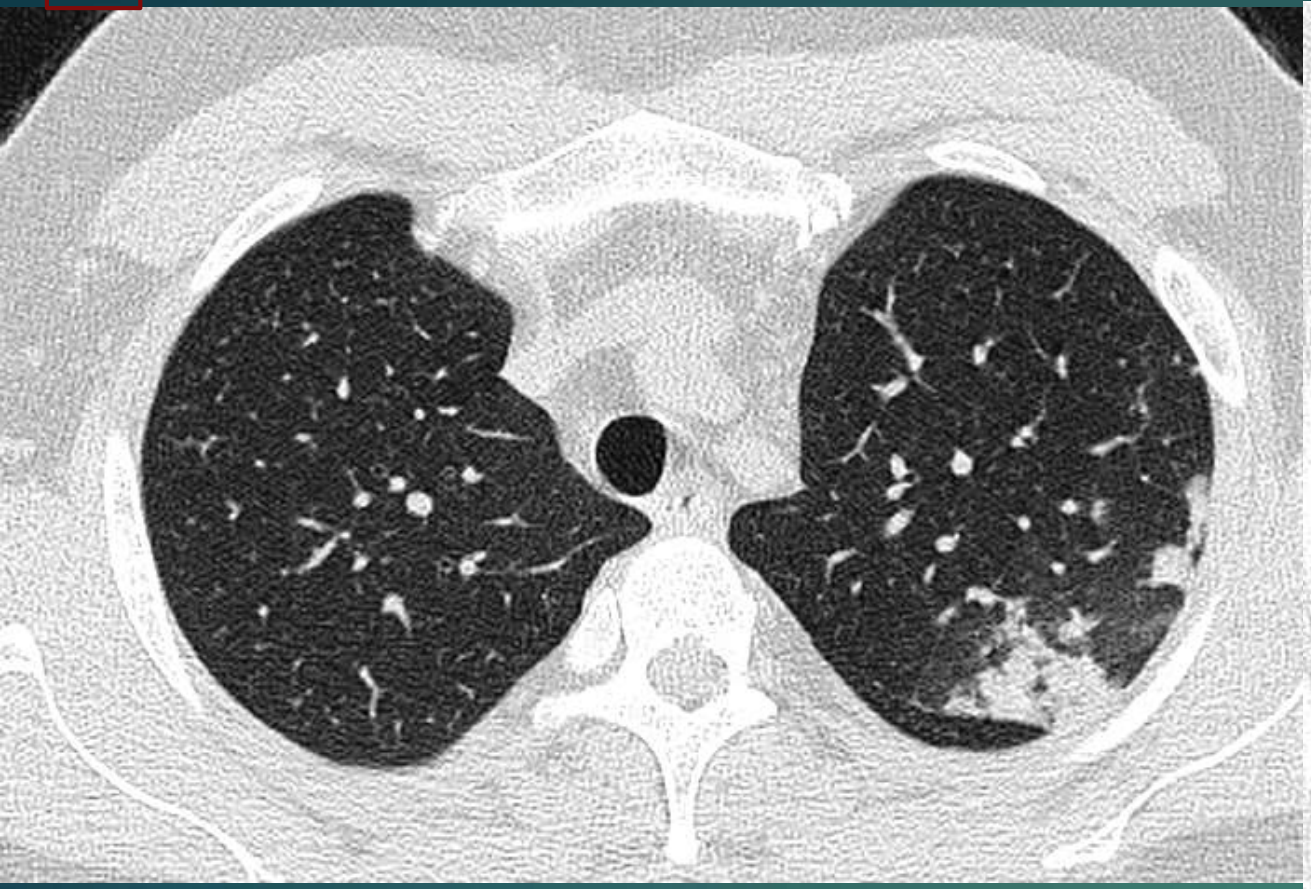
73 y/o man with cough and SOB,

A

B

Progression of GGO lesions in 5 days
83 y/o man , fever and cough , died in day 10 of disease.

A



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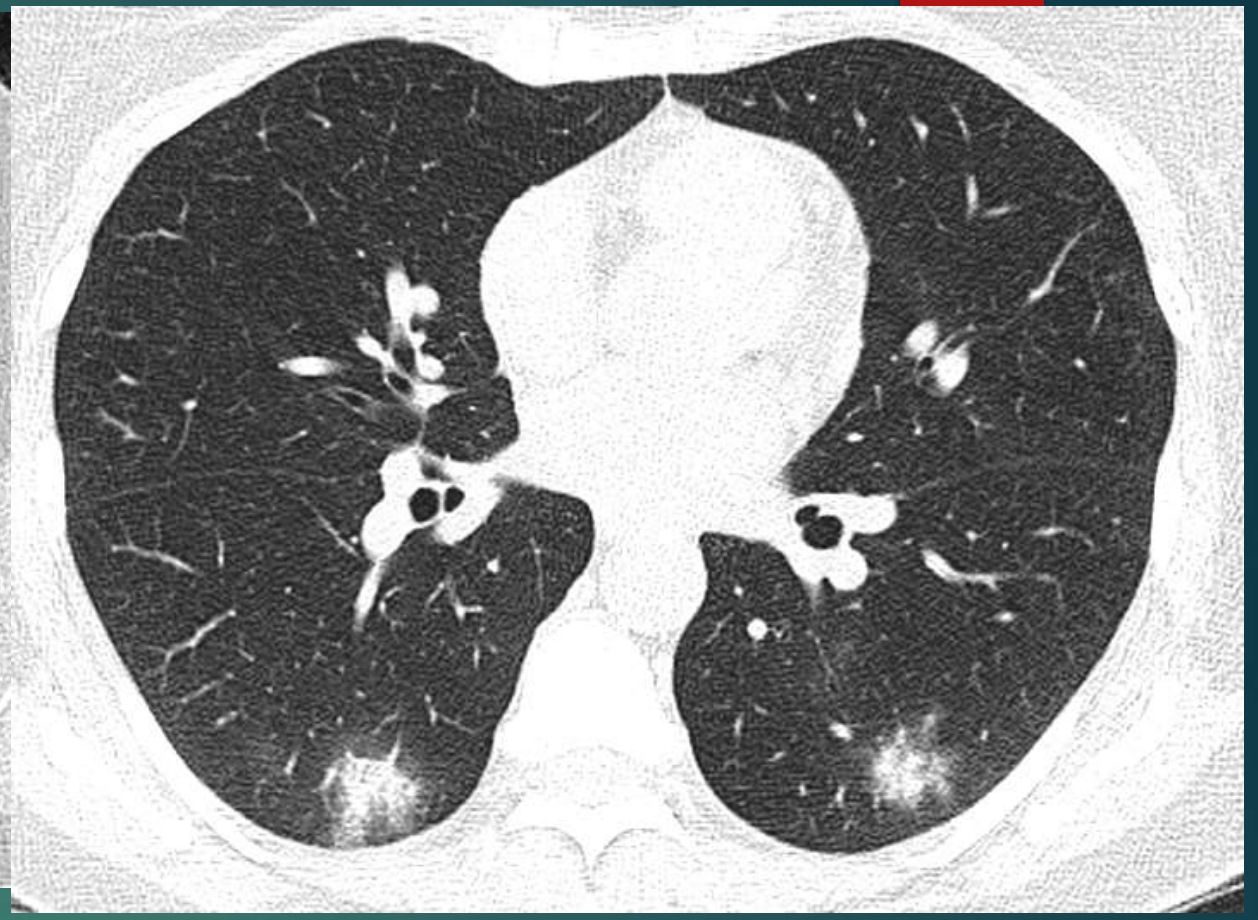
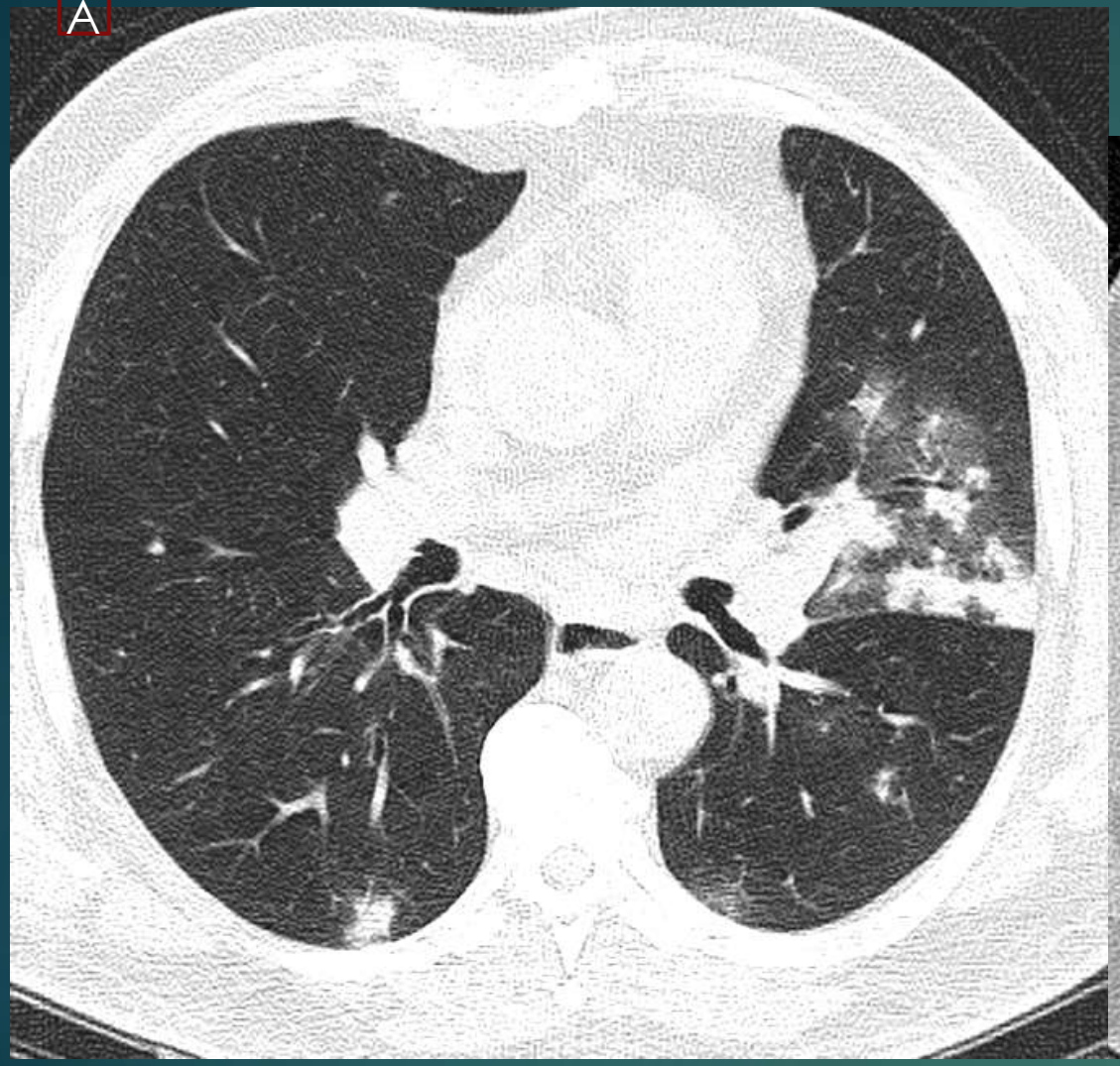
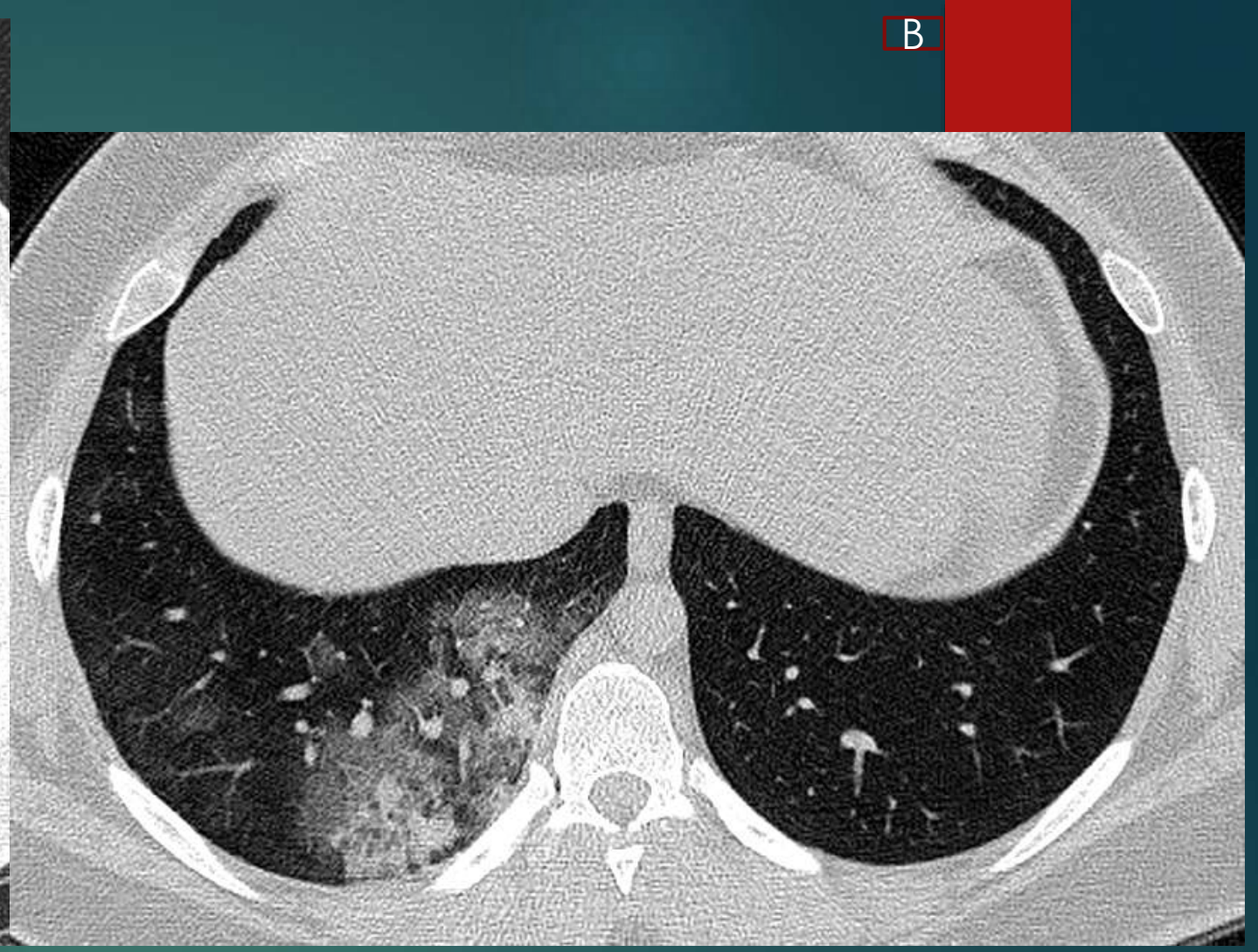


Air-space consolidation type.

A: 58 y/o man with 4 days Hx of fever.

B: 43 y/o women with 3 days Hx of Cough and SOB



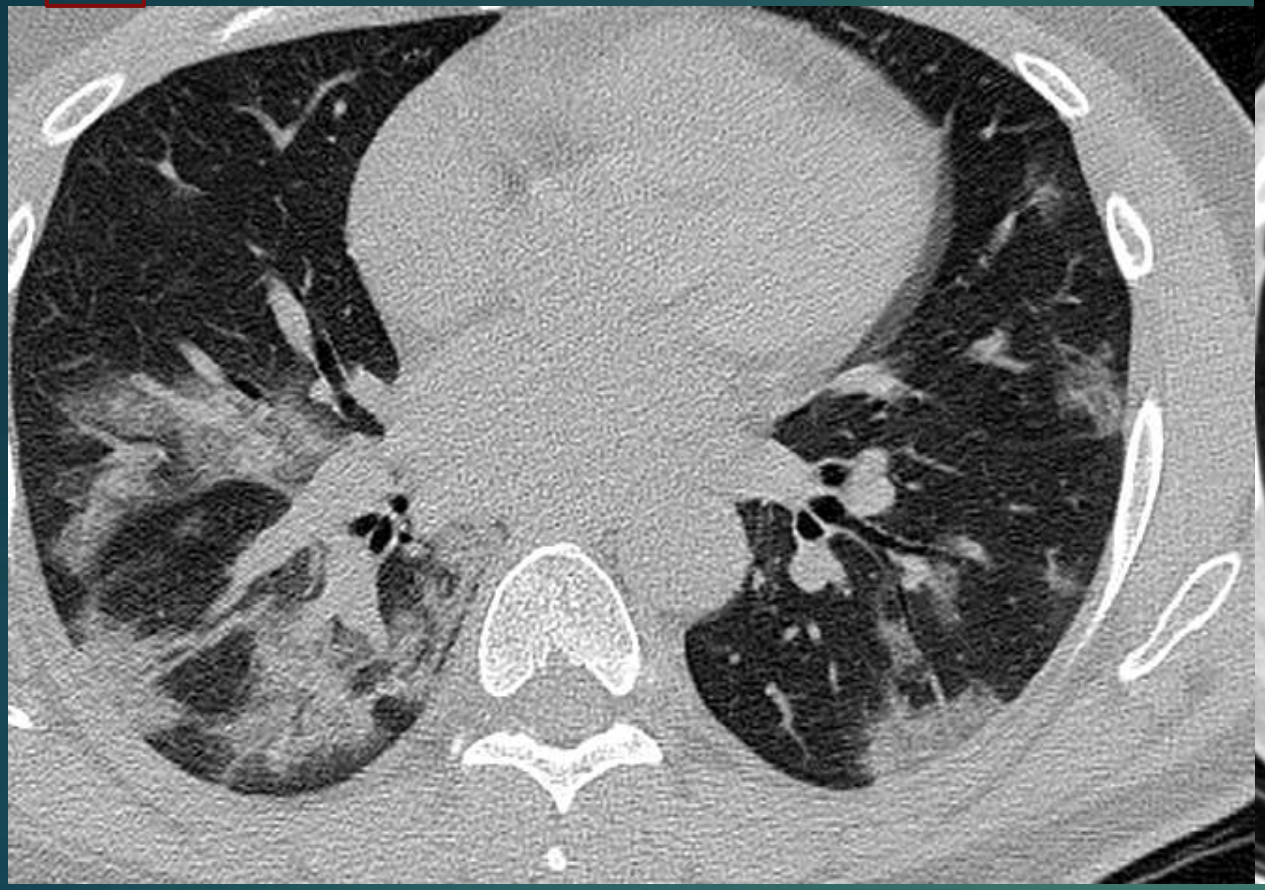


Mixed air-space consolidation and GGO

A: 68 y/o man with fever and cough(Day 10).

B: 30 y/o man with cough and SOB (Day 14).

A



B

Mixed GGO and consolidation in peri-bronchovascular and peripheral

A: 54 y/o man with cough and SOB.

B:31 y/o man with fever and cough (4 days).

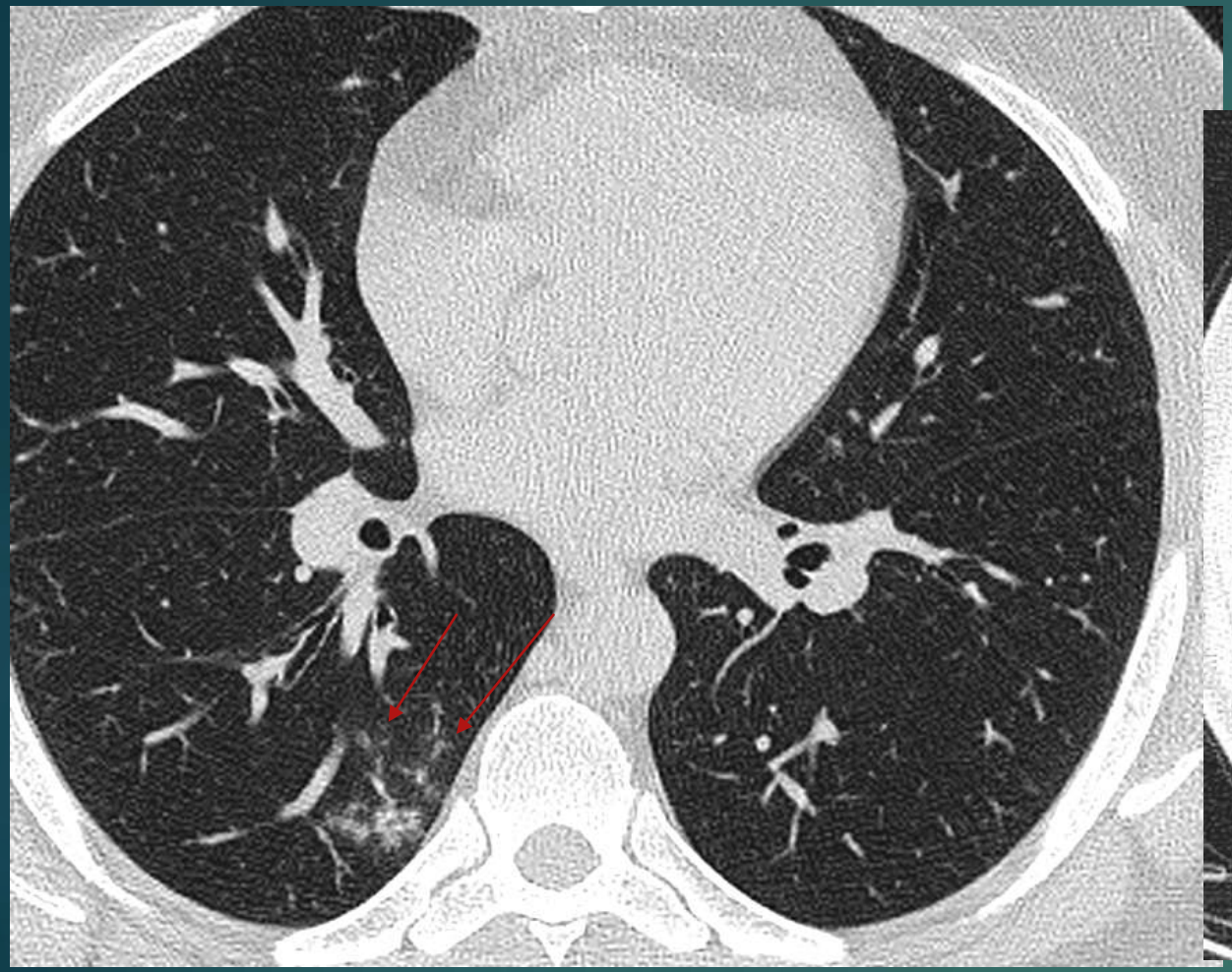
A

B

Halo sign (mixed GGO and consolidation)

A: 35 y/o with cough, fever, SOB. PCR positive
B: 33 y/o with fatigue, myalgia and fever, PCR positive

A



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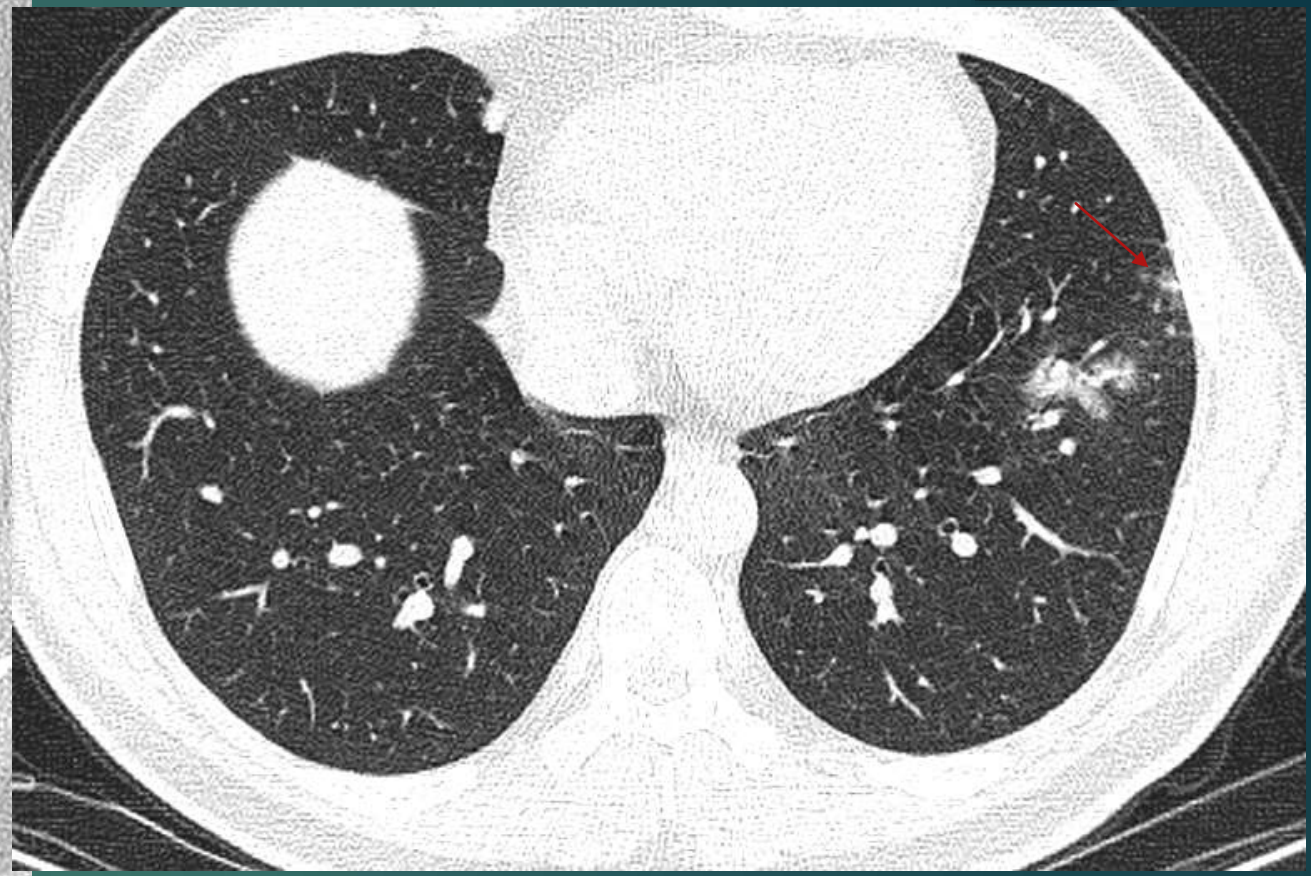
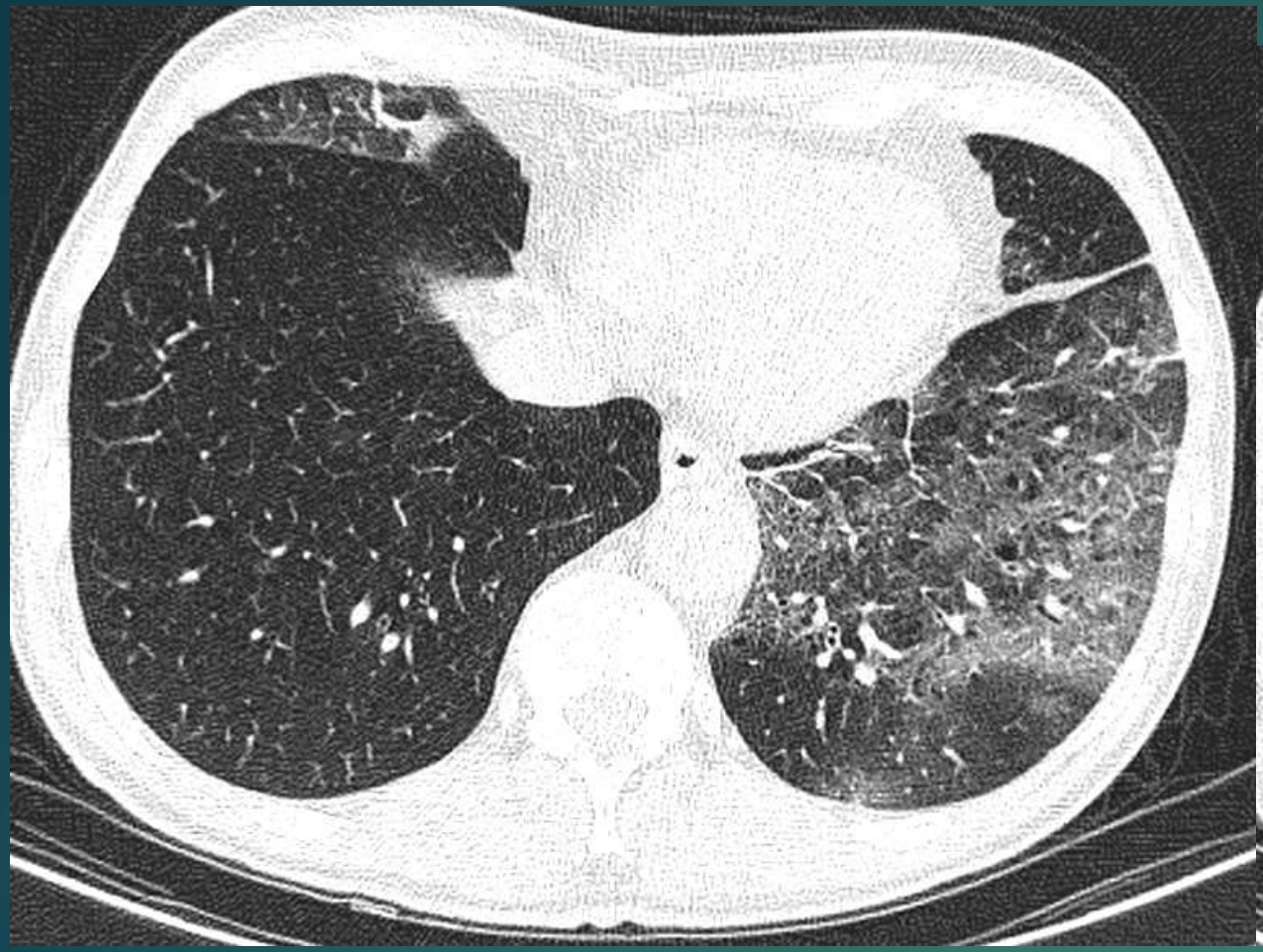


Centrilobular nodules.

A: 43 y/o man, Hx of contact with positive COVID-19 case, PCR positive

B: 39 y/o man, ICU nurse, close contact with COVID-19 patients, Cough, fever and myalgia,



Temporal change of CT findings ,

66 y/o man with HX of Cough and SOB.

A: 6 days after onset of symptoms.

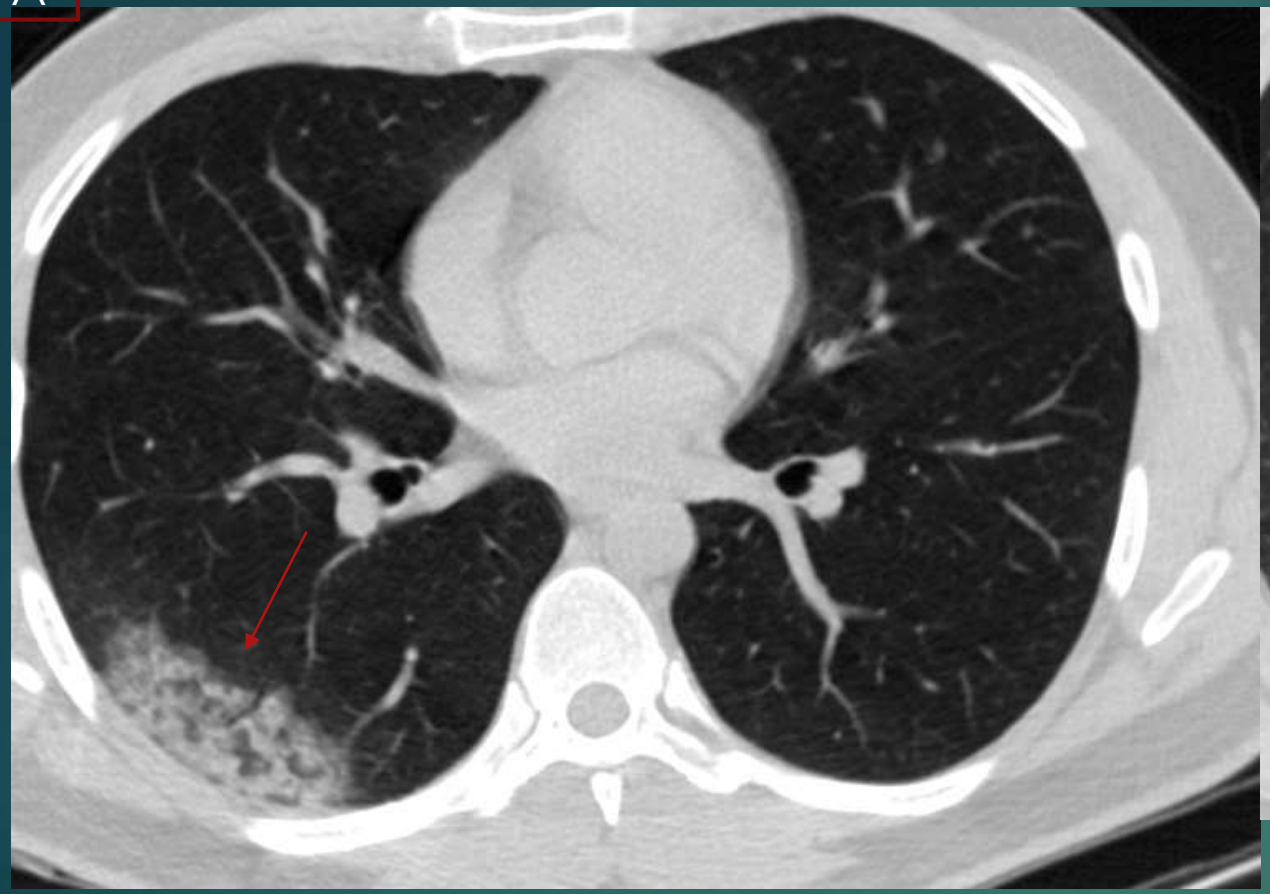
B: 13 days after onset of symptoms.

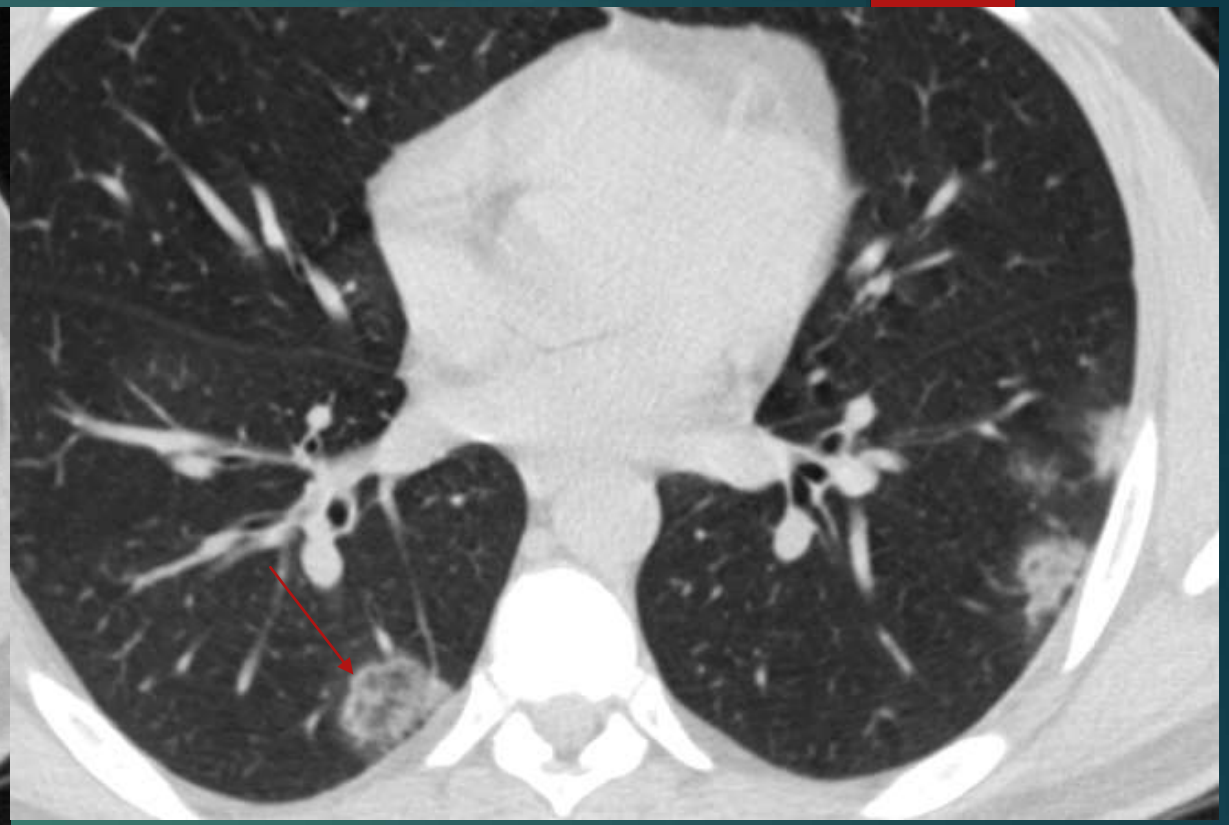
A

Temporal change of CT findings from GGO to Irregular lines superimposed with GGO

66 y/o man with HX of Cough and SOB.
A: 5 days after onset of symptoms.
B: 12 days after onset of symptoms.

A

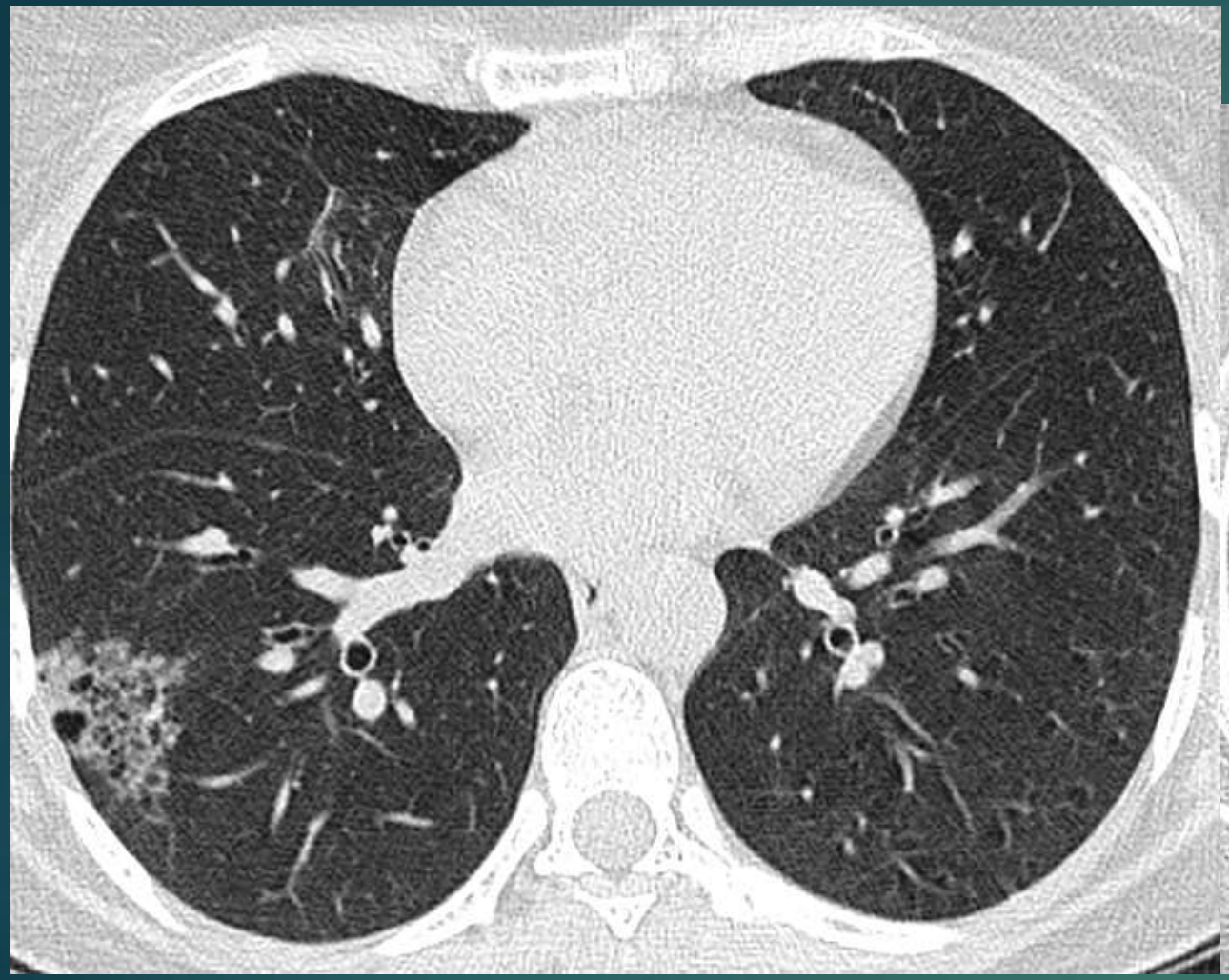




Organizing pneumonia pattern with Reverse halo sign (Atoll sign).

A: 39y/o man with one week fever, mild cough.

B: 33 y/o man one week fever,



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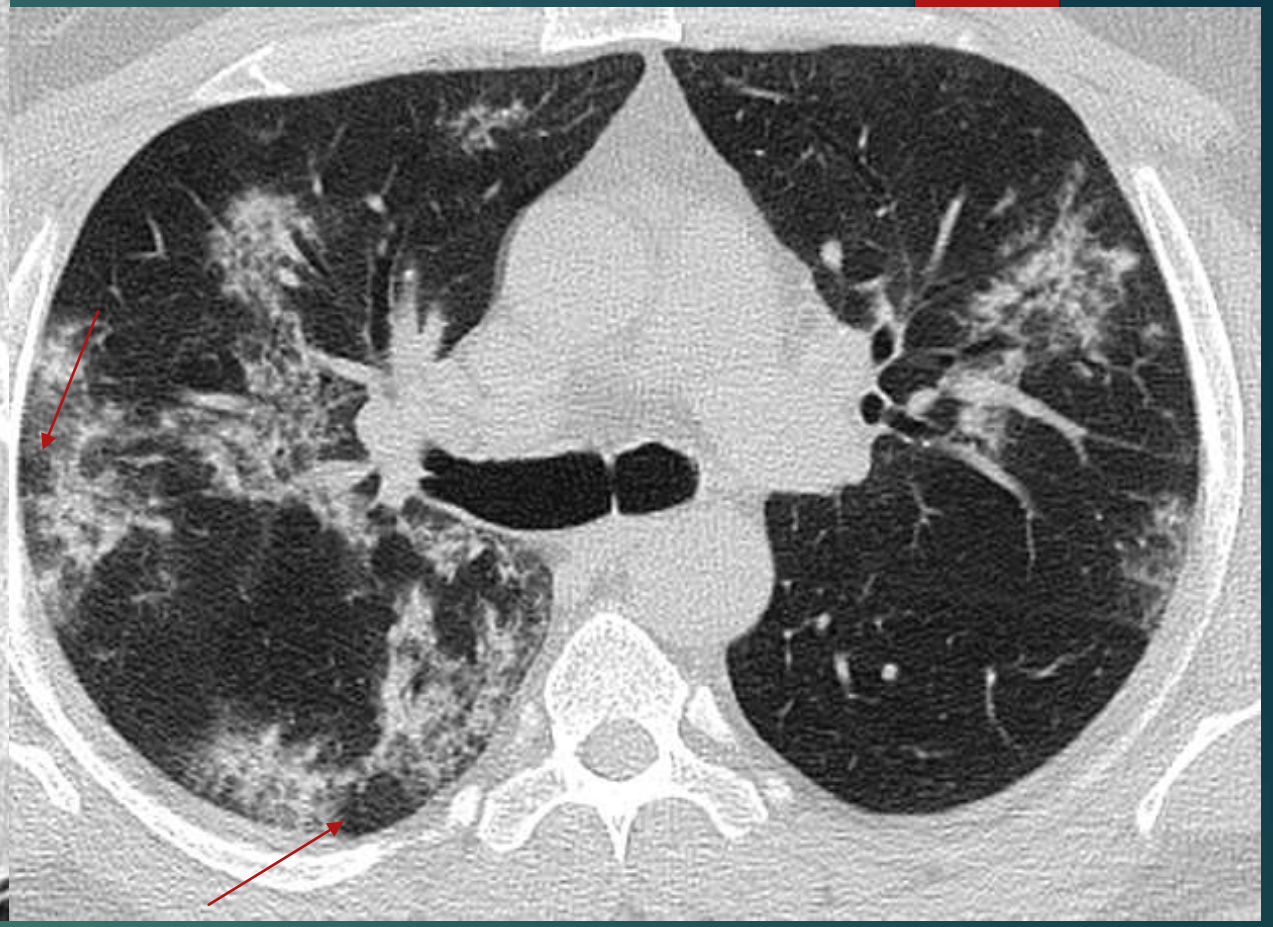


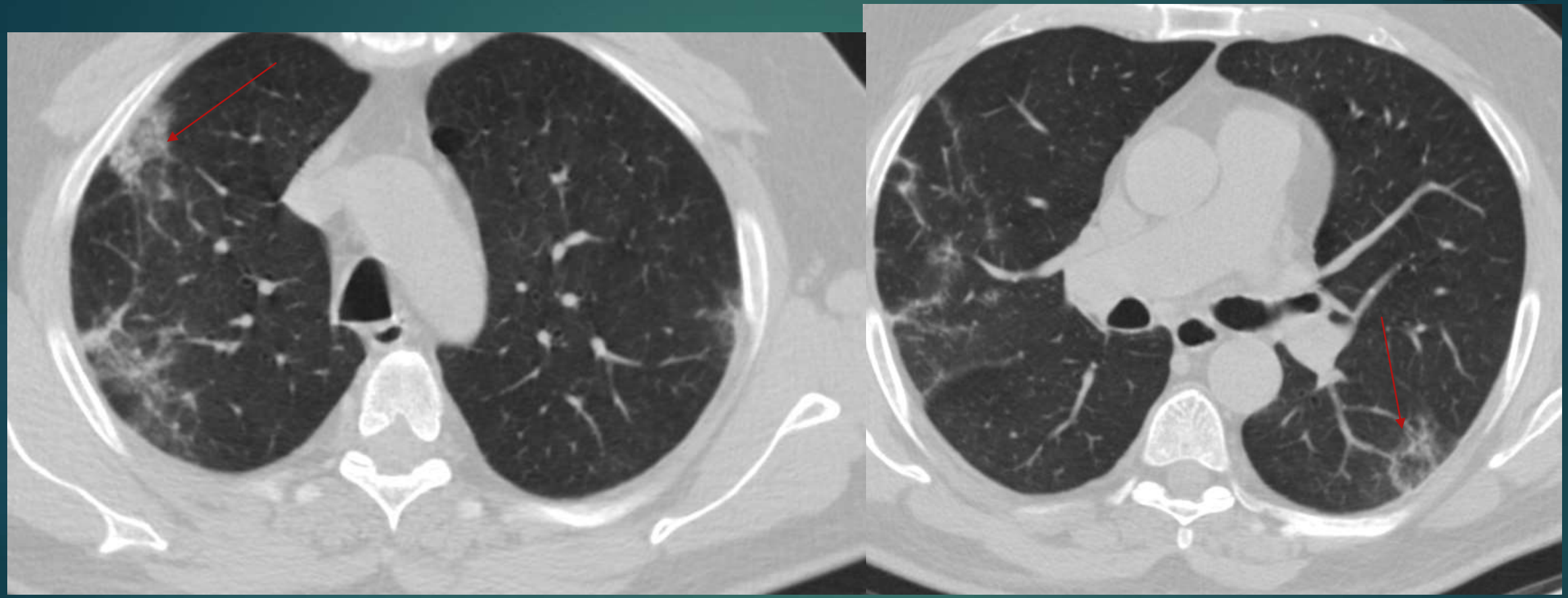
Organizing pneumonia .

A: 51 y/o women, Contact with positive case 3 weeks earlier (Reverse halo sign).

B: 49 y/o man with SOB (Perilobular pattern).

A

B

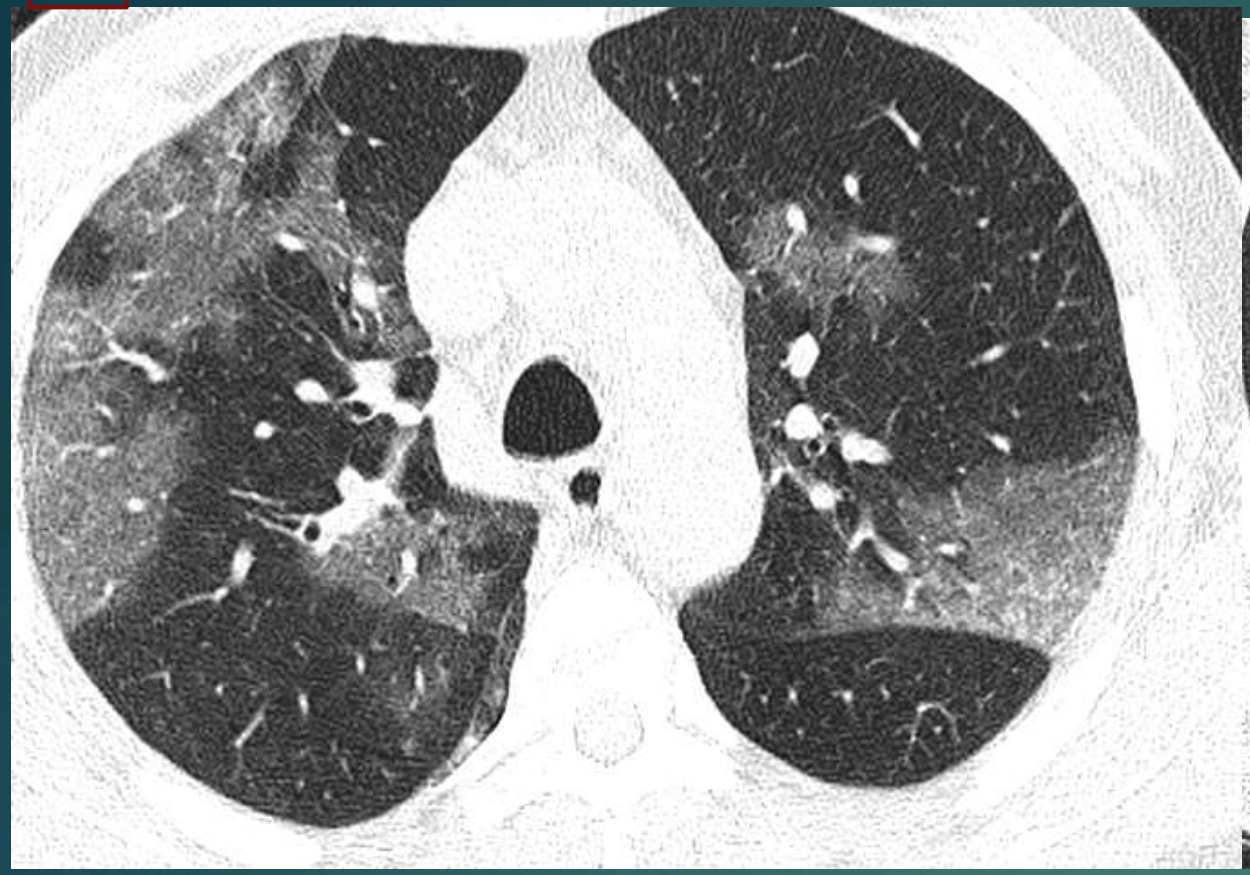


Irregular lines and interfaces with architectural distortion superimposed on GGO , OP-pattern (Reverse halo sign, arrow).

65 y/o , Hx of travelling to China 2 months earlier(Patient 0?).

Symptoms begun 2 weeks after arriving to Iran.

A

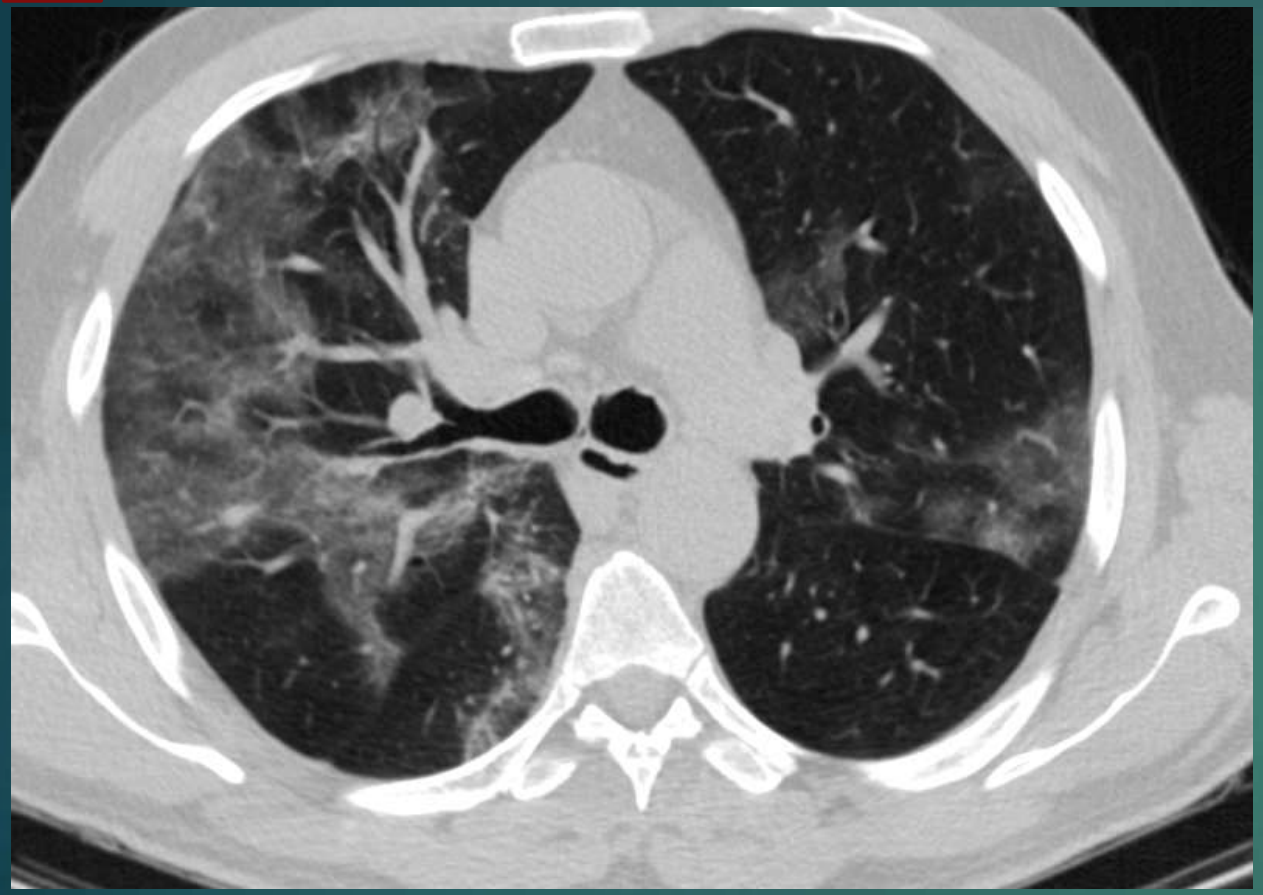


B

Different type of disease at same time

57 y/o man with 2 weeks Hx of cough and fever, Positive PCR

A



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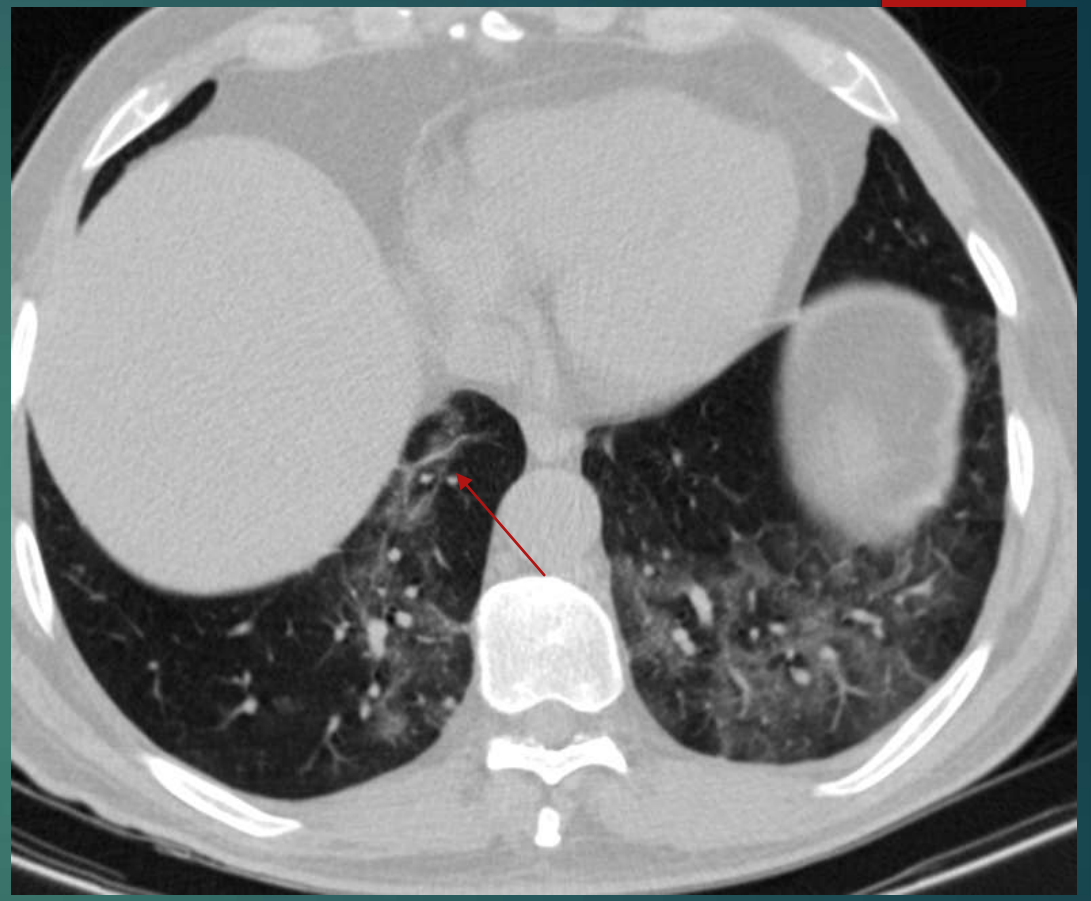
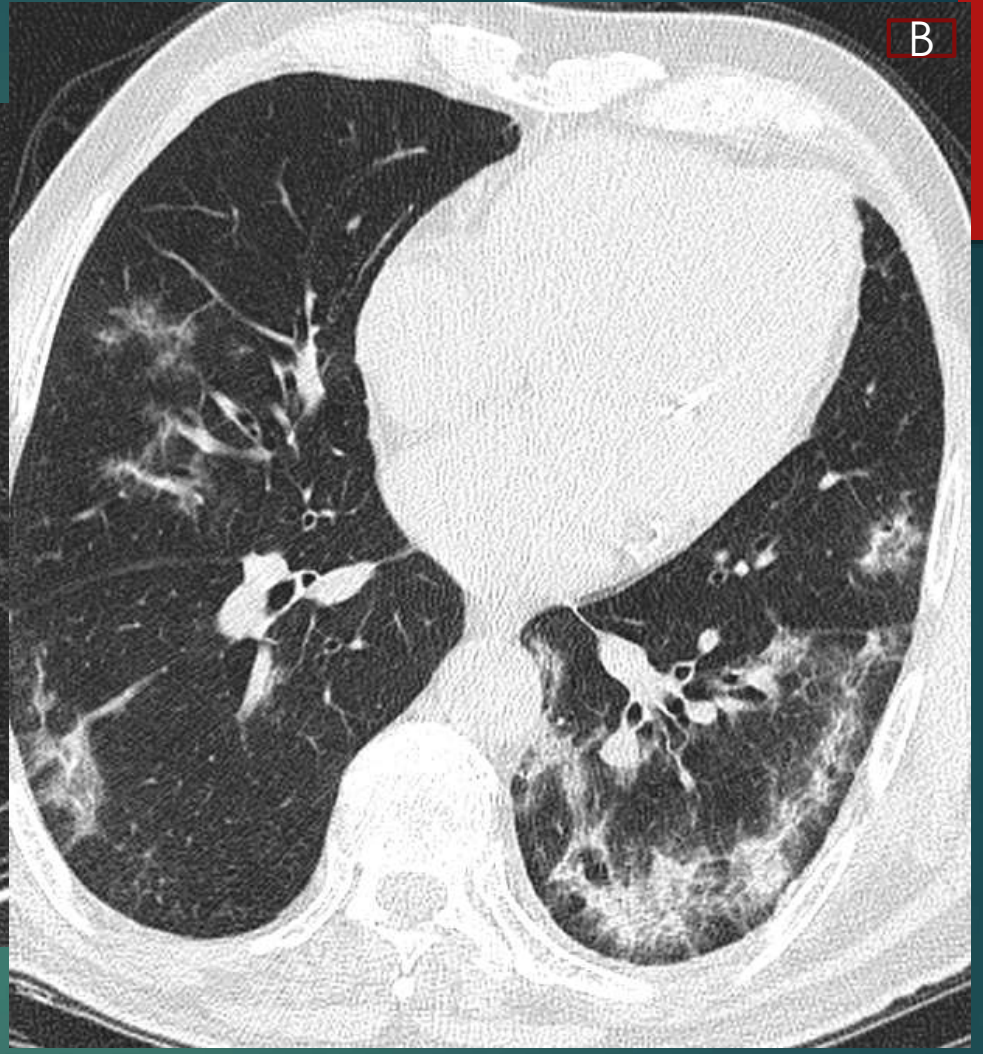
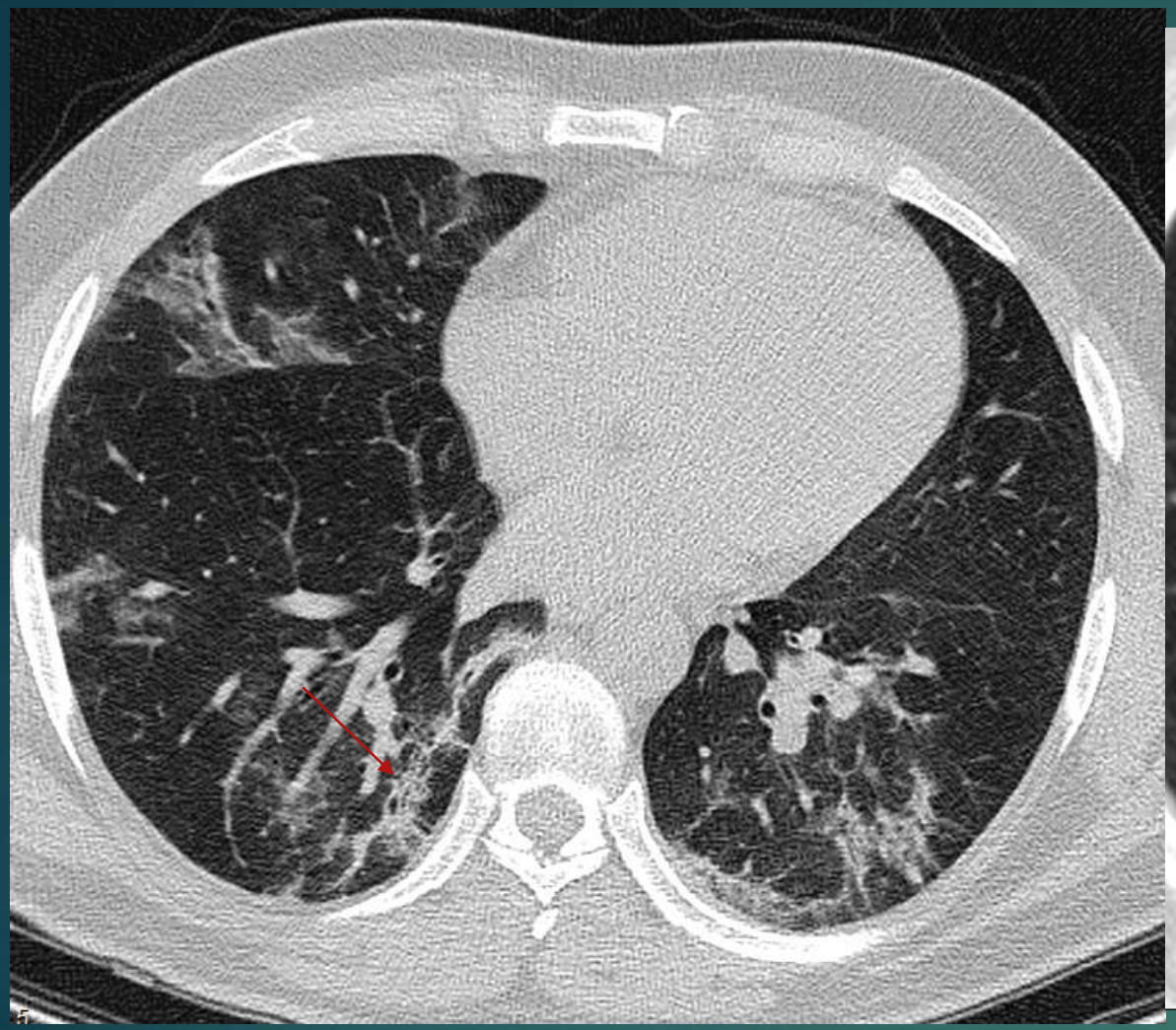


57 y/o man with cough, fever and fatigue, Positive PCR.
Bilateral GGO and mild fibrotic changes in the right base.



Irregular lines and interfaces with architectural distortion superimposed on GGO. Tractional bronchiectasis.
56 Y/O10 days cough and SOB .
84 y/o man 7 days cough and fever.

A



B

Irregular lines and interfaces with architectural distortion superimposed on GGO ,Tractional bronchiectasis.

A: 51 y/o man with 10 days cough.

B: 73 y/o man with SOB, cough .

Key Results

- The most discriminating features for COVID-19:
- Ground glass opacities.
- Peripheral distribution.
- Vascular thickening.
- The extent of CT abnormalities progress rapidly after symptom onset with peaked during second week (6-13 days).
- The percentage of mixed pattern peaked during second and third weeks of illness.