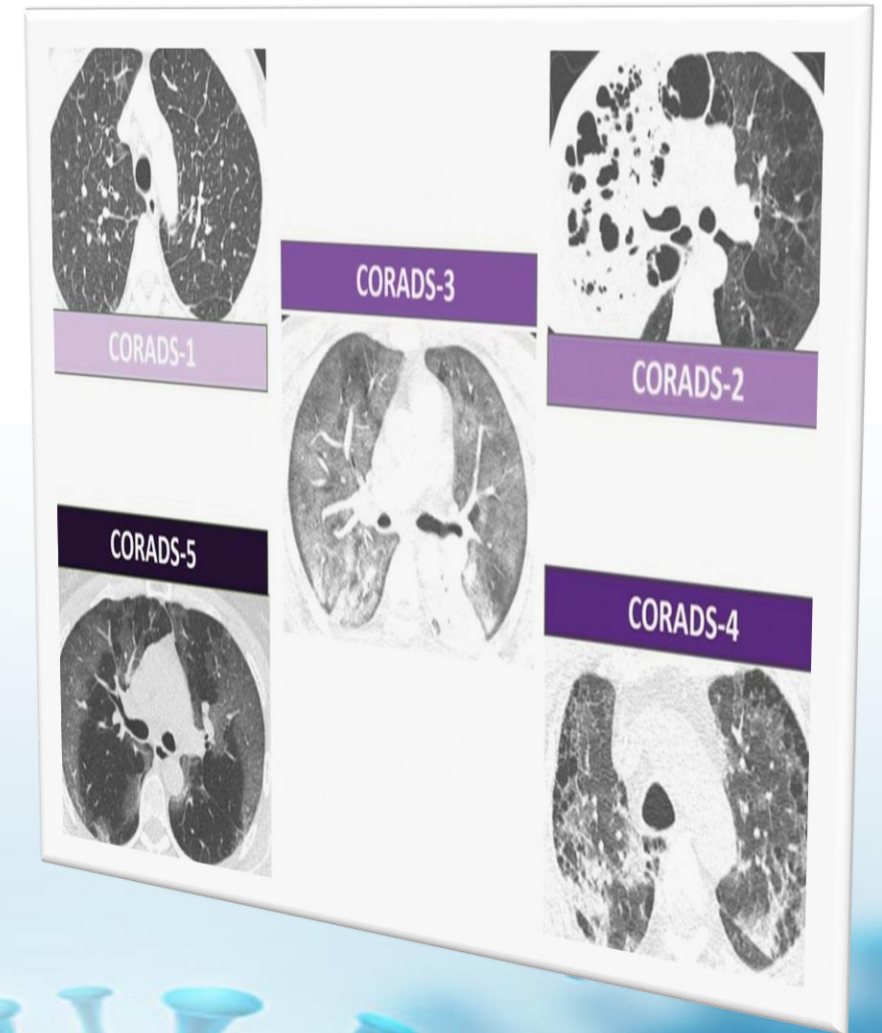# CO-RADS classification

Dr Soroor Kalantari

Assistant Professor of Radiology

Zanjan University of Medical Sciences

COVID-19 Reporting and Data System (CO-RADS)

- The Dutch Radiological Society developed CO-RADS based on other efforts for standardization, such as the Lung Imaging Reporting and Data System or Breast Imaging Reporting and Data System

- The CO-RADS classification is a standardized reporting system for patients with suspected COVID-19 infection

- Based on the CT findings, CO-RADS assesses the suspicion for pulmonary involvement of COVID-19 on a scale from 1 (very low) to 5 (very high).

COVID-19 REPORTING AND DATA SYSTEM (CO-RADS)

- CORADS-1 has a high negative predictive value in patients with complaints for four or more days.

- CORADS 5 has a very high positive predictive value given the high a priori-chance in this epidemic.

- The interobserver variation of CORADS 2-4 is still high and has a poor negative and predictive value.

- The interpretation of the CT findings has to be combined with the clinical symptoms and the duration of the symptoms, as a CT can be negative in the first few days of a mild infection.

CO-RADS*

Level of suspicion COVID-19 infection

		CT findings
CO-RADS 1	No	normal or non-infectious abnormalities
CO-RADS 2	Low	abnormalities consistent with infections other than COVID-19
CO-RADS 3	Indeterminate	unclear whether COVID-19 is present
CO-RADS 4	High	abnormalities suspicious for COVID-19
CO-RADS 5	Very high	typical COVID-19
CO-RADS 6	PCR +	

COVID-19

Typical findings

Multifocal groundglass opacities

Peripheral and basal distribution

Unsharp demarcation

Vascular thickening

Round

Crazy paving

Ground glass and Consolidations

(Reversed) halo

Spider web

Atypical findings

Central or peribronchovascular

More apical distribution

Lymphadenopathy *

Very Atypical

Cavitation - calcification

Tree-in-bud, bronchiolitis

Nodular pattern

Mass

Pleural thickening

CO-RADS 0

CO-RADS category 0 is chosen if **none of the five categories** can be assigned because scans are incomplete or of insufficient quality, for example because of severe artifacts due to coughing or breathing.
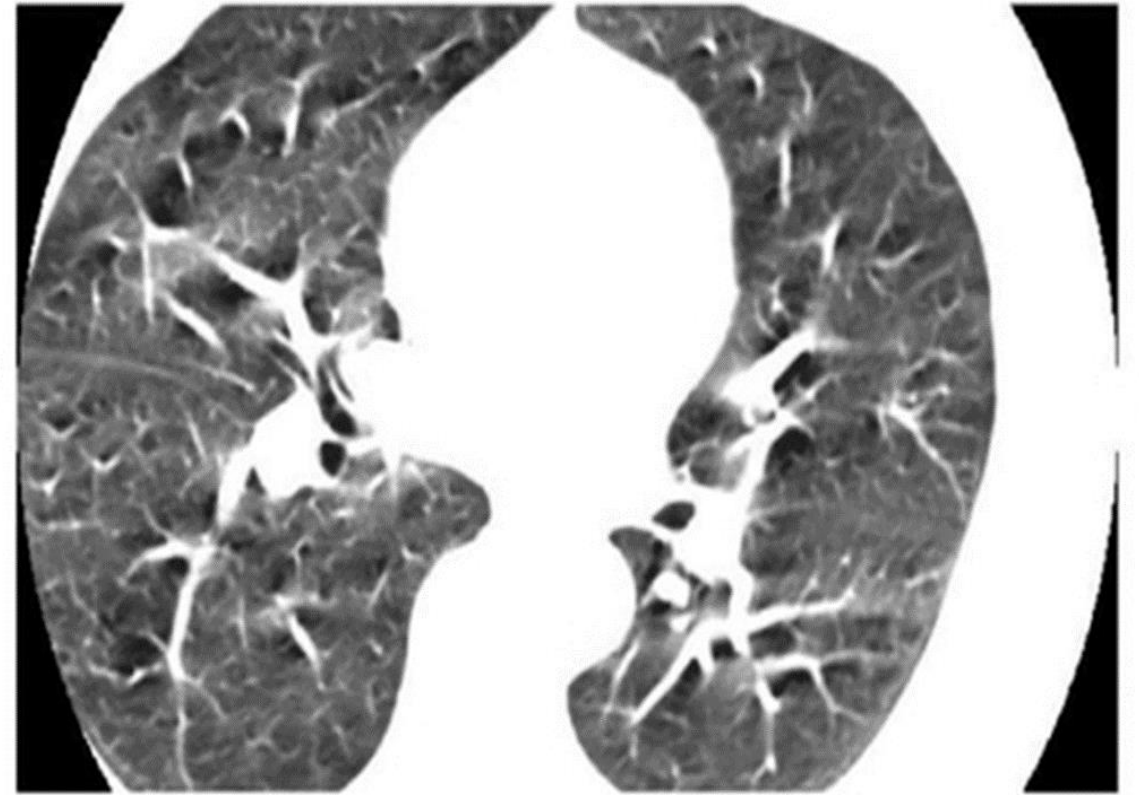
CORADS I

COVID-19 is highly unlikely

The CT is normal or there are findings that indicate a non-infectious disease like congestive heart failure, sarcoid, mild
or severe emphysema, perifissural nodules, lung tumors and
fibrosis UIP or fibrotic NSIP

An exeption has to be made for the first few days of a mild infection when the CT can be normal.

The CT-image is of a patient with complaints for five days.
There are no abnormalities and the PCR was negative.
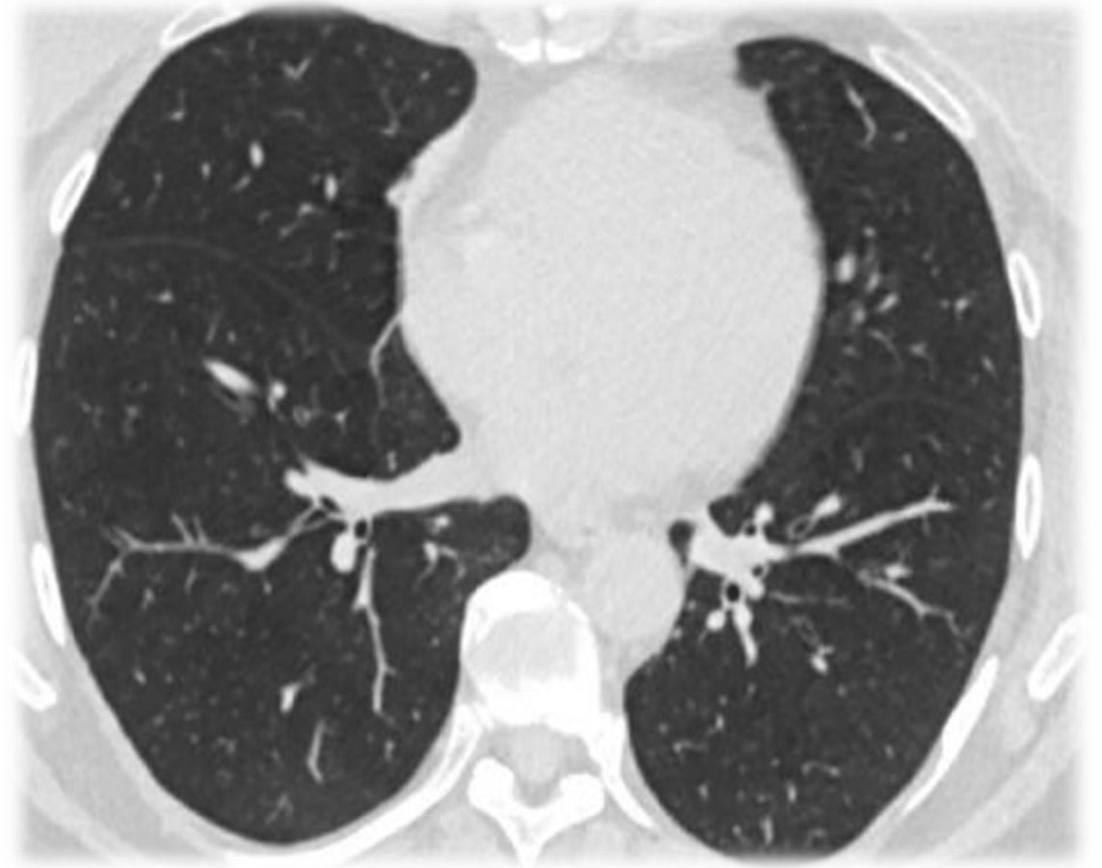
CO-RADS 1. Normal chest CT.

CORADS 2

Level of suspicion of COVID-19 infection is low.

Findings consistent with other infections like typical bronchiolitis with tree-in-bud and thickened bronchus walls, tbc, pulmonary abscess and lung cavitation.

No typical signs of COVID-19.

The CT-image shows bronchiectasis, bronchial wall thickening and tree-in-bud (arrows).
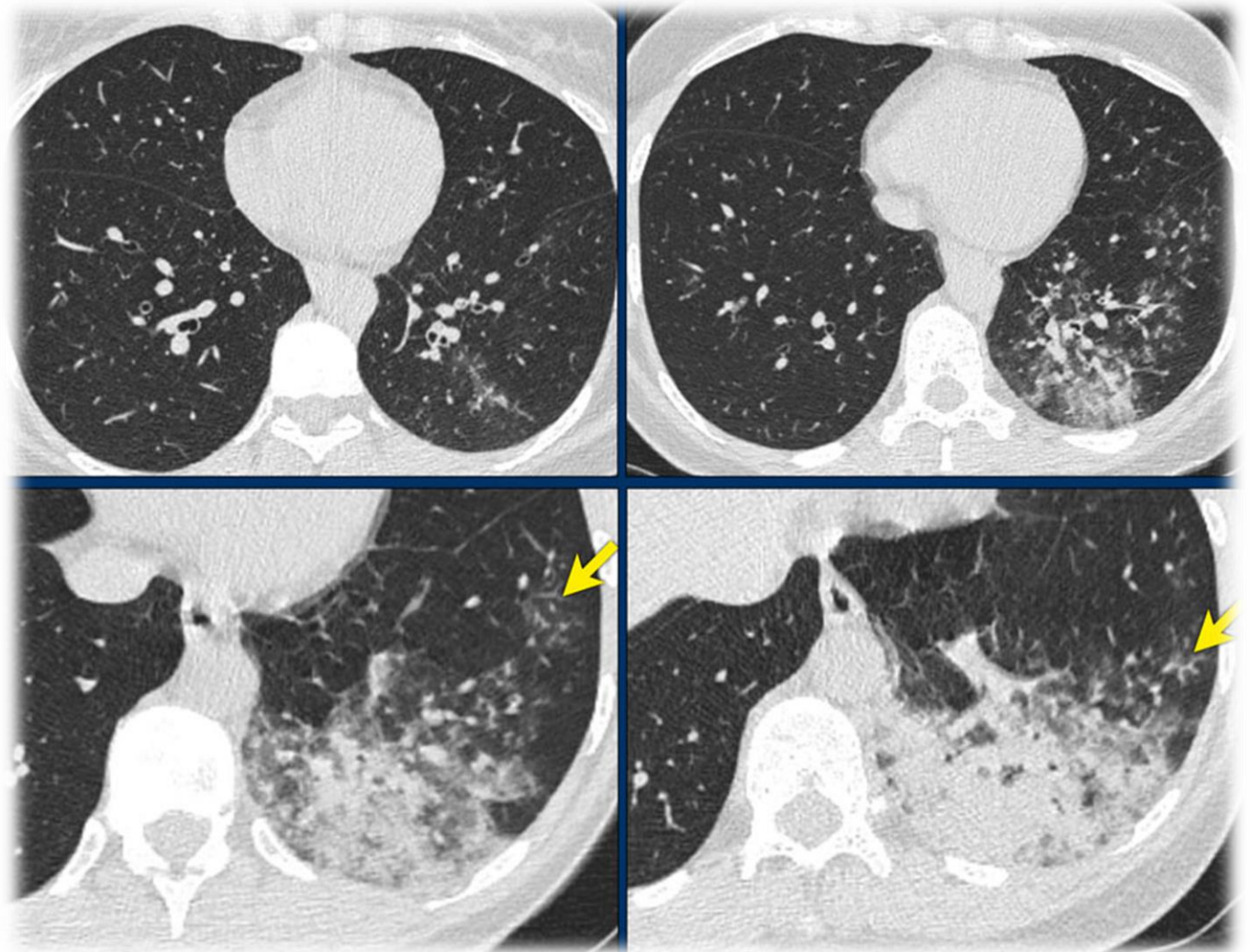There are no ground glass opacities.
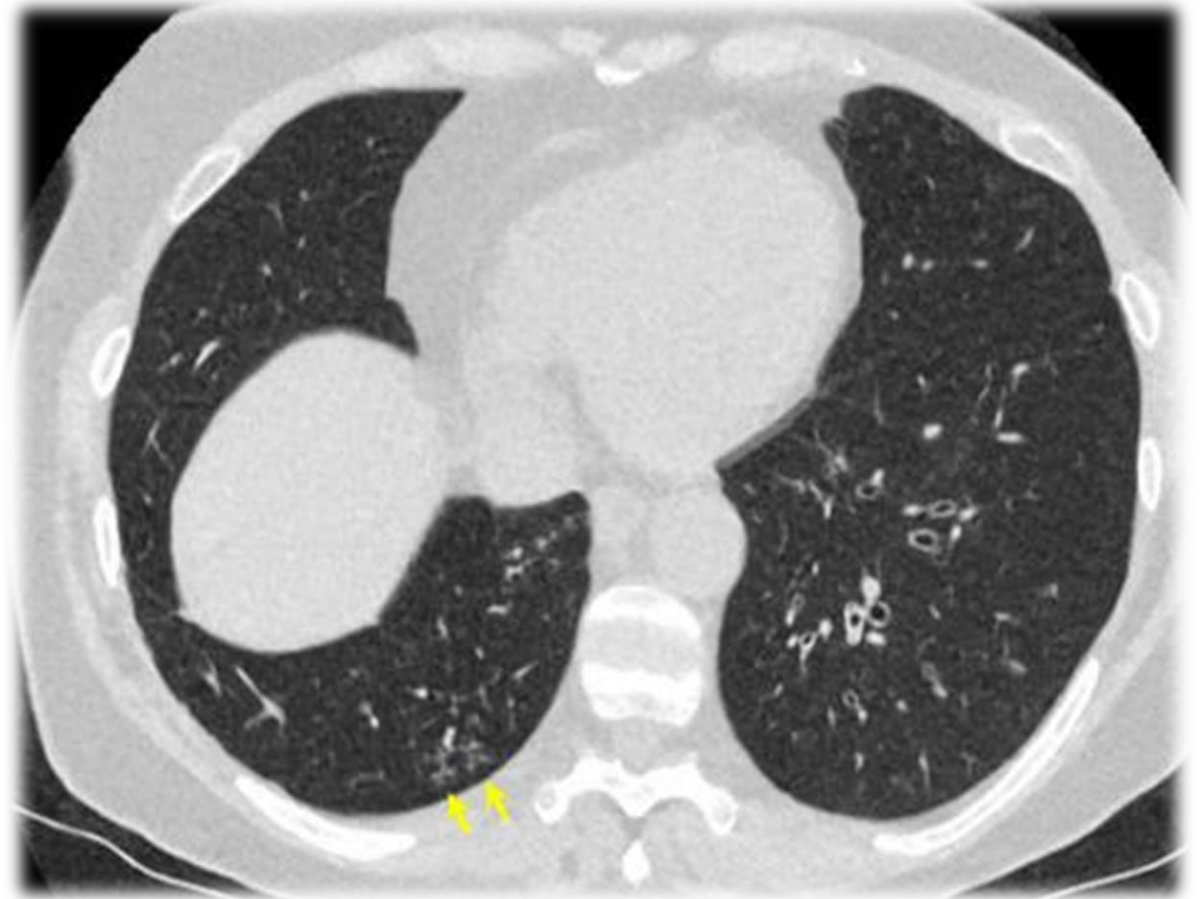
CO-RADS 2. Non COVID-19 infection

40 year old woman with fever and coughing.

CT findings:
lobar consolidation and tree-in-bud (arrows) consistant with a bacterial infection, i.e. CORADS 2.

COVID-19 unlikely.

CORADS 3

COVID-19 unsure or indeterminate

CT abnormalities indicating infection, but unsure whether COVID-19 is involved, like widespread bronchopneumonia, lobar pneumonia, septic emboli with ground glass opacities.

Case 1.
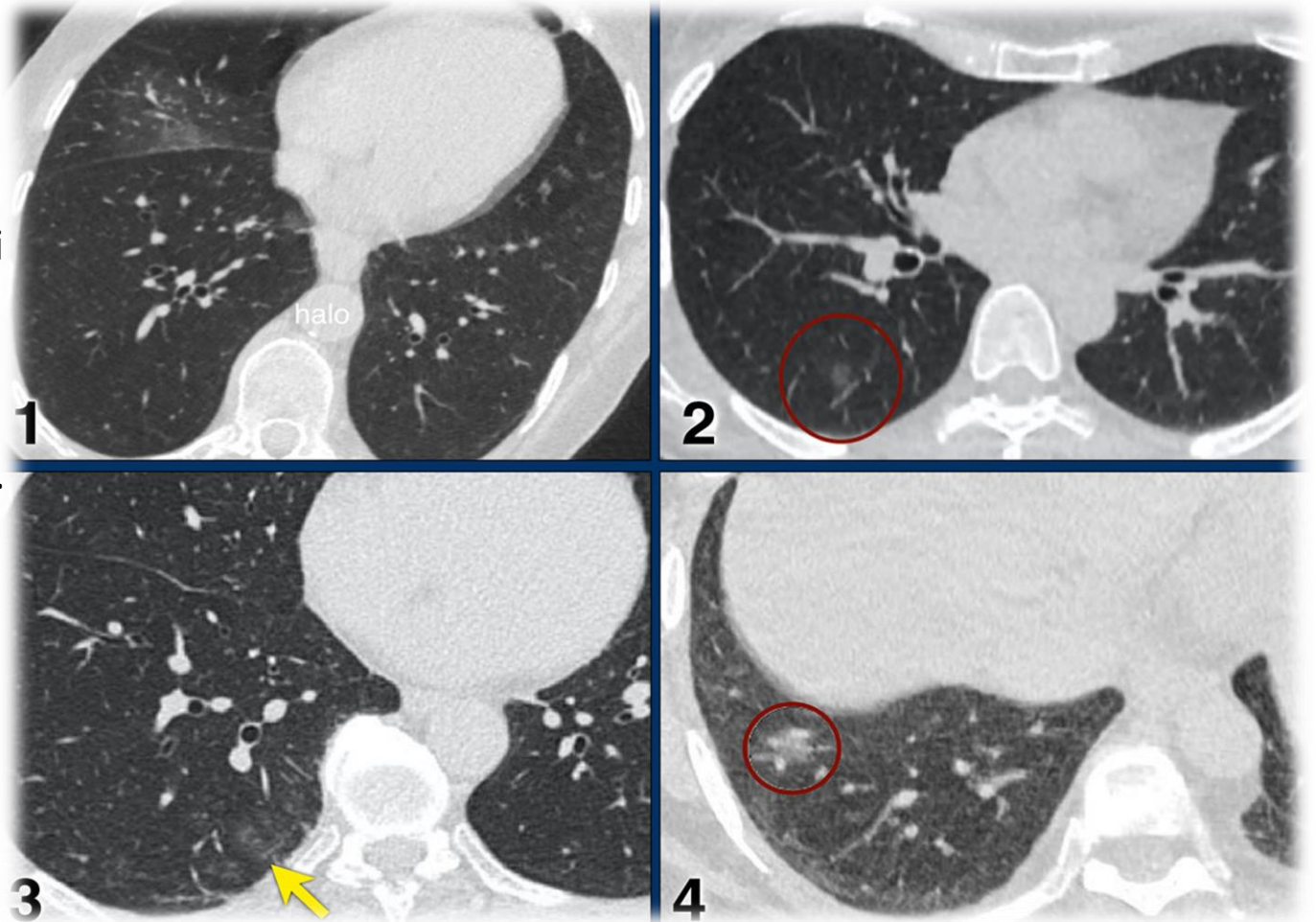One day complaints. CT: Unifocal GGO. PCR negative.

Case 2.
CT: Unifocal GGO (circle).

Case 3.
CT: Unifocal GGO (arrow).

Case 4.
CT: Unifocal GGO (circle).

CORADS 3

perihilar ground-glass opacity, homogenous extensive ground-glass opacity ,ground-glass opacity together with smooth interlobular septal thickening with or without pleural effusion in the absence of other typical CT findings.

CO-RADS category 3 also includes small ground-glass opacities that are not centrilobular (otherwise they would be CO-RADS category 2) or not located close to the visceral pleura (otherwise they would be CO-RADS category 4).

In addition, it contains patterns of consolidation compatible with organizing pneumonia without other typical findings of COVID

CORADS 4

In CO-RADS 4 the level of suspicion is high

Mostly these are suspicious CT findings but not extremely typical:

- Unilateral ground glass
- Multifocal consolidations without any other typical finding
- Findings suspicious of COVID-19 in underlying pulmonary disease.

Findings are similar to those for CO-RADS category 5; however,

- they are not in contact with the visceral pleura,

- located strictly unilaterally

- a predominant peribronchovascular distribution

- superimposed on severe diffuse preexisting pulmonary abnormalities.

Case 1

7 days of compaints
CT: unilateral areas of GGO in left upper lobe.
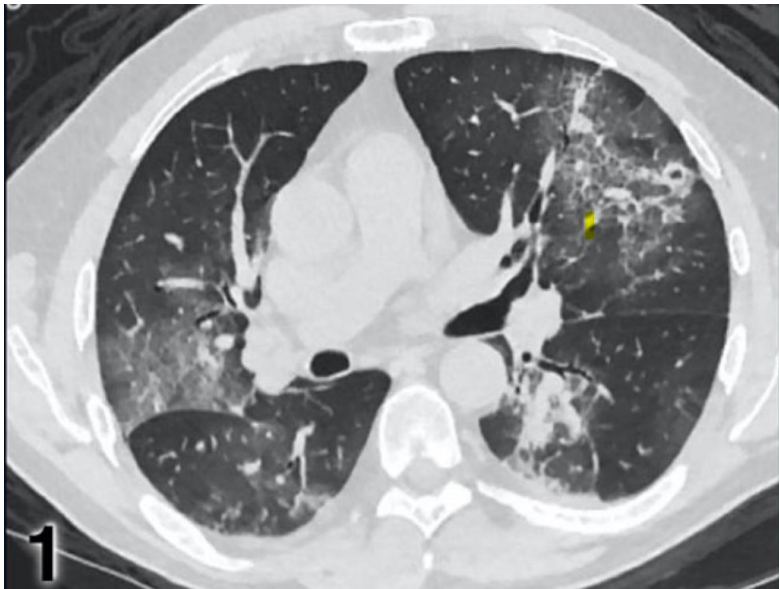PCR: positive.

Case 2

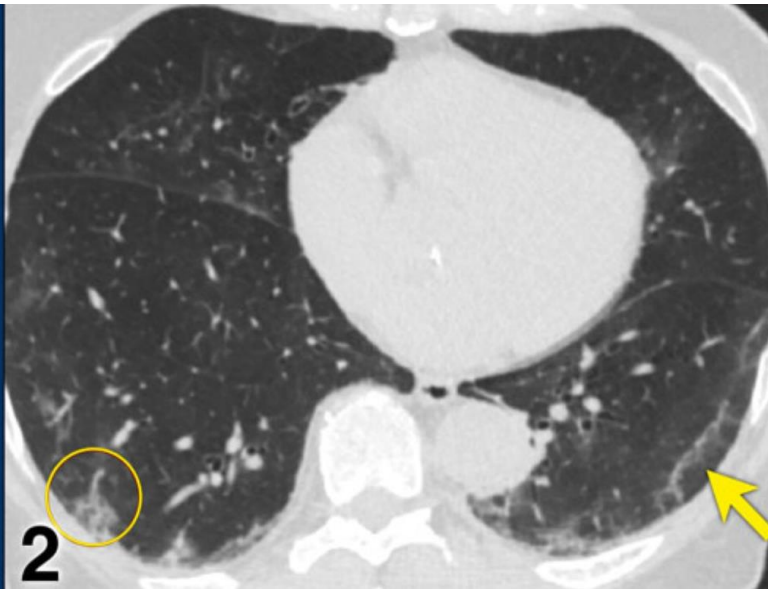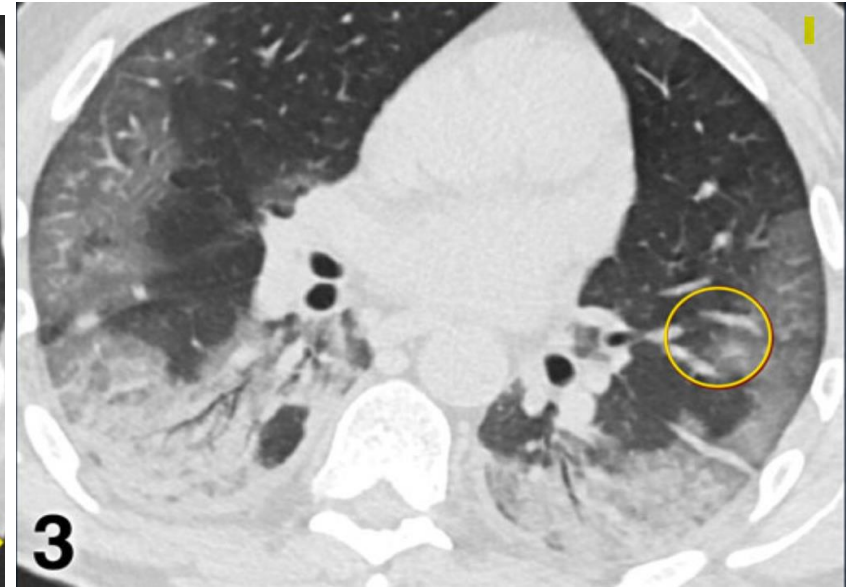CT: bilateral GGO in a patient with emphysema.
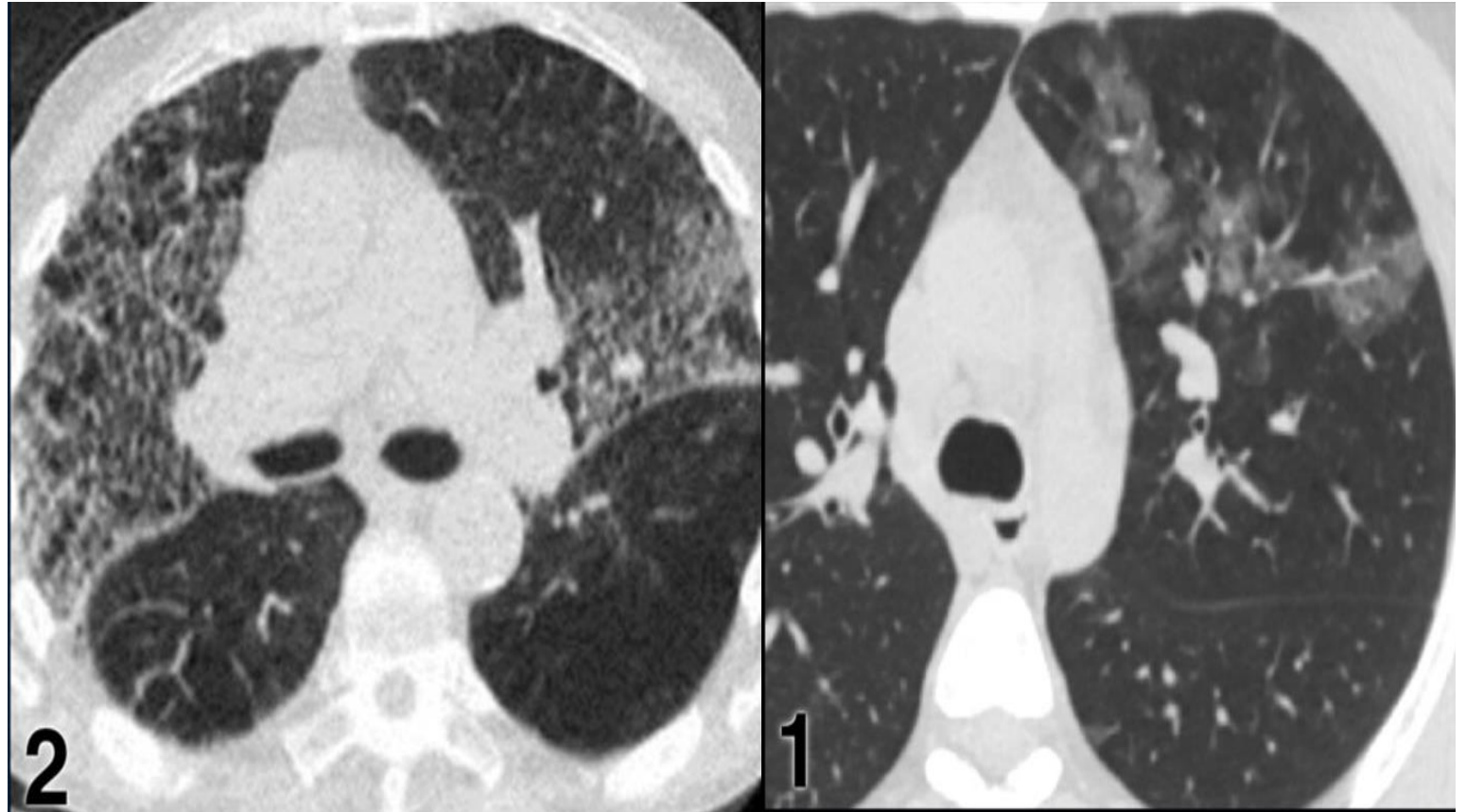
CORADS 5

In CO-RADS 5 the level of suspicion is very high
(Typical findings for covid-19)

Case 1
Multifocal GGO and consolidation

Case 2
10 days of complaints.
CT: bilateral multifocal GGO, vascular thickening (circle), subpleural bands (arrow).
PCR: positive

Case 3
Eleven days of complaints
CT findings: Bilateral GGO and consilidation, basal preference, vascular thickening (circle).
PCR: positive

CORADS 5

Mandatory features:

- **Ground-glass** with or without consolidations close to visceral pleural surfaces, including fissures

AND

- **Multifocal bilateral**

Confirmatory patterns:

- **Ground-glass**

• Unsharp demarcation, (half) rounded shape

• Sharp demarcation, outlining multiple adjacent secondary pulmonary lobules

- **Crazy paving**

- Patterns compatible with organizing pneumonia, such as

• Reverse halo sign

• Extensive subpleural consolidations with air bronchogram

• Subpleural curvilinear bands

- **Thickened vessels** within abnormalitie
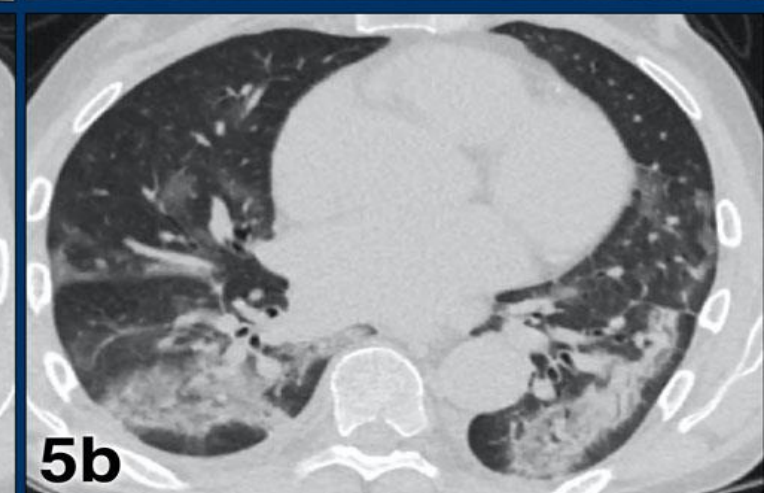
CORADS 5

Case 4
CT findings: multifocal areas of groundglass and consolidation
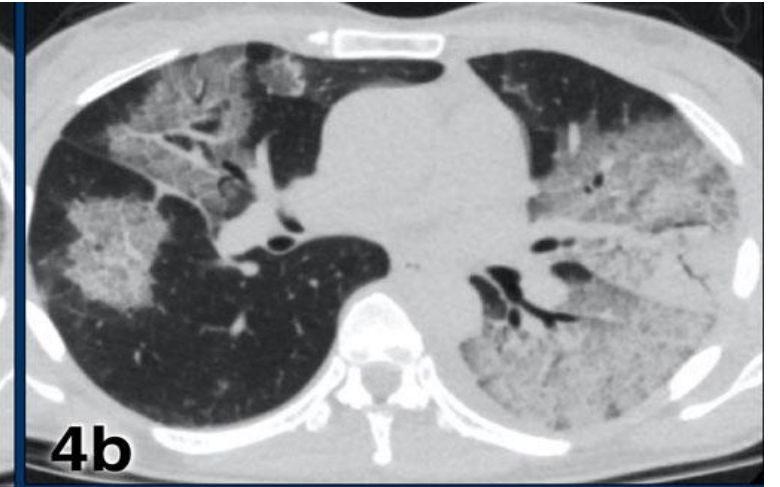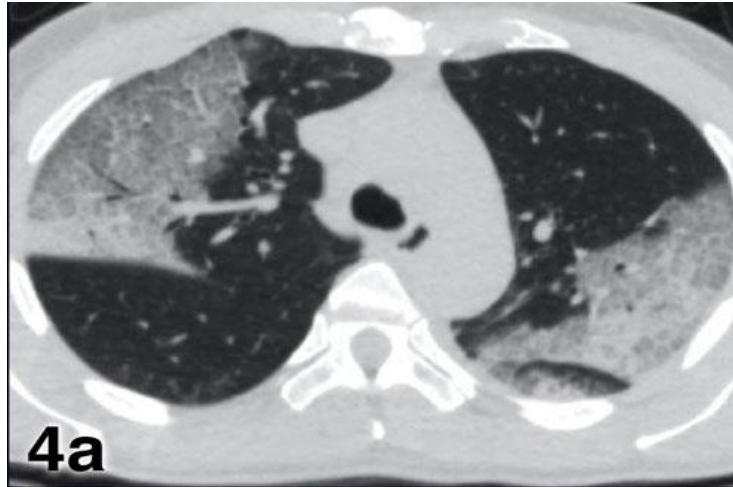
Case 5
CT findings: multifocal areas of groundglass and consolidation

CORADS 5

Mandatory features are ground-glass opacities with or without consolidations in lung regions close to visceral pleural surfaces, including the fissures, and a multifocal bilateral distribution(vicinity to the minor or major fissure is also typical)
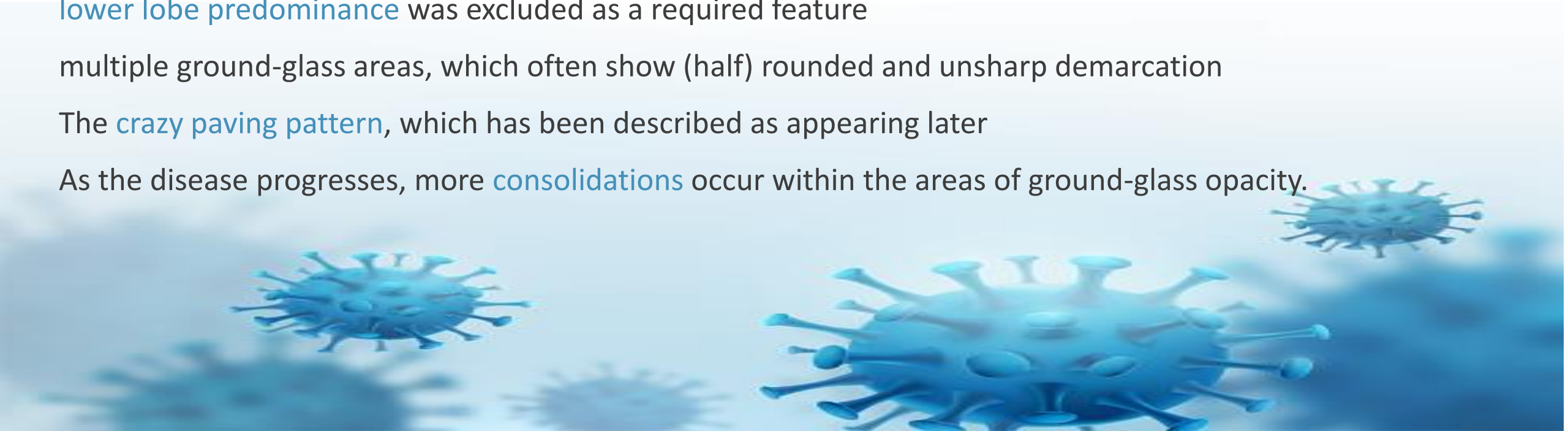
Subpleural sparing can be present

lower lobe predominance was excluded as a required feature

multiple ground-glass areas, which often show (half) rounded and unsharp demarcation

The crazy paving pattern, which has been described as appearing later

As the disease progresses, more consolidations occur within the areas of ground-glass opacity.

CORADS 5

- Finally, opacities that resemble organizing pneumonia occur, such as reverse halo signs or ground-glass opacity with extensive subpleural consolidations.

- Subpleural curvilinear bands or bands of ground glass with or without consolidation in a tethered arching pattern with small connections to the pleura are also considered typical findings.

- Thickened vessels within lung abnormalities are typical

CORADS 6

proven COVID-19

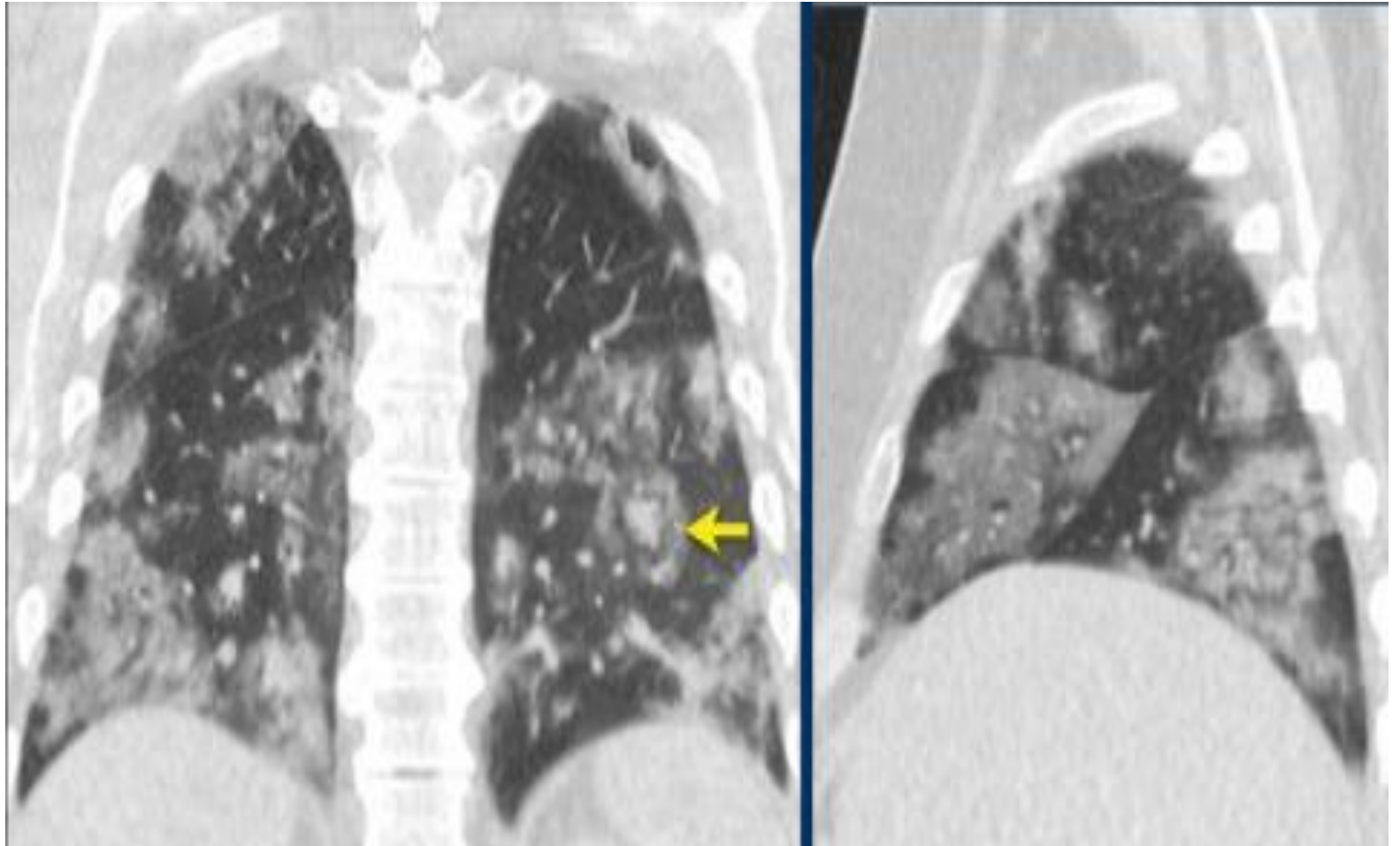Patient with positive PCR and bilateral GGO.

Notice halo sign (arrow).

Table 1: Overview of CO-RADS Categories and the Corresponding Level of Suspicion for Pulmonary Involvement in COVID-19

| CO-RADS Category	Level of Suspicion for Pulmonary Involvement of COVID-19	Summary
0	Not interpretable	Scan technically insufficient for assigning a score
1	Very low	Normal or noninfectious
2	Low	Typical for other infection but not COVID-19
3	Equivocal/unsure	Features compatible with COVID-19 but also other diseases
4	High	Suspicious for COVID-19
5	Very high	Typical for COVID-19
6	Proven	RT-PCR positive for SARS-CoV-2

Note.—CO-RADS = COVID-19 Reporting and Data System, COVID-19 = coronavirus disease 2019, RT-PCR = reverse transcription-polymerase chain reaction, SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2.
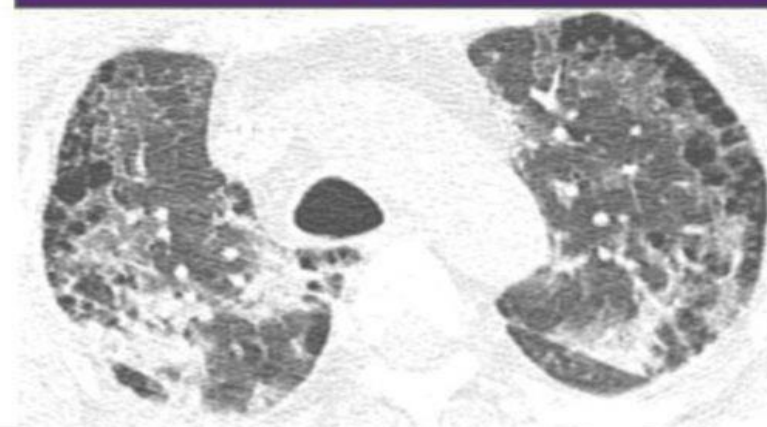
CORADS-1
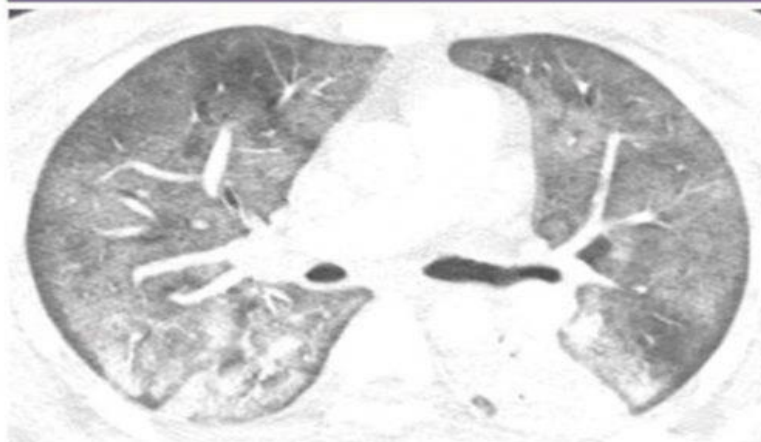
CORADS-2
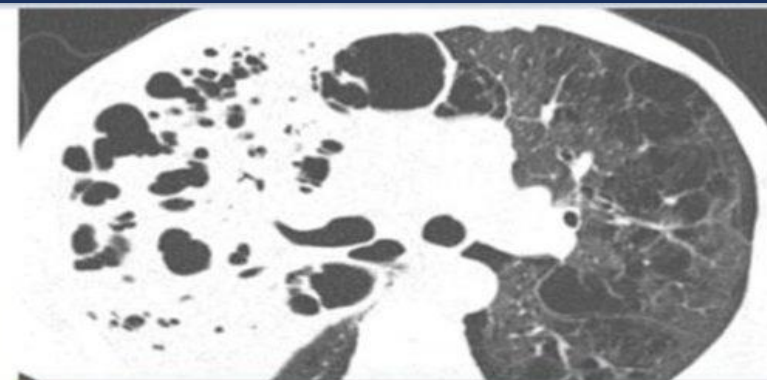
CORADS-3

CORADS-4

CORADS-5

CT-Report

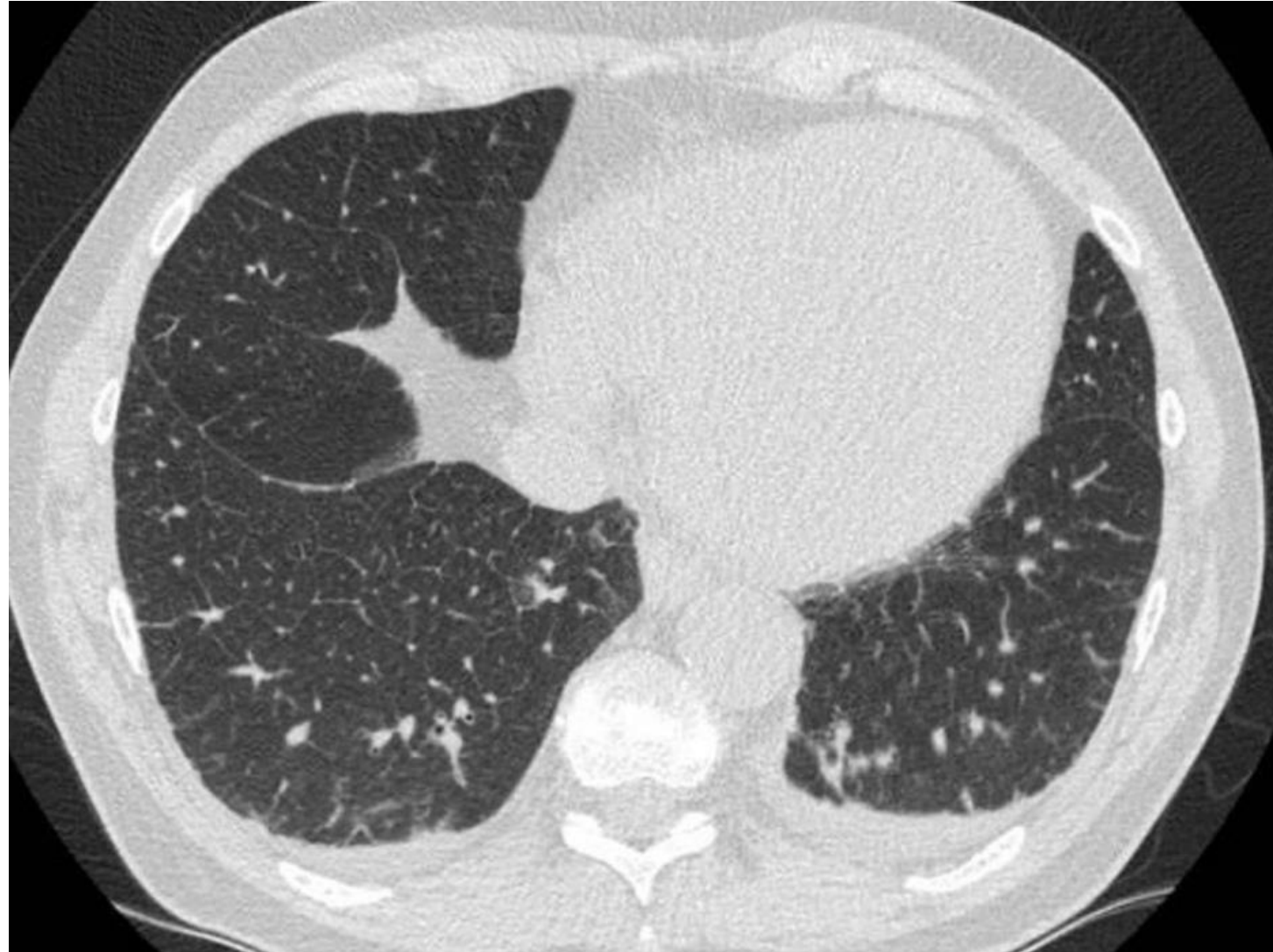|	
Duration of complaints	in days
CT findings	GGO - consolidation - distribution
	Crazy paving
	(Reversed) halo - spider web sign
	Vascular thickening
	Pleural fluid
	Enlarged lymph nodes etc
CORADS	Determine level of suspicion
	COVID-19
CT severity score	
Additional findings	co-morbidity
Conclusion	CORADS
	Severity

Interstitial pulmonary edema. No groundglass opacities. Bilateral pleural effusion in patient with cardiac failure. CO-RADS 1
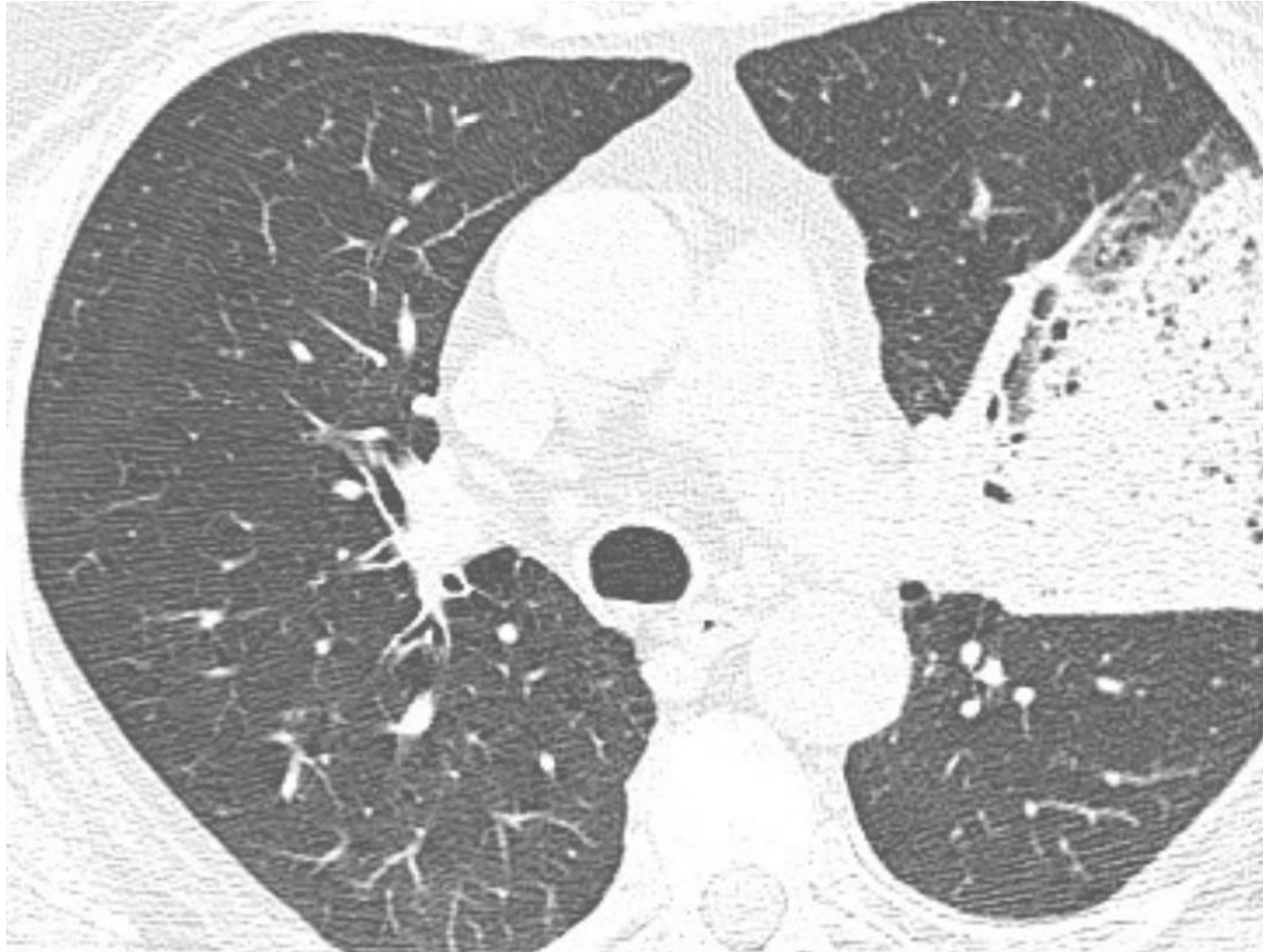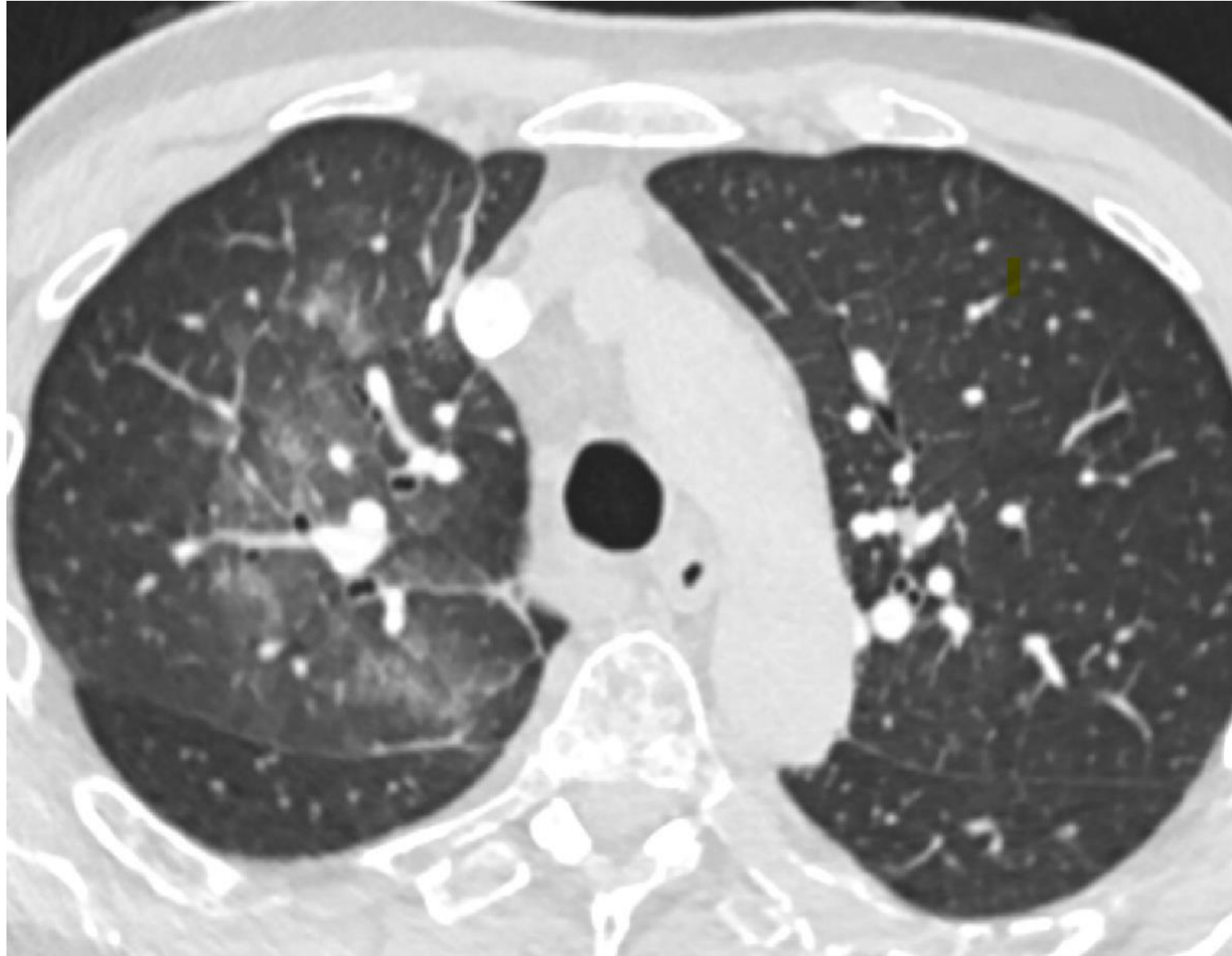
Consolidation in lobar pneumonia. CO-RADS 2

CO-RADS 2

Bilateral ground-glass opacities, interlobular septal thickening and pleural effusion in patient with cardiac decompensation. CO-RADS 3

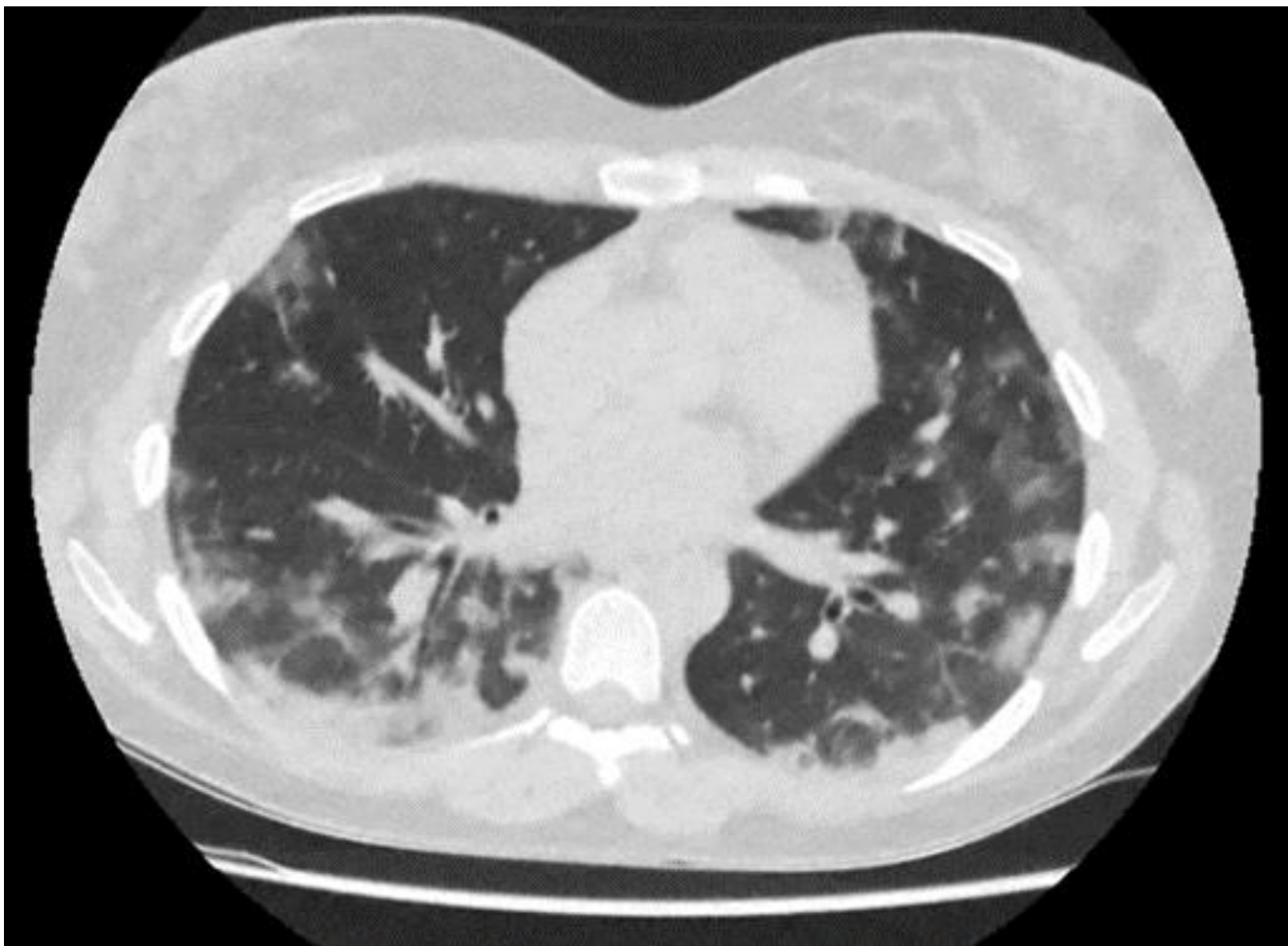Single focus of ground-glass opacity RLL (arrow) CO-RADS 3

Unilateral ground-glass opacities with pleural contact at the major fissure. CO-RADS 4
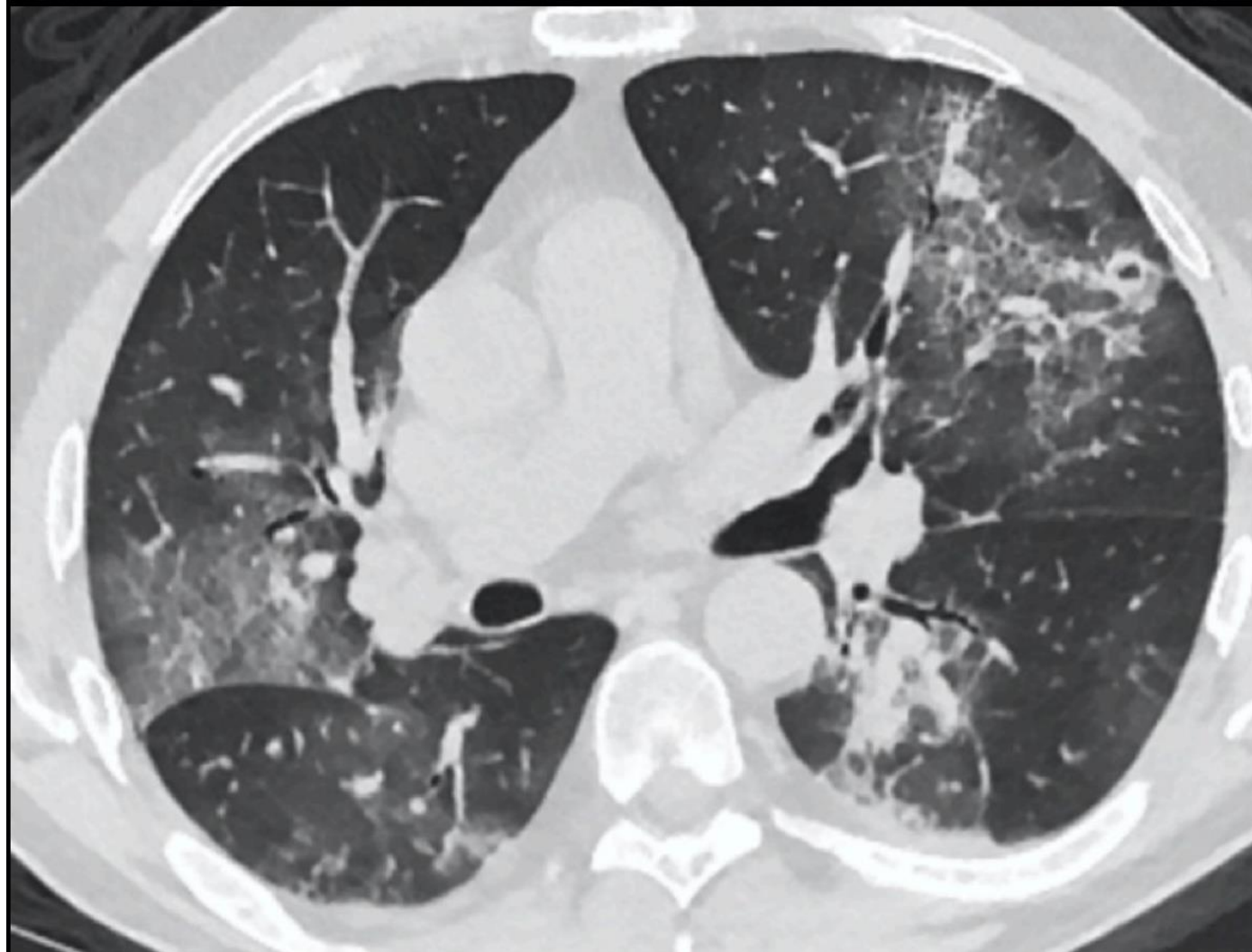
CO-RADS 4: CT Scan of 33-year old female with COVİD-19
Right lung, lower lob, dorsal distribution, unilateral peripheral carzy paving patern (thickened interlobuler)

CORADS 5

Multifocal bilateral subpleural ground-glass opacities on the right in contact with the major fissure, crazy paving and consolidation on the left. CO-RADS 5

conclusion

- The coronavirus disease 2019 (COVID-19) Reporting and Data System (CO-RADS) is a categorical assessment scheme for pulmonary involvement of COVID-19 at unenhanced chest CT that performs very well in predicting COVID-19 in patients with moderate to severe symptoms and has substantial interobserver agreement, especially for categories 1 and 5

THANK YOU