CO-RADS

Categorical CT assessment scheme for patients with suspected COVID-19

Final update 13/5/2020, previous version 10/4/2020

Slides adjusted in line with recently published article "CO-RADS – A categorical CT assessment scheme for patients with suspected COVID-19: definition and evaluation. Radiology. 2020;201473"

https://doi.org/10.1148/radiol.2020201473

- CO-RADS

- CT Severity Score (CTSS)

- Patterns

- Report

CO-RADS

- COVID-19 Reporting and Data System

- Classification level of suspicion for *pulmonary* COVID-19

- Objectives:

  - Improve communication with referring physicians

  - Compare data across institutions and populations

 - Provide basis for gathering of better scientific evidence

CO-RADS
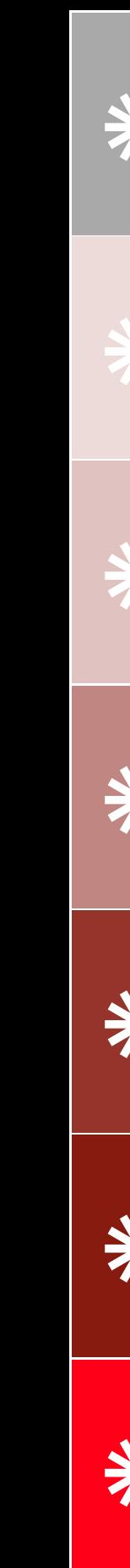
CO-RADS 0: not interpretable

CO-RADS 1: very low

CO-RADS 2: low

CO-RADS 3: equivocal / unsure

CO-RADS 4: high

CO-RADS 5: very high

CO-RADS 6: RT-PCR SARS-CoV-2 positive

CO-RADS 0

- Incomplete depiction of the lung on CT *or*

- Technically insufficient for assigning a CO-RADS classification

  - Example: severe breathing or coughing artifacts

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CO-RADS 1

- Level of suspicion: Very low

- To be used in case of:

  - Normal chest CT

  - Findings of unequivocal non-infectious etiology

  - Findings are stable compared to pathology on previous imaging

  - Example alternative diagnoses: emphysema, (known) interstitial pneumonitis, nodules, tumor, interstitial edema
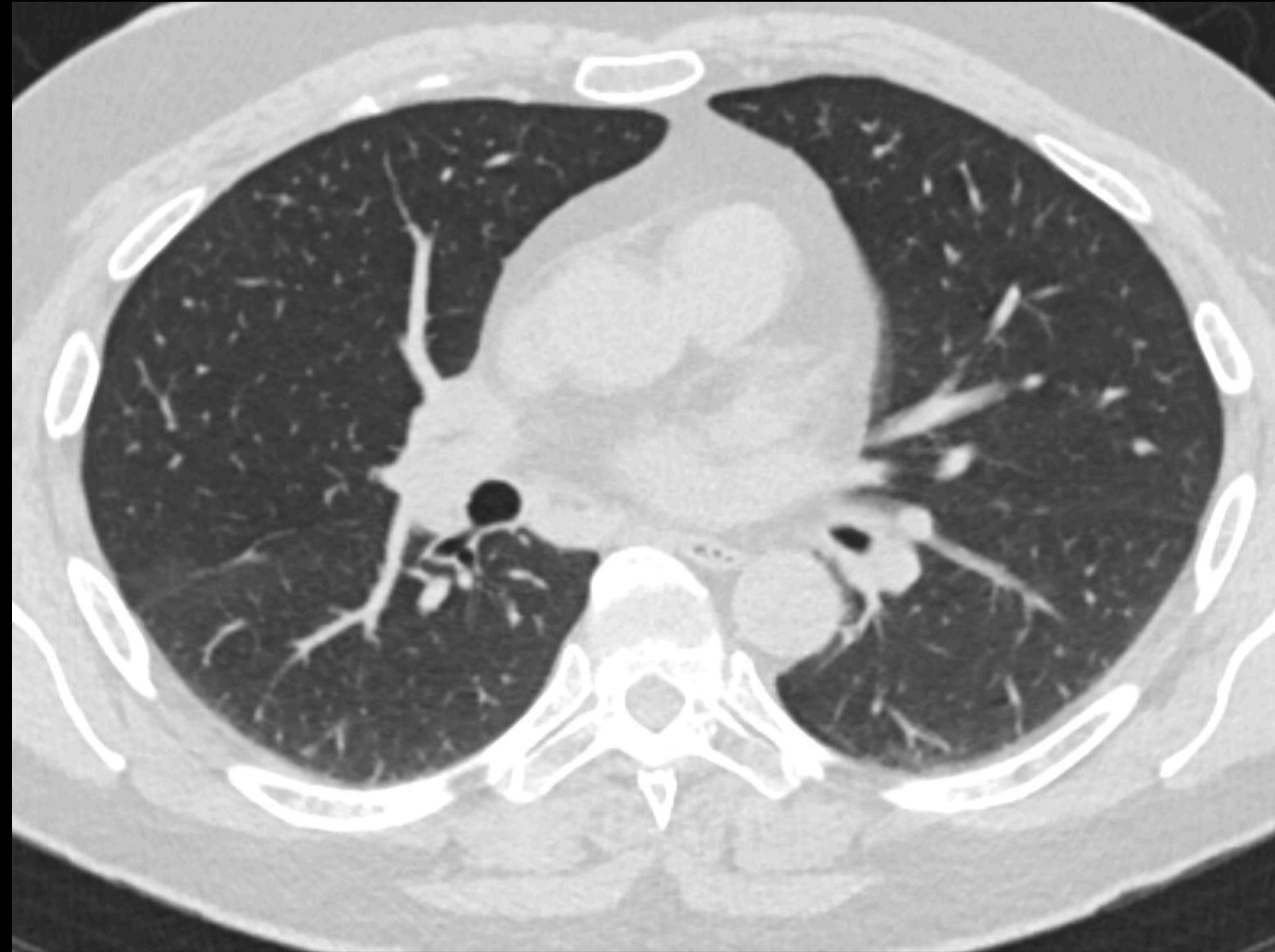
Normal low-dose CT.

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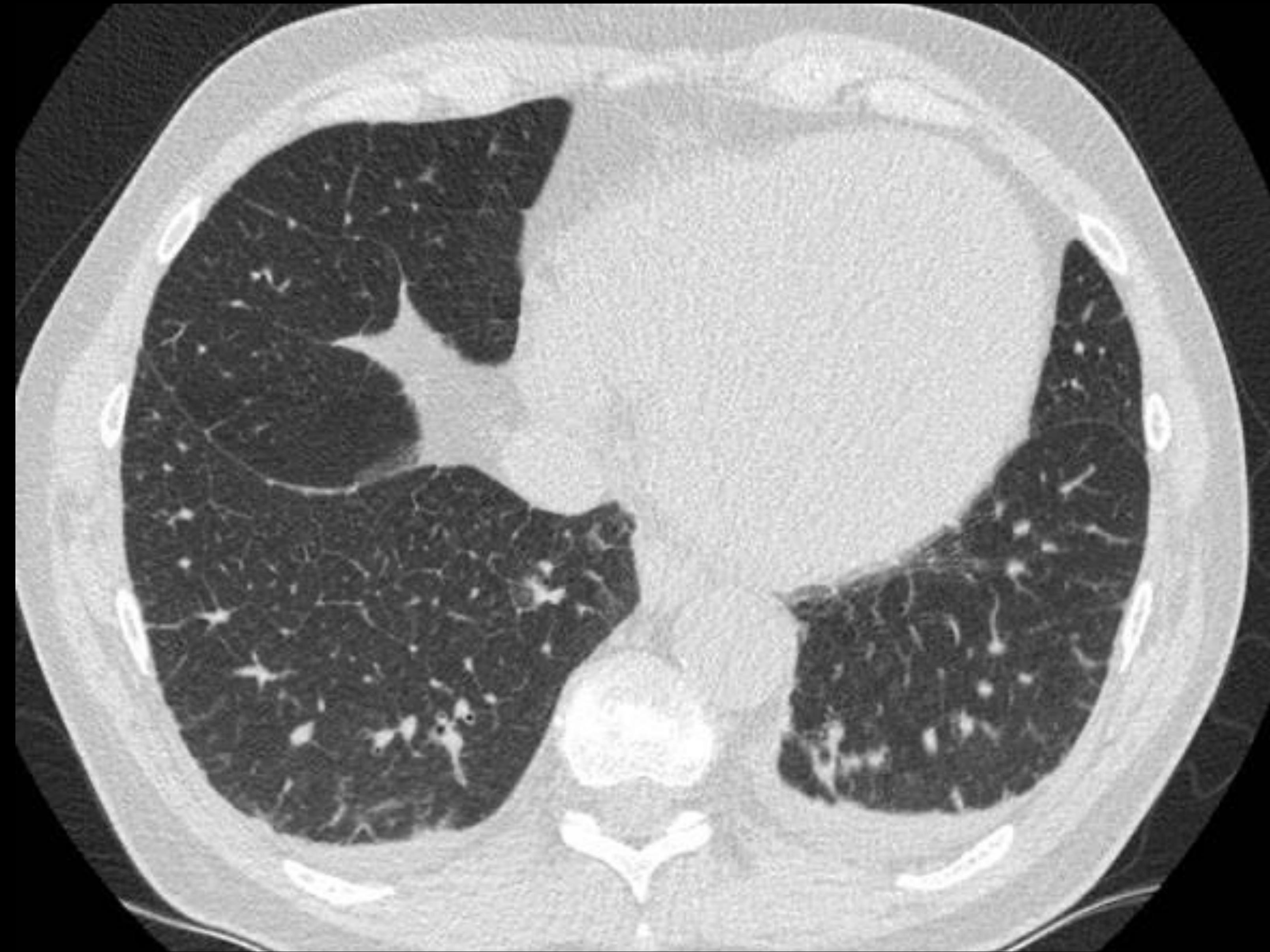
Interstitial pulmonary edema. No groundglass opacities. Bilateral pleural effusion in patient with cardiac failure.

CO-RADS 1

CO-RADS 2

- Level of suspicion: Low

- Findings typical of infectious etiology

- AND considered not compatible with COVID-19

- AND absence of features of CO-RADS categories 3-5

Example alternative diagnoses:

- Bronchitis
- Infectious bronchiolitis
- Bronchopneumonia
- Lobar pneumonia
- Pulmonary abscess

Example features:

- Tree-in-bud sign
- Centrilobular nodular pattern
- Lobar or segmental consolidation
- Cavitation
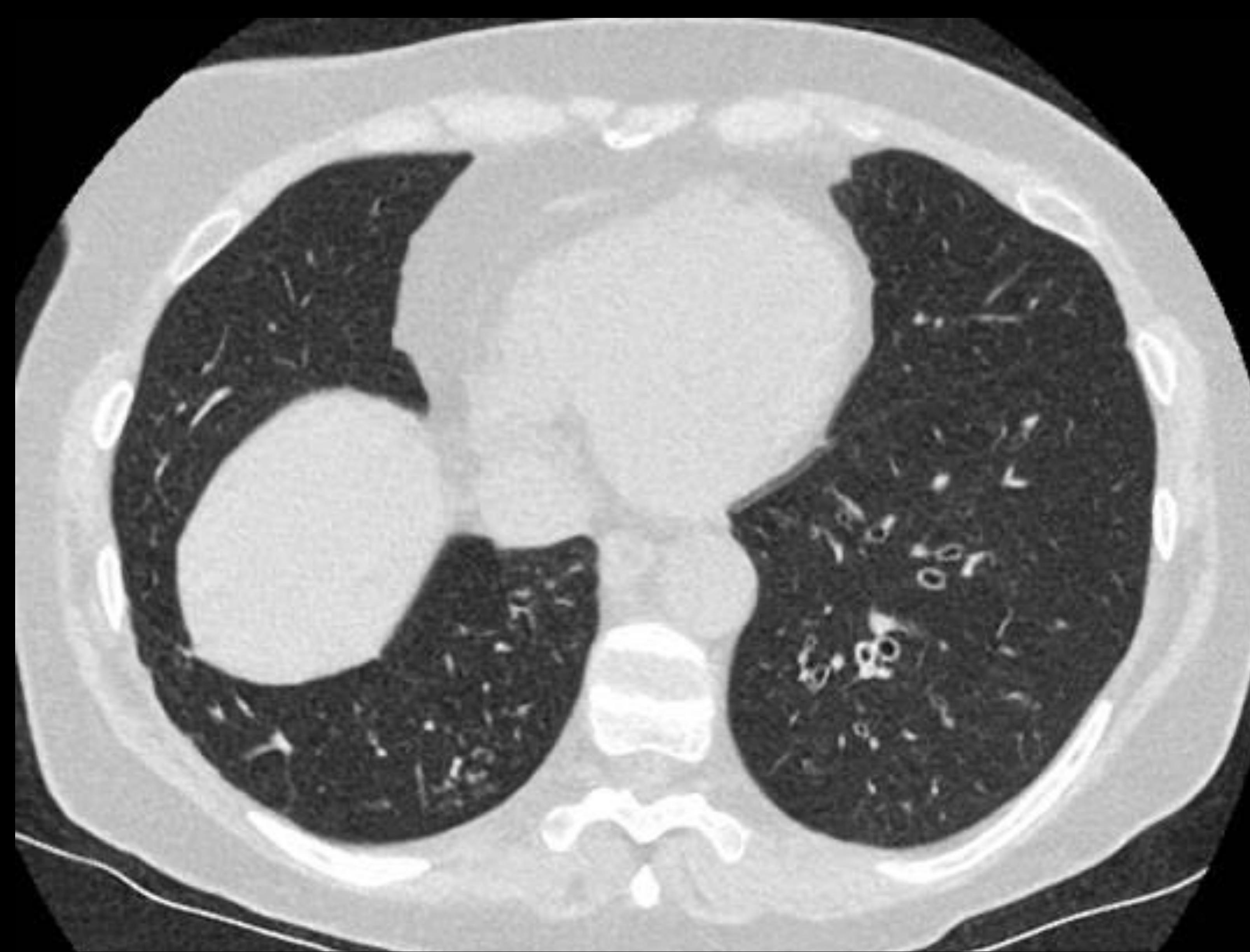
Dilated bronchi with thickened bronchial walls.

CO-RADS 2
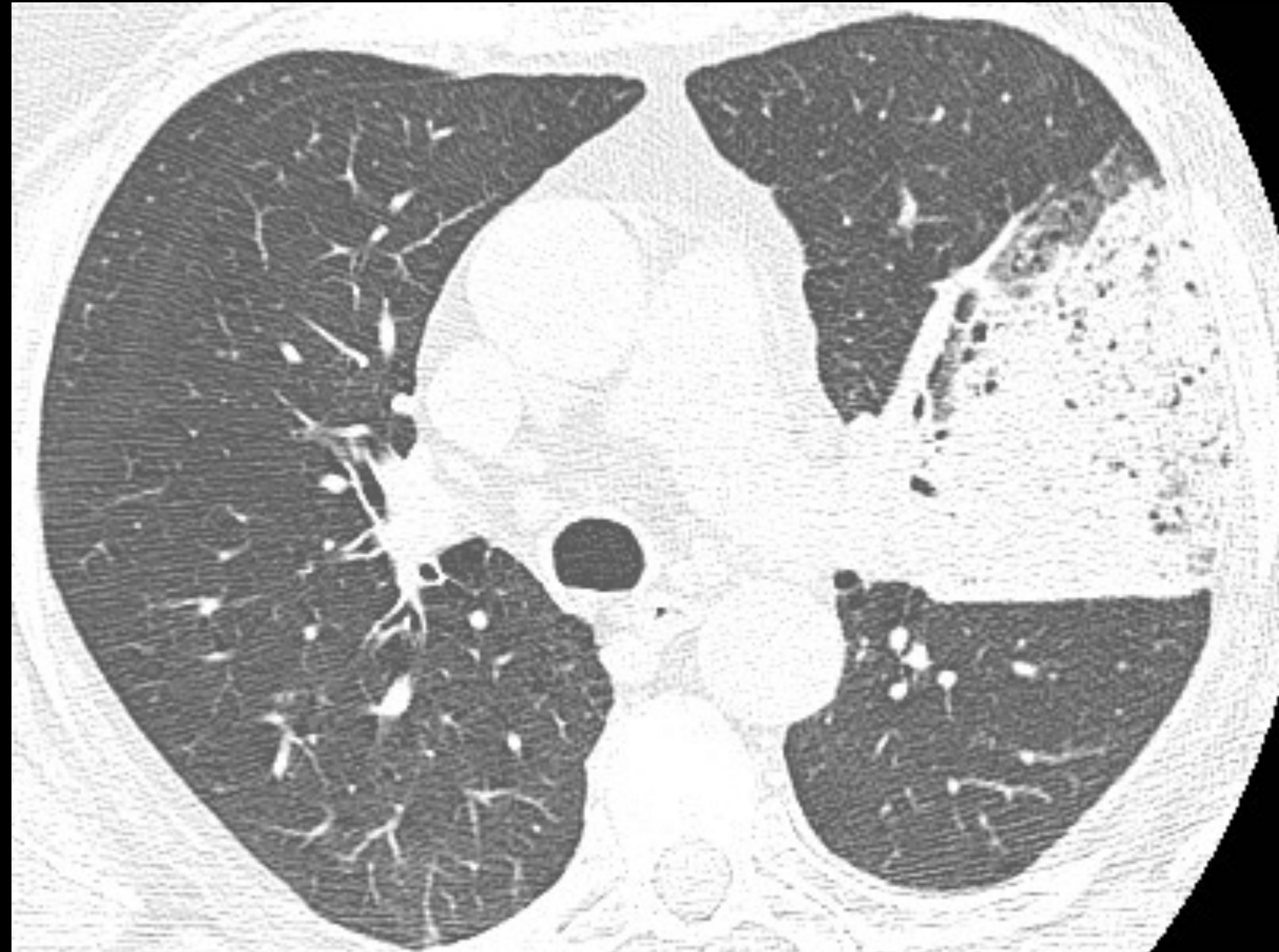
Consolidation in lobar pneumonia.

CO-RADS 2
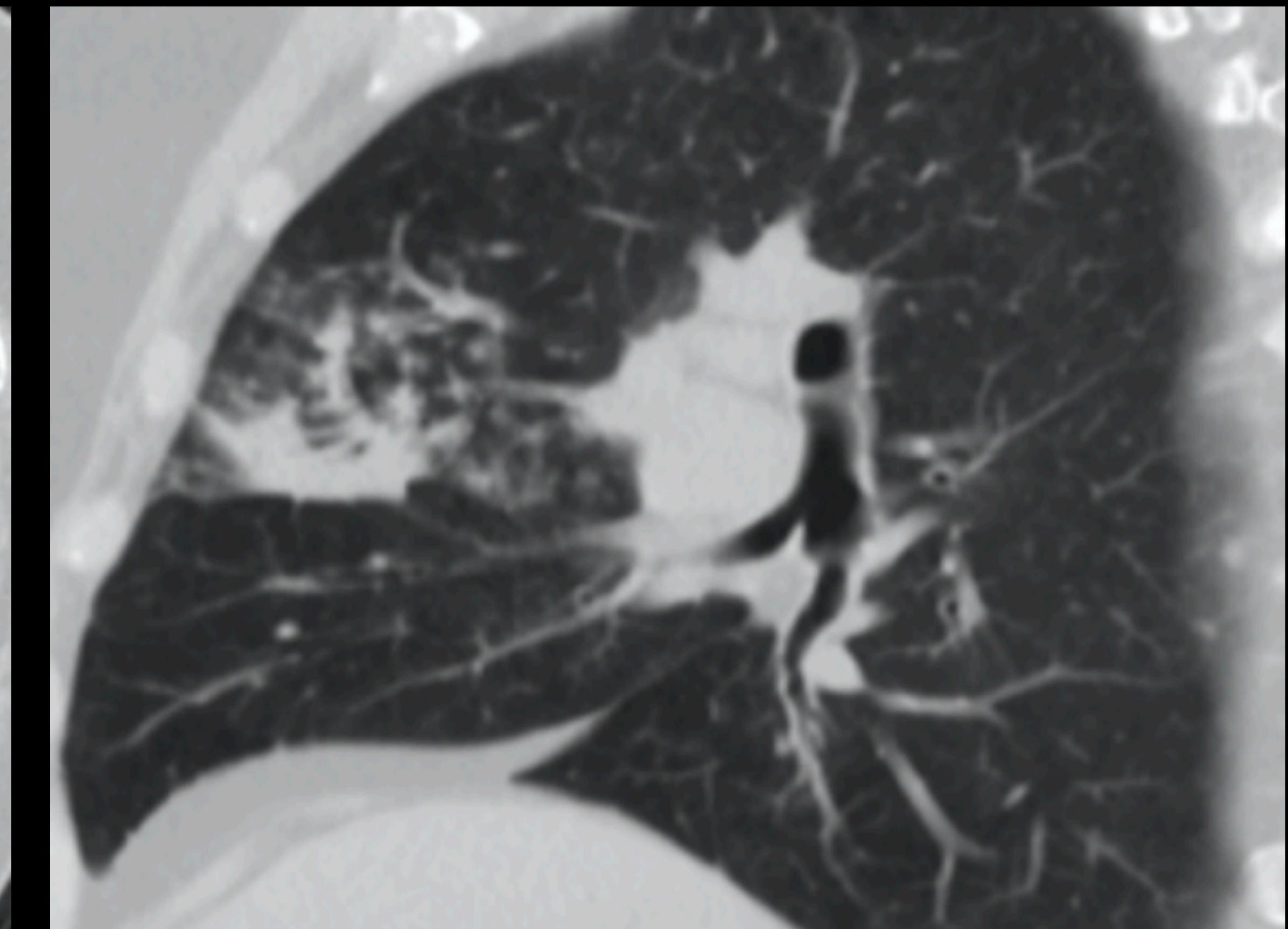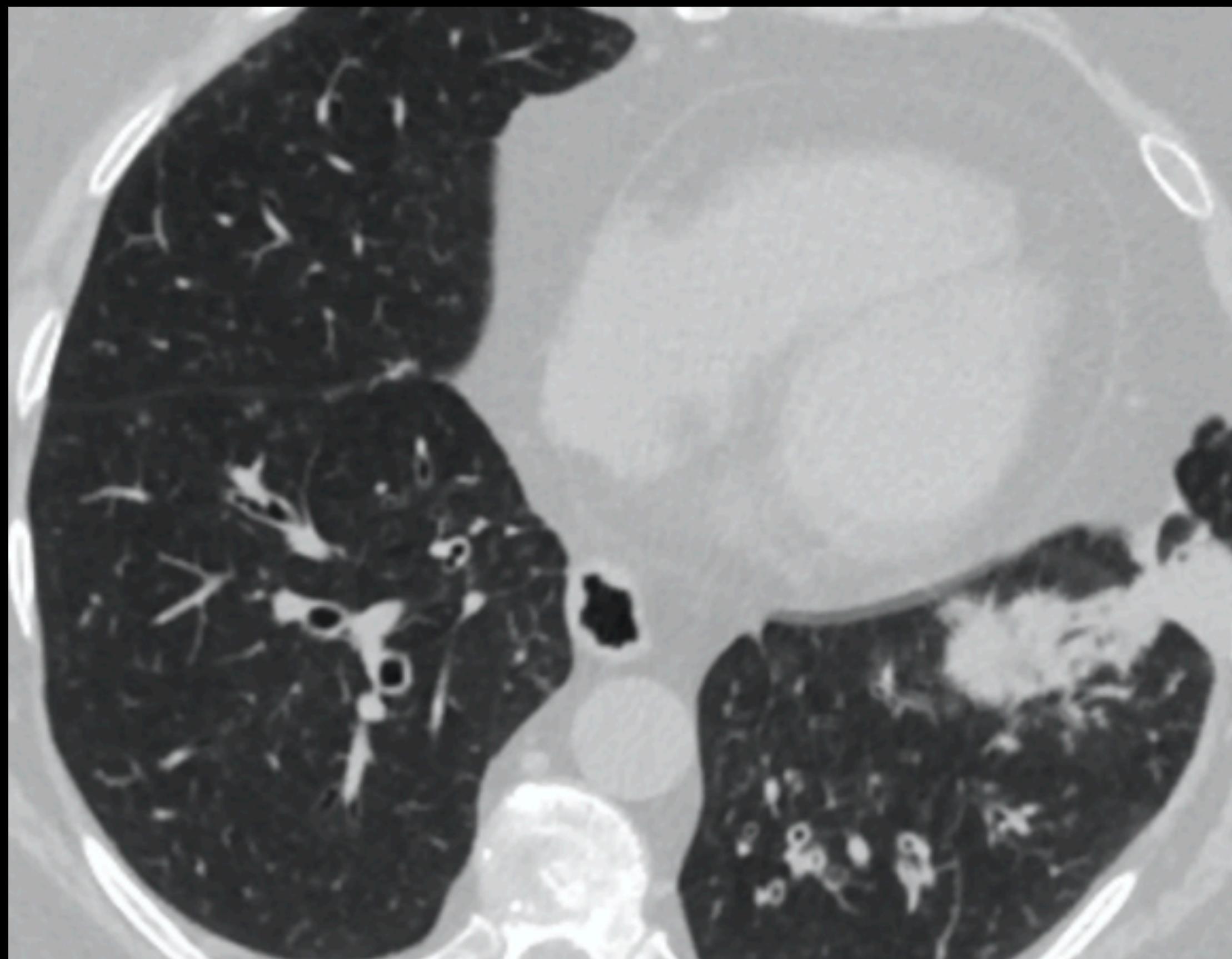
Thickened bronchial walls, tree-in-bud pattern and consolidation. No ground-glass opacities.

CO-RADS 2

CTSS

PATTERNS

REPORT

CO-RADS 3

- Level of suspicion: equivocal

- Features that can also be found in other viral pneumonias or non-infectious etiologies.

- Findings have to be new or increased in magnitude

Example alternative diagnoses:

- Influenza

- RSV or other viral pneumonias

- Atypical alveolar edema

- Pulmonary hemorrhage

- Alternative infections combined with SARS-CoV-2

Example patterns:

- Perihilar ground-glass

- Ground-glass together with smooth interlobular septal thickening +/- pleural effusion

- Extensive homogeneous ground-glass opacity

- Small ground glass opacities, not centrilobular, not located close to the visceral pleura

- Consolidation compatible with organizing pneumonia without other typical findings of COVID-19

Single focus of ground-glass opacity RLL (arrow). rt-PCR positive

CO-RADS 3

Single focus of ground-glass opacity RUL (arrow).

CO-RADS 3

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

CO-RADS 3

CO-RADS 4

- Level of suspicion: High

- Findings are typical for COVID-19 but showing some overlap with other (viral) pneumonias

- Findings similar to CO-RADS 5 *but*

  - Predominantly no contact with visceral pleura *or*

  - Located strictly unilaterally *or*

  - Predominant peribronchovascular distribution *or*

  - Superimposed on severe diffuse pre-existing pulmonary abnormalities
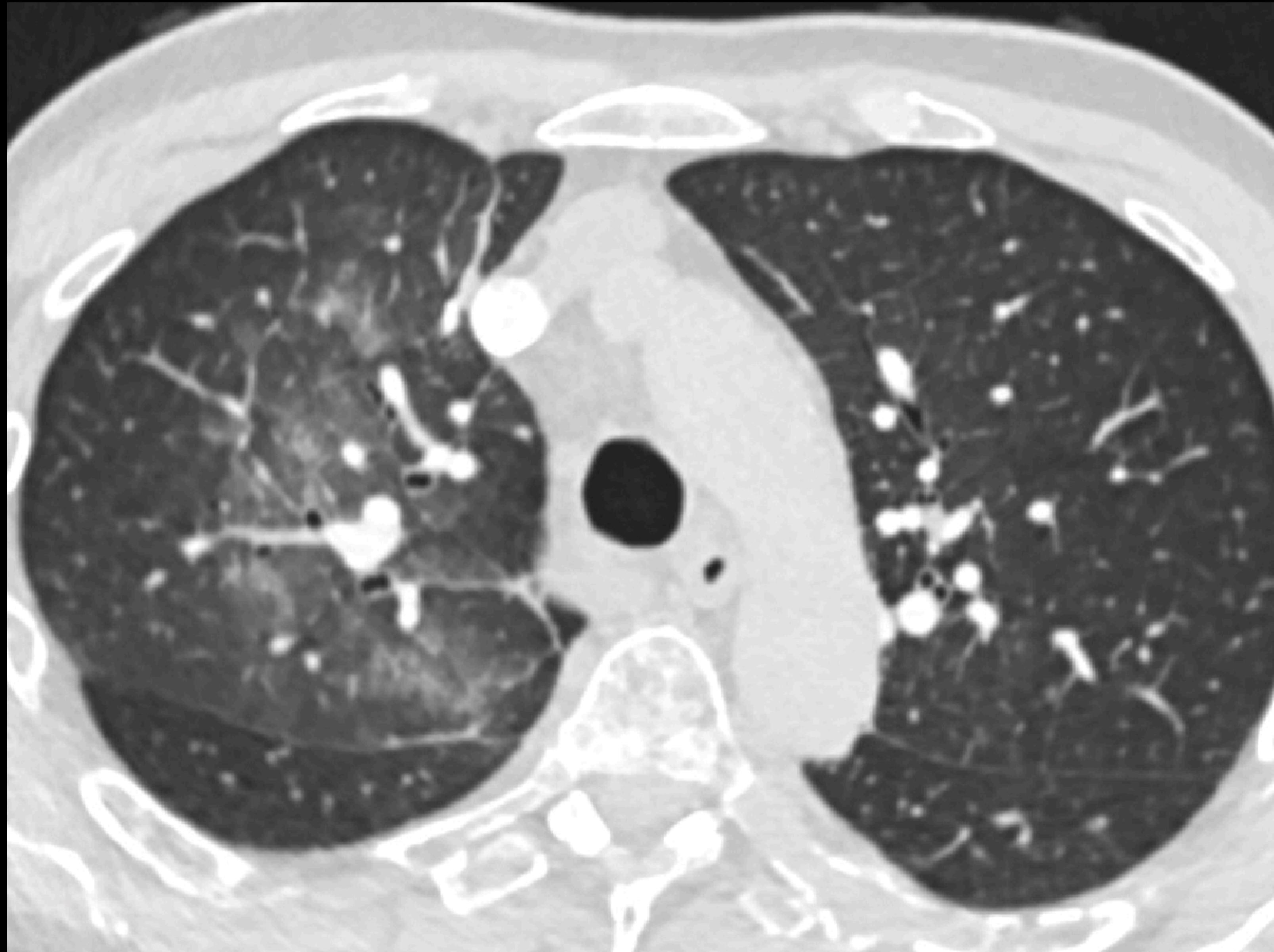
Unilateral ground-glass opacities with pleural contact at the major fissure.

CO-RADS 4
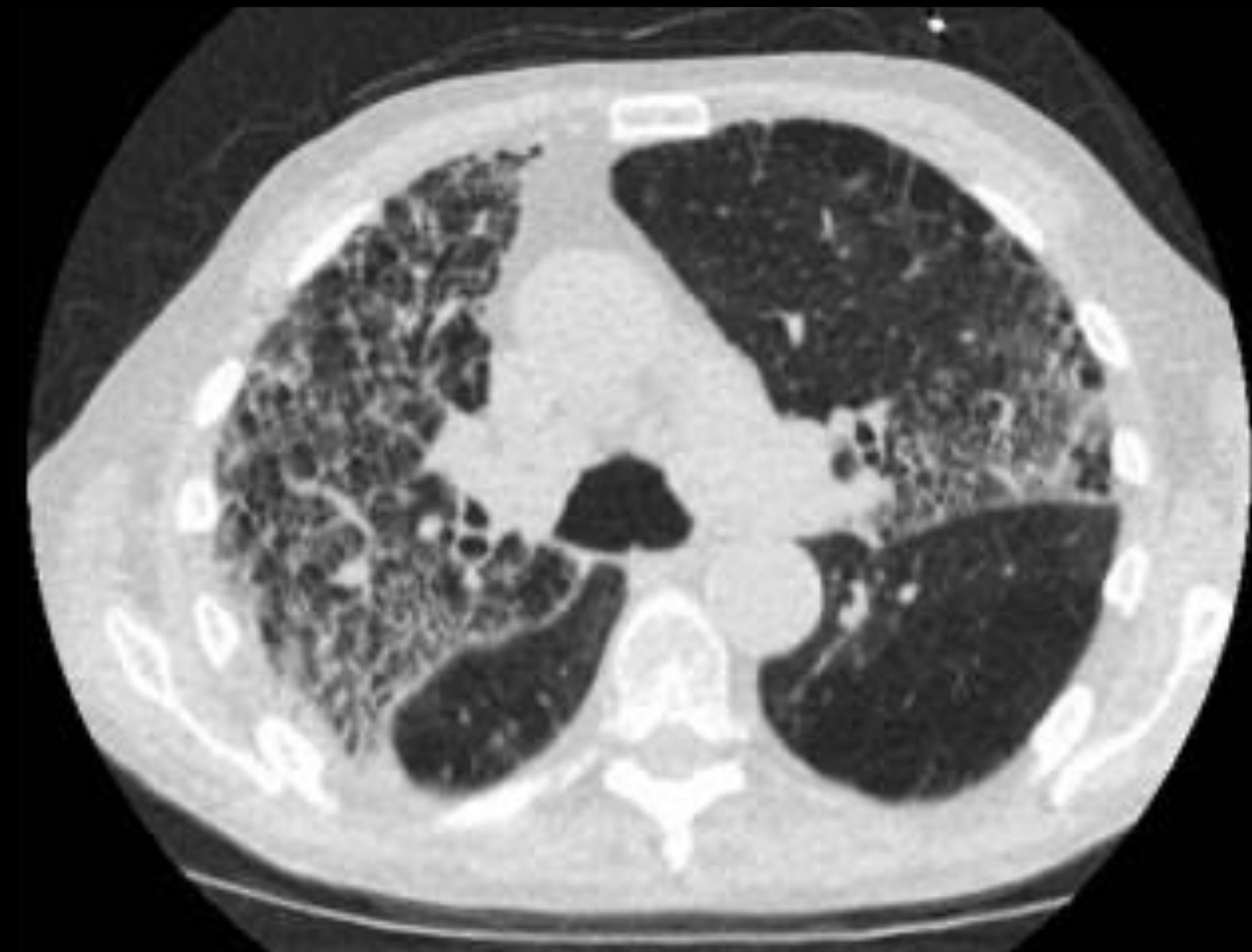
Ground-glass superimposed on severe emphysema, visceral pleural contact, unsharply demarcated. (rt-PCR positive)

CO-RADS 4

CO-RADS 5

- Level of suspicion: Very high

- Findings typical for pulmonary involvement of COVID-19

- Findings have to be new or increased

- Both mandatory features and at least one confirmatory pattern should be present

| **Mandatory features:**	**Confirmatory patterns:**
Ground-glass with or without consolidations close to visceral pleural surfaces, including fissures AND **Multifocal bilateral**	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 • Ground glass with or without consolidation in an arching, tethered pattern with small connections to the pleura **Thickened vessels** within abnormalities

Multifocal bilateral subpleural ground-glass opacities, some with subpleural sparing.

CO-RADS 5
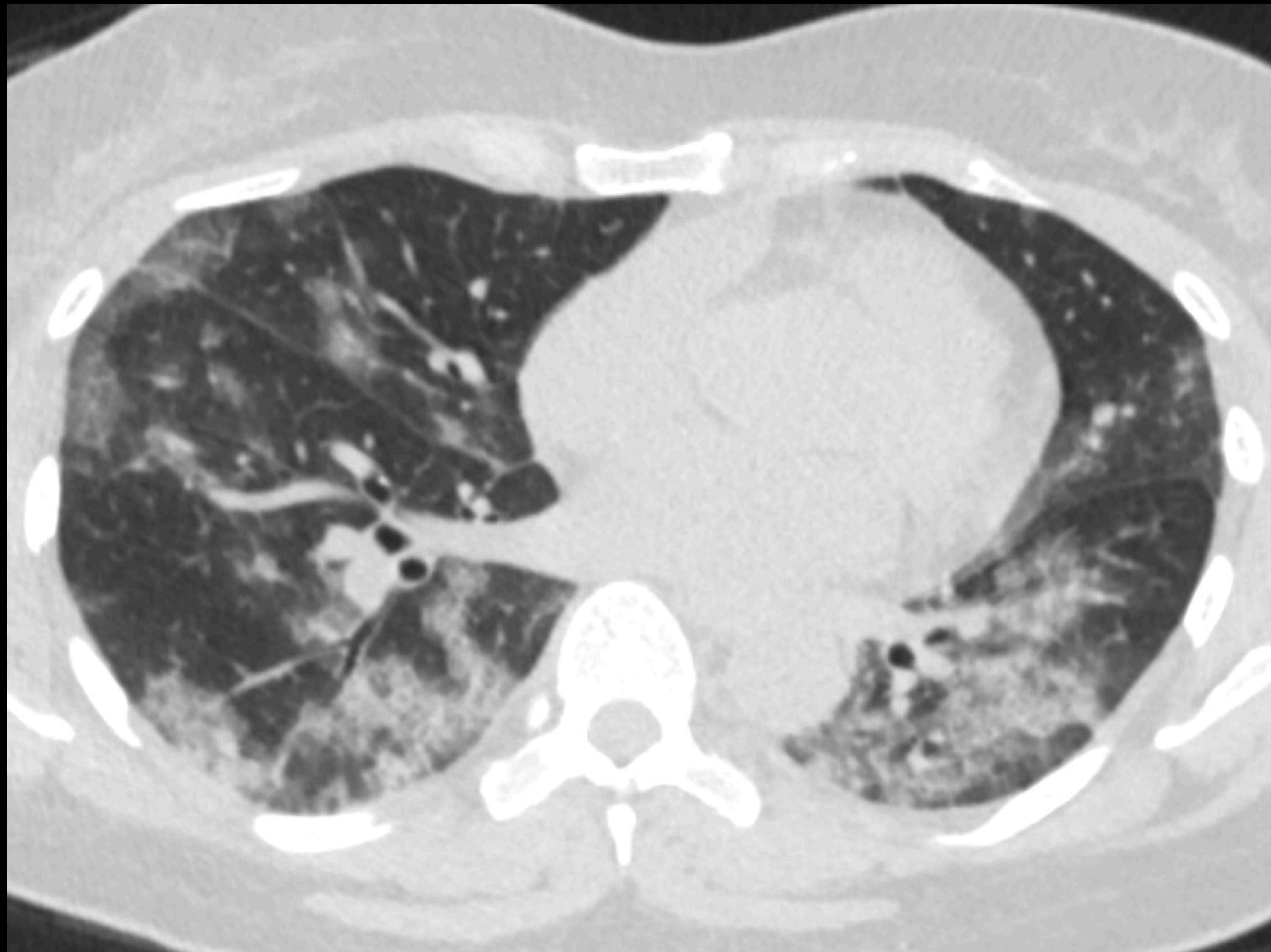
Bilateral multifocal ground-glass opacities and consolidation.

CO-RADS 5

Bilateral multifocal ground-glass opacities with crazy paving.

CO-RADS 5

Extensive bilateral ground-glass opacities with sharp demarcation and sparing of adjacent secondary pulmonary lobules (arrow) and vascular thickening (circle)

CO-RADS 5
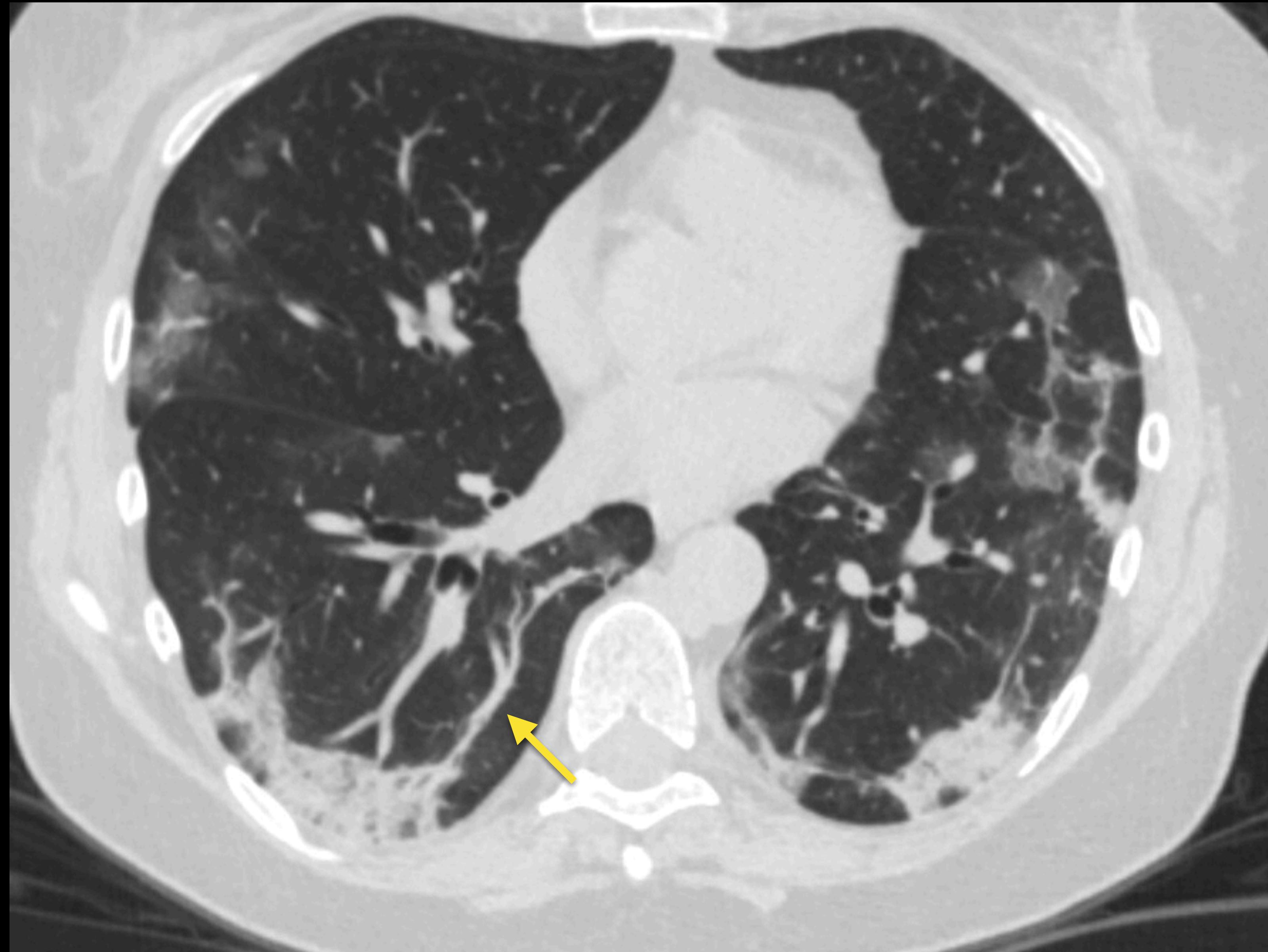
Bilateral multifocal ground-glass opacities, consolidation and subpleural curvilinear bands (arrow).

CO-RADS 5
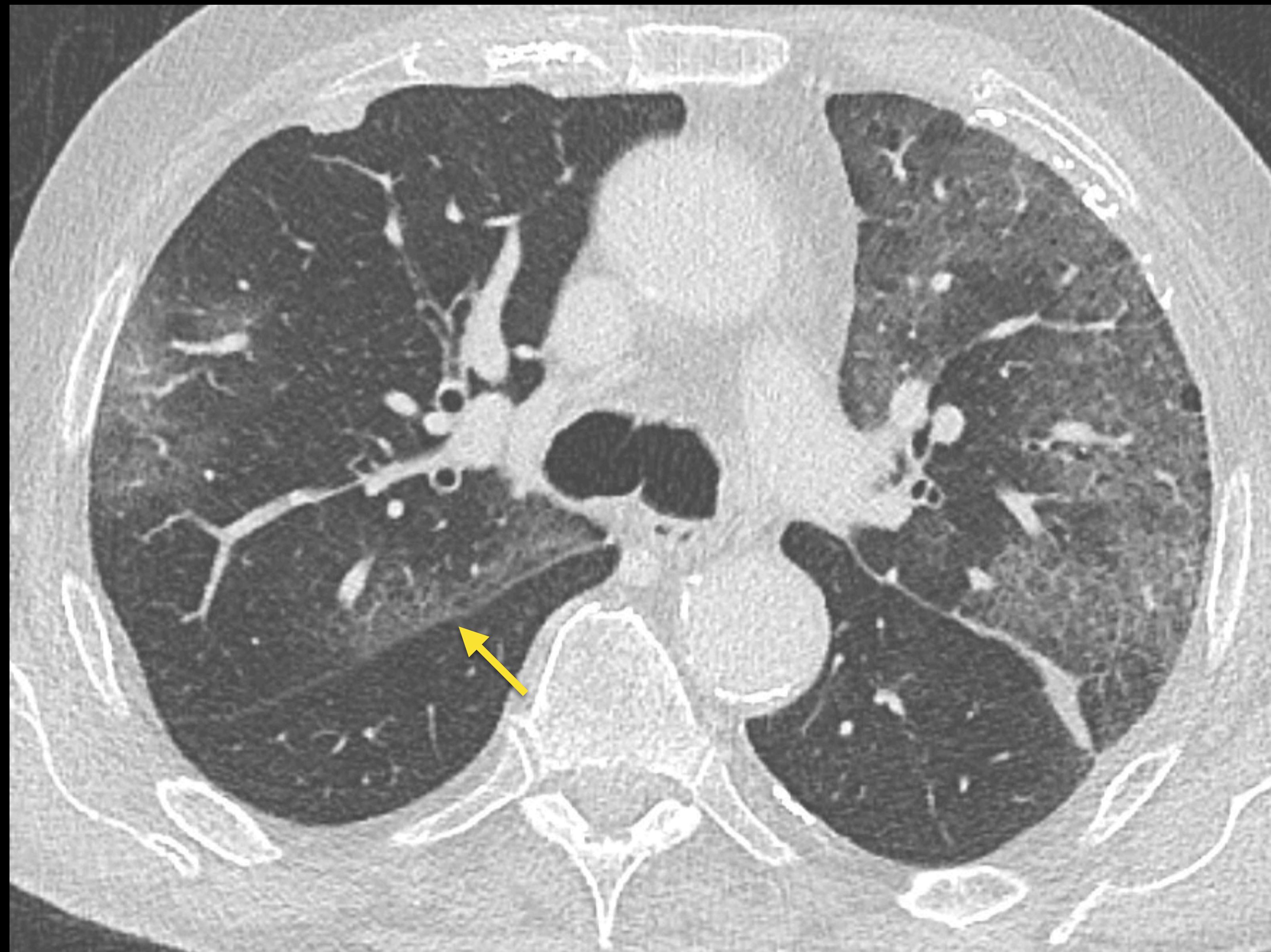
Multifocal bilateral ground-glass opacities, on the right with broadbased contact with the major fissure (arrow).

CO-RADS 5
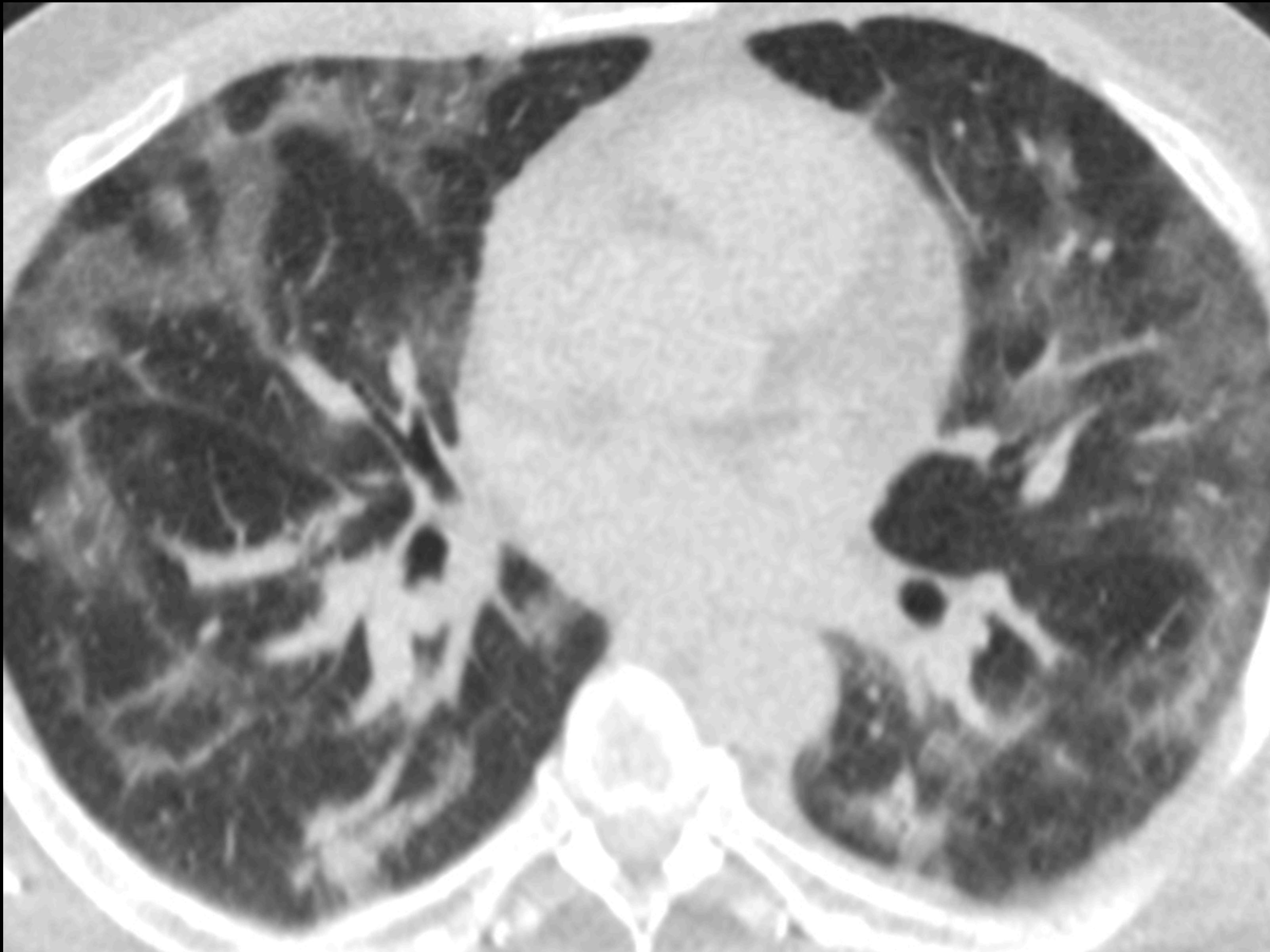
Multifocal bilateral subpleural ground-glass opacities.
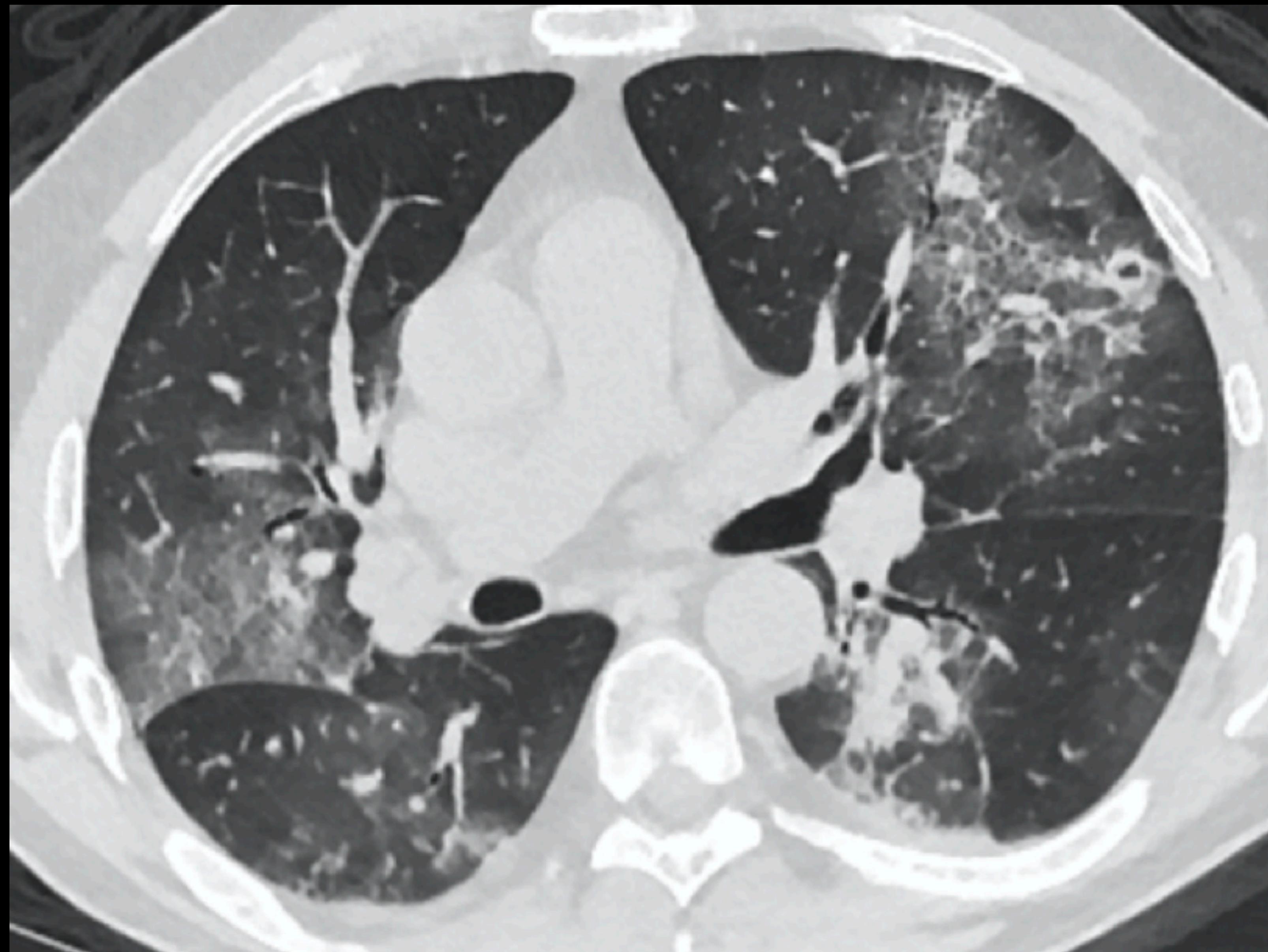
CO-RADS 5

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

CO-RADS 6

- RT-PCR SARS-CoV-2 positive test

- Any pulmonary findings

CT SEVERITY SCORE (CTSS)

- Estimates the extent of lung involvement due to potential COVID-19

- Several methods published - no consensus which to use for COVID-19

- Only in case of CO-RADS categories 3 to 5

- Easy for follow up

- Possible use as part of clinical decision tree for hospitalisation/expected need of care in the future.

CTSS

- CT Severity Score per lobe:

  - 0 % — 0 points

  - 1-5 % — 1 point

  - 5-25 % — 2 points

  - 25-50 % — 3 points

  - 50-75 % — 4 points

  - > 75 % — 5 points

RUL
ML
RLL
LUL
LLL

Max. 25 points

Chang YC. Pulmonary sequelae in convalescent patients after severe acute respiratory syndrome: evaluation with thin-section CT. Radiology 2005;236(3):1067-75
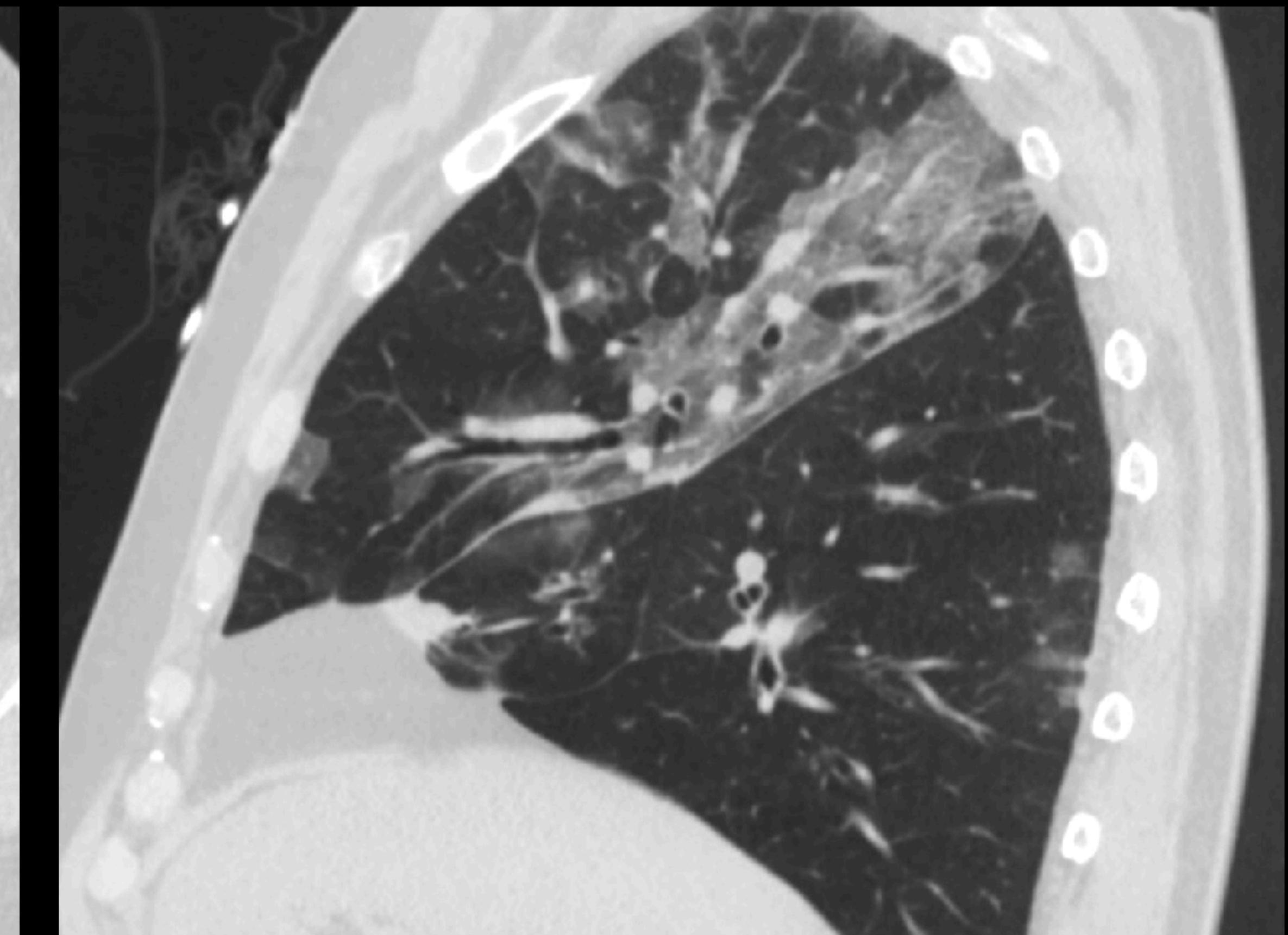
CTSS

A combined axial / sagittal view makes estimation of extent of the abnormalities more easy

Patterns

Work in progress
Not yet part of the reporting template

- Initial   1-4 days   GGO

- Progressive   5-8 days   Crazy Paving + ↑ CTSS

- Peak   10-13 days   Consolidation + ↑ CTSS

- Absorption   >14 days   Resolving crazy paving
                                      OP-pattern
                                      ↓ CTSS

Pan et al., "Time Course of Lung Changes On Chest CT During Recovery From 2019 Novel Coronavirus (COVID-19) Pneumonia." PMID: 32053470

Blanco CT Thorax
COVID Standaardverslagitems.

In bold items die het meest belangrijk zijn.
Dit standaardverslag is zelf om te bouwen naar het voor het ziekenhuis gebruikelijke en meest makkelijke format. De items zijn nu genummerd, met uitleg in de kopjes eronder.

1. Aard van klachten: ***
   Duur van klachten: *** dagen

2. **CO-RADS: ***

3. **CT Severity Score: ***

4. **Pleuravocht *** Pericardvocht *** Vergrote lymfeklieren:**

5. Relevante nevenbevindingen: ***

Conclusie:
*** CT Thorax.
CO-RADS *
CT Severity Score: *
Relevante co-morbiditeit: ***

6. Disclaimer ***

Uitleg en voetnoten:
1. Bepaalt de a priori-kans op COVID-19 en het te verwachten stadium van de ziekte. Doordring aanvragers van het belang van volledigheid van klinische gegevens voor toetsen CT-bevindingen aan de klinisch context.

2. CO-RADS: doet o.b.v. CT kenmerken an sich een uitspraak hoe hoog de verdenking op COVID-19 is.
   Mate van verdenking COVID -19:
   CO-RADS 0: Niet interpreteerbaar.
   CO-RADS 1: Zeer laag
   CO-RADS 2: Laag
   CO-RADS 3: Onzeker
   CO-RADS 4: Hoog
   CO-RADS 5: Zeer hoog
   CO-RADS 6: RT-PCR SARS-CoV-2 positief

3. CT Severity Score - bepaalt de uitgebreidheid van de ziekte. Mogelijk geeft de mate van aangedaan parenchym een indicatie voor ernst/ verloop van de infectie en kan deze gebruikt worden voor follow-up. Alleen noemen bij CO-RADS 3-6.
Kwantitatieve score - % aangedaan longparenchym per kwab waarvan wordt verondersteld dat deze door COVID-19 wordt veroorzaakt. Bij status na lobectomie is nog geen consensus over hoe de score over de resterende longkwabben gescoord moet worden.

Per kwab aangedaan (%) – max. 25 punten.

0%:	0 punten	RBK:
<5%:	1 punt	MK:
5-25%:	2 punten	ROK:
25-50%:	3 punten	LBK:
50-75%:	4 punten	LOK:
>75%:	5 punten	Totaal CT Score:

4. Bespreekt het longbeeld, de kans op COVID-19 en de differentiaaldiagnose.
CT kan bij COVID-19 negatief zijn in de eerste dagen na het ontstaan van symptomen.
CO-RADS 5 lijkt een zeer sterk positief voorspellende waarde te hebben voor aanwezigheid COVID-19 bij een hoge a priori-kans.
CO-RADS 1 heeft mogelijk een hoge negatief voorspellende waarde bij klachten > 4 dagen en een hoge a priori-kans.
De interobserver variatie CORADS 2-4 is hoger te zijn dan voor CO-RADS 1 en 5 en heeft waarschijnlijk een slechtere negatief of positief voorspellende waarde dan CO-RADS 1 en 5. Dit kan als disclaimer onder het verslag gezet worden.

Items die ter ondersteuning van CO-RADS interpretatie genoemd kunnen worden: Consolidaties, matglas, distributie, scherpe/ onscherpe begrenzing, crazy-paving, luchtbronchogrammen, lokaal verdikte vasculatuur, spider-web sign, (reversed) halo sign. Alternatief, kenmerken die de aanwezigheid van COVID-19 ontkrachten zijn tree-in-bud, lobaire pneumonie, cavitatie, calcificatie, pleurale verbreding, massa, brochuswandverdikking.
Kan een rol is spelen in het bepalen van het stadium van de ziekte. Het indelen in stadia analoog aan Pan et al., Radiology is work-in-progress. Dit wordt nu niet (meer) in het standaardverslag toegepast.

5. Bepaalt de co-morbiditeit, in het bijzonder emfyseem, fibrose, coronaire ziekte, tumoren, metastasen, ander onderliggend longlijden. Aanvullende relevante pathologie abdominaal en ossaal.

6. Kan de lezer waarschuwen voor foutnegatieve CT in de eerste dagen na presentatie klachten en kan gebruikt worden om te noemen dat de CO-RADS geïnterpreteerd moet worden met klinische gegevens, om te beoordelen of de patiënt COVID-19 zou kunnen hebben.

CT chest - non-contrast.
COVID-19 Reporting template.

1. Symptoms: ***
   Duration: *** days

2. **CO-RADS: ***

3. CT Severity Score: ***

4. Pleural effusion *** Pericardial effusion *** Enlarged lymph nodes:**

5. Other relevant findings : ***

Impression/conclusion:
*** Chest CT.
CO-RADS *
CT Severity Score: ***
Relevant co-morbidity: ***

6. Disclaimer ***