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## Cystic airspaces associated with COVID-19 pneumonia

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Sir,

We retrospectively reviewed chest computed tomography (CT) images of 43 adult nonsmoking patients with COVID-19-related pneumonia. All patients' COVID-19 diagnoses were confirmed by positive results of reverse-transcriptase polymerase chain reaction assays of specimens collected on nasopharyngeal swabs. The patients underwent chest CT in March/April 2020 at a private hospital in Rio de Janeiro, Brazil, at a median of 7 (range, 3–13) days after symptom onset. No patient

was on mechanical ventilation at the time of the CT examination. Our Institutional Review Board approved the study, and all patients provided written informed consent.

Although several reports have described CT features of COVID-19-related pneumonia, few have highlighted the presence of cystic changes,<sup>[1-4]</sup> manifesting as small air-containing spaces associated with other findings in the lung parenchyma. Cystic airspaces associated with COVID-19-related pneumonia have been described as the air bubble sign,<sup>[1]</sup> vacuoles,<sup>[2]</sup> round cystic changes,<sup>[3]</sup>

and the cavity sign.<sup>[4]</sup> All reports on them describe their intermingling with areas of lung parenchyma infiltrates.

We observed small cystic airspaces in the subpleural region and along the peribronchovascular interstitium in infiltrated lung areas in our series [Figure 1]. Thirteen (30.2%) patients presented cystic changes; five (11.6%) patients had cystic airspaces only in the subpleural region and along the peribronchovascular interstitium, and eight (18.6%) patients had cystic airspaces admixed with areas of opacity in the lung parenchyma. Most air-containing spaces had diameters <5 mm, and these spaces were distributed predominantly in the lower lobes.

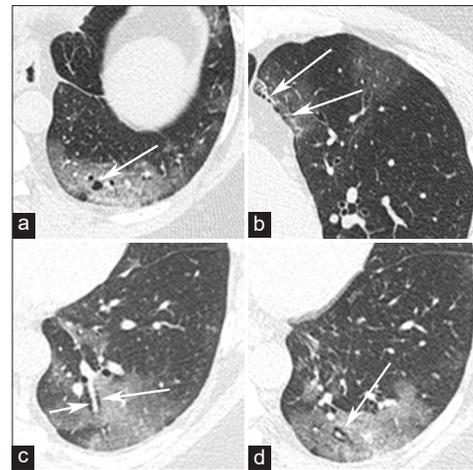
The pathophysiology of these cystic airspaces in areas of infiltrates remains unclear. Shi *et al.*<sup>[3]</sup> suggested that they can be explained by infection-generated damage to the alveolar walls, which leads to pneumatoceles. Ye *et al.*<sup>[1]</sup> hypothesized that they are related to physiological space dilation, are cross-sections of bronchiolectasis, or are associated with consolidation resorption. Zhou *et al.*<sup>[2]</sup> observed cystic airspaces (which they referred to as vacuolar signs) often in the advanced phase of COVID-19 pneumonia (8–14 days after symptom onset), associated with interstitial involvement and accompanied by repair changes. Other authors<sup>[5,6]</sup> have described the development of bulla or emphysema in consolidation areas. We assume that the cystic airspaces may be related to small bulla or emphysema.

Cystic airspaces associated with areas of opacity have not been described often in association with other viral infections. Thus, their presence in areas of infiltrates in association with other features of COVID-19 pneumonia may increase the specificity of the diagnosis in patients for whom confirmatory testing has not been performed. In addition, the rupture of cysts, although rare, may cause spontaneous pneumothorax and/or pneumomediastinum.

In conclusion, air-containing spaces in the lungs are not uncommon CT features of COVID-19–related pneumonia. They may occur in the subpleural region and along the peribronchovascular interstitium in areas of infiltrates. Radiologists should be aware that these cystic changes may be present in association with other features suggestive of COVID-19-related pneumonia. Inappropriate epidemiological and clinical settings, these findings may aid diagnosis.

#### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.



**Figure 1:** (a) Axial computed tomography image showing a small, round air-containing area (arrow) within ground-glass opacities in the posterior basal segment of the left lower lobe in a 56-year-old male with COVID-19 pneumonia. (b) Axial computed tomography image showing mild peripheral ground-glass opacities in the left upper lobe of a 64-year-old male with COVID-19 pneumonia. Small subpleural cystic airspaces (arrows) are also present. (c and d) Axial computed tomography images showing ground-glass opacities in the left lower lobe of a 48-year-old male with COVID-19 pneumonia. Note also the presence of tiny cystic airspaces (arrows) along the peribronchovascular interstitium

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#### Conflicts of interest

There are no conflicts of interest.

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