

Some Chest Imaging Findings in COVID-19

Kunal Som, Rudrajit Paul**, Dipanjan Bandyopadhyay****

The COVID-19 pandemic has changed the rhythm of human life all over the planet. This respiratory virus causes sudden, rapidly progressive pneumonia, leading to acute lung injury, along with other systemic manifestations. Chest imaging findings, or more specifically high resolution CT scan (HRCT) of the chest, gives significant insights into the pathophysiology and pathology of the infection. RT-PCR is the gold standard for the diagnosis of COVID-19. But there are many shortcomings of the test, including faulty sample collection (which can give false negative results), cost and delay in getting the results. CT scan, on the other hand, is a quick imaging modality (taking less than 5 minutes) and is quite sensitive in picking up early pulmonary changes of COVID-19¹. Thus, in cases where the RT-PCR test is inaccessible, HRCT of the thorax can be a valuable tool for diagnosis. In fact, in some countries, early CT scan of the thorax is proposed as a viable diagnostic test for COVID-19 infection in the proper epidemiological setting².

This pictorial essay is aimed to sensitize clinicians in India about the common CT findings of the lung in COVID-19. This will help the internist in suspecting a diagnosis of COVID-19 even before the RT-PCR report is available and thus, proper treatment may be started.

Scientific publications over the last ten months have documented a variety of radiological findings in the COVID-19 lung.

Ground-glass opacity (GGO): Fig. 1

GGO is defined as hazy areas in the parenchyma through which underlying vascular structures can be seen¹. GGO is the most commonly described radiological abnormality in the COVID-19 lung³. This was found to be present at an early stage (2 - 3 days), is usually peripheral and multi-lobar.

Consolidation: Fig. 2

Consolidation, the complete replacement of alveolar air with fluids/cells/exudate, is not specific for COVID-19. Radiologically, this is seen as opaque shadows which obscure the underlying vascular structures or septal lines completely. In COVID-19, especially in the late stages, the consolidation tends to be multi-lobar or segmental with

peripheral distribution⁴. This is more common in the elderly. Consolidation may progress for up to 2 weeks after disease onset⁵. Areas of GGO and consolidation may overlap.

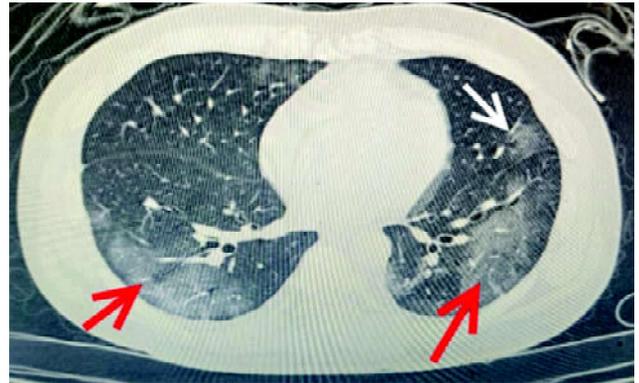


Fig. 1: Ground glass opacity in both posterior lobes (red arrow) and left middle lobe (white arrow).

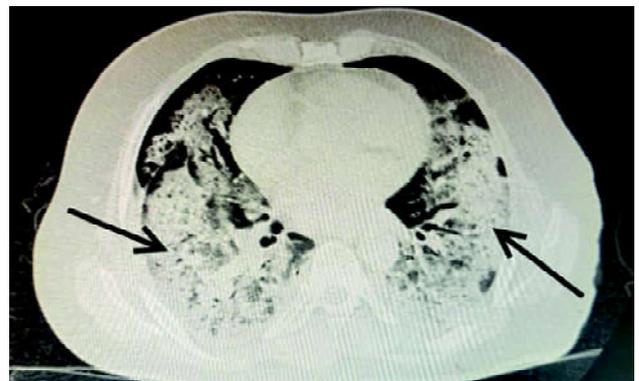


Fig. 2: CT Massive multi-lobar consolidation (black arrows) with air bronchogram.

Air bubble sign: Fig. 3

This is a new radiological sign described in the COVID-19 lung. It is an air-filled space surrounded by areas of consolidation or GGO. Different authors have called this "cystic changes", "vacuolar sign", "cavity sign" or "sieve-hole sign". Its exact pathophysiology is unclear as of now; the "air bubbles" are thought to be areas of resolved consolidation or pathological dilatation of airspaces⁶. This is a comparatively rare finding in COVID-19 lung.

Associate Consultant, Desun Hospital, Kolkata, **Consultant Physician, Ruby General Hospital, Kolkata - 107, *Professor and HOD, Department of Medicine, North Bengal Medical College, Kolkata.*

Corresponding Author: Dr Rudrajit Paul, Consultant Physician, Department of Medicine, Ruby General Hospital, Anandapur, Kolkata - 700 107. Phone: 9433824341, E-mail: r.paul.medicalcollege@gmail.com.

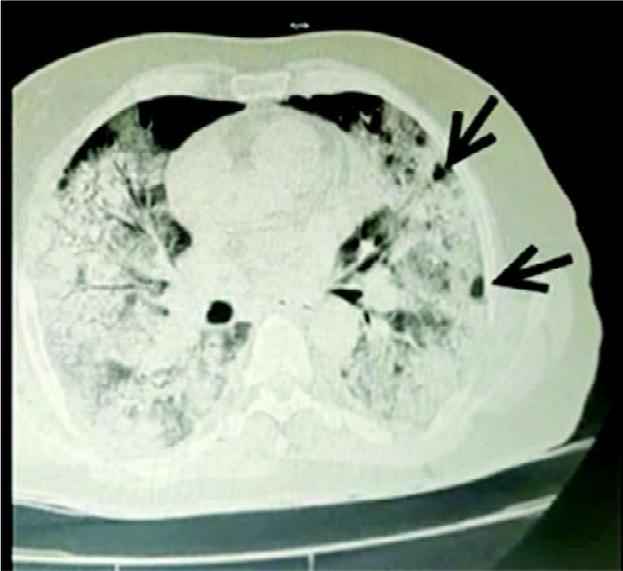


Fig. 3: Bilateral consolidation with air bubble sign (black arrows).

Reticular patterns: Fig. 4

Reticular pattern is defined as thickened lung septa giving rise to multiple closely spaced lines in the parenchyma image¹. There are many causes of reticular pattern in lung imaging, but in cases of COVID-19, this pattern is thought to be due to lymphocytic infiltration of interlobar septa. This imaging appearance may be found in the later stages of the disease^{6,7}. The prevalence of this radiological finding varies in different studies, but some studies have found rates as high as 80%⁶.



Fig. 4: Reticular pattern (black arrow) in left lingular lobe with areas of rounded consolidation (green arrows) in both lungs.

Spider web sign: Fig. 5

This is a comparatively rare sign, described only in a handful of publications^{8,9}. It is provisionally defined as

angular or triangular shaped peripheral GGO with septal thickening, giving the appearance of a spider web lung with web-strings. Li *et al* described this finding in a substantial number of their patients⁹. However, other authors have not described this imaging appearance separately. This finding has not been described from India till now.

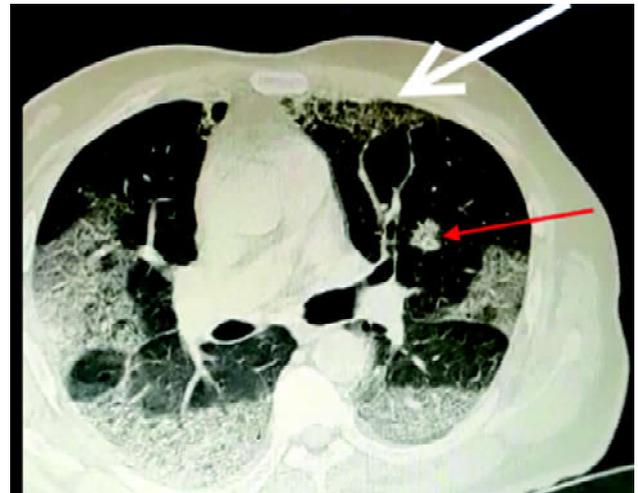


Fig. 5: Spider web sign in left lung (white arrow). Incidentally seen: nodule (red arrow) in left lung.

Nodule: Fig. 6; also see Fig. 5

Nodules are small (< 3 cm) opacities in the lung parenchyma. These are not specific for COVID-19 infection and are found in a variety of other infections too. Some authors have also documented a *halo sign* associated with lung nodules in COVID-19⁹. However, these are rare findings. In general, any viral pneumonia may be associated with lung nodules¹⁰.

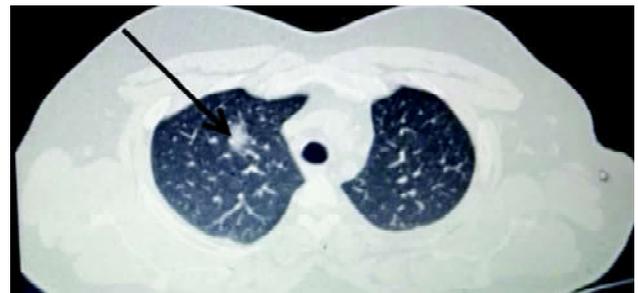


Fig. 6: A lung nodule in right upper lobe (black arrow).

Reverse Halo sign: Fig. 7

Reverse Halo sign or the Atoll sign is a GGO surrounded by consolidation. This was earlier thought to be a radiological sign linked to cryptogenic organising pneumonia¹¹. But now, many cases of COVID-19 with Atoll sign have been

reported¹². This may represent progressive disease where a patch of GGO is replaced with consolidation from the periphery.



Fig. 7: Reverse Halo sign in left lung (black arrow).

There are many other HRCT findings in COVID-19 patients, some of which are demonstrated in Fig. 8.

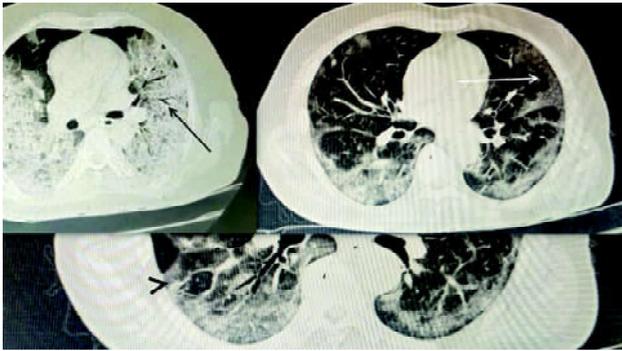


Fig. 8: Some non-specific CT findings of COVID-19: air bronchogram (black arrow), peripheral based infiltrations (white arrow) and crazy paving appearance (black arrowhead) (GGO with superimposed thickened septal lines).

These images are presented here to sensitize clinicians to the various HRCT appearances during this pandemic. Even in the absence of an RT-PCR report, these imaging findings,

in conjunction with proper clinical presentation, can be diagnostic of COVID-19 infection.

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References

1. Ye Z, Zhang Y, Wang Y *et al*. Chest CT manifestations of new coronavirus disease 2019 (COVID-19): a pictorial review. *Euro Radiolo* 2020; 30: 4381-9.
2. National Health Commission of the People's Republic of China (2020). The diagnostic and treatment protocol of COVID-19. China. Available via http://www.gov.cn/zhengce/zhengceku/2020-02/19/content_5480948.htm [Accessed 09 Nov 2020].
3. Chung M, Bernheim A, Mei X *et al*. CT Imaging Features of 2019 Novel Coronavirus (2019-nCoV). *Radiology* 2020; 295: 202-7.
4. Bernheim A, Mei X, Huang M *et al*. Chest CT Findings in Coronavirus Disease-19 (COVID-19): Relationship to Duration of Infection. *Radiology* 2020; 295: 685-91.
5. Pan F, Ye T, Sun P *et al*. Time Course of Lung Changes at Chest CT during Recovery from Coronavirus Disease 2019 (COVID-19). *Radiology* 2020; 295: 715-21.
6. Ufuk F, Savas R. Chest CT features of the novel coronavirus disease (COVID-19). *Turk J Med Sci* 2020; 50 (4): 664-78.
7. Pan Y, Guan H, Zhou S. Initial CT findings and temporal changes in patients with the novel coronavirus pneumonia (2019-nCoV): a study of 63 patients in Wuhan, China. *Euro Radiolo* 2020; 10 [Online first].
8. Wu J, Wu X, Zeng W, Guo D, Fang Z. Chest CT findings in patients with corona virus disease 2019 and its relationship with clinical features. *Investigative Radiolo* 2020; 55: 257.
9. Li K, Wu J, Wu F *et al*. The clinical and chest CT features associated with severe and critical COVID-19 pneumonia. *Investigative Radiolo* 2020; 10: [online first].
10. Franquet T. Imaging of pulmonary viral pneumonia. *Radiology* 2011; 260: 18-39.
11. Hansell DM, Bankier AA, MacMahon H *et al*. Fleischner Society: glossary of terms for thoracic imaging. *Radiology* 2008; 246: 697-722.
12. Yoon SH, Lee KH, Kim JY *et al*. Chest Radiographic and CT Findings of the 2019 Novel Coronavirus Disease (COVID-19): Analysis of Nine Patients Treated in Korea. *Korean J Radiol* 2020; 21: 494-500.