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Cardiothoracic Imaging

Single, unilateral halo sign in COVID-19 pneumonia

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We read with great interest the article by McLaren et al., recently published in *Clinical Imaging*.¹ We agree on the importance of describing atypical CT findings in COVID-19 to better and more comprehensively understand this newly emerged disease and on the effort of correlating pathologic alterations (as diffuse alveolar damage, organizing pneumonia, microthrombi and hemorrhagic infarcts) with CT findings. We think CT could be a useful tool to enlighten its pathophysiology through the study of the abnormalities that we can observe with High Resolution Chest CT (HRCT) at a very high anatomical detail.

McLaren et al. described the bullseye sign, a variant of the reverse halo sign, as an atypical manifestation of COVID-19 pneumonia. Similarly, Poerio et al.² described a combination of multiple and bilateral halo sign, reverse halo sign and double halo sign as main CT findings in a 55 year-old woman with COVID-19. Both authors explained these atypical findings as manifestations of organizing pneumonia (reverse halo sign) and extensive thrombotic damage of pulmonary microcirculation (halo sign and double halo sign).

At our center, a reference hospital for COVID-19 in Northern Italy, we collected a large series of chest X-ray and CT in symptomatic patients with suspicion and/or confirmation of SARS-CoV-2 infection. Among these, we believe it could be useful to describe the case of a 42 year-old male nurse presented with a 2 days history of arthromyalgia and an isolated episode of fever up to 38 °C (100.4 °F). At admission, laboratory studies showed leucopenia and elevated C-reactive protein (15.2 mg/L); a positive rapid antigen test confirmed SARS-CoV-2 infection. Chest x-ray showed no alterations, whereas a chest CT showed, as single finding, a rounded consolidation surrounded by ground-glass opacity (halo sign) in the left lower lobe (Fig. 1). The patient was then discharged to quarantine at home.

Asymptomatic or paucisymptomatic COVID-19 patients might have normal chest CT³; in case of lung abnormalities, CT findings are frequently unilateral (58.6%).⁴ Moreover, Shi et al. reported that the predominant pattern in early stages is characterized by unilateral, although multifocal GGO.⁵ To the best of our knowledge, a single focal halo-sign lesion has never been described before as manifestation of COVID-19 pneumonia. Halo sign has rather been observed, in the

context of more typical CT findings, as multiple and bilateral lesions, sometimes associated with reverse CT halo sign.⁶

Halo-sign is non-specific and histopathologically usually represents alveolar edema and hemorrhage.⁷ Although different from the bullseye sign, the lesion we presented showed connection to the vascular system too, as suggested from a pulmonary vein branch reaching it. Thus, it is likely that in SARS-Cov-2 infection halo sign represent a consequence of thrombotic damage of pulmonary microcirculation.

In conclusion, we believe that radiologists should know the atypical CT findings of COVID-19 pneumonia as well as the typical ones. In the setting of asymptomatic patients and in case of short time between symptom onset and hospital admission, the presence of unilateral single halo-sign should alert to the possibility of COVID-19 pneumonia.

Conflict of interest

No conflict of interest or industry support for the two authors.

References

- [1] McLaren TA, Gruden JF, Green DB. The Bullseye sign: a variant of the reverse halo sign in COVID-19 pneumonia. *Clin Imaging* 2020;68:191–6. <https://doi.org/10.1016/j.clinimag.2020.07.024>.
- [2] Poerio A, Sartoni M, Lazzari G, et al. Halo, reversed halo, or both? Atypical computed tomography manifestations of coronavirus disease (COVID-19) pneumonia: the “double halo sign”. *Korean J Radiol* 2020;21(10):1161–4. <https://doi.org/10.3348/kjr.2020.0687>.
- [3] Kwee TC, Kwee RM. Chest CT in COVID-19: what the radiologist needs to know. *RadioGraphics* 2020;40(7):1848–65. <https://doi.org/10.1148/rg.2020200159>.
- [4] Heng M, Xiong R, He R, et al. CT imaging and clinical course of asymptomatic cases with COVID-19 pneumonia at admission in Wuhan, China. *J Infect* 2020;81:e33–9. <https://doi.org/10.1016/j.jinf.2020.04.004>.
- [5] Shi H, Han X, Jiang N, et al. Radiological findings from 81 patients with COVID-19 pneumonia in Wuhan, China: a descriptive study. *Lancet Infect Dis* 2020;20(4):425e34. [https://doi.org/10.1016/S1473-3099\(20\)30086-4](https://doi.org/10.1016/S1473-3099(20)30086-4).
- [6] Shaghghi S, Daskareh M, Irannejad M, et al. Target-shaped combined halo and reversed-halo sign, an atypical chest CT finding in COVID-19. *Clin Imaging* 2020;69:72–4. <https://doi.org/10.1016/j.clinimag.2020.06.038>.
- [7] Pinto PS. The CT halo sign. *Radiology* 2004;230:109–10.

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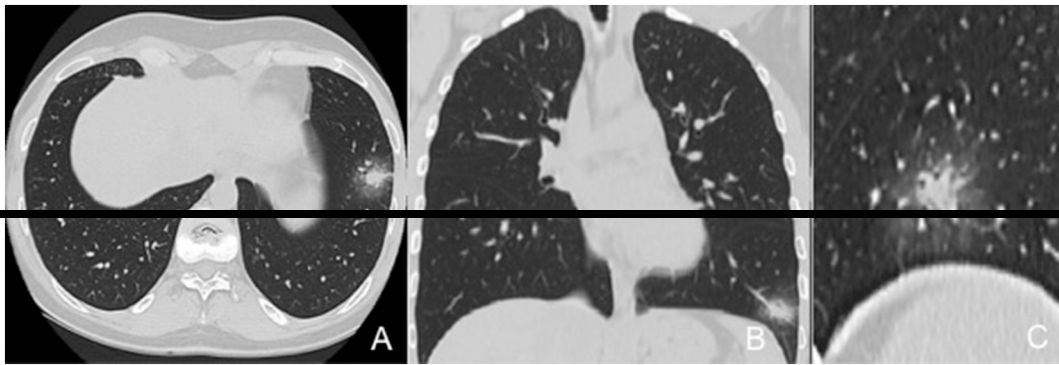


Fig. 1. Axial-2D (A), coronal-2D (B) and sagittal-2D (C) chest CT images show a left lower lobe single rounded consolidation surrounded by well-defined ground-glass opacity (halo sign). A distal pulmonary vein branch reaching the lesion is shown in B.