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Case Report

Simultaneous presence of the “bullseye” and “reversed halo” sign at CT of COVID-19 pneumonia: A case report

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ABSTRACT

The “bullseye” sign has been exclusively reported in patients suffering from coronavirus disease 2019 (COVID-19) pneumonia. It is theorized that this newly recognized computed tomography (CT) feature represents a sign of organizing pneumonia. Well established signs of organizing pneumonia also reported in COVID-19 patients include linear opacities, the “reversed halo” sign (or “atoll” sign), and a perilobular distribution of abnormalities. These findings are usually present on imaging in the intermediate and late stage of the disease. This is a case of simultaneous presence of the “bullseye” and the “reversed halo” sign on chest CT images of a COVID-19 patient examined 22 days after symptom onset.

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Abbreviations: COVID-19, coronavirus disease 2019; GGO, ground glass opacity; RT-PCR, reverse transcription polymerase chain reaction; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

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Introduction

Since the detection and isolation of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Wuhan, China, in December 2019, chest computed tomography (CT) plays an important role in the diagnosis of patients with Coronavirus disease 2019 (COVID-19) [1,2]. Several CT features specific for COVID-19 pneumonia have been described [3–8]. Signs of organizing pneumonia have been reported to present in the intermediate and late phase of COVID-19 pneumonia [3,9]. A rare CT finding, referred to as the “bullseye” sign, is also considered to represent a sign of organizing pneumonia [10,11]. We report a case of a COVID-19 patient with a chest CT scan demonstrating the “bullseye” and the “reversed halo” sign in both lungs simultaneously.

Case presentation

A 76-year-old male presented to the emergency department with a main symptom of progressive dyspnoea during the past 21 days. Accompanying symptoms were dry cough and mild fever with 37.5°C being the highest body temperature measured. The first positive reverse transcription polymerase

chain reaction (RT-PCR) test for SARS-CoV-2 was acquired 3 days prior to the hospital admission. The past medical history of the patient included arterial hypertension, severe coronary artery disease, left bundle branch block, paroxysmal atrial fibrillation, hypercholesterolemia, and asthma. The patient was a 20 pack-years former smoker with cessation 14 years before. On admission the patient’s oxygen saturation as measured by pulse oximetry (SpO₂) was 92% while receiving 3 L/min oxygen by nasal cannula and his body temperature was 37.8°C. The chest auscultation revealed normal vesicular breath sounds and the chest percussion a normal resonant note. The laboratory tests showed elevated CRP of 233 mg/L (reference range: <5 mg/L), lymphocytopenia with a total lymphocyte count of 0.59/nL (reference range: 1.0–4.8/nL), elevated procalcitonin of 0.50 (reference range: <0.05 ng/mL) and elevated D-dimer of 1.3 mg/L (reference range: <0.5 mg/mL).

On hospital day 1, 22 days after symptom onset, the patient underwent a non-contrast-enhanced chest CT. Extended ground glass opacity (GGO) represented the main pathologic finding and were accompanied by areas demonstrating the crazy paving pattern [12]. The findings showed a predilection for the upper lung zones. Enlargement of segmental and subsegmental pulmonary arteries was observed in areas of pulmonary abnormalities, as previously described in COVID-19 pneumonia [4,5] (Fig. 1). A target shaped lesion with a

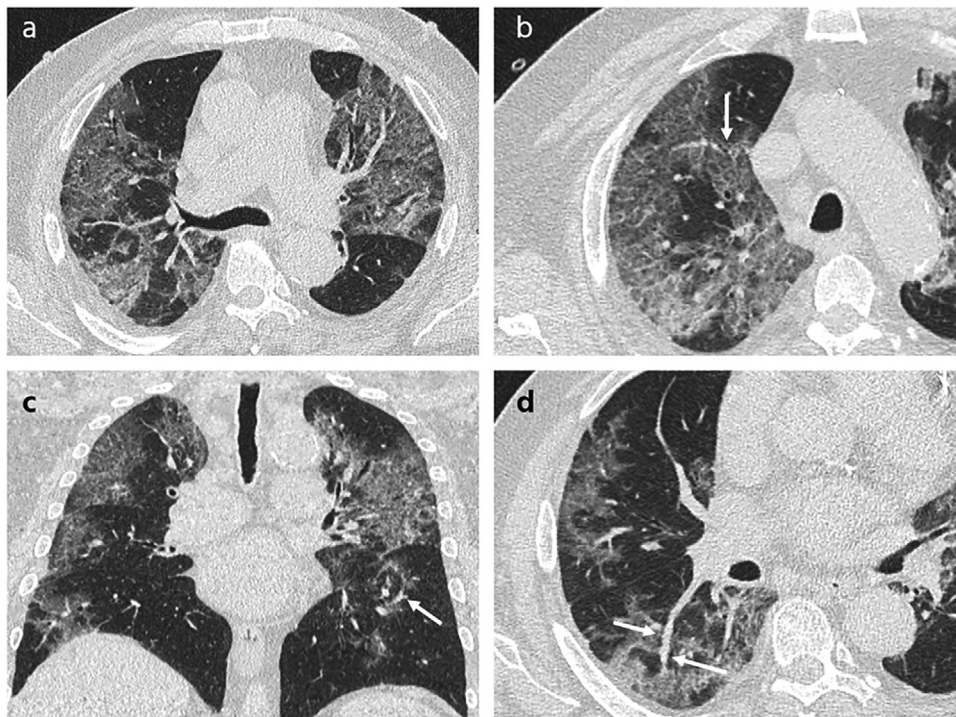


Fig. 1 – Areas showing typical signs of COVID-19 pneumonia. (a) Axial CT image demonstrating extended areas of ground glass opacity, which represented the main CT feature. (b) Axial CT image showing an area demonstrating the “crazy paving” pattern in the right upper lobe adjacent to extended ground glass opacities (arrow). (c) Coronal CT image showing the predilection of the abnormalities for the upper lung zone. Note an area demonstrating the “bullseye” sign in the left lower lobe (arrow). (d) Axial CT image showing an enlarged segmental pulmonary artery, running through areas of ground glass opacity (arrows).

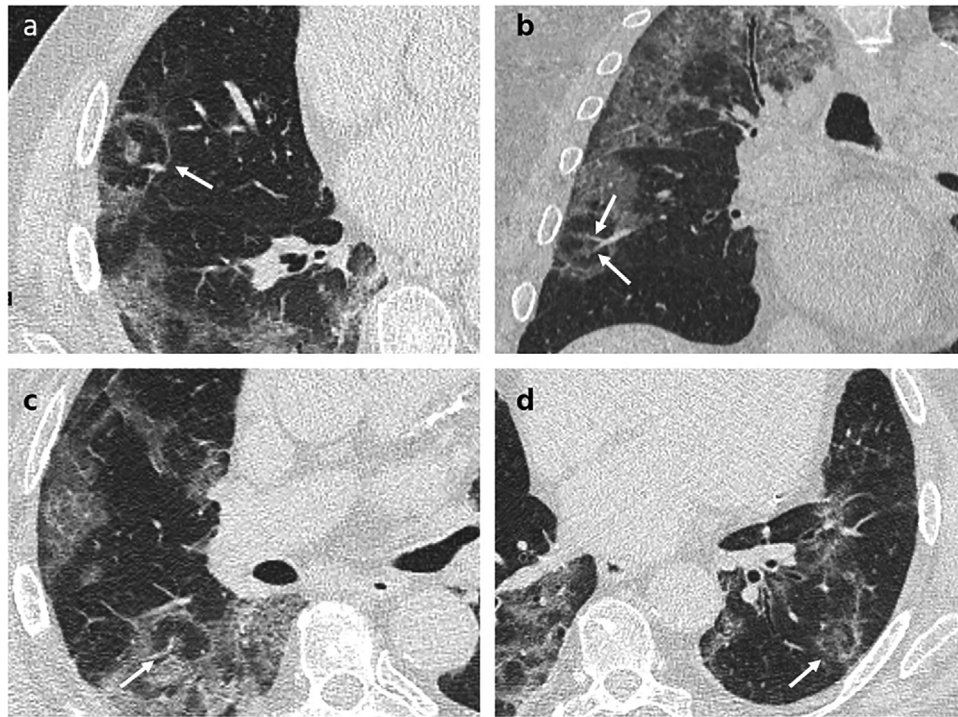


Fig. 2 – Areas demonstrating the “bullseye” sign. (a) Axial CT image demonstrating the first identified “bullseye” sign in the middle lobe (arrow). (b) Coronal CT image demonstrating the first identified “bullseye” sign in the middle lobe. Pulmonary veins can be seen traversing the inner ring of normally aerated lung (arrows). (c) Axial CT image showing a “bullseye” sign in the right lower lobe. The right border is to a great extent obscured by adjacent ground glass opacities (arrow). (d) Axial CT image showing a “bullseye” sign in the left lower lobe (arrow).

central GGO nodule surrounded by an inner ring of normally aerated lung and an outer ring of linear GGO was observed in the middle lobe. This lesion represents a nice example of the “bullseye” sign (Fig. 2a-b). After the identification of the above-mentioned lesion, a second careful look at the CT scan in all 3 planes revealed a total of 17 lesions with similar morphology in both lungs (9 lesions in the right lung and 8 lesions in the left lung). Some of the lesions demonstrated a complete outer ring of linear consolidation or GGO and some an incomplete outer ring interrupted by normally aerated lung or confluent with larger adjacent GGO (Fig. 2c-d). Furthermore, lesions representing the “reversed halo” sign were identified in both lungs. These lesions demonstrated an outer ring of linear consolidation, which surrounded a central area of GGO or clearing (Fig. 3). Neither mediastinal lymphadenopathy nor pleural effusions were observed. A CT examination of the lung, which was incidentally performed 33 days before in order to exclude an asbestos-related lung disease, revealed no abnormalities of the pulmonary parenchyma or the pleura.

Sputum and blood cultures during the hospital stay revealed no concomitant bacterial superinfection. The patient received corticosteroid therapy with intravenous administration of dexamethasone and antibiotic therapy, which consisted of a combination of piperacillin-tazobactam and azithromycin. The patient remained in an isolation room on the COVID-19 ward during his entire stay and apart from supplementary oxygen, no respiratory support was required, de-

spite extensive lung abnormalities at chest CT. After a total of 11 days of hospitalization the patient was discharged in good clinical condition to self-isolation at home.

Discussion

Signs of organizing pneumonia, namely, linear opacities, the “reversed halo” sign (or “atoll” sign), and a peribubular distribution of abnormalities have been reported in the intermediate and late phase of COVID-19 pneumonia [3,9]. Among them, the “reversed halo” sign has been reported to occur more often in patients with COVID-19 pneumonia in comparison to patients with non-COVID-19 viral pneumonia [13]. A newly described CT sign termed as the “bullseye” sign, which is observed in COVID-19 patients, is also considered to represent a sign of organizing pneumonia [10,11]. It is similar to the “reversed halo” sign, while the latter consists of 2 components: an outer ring of consolidation, which surrounds a central GGO. The “bullseye” sign, on the other hand, comprises 3 components: a central GGO-nodule, which is surrounded by an inner ring of normal aerated lung and an outer ring of GGO or consolidation.

This case report describes the CT signs of a patient suffering from COVID-19 pneumonia during the late CT stage of the disease (22 days after symptom onset) [14]. Among the ex-

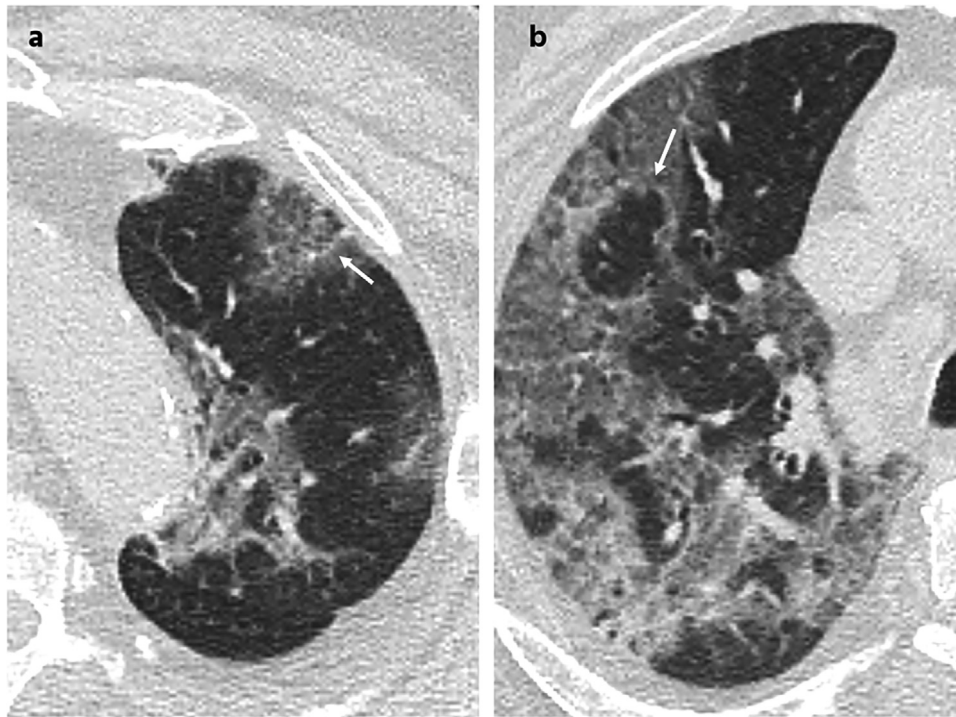


Fig. 3 – Areas demonstrating the “reversed halo” sign. (a) Axial CT image showing a lesion in the left upper lobe demonstrating the “reversed halo” sign with a central area of ground glass opacity surrounded by a discrete ring of linear consolidation (arrow). (b) Axial CT image showing an area in the right upper lobe demonstrating the “reversed halo” sign with a central area of clearing surrounded by a ring of linear consolidation (arrow).

tended GGO, multiple lesions representing the “bullseye” sign were revealed. The inner ring of normally aerated lung of at least one of those lesions was traversed by clearly visible pulmonary veins and arteries (Fig. 2b), which potentially proves that the “bullseye” lesions are not limited inside the borders of a secondary lobule. In our case report, the simultaneous presence of areas demonstrating the “bullseye” sign and areas demonstrating the “reversed halo” sign led us to believe that these lesions may represent areas of organizing pneumonia at a different stage of evolution, which is in line with the theory formed by McLaren et al. in their case series from July 2020 [10]. This theory is also supported by a case report of Wu et al., which demonstrated the gradual evolution of rounded consolidations into areas representing the “bullseye” sign [15]. Since our patient underwent neither a CT examination in an earlier stage of the disease nor a follow-up CT, we are not able to monitor the temporal evolution of the pulmonary lesions. However, the presence of areas representing the “reversed halo” sign in the late CT stage of COVID-19 pneumonia is highly indicative of organizing pneumonia.

It can be safely assumed that the “bullseye” sign is an eye-catching CT feature and although it seems to be a rather rare finding, it is expected to be identified by radiologists when present. Thus, collecting a sufficient number of CT scans demonstrating the “bullseye” sign will allow scientists to understand the pathophysiology of this new CT feature and test its ability to differentiate COVID-19 pneumonia from non-COVID-19 pneumonias and other acute or chronic pulmonary conditions.

Patient consent statement

Approval of the Ethics Committee of the Medical Faculty, University of Heidelberg (S293/2020) was obtained for this study.

Written informed consent was waived by the Institutional Review Board.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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