Bull's eye sign – A diagnostic clinch in COVID-19 pneumonia

Navdeep Kaur[1], Amandeep Kaur[2], Harvinder Singh Chhabra[3]

[1]Department of Radiodiagnosis, All India Institute of Medical Sciences, Bathinda; [2]Department of General Medicine, All India Institute of Medical Sciences, Bathinda; [3]Department of Forensic Medicine, Guru Gobind Singh Medical College and Hospital, Faridkot, India

Abstract

Although typical imaging findings of COVID-19 pneumonia has been described it may be difficult at times to distinguish it from other viral pneumonias. In the following case series, we describe a typical sign i.e., Bull's-eye sign in COVID-19 pneumonia. As this sign is not associated with any known pulmonary disease, so its presence may help radiologists to differentiate COVID-19 pneumonia from its mimics.

Correspondence: Dr. Navdeep Kaur, Assistant Professor, Department of Radiodiagnosis, All India Institute of Medical Sciences, Bathinda, Punjab, India.
Tel. +91.9804400001.
E-mail: drdhillonnavdeep@gmail.com

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Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) originated in Wuhan, Hubei Province of China in December 2019 and now has spread worldwide [1]. Although the disease is known to have multi-organ involvement but most patients present to the hospital with respiratory involvement. Chest tomography is routinely being used for evaluating patients with COVID-19 pneumonia. The predominant imaging findings include multifocal ground-glass opacities (GGO's), consolidation or both with peripheral subpleural and basal predominance [2,3]. Lymphadenopathy, pleural effusion, and cavitation are uncommon [4]. The disease has been established to follow an acute course for 1-2 weeks and then resolve by organizing pneumonia pattern. Reverse halo sign (RHS) is a less frequent finding in COVID-19 pneumonia seen during the disease's organizing phase i.e., a region of consolidation surrounding a central GGO or normal lung parenchyma [5-7]. In the following case series, we describe a variant of reverse halo sign, i.e. "bull's-eye sign" seen in few COVID-19 pneumonia patients. Very few cases are available in the literature explaining this finding.

Case #1

A 67-year-old male with no significant past medical history presented to the hospital with the chief complaint of fever associated with cough and fatigue. On examination, he was febrile with a temperature of 38.6°C and blood oxygen saturation of 94%. Nasopharyngeal Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) confirmed the COVID-19 infection. Investigations revealed raised D-dimer levels - 1003.3ng/ml, C-reactive protein (CRP) -110 mg/l, erythrocyte sedimentation rate (ESR)- 92 mm, serum ferritin -788.2 ng/ml, serum lactate dehydrogenase (LDH) - 352 U/L, and interleukin-6 (IL-6) -92 pg/ml. His complete blood count, renal function tests and liver function tests were unremarkable. Dengue and enteric fever tests were negative. The patient was admitted to the hospital and treated with supportive care along with injection remdesevir, low molecular weight heparin (LMWH), and steroids. With 2 l/min oxygen by nasal cannula, blood oxygen saturation improved to >95%. With the initiation of treatment, the patient improved and was discharged in a satisfactory condition on room air on day 21 of his illness.

Chest computed tomography (CT) on admission showed multifocal areas of consolidation in the peripheral subpleural location in both the lower lobes and left upper lobe. Multiple "bulls eye lesions" i.e., central ground glass nodule surrounded by an inner ring of air and outer ring of ground glass were seen in

peripheral subpleural location in right upper lobe, right lower lobe and left upper lobe. There were also scattered areas of classic reverse halo sign i.e., central area of GGO or normal lung parenchyma surrounded by an area of consolidation in the lower lobes (Figure 1).

Case #2

A 62-year-old male healthy without any underlying comorbidities. He presented with chief complaint of fever associated with fatigue and was started on tab azithromycin with clinical suspicion of COVID-19. The diagnosis of COVID-19 was confirmed using the nasopharyngeal sample for RT-PCR, which was found to be positive. Following confirmation, he was started on tablet doxycycline and tablet ivermectin along with supportive care. About one week later he developed shortness of breath on exertion. He was then admitted to the hospital with tachypnea and SPO_2 of 92%. With 2 l/min oxygen by nasal cannula, saturation improved to >95%. Blood investigations revealed a normal blood cell count. Renal function tests, along with liver function tests, were within normal limits. The fever profile for dengue and enteric fever was negative. His CRP (105 mg/l), ESR (90 mm), D-dimer levels (883.3 ng/ml), serum ferritin (765.2 ng/ml), serum LDH (346 U/L), and IL-6 (83.8 pg/ml) levels were raised. The patient was started on injection remdesevir, steroids and LMWH. He improved with treatment and was discharged in a satisfactory condition on day 16 of his illness.

Chest CT showed multiple ill-defined areas of consolidation in both lungs in peripheral subpleural and in peri-bronchial location. Multiple bulls eye lesions were seen scattered within these areas of consolidation in the subpleural location in the right lung (Figure 2).

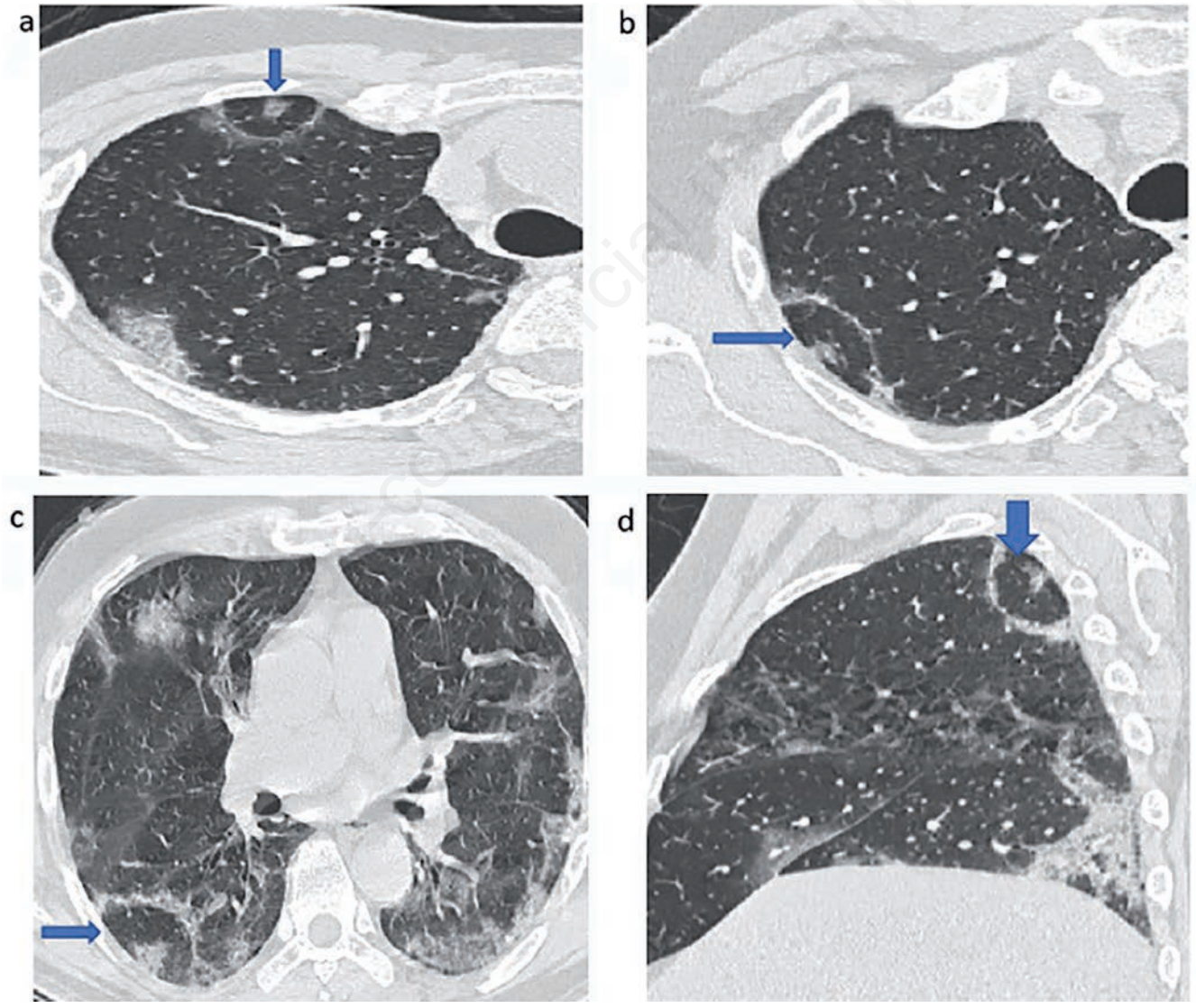

Figure 1. HRCT (on day 10 of illness) showing Bull's eye sign in a 67-year-old male complaining of fever, cough and fatigue. Axial (a-c) and sagittal (d) CT image showing centrilobular nodule surrounded by an inner ring of air (the spared pulmonary lobule) surrounded by an outer ring of consolidation which is perilobular in location. Areas of consolidation are seen in peripheral subpleural location in both the lower lobes.

Case #3

The patient was a 29-year-old male with no associated comorbidities. He presented with chief complaint of fever associated with sore throat and myalgias. On examination, patient was stable with temperature of 38º C and with normal blood oxygen saturation of 98%. Nasopharyngeal RT-PCR confirmed the presence of COVID 19 infection. Patient was started on symptomatic treatment with tablet ivermectin and doxycycline and LMWH. Investigations revealed normal blood count with raised CRP and D-dimer levels. The patient became afebrile with treatment after 1 week and was discharged satisfactory in a stable condition.

His chest CT showed multifocal areas of ground glass opacities scattered in peripheral subpleural location in both the lungs. Few Bull's eye lesions were seen in peripheral subpleural location in both the lower lobes (Figure 3).

Discussion

GGO's, consolidation, or both with multifocal, bilateral, peripheral, and subpleural distribution are the most frequent findings on chest CT in COVID-19 [2,3]. RHS is associated with organizing pneumonia pattern [8]. RHS is a less frequent finding in COVID - 19 pneumonia and is seen after 6-12 days of symptom onset [9]. A study by Bai *et al*. suggested RHS to be present in 11% of cases with COVID-19 pneumonia in contrast to only 1% of patients with non-COVID-19 pneumonia demonstrating this sign. Thus, the presence of RHS can help distinguish COVID-19 pneumonia from other causes [10-12]. Another unpublished study demonstrated RHS in 25% of patients within two weeks of symptom onset. The majority of lesions were peripherally located and in lower lobes. RHS is considered a useful prognostic indicator in COVID-19 pneumonia as it was mostly found in patients with moderate disease with mostly improving or resolving on subsequent CT [13].

Bull's-eye sign is possibly a variant of RHS. The central ground-glass nodule is centrilobular and peripheral ring of GGO is perilobular in location middle layer of air representing the spared pulmonary lobule [14]. The central nodular opacity indicate perivascular inflammation as central pulmonary artery could be traced in some lesions leading into this nodule. There is growing pathological evidence that COVID-19 infects host cell through angiotensin converting enzyme 2 receptor which is expressed throughout the vascular endothelium [15]. Endothelial dysfunction may lead to infarct or haemorrhage in centrilobular location leading to formation of bull's eye lesions [16].

A case description by Wu *et al*. demonstrated the evolution of a nodular opacity into bull's-eye lesion on day 8 of symptom onset, which resolved with treatment on follow-up studies [17]. Shaghai *et al*. described this as a target sign which completely resolved on follow up CT [18]. Similarly, in our cases, bull's-eye lesions were seen with peripheral subpleural distribution with predilection for lower lobes. They were found during the late stages of the disease during its resolving stage. No additional medication was given to these patients to treat these bull's eye lesions and they recovered completely with the conventional treatment for COVID-19

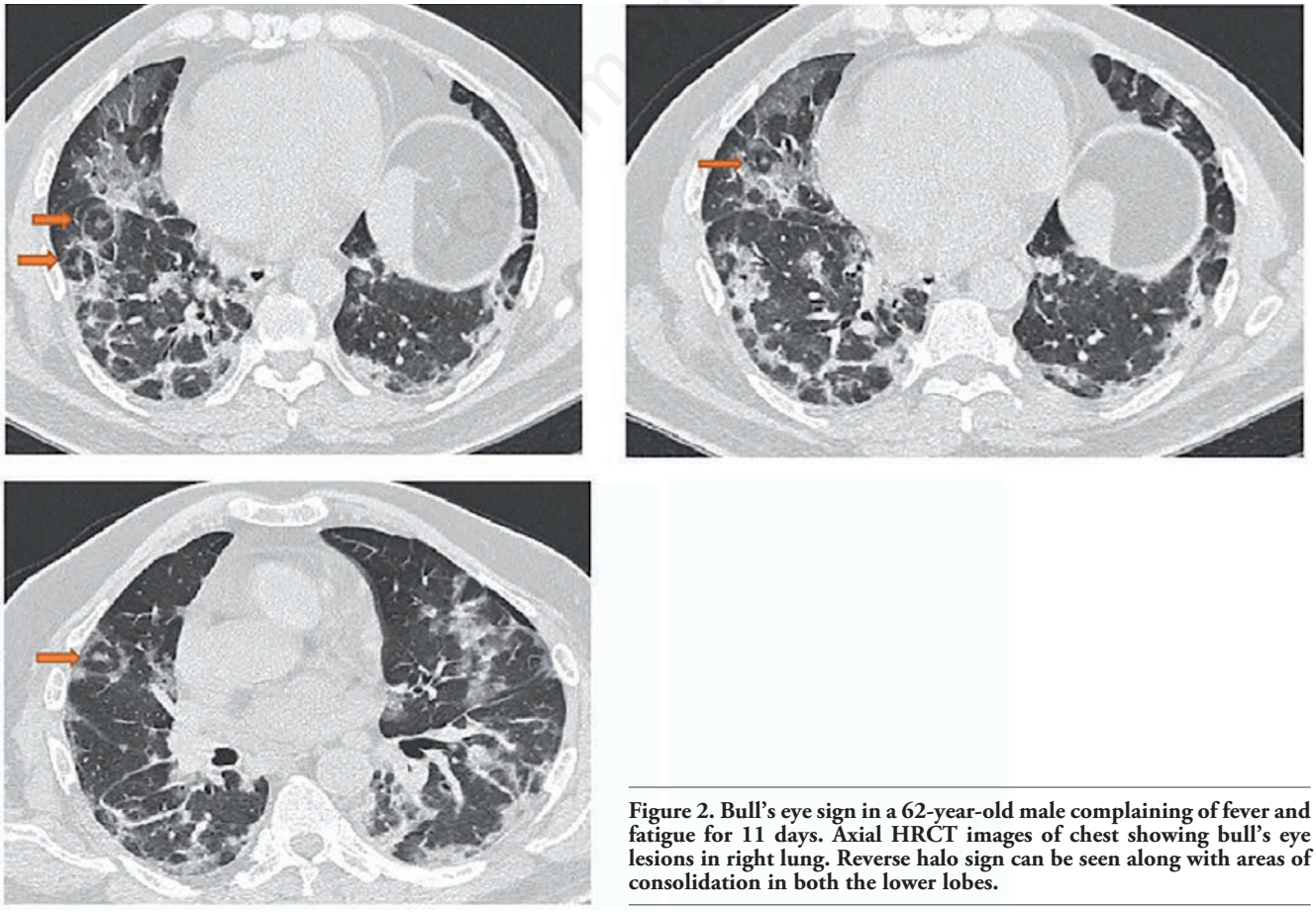

Figure 2. Bull's eye sign in a 62-year-old male complaining of fever and fatigue for 11 days. Axial HRCT images of chest showing bull's eye lesions in right lung. Reverse halo sign can be seen along with areas of consolidation in both the lower lobes.

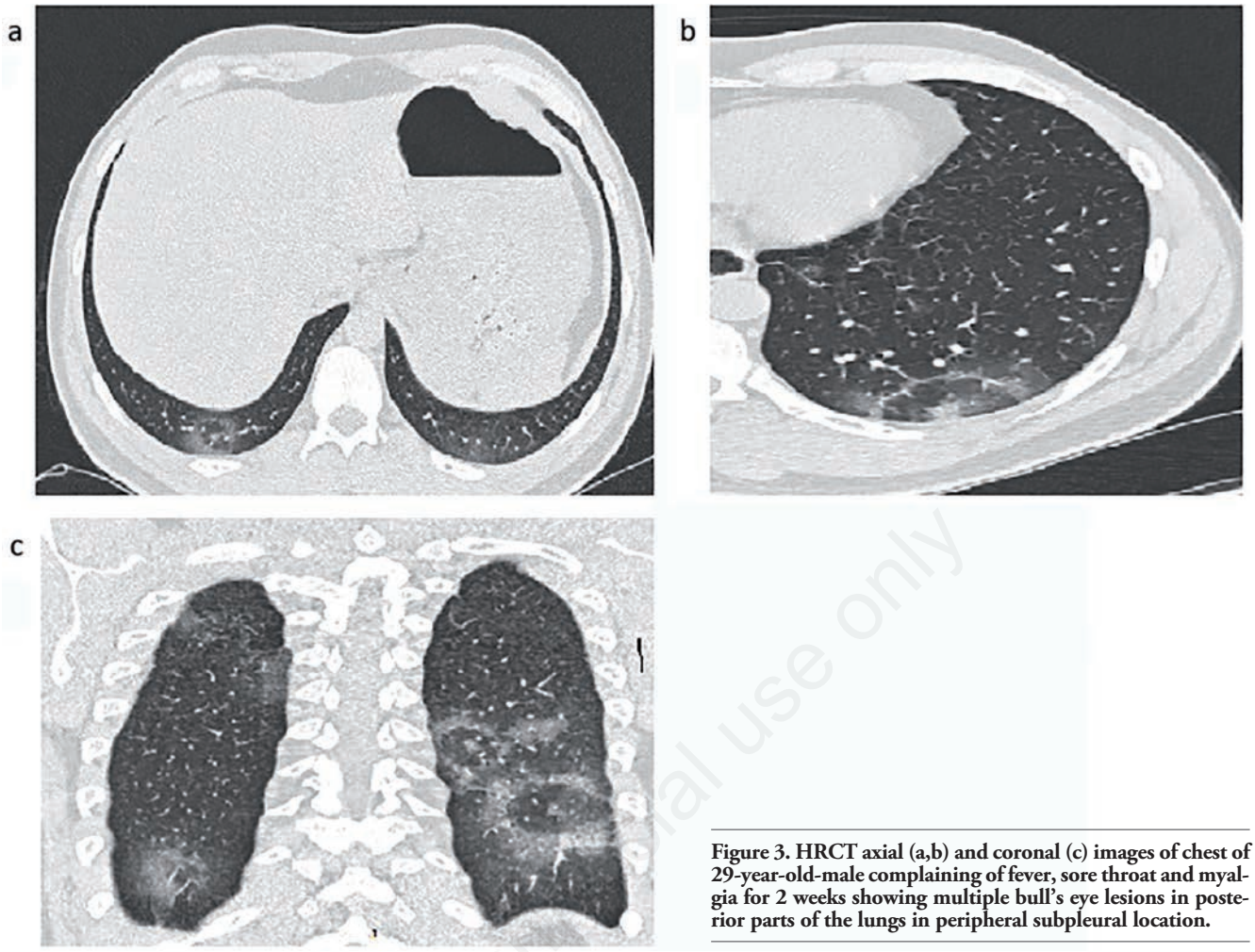

Figure 3. HRCT axial (a,b) and coronal (c) images of chest of 29-year-old-male complaining of fever, sore throat and myalgia for 2 weeks showing multiple bull's eye lesions in posterior parts of the lungs in peripheral subpleural location.

pneumonia. This signifies that bull's eye lesions represent a spectrum COVID-19 pneumonia only and does not indicate any super-aided pathology. None of the patients required intubation or mechanical ventilation. This supports a favorable outcome in patients with bull's eye lesions on imaging as reported by Shaghai *et al*. [18]. The lesions showing typical reverse halo sign could simultaneously be demonstrated in the patients which has been well established to be associated with organizing pneumonia pattern [8].

Conclusions

To conclude, bull's eye sign is seen on HRCT during the organizing phase of COVID-19 pneumonia. It may aid the clinicians to differentiate COVID-19 pneumonia from other viral pneumonias and may point towards a favorable outcome.

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