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Case Report

Legionella pneumonia presenting with reverse halo sign

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ABSTRACT

A case of a previously healthy man with community-acquired pneumonia who progressed to acute respiratory distress syndrome, with reverse halo sign (RHS) on chest computed tomography, is reported. A urinary *Legionella* antigen test was positive for *Legionella pneumophila*. The typical radiographic features of *Legionella* pneumonia are bilateral or unilateral, single or multifocal airspace opacifications (most common), and/or ground-glass opacities. However, a wide variety of radiographic findings have been observed. The RHS is characterized by a central ground-glass opacity surrounded by a more or less complete ring of consolidation. First reported in cryptogenic organizing pneumonia, it was initially thought to be specific for this disease, but was subsequently described in a variety of neoplastic and non-neoplastic pulmonary diseases. In this manuscript, we present a case of *Legionella* pneumonia with a RHS.

Keywords: Reverse halo sign, *Legionella* pneumonia, Radiologic images

INTRODUCTION

The reverse halo sign (RHS) was initially reported to be specifically associated with cryptogenic organizing pneumonia (COP), but was subsequently described in a variety of pulmonary diseases. Here, we present a case of *Legionella* pneumonia with a RHS.

CASE PRESENTATION

The patient was a 53-year-old male with an unremarkable medical history. He has been a smoker with a 20-pack-years smoking history and on no medications. The patient was on vacation in an Albanian camp and was in his usual state of health until the day he started developing symptoms of fever, dyspnea, and malaise.

On presentation to the emergency department of the hospital, he was found to have low oxygen saturation 86% while breathing room air, high fever of 38.4°C, elevated heart rate 100/min, and respiratory rate of 20 breaths/min. He was alert and oriented, with Glasgow Coma Scale of 15/15. His chest examination revealed inspiratory crackles and bronchial breath sounds at lung bases bilaterally, more pronounced on the right chest X-ray demonstrated bilateral pulmonary infiltrates [Figure 1a and b]. A chest computed tomography (CT) scan performed on presentation revealed bilateral patchy parenchymal infiltrates, large size consolidations with air-bronchogram in the lower lobes, halo sign on the left upper lobe, and bilateral pleural effusions [Figure 1c]. On presentation, he had elevated white blood cells count: 16.5 × 10^3/μL (reference range 3.8–9.8 × 10^3/μL); and C-reactive protein: 267 mg/L (reference range 6–8 mg/L); hyponatremia,

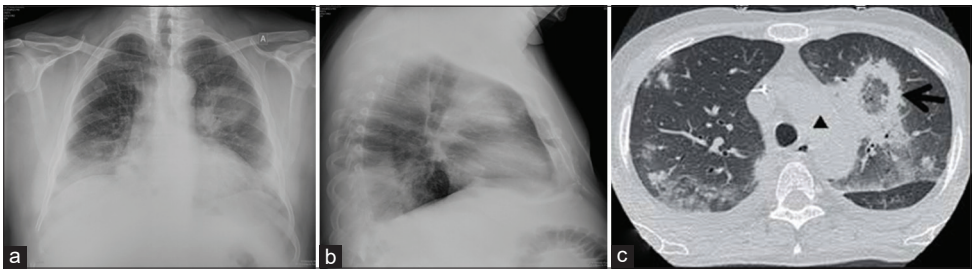

Figure 1: A 53-year-old male presenting with fever and dyspnea. (a and b) Chest X-ray demonstrating bilateral pulmonary infiltrates more prominent in the left upper and the lower lobes. (c) Chest computed tomography demonstrating reversed halo sign in the left upper lobe (arrow), patchy bilateral infiltrates, and bilateral pleural effusions.

Na: 122 mmol/L (reference range 135–145 mmol/L); rhabdomyolysis, creatine phosphokinase: 1700 U/L (reference range 55–170 U/L); elevated liver enzymes, aspartate aminotransferase: 71 U/L (reference range 5–40 U/L); and alanine aminotransferase: 62 U/L (reference range 7–56 U/L. The HIV test was negative. He was started on intravenous antibiotics including piperacillin/tazobactam, levofloxacin, linezolid, as well as oseltamivir tablets orally.

Urinary antigen for *Legionella* was positive and the diagnosis of *Legionella* pneumonia was made. The patient continued receiving levofloxacin until he was discharged 10 days after admission.

The center for disease control was informed and after thorough investigation, *Legionella pneumophila* was isolated from one of the camping's showerheads.

DISCUSSION

Legionella is a genus of pathogenic Gram-negative bacteria that include the species *L. pneumophila*, causing legionellosis (all illnesses caused by *Legionella*) including a pneumonia-type illness called Legionnaires' disease and a mild flu-like illness called Pontiac fever. Each year, an estimated 10,000–18,000 people are infected with *Legionella* in the United States.[1] *Legionella* is found naturally in freshwater environments such as lakes and streams. It can become a health concern when it grows and spreads in human-made building water systems such as: Showerheads and sink faucets, cooling towers, hot water tanks and heaters, and large plumbing systems. Home and car air-conditioning units do not use water to cool the air, so they are not a risk for *Legionella* growth.[2]

Diagnosis

Specialized tests are required to diagnose *Legionella* infection, which must be specifically requested by the treating clinician. Available tests for the diagnosis of *Legionella* infection accompanied by general ranges for the sensitivity and specificity of each diagnostic test are provided in [Table 1].[3]

Table 1: Performance of specialized laboratory tests for the diagnosis of *Legionella* infection.

Test	Sensitivity (%)	Specificity (%)
Culture (lower respiratory secretions, lung tissue, pleural fluid)	20–80	100
Urinary antigen	70–100	95–100
PCR (lower respiratory secretions, lung tissue, pleural fluid)	95–99	>99
Serology	80–90	>99
Direct fluorescent antibody stain	25–75	≥95

The test most widely used in daily practice is urinary antigen, which only detects *Legionella pneumophila* serogroup 1 that accounts for up to 70–84% of cases.

Radiographic features

The typical radiographic features of *Legionella* pneumonia are bilateral or unilateral, single or multifocal airspace opacifications (most common), and/or ground-glass opacities. However, a wide variety of radiographic findings have been observed.[4] Those with extensively consolidated lesions can have associated cavitation, while pleural effusions can be common and are occasionally seen, even in the absence of lung field infiltrates. Rarely, as in this case, we present, *Legionella* pneumonia can present with RHS on CT. Radiographic appearances often lag behind the clinical picture and there can be deterioration on imaging despite clinical improvement. Resolution of infiltrates may be slow, and the tendency for delayed improvement should be considered before initiating any further invasive diagnostic investigation.

Clinical significance of the reversed halo sign (RHS)

The RHS is characterized by a central ground-glass opacity surrounded by a more or less complete ring of consolidation

on high-resolution CT.[5] It has also been described as the "atoll sign" because of its resemblance to a coral atoll.[4] First reported in COP, it was initially thought to be specific for this disease, but was subsequently described in a variety of pulmonary diseases. Despite being no longer considered specific, its presence in association with ancillary CT findings and the clinical history can be useful in narrowing the differential diagnosis.[6]

In this article, we discuss the spectrum of neoplastic and non-neoplastic diseases that may show the RHS and present clues that are helpful in the differential diagnosis. When the RHS is recognized on CT, by integrating the ancillary radiological and clinical data, the radiologist should be able to reach a succinct differential diagnosis to guide clinical decision-making and/or determine treatment options.[7] In our case, the patient appearing with acute onset symptoms and having elevated inflammatory markers should, at first, direct differential diagnosis to infectious diseases. Having no medical history of immunosuppression or angiitis and negative HIV test would rule out the diagnosis of *Pneumocystis jiroveci* pneumonia and fungal infections. No present history of travel to an area with endemic infections should exclude zoonotic and parasitic infections. Finally and most important, living in a camp should further narrow the differential diagnosis. Delivering this information would support the radiologist concurrently with RHS on CT considering *Legionella* as a possible diagnosis.

The RHS can be encountered in the following diseases:[8] (1) Infectious diseases: (a) Invasive fungal pneumonia (invasive pulmonary aspergillosis; usually presenting with halo sign and pulmonary zygomycosis), (b) endemic fungal infections[9] (paracoccidioidomycosis, histoplasmosis, and cryptococcosis), (c) *Pneumocystis jiroveci* pneumonia, (d) tuberculosis, (e) bacterial pneumonia (pneumococcal pneumonia, and psittacosis); (2) non-infectious, non-neoplastic diseases: (a) cryptogenic organizing pneumonia, (b) non-specific interstitial pneumonia, (c) sarcoidosis, (d) lipoid pneumonia, (e) granulomatosis with polyangiitis (formerly called Wegener's granulomatosis), and (f) acute pulmonary embolism with pulmonary infarction; and (3) neoplastic diseases: (a) Lymphomatoid granulomatosis (also known as angiocentric lymphoma or angiocentric immunoproliferative lesion), (b) lung adenocarcinoma, which includes the spectrum from adenocarcinoma *in situ* to lepidic predominant invasive adenocarcinoma,[10] and (c) metastatic disease; and (4) post-treatment changes: (a) Radiofrequency ablation and (b) radiation therapy.

The RHS can also be encountered in viral infections. Several reports were made from patients suffering from COVID-19 pneumonia, to present with RHS on CT or with "the bullseye sign," one of its recently reported variants.[11]

Tuberculosis should be suspected when the RHS has a nodular appearance and is associated with centrilobular nodules and pattern of endobronchial spread, especially if seen in an individual with increased risk, such as a patient with AIDS, an immigrant or a prison inmate.

In the setting of post-treatment changes, the RHS probably represents pulmonary infarction or inflammation. With the correct clinical history and timing after therapy, a biopsy can be avoided.[12]

CONCLUSION

Since its original description, the RHS has been reported in a variety of conditions. Although a biopsy is frequently needed to establish the diagnosis of many of the diseases that can be encountered with the RHS, by combining the clinical history and additional CT findings, in certain scenarios a biopsy can be avoided. Knowledge of the various manifestations of the RHS and its etiologies is useful in avoiding misinterpretation, and can lead to appropriate, timely clinical management. Motivated by the present case report, we suggest that when RHS is encountered, physicians and radiologists should consider the possibility of *Legionella* infection in the appropriate clinical setting and history of exposure to consistent agents.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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