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## Case Report

Diffuse reversed halo sign in an immunocompetent patient<sup>☆</sup>K. Aitnasser<sup>a,b,\*</sup>, I. Nakkabi<sup>b,c</sup>, H. Naji Amrani<sup>d,e</sup> <sup>a</sup> Pneumo-Phthisiology Department, Souss Massa University Hospital Center, Agadir, Morocco<sup>b</sup> Medical and Pharmacological Faculty, Ibn Zohr University, Agadir, Morocco<sup>c</sup> ENT and Cervico-Facial Surgery Department, Oued Eddahab Military Hospital, Agadir, Morocco<sup>d</sup> Pneumo-Phthisiology Department, Oued Eddahab Military Hospital, Agadir, Morocco<sup>e</sup> Medical and Pharmacological Faculty, Sidi Mohammed Benabdellah University, Fes, Morocco

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## ABSTRACT

The reversed halo sign (RHS) is a specific radiological image observed mostly on computed tomography (CT) scans as a focal round area of ground-glass attenuation surrounded by a crescent or ring of consolidation. It is common to many entities of respiratory diseases and can be found in both infectious, noninfectious inflammatory pathologies and some malignant tumors, including invasive pulmonary fungal infection, tuberculosis (TB), community-acquired pneumonia, granulomatosis, sarcoidosis. It is also seen in pulmonary neoplasms and infarction, and following radiation and radiofrequency.

We report the case of an immunocompetent 54-year-old North African male patient, initially hospitalized for chronic cough associated with dysphonia and general symptoms such as weight loss, fever, and night sweats. Radiological exploration surprisingly confirmed the presence of RHS, tuberculosis was confirmed by a postbronchoscopy positive sputum Xpert MTB/RIF essay tuberculosis after we started antibacterial treatment, and the evolution was spectacular with regression of the lesions.

The objective of this report is to increase knowledge about RHS and its pathological correlation with TB. Since it is not specific to any disorder, it is important to explore its finding in a clinical and epidemiological manner, especially in endemic countries where the prevalence of tuberculosis is still high.

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## Introduction

The reversed halo sign (RHS) is a well-established radiological sign of organizing pneumonia, it is characterized by a par-

tial or complete rim of consolidation surrounding a central ground-glass opacity [1]. The presence of RHS-type lesions in patients with pulmonary tuberculosis has only recently been described; it is considered a rare, atypical but fairly specific sign of active tuberculosis in immunocompetent patients

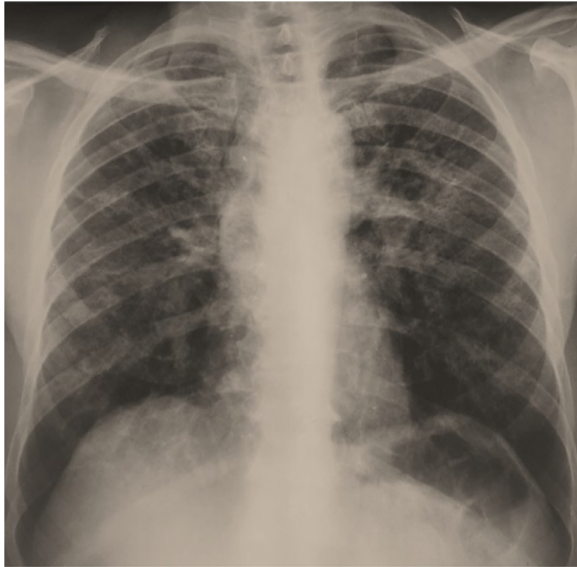
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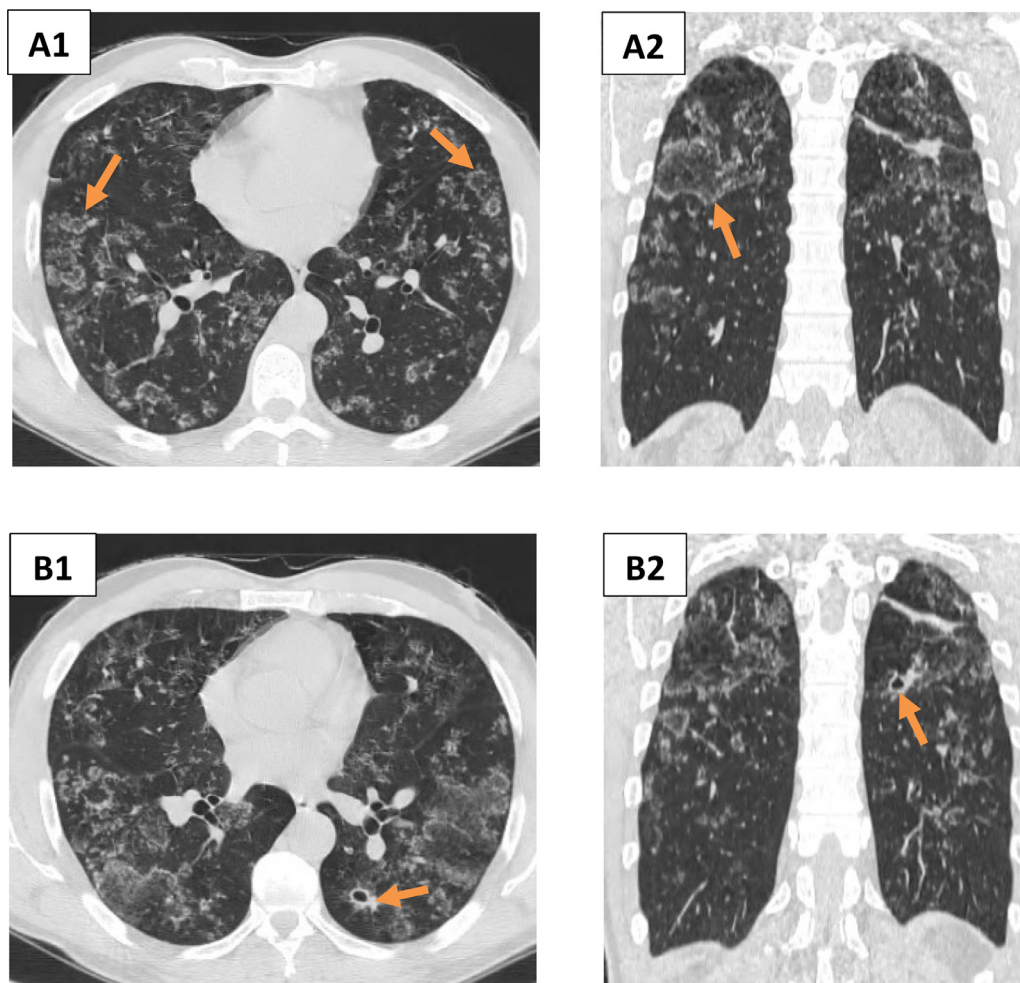


**Fig. 1 – Frontal chest X-ray: diffuse opacities with reticular and nodular patterns especially in upper lobes.**

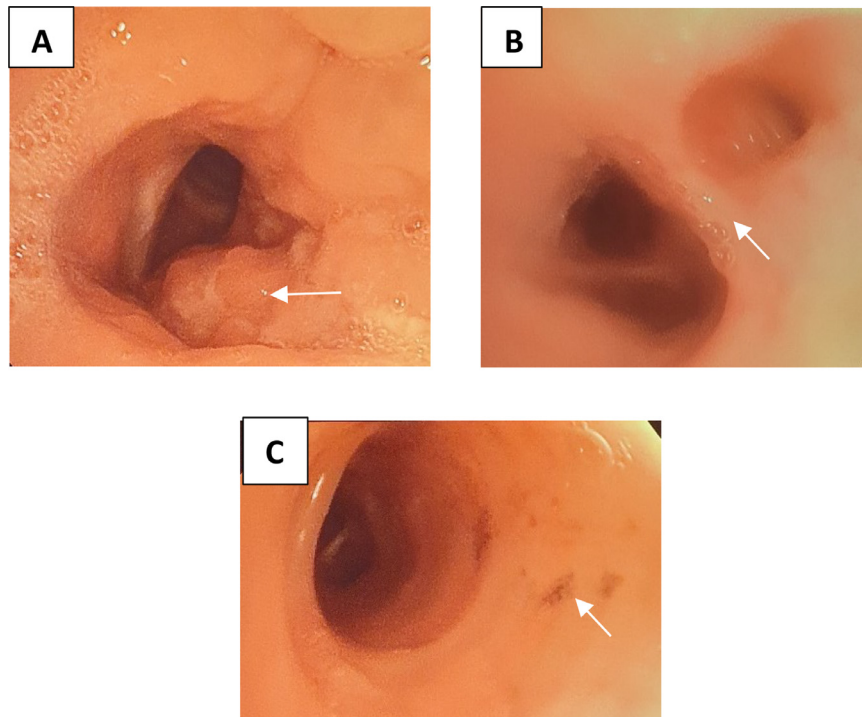
[2–4]. This work describes the rare finding of the radiological RHS sign, in an immunocompetent subject hospitalized for chronic respiratory symptoms secondary to a *Mycobacterium tuberculosis* infection.

### Case report

We report the case of a 54-years-old male patient, of North African descent where there is a high prevalence of TB. The patient is a nonsmoker, has no known occupational exposure, and most importantly no history or exposure to tuberculosis. He received 2 doses of the Covid-19 vaccine and was treated for a mild form of Covid-19 pneumonia in 2020. The patient was admitted to the pulmonary department for chronic dry cough and dysphonia evolving for the past 7 months, without dyspnea, hemoptysis, or fever. Accompanying symptoms were severe asthenia, anorexia, weight loss, and night sweats. The physical examination revealed normal vital signs, with no palpable peripheral lymph nodes, and pulmonary, cardiovascular, and abdominal examinations were unremarkable.



**Fig. 2 – A1, A2 diffuse RHS, tree-in-bud pattern (black arrow). B1, B2 excavated nodule in the apical segment of the left lower lobe (white arrow).**



**Fig. 3 – Bronchoscopy. (A) Left vestibular fold tumor extending to the anterior commissure. (B) Thickening of the interculminolingual spurs. (C) Petechial lesions in the apical segment of the right lower lobe.**

The initial chest radiography demonstrated diffuse opacities with nodular patterns predominant in the upper lobes (Fig. 1).

Chest CT scan revealed diffuse areas of ground-glass opacities surrounded by parenchymal consolidation; this radiological lesion represents a RHS. Additionally, we objectified small nodules throughout the lungs with a tree-in-bud pattern, and an excavated nodule at the apical segment of the left lower lobe (Fig. 2).

Blood analysis showed normal blood cell count, and liver and renal function tests were also within the normal range, sputum and blood cultures during the hospital stay revealed no bacterial or fungal infections and were negative for *Mycobacterium tuberculosis*. To eliminate an immune-depression state, we ruled out by blood tests human immunodeficiency viruses 1 and 2, hepatitis B and C, as well as autoimmune diseases by dosing ANCAs, ANA, and anti-CCP antibodies.

We performed a bronchoscopy that showed a left vestibular fold tumor at the left vocal cord extending to the anterior commissure. After intubation: we observed a thickening of the left interculminolingual spur and left culmen segmental spurs, in addition to the presence of petechial lesions in the apical segment of the right lower lobe (Fig. 3). A bronchoalveolar lavage showed a nonspecific cellular formula with a predominance of macrophages at 80%, 10% were lymphoplasmocytes, 5% of neutrophils, and 5% of regular bronchial cells. All samples were smear-negative for acid-fast bacilli, bacteria, and fungi, as were the bacterial cultures.

Histopathological examination of the specimen obtained from the lung by biopsy showed congestive bronchial mucosa with nonspecific inflammatory lesions.



**Fig. 4 – Frontal chest X-ray: significant improvement after 3 months of antituberculosis drugs.**

Furthermore, we performed a laryngoscopy under general anesthesia and we continued the investigation with a vestibular tumor biopsy that objectified the presence of epithelioid



cell granuloma with caseating necrosis, which is a typical pathological finding in tuberculosis.

Postbronchoscopy sputum Xpert MTB/RIF tests came back positive confirming active laryngeal and pulmonary tuberculosis. An antibacillary treatment was initiated with isoniazid in combination with rifampin, pyrazinamide, and ethambutol for 02 months, followed by 04 months of a rifampin and isoniazid association.

Three months after the beginning of the treatment, the patient presented no clinical symptoms and the follow-up chest X-ray showed significant improvement in the radiological lesions (Fig. 4).

## Discussion

The reversed halo sign was initially considered to be specific to cryptogenic organizing pneumonia, especially in immunocompetent patients [5–7]. Typically, it is found in the subpleural or peribronchovascular areas bilaterally, with a preference for the lower lobes of the lungs. The consolidation of airspaces in a ring or crescent shape in the outer regions corresponds to the presence of organizing pneumonia. On the other hand, the central ground-glass opacity represents cellular debris and inflammation in the alveolar septa within the alveolar spaces [8].

Later on, it was also observed among some immunocompetent patients with infectious pneumonia, such as tuberculosis or other bacterial and fungal infections [9–11]. It was also reported in several inflammatory conditions like sarcoidosis, pulmonary neoplasms, and after radiotherapy [12]. Marchiori et al proposed several radiological criteria to distinguish between these conditions. Their study suggests that the presence of nodular walls or nodules within the lesion indicates granulomatous etiologies such as tuberculosis and sarcoidosis rather than organizing pneumonia [6]. Similarly, greater rim thickness (>1 cm), the presence of reticulation within the consolidating rim, and the presence of an associated pleural effusion indicate a fungal infection rather than organizing pneumonia [13].

During the Covid-19 pandemic, it was often considered that the viral infection manifests on chest CT as ground-glass opacities or crazy paving, but in mild to severe forms, it was observed that radiological features of Covid-19 may also include traction bronchiectasis within the areas of ground-glass opacities, reticular thickening and subpleural bands formation, halo sign, or reversed halo sign [14].

Characteristic features observed in patients with active tuberculosis and immune reconstitution syndrome may include centrilobular or airspace nodules, branched linear structures (arborescent), consolidations, cavitations, bronchial wall thickening, miliary nodules, tuberculomas, calcifications, parenchymal bands, interlobular septal thickening, ground-glass opacities, and per-scar emphysema [15]. Our patient presented with diffuse RHS, small nodules throughout the lungs with a tree-in-bud pattern, an excavated nodule and there was no evidence of lymphadenopathy.

Some authors suggest that *Mycobacterium tuberculosis* may also be considered as a cause of organizing pneumonia [16],

thus creating patterns at the same site through inflammation, and can be successfully treated using only antituberculosis medication.

## Conclusion

Based on this clinical case, the authors recall that pulmonary tuberculosis may present as an inverted halo on chest CT scans, whether it is a pattern of organized pneumonia secondary to tuberculosis or a direct manifestation of *Mycobacterium tuberculosis* itself. The diagnosis can be based on the radiological presentation, but in most cases, a lung biopsy may be necessary for the final diagnosis.

## Patient consent

The authors of this manuscript have obtained written, informed consent from the patient to write up the case report and for the use of images pertinent to the case. We have ensured anonymity of all clinical and graphical data used.

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