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Case Report

# Pulmonary mucosa-associated lymphoid tissue lymphoma forming a reversed halo sign from ground-glass opacity ☆

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ABSTRACT

The reversed halo sign (RHS) has been associated with various pulmonary diseases. We report a rare case of pulmonary mucosa-associated lymphoid tissue lymphoma forming a RHS from a ground-glass opacity (GGO). A 73-year-old man was followed-up for the GGO on his computed tomography images, which gradually extended peripherally. During the fourth year of follow-up, the GGO significantly evolved into a well-demarcated, oval lesion, with interlobular and intralobular septal thickenings, and multiple air spaces were surrounded by a well-defined thin consolidative rim, called the RHS. A pathologic study of the specimen via transbronchoscopic biopsy revealed pulmonary mucosa-associated lymphoid tissue lymphoma.



## Introduction

Pulmonary mucosa-associated lymphoid tissue (MALT) lymphoma presents with variable chest computed tomography (CT) findings, including consolidations, nodules, and masses [1–5]. We report the case of a patient with pulmonary MALT lymphoma who presented with a rare imaging finding of ground-glass opacity (GGO) that evolved into an oval lesion exhibiting the reversed halo sign (RHS).

## Case report

A 73-year-old male patient with a 56 pack-year smoking history presented with chest discomfort and palpitations.

☆ Competing Interests: The authors disclose no conflict of interest.

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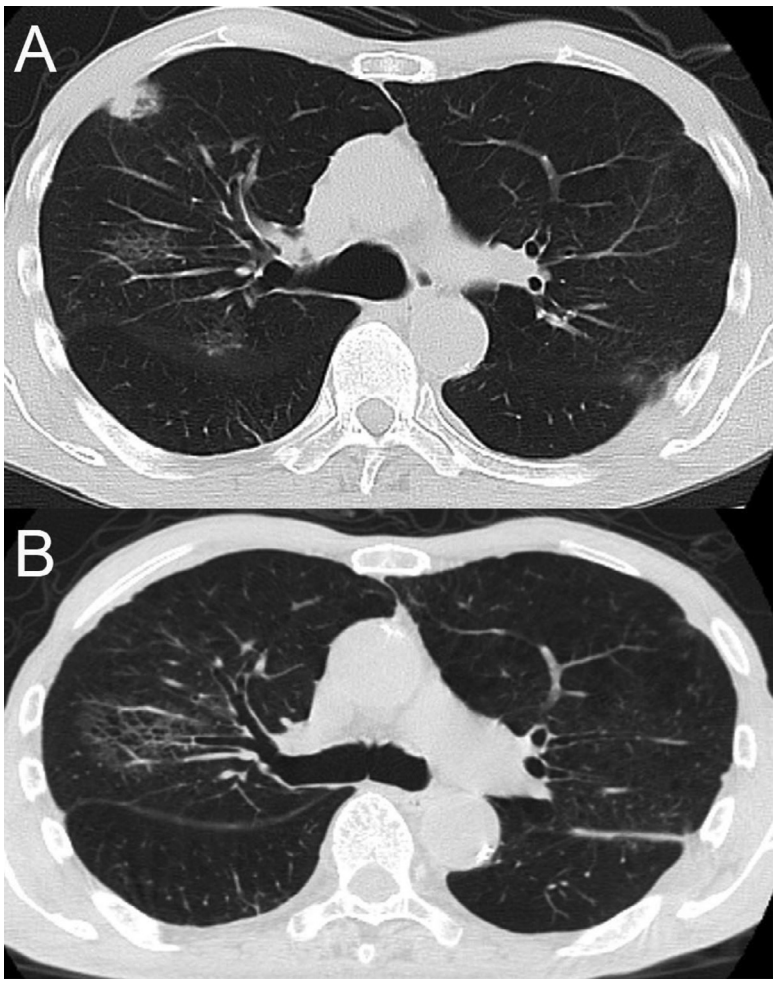


**Fig. 1 – Initial visit high-resolution chest CT. GGOs along the posterior segment (A) bronchus (B2b). After 3 years, one of the GGOs enlarged toward the periphery, with increased small air spaces (B). CT, computed tomography; GGOs, ground-glass opacities.**

The physical examination was unremarkable. High-resolution chest CT showed 2 areas of GGOs and a consolidation in the right lung (Fig. 1A). Emphysematous changes were noted on both lungs. One of the GGOs along the bronchovascular band of the posterior segment of the upper lobe gradually extended peripherally with increased air spaces over 3 years (Fig. 1B). The gradual growth of the GGO raised the suspicion of adenocarcinoma in situ. Thus, the patient was closely monitored. During the fourth year of follow-up, the GGO significantly changed into a well-demarcated oval lesion, with interlobular and intralobular septal thickenings, and multiple air spaces were surrounded by a well-defined thin consolidative rim. Its appearance was consistent with the RHS. The area containing the lesion between the trunk of 2 pulmonary veins caused an interlobar pleural indentation (Fig. 2). Images taken by 18F-fluorodeoxyglucose-positron emission tomography (FDG-PET) showed uptake in the shadow with a maximal standardized uptake value of 8.49. Strong uptake was observed at the ring of the lesion (Fig. 3). No other FDG-avid lesions were observed. Histopathological examination of the specimen obtained from the ring by transbronchoscopic biopsy showed dense infiltration of small lymphocytes with slightly irregular nuclei and plasma-like differentiation (Fig. 4). Immunohistochemical analysis showed that the lymphoid cells were positive for CD20 but negative for CD3, CD5, CD10, and cyclin D1. Light chain restriction by in situ hybridization was also observed. The patient was diagnosed with pulmonary MALT lymphoma. Since this type of lymphoma has an indolent course, the patient was closely monitored, and remained asymptomatic for 1.5 years after diagnosis.

## Discussion

Pulmonary MALT lymphoma represents only 3.6% of extranodal non-Hodgkin lymphoma cases and 0.5%-1% of primary pulmonary malignancies. However, it is the most frequent subset of primary pulmonary lymphomas [6–8]. The most frequent imaging patterns of pulmonary MALT include consolidations, nodules, and masses, as well as air bronchograms or bronchial and/or bronchiolar dilatation [1–5]. GGOs have been less frequently observed. The patient in this report presented with CT findings of GGOs with small air spaces. After 4 years

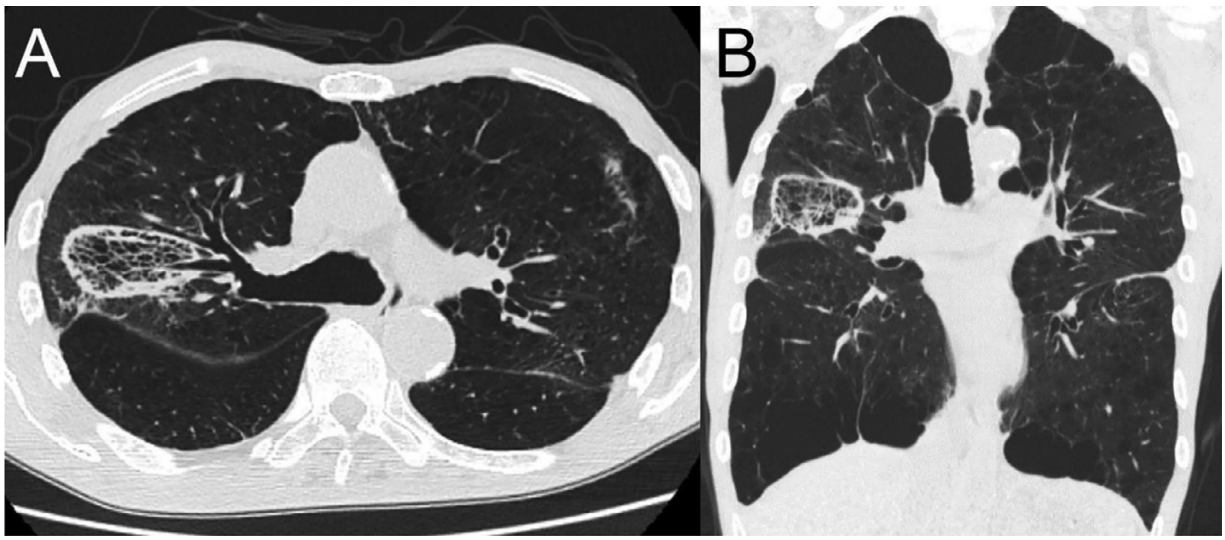


**Fig. 2 – Chest CT after 4 years of follow-up. Axial view (A) and coronal view (B). The GGO changed into an opaque oval lesion, which was surrounded by a well-defined thin consolidative rim, called the RHS. The area had shrunk and had caused an interlobar pleural indentation. CT, computed tomography; GGO, ground-glass opacity; RHS, reversed halo sign.**

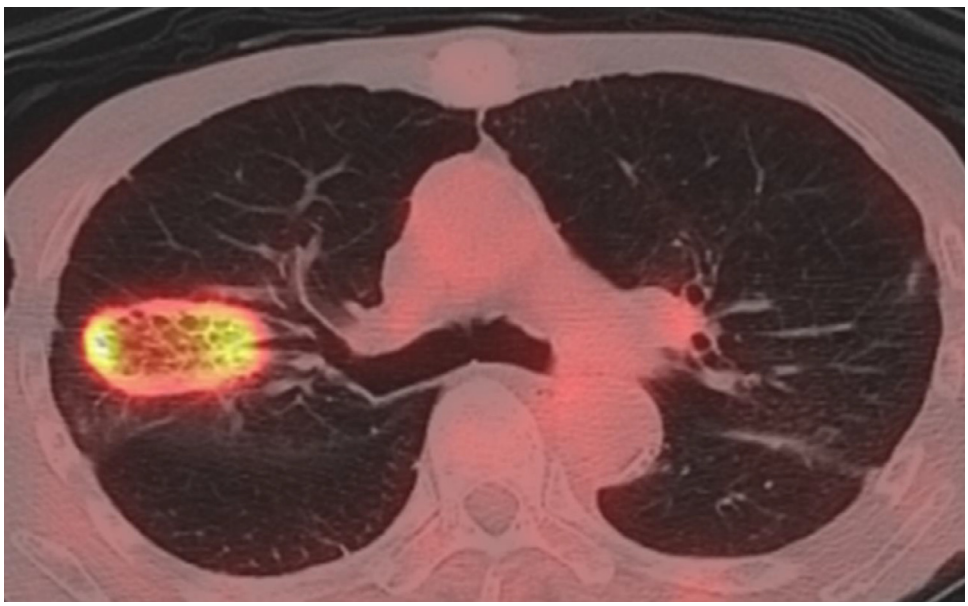

**Fig. 3 – FDG-PET scan. Uptake in the shadow was observed, with a maximal standardized uptake value of 8.49. The uptake was stronger at the ring of the lesion. FDG-PET, 18F-fluorodeoxyglucose-positron emission tomography.**

of follow-up, these findings had evolved into an oval lesion with increased air spaces surrounded by a ring of consolidation. The appearance of the lesion was consistent with the RHS, which is defined as the presence of a focal ring-shaped area of a GGO within a peripheral rim of consolidation [9]. In our case, the lesion resembled a typical adenocarcinoma lesion, in that it enlarged gradually, but it differed from an adenocarcinoma in the ring-like consolidation that had occurred, with high FDG levels. If GGOs contain air bronchograms or bronchial dilatation, or there is a ring of consolidation around the GGO, the possibility of MALT lymphoma may be considered.

The RHS was first described in patients with cryptogenic organizing pneumonia. Subsequently, it has been associated with several pulmonary diseases, including infectious diseases, such as paracoccidioidomycosis, tuberculosis, pulmonary mucormycosis, invasive pulmonary aspergillosis, *Pneumocystis jirovecii* pneumonia, and COVID-19, as well as noninfectious pathologies such as sarcoidosis, pulmonary embolism, granulomatosis with polyangiitis, and lung adenocarcinoma [9–11]. The RHS has been reported in a patient with intravascular large B cell lymphoma [12] and primary pulmonary diffuse large B cell lymphoma [13]; however, there have been no previous reports on pulmonary MALT lymphoma exhibiting the RHS.

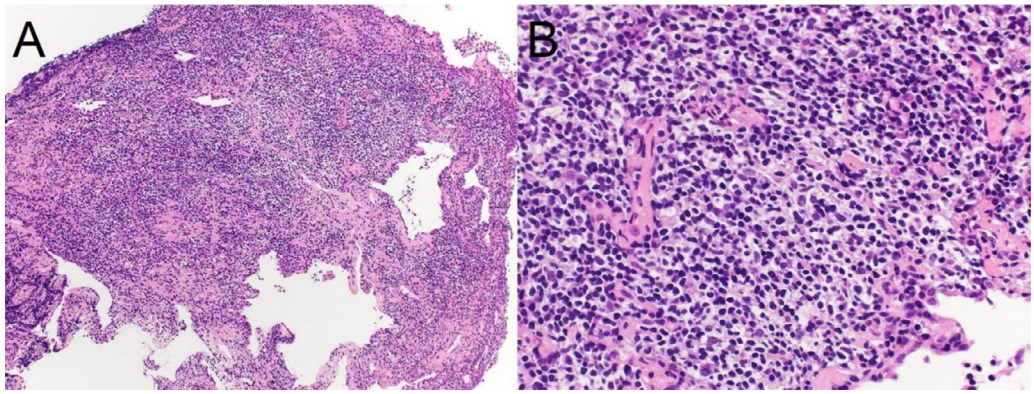


**Fig. 4 – Histopathology of the ring specimen. Dense infiltration of plasma cells and small lymphocytes with slightly irregular nuclei. Hematoxylin-eosin images at original magnification of 10 × (A) and 40 × (B).**

According to previous studies on the correlation between CT imaging and pathologic findings in pulmonary MALT lymphoma [4,5], differences in the extent and location of the lymphomatous infiltration accounted for differences in CT findings. The GGOs and micronodules resulted from lymphomatous infiltration of the interlobular septa and interalveolar wall. Subsequently, the lymphomas expanded and destroyed the alveolar walls, and filled the alveolar space with dense lymphomatous infiltration. These manifested as consolidations and mass formation in images. In addition, there was no destruction of the bronchial wall during airway dilation. Airway dilation resulted from the collapse and destruction of the peribronchial parenchyma secondary to lymphomatous proliferation.

In contrast, a rare clinical progression was observed in this case. The GGO changed into an opaque oval lesion exhibiting the RHS. Although it is a conjecture because of the lack of surgical specimens in this case, the following changes could have occurred: the dense lymphoma infiltration may have spread gradually into the periphery, accompanied by destruction of the internal lung parenchyma and impairment of local ventilation, resulting in shrinkage of the involved area. Thus, the peripheral lesions manifested as a ring with pleural indentation. The increased accumulation of FDG in the ring structure of the lesion supports this hypothesis.

Herein, we reported a rare case of pulmonary MALT lymphoma with the RHS from GGO. Pulmonary MALT lymphoma presents with various imaging findings, and it should be considered in the differential diagnosis of the RHS.

## Patient consent

Informed consent for publication of this case report was obtained from the patient described in this case.

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