



Coronavirus disease 2019 associated pulmonary mucormycosis

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A 55-year-old male with no previous comorbid illness presented with increasing breathlessness, productive cough, and minor hemoptysis for one week. At arrival, he was hemodynamically stable, had a respiratory rate of 26 breaths/min and oxygen saturation of 96% at ambient air. Random blood glucose was 258 mg/dL, and glycated hemoglobin level was 10.5% (reference range 4.0–6.0). Hemogram showed a hemoglobin of 13 gm/dl with leukocytosis (19.290/ μ l) and neutrophilia (90%). Three weeks before this presentation, he was diagnosed with coronavirus disease 2019 (COVID-19) and received Remdesivir and methylprednisolone (360 mg over 15 days) elsewhere. A previous computed tomography scan of the chest showed bilateral multiple lung lesions with central ground-glass opacifications surrounded by denser rings of consolidation (Fig. 1A), a finding classically described as reversed halo sign [1, 2]. The successive image revealed cavitation of the central ground-glass areas (Fig. 1B). Considering the clinical background, we initiated amphotericin suspecting pulmonary mucormycosis. Bronchoscopic biopsy of the necrotic plugs occluding the left lower lobe (Fig. 1C) demonstrated aseptate, broad, twisted, and folded hyphae indicating Mucorales (black arrows, Fig. 1D) confirming COVID-19-associated mucormycosis (CAM). He had no features suggestive of rhino-orbital-cerebral involvement. On the 9th day of hospitalization, he had massive hemoptysis leading to hypotension and respiratory distress, and the hemoglobin dropped to 8.3 gm/dL. He was emergently intubated and mechanically ventilated. A repeat bronchoscopy revealed a blood clot and fresh bleeding in the

left bronchial tree. He worsened progressively and passed away on the 10th day. He received 850 mg of amphotericin, including liposomal and amphotericin deoxycholate.

The majority of CAM occurs after a week of illness. The risk factors, clinical spectrum and mortality are similar between CAM and non-covid mucormycosis [3]. Diabetes mellitus remains the major risk factor for mucormycosis in developing nations, compared to hematological malignancies and solid organ transplants in developed countries [3–5]. Further, hypoxemia and inappropriate corticosteroid use contribute to the development of CAM [3, 4]. Older age, intensive care admission, and pulmonary and rhino-orbital-cerebral involvement increase the risk of death in CAM [3, 5]. Reversed halo sign is not pathognomonic of pulmonary mucormycosis, and a biopsy seems imperative to confirm the diagnosis [1, 2]. The diagnosis of pulmonary mucormycosis is challenging due to the low index of clinical suspicion, lack of an approved biomarker, limited access to diagnosis expertise, and difficulty obtaining tissue for diagnosis.

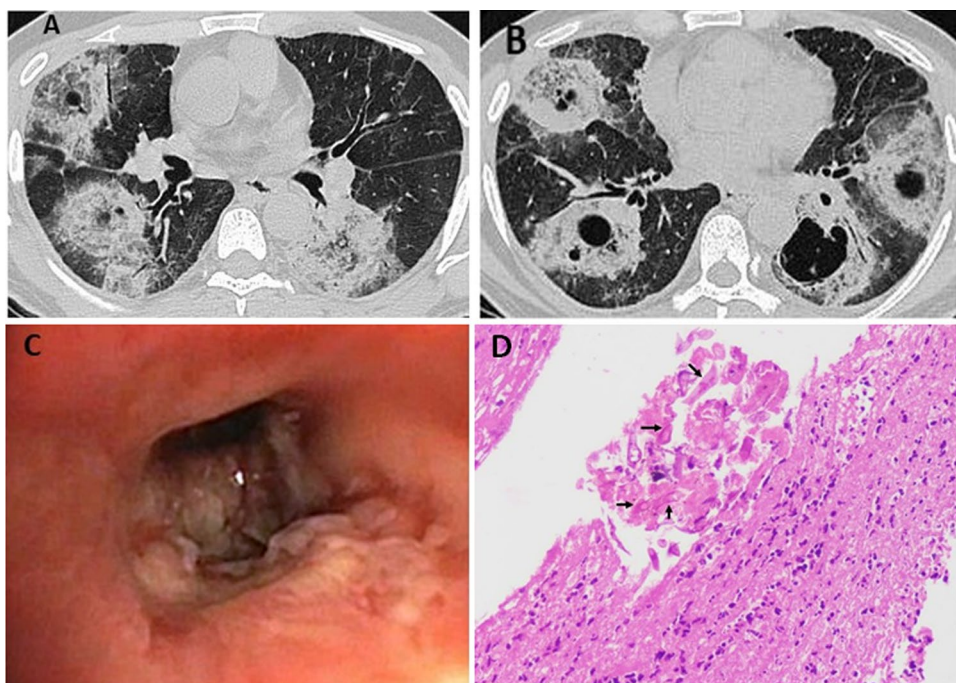
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Fig. 1 **A** shows bilateral central ground-glass opacification areas surrounded by denser consolidation rings described as a 'reversed halo sign'. **B** Cavitation of the central areas seen in successive image. **C** Flexible bronchoscopy revealed thick mucus plugs obstructing the left lower lobe bronchus. **D** Bronchoscopic biopsy of the mucus plug demonstrated aseptate, broad, twisted, and folded hyphae indicating Mucorales (black arrows)



Author contributions MKP conceptualized the idea, wrote the initial draft and reviewed the final draft. PS was involved in the patient's initial care and contributed to the writing. PM contributed to the writing and reported the histopathological findings. GD was involved in the patient's clinical care and contributed to the writing. All authors were involved in the care of the patient. All authors read and approved the final version of the manuscript.

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Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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Consent for publication Obtained.

References

1. Maturu VN, Agarwal R. Reversed halo sign: a systematic review. *Respir Care*. 2014;59:1440–9.
2. Sullivan T, Rana M. The reversed halo sign and mucormycosis. *Lancet Infect Dis*. 2019;19:1379.
3. Patel A, Agarwal R, Rudramurthy SM, et al. Multicenter epidemiologic study of coronavirus disease-associated mucormycosis. *India Emerg Infect Dis*. 2021;27:2349–59.
4. Muthu V, Agarwal R, Rudramurthy SM, et al. Multicenter case-control study of COVID-19-associated mucormycosis outbreak. *India Emerg Infect Dis*. 2023;29(1):8–19.
5. Muthu V, Rudramurthy SM, Chakrabarti A, et al. Epidemiology and pathophysiology of COVID-19-associated mucormycosis: India versus the rest of the world. *Mycopathologia*. 2021;186:739–54.