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Comprehensive Management of Rhino-Orbito-Cerebral Mucormycosis Post-COVID-19: A Case Report

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ABSTRACT

Post-COVID-19 mucormycosis, particularly the rhino-orbital-cerebral form, can be life-threatening. This case highlights the importance of maintaining high clinical suspicion, especially in patients with recent COVID-19 history. Prompt diagnosis, aggressive surgical debridement, and antifungal therapy are crucial for successful management, even in patients without traditional risk factors.

1 | Introduction

Mucormycosis, often referred to as the "black fungus," is a severe opportunistic infection caused by a group of molds known as mucormycetes. These fungi are ubiquitous in the environment but typically do not affect individuals with a healthy immune system [1, 2]. However, certain conditions can predispose individuals to mucormycosis, including diabetes mellitus, hematologic malignancies, organ transplantation, long-term corticosteroid therapy, immunosuppressive treatment, and renal failure, among others [3].

The pathogenesis involves the inhalation of fungal spores, with the nose and paranasal sinuses being common initial sites due to their exposure to the external environment. Mucormycosis is notorious for its aggressive course, often spreading to adjacent structures either directly or through vascular invasion, leading to thrombosis and subsequent tissue necrosis [4].

Clinically, mucormycosis can present in various forms, categorized into six primary types: rhino-orbito-cerebral, cutaneous, pulmonary, disseminated, gastrointestinal, and miscellaneous, each associated with distinct clinical features. Among these, rhino-orbito-cerebral mucormycosis is particularly notable for symptoms such as facial pain, nasal congestion, headache, sinusitis, fever, and nasal discharge [5].

Timely diagnosis and aggressive management are crucial for improving outcomes in patients afflicted with this infection. Diagnostic modalities like computed tomography (CT) and magnetic resonance imaging (MRI) play vital roles in assessing the extent of the disease [4]. Treatment typically involves a combination of surgical debridement of infected tissue and antifungal therapy. Despite these measures, the mortality rate remains high, influenced by the site of infection and overall patient health [6].

In this case report, we discuss a patient who developed extensive mucormycosis of the frontal bone and sinus following a COVID-19 infection, highlighting the complexities and challenges associated with managing this formidable fungal infection in a post-pandemic context.

Abbreviations: COVID-19, Coronavirus Disease 2019; CT, computed tomography; MRI, magnetic resonance imaging; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

2 | Case History/Examination

A 42-year-old male presented to the Department of Plastic Surgery with a 2-month history of persistent headache and frontal sinus infection refractory to antibiotic therapy. His symptoms had gradually worsened, and he developed progressive forehead swelling with scalp involvement. The patient had no remarkable past medical history or history of trauma. However, he reported a recent COVID-19 infection preceding the onset of his current illness. The patient reported being unvaccinated against COVID-19 at the time of his infection. Ophthalmological examination revealed no signs of ocular involvement, with normal visual acuity, extraocular movements, and fundoscopic findings. Neurological assessment showed no focal deficits or signs of increased intracranial pressure.

2.1 | Diagnostic Assessment

On physical examination, tenderness and fluctuance were noted in the forehead and supraorbital regions. Computed tomography (CT) imaging of the area revealed extensive destruction of the frontal bones and bilateral frontal sinuses. Magnetic resonance imaging (MRI) of the head and neck was performed pre-operatively. T1-weighted images with gadolinium enhancement showed extensive involvement of the frontal sinuses and frontal bone, with minimal extension into the anterior cranial fossa. Microbiological and histopathological examinations were performed to confirm the diagnosis. Direct microscopy of the necrotic tissue using potassium hydroxide (KOH) mount revealed broad, aseptate hyphae with right-angle branching, characteristic of mucormycetes.

2.2 | Therapeutic Intervention

The patient was taken to the operating room for surgical debridement under general anesthesia. A coronal incision was made, exposing the forehead. Copious thick purulent material and necrotic tissue were encountered and evacuated. Debridement involved the removal of all devitalized frontal bones, frontal sinuses, and supraorbital rims. The dura mater and forehead were covered with a galeal flap to provide vascular supply and promote healing. Following surgical debridement, the surgical site was irrigated with an amphotericin B solution (1 mg/mL) to ensure thorough local antifungal treatment. Antifungal therapy was initiated immediately upon suspicion of mucormycosis. The patient received liposomal amphotericin B (5 mg/kg/day) intravenously for 4 weeks. Following this, the patient was transitioned to oral posaconazole (300 mg twice daily on day 1, followed by 300 mg once daily) for additional 12 weeks.

2.3 | Follow-Up and Outcomes

A Jackson–Pratt drain was placed, and the wound was closed in layers. The patient's postoperative course was uneventful, and he was discharged after 1 week in stable condition. The patient was followed up for a total of 8 months post-surgery. During this period, regular clinical and radiological assessments were conducted to monitor for any signs of recurrence or complications. At the 8-month follow-up, the patient reported significant improvement in his quality of life. He had returned to his regular daily activities and work. The patient experienced no visual deficits or neurological sequelae. However, he reported mild cosmetic concerns due to the frontal bone defect, which will be addressed in a future cranioplasty procedure. The patient's overall satisfaction with the treatment outcome was high, despite the need for future reconstructive surgery.

3 | Discussion

After candidiasis and aspergillosis, mucormycosis represents the third most common angioinvasive and potentially fulminant fungal infection. The first case of mucormycosis was reported by Paultauf in 1885 [7]. While the causative agents of this disease, fungi from the order Mucorales, can be found in the natural environment and may even colonize the respiratory and gastrointestinal tracts of healthy individuals asymptomatically, they typically cause disease only in immunocompromised hosts [7, 8].

The main risk factors predisposing patients to mucormycosis include diabetes mellitus, hematological malignancies, organ transplantation, long-term corticosteroid or immunosuppressive therapy, neutropenia, iron overload, and malnutrition [9]. In a systematic review by W. Jeong et al., which analyzed 600 case reports involving 851 patients, diabetes mellitus emerged as the primary risk factor for developing mucormycosis. Our patient did not have any known predisposing conditions prior to his COVID-19 infection [10].

The COVID-19 pandemic has introduced a new risk factor for opportunistic fungal infections, including mucormycosis. The widespread use of corticosteroids and other immunomodulatory therapies in the management of severe COVID-19 cases can lead to impaired immune function, creating a favorable environment for the growth and dissemination of fungi [11]. Furthermore, the hyperglycemic state induced by corticosteroids may contribute to the pathogenesis of mucormycosis by providing an acidic blood environment conducive to fungal proliferation. Patients with pre-existing diabetes or other underlying conditions may be particularly susceptible to developing mucormycosis following COVID-19 infection and treatment [12]. In our case, the patient had a history of COVID-19 infection and likely received corticosteroid therapy during his hospitalization, which could have predisposed him to the development of this opportunistic fungal infection.

The rhino-orbital-cerebral form of mucormycosis, as seen in our patient, typically presents with symptoms such as facial pain, headache, fever, malaise, nasal discharge, nasal congestion, and sinusitis. Timely diagnosis through a combination of clinical evaluation, laboratory investigations, and radiological imaging is crucial for effective management and improved outcomes [13].

Several factors may contribute to the increased risk of mucormycosis in COVID-19 patients. First, SARS-CoV-2 can damage endothelial cells and create a pro-inflammatory state, potentially facilitating fungal invasion [14]. Second, the use of corticosteroids in COVID-19 management, while life-saving, can lead to immunosuppression and impaired neutrophil function [15]. A study by Singh et al. (2021) found that 76.3% of CAM patients

had received corticosteroids, with 60% developing hyperglycemia [16]. Third, COVID-19 itself can cause transient hyperglycemia, creating an ideal environment for mucormycetes growth. Lastly, the overall immunosuppressive state induced by severe COVID-19 may allow opportunistic fungi to thrive [17, 18]. These factors, combined with possible lapses in infection control measures during the pandemic, may explain the surge in mucormycosis cases among COVID-19 patients and survivors [19].

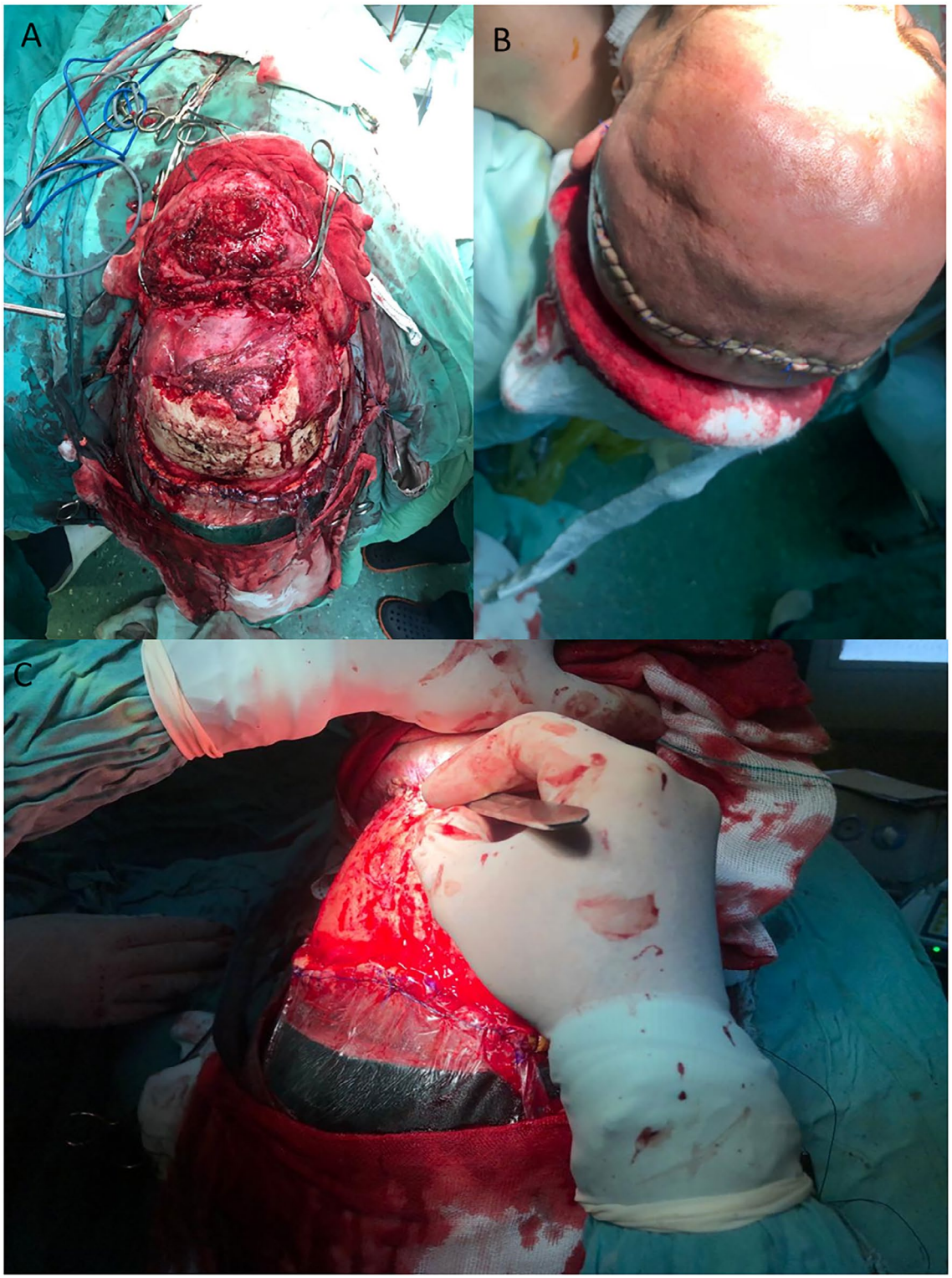

FIGURE 1 | Intraoperative photographs demonstrating the surgical management of extensive rhinoorbital mucormycosis. (A) Exposure of the forehead and frontal region via a coronal incision, revealing necrotic tissue and purulent material. (B) Debridement of devitalized frontal bones, frontal sinuses, and supraorbital rims. (C) Placement of a Jackson–Pratt drain and closure of the surgical wound.

In our case, the patient underwent extensive surgical debridement of the involved frontal bones, frontal sinuses, and supraorbital rims, with coverage of the dura and forehead using a vascularized galeal flap. This aggressive surgical approach, combined with the elimination of predisposing factors and appropriate antifungal therapy, is essential for the successful treatment of mucormycosis (Figure 1).

Despite prompt intervention, mucormycosis carries a significant risk of morbidity and mortality, necessitating long-term follow-up and potential reconstructive procedures, as highlighted by the need for future cranioplasty in our patient to address the calvarial defect.

4 | Conclusion

This case report illustrates the potential for COVID-19 and its associated treatments to predispose patients to rare but life-threatening opportunistic fungal infections such as mucormycosis. Maintaining a high index of suspicion, early diagnosis, and a multidisciplinary approach to management is crucial in improving outcomes for these challenging cases.

Author Contributions

Mohammad Dehbozorgi: methodology, writing – original draft, writing – review and editing. **Gholamreza Motazedian:** writing – original draft, writing – review and editing. **Ali Mohammad Fallah-Tafti:** writing – original draft, writing – review and editing. **Mehryar Nahaei:** writing – original draft, writing – review and editing. **Ebtesam Jabari Nia:** methodology, writing – original draft, writing – review and editing. **Fateme Salari:** writing – original draft, writing – review and editing. **Seyed Ali Nabavizadeh:** data curation, writing – original draft, writing – review and editing.

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The authors have nothing to report.

Ethics Statement

The present study was approved by the Medical Ethics Committee of Shiraz University of Medical Sciences. The purpose of this report was completely explained to the patient and written inform consent was obtained from the patient.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The de-identified data that support the findings of this case report are available from the corresponding author upon reasonable request, subject to institutional review board approval and patient privacy regulations.

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