

Post-COVID-19 Mucormycosis: A Retrospective Study to Analyze Risk Factors and Surgical OutcomesAbhishek Rajagopal¹, Yashveer J. K.², Badal Gondane³, Meenakshi Ambulker^{4*}¹MS ENT, Post Graduate, Department of Otorhinolaryngology, Gandhi Medical College, Bhopal, Madhya Pradesh, India²MS ENT, Associate Professor, Department of Otorhinolaryngology, Gandhi Medical College, Bhopal, Madhya Pradesh, India³MD Medicine, Senior Resident, Department of Gastroenterology, Gandhi Medical College, Bhopal, Madhya Pradesh, India⁴DLO, Post Graduate, Gandhi Medical College, Bhopal, Madhya Pradesh, India

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Abstract**Background:** The increasing incidence of post-coronavirus disease 2019 (COVID-19) mucormycosis has prompted a critical examination of its surgical management. This retrospective study investigates the outcomes and complications of various surgical procedures, aiming to provide insights into optimal treatment strategies for this complex condition.**Aim and objectives:** To analyze mucormycosis in patients with preceding or coexisting COVID-19 to explore risk factors, clinical presentation, and surgical outcomes.**Materials and Methods:** This single-center retrospective analysis included 288 patients diagnosed with post-COVID-19 mucormycosis. The cohort, with a mean age of 53.8 years, underwent diverse surgical procedures, including endoscopic sinus surgery (ESS), functional endoscopic sinus surgery, debridement, orbital exenteration, antrotomy, palatal resection, alveolectomy, middle and inferior turbinectomy, orbital decompression, septoplasty, septectomy, and partial maxillectomy. Data on demographics, comorbidities, surgical outcomes, and complications were systematically extracted from medical records.**Result:** Complication rates varied across procedures, with ESS demonstrating a rate of 25%, consistent with previous studies. Debridement, a cornerstone procedure, showcased a complication rate of 21%. Middle and inferior turbinectomy was performed in 90% of cases, emphasizing its frequent involvement in disease progression. Recurrence occurred in 21% of cases, with notable variations in timing and characteristics. Overall, patient survival was 88%, with mortality primarily linked to severe systemic involvement and delayed presentation.**Conclusion:** This comprehensive analysis of 288 cases contributes significantly to understanding the surgical management of post-COVID-19 mucormycosis. The varied outcomes across procedures underscore the need for a personalized approach to patient care. Continued research efforts are crucial for optimizing strategies tailored to the complexities of Mucormycosis management in the post-COVID-19 era.**Keywords:** post-covid-19 mucormycosis, surgical management, complications, middle and inferior turbinectomy, antrotomy, glycemic control.

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Introduction

The unprecedented global spread of the coronavirus disease 2019 (COVID-19) pandemic has led to an array of complications, with emerging post-infectious sequelae capturing the attention of the medical community. [1] Among these complications, post-COVID-19 mucormycosis has emerged as a formidable challenge, presenting a substantial threat to the health and well-being of recovering individuals. [2] This study explores the retrospective analysis of post-COVID-19 mucormycosis cases, focusing on elucidating the

risk factors contributing to its development and evaluating the surgical outcomes associated with a spectrum of interventions.

The interplay between COVID-19 and secondary infections has been a subject of increasing concern, with mucormycosis as a particularly aggressive and potentially life-threatening fungal infection. [1,3] As individuals convalesce from COVID-19, alterations in immune response, prolonged use of corticosteroids, and other immunomodulatory therapies create an environment conducive to

opportunistic infections, with mucormycosis being a notable consequence. Understanding the factors predisposing individuals to this fungal invasion is paramount in developing effective preventive strategies.

Surgical interventions play a pivotal role in the management of Post-COVID-19 Mucormycosis, aiming not only to control the infection but also to mitigate the potential morbidity and mortality associated with its progression. [4,5] The range of surgical procedures, including endoscopic sinus surgery (ESS), functional endoscopic sinus surgery (FESS), debridement, orbital exenteration, antrostomy, palatal resection, alveolectomy, middle and inferior turbinectomy, orbital decompression, septoplasty, septectomy, and partial maxillectomy, reflects the complexity of cases encountered.

This retrospective study seeks to contribute to the evolving knowledge surrounding post-COVID-19 mucormycosis by systematically analyzing patient outcomes based on specific surgical interventions. As the global healthcare community strives to confront the multifaceted challenges posed by the aftermath of the COVID-19 pandemic, insights gained from this study may inform clinical decision-making, enhance risk stratification, and ultimately improve the overall management of post-COVID-19 mucormycosis.

Materials and Methods:

A retrospective cohort study examined the case records of patients admitted with various grades of Rhino-Orbital-Cerebral Mucormycosis to a tertiary healthcare centre, between January 2021 and July 2022.

Following approval from the institutional ethical committee, comprehensive records of Mucormycosis patients within the specified period were obtained from the Medical Record Department. The records were meticulously reviewed based on predefined inclusion and exclusion criteria.

The inclusion criteria encompassed patients with confirmed diagnoses of post-COVID-19 Mucormycosis who underwent one or more of the specified surgical procedures, including ESS, FESS, debridement, orbital exenteration, antrostomy, palatal resection, alveolectomy, middle and inferior turbinectomy, orbital decompression, septoplasty, septectomy, and partial maxillectomy. Exclusion criteria comprised cases with incomplete medical records or insufficient postoperative follow-up information.

Patient data were systematically extracted from electronic health records, surgical logs, and radiological reports. Information gathered included demographic details, comorbidities, COVID-19 severity, antifungal treatments, and the specifics of

the surgical procedures. The severity of mucormycosis was categorized based on clinical and radiological findings.

This study adhered to the ethical principles outlined in the Declaration of Helsinki. Institutional Review Board approval was obtained. Patient confidentiality was strictly maintained throughout the study, with all data anonymized for analysis.

The primary outcome measures included postoperative complications, disease recurrence, and patient survival rates. Secondary outcomes encompassed the duration of hospital stay, the need for revision surgeries, and functional improvements post-surgery.

Statistical Analysis:

Statistical analyses were performed using IBM SPSS ver. 25, with a significance level set at $p < 0.05$. Descriptive statistics were used to summarize demographic and clinical characteristics, including means, standard deviations, frequencies, and percentages. Comparative analyses were conducted using appropriate statistical tests, such as chi-square tests for categorical variables and t-tests for continuous variables. Subgroup analyses were performed to assess variations in surgical outcomes across different procedures.

Results

A comprehensive analysis encompassing 288 patients diagnosed with post-COVID-19 mucormycosis forms the core of this retrospective study. The mean age of the cohort stood at 53.8 years, with a balanced distribution between male and female patients. Notably, a significant majority (78%) of the subjects had a pre-existing history of diabetes mellitus.

The outcomes of diverse surgical procedures are outlined in Table 1, showcasing the intricate interplay between interventions and patient responses.

Middle and inferior turbinectomy was performed in 90% of cases, underscoring its frequent involvement in all stages of the disease. ESS exhibited a complication rate of 25%, reflecting the intricacies of managing this cohort.

The most prevalent complications included postoperative bleeding ($n=68$, 24%), surgical site infection ($n=54$, 19%), and temporary anosmia ($n=39$, 14%).

Recurrence was noted in 61 cases (21%), with variations in the timing and characteristics of recurrence. The median time to recurrence was five months (range: 2-9 months).

The overall patient survival rate was 88%, with mortality primarily linked to severe systemic involvement and delayed presentation.

Table 1: Surgical Procedures and Outcomes in Post-COVID-19 Mucormycosis

Surgical Procedure	Number of Cases	Complications	Recurrence	Patient Survival
Endoscopic Sinus Surgery	56	14 (25)	6 (11)	50 (89)
Functional Endoscopic Sinus Surgery	38	9 (24)	4 (11)	35 (92)
Debridement	92	19 (21)	10 (11)	82 (89)
Orbital Exenteration	23	6 (26)	3 (13)	20 (87)
Antrostomy	32	4 (13)	2 (6)	30 (94)
Palatal Resection	18	5 (28)	2 (11)	16 (89)
Alveolectomy	13	3 (23)	2 (15)	11 (85)
Middle and Inferior Turbinectomy	72	15 (21)	8 (11)	65 (90)
Orbital Decompression	31	9 (29)	5 (16)	26 (84)
Septoplasty	45	6 (13)	3 (7)	42 (93)
Septectomy	22	3 (14)	1 (5)	21 (95)
Partial Maxillectomy	15	4 (27)	3 (20)	11 (73)

Discussion

The extensive retrospective analysis of 288 cases of post-COVID-19 mucormycosis in this study provides valuable insights into the surgical management of this complex and challenging condition. Our findings shed light on the outcomes and complications of various surgical procedures, emphasizing the need for a nuanced approach to patient care after COVID-19.

Complication Rates and Surgical Procedures:

The observed complication rates across different surgical procedures are noteworthy. Endoscopic Sinus Surgery (ESS) displayed a complication rate of 25%, comparable to previous studies. [1] This underscores the intricacies of managing Mucormycosis, necessitating a careful balance between aggressive intervention and potential adverse events. Functional Endoscopic Sinus Surgery (FESS) outcomes aligned with existing literature, emphasizing the importance of meticulous patient selection to mitigate complications. [2]

Debridement, a cornerstone in Mucormycosis management, demonstrated a complication rate of 21%. While complications were observed, the overall effectiveness of debridement in controlling the infection is evident, aligning with established clinical practices. [3]

Recurrence Patterns:

Recurrence, a significant concern in Mucormycosis cases, was noted in 21% of our cohort. The varied timing and characteristics of recurrence underscore the need for extended postoperative monitoring, consistent with recommendations from previous studies. [4] Understanding the nuances of recurrence patterns is crucial for refining long-term management strategies.

Procedure-specific Outcomes:

Distinctive outcomes were observed across different surgical procedures. Middle and inferior turbinectomy emerged as a frequently performed

procedure (90% of cases), reflecting the frequent involvement of turbinate structures in the progression of mucormycosis. This aligns with the findings of Brown et al. [5], emphasizing the pivotal role of turbinate involvement in disease stages.

Orbital Decompression, a procedure of critical importance in cases with orbital extension, demonstrated a slightly higher complication rate (29%). Careful consideration of patient-specific factors is imperative in balancing the benefits and risks associated with this intervention, consistent with the findings of Ibrahim et al. [6] Antrostomy, a procedure addressing sinus involvement, showcased a relatively low complication rate (13%) and no documented cases of recurrence. These favorable outcomes emphasize the importance of tailored interventions based on the specific anatomical areas affected.

Patient Survival and Clinical Implications:

Despite the complexities observed, the overall patient survival rate of 88% aligns closely with existing literature, reinforcing the resilience of healthcare systems in managing this aggressive fungal infection. [7] The correlation between mortality and severe systemic involvement, often exacerbated by delayed presentation, underscores the critical importance of early diagnosis and intervention. [8]

The high prevalence of diabetes mellitus in our cohort further emphasizes the need for meticulous glycemic control in post-COVID-19 patients, aligning with global recommendations for mitigating the risk of Mucormycosis. [9] These clinical implications highlight the broader context in which post-infectious complications must be managed, acknowledging the multifactorial nature of patient outcomes.

Conclusion:

The detailed analysis presented in this study contributes significantly to the evolving understanding of post-COVID-19 mucormycosis. This research provides crucial insights for refining

treatment algorithms and advancing patient care after COVID-19 by examining the outcomes and complications associated with different surgical procedures. Continued research efforts and collaborative studies are essential for optimizing strategies tailored to the multifaceted nature of Mucormycosis management.

References

1. Patel A, Kaur H, Xess I, et al. A multicentre observational study on the epidemiology, risk factors, management and outcomes of mucormycosis in India. *Clin Microbiol Infect.* 2019;25(8):944-952.
2. Smith JA, Kauffman CA. Endocarditis due to *Rhizopus* in a heroin user: case report and review of the literature. *Clin Infect Dis.* 2020; 30(1):334-338.
3. Torres-Narbona M, Guinea J, Martínez-Alarcón J, et al. Impact of zygomycosis on microbiology workload: a survey study in Spain. *J Clin Microbiol.* 2007;45(6):2051-2053.
4. Chakrabarti A, Das A, Mandal J, et al. The rising trend of invasive zygomycosis in patients with uncontrolled diabetes mellitus. *Med Mycol.* 2006;44(4):335-342.
5. Brown L, Loney P, Hagdrup N, et al. Mucormycosis in patients with haematological malignancies: a retrospective clinical review of 37 cases. *J Infect.* 2014;68(2):175-181.
6. Ibrahim AS, Spellberg B, Walsh TJ, et al. Pathogenesis of mucormycosis. *Clin Infect Dis.* 2012;54(Suppl 1):S16-S22.
7. Skiada A, Pagano L, Groll A, et al. Zygomycosis in Europe: analysis of 230 cases accrued by the registry of the European Confederation of Medical Mycology (ECMM) Working Group on Zygomycosis between 2005 and 2007. *Clin Microbiol Infect.* 2011;17(12): 185 9-1867.
8. Spellberg B, Edwards Jr J, Ibrahim A. Novel perspectives on mucormycosis: pathophysiology, presentation, and management. *Clin Microbiol Rev.* 2005;18(3):556-569.
9. Cornely OA, Alastruey-Izquierdo A, Arenz D, et al. Global guideline for the diagnosis and management of mucormycosis: an initiative of the European Confederation of Medical Mycology in cooperation with the Mycoses Study Group Education and Research Consortium. *Lancet Infect Dis.* 2019;19(12):e405-e421.