https://africanjournalofbiomedicalresearch.com/index.php/AJBR
Afr. J. Biomed. Res. Vol. 27(September 2024); 106-109

Research Article

Fungal Infections of the Paranasal Sinuses: Microbiological Profiles and Treatment Outcomes

Dr. Priyanka[a], Dr. Kanupriya Tiwari[b], Dr Gauri E Yadav[c], Dr Sanya Datta[d*]

[a]Department of Microbiology, Varunarjun Medical College
[b]Post graduate Department of Clinical Microbiology, King George's Medical University
[c]Department of Microbiology, M.I.M.E.R. Medical College and Dr. B.S.T.R. Hospital
[d]Department of Otorhinolaryngology -Head and Neck Surgery, Government Medical College Kota*

Abstract
Fungal infections of the paranasal sinuses, while less prevalent than bacterial infections, present complex clinical challenges due to their varying severity and diverse fungal etiology. This prospective study, spanning two years at a tertiary care hospital, aimed to characterize the microbiological profiles of fungal pathogens involved in sinus infections and evaluate the efficacy of different treatment strategies. Out of 200 patients with fungal sinusitis, Aspergillus spp. was identified in 60% of cases, while Mucor spp. was found in 25%. Treatment outcomes varied with antifungal therapy alone achieving a 75% success rate, surgical intervention alone 80%, and combined therapy 90%. Kaplan-Meier survival analysis highlighted significantly better outcomes for combined therapy compared to monotherapies. Adverse effects from antifungal treatments included hepatotoxicity (10%) and nephrotoxicity (5%), while surgical complications were minimal. This study emphasizes the importance of a tailored treatment approach, particularly combined therapies, in managing severe fungal sinusitis and improving patient outcomes.

Keywords: Fungal rhinosinusitis, Aspergillus spp., Mucor spp., antifungal therapy, surgical intervention, combined therapy, Kaplan-Meier survival analysis

***Author for correspondence: Email:** *sanyadatta95@gmail.com*

Receiving date: 10/07/2024 Acceptance date: 20/08/2024

DOI: https://doi.org/10.53555/AJBR.v27i1S.1217

INTRODUCTION

Fungal infections of the paranasal sinuses, known as fungal rhinosinusitis, range from benign to severe and potentially life-threatening conditions. These infections are classified into non-invasive and invasive types. Non-invasive fungal sinusitis includes allergic fungal sinusitis (AFS) and fungal ball sinusitis, predominantly associated with Aspergillus spp., especially Aspergillus fumigatus. These typically occur in immunocompetent individuals and are often chronic [1][2]. Conversely, invasive fungal sinusitis is characterized by aggressive tissue invasion and is primarily caused by Mucor spp., including Rhizopus and Lichtheimia. This form frequently affects immunocompromised patients, such as those with diabetes mellitus, undergoing chemotherapy, or on long-term corticosteroid therapy [3][4]. Candida spp. also contributes to both chronic and acute fungal sinusitis, though less frequently [5].

Clinically, fungal sinusitis may present with symptoms ranging from chronic nasal obstruction and facial pain to severe, rapidly progressing signs indicative of invasive disease [6]. Diagnosis involves clinical assessment, imaging studies (CT or MRI), and microbiological confirmation through culture and molecular techniques [7][8]. Treatment strategies include antifungal therapy, surgical debridement, or a combination of both [9][10]. Antifungal agents such as voriconazole and amphotericin B are used, with voriconazole being effective against Aspergillus infections and amphotericin B against Mucor infections [11][12]. Surgical intervention is crucial for invasive fungal

sinusitis, as early debridement of infected tissue can be lifesaving [13]. However, managing fungal sinusitis remains complex due to pathogen virulence variations, patient comorbidities, and potential treatment-related adverse effects [14].

This study aims to provide a comprehensive analysis of the microbiological profiles associated with fungal sinus infections and evaluate the effectiveness of various treatment modalities. By examining clinical cases and treatment outcomes, we seek to offer insights into optimizing management strategies for these challenging infections.

Methods

Study Design

This prospective study was conducted at a tertiary care hospital from January 2022 to December 2023. Ethical approval was obtained from the institutional review board, and informed consent was obtained from all participants.

Patient Selection

Patients presenting with symptoms suggestive of fungal sinusitis, such as nasal obstruction, facial pain, and nasal discharge, were included. Inclusion criteria required clinical suspicion of fungal sinusitis confirmed by imaging (CT or MRI) and positive fungal culture. Patients with bacterial sinusitis or prior antifungal treatment were excluded.

Data Collection

Data on patient demographics, clinical presentations, diagnostic imaging, microbiological findings, and treatment outcomes were systematically recorded. Fungal species were identified using culture methods, with molecular techniques employed for species confirmation when necessary.

Treatment Modalities

Treatment strategies included antifungal therapy, surgical intervention, or a combination of both, tailored to the type and severity of infection, as well as patient comorbidities.

Statistical Analysis

Descriptive statistics were used to summarize the data. Treatment outcomes were compared using chi-square tests and Kaplan-Meier survival analysis, with a significance level set at $p<0.05$.

Results

Demographics and Clinical Presentation

A total of 200 patients with confirmed fungal sinusitis were included in the study. The mean age was 47 years, with a slight male predominance (55%). The most common symptoms were nasal obstruction (85%), facial pain (75%), and nasal discharge (65%).

Demographic Parameter	Value
Mean Age (years)	47
Gender Distribution	Male: 55%, Female: 45%
Common Symptoms	Nasal obstruction: 85%, Facial pain: 75%, Nasal discharge: 65%

Comorbidities

Significant comorbidities included diabetes mellitus (30%), immunosuppression (25%), and chronic kidney disease (10%).

Comorbidity	Number of Cases	Percentage (%)
Diabetes Mellitus	60	30
Immunosuppression	50	25
Chronic Kidney Disease	20	10
Others	70	35
Total	**200**	**100**

Microbiological Findings

The predominant fungal pathogens identified were Aspergillus spp. (60%), followed by Mucor spp. (25%), and Candida spp. (15%).

Pathogen	Number of Cases	Percentage (%)
Aspergillus spp.	120	60
Mucor spp.	50	25
Candida spp.	30	15
Total	**200**	**100**

Imaging Findings

Imaging studies revealed characteristic findings associated with fungal sinusitis. Common radiological features included heterogeneous opacification (80%), bone erosion (30%), and intracranial extension (10%).

Imaging Finding	Number of Cases	Percentage (%)
Heterogeneous Opacification	160	80
Bone Erosion	60	30
Intracranial Extension	20	10
Total	**200**	**100**

Treatment Outcomes

Antifungal Therapy Alone: Success rate of 75%

Surgical Intervention Alone: Success rate of 80%

Combined Therapy: Success rate of 90%

Treatment Modality	Number of Cases	Success Rate (%)	Mortality Rate (%)
Antifungal Therapy Alone	100	75	10
Surgical Intervention Alone	70	80	5
Combined Therapy	30	90	5
Total	**200**	**85**	**10**

Kaplan-Meier Survival Analysis

Kaplan-Meier survival analysis was performed to compare the survival rates among the different treatment groups. The results showed that patients receiving combined therapy had the best prognosis, with a significant difference in survival rates compared to those receiving antifungal therapy alone ($p<0.05$).

Time (Months)	Antifungal Therapy	Surgical Intervention	Combined Therapy
0	100	100	100
1	95	97	99
3	90	94	97
6	85	90	95
12	75	85	90
18	70	82	90
24	65	80	90

Adverse Effects

Antifungal Therapy: Hepatotoxicity (10%), nephrotoxicity (5%), allergic reactions (3%)

Surgical Intervention: Bleeding (5%), postoperative infections (2%)

Adverse Effect	Number of Cases	Percentage (%)
Hepatotoxicity (Antifungal)	20	10
Nephrotoxicity (Antifungal)	10	5
Allergic Reactions (Antifungal)	6	3
Bleeding (Surgical)	10	5
Postoperative Infections	4	2
Total	**50**	**25**

Discussion

Comparative Analysis of Microbiological Profiles

Our study found Aspergillus spp. (60%) and Mucor spp. (25%) as the predominant pathogens in fungal sinusitis, consistent with previous studies [1][4]. Aspergillus spp. is commonly associated with non-invasive forms of fungal sinusitis, whereas Mucor spp. is linked to invasive cases [3][5]. Candida spp., although less common, still plays a significant role in both chronic and acute fungal infections.

Treatment Modalities

Antifungal Therapy

Antifungal therapy alone achieved a success rate of 75%, highlighting its effectiveness for non-invasive fungal sinusitis. Voriconazole was preferred for Aspergillus infections [11]. However, the 10% mortality rate in invasive cases underscores the need for more aggressive treatments.

Surgical Intervention

Surgical intervention had an 80% success rate and is crucial for debridement in invasive fungal sinusitis. Endoscopic sinus surgery was the primary approach used [13]. Despite its effectiveness, the 5% mortality rate indicates that surgery alone may not be sufficient for severe cases.

Combined Therapy

Combined therapy demonstrated the highest success rate (90%) and lowest mortality rate (5%). This suggests that multimodal treatment, combining surgical debridement and targeted antifungal therapy, is most effective, particularly for severe invasive infections [9][10].

Kaplan-Meier Survival Analysis

Kaplan-Meier survival analysis highlighted that combined therapy offers significantly better outcomes compared to monotherapies, especially beyond the 6-month mark. This supports the need for early and aggressive combined treatment strategies [12].

Adverse Effects

Adverse effects from antifungal therapy included hepatotoxicity (10%) and nephrotoxicity (5%), necessitating careful monitoring. Surgical complications were minimal, with bleeding (5%) and postoperative infections (2%) being the most common issues.

Comparative Clinical Implications

Microbiological Identification: Accurate pathogen identification is critical for selecting appropriate treatments. Misidentification can lead to ineffective therapy [1][8].

Patient Comorbidities: Immunocompromised patients are at higher risk for invasive fungal sinusitis, requiring more aggressive treatment approaches [6][9].

Tailored Treatment Approaches: Non-invasive fungal sinusitis can often be managed with antifungal therapy alone, while invasive cases benefit from combined surgical and antifungal treatment [10][13].

Monitoring **and Follow-Up**: Regular follow-up is essential for managing treatment efficacy and adverse effects. Long-term outcomes favor combined therapy, highlighting the need for sustained management strategies [11][14].

Limitations

This study's single-center design may limit the generalizability of the findings. Additionally, the relatively short follow-up period may not capture long-term outcomes or late recurrences. Future multicenter studies with extended follow-up are needed to validate these results and provide more comprehensive insights.

Conclusion

Fungal infections of the paranasal sinuses present significant diagnostic and therapeutic challenges. This study underscores the importance of understanding the microbiological profiles for effective management. Combined therapeutic approaches offer the best outcomes, particularly for invasive infections. Early diagnosis and tailored treatment strategies are crucial for improving patient outcomes.

References

Chakrabarti, A., & Denning, D. W. (2015). Fungal sinusitis in the world's most populated country. *Mycoses*, *58*(Suppl 1), 65-75.

deShazo, R. D., Chapin, K., & Swain, R. E. (1997). Fungal sinusitis. *The New England Journal of Medicine*, *337*(4), 254-259.

Ferguson, B. J. (2000). Definitions of fungal rhinosinusitis. *Otolaryngologic Clinics of North America*, *33*(2), 227-235.

Galan, J., & Rivas, M. (2016). The role of surgical debridement in the management of invasive fungal sinusitis. *European Archives of Oto-Rhino-Laryngology*, *273*(9), 2821-2828.

Godey, B., & Behari, A. (2003). Fungal rhinosinusitis: An update. *Indian Journal of Otolaryngology and Head & Neck Surgery*, *55*(1), 52-59.

Godey, B., & Behari, A. (2003). Fungal rhinosinusitis: An update. *Indian Journal of Otolaryngology and Head & Neck Surgery*, *55*(1), 52-59.

Lee, C. H., & Lin, P. Y. (2018). The role of imaging in fungal sinusitis. *Journal of Medical Imaging and Radiation Sciences*, *49*(4), 413-420.

Montone, K. T., Livolsi, V. A., Feldman, M. D., Palmer, J., Chiu, A. G., Lanza, D. C., ... & Loevner, L. A. (2013). Fungal rhinosinusitis: a retrospective microbiologic and pathologic review of 400 patients at a single university medical center. *The Laryngoscope*, *123*(8), 1849-1855.

Murr, A. H., Smith, T. L., Hwang, P. H., Bhattacharyya, N., Lanier, B. J., & Stankiewicz, J. A. (2010). Safety and efficacy of combined endoscopic sinus surgery and antifungal therapy for chronic rhinosinusitis. *Annals of Otology, Rhinology & Laryngology*, *119*(5), 365-371.

Pant, H., Kette, F. E., Smith, W. B., Wormald, P. J., Macardle, P. J., & Harvey, R. J. (2009). Chronic rhinosinusitis: A microbiological and immunological review. *American Journal of Rhinology & Allergy*, *23*(2), 125-132.

Rains, B. M., & Mineck, C. W. (2003). Treatment of invasive fungal sinusitis with amphotericin B: a retrospective study. *Journal of the American Academy of Audiology*, *14*(6), 380-386.

Rupa, V., Jacob, M., Mathews, M. S., & Thomas, M. (1997). Clinicomycological and pathologic study of allergic fungal sinusitis. *The American Journal of Otolaryngology*, *18*(4), 231-235.

Sharma, S., & Yadav, D. (2018). Allergic fungal rhinosinusitis: Clinicopathological characteristics. *Nigerian Journal of Clinical Practice*, *21*(6), 755-759.

Zhang, T., & He, H. (2017). Efficacy of voriconazole for the treatment of Aspergillus sinusitis: A meta-analysis. *Journal of Antimicrobial Chemotherapy*, *72*(4), 1120-1127.