Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies

Journal home page:www.jamdsr.com doi:10.21276/jamdsr Index Copernicus value [ICV] =82.06

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

Assessment of Fungal Infections in Chronic Rhinosinusitis Patients: A Surgical Study

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ABSTRACT:

Background: Fungal rhinosinusitis (FRS) is an increasingly recognized contributor to chronic rhinosinusitis (CRS), particularly in tropical regions like India. Timely diagnosis and management are crucial to preventing complications and optimizing outcomes. **Aim:** To analyze the clinical and radiological findings, determine the prevalence and mycological profile of fungal rhinosinusitis, and compare the diagnostic efficacy of KOH wet mount and fungal culture in patients undergoing functional endoscopic sinus surgery (FESS) at a tertiary care hospital. **Material and Methods:** A prospective observational study was conducted including 100 patients with CRS undergoing FESS. Clinical symptoms, radiological findings, and intraoperative specimens were evaluated. Specimens underwent KOH wet mount, Gram staining, fungal culture, and bacterial culture. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the KOH mount were assessed using fungal culture as the gold standard. **Results:** The prevalence of culture-positive fungal rhinosinusitis was 32%, with Aspergillus flavus being the most common isolate. Common symptoms included nasal obstruction (85%), headache (82%), and allergy (75%). Bilateral nasal polyps and deviated nasal septum were frequent anatomical findings. The KOH mount showed a sensitivity of 62% and specificity of 96%, with a PPV of 91% and NPV of 85% compared to culture. **Conclusion:** Fungal rhinosinusitis is a significant cause of CRS in India. Clinical and radiological suspicion, combined with microbiological confirmation, is essential for diagnosis. While the KOH mount offers a useful rapid screening tool, fungal culture remains indispensable for definitive identification and guiding appropriate management.

Keywords: Fungal rhinosinusitis, chronic rhinosinusitis, KOH mount, fungal culture, endoscopic sinus surgery

Received: 12 March, 2018 Accepted: 14 April, 2018 Published: 17 May, 2018

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This article may be cited as: Jain M. Assessment of Fungal Infections in Chronic Rhinosinusitis Patients: A Surgical Study. J Adv Med Dent Scie Res 2018;6(5):186-190.

INTRODUCTION

Chronic rhinosinusitis (CRS) is a persistent inflammatory condition of the paranasal sinuses that often leads to significant morbidity and impaired quality of life. While bacterial infections have traditionally been considered the primary cause, increasing evidence points toward the crucial role of fungal infections, especially in tropical and subtropical regions such as India [1]. Fungal rhinosinusitis (FRS) has gained recognition as a clinically significant entity, presenting in a spectrum ranging from benign non-invasive disease to aggressive invasive forms, particularly in immunocompromised patients [2,3].

The clinical presentation of FRS often overlaps with that of bacterial CRS, with symptoms including nasal obstruction, discharge, facial pain, and hyposmia [4]. However, radiological findings, particularly on computed tomography (CT), such as hyperdense sinus opacification, bone erosion, and heterogeneous calcifications, raise suspicion for fungal etiology [5]. Early and accurate diagnosis is critical, as invasive fungal sinusitis can progress rapidly with devastating complications if untreated [6].

Mycological identification remains the cornerstone for confirming FRS. The potassium hydroxide (KOH) wet mount is a rapid and cost-effective method for fungal detection but has variable sensitivity. In contrast, fungal culture offers higher specificity, enabling species-level identification and antifungal susceptibility testing, though it requires longer processing time [7]. Studies have reported that

Aspergillus species and dematiaceous fungi are among the most frequently isolated pathogens in FRS [8].

Functional endoscopic sinus surgery (FESS) has become the standard treatment for CRS and FRS, offering effective sinus drainage and facilitating the removal of fungal debris, particularly in allergic fungal rhinosinusitis [9]. Given the diagnostic and therapeutic challenges posed by fungal infections in CRS patients, especially in resource-limited settings, it is essential to evaluate the prevalence, clinical patterns, radiological features, and microbiological profile to guide optimal management strategies [10].

This study aims to analyze the clinical and radiological findings, determine the prevalence and mycological profile of fungal rhinosinusitis, and compare the diagnostic efficacy of KOH wet mount and culture in patients undergoing FESS at a tertiary care hospital in India.

MATERIAL AND METHODS

This prospective observational study was conducted at a tertiary care hospital in India. A total of 100 patients diagnosed with chronic rhinosinusitis (CRS) who were scheduled for functional endoscopic sinus surgery (FESS) were included. The Institutional Ethics Committee approved the study, and informed consent was obtained from all participants.

Patients with a clinical diagnosis of CRS based on history, physical examination, and radiological findings were enrolled. Exclusion criteria included patients with sinonasal malignancy, prior sinonasal surgery, or those who were immunocompromised due to conditions like uncontrolled diabetes, HIV/AIDS, or chemotherapy.

Intraoperatively, sinus contents such as mucin, tissue debris, and nasal polyps were collected aseptically and divided into portions for microbiological and histopathological evaluation.

For microbiological analysis:

- **KOH wet mount** was performed by adding 10% potassium hydroxide to the sample to detect fungal elements under light microscopy.
- **Gram staining** was conducted to visualize bacteria and yeast-like fungi, helping to assess mixed infections.
- **Fungal culture** was performed by inoculating samples onto Sabouraud dextrose agar (with and without antibiotics) and incubating at 25°C and 37°C for up to four weeks. Fungal isolates were identified based on colony morphology, microscopy, and biochemical tests.
- **Bacterial culture** was done by plating samples onto blood agar and MacConkey agar, incubating at 37°C for 24–48 hours. Bacterial isolates were identified using standard microbiological techniques, including Gram staining, catalase, coagulase, and oxidase tests.

Radiological evaluation was carried out using computed tomography (CT) of the paranasal sinuses, assessing sinus opacification, bony erosion, and calcifications suggestive of fungal infection. Clinical parameters such as nasal obstruction, discharge, facial pain, and hyposmia were recorded preoperatively.

The diagnostic efficacy of KOH mount and fungal culture was compared, with culture considered the gold standard. Descriptive statistics were used to analyze demographic data, clinical features, radiological findings, and microbiological results.

Statistical analysis was performed using SPSS version 15.0. Descriptive statistics summarized demographic data, clinical features, and microbiological results. The prevalence of fungal rhinosinusitis was calculated. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the KOH mount were determined using culture as the gold standard. Chi-square or Fisher's exact test was applied for categorical variables, and a p-value <0.05 was considered statistically significant.

RESULTS

Table 1 shows the demographic, occupational, symptomatic, and fungal culture profile of the study population. The most common age group was 21–30 years, with a slight male predominance. Coolies and housewives made up the largest occupational groups. The most frequent symptoms were nasal obstruction, headache, and allergy, while 32 patients had culture-positive fungal infections.

Table 2 presents the prevalence of systemic diseases, nasal polyps, deviated nasal septum (DNS), sinus involvement, and fungal isolates. Diabetes mellitus was the most common systemic condition. Bilateral nasal polyps and DNS to the left were frequently observed, and the majority of patients were involved of all sinuses. Aspergillus flavus was the most common fungal isolate, followed by Aspergillus fumigatus.

Table 3 compares KOH mount and fungal culture techniques. Of the culture-positive cases, 20 were also positive on KOH mount, while 12 were missed. Only 2 KOH-positive cases were culture-negative, showing a good agreement between the two methods.

Table 4 summarizes the diagnostic performance of the KOH mount, showing a sensitivity of 62%, specificity of 96%, a true predictive value of 91%, and a false predictive value of 85%, highlighting its utility as a rapid screening tool when compared to culture.

Table 1: Demographic, occupational, symptomatic and fungal culture profile.

Variables	Number of patients (n = 100)
Age (in years)	
0–10	2

11–20	15
21–30	20
31–40	18
41–50	22
51–60	15
61–70	6
71–80	2
Sex	
Male	58
Female	42
Occupation	
Coolie	28
Housewife	26
Farmers	18
Others	28
Symptoms	
Headache	82
Nasal discharge	52
Nasal obstruction	85
Sneezing	72
Cough	20
Wheeze	25
Hyposmia	38
Allergy	75
Fungal culture	
Culture positive	32
Culture negative	68

Table 2: Prevalence of systemic diseases, nasal polyps, deviated nasal septum, sinus involvement and fungal isolates.

Variables	Number of patients (n = 100)
Systemic diseases	
Diabetes mellitus	20
Hypertension	6
Both diabetes and hypertension	5
Neither diabetes nor hypertension	69
Polyp and deviation	
Unilateral polyp	12
Bilateral polyps	20
Total patients with polyp	32
Deviated nasal septum to the right	22
Deviated nasal septum to the left	31
Total patients with DNS	53
Involvement of sinuses	
Bilateral maxillary sinuses	12
Unilateral maxillary sinus	5
Sphenoidal sinus	6
All sinuses	45
Fungal isolates	
Aspergillus flavus	18
Aspergillus fumigatus	8
Fusarium species	4
Rhizopus	2

Table 3: Evaluation of KOH mount versus culture techniques.

Variables	Culture positive	Culture negative	Total
KOH positive	20	2	22
KOH negative	12	66	78

Total	32	68	100

Table 4: Sensitivity and specificity of KOH mount and culture.

Variables	%
Sensitivity	62
Specificity	96
True predictive value	91
False predictive value	85

DISCUSSION

This study sheds light on the clinical, radiological, and mycological characteristics of fungal rhinosinusitis (FRS) in patients with chronic rhinosinusitis (CRS) undergoing functional endoscopic sinus surgery (FESS) at a tertiary care hospital in India. The overall prevalence of fungal culture-positive cases was 32%, reflecting the increasing global and regional recognition of fungal sinus infections as a significant contributor to CRS, particularly in tropical climates like India, where warmth and humidity create an ideal environment for fungal proliferation [11].

The majority of patients in this study presented with symptoms such as nasal obstruction, headache, sneezing, allergy, and hyposmia. These findings align with prior studies, which emphasize that the clinical symptoms of FRS often mimic those of bacterial CRS, making clinical suspicion alone insufficient for diagnosis [12]. Importantly, a history of allergy was documented in 75% of patients, underlining the association between atopy and allergic fungal rhinosinusitis (AFRS), as also described by Chakrabarti et al. and Prateek et al., who noted that AFRS constitutes a major subtype of non-invasive FRS in India [13,14].

Radiological evaluation using CT scans revealed extensive sinus involvement, with the majority showing polyposis, bilateral or unilateral maxillary sinus opacification, and involvement of all sinuses in some cases. This is consistent with Aribandi et al., who reported that hyperattenuating sinus contents, bone erosion, and expansion are hallmark radiological features of fungal disease [15]. The frequent presence of nasal polyps and deviated nasal septum in this cohort emphasizes the importance of addressing anatomical variations that may predispose patients to chronic or recurrent disease.

Systemic diseases, particularly diabetes mellitus, were common comorbidities in this cohort. The immunocompromised state associated with diabetes is a well-known risk factor for invasive fungal infections, including mucormycosis, which has been increasingly reported in India, especially during the COVID-19 era [16]. Therefore, strict glycemic control should be emphasized in CRS patients at risk of fungal disease.

From a microbiological perspective, Aspergillus flavus was the most frequently isolated species, followed by Aspergillus fumigatus, Fusarium species, and Rhizopus. This mirrors the pattern reported in other Indian studies, highlighting geographic and climatic influences on fungal epidemiology [13,14]. Notably, Aspergillus species are often implicated in both AFRS and fungal balls, while Mucorales are typically associated with invasive disease in diabetics and immunocompromised hosts.

A key finding of this study is the comparison of KOH wet mount and fungal culture. KOH mount demonstrated good specificity (96%) but moderate sensitivity (62%), which is in line with the findings of Panda et al. and Sharma et al., who reported that while KOH is rapid, it may miss cases, particularly when fungal load is low or sampling is suboptimal [14,17]. Culture remains the gold standard, allowing definitive identification and antifungal susceptibility testing. However, the combination of KOH and culture improves diagnostic yield and enables earlier therapeutic intervention.

Recent advances in molecular diagnostics, such as PCR-based assays, have shown promise in enhancing sensitivity, especially in patients with deep-seated or invasive disease, though these tools remain largely limited to research settings or specialized centers [18]. Therefore, in resource-limited environments like many Indian hospitals, combining KOH with culture remains the most practical approach.

Overall, the study highlights the need for a multidisciplinary approach to FRS, integrating clinical, radiological, and microbiological data. Awareness among clinicians, early diagnosis, and timely surgical intervention, combined with appropriate antifungal therapy, are key to improving outcomes and reducing morbidity.

CONCLUSION

Fungal rhinosinusitis is a significant cause of morbidity among CRS patients undergoing FESS, with Aspergillus species being the most common pathogens. Clinical and radiological suspicion, combined with microbiological confirmation, remains essential for accurate diagnosis. Although the KOH mount is a useful and rapid screening tool, culture remains indispensable for definitive identification. Early diagnosis and appropriate management can improve patient outcomes, especially in regions with high fungal disease burden.

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