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Original Research Article

Proportion and clinico-mycological profile of fungal sinusitis in a tertiary care hospital

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ABSTRACT

Background: Rhinosinusitis is the inflammation of the nose and sinus cavities, which affects about 20% of the population. Earlier considered to be primarily affecting immunocompromised individuals, now increasingly being reported in immunocompetent patients as well. This was a prospective study aimed at evaluating the clinical and mycological profile of fungal sinusitis.
Methods: The collected samples were subjected to three methods: KOH mount, LPCB mount, and fungal culture.
Results: Out of 128, males were 53.5% and females were 46.4%. The fungal sinusitis contributed to 25%, with a mean age of 46.5 years. A significant association between fungal sinusitis and diabetes mellitus ($p<0.0001$) was noted. The common factors were agricultural occupation (53%) and monsoon season (35.7%). Nasal obstruction (64.2%) was the predominant symptom. CT scan revealed frequent maxillary and ethmoid involvement. Culture positivity was seen in 21.4%, of which the histopathology correlation was seen in 46.4% of the cases. The fungi isolated were *Aspergillus spp., Rhizopus spp., Fusarium spp., and Curvularia spp*. Complications like osteomyelitis, adenoiditis, and facial palsy were noted in 21%, and mortality was 3.5%.
Conclusions: A higher incidence was noted in middle-aged females, diabetics, and during the monsoon season. Maxillary and ethmoid sinuses were the most frequently affected. Aspergillus species were the predominant pathogens. Early diagnosis and treatment are essential, and it is crucial to employ a combination of diagnostic methods to reach a conclusive result rather than relying solely on a single technique.

Keywords: Fungal culture for 37°C and 25°C, Fungal sinusitis, KOH mount, LPCB mount

INTRODUCTION

Fungal rhinosinusitis (FRS) encompasses a spectrum of sinus diseases caused by fungal organisms and is recently been recognized as a significant cause of morbidity, particularly in immunocompromised individuals, especially in areas with warm, humid climates, in developing countries like India.[1] The disease spectrum spans from benign non-invasive forms to aggressive, potentially fatal invasive types. The concomitant global increase in the prevalence of immunosuppressive conditions such as diabetes mellitus, malignancies, and post-COVID-19 states has contributed to an increase in cases of invasive fungal rhinosinusitis (IFRS).[2] The invasive nature of the disease was noted to be associated with Mucorales and Aspergillus species, often requiring immediate medical and surgical interventions. The non-invasive types, such as allergic fungal rhinosinusitis (AFRS) and fungal ball, are more common in immunocompetent individuals, and it presents with chronic symptoms and often mimic chronic rhinosinusitis (CRS).[3]

In India, there has been a high burden of both invasive and non-invasive fungal sinusitis reported, particularly during the COVID-19 pandemic, during which there was a surge in the cases of mucormycosis. This highlighted the critical need for early suspicion and diagnosis.[4,5] Despite this, the epidemiology of FRS remains under-researched in many developing countries, and the diagnosis is based on a high index of clinical suspicion. Although there are clues from clinical presentation, the diagnosis depends on a combination of investigations like direct microscopy, culture, histopathology of the tissue, and radiology. Diagnosing early and classifying accurately help in deciding the right treatment protocol.[6] Beyond awareness, the most essential parameter to understand and accurately assess the prognosis of the disease is to improve a patient's quality of life. In India, fungal sinusitis has not been investigated much from a microbiological point of view, due to a lack of research. This study was undertaken to bridge the gap that exists in the literature regarding clinical and histological representations of fungal infection.

Objectives

The objectives were to evaluate the clinical profile of patients presenting with chronic sinusitis and to assess the mycological profile of sinusitis.

METHODS

Study type

It was a prospective observational study.

Study place and duration

The study was carried out at department of microbiology, KMCHIHSR. The study took place for a period of 1 year from June 2024 to June 2025.

Sample size

Total 128 samples were included in the study.

Inclusion criteria

Patients with chronic inflammatory disease of the sinuses undergoing functional endoscopic sinus surgery (FESS), chronic, recurrent or allergic sinusitis not responding to medical treatment were included in the study.

Exclusion criteria

All patients with acute sinusitis or malignancy of paranasal sinuses were excluded from the study.

After obtaining approval from the Ethics committee, all patients who presented to the ENT outpatient department with symptoms of nasal discharge, headache, and facial pain were included in the study. After physical examination, a diagnostic nasal endoscopy (DNE) was done preoperatively for all patients with the classical sinus symptoms to assess the extent of disease and presence of discharge and inflammation. Based on the DNE finding, a preliminary clinical diagnosis was made, and the patient was prepared for surgery (FESS) after obtaining informed consent. In addition to this, the computerised tomography of the paranasal sinuses was performed when needed. The staging and grading were performed as per the following grading (Tables 1 and 2).[7,8]

Table 1: Grading for acute invasive fungal sinusitis.

Grade	Nasal endoscopy findings
0	Normal pink nasal mucosa
I	Congestion and edematous nasal mucosa
II	Thick purulent secretion in the middle meatus and choana
III	Blackening of the middle turbinate and the nasal mucosa
IV	Black necrotic eschar tissue with underlying purulent exudates

Table 2: Staging for acute invasive fungal sinusitis.

Stage	Endoscopic finding
0	No mucosal edema or allergic mucin
1	Mucosal edema with or without allergic mucin
2	Polypoidal edema with or without allergic mucin
3	Sinus polyps with fungal debris or allergic mucin

In cases where the diagnostic nasal endoscopy (DNE) demonstrated findings consistent with sinusitis and raised suspicion of fungal involvement, the computed tomography (CT) was performed to see the extension of the lesion and the involvement of other sinuses. Patients showing unilateral or bilateral sinus disease with evidence of a characteristic "double density" sign within the sinuses on CT were counselled for FESS, and the intraoperative specimens were collected for microbiological and histopathological analysis.

The grading of fungal sinusitis in computed tomography was based on the assessment of sinus opacification, bony erosion, and extra-sinus extension. The severity was categorized from mild to severe using a computed tomography severity index (CTSI). Characteristic radiological features were hyperdense intraluminal material within the affected sinuses, bony destruction, and periantral fat infiltration. These findings helped to differentiate the non-invasive forms (such as mycetoma and allergic fungal sinusitis) from invasive fungal sinusitis.[8]

Any "cheesy" or "clay-like" greenish black material, whenever found within the sinuses or polypoidal tissues with associated edema or mucosal thickening, a provisional diagnosis of fungal ball (mycetoma) or allergic

fungal rhinosinusitis (AFRS) was made, depending on the number of sinuses involved and the presence or absence of thick tenacious secretions along with edema. The intraoperative findings were assessed, and the tissue and debris were sent for fungal staining and culture. The exudates from paranasal sinus mucosa, tissue biopsy from nasal polyp, and tissue specimens were received in normal saline in the department of microbiology.

In the laboratory, the tissue samples were minced into small pieces using a sterile scalpel (No.22). A portion of the sample was subjected to initial screening by 10% KOH mount using light microscopy to look for the presence of fungal elements (hyaline or dematiaceous, septate or non-septate filamentous hyphae and budding yeast-like cells) and hematoxylin and eosin stain on the day of receiving the sample. The rest of the sample was inoculated into two sets of Sabouraud's dextrose agar (SDA), in duplicates, one set with cycloheximide and gentamicin on the same day. One set was incubated at 25°C and another at 37°C for up to four weeks to observe visible growth. Further identification of the fungal isolates was done by macroscopic appearance of the colonies and microscopic morphology by lactophenol cotton blue mount (LPCB) and slide culture (3, 5, 9) (anytime within the 4-week incubation period, depending on the load of the organism in the sample). Results of fungal cultures were reviewed by two readers, correlated with clinical, histopathological, and radiological findings, which will help in arriving at the final diagnosis and characterisation of FRS.

Statistical analysis

Data analysis was performed using the Microsoft Excel and IBM SPSS Statistics version 30.0 software (SPSS Inc. Chicago II. USA), and results were obtained. All statistical analyses were carried out at 5% level of significance, and a p value less than 0.05 was considered significant. The discrete data collected were expressed as frequencies and percentages. Associations in them, if any, were analysed using the chi-square test.

RESULTS

A total of 128 cases of chronic rhinosinusitis (CRS) were included in the study, with (56.4%) males and (43.5%) females. The incidence of fungal sinusitis in our study was 21.7% of which 10.8% cases were diagnosed in females. The highest incidence 29% was noted in the 5th to 6th decade of life (Figure 1). The mean age of patients with fungal sinusitis was 49.1 years.

In our study, we noted that about 53% cases of fungal sinusitis were among patients with agriculture as their occupation, and 49% of cases were diagnosed during the monsoon season. There was no significant relationship between smoking and alcohol consumption in the incidence of fungal sinusitis (p-0.4 and p-0.7 respectively). In our study, no association was seen with HIV or HBV infection. Around 21.7% of diabetic patients were diagnosed with chronic sinusitis and 16% patients with allergy had fungal sinusitis. Diabetes mellitus ($p<0.0001$) was found to show a statistically significant correlation to the incidence of fungal sinusitis. The mean RBS value was determined to be 138, and the mean HbA1c (turbidimetric inhibition immunoassay (TINIA) value for fungal sinusitis cases was found to be 9.4 in this study, hence proving that poor diabetic control is an important factor predisposing to fungal sinusitis.

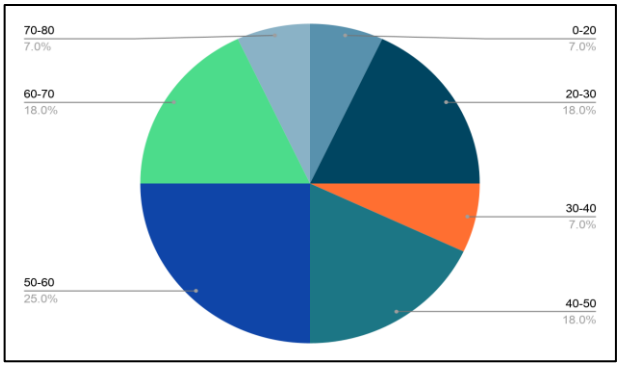

Figure 1: Number of patients.

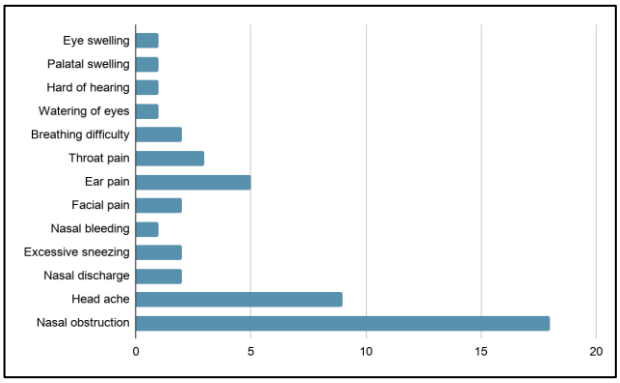

Figure 2: Symptomatology in fungal sinusitis.

The most common clinical symptoms observed in our study were nasal obstruction (23.7%) and headache (10.8%). The other symptoms included nasal discharge, excessive sneezing, nasal bleeding, facial pain, ear pain, throat pain, breathing difficulty, watering of eyes, hard of hearing, palatal swelling, eye swelling, blurred vision, and loss of sensation (Figure 2).

All patients were subjected to diagnostic nasal endoscopy (DNE), computed tomography (CT), or magnetic resonance imaging (MRI) findings of paranasal sinuses before surgery. Based on the DNE findings, 8.9% cases of fungal sinusitis showed polypoidal changes, 19.8% cases showed blackish eschar, and 3.9% cases showed mucopurulent discharge. Preseptal cellulitis and orbital cellulitis were coexisting findings seen in one of the patients in our study. The most commonly involved sinuses were the maxillary sinus 12.8% and the ethmoidal sinus 13.8%. The correlation with microscopic findings and culture was found in 22.7% cases positive for fungal

sinusitis. This helped in deciding the right empirical treatment for the patient at the earliest possible time. The majority of cases had no fungus seen in the direct microscopic microscopy but later on grew the had fungi at two different temperatures consistently.

About 28.5% fungal sinusitis cases showed bilateral involvement of sinuses, where the causative agents were *Candida tropicalis* and *Aspergillus niger,* and 17.8% cases showed bone erosion on Computed tomography (CT) scan, where the causative agents were *Aspergillus flavus* and *Aspergillus niger*.

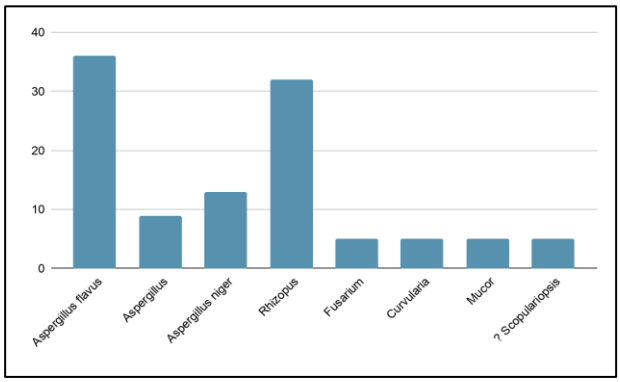

Figure 3: Distribution of culture-positive cases based on the type of fungus.

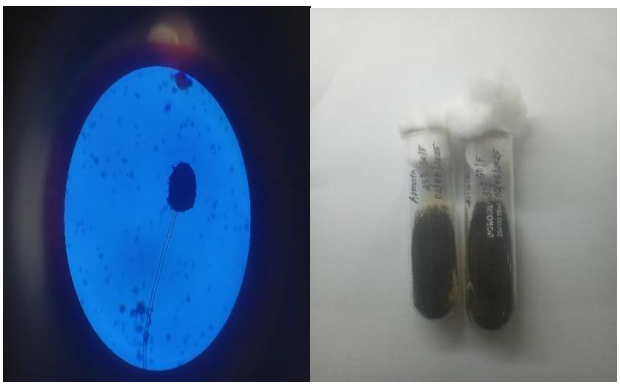

Figure 4: SDA tubes, LPCB mount and KOH mount (*Aspergillus niger*).

Functional endoscopic sinus surgery (FESS) was performed for 23.7% cases. There were no significant postoperative complications. About 11.8% of the Chronic fungal sinusitis (CRS) had a positive fungal culture. However, only 1.9% of them were positive for fungal staining with potassium hydroxide (KOH), whereas histopathological examination showed features of fungal sinusitis in 13.8% of the cases. Almost 21.4% of the fungal sinusitis cases detected were non-invasive in nature. The most common fungal organism cultured was *Aspergillus flavus,* accounting for 7.9% fungal sinusitis cases (Figures 3 and 4). The other fungi cultured were *Aspergillus fumigatus, Aspergillus flavus, Rhizopus, Fusarium and Curvularia* (Figures 5-8).

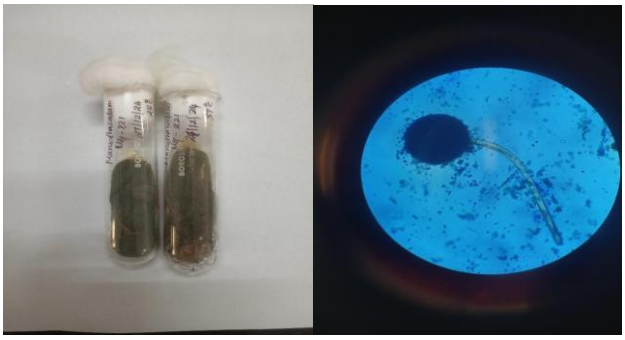

Figure 5: SDA tubes and LPCB mount (*Aspergillus fumigatus*).

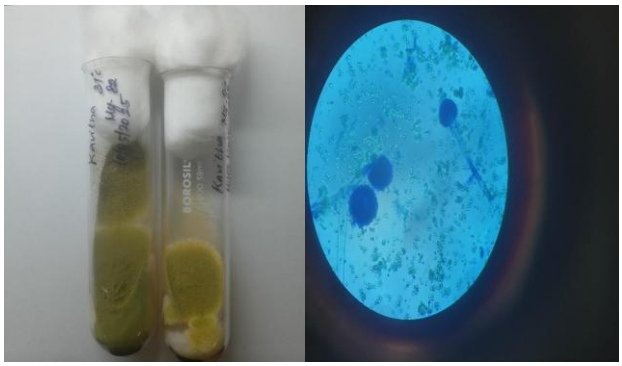

Figure 6: SDA tubes and LPCB mount (*Aspergillus flavus*).

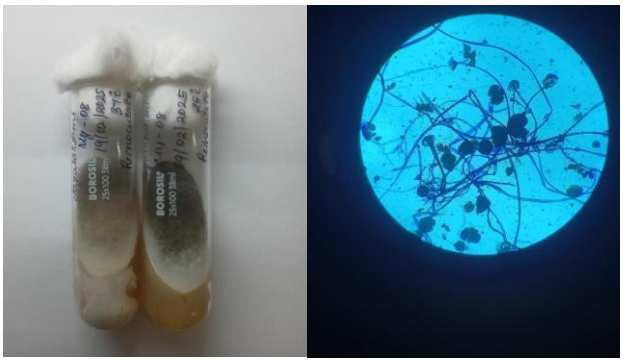

Figure 7: SDA tubes and LPCB mount (*Rhizopus*).

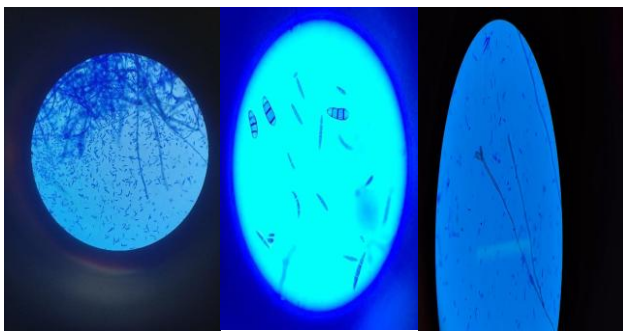

Figure 8: SDA tubes, KOH mount, LPCB mount and Slide culture (septate and aseptate hyphae seen, *Fusarium* and *Curvularia*).

About 21% cases of fungal sinusitis presented with complications, which included chronic adenoiditis, rhino-orbital mucormycosis, palatal osteomyelitis, chronic osteomyelitis, chronic otitis media, and squamosal type with right facial palsy and orbital cellulitis. The mortality noted in our study was (3.5%). Acute fulminant rhino-orbital mucormycosis with Rhizopus and mucor in the fungal culture. Treatment with injection liposomal amphotericin B.

One of the patients who presented with chronic otitis media and facial palsy was also an uncontrolled diabetic for the past 25 years. The patient sample showed sphenoid and hyaline septate hyphae in routine microscopic examination. The necrotic bone specimen yielded two distinct types of fungi grown in culture, which included *Fusarium* and *Curvularia* species (Figure 8). The patient was treated with injection liposomal amphotericin B at a cumulative dosage of 2.5 gm.

DISCUSSION

Fungal sinusitis is an increasingly prevalent sinonasal disease with diverse clinical presentations. In recent years, its incidence has been rising and is largely related to immunosuppression, particularly due to diabetes, malignancies, and cancer therapies. The factors that predispose the affected individuals to recurrent or chronic sinusitis include reduced immune surveillance, chemotherapy-induced mucosal damage, and neutropenia that impair the sinonasal defense mechanisms.[9-11]

The mean age of patients with fungal sinusitis in our study was 46.5 years, comparable to other similar studies.[12,13] About 25% of cases occurred in the 5th and 6th decades, consistent with findings by Satish et al, though some studies report peak incidence in younger decades.[14] A female predominance was observed in our study, which contrasts with several earlier reports.[15-17] While many studies report male predominance, those focusing on allergic fungal rhinosinusitis often show female preponderance. Overall prevalence varies with immune status, diabetes, and geographic factors.[9]

In our study, 35.7% of fungal sinusitis cases were diagnosed during the monsoon season. This contrasts with other studies reporting a higher incidence during winter months.[16] The discrepancy suggests a possible role of climatic variation. Increased humidity during the monsoon may significantly contribute to the development of fungal sinusitis.[18,19]

In our study, the mean random blood sugar level among patients with fungal sinusitis was elevated at 137.92. Previous studies have also shown a significant association between raised RBS levels and fungal sinusitis.[20,21] Glycated hemoglobin (HbA1c), reflecting chronic hyperglycemia, shows the strongest correlation with disease prevalence and invasiveness. These findings signify the poor glycaemic control as a key predisposing factor for fungal sinusitis. In our study, 50% of patients with fungal sinusitis were found to have type II diabetes mellitus, making it the most common comorbidity, consistent with earlier reports.[14] No significant association was observed between fungal sinusitis and smoking or alcohol consumption. This finding closely aligns with the 63% prevalence reported by Rajiv et al.[12]

The reported prevalence of diabetic ketoacidosis at presentation ranges from 14.2% to 23.1%, indicating that factors beyond ketoacidosis contribute to pathogenesis.[22] In our study, only 7.1% of patients had documented diabetic ketoacidosis, supporting this observation. Proteinuria was noted in 3.5% of cases. Consistent with other studies, no association was found between alcohol consumption and fungal sinusitis. Fungal sinusitis presents with a wide spectrum of clinical manifestations. In our study, nasal obstruction (64.2%) and headache (32.1%) were the most common symptoms. Other symptoms included nasal discharge, sneezing, epistaxis, facial and ear pain, throat pain, breathing difficulty, watering of eyes, hearing impairment, and palatal swelling. Similar findings were reported by Celso et al. and Satish et al., with nasal obstruction, discharge, and chronic headache being predominant.[13,14]

The diagnostic nasal endoscopy revealed polypoidal changes in 17.8% of cases, blackish debris in 7.1%, and mucopurulent discharge in 10.7% among our patients. Similar studies have identified debris and polyps as important endoscopic findings. Polypoidal changes were also commonly reported by Sandeep et al and Karthikeyan et al. Eschar formation has been noted in less than 15% of cases in other studies.[7,15] Our study revealed that maxillary (35.7%) and ethmoid (35.2%) sinuses were most commonly involved, consistent with findings by Sandeep et al.[15] Maxillary sinus predominance may be due to its anti-gravity drainage and a low-lying ostium, which facilitates microbial entry. Bilateral sinus involvement was observed in 28.5% of cases. On CT, 17.8% of patients showed bony erosion, comparable to earlier reports, while metal-dense deposits have been reported variably in the literature.[16] In our study, bilateral disease and bony erosion were associated with *Candida tropicalis, Aspergillus flavus, and Aspergillus niger.*

Recent studies indicate a rising incidence of fungal sinusitis, particularly among chronic rhinosinusitis patients in the post-COVID era. Various south Indian data in 2023 reported fungal rhinosinusitis in 38% of CRS cases, predominantly due to *Aspergillus* species.[24] During the COVID-19 pandemic, tertiary-care centre studies showed a marked increase in invasive fungal sinusitis, largely caused by Mucorales and strongly associated with diabetes mellitus. This surge has been linked to corticosteroid use and poor glycaemic control, raising concerns about acute invasive fungal sinusitis as an emerging clinical entity.[25]

In our study, Aspergillus species accounted for 21.4% of fungal sinusitis cases, with *Aspergillus niger* being the most common species isolated. Literature revealed evident geographical variation, with *A. fumigatus* predominating in the USA and *A. flavus* in India, likely due to climatic and environmental factors. *A. niger* is capable of causing both non-invasive and invasive forms of fungal sinusitis. Although less frequent than *A. flavus*, it remains a significant pathogen, especially in immunocompromised patients.[16]

A positive KOH finding was seen in 7.14% of cases, while fungal culture was positive in 21.4%. There were about twenty wo cases were positive by both KOH and culture. The low KOH yield might likely be due to sample drying and also in selection of the potion of the tissue for KOH. These findings emphasize the importance of using multiple diagnostic modalities rather than relying on a single test. Histopathological examination in our study showed invasive fungal sinusitis in only 25% of chronic rhinosinusitis cases, consistent with reports of 6-24% in other studies.[13,26] Invasive disease is less common because it typically occurs in immunocompromised patients, while most CRS patients are immunocompetent. The majority of fungal sinusitis cases are non-invasive forms such as allergic fungal rhinosinusitis or fungal balls. Under-detection due to limited tissue sampling and early-stage presentation may further reduce observed invasion rates. Many epidemiological studies, including those from South India, similarly report a predominance of non-invasive disease.[27,28]

About 21% of fungal sinusitis spectrum cases in our study developed complications, including chronic adenoiditis, rhino-orbital mucormycosis, palatal osteomyelitis, chronic osteomyelitis, and squamosal chronic otitis media. There are studies in literature documenting the severe complications such as orbital apex and superior orbital fissure syndromes, intracranial and orbital complications, including meningoencephalitis, orbital cellulitis, cavernous sinus thrombosis, ophthalmoplegia, and proptosis.[16-19]

CONCLUSION

In conclusion, fungal sinusitis should be considered in the differential diagnosis of patients presenting with chronic rhinosinusitis, irrespective of immune status, particularly when there is clinical or radiological suspicion. A structured combination diagnostic approach incorporating direct microscopy, fungal culture, histopathological examination, and computed tomography imaging enhances diagnostic accuracy and facilitates appropriate classification into invasive and non-invasive forms. This also warrants role of greater coordination between the surgical team and the microbiologist involved in patient care.

The management strategies should involve the assessment of disease subtype and extent, with surgical intervention playing a central role in selected cases, often in conjunction with antifungal therapy when indicated. Since there is rapid progression and mortality in invasive forms timely recognition and intervention are important. The practical challenges such as delayed diagnosis, prior empirical medication use, access to surgical care, and the financial implications of antifungal therapy must be addressed to improve overall outcomes.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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