



RESEARCH ARTICLE

Evaluation of CT Imaging and Microbiological Culture in Diagnosing Sinonasal Fungal Infections

Sanjeev Suman^{1*}, Babita²

ABSTRACT

Background: Sinonasal fungal infections are increasingly recognized causes of chronic rhinosinusitis, particularly among immunocompromised individuals. Early diagnosis is crucial because invasive fungal infections can lead to significant morbidity and mortality. Computed tomography (CT) imaging and microbiological culture are commonly employed diagnostic modalities.

Aim: To evaluate the diagnostic utility of CT imaging and microbiological culture in patients with suspected sinonasal fungal infections.

Methods: A prospective study was conducted at Patna Medical College Hospital from July 2024 to June 2025. A total of 75 patients with clinically suspected sinonasal fungal infections underwent CT imaging and microbiological culture. Histopathological examination served as the reference standard. Diagnostic performance, fungal spectrum, and radiological findings were analyzed.

Results: Among 75 patients, fungal infection was confirmed in 52 (69.3%) cases. CT imaging demonstrated a sensitivity of 90.4% and specificity of 73.9%, whereas microbiological culture showed a sensitivity of 80.8% and specificity of 95.7%. *Aspergillus* species were the most frequently isolated fungi (53.8%), followed by *Mucor* species (28.8%). Hyperdense sinus opacification and bony erosion were significantly associated with fungal infection ($p < 0.001$).

Conclusion: CT imaging is highly sensitive for detecting sinonasal fungal infections, while microbiological culture offers superior specificity. Combined use of radiological and microbiological methods significantly improves diagnostic accuracy.

Keywords: Sinonasal fungal infection, CT imaging, microbiological culture, *Aspergillus*, *Mucormycosis*.

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INTRODUCTION

A significant subset of sinonasal disorders are sinonasal fungal infections, which range from non-invasive fungal colonisation to potentially fatal invasive fungal infections. Diabetes mellitus, immunosuppressive medication, cancer, organ transplantation, and other immunocompromised conditions have all become more common in recent years, increasing the incidence of these infections. Due to poor drainage, mucosal inflammation, and local immunological dysfunction, the paranasal sinuses create an ideal environment for fungal development. *Aspergillus* species, *Mucor* species, *Candida* species, and dematiaceous fungi are the most often implicated fungi. Clinically, individuals may exhibit ocular symptoms, rhinorrhea, headaches, nasal blockage, facial pain, and, in more severe situations, cerebral problems[1].

Early diagnosis is crucial because, especially in cases with invasive fungal sinusitis, postponing treatment can lead to serious morbidity and mortality. Numerous diagnostic

¹HOD & Associate Professor, Department of Radiology, Patna Medical College Hospital, Patna, Bihar, India

²Associate Professor, Department of Microbiology, Nalanda Medical College & Hospital, Patna, Bihar, India

Corresponding Author: Babita, Associate Professor, Department of Microbiology, Nalanda Medical College & Hospital, Patna, Bihar, India.

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methods are accessible, such as molecular procedures, radiographic imaging, microbiological culture, and histology. The preferred imaging technique for assessing

Table 1: Demographic Characteristics

Variable	Frequency (n=75)	Percentage (%)	p-value
Male	46	61.3	0.031*
Female	29	38.7	
Mean Age	48.6 ± 13.2 years	-	0.012*
Diabetes Mellitus	39	52.0	

Table 2: CT Findings in Suspected Fungal Sinusitis

CT Finding	Frequency	Percentage (%)	p-value
Hyperdense Opacification	42	56.0	<0.001*
Bony Erosion	24	32.0	
Calcification	18	24.0	
Orbital Extension	9	12.0	

Table 3: Diagnostic Performance

Diagnostic Method	Positive Cases	Sensitivity (%)	Specificity (%)	p-value
CT Imaging	57	90.4	73.9	0.002*
Microbiological Culture	48	80.8	95.7	

Table 4: Spectrum of Fungal Isolates

Organism	Frequency	Percentage (%)	p-value
Aspergillus spp.	28	53.8	0.001*
Mucor spp.	15	28.8	
Candida spp.	6	11.5	
Dematiaceous fungi	3	5.9	

sinonasal architecture and disease severity is still computed tomography (CT). Fungal aetiology may be suggested by characteristic features such as calcifications, unilateral sinus involvement, hyperdense sinus contents, and bone erosion. The conventional approach of diagnosing fungal infections and directing antifungal treatment is still microbiological culture. However, slow fungal growth, insufficient specimen collection, and previous antifungal therapy may restrict culture sensitivity. Because histopathological examination shows fungal invasion and tissue reaction, it is still considered the gold standard for conclusive diagnosis[2].

The relative diagnostic performance of CT imaging and microbiological culture differs across research, despite the fact that both are often utilised in clinical practice. It's

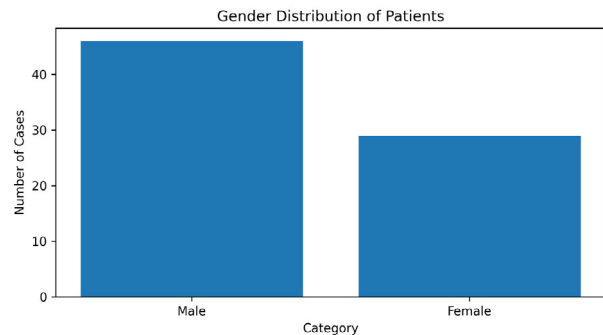


Figure 1: Gender distribution of patients

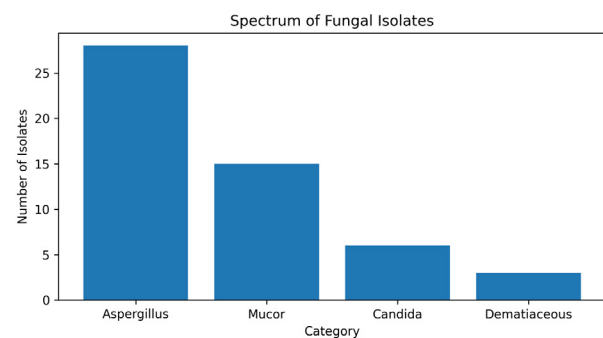


Figure 2: CT imaging findings in fungal sinusitis

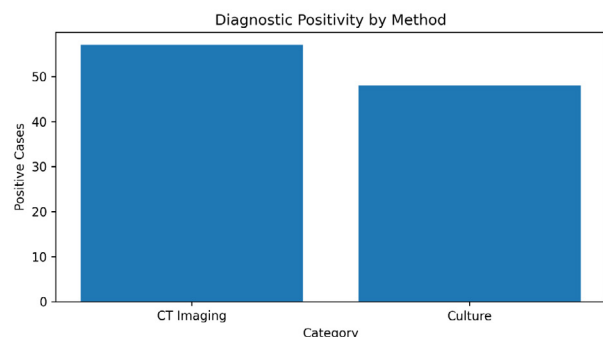


Figure 3: Diagnostics positivity by methods

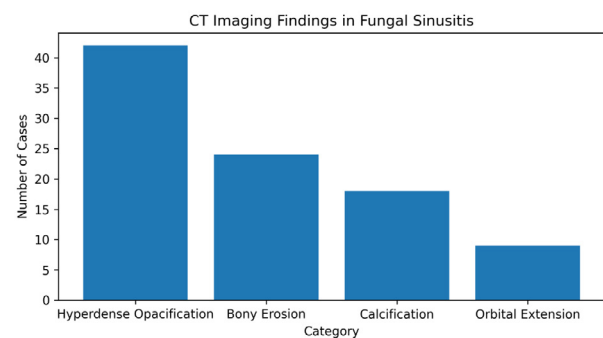


Figure 4: Spectrum of fungal isolates

critical to comprehend their advantages and disadvantages in order to maximise patient care and guarantee prompt therapeutic beginning. The purpose of this prospective study was to assess the diagnostic value of microbiological culture and CT imaging in individuals suspected of having sinonasal fungal infections. Additionally, the study sought to evaluate the range of fungal pathogens and radiological characteristics linked to these infections in patients who came to a teaching hospital for tertiary treatment[3].

MATERIALS AND METHODS

Study Design

Prospective observational study.

Study Setting

Department of ENT and Microbiology, Patna Medical College Hospital.

Study Duration

July 2024 – June 2025 (12 months).

Sample Size

75 patients.

Inclusion Criteria

- Clinical suspicion of sinonasal fungal infection.
- Age ≥ 18 years.
- Availability of CT imaging and microbiological culture.
- Exclusion Criteria
- Prior sinonasal surgery.
- Incomplete investigations.
- Refusal to participate.
- Data Collection
- Demographic profile.
- Clinical presentation.
- CT findings.
- Microbiological culture results.
- Histopathological diagnosis.

Statistical Analysis

Data were analyzed using SPSS version 26. Chi-square test was used for categorical variables. A p-value < 0.05 was considered statistically significant.

RESULTS

Among the 75 patients evaluated, histopathology confirmed fungal infection in 52 cases. In 57 individuals, CT imaging revealed positive results suggestive of fungal sinusitis. The most prevalent radiological sign was hyperdense sinus opacification, which was followed by calcification and bone erosion.

Interpretation

Most patients were male, and diabetes mellitus was the most common associated risk factor.

Interpretation

Hyperdense opacification was the most common CT finding.

Interpretation

CT imaging demonstrated higher sensitivity, while culture showed greater specificity.

In 48 instances, microbiological culture revealed fungal development. More than half of all isolates were *Aspergillus* species, and approximately one-third were *Mucor* species. While microbiological culture offered better specificity, CT imaging showed higher sensitivity for fungal illness detection.

Early diagnosis was made easier and diagnostic accuracy was greatly increased when CT imaging and microbiological culture were used together.

Interpretation

Aspergillus species were the most common fungal isolates.

DISCUSSION

The current prospective study assessed the diagnostic utility of microbiological culture and CT imaging for sinonasal fungal infections. Due to the possibility of severe local invasion, ocular problems, cerebral extension, and increased mortality, accurate identification of fungal sinusitis is still crucial. The research population was found to be predominately male, which is in line with a number of other publications. Diabetes mellitus was shown to be the most prevalent related risk factor, and the majority of patients were middle-aged people. Through decreased neutrophil activity, modified cellular immunity, and tissue sensitivity brought on by hyperglycemia, diabetes puts people at risk for fungal infections[4].

Fungal sinusitis can be detected with great sensitivity using CT imaging. The most common radiological finding was hyperdense sinus opacification. This characteristic is caused by thick fungal concretions that contain iron, manganese, and calcium salts. Invasive diseases were more likely to exhibit bony erosion and orbital extension, which were significantly correlated with verified fungal infection. CT imaging's great sensitivity emphasises its usefulness as a preliminary diagnostic tool[5]. In addition to detecting the existence of disease, CT also defines the breadth of anatomy and directs surgical planning. However, radiological results by themselves cannot accurately

identify the particular fungal organism, and false-positive results can happen in inflammatory situations such as chronic bacterial sinusitis[6].

Microbiological culture showed significantly higher specificity but decreased sensitivity. Fungal diseases may be definitively identified through culture, which also makes testing for antifungal susceptibility possible. However, nonviable organisms, previous antifungal exposure, or insufficient sampling may lead to false-negative results. The sensitivity found in this investigation is similar to reports that have already been published. The most common isolates were *Aspergillus* species. Globally, *Aspergillus* continues to be the most commonly documented cause of fungal sinusitis, especially in chronic non-invasive forms. The second most prevalent pathogen was *Mucor* species, which were primarily linked to diabetes individuals. The results demonstrate the increasing clinical significance of mucormycosis in areas with a high prevalence of diabetes[7].

The study shows that microbiological culture and CT imaging should not be utilised separately. While culture allows microbiological confirmation and organism identification, CT offers quick assessment and great sensitivity. When used in tandem, they greatly increase diagnostic confidence. This study's prospective design and use of histopathology as the reference standard are among its strong points. However, the single-center arrangement and somewhat limited sample size are drawbacks. Although they could increase diagnostic output, molecular diagnostic methods like PCR were unavailable[8].

Overall, the results are consistent with a multimodal diagnostic strategy that includes histological confirmation, CT imaging, microbiological culture, and clinical assessment. In order to avoid problems and enhance patient outcomes, early diagnosis and timely treatment are still essential.

CONCLUSION

The current study shows that when assessing sinonasal fungal infections, CT imaging and microbiological culture are complementing diagnostic techniques. While microbiological culture delivers high specificity and precise pathogen identification, CT imaging offers outstanding sensitivity and enables quick assessment of illness extent. The most frequent radiographic abnormalities linked to fungal infection were hyperdense sinus opacification and bone erosion. The most common fungal pathogen was found to be *Aspergillus* species, which were followed by

Mucor species. One significant risk factor was found to be diabetes mellitus.

Although fungal aetiology may be suggested by CT imaging alone, microbiological and histological confirmation are frequently necessary for a definite diagnosis. Early therapeutic intervention is made easier and diagnostic accuracy is greatly increased when imaging and culture are used together. Clinicians should retain a high index of suspicion when distinctive radiological abnormalities are present since fungal sinusitis is becoming more common, especially in immunocompromised and diabetic patients. Life-threatening consequences can be avoided and disease-related morbidity can be significantly decreased with prompt diagnosis and treatment.

To further enhance pathogen identification and diagnostic sensitivity, future multicentric research utilising molecular diagnostic approaches are advised. For the best patient care, a multidisciplinary strategy comprising radiologists, microbiologists, pathologists, and ENT specialists is still crucial.

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