

Clinical and Microbiological Profile of Fungal Keratitis: A Hospital-Based Study at Sri Krishna Medical College & Hospital (SKMCH), Muzaffarpur

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Abstract:

Background: Fungal keratitis is a major cause of corneal blindness in tropical regions, often resulting from trauma and delayed diagnosis. Sri Krishna Medical College & Hospital (SKMCH), Muzaffarpur, serves a largely rural population at risk due to agricultural exposure.

Aim: To evaluate the clinical features, microbiological profile, and risk factors of fungal keratitis in patients presenting with corneal ulcers at SKMCH.

Methodology: A prospective cross-sectional study was conducted over seven months, including 60 patients with suspected fungal keratitis. Detailed clinical evaluation and corneal scrapings were performed. Samples were analyzed via KOH and Gram stains and cultured on blood agar, chocolate agar, and Sabouraud's Dextrose Agar. Fungal isolates were identified based on colony morphology and microscopic characteristics.

Results: Among 60 cases, 36 (60%) had pure fungal infections, and 4 (6.7%) had mixed fungal-bacterial infections. Fungal keratitis predominantly affected males (66.7%) and rural residents (61.1%), mainly following corneal trauma (77.8%), especially from vegetative matter (57.1%). *Fusarium* spp. (38.9%) and *Aspergillus* spp. (22.2%) were the most frequently isolated fungi. Clinical suspicion correlated with microbiological findings in most cases, though KOH and Gram staining provided additional confirmation.

Conclusion: Fungal keratitis in north Bihar is primarily trauma-related, with hyaline fungi—particularly *Fusarium* and *Aspergillus*—being the leading pathogens. Accurate diagnosis requires combined clinical and microbiological evaluation for effective management.

Keywords: Fungal keratitis, corneal ulcer, *Fusarium*, *Aspergillus*, corneal trauma, microbiological profile, SKMCH, Muzaffarpur.

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Introduction

Corneal ulcer is an inflammatory or rather more dangerous, infective disease of the cornea that is characterized by the destruction of the epithelial layer and penetration of the corneal stroma. An infectious etiology is usually called a corneal ulcer in ophthalmology, whereas physical abrasions are the corneal abrasions [1]. Since the cornea is a transparent and avascular organ, which is critical to the refraction and visual acuity, a small injury will cause severe visual loss. Fungal keratitis is one of the most difficult forms of infectious causes of corneal ulceration to diagnose and treat owing to the insidious onset, chronic nature, and scarcity of effectiveness with empirical treatment.

Fungal corneal ulcer or fungus keratitis or Keratomycosis is an infectious disease of the cornea caused

by any one of the various pathogenic fungi which can penetrate the ocular surface. These organisms can attack the corneal tissue after a trauma, damaged epithelial integrity, or local immunity dislocation. In practice, fungal keratitis is a progressive, intractable condition, which needs to be differentiated with other types of corneal conditions having similar symptoms, especially its bacterial variant, which constitutes the overwhelming majority of microbial corneal infections. The patients usually come up with redness, pain, photophobia, shedding tears, discharge and gradual loss of vision. Hypopyon formation and stromal necrosis can occur in advanced cases leading to permanent visual disability. Unfortunately, the suspected infection can go through corneal perforation, endophthalmitis, and eventually blindness in case it is untreated or misdiagnosed.

As shown by the World Health Organisation (WHO) statistics, there is an annual occurrence of 1.5 to 2 million new cases of corneal blindness that is a result of corneal ulceration, making it a severe risk to the health of the population [2]. The heavy load is especially uneven in the tropical and subtropical areas where warm and damp climatic conditions are favourable to the growth of fungi. Agricultural exposure, delayed access to healthcare and ignorance contribute a significant portion of the global corneal blindness burden, which is conferred by the developing countries. The age groups that have been hit are economically productive and this has resulted in the loss of livelihood and a greater social economic burden to families and society.

Fungi represent the most common etiological agents and cause 30-40% of all cases of suppurative keratitis, be it bacteria [3]; this also depends on the geographical location [3]. In tropical areas, filamentous fungi like *Aspergillus* and *Fusarium* species are the most common and yeast-like fungi are more commonly reported in temperate climate and immunocompromised people. Environmental exposure, occupation, agricultural practices and climate affect the distribution of causative organisms. In a case in point, vegetative matter trauma is a significant predisposing aspect in the rural communities, especially among farmers, labourers and outdoor workers. Other identified risk factors are contact lens wear, previous ocular surgery, chronic use of topical steroids, ocular surface disease and systemic immunosuppression.

This is shown in the fact that 90 percent of the cases of ocular trauma and corneal ulceration that result to corneal blindness are experienced in the developing countries [4]. Fungal keratitis is particularly widespread in rural and agrarian-based communities in India, where occupational risks and absence of immediate medical treatment led to the severity of the disease. Patients tend to consult treatment when the disease is at an advanced stage, already having tried home remedies or non-prescription drugs, which further complicates the situation in the treatment. In addition, empirical antibacterial therapy is often instituted because of the inability to differentiate bacterial keratitis at an early stage, and it leads to the development of the disease.

Corneal ulcer is an eye disease that needs urgent treatment. Therefore, accurate information about the causative agents and their patterns of susceptibility has a role to play in the determination of the correct plan of action in treatment [5]. Microbiological confirmation early in treatment is very important as the antifungal agents vary considerably in terms of spectrum, penetration and efficacy. In comparison to bacterial keratitis, fungal keratitis is slow in reacting to treatment and may take extensive therapy and close observation. Treatment can result in the

development of dense corneal scarring that results in permanent blindness despite treatment.

In suspected cases laboratory diagnosis is thus necessary. The microscopic examination with the use of potassium hydroxide (KOH) mount, Gram stain and culture on the right media still remains the key to diagnosing [6]. The next development, like the confocal microscopy and molecular diagnostic methods, has enhanced detection but is not easily accessible in a number of resource-wrapped environments. Therefore, traditional microbiological procedures remain highly applicable, particularly in the tertiary care hospitals that deal with the rural population.

Knowledge of clinical profile of fungal keratitis will assist clinicians to identify the signs of fungal infection early on. Other features like dry appearance of ulcer surface, feathery margins, satellite lesions, endothelial plaque and hypopyon are commonly mentioned but are not always present. Thus, clinical judgement can result in misdiagnosis when relying on clinical judgement. Local epidemiological records are necessary to learn about common species of fungi and empirical therapy before culture reports are reported [7].

Sri Krishna Medical College & Hospital (SKMCH), Muzaffarpur, has a high population of north Bihar and its surrounding areas where the major occupation is farming. Fungal keratitis is a major cause of ocular morbidity in the region due to the nature of climatic conditions, the high prevalence of ocular trauma by vegetable substances, and lack of access to early specialized eye care. Nevertheless, local patterns of microbiology and clinical features can be different in the rest of the territory, so institution-specific data will be helpful regarding successful management procedures.

A study of fungal keratitis hospital-based offers an insight into demographic distribution, risk factors, clinical presentation, laboratory findings and prevalent fungal species in the area. Such data helps ophthalmologists to start timely and proper treatment, minimizes complications and becomes a part of preventative measures. Microbiological trend knowledge can also be used to assist in the rational choice of antifungal, thereby reducing the number of empirical incorrect drug use and enhancing patient outcomes.

Corneal ulcers that are caused by infections must be treated upon occurrence in order to safeguard vision. Provided the infection is not treated, a fungal infection may cause perforation of the cornea, vision loss, and loss of eye. Thus, clinical features and laboratory confirmation should be evaluated in a systematic manner to be adequately diagnosed and treated. The current work is expected to analyze the clinical attributes, laboratory diagnosis and microbiological profile of fungal keratitis in patients in the Sri

Krishna Medical College & Hospital (SKMCH), Muzaffarpur, thus helping in understanding and enhancing the management of the significant cause of avoidable corneal blindness.

Methodology

Study Design: This study was designed as a prospective cross-sectional study to evaluate the clinical and microbiological profile of fungal keratitis among patients presenting with corneal ulcers. The study aimed to assess demographic characteristics, predisposing factors, clinical features, and microbiological patterns associated with fungal keratitis.

Study Area: The study was conducted in the Department of Ophthalmology at Sri Krishna Medical College and Hospital (SKMCH), located in Muzaffarpur, Bihar, India

Study Duration: The study was carried out over a period of seven months from April 2025 to October 2025.

Sample Size: A total of 60 patients who presented with clinical features suggestive of fungal keratitis during the study period were included in the study. All eligible patients meeting the inclusion criteria and providing informed consent were enrolled consecutively.

Study Population: The study population comprised patients presenting with corneal ulcers to the Ophthalmology Department of SKMCH during the study period. Patients of all age groups and both genders were considered for inclusion, provided they fulfilled the clinical criteria suggestive of fungal keratitis.

Inclusion Criteria

Patients were included if they met the following criteria:

- Presence of a corneal ulcer with or without intact epithelium.
- Clinical features suggestive of fungal keratitis, such as:
 - Dry, raised slough
 - Stromal infiltrate with feathery edges
 - Satellite lesions
 - Thick endothelial exudates

Exclusion Criteria

Patients were excluded if they had:

- Complicated corneal ulcers associated with endophthalmitis or perforation
- Typical viral ulcers, Mooren's ulcers, interstitial keratitis, or sterile neurotrophic ulcers
- Ulcers associated with autoimmune diseases

Data Collection: Data were collected using a standardized predesigned proforma. Information recorded included sociodemographic details such as age, sex,

and occupation; duration of symptoms; history of ocular trauma; associated ocular or systemic conditions; and any prior ocular therapy. Detailed clinical findings, including presenting visual acuity and slit-lamp findings, were systematically documented.

Clinical Examination: Each patient underwent a comprehensive ophthalmic evaluation, including visual acuity assessment and slit-lamp biomicroscopy. Ulcers were stained with 2% sodium fluorescein, and ulcer size was measured in millimeters by recording the longest vertical and widest horizontal dimensions. The size and depth of stromal infiltrate were assessed, and the height of hypopyon was measured when present. Additional features such as ulcer margins, floor characteristics, presence of satellite lesions, retained foreign body, and pigmentation were documented. History of contact lens use and prior topical corticosteroid or antibiotic therapy was also recorded.

Microbiological Examination: Under strict aseptic precautions, corneal scrapings were obtained using a sterile No. 15 Bard-Parker blade after instillation of 4% topical lignocaine under slit-lamp magnification. Scraping was performed from both the leading edge and the base of the ulcer to maximize pathogen yield. The collected material was inoculated directly onto sheep's blood agar, chocolate agar, and Sabouraud's Dextrose Agar (SDA) using a C-shaped streak pattern. Additional scrapings were smeared onto two clean glass slides for Gram staining and 10% potassium hydroxide (KOH) wet mount preparation.

Culture and Identification: Blood agar and chocolate agar plates were incubated aerobically at 37°C and examined after 24–48 hours. Sabouraud's Dextrose Agar plates were incubated at 27°C and observed daily for fungal growth, with cultures discarded after three weeks if no growth occurred. A positive microbial culture was defined as growth of the same organism on two or more solid media, confluent growth at the inoculation site on one medium, or growth consistent with findings on direct microscopy (KOH or Gram stain). Fungal isolates were identified based on colony morphology on SDA and microscopic features observed using lactophenol cotton blue (LPCB) mount.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 25.0. Descriptive statistics, including mean and standard deviation for continuous variables and frequency and percentage for categorical variables, were calculated. Comparative analysis between categorical variables was performed using the Chi-square test or Fisher's exact test where appropriate. A p-value of less than 0.05 was considered statistically significant."

Result

Table 1 summarizes the demographic details, predisposing factors, and traumatic agents in 36 fungal keratitis cases. Males predominated with 24 cases (66.7%) versus 12 females (33.3%). Age distribution showed the largest group was >40 years (14, 38.9%), followed by 31–40 years (10, 27.8%), 21–30 years (8, 22.2%), and <21 years (4, 11.1%). Most patients were from a rural lifestyle (22, 61.1%) compared to urban (14, 38.9%). The main predisposing factor was corneal trauma (28, 77.8%), with

additional factors including co-existing ocular disease (6, 16.7%), topical steroid use (5, 13.9%), and systemic diseases (8, 22.2%). Among traumatic agents (n = 28), vegetative matter was most common (16, 57.1%), followed by foreign bodies (7, 25%), insects (3, 10.7%), and other causes (2, 7.1%). Overall, fungal keratitis predominantly affected older males from rural areas, with corneal trauma—especially from vegetative matter—being the primary risk factor.

Table 1: Demographic details, predisposing factors and traumatic agents in fungal keratitis cases (n = 36)		
Variables	Number	%
Gender		
Male	24	66.7
Female	12	33.3
Age (years)		
<21	4	11.1
21–30	8	22.2
31–40	10	27.8
>40	14	38.9
Lifestyle		
Rural	22	61.1
Urban	14	38.9
Predisposing factors		
Corneal trauma	28	77.8
Co-existing ocular disease	6	16.7
Topical steroids use	5	13.9
Systemic diseases	8	22.2
Traumatic agent (n = 28)		
Vegetative matter	16	57.1
Foreign body	7	25
Insects	3	10.7
Others	2	7.1

Table 2 presents the microbiological profile of corneal ulcers among 60 patients (N = 60). Pure fungal growth was observed in 36 cases (60%), while mixed infections (fungal + bacterial) were seen in 4 cases (6.7%). Pure bacterial growth was identified in

10 cases (16.7%), and 10 cases (16.7%) were culture negative. Overall, fungal infections were the predominant cause of corneal ulcers in this study population.

Table 2: Microbiological profile of corneal ulcers (N = 60)		
Etiology	Number	%
Pure fungal growth	36	60
Mixed infection (fungal + bacterial)	4	6.7
Pure bacterial growth	10	16.7
Culture negative	10	16.7
Total	60	100

Table 3 summarizes the fungal pathogens isolated from 36 microbiologically positive cases. Among hyaline fungi, *Fusarium* spp. was the most common (14 cases, 38.9%), followed by *Aspergillus* spp. (8, 22.2%), *Mucor* spp. (3, 8.3%), and *Rhizopus* spp. (1,

2.8%). Among dematiaceous fungi, *Cladosporium* spp. accounted for 5 cases (13.9%), *Curvularia* spp. for 3 cases (8.3%), and *Bipolaris* spp. for 2 cases (5.6%). Overall, hyaline fungi were more frequently isolated than dematiaceous fungi in this cohort.

Type of fungi	Species name	Number	%
Hyaline fungi	Fusarium spp.	14	38.9
	Aspergillus spp.	8	22.2
	Mucor spp.	3	8.3
	Rhizopus spp.	1	2.8
Dematiaceous fungi	Cladosporium spp.	5	13.9
	Curvularia spp.	3	8.3
	Bipolaris spp.	2	5.6
Total		36	100

Table 4 presents the correlation between clinical diagnosis and microbiological findings in 60 patients (N = 60) with suspected fungal keratitis. Fungal elements were detected in 10% KOH smear in 34 cases and were absent in 26 cases. In Gram-stained smears, fungi were identified in 29 cases and not detected in 31 cases. Clinically, fungal keratitis was

suspected on slit-lamp examination in 40 cases, while 20 cases were not clinically suspected. Overall, the table highlights that clinical suspicion identified more cases than either microbiological method, though both KOH and Gram stains contributed significantly to diagnosis.

Results	Detection of fungal elements in 10% KOH smear	Detection of fungal elements in Gram-stained smear	Clinical suspicion of fungal keratitis on slit-lamp examination
Positive	34	29	40
Negative	26	31	20
Total	60	60	60

Discussion

Our study result reveals that 66.7 of the cases were represented by the males, and by females, it was 33.3 and reveals a distinct male dominance. This is in line with the results of Titiyal et al. (2006) [8] whose sample has more males (70.4) affected, and also Mehta and Mehta (2017) [9] found that in central India the population of males with the disease is higher. Male preponderance in fungal Keratitis is often assumed to be a result of occupational exposure especially in agricultural hospitals where trauma with vegetative matter is prevalent. Nonetheless, research in Nepal by Upadhyay et al. (1991) [10] has revealed almost equal ratio, and it demonstrates that due to regional occupational trends, the prevalence varies largely based on sex.”

The ages in our study revealed that the highest incidence was recorded in patients over 40 years (38.9%), then those aged 31 to 40 years (27.8), and the lowest number (11.1) of cases was in patients below 21 years. Similar data was noted by Li et al. (2014) [11] 83.21% of corneal ulcers were observed in patients aged 50-59 years, and by Sharmila Suwal et al. (2016) [12] 40% of cases were in the age category of 51-60 years. On the other hand, Rumpa Saha and Das (2006) [13] observed that 31-40 years were the worst hit in Delhi which implies that age distribution difference might have correlated with the difference in occupational exposure, environmental influences and local population demographics.

Residence in the rural area was also an important predisposing factor in our cohort, having 61.1% of the patients living in rural areas, and 38.9% living in urban areas. This finding is in line with other studies in southern India and Ghana that indicated the prevalence of fungal keratitis was higher in rural population that are involved in agricultural activities (Gopinathan et al., 2002; Hagan et al., 1995) [14,15]. The rural environment is more associated with the risk of corneal trauma by vegetative material as they were engaged in working the farms, and in our research, this constituted 57.1 of all cases of trauma. All in all, 77.8% of patients had corneal trauma, which was closely similar to other studies on Indians where 70-80% of cases were due to trauma (Dandona and Dandona, 2003; Gopinathan et al., 2002) [7,14]. Other etiologies of fungal keratitis in rural populations were more varied in the proportion of foreign bodies (25%), insect injuries (10.7%), and other unspecified causes (7.1%).

Systemic conditions were found in 22.2 percent of the patients, whereas comorbid ocular conditions and topical steroid were found in 16.7 and 13.9 percent, respectively. Such results indicate that systemic and local immunocompromising factors are in a supportive role in the pathogenesis of fungal keratitis, which supports previous research on comorbidities as a risk enhancer (Brown et al., 2020; Richardson and Warnock, 2012) [16,17].

Microbiologic findings showed that pure fungal infections were common with 60 percent of the cases

being infected by this type of infection, and mixed bacterial-fungal infections were infrequent (6.7). Pure bacterial infections and culture-negative cases were also evenly spread with 16.7 each. The most commonly isolated fungi were *Fusarium* species (38.9%), *Aspergillus* species (22.2%), *Mucor* and *Rhizopus* were not common (8.3 and 2.8, respectively). The dematiaceous fungi were 27.8% of the isolates. These findings can be compared to the findings of Idiculla et al. (2009) [18] in which *Fusarium* spp. made 50 percent of isolates and *Aspergillus* 34.5 percent. On the contrary, Alkatan and Athmanathan (2012) [19] indicated prevalence of *Aspergillus* (27.6%), as compared to *Fusarium* (17.2%), implying that climatic and environmental conditions in a region have a strong effect on the distribution of the fungal species. *Fusarium* was also found to prevail in studies in the southern part of India, which aligns with the results we get (Chittur & Waddepally, 2016) [20].

This result was evidenced by the correlation between clinical and microbiological diagnosis in our study, which showed that KOH smear detected elements of fungi in 34 out of 60 cases, and Gram-stained smears were positive in 29 cases. Slit-lamp examination clinical suspicion had a higher number, 40 positive cases, indicating that clinical examination can overestimate fungal keratitis. This exaggeration is in line with the existing body of literature that suggests that clinical manifestations including ulcers that are dry, with feathery edges, hypopyon, and satellite lesions are suggestive, yet laboratory testing is necessary to make an accurate diagnosis (Brown et al., 2020; Richardson and Warnock, 2012) [16,17]. The difference between clinical and laboratory diagnosis shows the necessity of microbiological verification, especially in mixed infections or atypical manifestation.

Overall, our results provide support to available trends in the epidemiology of fungal keratitis: predominance among men, increased rates in the middle-aged and older population, work-related exposure of the cornea to vegetative matter is the main predisposing factor. *Fusarium* spp. is still the most widespread of fungal pathogen, but there are regional differences with *Aspergillus* and dematiaceous fungi playing an important role. There is a tendency to overestimate fungal involvement in clinical suspicion, which can be highly crucial in ensuring proper diagnosis and consequent management. These results are widely in line with those of the literature in India and other tropical areas, but some small differences are attributable to the effect of local environmental, demographic, and occupational factors.

Conclusion

The paper has indicated that fungal keratitis is most common in middle aged adults, and that it is more

common in males and rural populations. As the most frequently occurring predisposing factor, corneal trauma, especially due to vegetative matter, appeared. Microbiological examinations showed that corneal ulcers were mainly caused by fungal infections with hyaline fungi and *Fusarium* and *Aspergillus* species being the most common isolate. The correlation between clinical diagnosis and microbiological results was fairly high but there were cases of divergence thus underlining the need to confirm laboratory results with clinical assessment of fungal keratitis to enable proper diagnosis and proper management of fungal infections.

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