Clinico-Mycological Analysis of Ocular Infections in Immunocompetent vs. Immunocompromised Patients

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Abstract

Fungal pathogens have a crucial role in causing eye infections worldwide, which can often result in avoiding blindness. The use of corticosteroids has contributed to the recent surge in occurrences of fungal keratitis. The aim of this study was to determine the occurrence of ocular fungal infections in patients with immunocompetent and immunosuppressed patients. The study divided 184 case into two groups: immunocompetent and immunocompromised. We directly examined collected clinical samples under a microscope using a KOH mount and a modified LPCB mount, before exposing them to fungal culture. These diagnostic techniques made it easier to identify fungal species in the samples. Both groups showed keratitis as the most common clinical symptom. In patients with a normal immune system, trauma was the main factor that made them more susceptible to the condition, whereas in patients with a weakened immune system, systemic candidiasis was the most common contributing factor.

Fusarium was the predominant causal agent in immunocompetent patients while immunocompromised individuals more frequently observed Candida and Aspergillus species. These findings emphasise the need to take into account a patient's immunological condition when diagnosing and treating ocular fungal infections. This calls for additional research to improve treatment approaches and to evaluate antifungal susceptibility on a broader level.

Keywords: Ocular fungal infections, keratitis, immunocompetent, immunocompromised.

Introduction

Globally, ocular mycoses are causing a significant amount of preventable blindness and are becoming a serious problem in ocular infections. The main causes of an upsurge in cases of fungal keratitis are the widespread use of corticosteroids and the rising use of contact lenses, both of which are recognised as important risk factors[13]. India has a population of over 4.95 million blind individuals, along with 70 million people who have visual impairments. Among these, there are 0.24 million children. Interestingly, fungal infections play a critical role in preventing a significant portion of these cases: specifically, 82.3% of blindness in adults and 35% in children[5].

Fungal keratitis, a main cause of corneal blindness, often comes on by trauma that introduces fungal spores into the cornea. About 55–65% of all cases of fungal keratitis are caused by this infection[15]. Agricultural workers are especially at risk since they are frequently in contact with soil and plant materials, which are significant sources of fungal spores[9]. The hazards of this work are increased by the challenges in managing Mycotic keratitis (MK). Since the existing antifungal medications merely delay the fungus's development, the condition often progresses slowly and requires long-term treatment programs for infection management and cure[4].

MK can have major repercussions including significant vision impairment, total blindness, or even central nervous system involvement, if it is not treated quickly and effectively. This highlights the importance of timely and proper medical intervention[11]. While over 390 different species of filamentous fungus and yeast have been identified as potential etiological agents of FK, Fusarium spp. is thought to be the most frequent cause of this illness. Fusarium species are hyalohyphomycetes that are extensively distributed and proliferate quickly. They may be found in soil, water, plants and vegetative detritus[8].

Even with improved diagnostic methods and greater knowledge, people still undervalue and improperly treat ocular mycotic diseases. Failure to recognise and respond to this condition may cause delay in diagnosing and treating it, which may impair the overall health outcomes of the individuals affected. The use of sophisticated fungal isolation techniques and expanding understanding have made it easier to diagnose this clinical entity early[3,17]. Ocular mycoses are complex conditions with significant consequences, thus it is essential to investigate their frequency and aetiology in order to develop better treatment strategies. The intent of this study was to investigate the prevalence of ocular fungal infections in patients undergoing treatment for immunocompetent and immunocompromised. The study aims to identify the predominant fungus species responsible for these infections in order to facilitate the beginning of targeted empirical therapy.

Material and Methods

Study design: This cross-sectional research involved patients who attended Multi-specialty hospital between

January 2022 and June 2024 (18 months). The Institutional Ethical Review Board granted ethical approval. Following the acquisition of informed consent, the study included all patients who had clinical suspicion of ocular infections. We selected and categorised 184 individuals into two groups: immunocompetent and immunocompromised to underlying systemic and ocular illnesses.

Inclusion and exclusion criteria: Patients of all ages who gave their consent and had a clinical suspicion of ocular infections fulfilled the inclusion criteria. On the other hand, individuals who did not provide their consent, had non-fungal ocular illnesses, or had taken antifungal medication in the two weeks before presentation, were excluded.

Data collection: Predisposing variables, clinical history and epidemiological details have been documented using a structured proforma as part of the data collection procedure. We maintained thorough documentation of the events leading up to the eye infection. Consultant ophthalmologists did complete eye exams that included checking the patient's visual acuity to see if they were losing their sight, looking at the cornea and front part of the eye with a slit lamp, staining the cornea with fluorescein to find sores and ulcers on the cornea, measuring the patient's intraocular pressure digitally to see how high their blood pressure was and syringing the eye to see if the nasolacrimal duct was clear.

KOH mount: A 10% KOH mount was created from another slide using corneal scraping, coated with a coverslip and examined under a microscope to check for the presence of any fungal components.

Culture: Scrapings were aseptically inoculated on Sabouraud's dextrose agar (SDA) and potato dextrose agar. The growth of fungal pathogens was facilitated by the proper incubation of the culture material.

Fungal culture: Two inoculated Sabouraud dextrose agar plates containing 0.05 mg/mL of chloramphenicol were used as the infected media and they were incubated at 37°C and 22°C for a duration of 14 days. The inoculated media were tested for signs of fungal development on the third, seventh and fourteenth days. In cases of fungal growth, the identification procedure involved both microscopic examination of the fungal morphology in lactophenol cotton blue (LPCB) mount and slide culture, as well as a consideration of the features of the colony. FK was diagnosed only when both the fungal culture and the KOH mount showed positive results, or when the same growth was observed in both Sabouraud dextrose agar media.

Statistical analysis: Data analysis necessitated the use of appropriate statistical techniques. Descriptive statistics provided a concise summary of the data, encompassing measures such as means, standard deviations, frequencies and percentages. We conducted a comparative analysis between two groups: immunocompetent individuals with a normal immune system and immunocompromised individuals with a weakened immune system. Categorical variables were analysed using chi-square tests, while continuous variables were analysed using t-tests. A p-value of less than 0.05 was regarded as statistically significant.

Results

There were 184 participants in this research. 119 individuals in group 1 were categorised as immunocompetent, while 65 individuals in group 2 were immunocompromised as a result of systemic or ocular diseases. Diabetes mellitus was the most prevalent of the several systemic conditions found, followed by asthma patients on long-term steroids. Males comprised of 70% of the population in group 1 and 58% of the population in group 2. Furthermore, a significant proportion of these persons were engaged in agricultural work. The primary factor in group 1 that raised the risk of eye infections was trauma from soil or vegetable debris. In contrast, systemic candidiasis was the main cause of ocular infections in group 2, which frequently exacerbated pre-existing conditions such glaucoma or corneal edoema.

A detailed breakdown of the prevalence of several systemic and ocular issues among members of group 2 is shown in table 1. It focuses especially on how orbital cellulitis, conjunctivitis, corneal ulcers and eyelid abnormalities develop in relation to each ailment. All systemic diseases have a high prevalence of corneal ulceration, but it is more prevalent in those with diabetes mellitus and those receiving steroid treatment for asthma. This pattern shows how ocular illnesses can manifest in numerous manners as well as how important it is to consider general health when treating them.

The most prevalent ocular symptom in both group 1 (immunocompetent) and group 2 (immunocompromised) patients was corneal ulcer, which was seen in 77 (65%) and 55 (85%) instances respectively (Table 2). Other manifestations included orbital cellulitis, conjunctivitis, panophthalmitis and eyelid disorders, with varying prevalences in both cohorts. We used a variety of ocular samples, including corneal scrapings, conjunctival swabs, aqueous chamber fluid, lacrimal gland and duct swabs and eyelid swabs, for diagnostic processes such as KOH mount, modified LPCB mount and fungal culture.

Table 3 shows the diagnostic results, showing the varying percentages of positives for modified LPCB mount, KOH mount and culture in groups 1 and 2. Comparison of the KOH mount, modified LPCB mount and fungal culture's diagnostic efficacy for ocular fungal infections across the research groups is summarised in table 3. The distribution of fungal isolates identified by culture in members of groups 1 and 2 is shown in table 4.

The most prevalent species in group 1 was Fusarium species (47.6%), whereas the most common species in group 2 was Candida species (47.6%). In both groups, Aspergillus species was also isolated.

Table 1
Underlying systemic and ocular disorders in Group 2 individuals (n-184)

Underlying disorders	No of patients n (%)	Corneal ulcer n (%)	Conjunctivitis n (%)	Orbital Cellulitis n (%)	Eyelid Disorders n (%)
Diabetes Mellitus	20 (31%)	18 (90%)	1 (5%)	0 (0%)	1 (5%)
HIV	7 (11%)	6 (86%)	1 (14%)	0 (0%)	0 (0%)
Asthma patients on steroid therapy	17 (26%)	15 (88%)	1 (6%)	0 (0%)	1 (6%)
SLE	2 (3%)	1 (50%)	1 (50%)	0 (0%)	0 (0%)
Leprosy	1 (2%)	1 (100%)	0 (0%)	0 (0%)	0 (0%)
Malignancy	10 (15%)	8 (80%)	0 (0%)	2 (20%)	0 (0%)
Ocular diseases	8 (12%)	6 (75%)	0 (0%)	0 (0%)	2 (25%)
Total	**65 (100%)**	**55 (84.7%)**	**4 (6.1%)**	**2 (3.1%)**	**4 (6.1%)**

Table 2
Ocular presentation of study participants (Group 1 and 2) (n-184)

Ocular manifestations	Group 1	Group 2
Corneal ulcer	77 (65%)	55 (85%)
Conjunctivitis	22 (18%)	4 (5%)
Panophthalmitis	7 (5%)	0 (0.3%)
Orbital cellulitis	6 (5%)	3 (5%)
Eyelid Disorders	7 (6%)	3 (4%)
Total	**119 (64.6%)**	**65 (35.4%)**

Table 3
Percentage positivity of samples based on culture, KOH mount and modified LPCB mount

Groups	Diagnostic methods		
	Culture Positive n (%)	KOH Positive n (%)	Modified LPCB Positive n (%)
Group 1	51(43%)	45(38%)	48(40%)
Group 2	25(38%)	22(34%)	23(36%)

Table 4
Distribution of fungal isolates from among Group 1 and 2

Fungi	Group 1 n (%)	Group 2 n (%)
Fusarium species	26 (47.6%)	5 (20%)
Aspergillus species	21 (39.7%)	7 (26.1%)
Curvalaria species	3 (6%)	1 (4.6%)
Candida species	2 (4%)	12 (47.6%)
Penicillium species	1 (1%)	0 (0%)
Zygomycosis	1 (1%)	0 (0%)
Total	**54 (67.5%)**	**26 (32.5%)**

Discussion

On examining the epidemiological traits, causative agents and clinical presentations of ocular fungal infections, this study offers valuable insights into their diagnosis and treatment. The experiment had 184 patients including both immunocompetent and immunocompromised people. Results from previous studies are in line with the greater percentage of men (66.4%) and the highest incidence of infections among those between the ages of 21 and 40[3,17]. Occupational exposure is a significant risk factor for ocular fungal infections, as evidenced by the significant proportion of patients in both groups who worked in agriculture (75% in group 1 and 56% in group 2)[3].

A mere 10 percent of immunocompromised individuals had a history of trauma or foreign bodies, compared to seventy-three percent of immunocompetent patients. These findings are consistent with earlier research[6,16]. The overall incidence of fungal eye infections in this research was 43.4%, which is comparable to the results of Chander et al[3] and Nath et al[10]. However, in other areas, like West Bengal, where the frequency was proven to be 63%, higher rates of fungal eye infections have been observed[1]. The presence of regional, climatic and socioeconomic factors significantly affects the prevalence of fungal keratitis[15].

Geographically, Aspergillus, Fusarium and Curvularia species are more prevalent in tropical locations, while yeasts are more frequently found in temperate climates[7]. In line with these trends, the present investigation discovered that Fusarium species (47.6%) was the most common pathogen among people with a healthy immune system, followed by Aspergillus species (39.7%). Bharathi et al[2] also found similar results in South India, but other regions of the country more commonly reported the presence of Aspergillus species[3,14].

In this study, Candida species was the most prevalent (47.6%) among persons with weakened immune systems followed by Aspergillus species (26.1%). This finding is consistent with prior research that has emphasised Candida as a prominent pathogen in this particular population[3]. India exhibits regional variations in the distribution of fungal species, with Aspergillus species being more frequent in the Northern and Eastern regions. Fusarium species is more commonly found in the Western and Southern areas[12]. This emphasises the significance of utilising local epidemiology data to inform empirical treatment approaches for ocular fungal diseases.

Although this work has made valuable contributions, it also has certain drawbacks. First, the fact that it was conducted in a single centre may restrict the applicability of the results to other populations or situations. Furthermore, the study did not examine the antifungal susceptibility patterns of the detected isolates, a critical factor in optimising treatment regimens. To overcome these limitations, future research should focus on conducting multicenter trials and include antifungal susceptibility testing. This would help to improve the clinical relevance and application of the findings.

This study highlights the substantial impact of fungal infections in the eyes, especially among males involved in agriculture in the study area. Identifying the main fungal species and their distribution among people with normal and weakened immune systems is crucial for enhancing the accuracy of diagnosis and the effectiveness of treatment in clinical settings.

Conclusion

FK is a major contributor of visual impairment, especially in developing countries such as India. The variety of causative agents highlights the need of understanding the differences in microbiological profiles across various climates and geographic regions. As a result, it is critical to inform rural residents and farmers in particular, about FK and how it may endanger eyesight. Farmers have to be counselled to use safety goggles when working, to report any eye injuries immediately and follow ophthalmologists recommended treatment plans. The slow progression and clinical picture similar to that of other infectious agents may predispose patients to delayed presentation and treatment. The results are intended to give ophthalmologists and legislators clear information so that protocols for the efficient treatment of FK may be developed.

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