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Original Research Article

Prospective Clinical Study on Clinical Profile and Risk Factors in Microbiological Various Type Infective Corneal Ulcer

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Abstract

Background: Corneal ulcer is a major cause of visual impairment worldwide. The epidemiology and microbiology of corneal ulcer varies in different regions. In this study, we aimed to investigate the clinical and microbiological features of corneal ulcers in a tertiary care hospital in a developing country.

Aims & Objectives: The aim of this study was to investigate the common causes, clinical characteristics and microbiological features of infective corneal ulcers in a tertiary care hospital in a developing country.

Methods: This was a prospective study conducted over a period of one year. A total of 50 patients with clinical features of corneal ulcer were enrolled. Detailed history and ophthalmic examination were done. Corneal scrapings were obtained for microbiological evaluation, including Gram staining, Giemsa staining, potassium hydroxide (KOH) mounting, and culture.

Results: The most affected age group was 60-70 years, with a male predominance. The most common symptom was pain, followed by redness of the eye. Injury or trauma to the eye was the leading cause of corneal ulcer. Fungal corneal ulcer was the most common, followed by bacterial corneal ulcer and mixed pathogens. Aspergillus and Fusarium were the most common fungal isolates, while Staphylococcus and Pseudomonas were the most common bacterial isolates. Most of the patients had poor visual acuity.

Conclusion: Corneal ulcer is a common and serious condition, especially in developing countries. The epidemiology and microbiology of corneal ulcer vary in different regions. In our study, we found that fungal corneal ulcer was the most common, followed by bacterial corneal ulcer and mixed pathogens. Early diagnosis and appropriate treatment are essential to prevent visual impairment.

Keywords: Corneal Ulcer; Microbial Keratitis; Microbiological Agents; Vision.

Introduction

Microbial Keratitis (MK) is a serious ocular infectious disease that can lead to the loss of the corneal epithelium and stromal infiltration and suppuration associated with signs of inflammation. It can result from bacterial, fungal, and protozoal etiologic organisms which can potentially cause ocular morbidity and disability. The prevalence of Microbial

Keratitis varies according to type, geographical location, and causative factors.

In 2017, corneal opacity was estimated to account for 3.2% of global blindness, affecting 1.3 million people bilaterally [1]. Globally, Microbial Keratitis is the fifth leading cause of blindness affecting one eye in tropical regions after cataract, causing approximately 2 million cases of monocular blindness per year [2,3].

In India, the prevalence of blindness is high, with approximately 18.7 million blind individuals as of 2019 [4]. Corneal blindness accounts for a significant portion of this, accounting for 62.6% cases of all blindness with an incidence of 15.4% according to Murthy *et al* [4]. While Rekhi *et al* reported corneal opacity as leading cause of blindness accounting for 37.2% cases [5].

Epidemiological variations in causation of Microbial Keratitis are reflected by variable findings in multiple studies. Studies by Sharma *et al* [6] and Bharathi *et al* [7] in North India reported contrasting results with bacterial keratitis and fungal keratitis as most common type in these two studies respectively while a study in Southern India by Bharathi *et al* [8] reported Pseudomonas aeruginosa as the most common microbe. Bacteria was identified a most common causative organism by Gonzalez-Salinas *et al* [9] in Northern Mexico. These differences in findings highlight the need for further research to come to a conclusive result on epidemiological distribution of causative microbe of Microbial Keratitis.

Overall, Microbial Keratitis is a significant public health problem in India, and understanding its epidemiology, causative organisms, clinical profile and risk factors is critical for developing effective prevention and treatment strategies. Understanding the epidemiology and risk factors of Microbial Keratitis in a specific population becomes important so that prevention and treatment can be tailored as per the epidemiology and risk factors of that particular population.

So, the present study was designed with aims and objectives to find out the common causes and clinical characteristics of suppurative keratitis and to find out the various microbiological organism responsible for corneal ulcers in patient attending Outpatient department of Ophthalmology at Government Medical College, Kota.

Material and Methods

This clinical study was conducted at the outpatient Department of Ophthalmology in Government Medical College and Associated group of Hospitals in Kota, North India from December 2020 to June 2022. Study included 50 patients who fulfilled the criteria laid down for the study.

All cases of keratitis due to ocular infections (bacterial and fungal) confirmed either by clinical examination or by investigation were included in this study. Patients with viral, non-infectious keratitis, neurotrophic and exposure keratitis were excluded from this study.

A standardized form was filled out on each patient documenting socio-demographic information as well as clinical information including duration of symptoms, previous treatment, predisposing ocular conditions, comorbidities and associated risk factors. A detailed ocular examination was carried out using torch and slit lamp paying special attention to site, size, shape, surface, dry or moist, floor of ulcer whether covered with slough or not and edges were regular or frayed. Corneal vascularisation and corneal sensation were noted. Ulcer was stained with 2 % fluorescein to determine the extent and the details of the ulcer. The amount of hypopyon in anterior chamber, its colour and consistency were noted, along with shape of upper level was determined. The depth of the ulcer was determined by the slit lamp. Lacrimal sac patency was checked by doing sac syringing.

Scrapping was performed after instillation of 4% Lignocaine. Material obtained by blade no 15 scraping the leading edge and base of each

ulcer was inoculated directly into Blood agar, Chocolate agar and Sabouraud Dextrose Agar (SDA). Material from the corneal scrapping was also smeared on three separate glass slides- for Gram stain, Giemsa stain and for microscopic examination as a 10% KOH wet mount. Microbial cultures were considered positive only if growth was demonstrated on two or more solid media. The specific identification of bacterial pathogens was based on microscopic morphology, staining characteristics, and biochemical properties using standard laboratory criteria. Fungi were identified by their colony character on SDA and by their microscopic appearance in KOH.

Laboratory investigations included CBC, urine examination, blood for FBS/RBS. Treatment was started with broad-spectrum antibiotics and antifungals, and non-specific treatment such as cycloplegic drugs, systemic analgesic and inflammatory drugs, and vitamins (A and C) were also given. Debridement of the ulcer bed was carried out several times. Treatment was changed according to microbiological culture and sensitivity reports.

Results

Table 1: Sociodemographic distribution and clinical profile of study participants

Variables		Number of Patients	Percentages
Age	<10 years	2	4%
	11-20 years	3	6%
	21-30 years	4	8%
	31-40 years	8	16%
	41-50 years	9	18%
	51-60 years	7	14%
	61-70 years	15	30%
	>71 years	2	4%
Gender	Male	32	64%
	Female	18	36%
Eye Involved	Right eye	33	66%
	Left eye	17	34%
Occupation	Farmer	15	30%
	Labourer	11	22%
	Housewife	10	20%
	Driver	2	4%
	Others	12	24%
Comorbidities	Diabetes Mellitus	4	8%
	Hypertension	6	12%
	No comorbidities	40	80%
Symptoms	Painful DOV	19	38%
	Redness in Eyes	44	88%
	Pain in Eyes	48	96%
	Irritation of Eyes	2	4%
	Headache	2	4%
	Swelling	11	22%
	Photophobia	28	56%
	Itching of Eyes	2	4%
	Watering	26	52%

	Discharge	2	4%
Vision	>6/24	12	24%
	6/24-6/60	1	2%
	<6/60	37	74%
Presence of Hypopyon	Yes	14	28%
	No	36	72%

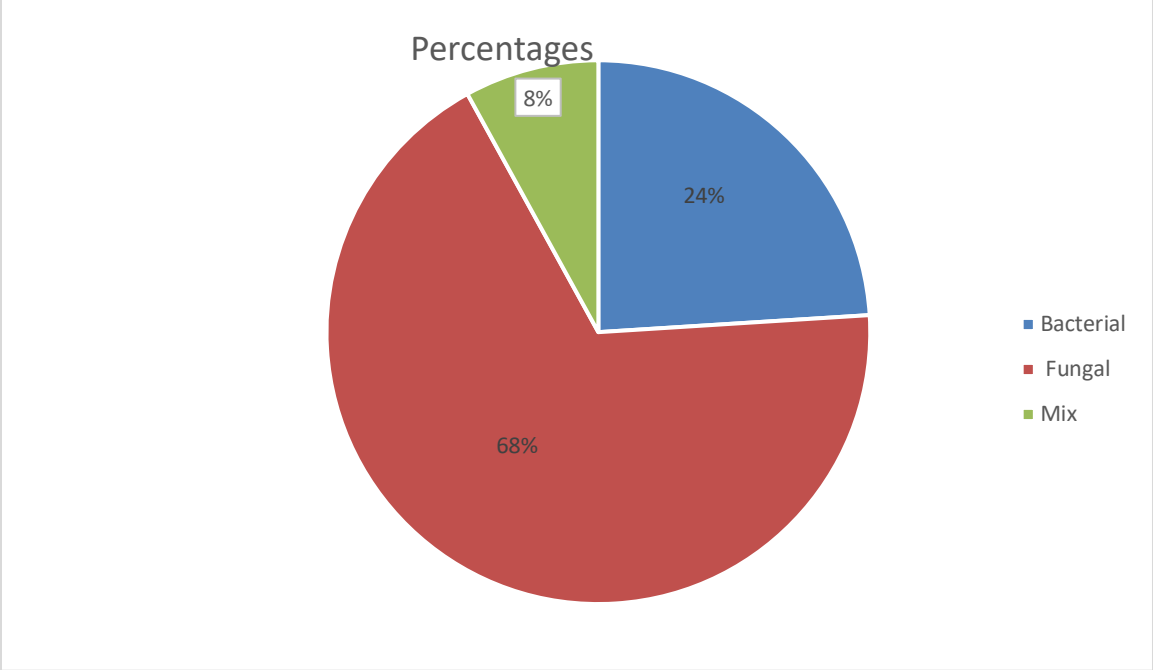

Figure 1: Diagnosis of corneal ulcer in study group on the basis of clinical and microbiological (Culture and Smear) report

Table 2: Distribution as per predisposing factors

Past ocular history		**Study Group**	**Percentage**
Injury Trauma to eye (38)	Vegetative material	20	40%
	Dust	11	22%
	Cilia/corneal	3	6%
	Metal	3	6%
	fingernail	1	2%
Animal origin (1)		1	2%
Others* (11)		11	22%
TOTAL		50	100%

*lacrimal sac disease, optical keratoplasty, insect bite and unknown

Table 3: Corneal Examination Distribution of study group

Corneal examination		**Study group n (%)**
Site	Peripheral	13(26%)
	Central	18(36%)

	Paracentral cornea	14(28%)
Depth	Superficial	31(62%)
	Deep	16(32%)
	Impending	1(2%)
	Perforated	2(4%)
Edges	Feathery	6(12%)
	Irregular	33(66%)
	Elevated	2(4%)
	Perforated	2(4%)
	Regular	7(14%)

Table 4: Smear characteristics of study group

Staining of Smear		**Study Group N (%)**
Gram Stain	Negative	38(76%)
	Positive	12(24%)
	GPC*	8(16%)
	GNB**	4(8%)
Giemsa stain	Positive	20(40%)
	Negative	30(60%)
KOH mount (10%)	Positive	25(50%)
	Negative	25(50%)

* gram positive cocci; ** gram negative bacilli

Table 5: Distribution of patients according to Microbiological culture report

Culture Results And Pathogen Isolated			**Study Group N (%)**
Positive culture report			33(66%)
Pathogen isolated	Fungus	Aspergillus	13(26%)
		Fusarium	8(16%)
	Bacteria	Staphylococcus	8(16%)
		Pseudomonas	4(8%)
Negative culture report			17(34%)
Total			50

In our study, individuals aged 60-70 years were the most affected by corneal ulcer while children under 10 years and adults over 70 years were less prone to it. The male-to-female ratio of study participants was 1.7:1. Right eye was the most affected (66%). Farmers were the most commonly (30%) affected occupational group. Most common symptoms observed in our study group was pain (96%) followed by redness of eye (88%). Injury or trauma to the eye was the leading cause of corneal ulcer, with vegetative matter being the most common (40%) culprit. Most patients had no chronic illness, while diabetes and hypertension were present in a small percentage. Central ulcers were the most common (36%), and superficial ulcers were the most frequent (62%) according to depth. The majority (66%) of ulcers had irregular edges. Hypopyon was present in 28% of patients. Most had poor visual acuity.

On gram staining, 76% were negative, 16% were stained positive for gram positive cocci (GPC) while 8% were positive for gram negative bacilli (GNB). On Giemsa staining, 60% of the smears were negative for Giemsa staining, while 40% positive for fungus in

which fungal hyphae was found in 32% of the smears. Spores were seen in 8% of smears. On KOH mounting, 50% of the smears were positive in our study group.

66% were microbiological culture positive. Out of these, 42% were positive for fungus, in which 26% and 16% were aspergillus and fusarium respectively and remaining 24% were positive for bacteria, in which 16% and 8% were staphylococcus and pseudomonas respectively.

According to clinical and microbiological report, Fungal corneal ulcer was the most common (68%), followed by bacterial corneal ulcer and mixed pathogens.

Discussion

This study found higher incidence of corneal ulcer in the age group of 60-70 years. The findings from various studies are in line with the age distribution observed in our study. Specifically, the study by Bharathi *et al*. (2003) [8] found that the highest incidence of microbial keratitis was in patients aged 60 years and older. Similarly, the study by Green *et al*. (2008) [9] found that older age was associated with an increased risk of microbial keratitis. These findings support the idea that older individuals may be at higher risk for corneal ulcers, which is likely due to age-related changes in the cornea, such as decreased sensitivity and slower healing.

The finding that males are more affected by microbial keratitis than females is in line with previous studies (Nesaraj *et al* [10], 2020; Qian *et al* [11]. The reason for this gender difference is not completely understood, but it may be attributed to the fact that males are more involved in outdoor activities that increase their risk of eye trauma and exposure to environmental pathogens (Qian *et al*., 2016 [11]. Males may also be more prone to rubbing their eyes, which can introduce pathogens into the cornea (Nesaraj *et al* [10]. However, other studies have reported conflicting results, with some finding no significant gender difference in the incidence of microbial keratitis (Bharathi *et al*., 2002; Wu *et al*., 2017) [8,12]. Further research is needed to fully understand the relationship between gender and microbial keratitis.

It was found that the right eye is more commonly affected by microbial keratitis than the left eye or both eyes. One study from India reported that majority(58.56%) of cases of microbial keratitis involved the right eye (Srinivasan *et al*., 2006) [13]. Another study from China also found that the right eye was more frequently involved (Li *et al*., 2017) [14]. These results suggest that microbial keratitis may be more likely to affect the right eye, although the reasons for this asymmetry are not entirely clear and further research is needed.

The finding that farmers are the most commonly affected group by microbial keratitis is supported by several previous studies. A study from India found that farmers had the highest incidence of microbial keratitis, accounting for 33.3% of cases (Srinivasan *et al*., 1997) [13]. Another study from China found that agricultural workers had the highest incidence of corneal ulcers caused by fungal infection, with an incidence rate of 61.8% (Wu *et al*., 2019) [12]. The higher risk of microbial keratitis among farmers can be attributed to their frequent exposure to soil, plant material, and animal waste, which can harbour microorganisms that can cause corneal infections. This finding has important public health implications, as it suggests that interventions targeting this high-risk group could help to reduce the burden of microbial keratitis. Pain in ulcerative eye is the most common symptom of corneal ulcer in our study. Similar result were found in study done by Almahmoud *et al* [15]. where pain was reported by 90.5% of patients. Pain occurs due to mechanical effects of lids and chemical effects of toxins on the exposed nerve endings.

The finding that central location was the most common site of corneal ulcer in your study group is consistent with some previous studies

(e.g., Lalitha *et al*., 2012; Prajna *et al*., 2007) [16,17] . The reason for the high prevalence of central ulcers may be related to the greater exposure of the central cornea to environmental pathogens, as well as its increased susceptibility to trauma and poor oxygenation.

The finding that superficial ulcers and irregular edges were the most common types in your study is also consistent with previous research. Superficial ulcers are more common than deep ulcers and are associated with milder symptoms and better visual outcomes (Austin *et al*., 1998; Prajna *et al*., 2007) [18,19]. Irregular ulcer edges may indicate a more severe infection and a greater risk of complications such as corneal perforation (Srinivasan *et al*., 2006) [19].

The finding of 76% negative results on gram staining, with the remaining 24% showing positive results for either GPC or GNB, is consistent with previous studies on the microbiological profile of microbial keratitis (Bharathi *et al*., 2002; Srinivasan *et al*., 2002) [7,19]. Similarly, the finding of fungal hyphae in 32% of the Giemsa-stained smears is in line with other studies that have reported fungal keratitis as a common cause of corneal ulcers (Prajna *et al*., 2011; Green *et al*., 2008) [9,20]. However, the finding of spores in only 8% of the Giemsa-stained smears is lower than reported by other studies that have found a higher incidence of spores in fungal keratitis cases (Xie *et al*., 2016; Srinivasan *et al*., 2002) [19,21].

The finding that 50% of the smears were positive on KOH mounting is similar to previous studies that have reported a higher sensitivity of KOH mounts in detecting fungal elements in corneal ulcers compared to other staining techniques (Bharathi *et al*., 2002; Srinivasan *et al*., 2002) [7,19].

The finding that fungal corneal ulcer was the most common in our study group is consistent with several previous studies (Xie *et al*., 2016; Prajna *et al*., 2011; Green *et al*., 2008) [9,22,23] that have reported fungal keratitis as a major cause of corneal ulcers. The prevalence of specific fungal organisms in your study, such as Aspergillus and Fusarium, is also similar to previous reports that have identified these fungi as common causes of fungal keratitis (Gopinathan *et al*., 2009; Flor Cruz and Evans, 2010) [24,25].

But there are several studies that have reported contrasting results to the findings of this study. For example, one study conducted in South India found that bacterial corneal ulcers were more common than fungal ulcers, with Pseudomonas aeruginosa being the most common organism isolated from cultures (Srinivasan *et al*., 2002) [19]. Another study from Nepal reported that bacterial ulcers were more common than fungal ulcers, with Streptococcus pneumoniae and Pseudomonas aeruginosa being the most common organisms isolated (Upadhyay *et al*., 2011) [26]. A study from Brazil found a higher prevalence of Acanthamoeba keratitis compared to fungal and bacterial keratitis (Carvalho *et al*., 2013) [27]. Similarly, a study from Ethiopia reported that the majority of corneal ulcers were caused by Acanthamoeba (Gebreselassie *et al*., 2019) [28].

These contrasting results may be due to differences in the geographical location, population, and environmental factors, among other factors, and highlight the need for further research to better understand the microbiological profile of corneal ulcers.

Conclusion

The study found that individuals aged 60-70 years were most affected by corneal ulcers, with the male-to-female ratio being 1.7:1. Farmers were the most commonly affected occupational group. The most common symptoms observed were pain. Injury or trauma to the eye was the leading cause of corneal ulcer, with vegetative matter being the most common culprit. Fungal corneal ulcer was the most common type, followed by bacterial and mixed pathogens. Most ulcers

had poor visual acuity, and the right eye was most affected.

Implications

The present study provides insights into the epidemiology, causative organisms, clinical profile, and risk factors of Microbial Keratitis in North India. Results of this study will help in early suspicion/ diagnosis and prompt empirical treatment with appropriate antimicrobial agents which can reduce the risk of complications such as corneal perforation and visual impairment. The findings highlight the need for further research in different regions of India to understand the epidemiology of Microbial Keratitis better. It is also essential to promote public awareness of the risk factors associated with Microbial Keratitis and to improve the quality of eye care in the affected populations.

Strengths & limitations

The study provides useful information that can be used to inform preventative measures and treatment options for corneal ulcers in this population. But the results of the study should be assessed in the background of following limitations:

The study was conducted in a single centre, which may limit the generalizability of the findings to other populations. The sample size of the study was relatively small, which may affect the statistical power of the study. The study relied on self-reported data to collect information on risk factors, which may be subject to recall bias. The study did not investigate the long-term outcomes and consequences of corneal ulcers on the affected individuals.

Future directives

Study paves the way for further multicentric research on microbial keratitis with a larger sample size.

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