Special Focus, Cornea, Original Article

Clinical profile and treatment outcomes of *Fusarium* keratitis

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Purpose: To determine the seasonality, clinical profile, and treatment outcome of Fusarium keratitis. **Methods:** A retrospective medical chart review of 97 patients with culture-proven Fusarium keratitis at a tertiary eye care institution from January 2018 to December 2019. **Results:** The median (SD) age at enrollment was 44.6 (16) years; 75 (79.8%) of them were male. Presence of infiltrate less than 4 mm^2 at baseline indicated 4.4 times the odds of achieving final BCVA more than 20/60 (95% CI: 1.4–13.3; P = 0.008). The absence of surgical management indicated 8.1 times the odds of achieving final BCVA of more than 20/60 (95% CI: 0.9–71.5; P = 0.06). The visual acuity at presentation, duration between symptoms and presentation, history of ocular trauma, previous use of topical medications, and presence of hypopyon were not identified as significant predictors of final BCVA in the multivariable regression analysis. **Conclusion:** Smaller infiltrate size and absence of surgical management are the significant predictors of good visual outcome. Visual outcome of *Fusarium* keratitis is poor, and a significant number of patients did not respond to anti-fungal therapy and had to undergo surgeries. To the best of our knowledge, this is the largest case series on *Fusarium* keratitis to date.

Key words: *Fusarium* sp, hypopyon, keratitis, sugarcane leaf injury, trauma

Access this article online

Website: www.ijo.in

DOI: 10.4103/ijo.IJO_999_21

Quick Response Code:

Fungal keratitis is one of the most important infectious diseases causing visual disability and accounts for up to 50% of total microbial keratitis.[1,2] Since the last two decades, all studies from India on fungal keratitis reported that *Aspergillus* and *Fusarium* species have been the most common isolates in fungal keratitis.[2-8] Use of contact lenses is a major risk factor for fungal keratitis in developed countries[9-12] but not in most of the studies from India. In developing countries like India, ocular trauma caused by vegetative matter has been reported to be one of the major risk factors for fungal keratitis.[2-8] Tropical environment of India is an additional predisposing factor for fungal keratitis.[13]

Fusarium species are ubiquitous in air, soil, and plants. They cause a broad spectrum of infections in humans who are infected with direct inhalation or contact with Fusarium-contaminated materials. In 2006, there was an outbreak of *Fusarium* keratitis in the United States,[14] Singapore,[15] and Hong Kong.[16] Chang *et al*.[17] reported its association with the use of contact lens solution. In India, the proportion of fungal keratitis attributable to *Fusarium* species varies from 24% to 47%.[2-8] The incidence of *Fusarium* keratitis is seasonal and peaks during harvesting season.[13,18] *Fusarium* keratitis can lead to complications such as descemetocele, perforation, and even progression to endophthalmitis.[19,20]

Many studies describing the predisposing factors, clinical characteristics, and treatment outcome of fungal keratitis have been published from India during the last decade.[8,21-26] There are no published reports exclusively on the profile of *Fusarium* keratitis from India. A higher incidence of *Fusarium* keratitis has been observed at our institute. Thus, this study was undertaken to retrospectively analyze seasonality, predisposing factors, clinical characteristics, and treatment outcome of culture-confirmed *Fusarium* keratitis, diagnosed and treated at a tertiary eye care institute located in Moradabad (India).

Methods

The study has been approved by the institutional ethics committee. This study adhered to the principles of the Declaration of Helsinki. A medical chart review of consecutive patients presenting with corneal ulcers to the department of cornea between January 2018 and December 2019 was carried out. The institute is a tertiary eye care referral center and caters to patients from the agricultural belt of western Uttar Pradesh (India). All patients with a positive culture of *Fusarium* species obtained from corneal scraping were included in the analysis.

At the baseline visit, a complete medical history (i.e., age, sex, trauma, previous ocular surgery, and underlying systemic disease) was obtained from patients. A detailed examination of both eyes was performed using a slit-lamp biomicroscope. The visual acuity at presentation, symptoms, and size of epithelial defect (with or without hypopyon), and infiltrate as measured

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Received: 26-Apr-2021 Revision: 17-Aug-2021
Accepted: 06-Dec-2021 Published: 25-Feb-2022

Cite this article as: Khurana A, Kumar A, Chauhan L. Clinical profile and treatment outcomes of *Fusarium* keratitis. Indian J Ophthalmol 2022;70:852-9.

by the variable slit on the biomicroscope were documented on each visit, along with detailed posterior segment examination or B-scan ultrasonography where indicated, in all cases on the first visit. A standard case report form was developed to capture pre-identified variables. Sociodemographic data, predisposing risk factors, clinical details, prior treatment modalities (if any), and visual outcomes were noted. For further analysis, details were transcribed into Microsoft Excel. Incomplete records were excluded from the analysis.

Specimen collection and laboratory procedures

Corneal scrapings were obtained from the base and edge of the ulcer by using a sterile surgical blade (# 15 on a Bard–Parker handle) under topical anesthesia (0.5% proparacaine hydrochloride) and slit-lamp magnification in every case on the first visit. Gram stain and 10% potassium hydroxide mount were included as part of the standard protocol for microscopic evaluation of corneal smears. Gram-stained smears were examined at ×400 and ×1000 magnification; the KOH preparations were examined at ×200 and ×400 magnification under a light microscope. Scrapings for smears were collected prior to those for culture.

For cultures, the materials were inoculated onto chocolate agar, blood agar, brain heart infusion, and thioglycolate and incubated at 37°C, and Sabouraud dextrose Agar (SDA) was inoculated on two media and incubated at 25°C and 37°C and examined daily during the 1st week, twice weekly for the next 3 weeks, and discarded after 3–4 weeks if there was no growth. Fungi were identified by their colony characteristics on SDA and by the morphological appearance of the spores in lactophenol cotton blue stain, and in some cases by slide culture method. All laboratory methods were performed under standard protocols, which have been discussed in detail in the previous studies.[5,8]

Treatment protocol

Initially, the eyes were treated based on the clinical evaluation and microbiological smear examinations. The eyes were treated with 5% natamycin suspension on an hourly basis along with cycloplegics and oral analgesics in cases where smear examinations show fungal filaments/hyphae. Topical voriconazole 1% (Vozole, Aurolab, India) was supplemented for larger and deeper ulcers. In cases of no hyphae/filaments fortified cefuroxime (5%) per hourly and ciprofloxacin (0.3%) eye drops per hourly along with cycloplegics were prescribed.

Statistical analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) software, version 21. Demographic data were presented as mean, standard deviation, and percentage. Univariate analysis was done to assess associations between baseline patient and ulcer characteristics and BCVA at final follow-up. For analysis, duration between symptom and presentation, infiltrate size, and duration of antifungal therapy were grouped into different categories. Comparison of BCVA at final follow-up among different groups was done using an independent *t* test. Levene's test was used to assess the equality of variance among independent groups. The Mann–Whitney test was performed to compare the mean of the identified variable among two groups. Categorical data were presented as the number and percentage, and the differences between groups were tested using cross-tabulation, Chi-square test, or Fisher's exact test. Statistically significant predictors identified in univariate analysis ($P < 0.05$) were included in a subsequent binary logistic regression model. A Hosmer–Lemeshow test was used to test the goodness of fit of the model.

Results

Epidemiological characteristics

Of the 485 clinically suspected fungal keratitis patients, 94 (19.4%) were positive for *Fusarium* species. The median age of patients with *Fusarium keratitis* was 44.6 ± 16 years (range: 10–72 years). Of them, 79 (84%) belonged to rural locations and 15 (16%) to urban locations. There were 75 male patients (79.8%) and 19 female patients (20.2%) ($P = 0.00$; one sample binomial test). The left eye was involved in 52 (55.3%) patients, and the right eye was involved in 42 (44.7%) patients [Table 1]. There were 61 (64.8%) cases of antecedent ocular trauma prior to the onset of ulceration. Among patients with a history of injury, trauma with vegetative matter was found in 22 (36%) patients. Sugarcane leaf (n = 16/22; 72.7%) was the most common cause among vegetative reasons. Dust particles (n = 20/94; 21.3%) was the main nonvegetative cause of trauma. Distribution of inciting causes is presented in Fig. 1.

The median number of days from onset of symptoms to presentation was 10 days (range: 0–90 days). A total of 38 (40.4%) patients presented within 7 days, 25 (26.6%) between 8 and 14 days, 19 (20.2%) between 15 and 30 days, and 12 (12.8%) after 30 days. Maximum patients presented during summer (Apr–Jun) 32 (34%) and during autumn (Oct–Nov) 28 (29.8%). During winter (Dec–Jan) 9 (9.6%) patients, spring (Feb–Mar) 3 (3.2%) patients and monsoon (Jul–Sep) 22 (23.4%) patients had presented. A total of 41 (43.6%) patients presented during the Kharif cropping season (June–Nov monsoon crop) Table 1.

Seventy-nine (84%) patients had used some topical medications before presentation. Fifty six (n = 56/79; 70.8%) patients were on antibiotics, 44 (n = 44/79; 55.6%) on fluoroquinolone, 26 (n = 26/79; 32.9%) on natamycin, and 29 (n = 29/79; 26.7%) were using antifungal eye drops along with a cocktail of antibiotics and antiviral. Four patients were using steroids and nine were using anesthetic eye drops in combination with other antibiotics and antifungals. Details of medications at presentation are presented in Table 2. The mean duration between onset of symptom and presentation in

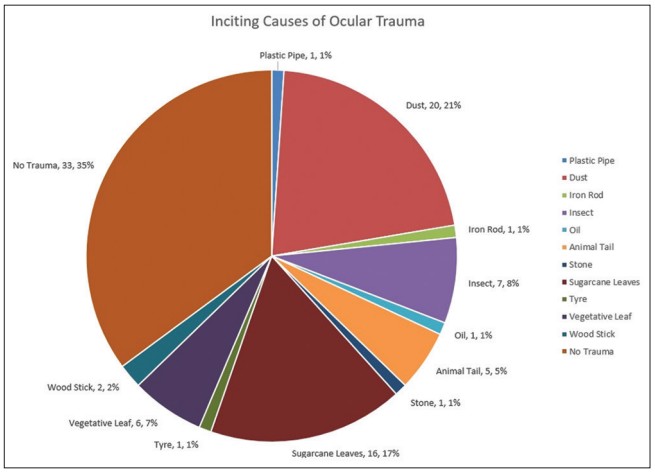

Figure 1: Distribution of inciting causes of Fusarium keratitis

patients who were not taking any medicine was 8.6 days and of patients who were on medication was 42.3 days ($P = 0.002$).

Clinical characteristics

At presentation, white-colored infiltrate was noted in 56 (59.5%) eyes, yellow in 21 (22.3%), grey in 16 (17.1%), and brown in 1 (1.1%) eye. Infiltrate edges were feathery in 67 (71.3%) and rounded in 27 (28.7%) eyes. Epithelial plaque was present in 41 (43.6%) eyes. Infiltrate margin was active in 63 (67%), resolving in 22 (23.4%), and scarred in 9 (9.7%) eyes. Thinning was present in 14 (14.9%) eyes. Surrounding cornea was edematous in 46 (48.9%), satellite lesions in 26 (27.7%), and scarred in 18 (19.1%) eyes. Descemetocele was present in 4 (4.3%) eyes.

Table 1: Demographic characteristics of patients

Variable	Category	Frequency	Percent
Age (years)	<18	4	4.3
	18-25	10	10.6
	26-35	11	11.7
	36-45	18	19.1
	46-55	24	25.5
	56-65	19	20.2
	>65	8	8.5
Gender	Female	19	20.2
	Male	75	79.8
Location	Rural	79	84.0
	Urban	15	16.0
Duration between onset of symptoms and presentation (days)	<7	30	40.4
	8-14	25	26.6
	15-30	19	20.2
	>30	12	12.8
Season	Winter	9	9.6
	Spring	3	3.2
	Summer	32	34.0
	Monsoon	22	23.4
	Autumn	28	29.8
Medication before presentation	Yes	79	84.0
	No	15	16.0

The location of the ulcer was central in 58 (61.7%) patients and paracentral/peripheral in 36 (38.3%) patients. The median infiltrate size (length × breadth) was 8.0 mm^2 (IQR: 16 mm^2). The mean infiltrate size of centrally located ulcer eyes was 17.5 mm^2 and of eyes with paracentral/peripheral ulcers was 8.1 mm^2 ($P = 0.003$). Hypopyon was present in 12 (12.8%) patients ranging from 0.5 to 2 mm. Clinical characteristics of Fusarium keratitis are presented in Fig. 2.

The presenting visual acuity in the affected eye was more than 20/30 in 16 (17%) eyes, less than 20/30 to 20/60 in 12 (12.8%) eyes, less than 20/60 to 20/200 in 13 (13.8%) eyes, and less than 20/200 in 53 (56.4%) eyes. A total of 10 (83.3%) patients with hypopyon had presenting visual acuity of less than 20/200. Although all scrapings grew fusarium on culture, only sixty-six (70.2%) were found to be positive for fungal hyphae on KOH staining of the corneal scrapings on the initial visit and Gram stain smears of the same smears were positive for fungal hyphae in only 30 (31.9%) cases. No mixed infection was reported in these patients.

Management and treatment outcome

The BCVA at last follow-up was more than 20/30 in 16 (17%) eyes, less than 20/30 to 20/60 in 15 (15.9%) eyes, less than 20/60 to 20/200 in 18 (19.1%) eyes, and less than 20/200 in 45 (47.8%) eyes. A comparison between presenting visual acuity and visual acuity at last follow-up is presented in

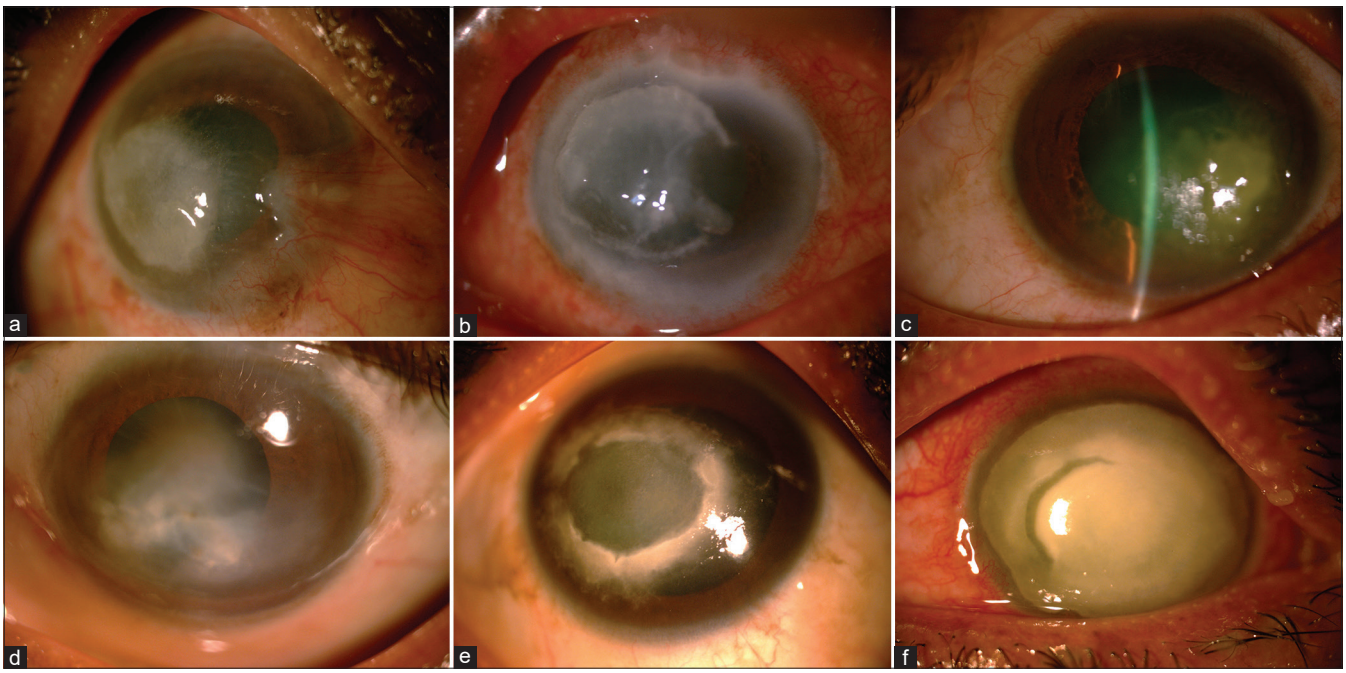

Figure 2: Clinical characteristics of Fusarium keratitis (a) feathery margin, (b) grey infiltrate, (c) active edges, (d) resolving infiltrate, (e) ring infiltrate, (f) dry plaque

Table 2: Medications at the time of presentation

Drug 1	Drug 2	Drug 3	Drug 4	No of Pts
Fluoroquinolones	Nil			7
	Antihistamine			1
	Anesthetic			2
	Azole antifungal	Nil		4
		Chloramphenicol		1
		Quinolone		1
		Aminoglycoside		1
		Steroid		2
	Aminoglycoside	Nil		4
		Quinolone		1
		Anesthetic		2
	Natamycin	Nil		4
		Aminoglycoside		1
		Anesthetic		1
		Triazole antifungal		2
		Azole antifungal	Nil	3
			Triazole antifungal	2
		Aminoglycoside	Triazole antifungal	2
		Imidazole antifungal	Anesthetic	3
Natamycin	Nil			1
	Chloramphenicol			2
	Azole Antifungal			3
	Polymyxins	Antiviral		1
	Quinolone	Azole antifungal		1
Quinolone	Nil			1
	Steroid			1
	Azole antifungal			1
Aminoglycoside	Nil			1
	Imidazole antifungal			1
	Triazole antifungal			1
Azole antifungal	Beta-lactams			1
Chloramphenicol	Steroid			1
Antiviral	Nil			1
Anesthetic	Nil			1

Table 3. The median duration of antifungal therapy given was 18 days (IQR: 26 days). Details of adjuvant therapy are presented in Table 4. A total of 69 (73.4%) patients were managed medically, and surgery was performed in 25 (26.5%) patients. A total of 23 (n = 23/58; 39.6%) patients with centrally located ulcer required surgery as compared to 2 (n = 2/36; 5.5%) with paracentral/peripheral ulcer ($P = 0.00$; Fisher exact test). Tissue adhesive and bandage contact lens were applied in 6 (6.4%) eyes, therapeutic penetrating keratoplasty (TPK) was performed in 14 (14.8%) eyes, and intraocular antibiotics were given in 3 (3.2%) eyes. Resurgery was done in 14 (14.9%) eyes. Visual acuity at last follow-up was improved or remained unchanged in 79 (84%) patients, and decreased in 15 (15.9%) patients. A total of 4 (n = 4/58; 6.8%) patients with centrally located ulcer achieved BCVA of more than 20/30 at last follow-up as compared to 12 (n = 12/36; 33.3%) with paracentral/peripheral ulcer ($P = 0.00$; Fisher exact test).

Univariate analyses comparing baseline characteristics of those who achieved BCVA of >20/60 at last follow-up compared with those who did not are outlined in Table 5. The best-corrected visual acuity at the last follow-up was 1.75 ± 1.2 logMAR in patients with infiltrate size of >4 mm^2 and 0.53 ± 0.86 log MAR in patients with infiltrate size of ≤4 mm^2 was ($P = 0.00$; Mann–Whitney test). Seven patients had total infiltrate at the time of presentation, and six of them required therapeutic penetrating keratoplasty. The BCVA at last follow-up of these patients was less than 20/200. Similarly, BCVA at last follow-up in patients who had undergone surgery was 2.27 ± 1.0 as compared to 1.01 ± 1 logMAR in medically managed patients ($P = 0.00$; Mann–Whitney test). The mean BCVA at last follow-up was 2.43 ± 0.8 logMAR in the patients in whom resurgery was performed as compared to 1.18 ± 1.1 logMAR in others ($P = 0.00$; Mann–Whitney test). The median infiltrate size of patients who were managed surgically was 9.5 mm^2, and of patients who were managed

Table 3: Cross-tabulation [Presenting BCVA vs. Final BCVA]

Presenting BCVA	BCVA at last follow-up *n* [Row percentage, Column percentage]			
	>20/30	20/30-20/60	20/60-20/200	<20/200
>20/30	8 [50%, 50%]	4 [25%, 26.7%]	3 [18.8%, 16.7%]	1 [6.3%, 2.2%]
20/30-20/60	3 [25%, 18.8%]	4 [33.3%, 26.7%]	2 [16.7%, 11.1%]	3 [25%, 6.7%]
20/60-20/200	2 [15.4%, 12.5%]	2 15.4%, 13.3%]	7 [53.8%, 38.9%]	2 [15.4%, 4.4%]
<20/200	3 [5.7%, 18.8%]	5 [9.4%, 33.3%]	6 [11.3%, 33.3%]	39 [73.6%, 86.7%]

P=0.00; Fisher exact test [Frequency distribution of categories are statistically significant]

Table 4: Adjuvant Therapy

Drug 1	Drug 2	Drug 3	Drug 4	Drug 5	Drug 6	No of Patients
Natamycin	Nil					7
	Anticholinergic	Ibuprofen/paracetamol (T)				9
		Ibuprofen/paracetamol (T)	Lubricating			2
	Cephalosporin	Fluoroquinolones	Anticholinergic	Ibuprofen/paracetamol (T)		1
	Azole (T)	Triazole	Anticholinergic	Lubricating		2
				Ibuprofen/ paracetamol (T)	Nil	10
					Lubricating	2
		Anticholinergic	Ibuprofen/paracetamol (T)	Nil		35
				Lubricating		6
			Lubricating			3
			Nil			1
	Triazole	Anticholinergic	Ibuprofen/paracetamol (T)	Lubricating		1
			Lubricating			1
Cephalosporin	Fluoroquinolones	Anticholinergic	Ibuprofen/paracetamol (T)			7
		Antiviral	Anticholinergic	Ibuprofen/paracetamol (T)		1
	Anticholinergic	Ibuprofen/paracetamol (T)				1
Fluoroquinolones	Anticholinergic	Ibuprofen/paracetamol (T)	Lubricating			1
	Anticholinergic	Ibuprofen/paracetamol (T)				1
		Lubricating				1
Triazole	Ibuprofen/ paracetamol (T)					1
	Anticholinergic	Lubricating				1

medically was 8 mm^2 (P = 0.11). A total of 92% of surgically managed patients had central location of ulcer as compared to 50% of medically managed patients (P = <0.001). Similarly, 88% of surgically managed patients had BCVA of <20/200 as compared to 44% of surgically managed patients (P = 0.003). Only 3 (12%) surgically managed patients had a presentation time of less than 7 days as compared to 24 (34%) medically managed patients (P = 0.03). Hypopyon was present in 24% surgically managed patients and in 8.6% medically managed patients (P = 0.07) [Table 6].

Results of the multivariate model reported that the presence of infiltrate <4 mm^2 at baseline indicated 4.4 times the odds of achieving final BCVA more than 20/60 (95% CI: 1.4–13.3; P = 0.008). The absence of surgical management indicated 8.1 times the odds of achieving final BCVA of more than 20/60 (95% CI: 0.9–71.5; P = 0.06). At last follow-up, scarring was present in 23 (24.4%) patients and healed cornea in 24 (25.5%) patients.

Discussion

Fusarium species is a leading cause of fungal keratitis. Reports of *Fusarium* keratitis are mainly from countries that experienced its outbreak during 2005–06 and also one recent report from Germany.[25] *Fusarium* has been isolated in almost every study on fungal keratitis published from India. Keratitis due to filamentous fungus mainly occurs during harvesting and other agriculture work in rural settings and in field/construction workers in urban settings.[18,27] In our study, the majority of the patients belonged to rural areas. Seasonal variation in the incidence of *Fusarium* keratitis was identified in our study. Majority of patients presented to us during the Kharif crop season. Sugarcane is the main crop of the Kharif season in the study area. In our study, injury by sugarcane leaf accounted for 72% of all ocular trauma caused by vegetative reasons. The seasonality of fungal keratitis has also been reported in previous studies.[6] Bharathi *et al*.[18] also reported that wind and crop harvesting play an important role in ocular injuries caused

Table 5: Best-corrected visual acuity at the last follow up in different groups

Variable	Category	*n*	BCVA at last follow-up		*P*
			Mean [log MAR]	Std. Deviation	
Days from onset of symptoms to presentation	≥7 Days	56	1.52	1.250	0.15
	<7 Days	38	1.13	1.119	
Inciting Cause	Yes	61	1.39	1.187	0.72
	No	33	1.30	1.262	
Infiltrate Size	>4 mm^2	64	1.75	1.155	0.00*
	≤4 mm^2	30	0.53	0.860	
Hypopyon	Yes	12	1.75	1.215	0.21
	No	82	1.30	1.204	
Surgery	Yes	26	2.27	1.002	0.00*
	No	68	1.01	1.099	
Re-surgery	Yes	14	2.43	0.852	0.00*
	No	80	1.18	1.167	

*Statistically significant

Table 6: Distribution of characteristics among medically and surgically managed patients

Variable	Category	Medical Management	Surgical Management	Total	*P*
Ulcer Location	Central	35	23	58	<0.001
	Paracentral	34	2	36	
Infiltrate Category	<4 mm	19	3	22	0.11
	>4 mm	50	22	72	
Presenting VA	>20/30	15	1	16	0.003
	20/30-20/60	11	1	12	
	20/60-20/200	12	1	13	
	<20/200	31	22	53	
Hypopyon	No	63	19	82	0.04
	Yes	6	6	12	
Medication at Presentation	No	12	3	15	0.52
	Yes	57	22	79	
Duration between symptom and presentation	<7 Days	24	3	27	0.03
	>7 Days	45	22	67	

by vegetative reasons. Male preponderance was reported in our study with a male:female ratio of 3.9:1. This ratio is higher than reported by Satpathy *et al*.[3] Males are more vulnerable to fungal keratitis due to their work profile in the study area where women do not work in the fields often.

Half of the patients presented after 10 days from onset of symptoms. The mean duration of delay was comparable among patients belonging to rural or urban locations. This delay was largely attributed to having visited other local eye care/health care providers. Self-medication and availing of over-the-counter medication from local pharmacies are also a reason behind this delay in presentation. The majority of the cases were on medication before presenting to us, and a significant number of patients were referred by general ophthalmologists from nearby areas. None of them had undergone a microbiological workup or species identification. This may be due to the limited availability of cornea specialists and ocular microbiology practice in the study area. The delay in diagnosis has also been reported in previous studies.[28-30] Patients who were taking medications were presented late at eye care centers. The significant difference in duration between onset of symptoms and presentation is because patients who are using topical medications without microbiological testing are under a false assurance and delay proper eye care consultation and present later and perhaps with a more advanced stage of ulcer than those who present without any prior medication to the eye care center.

In our study, we noticed that because of lack of microbiology workup, all cases at presentation were using either only antibiotics or anti-fungal therapy with a cocktail of antibiotics and antiviral, thereby causing further delay in healing due to drug toxicity or dilution. The alarming use of anesthetic eye drops was also noted in some cases in our area, which was not noted in other recent reports. These cases had further delay in presentation because of temporary improvement in symptoms but had worse presentation in ulcer size, time to healing, and complications. There was markedly less number of cases with topical corticosteroids abuse reported in our study as compared to older studies even though most cases were from rural background, suggesting

greater awareness about harmful side effects of steroids in ulcers. In a study on fungal keratitis by Cho *et al*., 36.1% of the study population were using topical corticosteroids previously.[31] Chowdhary *et al*.[11] from north India also reported the use of previous topical corticosteroids in 21% of patients. However, Kumar *et al*. from the same geographical area reported previous use of topical corticosteroids in 3.6% of patients of dematiaceous fungal keratitis.[22] The alarmingly high use of fluoroquinolones by physicians in all ulcers without microbiology workup may give rise to concerns about emerging antibiotic resistance.

In our study, the majority of eyes had a central ulcer. Srinivasan *et al*. also reported Fusarium as the most common fungal isolate among eyes with infectious central corneal ulceration, isolated in 47.1% of cases.[1] Ghosh *et al*.[6] also reported central location of ulcer in 69.8% of cases of *Fusarium* keratitis. The infiltrate size of central ulcer was significantly greater than that of paracentral/peripheral ulcer. Half of the patients presented with BCVA of less than 20/200. Approximately 80% of eyes with hypopyon had presenting BCVA of less than 20/200. The BCVA at last follow-up of eyes with central ulcer was worse as compared to paracentral/peripheral ulcer.

Topical natamycin was given in all cases in addition to voriconazole for larger and deeper ulcers. This is consistent with other studies from India and worldwide.[6] Prajna *et al*. also reported that Natamycin has a better treatment outcome as compared to voriconazole treatment for smear-positive filamentous fungal keratitis.[32] Jones *et al*. reported 16 of 18 consecutive cases of F. solani keratitis treated successfully with Natamycin.[33] Forty-seven percent of eyes had not achieved a visual acuity of >20/200. Poorer visual outcomes in cases of fungal keratitis have been reported in previous studies.[7,9] Surgical intervention was performed in one-fourth of the eyes. TPK was performed in 14% of eyes. In a previous study by Ghosh *et al*.,[6] TPK was performed in 23.3% of *Fusarium* keratitis eyes. In our study, TPK was performed in 15% of eyes. The visual outcome of most of these eyes was poor (<20/200). All eyes except one undergoing TPK had a central ulcer. Iyer *et al*.[9] reported final vision of less than 20/200 in 52% of eyes who had undergone TPK. There were a few limitations of this study. The depth of lesion was not included in the analysis as it was not available for all patients.

Conclusion

In conclusion, Fusarium keratitis is a serious ophthalmic condition associated with poorer outcomes. Males working in fields were mostly affected. Forty percent of eyes with centrally located ulcers required surgery. Patients who were managed medically had significantly better visual outcomes than patients who had undergone surgeries. Larger ulcer size was found associated with poorer visual outcomes. Location of ulcer, infiltrate size, BCVA at presentation, and eyes undergoing surgery was found significantly associated with BCVA at last follow-up. To the best of our knowledge, our study is the largest compilation of epidemiological features and treatment outcome of *Fusarium* keratitis.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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