Original Article

Demographic details, risk factors, microbiological profile, and clinical outcomes of pediatric infectious keratitis cases in North India

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Purpose: To study the demographic details, risk factors, microbiological profile, and clinical outcomes of pediatric infectious keratitis cases in North India. **Methods:** This retrospective case series included review of medical records of pediatric patients (0–16 years) diagnosed with infectious keratitis in a tertiary care center of North India during December 2011 to January 2017 was done. Demographic details, predisposing factors, microbiological investigations, and clinical outcomes were analyzed. **Results:** In this time period, 104 eyes of 104 children had a diagnosis of infectious keratitis. Culture was obtained for all 104 eyes and was positive in eighty eight eyes (84.2%). The most common causative factor was trauma, seen in 77 eyes (74%). Bacteria was the most common agent isolated in culture (54.2%) followed by fungi (40.8%) and acanthamoeba (2.1%). Successful healing of the keratitis with appropriate medical treatment occurred in 84 (80.7%) eyes, while 13 (12.5%) eyes required therapeutic keratoplasty. Of the 80 eyes with documentation of both preliminary and final visual acuity, improvement of two lines was seen in 35 eyes (43.7%), stayed the same in and worsened in 17 eyes (21%). Mean time to resolution of infection on medical treatment for bacteria was 23.65 ± 4.78 days, fungi 32 ± 5.19 days, and acanthamoeba 53.67 ± 4.78 days. **Conclusion:** Gram positive organism is the most common etiological agent of keratitis in children in our study population which is in contrast to pediatric infective keratitis study conducted by Aruljyothi *et al*. in South India (2011--2013). Though less in number than bacterial keratitis, fungus also remains an important causative agent. Along with early diagnosis and immediate medical intervention, it is important to identify regional profile of organisms and risk factors for good visual and anatomical outcome.

Key words: Clinical outcomes, fusarium, microbiological profile, pediatric keratitis, smear examination, staining, staphylococcus, ulcers

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Microbial keratitis is a serious cause of ocular morbidity in India second only to cataract.[1] It assumes a greater importance in pediatric population because of risk of irreversible ocular sequelae like visual deprivation or amblyopia.[1,2] What adds to the existing challenge of poor communication is difficulty in examination and sample collection due to lack of tertiary care services and compliance with the treatment prescribed.

There have been previous publications[1,3-6] which studied the microbiological profile of keratitis in pediatric population but some of these studies have also advocated the regional differences in the etiological agents.[3,6] Also, there is limited literature on microbiological profile and clinical outcomes of pediatric infective keratitis cases in North India with majority of previous studies[6,7] have looked at the literature in South India. This put our emphasis on studying local epidemiology which will serve an important tool in successfully managing this challenging morbidity.

The aim of this long-term retrospective study was to evaluate risk factors for pediatric infectious keratitis in North India and to analyze the microbial spectrum, antimicrobial sensitivity, clinical outcomes, and mean time to resolution of infection on medical treatment.

Methods

This is a single center, retrospective, noncomparative interventional case series conducted at the Cornea and Anterior Segment Services at a Tertiary Eye Hospital in north India. The study was conducted in accordance with the tenets of Declaration of Helsinki and clearance from the Institutional Ethics Committee was obtained.

The records of patients 16 years or younger who presented to our hospital between December 2011 and January 2017 and who were diagnosed with infectious keratitis were reviewed. The inclusion criteria were a clinical diagnosis of microbial keratitis, defined as the presence of a varying corneal stromal infiltrate with an overlying epithelial defect and anterior chamber inflammation. Patients were excluded from the study if the diagnosis was viral or neurotropic keratitis. Analysis of

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the demographic data, predisposing factors, microbial culture results, antibiotic sensitivity, and clinical outcomes was made. In clinical outcomes, both anatomical outcomes and visual outcomes was analyzed.

Visual acuity (VA) was recorded in all cooperative children. VA in young infants was evaluated by light response (considered as 2.6 in logarithm of minimal angle of resolution (LogMAR) scale), ability to fix and follow a target (considered as 2.3 in LogMAR scale) or by preferential looking with Teller Acuity Cards. In older children, VA was measured using a Snellen chart. After documenting the clinical characteristics, all the eyes were subjected to a microbiological evaluation. Corneal scrapings from the edge and base of the ulcer were obtained under topical anesthesia using 0.5% proparacaine. General anesthesia was used in very small children and those who were not cooperative for scraping under topical anesthesia.

Microbiological evaluation included two scrapings for smear examination (one each for Gram's stain and potassium hydroxide wet mount) followed by a subsequent sequential scraping for culture plating on blood agar, chocolate agar, sabarouds dextrose agar, and thioglycolate broth. Sabouraud's was incubated at 25°C to enhance the growth of fungi, and the remainder was incubated at 37°C. Blood agar was incubated under both aerobic and anaerobic conditions, chocolate agar was incubated at 5% carbon dioxide, and nonnutrient agar was incubated with an added *Escherichia coli* suspension. All media were incubated for a period of 14 days and examined daily for the growth of organisms. A culture was considered positive when there was growth of the same organism on two or more media, confluent growth at the site of inoculation on one solid medium, growth in one medium with consistent direct microscopic findings, or growth of the same organism on repeated corneal scraping. All growth had to be on "C" streaks, and a growth not on "C" streaks was considered as a contaminant.

If gram-positive organisms were identified on smears, the eyes were treated with topical preparation of 5% fortified cefazolin eye-drops on an hourly basis. If gram-negative organisms were identifies, 0.3% gatifloxacin was used on an hourly basis. Monotherapy was preferred and treatment modifications made in case of unresponsive ulcer based on culture and sensitivity report. Smear-negative patients were treated based on the clinical characteristic of ulcer. The eyes with positive fungal smears were treated with 5% natamycin suspension on an hourly basis. Topical voriconazole 1% was added for larger and deeper fungal ulcers. Topical antimicrobial therapy was supplemented with cycloplegics homatropine 2.5% applied once at bedtime.

The duration of treatment initiation to cure was documented. Systemic antibiotics and antifungals were added in children with deep and limbal threatening ulcers and those requiring surgical interventions. Patients whose ulcers progressed despite adequate and appropriate antimicrobial therapy underwent surgical interventions.

Visual results were obtained from the difference in VA pretreatment and posttreatment and categorized into three groups (1) improved, (2) no change, and (3) deteriorated. An improvement was defined as either a gain of two line or more. A deterioration was defined as a loss of two line or more (e.g. 20/80 to 20/60 or vice versa).

Statistical analysis

Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. Normality of data was tested by Kolmogorov--Smirnov test. If the normality was rejected then nonparametric test was used. Qualitative variables were correlated using Chi-square test. Spearman rank correlation coefficient was used to assess the association of various parameters with each other. A P value of <0.05 was considered statistically significant. The data were entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

Results

Demographic details and risk factors

This study involved 104 eyes of 104 patients. All patients had unilateral involvement. Table 1 describes the demographic details. Table 2 describes the predisposing factors and causative

Table 1: Demographic details of patients of pediatric infectious keratitis in a tertiary care hospital in North India

Variables	Number	Percentage
Age		
<1 year	5	4.8
1-7 year	47	45
7-16 years	52	50
Gender		
Male	61	58%
Time of presentation from onset of symptoms		
Within 24 h	11	10.5
1 day-week	67	64.4
1 week-month	16	15.3
Above 1 month	10	9.6

Table 2: Predisposing and causative factor of pediatric infectious keratitis cases in a tertiary care hospital in North India

Ocular comorbidity	Number	Percentage
	26	25%
Vernal keratoconjunctivitis	10	9.6%
Blepharokeratoconjunctivitis	5	4.8%
Squintsurgery/trabeculectomy	2	1.9%
SJS	2	1.9%
Exposure keratopathy	2	1.9%
Systemic comorbidity	5	1.9%
Vitamin A deficiency	2	2.8%
Systemic-illness (TB, hepatitis, pneumonia)	3	
No external risk factors	22	21%
History of trauma	77	74%
Stone/sand/dust	31	29.8%
Thorn/stick/vegetative matter	28	26.9%
Toys/pen/pencil/books	10	9.6%
Cow tail/goat horn/cat	4	3.8%
Finger nail injury	2	1.9%
Iron piece	2	1.9%
Miscellaneous risk factors	5	4.8%
Contact lens use	2	1.9%
Pond bath	3	2.8%

agent for pediatric keratitis. Mean age was 9.1 years (range 7 days to 16 years). There was a male preponderance with a male-to-female ratio of 1.4:1. The median duration from the onset of symptoms to time of presentation to our hospital was 5 days (range 1–60 days). –A total of 26 patients (25%) had pre-existing ocular comorbidity, such as vernal keratoconjunctivitis, blepharokeratoconjunctivitis, xerophthalmia, marginal keratitis, Steven Johnson syndrome, dry eyes, and were on appropriate treatment. Five patients had associated systemic comorbidity like vitamin A deficiency, TB, pneumonia. No risk factors were identified in 22 patients (21%). The most common causative factor was trauma, seen in 77 eyes (74%). The most common cause for trauma was injury by dust, sand, and stone accounting for thirty one cases (29.8%) followed by trauma with vegetative matter in 28 cases (26.9%). Miscellaneous risk factors like contact lens use in two (1.9%) patients and history of pond bath in three (2.8%) patients were noted. Of the 104 patients, 20 (19.2%) patients had prior treatment with antibiotics, 10 (9.6%) patients had prior treatment with a combination of antibiotics and antifungals, 18 (17.3%) patients had treatment with native herbal medications, and 15 (14.4%) patients had treatment with topical steroids. The most common antibiotics used were chloramphenicol (9, 45%) and tobramycin (11, 55%).

Microbiology

Hundred eyes (100) underwent microbiological smear examinations of which ninety-seven (97) were corneal scraping and three were anterior chamber tap. The remaining four eyes (4) had a retained foreign body, which was removed and plated on culture.

Of the 100 eyes subjected to microbiological smear examination, seventy-six (76%) eyes were positive for microbial organisms. Of these 76 positive smears, bacteria were identified in 40 (52.6%) smears, fungus in 25 (32.8%) smears, both bacteria and fungi in eight (10.5%) smears and acanthamoeba in three smears (3.9%)

Culture characteristics

Microbiological culture reports were positive in eighty-eight (84.6%) eyes of the 104 eyes that were subjected to this investigation. Bacteria were the most common organism isolated in 51 (57.9%) eyes followed by fungus in 31 (35.2%) eyes, mixed growth in four (4.5%) eyes, and acanthamoeba in two (2.2%) eyes. Fig. 1 depicts the smear and culture positive comparative analysis. Staphylococcus species was the most common bacteria identified in 24 (47.1%) eyes followed by fusarium in fourteen eyes (46.7%) eyes. Table 3 depicts the organisms isolated in culture in our study.

Bacteria were identified as the most common cause of corneal ulceration in patients with history of trauma as well as those without. Comparison of number of culture positive cases of bacteria and fungus in traumatic and nontraumatic cases of pediatric infective keratitis is depicted in Table 4.

Antibiotic sensitivity pattern for the four most common bacteria namely *Staphylococcous aureus, S. pneumoniae, P. Aeruginosa, and Nocardia spp.* are shown in Figs. 2 and 3.

Gram positive organisms showed maximum sensitivity to cefotaxime, chloramphenicols, and vancomycin, while *Staphylococcus* showed intermediate sensitivity to fluoroquinolones, streptococcus had a good sensitivity to fluoroquinolones.

Pseudomonas showed good susceptibility to fluoroquinolones and aminoglycosides. Nocardia showed 100% sensitivity to amikacin and good sensitivity to other aminoglycosides but had poor response to fluoroquinolones especially ciprofloxacin and ofloxacin.

Treatment methods and outcomes

All patients in the series were given topical antimicrobial therapy according to standard technique described in methods section. Meantime to resolution of infection on medical treatment was recorded for bacteria, fungus and acanthamoeba keratitis with P value significant for resolution on medical management between bacteria and fungus, bacteria and acanthamoeba and fungus and acanthamoeba ($P < 0.0001$) [Table 5].

Surgical intervention was required in 16 patients (15.3%) of which three cases were managed by tissue adhesives and bandage contact lens and 13 patients (12.5%) required therapeutic keratoplasty. The treatment mode and mean time to resolution of infection is illustrated in Table 5. Out of the 13 (12.5%) patients who required therapeutic keratoplasty, 7 (53.8%) were males and 5 (38.4%) were above 7 years. The etiological organisms identified were fungi in five patients (unidentified hyaline two, *Fusarium spp*.: one *Aspergillus* flavus: two), bacteria in three patients (*Streptococcus*

Table 3: Organisms isolated in culture in patients with paediatric infectious keratitis in a tertiary care hospital in North India

Culture species	Number	Percentage
Bacteria		
Staphylococcus	24	47.1%
Streptococcus	11	21.5%
Pseudomonas	6	11.7%
Other gram negative bacteria	3	5.8%
Nocardia	2	3.9%
Coagulase negative staphylococci	3	5.8%
Atypical mycobateria	1	1.9%
Diphtheroids	1	1.9%
Total	51	100%
Fungus		
Fusarium	14	46.7%
Unidentified demetiaceous	6	20%
Aspergillus	9	30%
Candida	1	3%
Total	30	100%
Acanthamoeba	2	2.2%
Mixed	5	5.6%

Table 4: Comparison of culture positive cases of bacteria and fungi in traumatic and nontraumatic causative agent

	Culture positive	
	Trauma by various modes sand, vegetative matter, finger nail, pencil, toy	Nontraumatic
Bacteria	39	12
Fungal	23	7

pneumoniae: one, *Haemophilus influenzae*: one, *Pseudomonas aeruginosa*: one) and acanthamoeba in one. Causative organism could not be identified in four patients. There was no significant difference of need for therapeutic keratoplasty between bacteria and fungi (P = 0.139), bacteria and acanthamoeba (P = 0.146), fungi and acanthamoeba (P = 0.345).

The predominant anatomical outcome at last follow-up, ranged between 8 days and 2.5 years from examination date, was complete clinical resolution on medical treatment with corneal scar with or without vascularization in 84 eyes (80.7%), three eyes had adherent leucoma (3.8%), anterior staphyloma in one (.9%), two eye underwent pthisis (1.9%), and seven (6.7%) were lost to follow-up. Of the 13 grafts, 6 remained clear (30.7%), 7 developed secondary glaucoma with failed graft. Anatomical outcome at the last follow-up is illustrated in Figure 4. Corneal scar group included 84 eyes and were divided into two groups of paracentral and central scar. Paracentral scar group comprised 50 eyes (10 eyes <3 mm, 20 eyes 3--6 mm, 20 eyes > 6 mm). Central scar group comprised of 34 eyes (8 eyes < 3 mm, 15 eyes 3--6 mm, 11 eyes >6 mm). Out of 31 eyes advised for optical keratoplasty, 24 eyes got registered for the same.

VA

VA was recorded for 80 eyes at last follow-up, ranging between 8 days and 2.5 years from examination date. The remaining 24 eyes either were lost to follow-up or VA could not be assessed because of inability to cooperate. The VA ranged from 5/200 to 20/40. 13 patients had VA equivalent to or less than 5/200, 30 patients had VA between 20/200 to 20/80, 17 patients had VA less 20/40 and 20 patients had VA better than 20/40.

As mentioned in methods, the visual outcome was documented as improved in 35 eyes (43.7%), remained same in 28 eyes (35%) and worsened in 17 eyes (21%). The visual outcome was also analyzed with respect to the organism responsible for the keratitis as shown in Table 6. Though the VA improvement outcomes was not significant between the organisms but the deterioration outcomes had a significant P value between gram positive and fungal (P <.021), between gram positive and gram negative (P < 0.005), between gram positive and acanthamoeba (P < 0.029) suggesting that gram positive organisms caused lesser deterioration of VA during the treatment period than gram negative, fungi and acanthamoeba [Table 7].

Discussion

The current study included 104 eyes of 104 children with microbial keratitis in North India. The main predisposing factor was trauma and the predominant pathogen was *Staphylococcus*. In our study, fortified antibiotics were the most frequent initial treatment and overall patients had good clinical outcomes with significant improvement in VA. Corneal ulcers in children is a rarer entity as compared to adults and accounts for approximately 13% of all cases;[8] however, the problem posed by keratitis in children is increased manifold due to the challenges that come with managing the pediatric cases. Non availability of facilities like general anesthesia, trained cornea

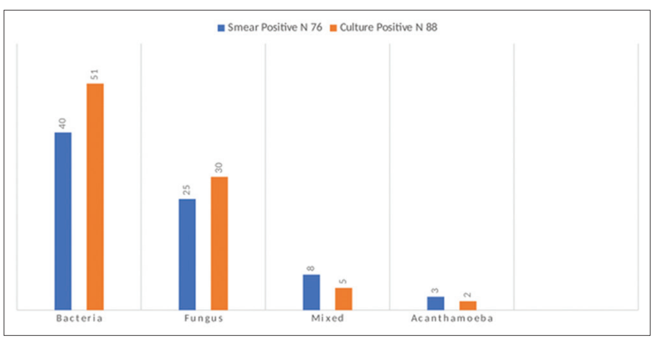

Figure 1: Smear and culture positive results of patients with pediatric infectious keratitis in North India

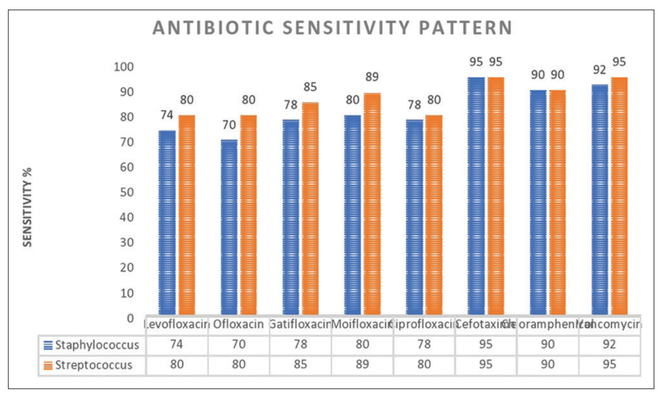

Figure 2: Antibiotic sensitivity percentages of common bacterial isolates of paediatric infectious keratitis

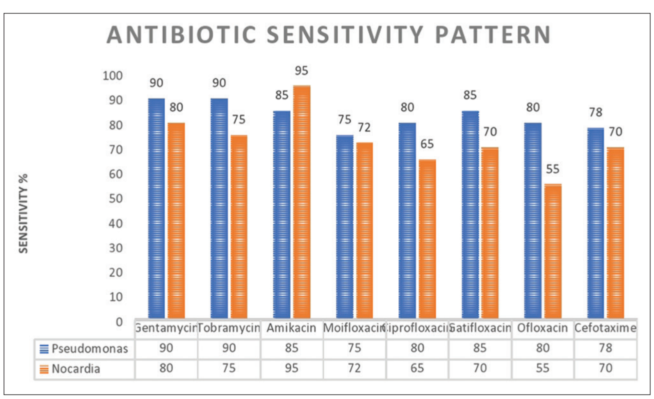

Figure 3: Antibiotic sensitivity percentages of common bacterial isolates of paediatric infectious keratitis

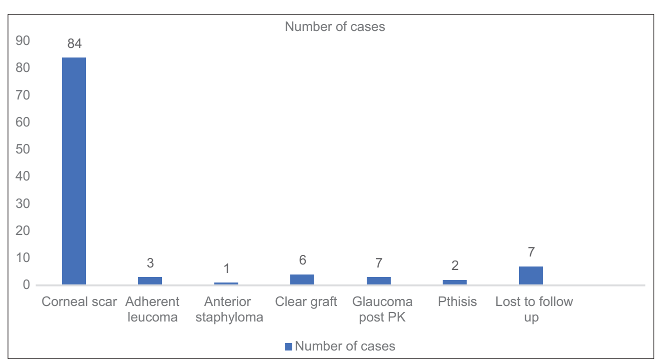

Figure 4: Anatomical outcomes at last follow-up in patients of pediatric infectious keratitis in North India

Table 5: Treatment mode and mean time-resolution of infection on medical treatment of pediatric infectious keratitis in North India

Treatment outcome	Number of eyes , percentage		
Healed with medical treatment	88 (84.6%)		
TA + BCL	3 (2.8%)		
Keratoplasty	13 (12.5%)		
TPK for bacteria	3 (23%)		
TPK for fungal	5 (38.4%)		
TPK for acanthamoeba	1 (7.6%)		
TPK for unknown organism	4 (30.7%)		
Mean time-resolution of infection on medical treatment (days)	**Number of days**	***P***	
Bacterial	23.65±4.78	Bacteria vs fungal	<.0001
Fungal	32±5.19	Bacteria vs acanthamoeba	<.0001
Acanthamoeba	53.65±4.78	Fungal vs acanthamoeba	<.0001

Table 6: Visual outcomes of paediatric infective keratitis patients in North India

Post treatment visual acuity	Number of eyes, percentage
Improved	
Gram +ve	35 (43.7%)
Gram -ve	21
Fungal	2
Acanthamoeba	12
No change	28 (35%)
Gram +ve	18
Gram -ve	1
Fungal	8
Acanthamoeba	1
Deteriorated	17 (21%)
Gram +ve	3
Gram -ve	4
Fungal	8
Acanthamoeba	2

specialist, a good microbiologist with an equipped lab adds to the existing woes. The potential sight threatening keratitis in younger age group requires immediate attention as the corneal involvement leads to scarring which may result in amblyopia[7] warranting several visual rehabilitation. Despite amblyopia management, these children are at increased risk of irreversible vision loss. Various studies conducted on the epidemiology and microbiological profiles of infectious keratitis in children differ in class of organism and treatment outcomes. Trauma was found to be the most common predisposing factor for microbial keratitis in most of the studies.[6,7,9,10] Other studies have found out contact lens as the most common etiology.[1,11-13] Studies from India and America had male preponderance in comparison to studies from Southeast Asia where female preponderance[11,12] was seen. The mean age reported varied in different studies from 8 to 14 years. Most of the studies found bacteria as the most common cause of infectious keratitis in children. *Pseudomonas* and *Staphylococcus epidermidis* were the most commonly isolated bacteria. We have added to the summary by Abdullah *et al*.[4] on the comparative analysis of previous case series of pediatric infectious keratitis conducted in 2012. Several studies have been published since then. Table 8 describes the comparative analysis of previous case series of pediatric infective keratitis.

Our study also showed a male preponderance for infective keratitis. In our study trauma was the most common predisposing factor accounting for 74% cases. Ocular comorbidity was present in 25% of cases. Vernal keratoconjunctivitis was the most common predisposing factor (10, 9.6%) followed by blepharokeratoconjunctivitis (5, 4.8%). Contact lens wear was seen as etiology in only two cases.

Gram positive microorganism is the most common etiological agent in this study. *Staphylococcus* species is most common organism isolated followed by Fusarium.

Kunimoto *et al*.[7] reported *Staphylococcus* (43.7%), *Streptococcus pneumoniae* (18.8%) as the most common isolate followed by fungi (17.2%), this is consistent with reported isolates in this study. Singh *et al*.[14] and Cruz *et al*.[11] have reported pseudomonas to be the most common cause of keratitis in children. In our study pseudomonas accounted for 11.6% of cases. One explanation for this could be very few contact lens related keratitis cases at our center. Quite similar to our results, a study on microbial keratitis in adults in South Florida[8] has shown a trend of increased incidence of *S. aureus* and a decreased incidence of *P. Aeruginosa*. Study by Aruljyothi *et al*.[6] documented exposure keratopathy as most common ocular comorbidity followed by VKC, while Noureddin *et al*.[15] reported BKC to be the most common.

Fortified cephalosporins (5% cefotaxime or 5% cefazolin) eye-drop is our preferred monotherapy for gram positive bacterial infections and fluoroquinolone eye-drops (0.3% gatifloxacin or 0.5% moxifloxacin) is our preferred monotherapy for patients with gram-negative bacterial keratitis. We substitute the medication according to sensitivity report in a case of nonresponding ulcer. Cases of fungal keratitis are treated with 5% natamycin monotherapy. We add voriconazole 1% in cases with ulcers involving posterior stroma, limbus threatening ulcers, and postpenetrating keratoplasty.

Therapeutic keratoplasty was required in 13 eyes (12.5%) which are almost similar to previous reports of therapeutic keratoplasty in pediatric keratitis.[7,11,16]

Table 7: Visual outcomes of paediatric infective keratitis patients in North India - Type of infection vs visual outcomes

P value	Gram +ve vs fungal	Gram +ve vs gram -ve	Gram +ve vs acanthamoeba	Gram -ve vs fungal	Gram -ve vs acanthamoeba	Fungal vs acanthamoeba
Improvement in VA	0.732	0.424	0.236	0.676	0.533	0.264
Deterioration in VA	0.021	0.005	0.029	0.2	1	0.237

Table 8: Comparative analysis of previous case series of pediatric microbial keratitis with our series from North India

References	Country patients enrolled (*n*; number)	Mean age (years)	Positive culture (%age)	Organism	Risk factors
Omerad *et al*., 1986	USA 47	6	87	*P. aeruginosa* (24); *S. pneumoniae* (20); *S. aureus* (17)	Trauma; ocular disease
Cruz *et al*., 1993	USA 50	11	86.3	*P. aeruginosa* (34); *S. aureus* (20); *Fungi* (18)	Trauma (44); Prior corneal surgery (24); Systemic disease (14); Contact lens (12)
Clinch *et al*., 1994	USA 29	8	76	*Staphylococcal species* (29); *Fungi* (17); *S. pneumoniae* (8); *P. aeruginosa* (8)	Trauma (34); Systemic disease (27); Contact lens 24)
Kunimoto *et al*., 1998	India 107	8	56.6%	Staphyloccoccal species (44); *S. pneumoniae* (20); *Fungi* (17); *P. aeruginosa* (9)	Trauma (18); (21); Ocular disease (18); Systemic disease (16); Contact lens (0)
Vajpayee *et al*., 1999	India 50	5	70%	*Staphylococcal species* (68); *Fungi* (14); *Paerugiosa* (14)	Trauma (38); Systemic disease (24); Ocular disease (12); Contact Lens (0)
Hsiao *et al*., 2003	Taiwan 81	10	58%	*P. aeruginosa* (44.7); *S. aureus* (19.1); *S. pneumoniae* (10.6); *Fungi* (6.4)	Contact lens (40.7); trauma (21); ocular disease (14.8); sustemc disease (11.1)
Singh *et al*., 2006	India 97	13	31.2	*P. aeruginosa* (17.8); *S. epidermidis* (15.8); *Fusarium* (16.8)	Trauma (69)
Otaibi *et al*., 2012	KSA 68	1.7	45.6	*Streptoccocus* (25.8); *S. epidermidis* (22.7); *P. aeruginosa* and *S. aureus* (19.3)	Trauma (39.7); ocular disease (30.8); contact lens (16.2)
Aruljyothi *et al*., 2016	India 234	9.3	74.3	*Fusarium* (59.7); *P. aeruginosa* (37.9); *S. pneumoniae* (24.1)	trauma (53.4); ocular disease (13.7); contact lens (1.2)
Noureddin *et al*., 2016	Canada 17	11	76	*Acanthamoeba* (23.5); *Staphylococcus epidermidis* (29.4)	
Rossetto *et al*., 2017	USA 107	13	58.4	*P. aeuginosa* (46.2); *Stenotrophomonas maltophilia* (19.2); *Fusarium* (13.5)	Contact lens (77.6); ocular trauma (8.4); systemic disease (4.7)
Current study	India 104	9	84.2	*Staphylococcal species* (47.1); *Fusarium* (46.7); *S. pneumoniae* (21.5)	Trauma (74); ocular disease (25); systemic disease (4.8); contact lens (1.9)

Our study found a positive culture rate of 84.6% which is quite similar to positive culture rate in other studies.[10,11,16]

Visual rehabilitation is very important in these children because microbial keratitis in early childhood can leave an eye with poor visual function, leading to anisometropic or stimulus-deprivation amblyopia and permanent failure to develop stereopsis despite successful treatment. All the children after successful treatment of keratitis at our hospital are referred to pediatric clinic for cycloplegic refraction and amblyopia management. In 80 eyes with final VA documentation, vision improved by two lines in 43.7% which is almost similar to study by Aruljyothi *et al*.[6] Of these 80 eyes, glasses were prescribed to 67 eyes of which 22 eyes were also under amblyopia management. Around 8 children in the age group of 14--16 years opted for contact lens. Younger age group children were neither cooperative and not very eager to wear contact lenses.

This to our best of knowledge (PubMed search of infective keratitis, pediatric, cornea, treatment, microbiology, India, vision) is the first study to compare the visual outcomes with the organism involved in pediatric keratitis cases and also the mean time to resolution of infection on medical management. Bacteria fairs better than fungus which fairs better than acanthamoeba on mean time to resolution of infection on medical management. This gives hope to treating clinicians as this may be long drawn battle worth fighting for.

Conclusion

Etiological agents for infectious keratitis in children vary depending on the geographical location and socioeconomic changes of individual regions. The predominant factor is ocular trauma but ocular comorbidity is also an important contributing factor. *Staphylococcus* species was the predominant causative organism of microbial keratitis in children. Fungus is also a major causative pathogen. Prompt diagnosis and management can lead to good visual and anatomical outcomes. Keratoplasty is indicated only when there is no response to medical management and post keratoplasty glaucoma should be an important consideration apart from the aim of maintaining a clear graft. A big step in the eradication of the disease burden caused by corneal blindness due to keratitis in children would be potassium hydroxide (KOH) staining at secondary centers by cornea fellows.

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Conflicts of interest

There are no conflicts of interest.

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