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Original Research Article

An Observational Study on Microbial Keratitis in a Tertiary Care Center.

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Abstract:

Objectives: Microbial keratitis (MK) is an infection of the cornea. MK is one of the main causes of corneal blindness and visual disability, especially in developing countries. The present study was to evaluate epidemiological profile and predisposing factors of microbial keratitis.

Methods: A detailed history was obtained to understand predisposing factors like the use of contact lenses, dry eye, previous ocular surgery, ocular trauma, and lid abnormalities (e.g., blepharitis, trachoma, trichiasis, and incomplete lid closure). The history of previous use of topical medications (e.g., antibiotics, steroids, cycloplegics, and traditional medicine) was also obtained. The presenting symptoms and duration were obtained from records on clinical examination, which included slit-lamp bio-microscopy (Topcon, USA), presented visual acuity notations using Snellen's visual acuity chart, perception of hand movement, and perception of light from all angles.

Results: A total of 152 eyes of 150 patients with a provisional diagnosis of microbial keratitis were included. Mean age was 40.1 ± 20.7 years. 87(58%) were males and 63(42%) were females. Contact lens usage was possibly a responsible factor in 50(33,33%) patient's eyes. Ocular trauma resulted in microbial keratitis in 18% patients. A total of 69(46%) eyes had no organism isolated from the specimen sent for culture and sensitivity. More than half of the eyes 81(54%) that had a positive report were found to have gram-positive bacteria as the causative agent. Fungus was isolated in 10(12.35%) eyes with microbial keratitis confirmed by laboratory tests.

Conclusions: Contact lens and ocular trauma are the most common predisposing factors of microbial keratitis. Most common gram-positive microorganism are Staphylococcus aureus and Streptococcus pneumoniae and the most common gram-negative organism is Pseudomonas aeruginosa for causes of corneal ulcer in microbial keratitis patients.

Key words: Microbial keratitis, Predisposing factors, Microorganisms

Introduction

Keratitis is an inflammation of the cornea, the transparent membrane that covers the colored part of the eye (iris) and pupil of the eye [1]. Microbial keratitis is a potentially vision threatening condition that requires prompt diagnosis and treatment to prevent untoward outcomes [2].

Based on the National Eye Survey conducted in Malaysia in 1996 [3] infectious corneal ulcer was found to be the fourth most common cause of blindness in Malaysia. In a study recently commissioned by the WHO South-east Asia Regional Office in New Delhi (WHO/SEARO), 2004 and it was estimated that 6 million corneal ulcers occur annually in the 10 countries of South-east Asia Region encompassing a total population of 1.6 billion. These estimates are based on the data from 4 countries where the incidence of corneal ulceration ranged from a low of 113 per 100,000 in India [4] to as high as 799 per 100,000 in Nepal [5].

The eye is composed of three layers: an outer layer (cornea/sclera), an inner layer (retina), and a middle layer (uvea, a continuous structure comprising iris, ciliary body, and choroid). The anterior chamber lies between the iris and the cornea, the posterior chamber between the lens and the iris, and the vitreous cavity (containing the vitreous gel, a type II/XI collagenous avascular extracellular matrix) describes the main chamber of the eye behind the lens [1].

Keratitis caused by bacteria, viruses, fungi and parasites. Bacteria account for 65% to 90% of infectious causes of keratitis [1]. It can also develop from non-infectious causes which include the Cogan syndrome, a disease causing inflammation of the blood vessel (vasculitis) with keratitis and inner ear disease, Fuch dystrophy, a slowly progressive disease, usually affecting both eyes, causing loss of cells and damage to the cornea. Abnormal

development of the cornea, such as keratoconus, iridocorneal endothelial syndrome, which leads to changes in the iris, swelling of the cornea, and development of glaucoma, Lattice dystrophy, an accumulation of amyloid proteins in the front of the eye and cornea, photokeratitis, due to intense ultraviolet radiation exposure such as in snow blindness or welder's arc eye, StevensJohnson syndrome (a rare, severe type of allergic reaction sometimes which can be caused by certain types of antibiotics) occasionally affects the cornea [1].

Keratitis can be classified by its location, severity, and cause. If keratitis only involves the surface (epithelial) layer of the cornea, it is called superficial keratitis. If it affects the deeper layers of the cornea (the corneal stroma), it is called stromal keratitis or interstitial keratitis. It may involve the center of the cornea or the peripheral part of the cornea (that portion closest to the sclera) or both. Keratitis may affect one eye or both eyes. Keratitis may be mild, moderate, or severe and may be associated with inflammation of other parts of the eye [1]. Keratoconjunctivitis is inflammation of the cornea and the conjunctiva. Keratouveitis is inflammation of the cornea and the uveal tract, which consists of the iris, ciliary body and choroid. Keratitis may be acute or chronic. It may occur only once or twice in an eye or be recurrent. It may be limited in its effects on the eye or be progressive in its damage [1].

In 2012, Karsten, Watson & Foster conducted a literature review investigating the spectrum of pathogens implicated in microbial keratitis. According to their review of the literature, 232 species from 142 genera representing 80 families were implicated in microbial keratitis, with bacterial keratitis, the most common. Since this publication, however, there have been over 2700 articles published investigating the identity and aetiology of causative pathogens of microbial keratitis. Therefore, an updated review is required to provide clinicians with current data on causative pathogens and management of microbial keratitis [6]. Objectives of our study was to evaluate epidemiological profile and predisposing factors of microbial keratitis.

Material & Methods

The present study was conducted in the Department of Microbiology with the collaboration of Department of Ophthalmology, Patna Medical College & Hospital, Patna, Bihar during a period from January 2023 to July 2023.

A total of 150 suspected case of microbial keratitis were enrolled in the present study. Data was collected with irrespective of age and sex. The demographic information sourced included age, gender, and eye involved. A detailed history was obtained to understand predisposing factors like the use of contact lenses, dry eye, previous ocular surgery, ocular trauma, and lid abnormalities (e.g., blepharitis, trachoma, trichiasis, and incomplete lid closure). The history of previous use of topical medications (e.g., antibiotics, steroids, cycloplegics, and traditional medicine) was also obtained. The presenting symptoms and duration were obtained from records on clinical examination, which included slit-lamp bio-microscopy (Topcon, USA), presented visual acuity notations using Snellen's visual acuity chart, perception of hand movement, and perception of light from all angles. The location, extent, and depth of associated infiltrate of corneal epithelial erosion and corneal ulcer were noted without and then with corneal staining. The presence of aqueous flare, iris inflammation status of a pupil, and keratic precipitates (KPs) on the posterior surface of the cornea were examined.

Statistical Analysis

Data was analysed by using SPSS software. Mean and standard deviations were observed. P value was taken less than or equal to 0.05 ($p \leq 0.05$) for significant differences.

Observations & Results

A total of 152 eyes of 150 patients with a provisional diagnosis of microbial keratitis were included. Mean age was 40.1 ± 20.7 years. 87(58%) were males and 63(42%) were females.

Contact lens usage was possibly a responsible factor in 50(33,33%) patient's eyes. Ocular trauma resulted in microbial keratitis in 18% patients.

Table 1: Predisposing factors resulting in microbial keratitis (N =150).

Predisposing factors	Character	No. of patients
Contact lens	Extended wear	44(29.33%)
	Daily wear	5(3.33%)
	Hard type	1(0.66%)
Ocular trauma		27(18%)
	Keratoplasty	12(8%)
	Cataract	6(4%)
Previous ocular surgery	Glaucoma	2(1.33%)
	Vitreoretinal surgery	8(5.33%)
	Refractive surgery	1(0.66%)
	Blepharitis	16(10.67%)

Ocular surface disorder	Trachoma	5(3.33%)
	Trichiasis	1(0.66%)
	Incomplete lid closure	4(2.67%)
	Dryness	6(4%)

The mean time interval of symptom development and presentation at our institution was 8.1 ± 4.2 days. In 39(26%) patients, topical treatment was already initiated by the family physician or referring ophthalmologist. Pain and redness were present in around 141(94%) eyes, but visual complaints were present in only 68(45.33%) eyes. Epithelial erosion was present in all cases, and corneal edema was present in 146(97.33%). The corneal ulcer was central in 48(32%), paracentral in 81(54%), and peripheral in 19(12.67%) eyes. The average size of the infiltrate was 6.9 mm (range: 0.2 mm to 10 mm). Hypopyon was present in 47(31.33%) eyes.

A total of 69(46%) eyes had no organism isolated from the specimen sent for culture and sensitivity. More than half of the eyes 81(54%) that had a positive report were found to have gram-positive bacteria as the causative agent. Fungus was isolated in 10(12.35%) eyes with microbial keratitis confirmed by laboratory tests.

Table 2: Microbial profile of eyes with clinically suspected corneal ulcer.

Microorganisms	No. of patients	Percentage
Culture positive	81	54%
Culture negative	69	46%
Bacterial isolate	72	88.89%
Gram positive	40	55.55%
Staphylococcus aureus	20	50%
Streptococcus pneumoniae	17	42.5%
Corynebacterium species	1	2.5%
Others	2	5%
Gram negative	27	39.13%
Pseudomonas aeruginosa	23	85.18%
Serratia spp	2	7.41%
Moraxella species	1	3.71%
Klebsiella species	1	3.71%
Fungus	10	12.35%
Fusarium species	5	50%
Aspergillus species	3	30%
Cryptococcus	1	10%
Candida	1	10%

The relationship between predisposing factors and type of organisms found in the ulcers is shown in Table 3. There was a significant association between organisms and the predisposing factor (P<0.001).

Table 3: Predisposing factor and microbial of corneal ulcer

Factors	Multiple	Fungus	Bacteria	No growth	P-value
Trauma	2	4	1	16	< 0.001
Contact lens	3	0	29	21	
Ocular surface disorder	0	2	6	6	
Previous ocular surgeries	2	0	13	5	
Unknown	1	5	11	23	

In the present study, 96(64%) patients were suffering from diabetes, and among them 70(73%) had poor glycemic control (hemoglobin A1C >10).

Discussions

Microbial keratitis (MK) is considered a major cause of visual loss worldwide. Understanding its epidemiology, risk factors, etiological agents, and clinical characteristics help to reach an accurate diagnosis and in turn proper management. MK varies demographically, and hence, regular regional updates become important.

The distribution of MK in men was higher than women in present study. Since, men working outdoors and involved in agricultural activities in developing countries are at higher risk of MK, as noted in India [7]. In the USA, more women use

contact lenses than males. In the wealthy urban areas of Saudi Arabia, this higher use of contact lenses among women could explain similar risks of MK in the present study [8].

Interestingly, many studies have reported that contact lens related MK has been shown to exhibit a female predominance of 57–69% [9]. Except for the Acanthamoeba group, there is a high male prevalence in all MK groups like other studies of MK in South America [10], Asia [11], and Africa [12] reported male prevalence, ranging from 58 to 75%. Srinivasan et al. [13] and Keay et al. [14] also found that the most predisposing factor for microbial keratitis was corneal trauma in 65.4%, and 36.4%, respectively. Blepharitis was significantly higher in the bacterial group (n=24–31.2%)). Schaefer et al. [15] also reported blepharitis as a predisposing factor for bacterial keratitis in 21% of cases. Other risk factors e.g., ocular surgery and diabetes, showed non-signifcant relationship. Similar findings were reported by Keay et al. [14].

MK affects individuals across all age groups, especially people aged between 30 and 55 years [16, 17]. In the present study, mean age of MK was 40.1 ± 20.7 years.

Overnight wearing of contact lenses is the main risk for infective keratitis. Emerging trends suggest that MK is increasingly caused by gram-negative organisms, fungi, and acanthamoeba. Resistance in gram-positive organisms to conventional antibiotics in MK has been noted [18]. More than 50% of users have bad hygiene practices when it comes to lens-case cleaning [19]. To combat this problem, research is ongoing to alter lenses and accessories to make them organism resistant [20]. Extended wearing of contact lenses was found to be the main culprit of MK in our study, an observation also noted by Seal et al. [21].

Acanthamoeba keratitis (AK) is highly related to CL wearing and poor lens hygiene especially if washing of lenses with tap water occurred. Al-Herrawy et al. isolated Acanthamoeba spp. from fnished water samples in Egypt [22] and it is not surprising that Acanthamoeba organisms have been cultured from lens cases and saline cleaning solutions [23]. Early detection and diagnosis with AK characteristic clinical picture are critical to the outcome of its clinical course [24, 25]. Ulceration in AK does not occur until very late in the disease process. Also, 29 to 49% only of AK cultured cases have a positive result [26, 27].

Apart from blepharitis, the results of the current study showed a few ocular surface disorders among patients with MK. Narayanan et al. [28] reported the absence of an association between dry eyes and MK. Apart from trachomatous trichiasis [29], other eyelid infective conditions may be present in eyes with MK, which reflects the poor hygienic practices of such patients, yet their causal association is difficult to establish. In our cohort, ocular trauma, be it accidental or surgically induced, was observed in more than one-third of MK cases. This was also noted in a study in Australia [30]. The intact corneal epithelium seems to act as a protective barrier against invading organisms, but when this barrier is broken by ocular trauma, MK can occur.

Most of the bacterial keratitis cases were due to Gram-positive organisms [30, 31]. Toth et al. and Puig et al. stated that Coagulase-negative Staphylococci (CoNS) were the most frequently isolated bacteria [32]. In contrast to our results, another Malaysian study [33] found Pseudomonas aeruginosa to be the main causative organism along with other Gram-negative bacteria. In our study, Pseudomonas aeruginosa was the most common gram-negative bacteria 23(85.18%%) similar to a paper published by Toth et al. [32] where Pseudomonas spp. was the etiological agent in 10% of cultured cases. This percentage is less than that reported by Norina et al. (40%) [34].

In our study, no organisms were detected in 69(46%) of microbial keratitis cases. This could be due to the use of antibiotics before patient presentation at our institute. The inability to detect organisms has been noted in both developing and industrialized countries [35, 36]. In the former, this could be due to a lack of resources, while in the latter, it could be due to previous antibiotic treatments. In the gram-positive bacteria group, Staphylococcus aureus and Streptococcus pneumoniae were the leading organisms, while Pseudomonas aeruginosa was the main gram-negative organism in our present study. The latter were also the primary gram-negative organisms in a study on MK in England [37]. The gram-positive organisms were found to be common results of MK cases in developing countries [38]. In our study, there were few instances of (12.35%) fungal keratitis, and the ones that we did discover were linked with a history of ocular trauma (wooden sticks) and diabetes.

The diagnosis of MK is made on the clinical basis together with microbiological evaluation [39]. The microbiological profile of microbial keratitis has shown great differences worldwide. An American study found that in the northern cooler states, bacterial keratitis is more prevalent while in the southern states fungal keratitis is more prevalent [40]. Due to the continuous shifting in microbiological profiles and antibiotics resistance profiles reported in several studies, microbiological investigations and antibiotic susceptibility are mandatory to provide an effective treatment [41].

Conclusions

The present study concluded that the contact lens and ocular trauma are the most common predisposing factors of microbial keratitis. Most

common gram-positive microorganism are Staphylococcus aureus and Streptococcus pneumoniae and the most common gram-negative organism is Pseudomonas aeruginosa for causes of corneal ulcer in microbial keratitis patients.

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