Etiology and Clinical Outcomes of Microbial Keratitis at a Tertiary Eye-Care Center in Northern Thailand

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Objective: *To establish the predisposing factors, microbial profiles, demographics of patients and clinical outcomes of microbial keratitis at a tertiary eye center in northern Thailand.*
Material and Method: *Patients admitted to Chiang Mai University Hospital with suspected microbial keratitis (non-viral) were studied retrospectively over a 36-month period (April 2003-March 2006, respectively) (n = 305 cases/310 eyes). Predisposing factors, causative organisms, patients' demographic and treatment outcomes were analyzed.*
Results: *Ocular trauma was the predisposing factor (43.9%) identified most commonly, followed by undetermined causes (16.1%), ocular surface diseases (13.2%), multiple factors (9.4%), systemic disease (6.8%), ocular surgery (3.9%) and use of contact lens (3.5%). Cultures of corneal scraping were positive in 25.6% of cases. Both bacteria and fungi were common pathogens (49.3% and 46.3%, respectively). Pseudomonas aeruginosa (14.9%) and fusarium spp. (26.9%) was the most common bacterial and fungal pathogen, respectively. Forty-one percent of eyes underwent surgery and the most common procedure was scleral patch graft (39.8%). A statistically significant predictor of poor visual outcome was an ulcer larger than 6 mm (OR 3.08, p = 0.002).*
Conclusion: *Ocular trauma was the most common predisposing factor leading to microbial keratitis. Both bacteria and fungi were common pathogens. A large lesion at presentation was a significant predictor for poor visual outcome.*

Keywords: *Bacterial keratitis, Corneal ulcer, Fungal keratitis, Microbial keratitis*

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Microbial keratitis is a common cause of monocular blindness worldwide[1-3]. Even though most community-acquired corneal ulcers are resolved with appropriate treatment, severe infections may result in acute perforation, scleritis, or endophthalmitis, or lead to blinding sequelae such as secondary glaucoma, corneal scarring, corneal perforation, or phthisis bulbi. Microbial keratitis not only causes visual impairment, but also has incalculable social and economic impact on affected individuals. In addition, the medical costs for treatment of microbial keratitis, particularly in severe cases or in fungal keratitis, are usually expensive[2].

In general, corneal infection is rare in the absence of predisposing factors, which also influence the type of infection. There are geographic variations in the spectrum of causative organisms and predisposing factors according to climate and socioeconomic status. In developing countries, the most common predisposing factor is usually ocular injury[4,5], whereas use of contact lens (CL) and ocular surface disease are common in developed countries[3,6]. Also, bacteria are common causative organism of microbial keratitis around the world, whereas fungi are endemic in tropical areas.

Understanding the epidemiology of microbial keratitis in each region is helpful in developing strategies to prevent and treat this potentially blinding and preventable condition. The present study aimed to identify the predisposing factors, microbial profiles, and treatment outcomes in microbial keratitis patients admitted to the tertiary eye-care center, Chiang Mai University Hospital (CMUH), northern Thailand.

Material and Method

The present study was approved before initiation by the Research and Ethics Committee, Faculty of Medicine, Chiang Mai University. New patients admitted to CMUH with suspected microbial keratitis were studied both retrospectively and prospectively

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over a 36-month period (April 2003-June 2004 and July 2004-March 2006, respectively). Cases of suspected viral keratitis were excluded.

After taking a complete medical history, demographic details were recorded, including the duration of symptoms, details of past and concurrent ocular and systemic diseases, history of ocular trauma, CL use and use of any ocular medications. Visual acuity (VA) was assessed, followed by a detailed clinical examination using a slit-lamp biomicroscope to evaluate the size and depth of the lesion, presence of hypopyon as well as any associated anterior segment findings. Intraocular pressure, lens and fundus were assessed if possible. If the patient's fundus view was obscured, B-scan ultrasonography was performed to rule out endophthalmitis.

Most patients underwent corneal scraping using a flame-sterilized Kimura spatula under a slit-lamp after application of tetracaine hydrochloride 0.5%. The material was smeared for Gram's staining and 10% potassium hydroxide wet mount. Subsequent scrapings were inoculated directly into the media for isolation of bacteria (blood and chocolate agar) and fungi (Sabouraud dextrose agar). All bacterial media were inoculated at 37°C in 5% CO_2 atmosphere. Fungal media were kept at room temperature.

Criteria for distinguishing pathogens included growth of an organism in 2 or more media, confluent growth (> 10 colonies) of a known ocular pathogen in one solid medium, or growth of an organism in one medium of an organism identified on a smear.

Corneal scraping was not performed in patients with impending perforated or perforated corneal ulcers, or those who were unwilling to participate. Specimens related to infection (*i.e.* CL, foreign body and aqueous and vitreous in endophthalmitis cases) were also used for microbial work-up. Corneal biopsy and polymerase chain reaction (PCR) were performed in some cases with negative cultures.

According to the authors' treatment guidelines for severe microbial keratitis, combined fortified cefazolin (33 mg/ml) and gentamycin (14 mg/ml) eye drops were the initial treatment in most patients after corneal scraping. The treatment was then modified according to clinical response and microbiologic results. Topical ketoconazole 2% or amphotericin B 0.015% was given to patients with suspected or proven fungal keratitis. Systemic antibiotics were considered only for patients with perforated or impending perforated ulcer, and intraocular or sclera extension. Surgery was carried out when necessary.

Statistical analysis

Mean and rate were used to analyze demographic data, clinical features, causative organisms and treatment. Pearson Chi-square and logistic regression were used to determine factors related to poor visual outcome (VA of hand movement or less), in terms of odd ratios with 95% confident interval (95% CI). A p-value of less than 0.05 was considered statistical significant.

Results

The present study recruited 310 eyes from 305 patients [203 males (66.6%) and 102 females (33.4%)] with suspected microbial keratitis. Of these, 236 (77.4%) were partially treated before referral to the study center, and most of the patients were laborers or farmers (54.8%) (Table 1). The age of patients ranged from 10 days to 91 years old (mean age 47.1 $\pm$ 20.7 years). Right eyes were affected in 151 cases (49.5%) and left ones in 149 (48.9%). Five patients had bilateral involvement. The onset of symptoms preceded presentation to the hospital by 1 week in 51.6% of patients, 1 week to 1 month in 37.2% and more than 1 month in 11.2%.

Ulcers involved central and paracentral cornea in 167 (53.9%) and 88 eyes (28.4%), respectively. Sixty-eight eyes (21.9%) had relatively large ulceration (> 6 mm) at presentation and the lesion affected the total cornea or nearly total cornea in 20 eyes (6.5%). Hypopyon was present in 127 eyes (41.8%), descemetocele in 25 (8.1%), corneal perforation in 49 (15.8%) and intraocular extension (endophthalmitis or panophthalmitis) in 13 (4.2%) (Table 1).

The most common predisposing factor was ocular injury (43.9%), followed by undetermined cause (16.1%), ocular surface disorders including previous herpetic eye diseases (13.2%), multifactorial (9.4%) and systemic diseases (6.8%), ocular surgery (3.9%), and CL use (3.5%) (Table 2).

Five patients presented with bilateral corneal ulcers, all of which were associated with underlying systemic disorders, including human immunodeficiency virus (HIV) infection (1), diabetes (1), malnutrition (2), and immunosuppressive treatment (1).

Corneal scraping was performed in 223 of the 310 eyes; of which 51 eyes (22.9%) were smear positive and 57 (25.6%) culture positive. Correlations between smear and culture results are demonstrated in Table 3. Sixty-seven pathogens were isolated from all methods of microbial work-up, except for smears (Table 4). Of these, 33 (49.3%) were bacteria, 31 (46.3%) fungi, and 3 (4.5%) mixed infection. *Fusarium* spp. was the most

Table 1. Occupation of patients prior to treatment, duration of symptoms and clinical features (n = 305 cases/310 eyes)

Occupation	(Case, %)
Laborers & farmers	167 (54.8)
Business persons & officers	27 (8.9)
Seniors citizens	52 (17)
Children & students	41 (13.5)
Others	16 (5.3)
Prior treatment	(Case, %)
Ophthalmologists	169 (55.4)
General practitioners	44 (14.4)
Health workers	5 (1.6)
Pharmacists	4 (1.3)
Multiple sources	14 (4.6)
None	69 (22.6)
Duration of symptoms*	(Case, %)
7 days or less	157 (51.6)
8-30 days	113 (37.2)
31 days or more	34 (11.2)
Clinical features	(Eye, %)
Location	
Central	167 (53.9)
Paracentral	88 (28.4)
Periphery	35 (11.3)
Nearly total, total	20 (6.5)
The greatest diameter	
Less than 2 mm	40 (12.9)
2-6 mm	202 (65.2)
More than 6 mm	68 (21.9)
Hypopyon**	127 (41.8)
Descemetocele	25 (8.1)
Perforated	49 (15.8)
Endophthalmitis/panophthalmitis	13 (4.2)

* The Data was missing in one patient (n = 304 cases)
** Hypopyon could not assess in 6 patients due to corneal perforation (n = 304 eyes)

common pathogen (26.9%), followed by *Pseudomonas aeruginosa* (14.9%), S*treptococcus pneumoniae* (7.5%), *Aspergillus* spp. (6%) and unidentified fungus (6%). Table 4 also shows the details of pathogens related to predisposing factors.

The most common initial topical treatment was combined fortified antibiotics (68%), followed by combined fortified antibiotics and antifungal (16.8%), and fluoroquinolone antibiotic (5.8%) (Table 5). One hundred and eighty-two (58.7%) eyes were treated with medication only and 128 (41.3%) underwent surgeries. Common procedures were scleral patch graft (39.8%), followed by evisceration or enucleation (25%) and tissue adhesive (16.4%) (Table 5). The VA after treatment improved one line from the level at presentation in 39%

Table 2. Demographics, predisposing factors, and clinical severity of microbial keratitis

Predisposing factor	n (eye, %)	(Mean ± SD)	Gender (M:F) (% Male)	Duration > 3 days (%)*	Diameter > 2 mm (%)	Hypopyon (%)**
Trauma	136 (43.9)	43.9 ± 19.5	96:40 (70.6)	103/136 (75.7)	115/136 (84.6)	55/136 (40.4)
Undetermined	50 (16.1)	57.8 ± 23.1	29:17 (58.0)	36/50 (72.0)	45/50 (90.0)	17/50 (34.0)
OSD	41 (13.2)	51.9 ± 17.8	29:12 (70.7)	32/41 (78.0)	36/41 (87.8)	21/41 (51.2)
Multiple risks	29 (9.4)	52.8 ± 22.3	22:7 (75.9)	20/29 (69.0)	27/29 (93.1)	8/29 (27.6)
Systemic diseases	21 (6.8)	47.1 ± 20.7	6:14 (28.6)	16/21 (76.2)	19/21 (90.5)	10/21 (47.6)
Ocular surgery	12 (3.9)	70.1 ± 11.9	9:3 (75.0)	4/12 (33.3)	12/12 (100.0)	8/12 (66.7)
CL wear	11 (3.5)	22.9 ± 6.4	4:7 (36.4)	2/11 (18.2)	7/11 (63.6)	4/11 (36.4)
Others	10 (3.2)	35.8 ± 17.9	8:2 (80.0)	7/10 (70.0)	9/10 (90.0)	4/10 (40.0)
Total	310 (100)	47.1 ± 20.7	203:102 (66.6)	220/304 (72.4)	270/310 (87.1)	127/304 (41.8)

* Data was missing in one patient (n = 304 cases), ** Hypopyon could not be assessed in 6 eyes with corneal perforation (n = 304 eyes), OSD: Ocular surface diseases including previous herpetic eye disease, CL: contact lens

Table 3. Results of smears and cultures from corneal scraping (n = 223)

	Case (%)
Smear Results	
Gram positive organisms	22 (9.9)
Gram negative organisms	5 (2.2)
Filamentous fungi	13 (5.8)
Yeast	1 (0.5)
Modified AFB branching bacteria	1 (0.5)
Mixed organisms	9 (4.0)
Negative	172 (77.1)
Culture	
Positive	57 (25.6)
Correlations between smear & culture	
Smear positive and culture positive	29 (13.0)
Smear positive and culture negative	28 (12.6)
Smear negative and culture positive	22 (9.9)
Smear negative and culture negative	144 (64.6)

of the eyes, remained stable in 28.7% and became worse in 28.4%. Fig. 1 compares initial VA with VA at discharge. Mean length of hospital stay was 20.3 $\pm$ 19.1 days (range 1-132 days).

From 57 patients with very poor vision after treatment (hand motion to no light perception or eye loss), bivariate analysis identified that old age (> 60 years old), poor initial VA (VA of HM or less), ulcer of 6 mm or more and stromal thinning were significant predictors for poor visual outcome. However, by using multivariate analysis, large ulcer (OR 3.084, CI 1.509-6.302, p = 0.002) was the only significant prognostic factor of poor visual outcome after treatment (Table 6).

Discussion

The present study verified the etiology and treatment outcome of microbial keratitis in patients admitted at a tertiary eye-care center in northern Thailand over a three-year period. Ocular trauma was identified as the major predisposing factor for corneal infection in this region, since pathogens can enter easily into the corneal stroma when epithelial barriers are disrupted after relatively minor corneal injury. Ocular trauma also has been reported as the most common predisposing factor in other previous studies, particularly from developing countries[4,5,7].

The majority of patients in the present case series were middle-aged (mid-40s) and in their most productive years and most of them worked as laborers or farmers. Males were twice more likely to be affected than females, especially in the trauma group (Table 2); presumably because their occupational settings and outdoor activities put them at a greater risk of eye injury.

The present study demonstrated that ocular surface diseases, prior ocular surgery and multiple risk factors were common in patients over 50 years old, while CL use was found to apply in patients younger than thirty. These findings were similar to those from previous studies of microbial keratitis, where systemic illness and ocular surface disorders were common risk factors in the elderly[8,9] and CL-related keratitis was predominate in younger patients[2,10].

CL use was reported as the most common risk factor for corneal ulcer, particularly in developed countries; however, the present study identified CL-related keratitis in only a few cases (3.5%). The low rate of CL-related keratitis in the present study may be due partly to the increased use of disposable rather than reusable CL, which might decrease chances of infection. Another reason might be because private clinics can treat mild degree CL-related keratitis patients effectively and only severe cases are presented at hospital centers. Dart et al reported that the risk of microbial keratitis has not been decreased by daily disposable CL, but visual loss is less likely when using them than the use of reusable soft CL[11].

Apart from the local risk factors predisposing to corneal infection, systemic evaluation should be performed with a holistic approach in all patients, as the present study found that few patients, particularly those who presented with bilateral corneal ulcers, were related to some certain systemic illnesses without identified local risk factors.

The positive culture rate (25.6%) in the present study was low when compared to other studies (52-79%)[1,3,4]. The reason may be because most of the patients (73%) in the present study were referred to CMUH after unsuccessful treatments. In ophthalmic practice, especially in developing countries, patients with infectious keratitis have probably received a variety of treatment, including antibacterial, antifungal, antiviral, or topical steroids in various combinations, prior to consulting a specialist[12]. This may influence the results of microbial work-up as well as modify the clinical features of patients. In addition, most of the authors' case series were severe and some presented with thin or perforated corneas, in which corneal scraping could not be performed or specimen collection from corneal scraping was inadequate. In cases of negative corneal scraping, other methods may be helpful in choosing appropriate antimicrobial therapy such as culture of materials related to an infection (*i.e.*

Table 4. Organisms isolated in microbial keratitis cases

Organism	Trauma (%)	Undetermined (%)	OSD (%)	Multiple risks (%)	Systemic diseases (%)	Ocular surgery (%)	CLW (%)	Others (%)	Total (%)
Bacteria	13 (19.4)	2 (3.0)	1 (1.5)	5 (7.5)	3 (4.5)	4 (6.0)	2 (3.0)	3 (4.5)	33 (49.3)
Gram-positive bacteria									
Staphylococcus aureus	-	-	-	1	-	-	-	1	2 (3.0)
Staphylococcus epidermidis	1	-	-	-	-	-	-		1 (1.5)
Coagulase negative staphylococcus spp.	1	-	-	-	-	-	-	1	2 (3.0)
Streptococcus pneumoniae	4	1	-	-	-	-	-	-	5 (7.5)
Streptococcus suis	-	-	-	-	1[f]	-	-	-	1 (1.5)
Bacillus spp.	-	-	-	1[d]	-	1[b]	-	-	2 (3.0)
Nocardia	1	-	-	-	-	-	-	-	1 (1.5)
Gram -negative bacteria									
Pseudomonas aeruginosa	3	1	1	2	-	1	1	1	10 (14.9)
Kliebsella pneumoniae	-	-	-		1[b]	-	-	-	1 (1.5)
Serratia marcescens	-	-	-	-	-	-	1[e]	-	1 (1.5)
Non-fermentative gram negative	-	-	-	-	-	2	-	-	2 (3.0)
Enterobactor cloacae	1[h]	-	-	-	1[a]	-	-	-	2 (3.0)
Citrobactor spp.	1[a]	-	-	-	-	-	-	-	1 (1.5)
Mixed bacteria									
P. aeruginasa & S. aureus	1	-	-	-	-	-	-	-	1 (1.5)
S. aureus & Kliebsella	-	-	-	1	-	-	-	-	1 (1.5)
Fungus	19 (28.4)	4 (6.0)	3 (4.5)	1 (1.5)	4 (6.0)	-	-	-	31 (46.3)
Aspergillus spp.	3 (1[a])	-	-	1	-	-	-	-	4 (6.0)
Fusarium spp.	11	3	2	-	2	-	-	-	18 (26.9)
Culvularia	1	-	-	-	-	-	-	-	1 (1.5)
Phycomycosis	1[a]	-	-	-	-	-	-	-	1 (1.5)
Foncecea pedrosoi	1	-	-	-	-	-	-	-	1 (1.5)
Rhodotorular spp.	-	1	-	-	-	-	-	-	1 (1.5)
Candida spp.	-	-	-	-	1	-	-	-	1 (1.5)
Unidentified fungus	2 (1[c])	-	1	-	1	-	-	-	4 (6.0)
Mixed bacteria & fungus	2 (3.0)	1 (1.5)	-	-	-	-	-	-	3 (4.5)
S.epidermidis & fusarium spp.	1	-	-	-	-	-	-	-	1 (1.5)
P. aeruginosa & candida spp.	-	1	-	-	-	-	-	-	1 (1.5)
S. epidermidis & identified fungus	1	-	-	-	-	-	-	-	1 (1.5)
Total	34 (50.7)	7 (10.4)	4 (6.0)	6 (9.0)	7 (10.4)	4 (6.0)	2 (3.0)	3 (4.5)	67 (100.0)

*Ten specimens were from a: corneal biopsy (3), b: aqueous or vitreous biopsy (2), c: PCR (1), d: foreign body (1), e: contact lens (1), f: hemoculture (1), h: pus (1)
(OSD = ocular surface disease, CLW = contact lens wear)

Table 5. Details of treatment

Treatment	Eyes (%)
Initial topical medication (n = 309)*	
Combined fortified antibiotics	210 (68.0)
Combined fortified antibiotics & antifungal**	52 (16.8)
Fluoroquinolone antibiotics	18 (5.8)
Combined fortified antibiotics & acyclovir	12 (3.9)
Fluoroquinolone antibiotics & antifungal**	8 (2.6)
Antifungal**	2 (0.6)
Others	7 (2.3)
Total	309 (100)
Surgery (n = 128)	
Scleral patch graft	51 (39.8)
Evisceration/enucleation	32 (25.0)
Tissue adhesive glue	21 (16.4)
Tarsorrhaphy/ lid surgery	9 (7.0)
Amniotic membrane graft	6 (4.7)
Penetrating keratoplasty	5 (3.9)
Others***	4 (3.1)
Total	128 (100)

* One eye underwent enucleation since admission due to corneal perforation and no perception of light
** Initial topical antifungal was ketoconazole 2%
*** Removal of foreign bodies in anterior chamber/cornea (3), conjunctival flap (1)

CL, foreign bodies), corneal biopsy to obtain the histopathology of the infected tissue, or PCR, which is a method for rapidly identifying causative organisms via DNA extraction and amplification. However, the latter may have the limitation of artifactual extraction of nonpathogenic organisms and non-availability for routine microbial work up in CMUH.

In cases of positive cultures, both bacteria and fungi were common pathogens for corneal infection in the authors' region. *Pseudomonas aeruginosa* was the most common bacteria isolated, and also the predominant organism in the authors' previous study in the same setting(13). *P. aeruginosa* is a common cause of serious corneal infection and the most frequent bacterial species found, particularly in CL-related keratitis(11,14). *P. aeruginosa* has a wide environmental and ecological distribution and remarkable ability to adapt to hostile environments with sparse nutrients(15). It has only a low-binding affinity to healthy corneal epithelial cells; however, its ability to adhere may be increased by disruption of local barriers(15).

Fusarium was the most common fungus and the most common pathogen isolated in the present study. This fungal pathogen has also been reported as the predominant organism for fungal keratitis in other studies, particularly from the tropics(4,7,16). Filamentous fungi such as the *fusarium* species are encountered in warm and humid environments. Risk of fungal keratitis is increased in cases with preceding ocular injury, particularly from vegetative matters(4,17). Therefore, fungal keratitis is endemic in the tropics, particularly in agricultural communities.

The ratio of fungal to bacteria keratitis in the present study was about 1:1. In other studies, this ratio varied from 1:10-1:17 in temperate or subtropical regions (USA(18), Japan(6), Australia(2), Hong Kong(19)) to 1:3-3:1 in tropical climes (Thailand(7), south India(16), Ghana(16), south Florida(20)). The authors' previous study in the same setting demonstrated this ratio at about 2:3 during the years 2000-2003(13). The increased trend of fungal keratitis in our region may be partly because most bacterial corneal ulcers can be cured with effective antibiotic treatment prescribed by community ophthalmologists. In contrast, fungal ulcers are generally difficult to treat, especially if the patient is seen late in the course of the disease.

Another reason is the limitation of commercial antifungal ophthalmic agents. Currently, the only commercially available topical antifungal medication in Thailand is 5% natamycin, which is also the preferred first-line drug for filamentous fungal keratitis. However,

Table 6. Factors related to poor visual outcome after treatment

Factors	No. of patients(eyes) with/without poor outcome	Odds ratio	95% CI	p-value
Age[a]				
Older than 60	22/61	2.192	1.192-4.029	0.01*
60 or less	32/186			
Initial VA				
HM or poorer	29/87	1.976	1.106-3.531	0.02*
FC or better	28/166			
Risk factor				
Trauma	24/112	0.916	0.512-1.638	0.766
Non-trauma	33/141			
Duration[b]				
More than 3 days	40/180	1.022	0.531-1.968	0.948
3 days or less	15/69			
Tertiary referred				
Yes	37/132	1.696	0.933-3.08	0.081
No	20/121			
Hypopyon[c]				
Present	27/100	1.721	0.940-3.152	0.076
Absent	24/153			
Size of lesion				
6 mm or more	25/43	3.815	2.059-7.075	0.0001**
Less than 6 mm	32/210			
Stromal thinning				
Thin to perforated	35/109	2.102	1.167-3.786	0.012*
Absent	22/144			
Culture results				
Negative	20/146	0.514	0.23-1.132	0.094
Positive	12/45			

**Ulcer larger than 6 mm was a significant factor with multiple logistic regressions (adjusted odds ratio = 3.08, 95% CI = 1.509-6.302, p = 0.002)

[a]Vision acuity could not be assessed in 4 patients who were too young (n = 301 cases), [b]The data was missing in one patient (n = 304 cases), [c]Hypopyon could not be assessed in 6 eyes presented with corneal perforation (n = 304 eyes)

its corneal penetration is thought to be poor, therefore, its effectiveness in deeper keratitis is limited(21). Also, this antifungal agent is not covered by government medicare in Thailand and is unaffordable for many patients. Other topical antifungal used in Thailand are hospital-made ketoconazole 2% and amphotericin B 0.015% eye drops, which are considered as primary therapy for fungal corneal ulcers.

Fungal keratitis generally begins with gradual onset of symptoms and mostly affects poor people, who may present late in the course of the disease. The delayed diagnosis and treatment of fungal keratitis make the infection more difficult to cure. Some fungal pathogens such as *fusarium* may also penetrate intact Descemet's membrane, resulting in endophthalmitis(22). A study from China recommended therapeutic keratoplasty as an effective treatment in fungal keratitis, particularly in patients who present with a moderate to severe degree of disease(23).

A large proportion of eyes in the present study required surgical interventions, due to corneal perforation or endophthalmitis. Of these, some patients first presented with complications (28%), while others developed complications during treatment. Sclera patch graft was the most common procedure to save the eye, while therapeutic keratoplasty was performed in only limited cases. Ideally, sclera patch graft is not considered as an optical treatment. The main reason for using sclera instead of corneal tissue is because of paucity of the donor cornea in this region. In addition, preserved sclera may be more suitable than tissue adhesive in cases of severe corneal perforation. This

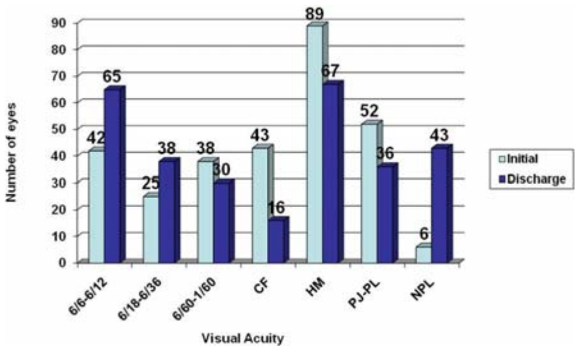

Fig. 1 Visual acuity at initial presentation compared with that at discharge (n = 295 eyes)
CF = counting finger, HM = hand motion, PJ = light projection, PL = light perception, NPL = no light perception

approach may delay keratoplasty procedure, which can be done later, after the infection and inflammation have subsided.

Miedziak et al found that older age, delay in referral to a corneal specialist, topical steroid treatment, post ocular surgery, poor vision at presentation, large size ulcer, and central location were risk factors for poor outcome, which require penetrating keratoplasty[24]. In another previous study, large ulcers have also been identified as a predictor for treatment failure in fungal keratitis, which is similar to the results of the present study[25].

The limitation of the present study was the inability to assess true incidence of microbial keratitis with precision, as there may be bias toward more severe and complicated cases. This may be because the present study was conducted in a tertiary center where most of the pathogens were unidentified. However, the present study demonstrated that microbial keratitis is a public health problem in Thailand. Furthermore, visual loss from microbial keratitis does not only impact quality of vision of the patient, but also involves socio-economic status as well as the patient's quality of life.

In conclusion, the present study found that trauma was a major predisposing risk factor for microbial keratitis in the authors' region and a large ulcer was related to poor visual outcome. The high proportion of severe degree ulcers and limitation of donor cornea warrant development of a prevention and treatment program, including improvement to primary health care and the referral system, as well as a refresher ophthalmic course for general practitioners in order to avoid delays in diagnosis and proper management. Additionally, public awareness of eye protection during work, as well as activities that make one prone to eye injury, should be promoted, particularly to the population at risk.

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Potential conflicts of interest

None.

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สาเหตุและผลการรักษาโรคกระจกตาอักเสบจากการติดเชื้อในผู้ป่วยที่เข้ารับการรักษาโรงพยาบาลตติยภูมิในภาคเหนือของประเทศไทย

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***วัตถุประสงค์**: เพื่อศึกษาถึงปัจจัยเสี่ยง เชื้อที่เป็นสาเหตุ ลักษณะผู้ป่วย และผลลัพธ์ในการรักษาของโรคกระจกตาอักเสบจากการติดเชื้อที่โรงพยาบาลตติยภูมิในภาคเหนือของประเทศไทย*

***วัสดุและวิธีการ**: ได้ทำการศึกษาในผู้ป่วยที่สงสัยว่าเป็นโรคกระจกตาอักเสบจากการติดเชื้อที่ไม่ใช่เชื้อไวรัส ซึ่งเข้ารับการรักษาในโรงพยาบาลมหาราชนครเชียงใหม่(โรงพยาบาลในสังกัดของมหาวิทยาลัยเชียงใหม่) ในช่วงระยะเวลา 36 เดือน โดยเป็นการศึกษาย้อนหลังระหว่างเดือนเมษายน พ.ศ. 2546 ถึง เดือน มิถุนายน พ.ศ. 2547 และศึกษาไปข้างหน้าระหว่างเดือนกรกฎาคม พ.ศ. 2547 ถึงเดือน มีนาคม พ.ศ. 2549 มีผู้ป่วยจำนวน 305 ราย (310 ตา) โดยได้วิเคราะห์ถึงปัจจัยเสี่ยงในการเกิดโรค เชื้อต้นเหตุ ลักษณะผู้ป่วย และผลลัพธ์ในการรักษา*

***ผลการศึกษา**: ปัจจัยเสี่ยงต่อการเกิดโรคกระจกตาอักเสบจากการติดเชื้อที่พบมากที่สุดคือ การบาดเจ็บทางตา (ร้อยละ 43.9) รองลงมาได้แก่ ไม่ทราบปัจจัยเสี่ยง (ร้อยละ 16.1) โรคของผิวตา (ร้อยละ 13.2) ปัจจัยเสี่ยงหลายอย่าง (ร้อยละ 9.4) โรคทางกาย (ร้อยละ 6.8) เคยได้รับการผ่าตัดตามาก่อน (ร้อยละ 3.9) และการใช้เลนส์สัมผัส (ร้อยละ 3.5) การเพาะเชื้อจากตัวอย่างที่ได้จากการขูดแผลที่กระจกตาได้ผลบวกร้อยละ 25.6 เชื้อก่อโรคที่พบบ่อยพบทั้งเชื้อแบคทีเรีย และเชื้อรา (ร้อยละ 49.3 และ 46.3 ตามลำดับ) โดยเชื้อ Pseudomonas aeruginosa เป็นเชื้อแบคทีเรียที่พบบ่อยที่สุด และเชื้อ fusarium เป็นเชื้อราที่พบบ่อยที่สุด ผู้ป่วยร้อยละ 41 ต้องรักษาด้วยการผ่าตัด โดยหัตถการที่ทำบ่อยที่สุดคือ scleral patch graft (ร้อยละ 39.8) ผู้ป่วยที่มีแผลที่กระจกตาขนาดใหญ่เกินกว่า 6 มิลลิเมตร เป็นตัวทำนายที่มีนัยสำคัญถึงผลลัพธ์ทางการมองเห็นที่ไม่ดีหลังการรักษา (OR 3.08, p = 0.002)*

***สรุป**: การบาดเจ็บทางตาเป็นปัจจัยเสี่ยงที่พบมากที่สุดที่นำไปสู่การติดเชื้อที่กระจกตา เชื้อก่อโรคที่เป็นสาเหตุที่พบบ่อยพบทั้งเชื้อแบคทีเรียและเชื้อรา รอยโรคที่มีขนาดใหญ่ตั้งแต่ก่อนรับการรักษาเป็นตัวทำนายที่มีนัยสำคัญถึงผลลัพธ์ทางการมองเห็นที่ไม่ดีหลังการรักษา*