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A review on contact lens related microbial keratitis in Asian countries

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A review on contact lens related microbial keratitis in Asian countries

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Abstract

Bacterial or fungal keratitis/corneal ulcer is the most dangerous complication which occurs when patients do not follow good hygiene practices in handling the contact lenses. When the ulcer heals, it results in corneal opacity and loss of vision. A review of the literature on keratitis/corneal ulcer in patients wearing contact lenses from different countries in Asia was performed in Pubmed, Google scholar and Science direct search engines. In patients of infectious keratitis/corneal ulcer, contact lens wear was reported as a risk factor in 0.4% to 69.4% in Asian countries. Soft lenses and those made of polymethylmethacrylate accounted for most ulcers. Poor hygiene, overnight wear and failure to air-dry casings were found to cause the ulcers. *Pseudomonas aeruginosa*, *Fusarium* and *Acanthamoeba* were the most common organisms isolated in contact lens related corneal ulcers. Maintenance of a contact-lens related corneal ulcers registry (like the one present in Malaysia) in every country will play a great role in reducing the prevalence of corneal blindness in patients using contact lenses.

Key words: *Acanthamoeba* keratitis, bacterial keratitis, contact lens, fungal keratitis, microbial keratitis

Introduction

Contact lenses (CL) are used not only to correct refractive errors in optical conditions but also therapeutically for irregular astigmatism, corneal opacity, anisometropia and unilateral aphakia. Those who do not want to wear glasses and those who intent for the color of their eyes to be different from what one is born with also use it for vanity. Depending on the wearing schedule, they can be daily, weekly, bi-weekly, monthly or quarterly disposable lenses or the non-disposable ones that can be used for up to a year. Contact lens worn by college/high school students and young adults is on the rise in recent years. Use of contact lenses can cause a variety of complications such as conjunctival hyperemia,

corneal neovascularization, sterile infiltrate and the most dreaded one is microbial keratitis.

Common symptoms and signs in these patients include moderate to severe pain of rapid onset, severe redness of conjunctiva, blurred vision, photophobia and discharge, corneal infiltration (central or paracentral), large irregular infiltrate, diffuse infiltration surrounding epithelial lesion and epithelial loss over the infiltrate. Permanent visual loss can occur in these patients following corneal ulcer perforation and its sequelae or due to corneal opacification after healing of the ulcer. The clinical features depend on the causative organism. However, the organisms isolated, and the management is similar to any other microbial keratitis.

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Methods

We performed literature search in Pub Med, Science Direct and Google Scholar for the articles on contact lens related corneal ulcers in Asian countries, using the key words such as contact lenses, complications, corneal ulcer, names of different countries in Asia and reviewed all of them. We categorized them into different subheadings.

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Results

Prevalence of contact lens wears as risk factor in microbial keratitis

The prevalence of contact lens wear as risk factor in patients with microbial keratitis is variable (0.4% to 69.4%) in different studies reported from various countries in Asia (Table 1). The probable factors for this could be the geographical contact lens wear and the residential status (urban or rural) of patients attending the hospital.

Types of contact lens wear and microbial keratitis

In a study of 23,068 patients (45,580 eyes), Hamano et al.²² from Japan reported that polymethylmethacrylate lenses had a significantly higher rate of corneal complications compared with other lenses, whereas daily disposable lens had a significantly lower rate for the same. The majority of corneal complications for all types of lenses consisted of superficial punctate keratopathy and there were no cases of corneal ulcers in their study.

Sharma et al.⁷ found that 28 of 23,889 (0.11%) contact lens wearing patients presented with laboratory-proven infectious keratitis; this constituted 0.56% of 4967 corneal ulcer patients seen during the same period (February 1991 to September 2000). Among these 28 patients, 15 used soft contact lenses on a daily basis, 2 used rigid gas-permeable lenses, 4 used therapeutic bandage contact lenses and 4 used SilSoft lenses. Twenty-five (89.2%) patients had bacterial infection. The organisms isolated in this study were *Pseudomonas* in 13 (52%), acanthamoeba, herpes simplex virus, and *Aspergillus niger* in one case each.

In 9 eyes of 7 female patients, Cheng et al.²³ reported acanthamoeba keratitis in different types of contact lens wear (monthly replaced in 5, biweekly replaced in 1, non-disposable soft in 1 and orthokeratology lens in 2 eyes). In a retrospective study of 4046 soft contact lens wearers in Nepal, Saptoka et al.²⁴ reported contact lens induced peripheral ulcer in 4% and microbial keratitis in 3% of patients. They

Table 1: The percentage of contact lens wear reported as risk factor in patients of microbial keratitis from different countries in Asia.

Author	Place, Country	No of patients with corneal ulcer	Percentage of contact lens wear
Tan et al. ¹	Singapore	103	34.0%
Lam ²	Hong Kong	50	28.0%
Reddy and Tan ³	KotaBharu, Malaysia	136	2.9%
Kunimoto et al. ⁴	Hyderabad, India	102	2.0%
Lam et al. ⁵	Hong Kong	223	26.0%
Bharathi et al. ⁶	Thirunelveli, India	1043	3.6%
Sharma et al. ⁷	Hyderabad, India	4967	0.56%
Panda et al. ⁸	New Delhi, India	1000	8.2%
Preechawat et al. ⁹	Ramathibodi, Thailand	435	18.6%
Kursiah et al. ¹⁰	Ipoh, Malaysia	28	17.8%
Reddy and Tajunisah ¹¹	Kuala Lumpur, Malaysia	169	33.0%
Narsani et al. ¹²	Hyderabad, Pakistan	300	3.6%
Ahmed et al. ¹³	Dhaka, Bangladesh	147	0.7%
Chaudhry et al. ¹⁴	Karachi, Pakistan	62	69.4%
Thananuvat et al. ¹⁵	Chang Mai, Thailand	305	3.5%
Hussain et al. ¹⁶	Peshawar, Pakistan	228	0.4%
Kaliamurthy et al. ¹⁷	Trichy, India	2170	0.7%
Kampitak et al. ¹⁸	Thammasat, Thailand	159	22.0%
Lai et al. ¹⁹	Hong Kong	51	45.0%
Ng et al. ²⁰	Hong Kong	260	42.7%
Jiang et al. ²¹	Beijing, China	259	29.8%

concluded that patient education in CL hygiene, after care schedule and frequent follow up examinations may help to minimize CL related complications.

Risk factors for microbial keratitis in contact lens wear patients

Prolonged wearing time appeared to be the main cause of eye damage in hard lens wearers, while soft lens and gas permeable hard lens associated injuries were more often a result of the state of the lens itself (scratches and defects in the plastic and contamination).²⁵ Lin *et al.*²⁶ reported multiple risk factors such as extended-wear, poor lens care, bilateral alternate wearing and smoking in a case of simultaneous bilateral corneal ulcers in an extended-wear soft contact lens wearer and the cultures in this case revealed growth of *Pseudomonas aeruginosa* and *Acinetobacter calcoaceticus*.

Other risk factors reported were lack of hygiene, use of tap water for storing lenses, failure to air-dry lens-storage cases or use of one-step hydrogen peroxide disinfectant keratitis in contact lens wear patients.²⁷ Patients with prior topical combined antibiotics-steroids present slightly later and with larger ulcers. However, the duration of stay, final visual acuity, treatment failure and complication rates were not statistically different from the non-treated group. This might be due to early presentation and therefore early treatment of contact lens-related microbial keratitis and the short duration of use of combined antibiotic-steroid eye drops.²⁸

Cheng *et al.*²³ reported the risk factors for acanthamoeba keratitis in contact lens wearers which include the type of contact lens worn, the disinfection procedure, overnight contact lens wear and swimming while wearing contact lenses. Loh and Agarwal²⁹ have summarized the risk factors from the literature as overnight wear of contact lens, low socioeconomic class, smoking, dry eye and poor hygiene which are the factors associated with increased risk of contact lens related corneal ulcers. Independent risk factors reported for contact lens related microbial keratitis in Singapore in patients wearing contact lenses were Chinese race, increasing age, not washing hands before handling contact lenses, occasional overnight wear and use of multipurpose type lens care solution.³⁰

Saw *et al.*³¹ found that ReNu with MoistureLoc significantly increased the risk of *Fusarium* keratitis and the risk was five times higher compared with the risk with use of ReNuMultiPlus, a multipurpose solution ($P < .001$). A cluster of *Fusarium* keratitis in 12 patients that used the Bausch & Lomb ReNuMostureLoc contact lens solution was reported by Rao *et al.*³² from Hong Kong. These two episodes highlight the need for clinical vigilance when dealing with corneal infiltrates in contact lens users.

Pathogens isolated in contact lens related microbial keratitis

Dyavaiah *et al.*³³ in their review article summarized various organisms isolated from the corneal scraping, contact lens solution and contact lens storage cases in different types of contact lens related microbial keratitis reported in the literature. Athmanathan *et al.*³⁴ reported herpes simplex virus antigen in a contact lens wearer who presented with a stromal infiltrate and small perforation where Giemsa stain showed multinucleated giant cells which gave a clue to the diagnosis.

Although United States Food and Drug Administration (USFDA) has approved continuous wear for 30 days of silicone hydrogel soft contact lenses, Lee and Lim³⁵ reported growth of *Pseudomonas aeruginosa* from the scrapings of corneal ulcer in a woman who wore it continuously for 26 days. She had gone water jet skiing and diving with her contact lenses. The case reported shows that sight-threatening microbial keratitis can still occur even with silicone hydrogel soft contact lenses.

Although Fungal Keratitis is rare among contact lens wearers, there was an outbreak of *Fusarium* species in Singapore nationwide from March 2005 through May 2006, estimated annual national incidence is 2.35 cases per 10,000 contact lens wearers.³⁶ In a study of infectious keratitis associated with contact lenses over a five year period, a total of 35 strains of bacteria were detected viz. gram-positive bacteria (82.9%), gram-negative bacteria (5.7%), fungi (8.6%) and acanthamoeba (2.9%).³⁷

In a review, the microbiological profile of ulcerative keratitis associated with culture proven contact lens (CL) associated microbial keratitis, Bharathi *et*

al.³⁸ from India reported that Gram-negative bacilli alone were recovered from the corneal scrapes of all 35 (100%) patients; *Pseudomonas aeruginosa* (71.43%) was isolated significantly higher ($P < 0.001$) from eyes with contact lens associated keratitis than other bacterial isolates (28.57%). They concluded that microbial contamination of contact lens storage cases was a great risk for gram-negative bacterial infection among soft contact lens wearers.

In a study of contaminants of contact lenses and accessories in Hong Kong, Yung et al.³⁹ reported that 9% of samples taken from the contact lenses, 34% from storage case and 11% from contact lens solutions were contaminated with ocular pathogenic microorganisms. *Serratia spp.*, *Staphylococcus aureus* and coagulase-negative *staphylococci* were the most common microorganisms isolated.

In a retrospective study of 57 eyes with infectious keratitis associated with contact lens wear, single organism was isolated from 39 out of 80 (48.7%) specimens—32 from corneal scrapings, 3 from contact lens and 4 from contact lens solution; while multiple organisms were isolated from 41 (51.3%) specimens (24 contact lens and 17 contact lens solutions). Fungus or acanthamoeba were not isolated from any of the specimens. *Pseudomonas aeruginosa* was the most common organism isolated (63 out of 80 specimens or 78.7%).¹¹

In a study of 10 cases of contact lens related severe, partially treated corneal ulcer, referred to a tertiary center, Subrayan et al.⁴⁰ reported that there was no significant difference between Polymerase Chain Reaction (PCR) and culture in detecting *P. aeruginosa* ($P < 0.05$). They concluded that PCR is as good as conventional cultures in detecting *P. aeruginosa*. However, it is a rapid assay as compared with culture and early detection enables prompt treatment thus reducing the destructive effect of the organism on the cornea.

Ali et al.⁴¹ reported a case of polymicrobial infection in a bilateral simultaneous infectious keratitis secondary to contact lens wear in which growth of *Pseudomonas aeruginosa*, *Alcaligenes* species and *Flavobacterium meningosepticum* were isolated, while Lekhanont et al.⁴² reported a rare case of *Pythium insidiosum* contact lens related cornea ulcer.

Among 13 patients (mean age 19 ± 3.8 years) who presented with microbial keratitis after coloured cosmetic contact lens wear, Singh et al.⁴³ reported *Pseudomonas aeruginosa* (54%), *Staphylococcus aureus* (25%), and *Staphylococcus epidermidis* (17%) as causative organisms and one case of viral keratitis.

A rare polymicrobial keratitis involving *Chryseobacterium meningosepticum* and *Delftia acidovorans* in a cosmetic contact lens wearer (a 14-year-old girl, who purchased contact lenses online) was reported by Ray and Lim.⁴⁴

Daily disposable soft contact lenses theoretically are believed to have a lower risk of infectious keratitis compared with other lens wear regimens. However, Su et al.⁴⁵ have reported *Pseudomonas aeruginosa* infection in a 34-year-old woman who had been using daily disposable soft contact lenses for 18 months and another case of *Staphylococcus aureus* infection in a 30-year-old woman who had been using conventional soft contact lenses for five years before switching to daily disposable soft contact lenses three months before presentation. They suggest that these lenses should be prescribed and used with great care to minimize contact lens-related infectious keratitis.

Venkata et al.⁴⁶ reported isolation of *Pseudomonas aeruginosa*, *Aeromonas* species and alpha-hemolytic *Streptococci* from daily-wear monthly-replacement soft contact lenses.

Pathogens isolated from contact lens care solutions and contact lens storage cases

Bharathi et al.³⁸ found bacterial growth in all 70 (100%) CL storage cases and also from CL-care solutions of six of the 35 patients (17.14%). In another study of 57 eyes with infectious keratitis associated with contact lens wear, Reddy and Tajunisha¹¹ reported that bacterial pathogens were isolated from 26.2% contact lens solution specimens. All 12 patients with unilateral *Fusarium* keratitis, used ReNuMostureLoc contact lens solution.³² Most contact lens patients in an outbreak of *Acanthamoeba* keratitis also reported using a complete brand multipurpose solution before infection.⁴⁷ *Pseudomonas aeruginosa* strains in cases of infectious keratitis associated with CL wear isolated in contaminated CL storage cases.⁴⁸ Positive cultures

in 68% from contact lens solutions and in 39% from contact lens cases were reported by Konda *et al.*⁴⁹

Coloured contact lenses from unauthorized providers

Young emmetropic individuals wear coloured contact lenses and sometimes they share the same among themselves. Singh *et al.*⁴³ from India in their study of 13 individuals who were emmetropic with microbial keratitis after wearing coloured cosmetic lens, found that they did not follow the recommended handling and storage technique; 7 lenses were dispensed without prescription or fitting from an unlicensed optical shop; 5 patients had shared lenses with friends/relatives and 1 patient obtained the lens from the garbage. They concluded that easy and unmonitored availability of these cosmetic lenses is followed by severe sight-threatening complications in young emmetropic individuals.

Ayesha *et al.*⁵⁰ from Malaysia reported two cases of contact lens related corneal ulcers in 21 year and 19-year-old women who purchased contact lenses from night markets, with final vision after treatment 6/60 and 6/24, respectively. Colored non-corrective contact lenses are being dispensed without a prescription or fitting from unlicensed vendors. Patients who acquire lenses from unauthorized providers are less likely to be instructed on appropriate lens use and care. Consequently, uninformed lens wearers are experiencing acute vision-threatening infections and inflammation.

In a retrospective study of 141 patients who complained discomfort after wearing contact lens, Li *et al.*⁵¹ from China reported that dry eye (36.88%) was the most common complication followed by superficial punctate keratitis (36.17%), blepharitis and Meibomian gland dysfunction in 31.9% of cases. They advised that lid margin and meibomian gland should be paid attention before contact lens prescription.

Contact lens registry

It is always better to have a contact lens registry in every country wherein all the computerized data about the use of contact lenses and their complications is available at one place. Malaysia has established a national registry of contact-lens related

corneal ulcers (CLRCU) in 2007 to monitor contact lens induced corneal ulcer outbreaks, identifying pattern of causative organisms, determining patient demography, risk factors, wearing patterns and monitoring outcome of treatment.

From the data available from CLRCU during 2007-2008, Goh *et al.*⁵² reported that a total of 202 young patients were notified and all patients wore soft contact lens and monthly disposable lenses were the most popular (83.5%). The majority of patients had bacterial CLRCU and the most common causative organism was *Pseudomonas* (79.7% of bacterial cases). No epidemics were identified during the period of data examination. This provides the ability to monitor outbreaks of disease and identify important causative and associated factors of the disease, which may be used to reduce future incidence.

Preventive measures for contact lens related microbial keratitis

Proper practice of the following of contact lens wear and care meticulously will help in reducing the microbial keratitis: (1) Thorough washing of hands with water and soap before wearing and removing them, (2) Removing contact lenses during sleep to reduce 4-5 times increased risk of susceptibility of infection, (3) Rubbing the contact lenses with a clean finger and rinsing them with disinfecting solution to remove the deposits and microbes from the contact lenses, (4) Replacement of contact lenses in the scheduled time as recommended by the doctors/manufacturers, and (5) Avoid mixing the fresh contact lens disinfectant solution with already used solution remaining in the bottle to minimize contamination.

Conclusion

Contact lenses used for variety of reasons ranging from refractive errors to cosmetic reasons are major source of corneal ulcers. The source of infection can be from the lens, casing or solutions. *Pseudomonas aeruginosa* and *Fusarium* are the most common bacteria and fungus isolated in these cases. People who purchase contact lenses from unauthorized providers and who are not careful on techniques of cleaning and wearing them are at higher risk for corneal infection. Awareness of contributory

risk factors for microbial keratitis in contact lens wearers and practice of safer lens wear modalities and hygiene regimes will minimize possible corneal infection.

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