Contact Lens - Related Microbial Keratitis

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Objective: *To review the clinical and microbiological profile in patients with contact lens-related microbial keratitis (CLRMK)*

Material and Method: *Hospital records of 435 patients with a diagnosis of microbial keratitis seen at Ramathibodi Hospital from January 1998 to December 2002 were retrospectively reviewed. All patients with CLRMK were included in the present study.*

Results: *Of the 435 cases, 81 (18.6%) were related to contact lens use. The disposable or frequent replacement of lenses were the most common lens-wearing type. Thirty-four percent of patients did not practice proper contact lens care and 67% wore contact lenses overnight. Corneal cultures were performed in 58 of 81 cases (72%) and were positive in 42 of 58 cases (72%). Pseudomonas aeruginosa was the most common organism (59%), followed by Klebsiella pneumoniae (11%). Polymicrobial infection was found in 19 cases. Most of the patients responded to medical treatment that led to the healing of ulcers whereas four patients required therapeutic penetrating keratoplasty. Most of the organisms were sensitive to antibiotics. After treatment, 43% of the patients have continued contact lenses-wearing.*

Conclusion: *CLRMK remains an essential problem in Thailand. Soft contact lens wear and overnight wearing seem to be the most important risk factors. Although the treatment outcome with medical therapy is good, keratitits may result in loss of vision. Ophthalmologist should warn contact lens wearers of this potential problem and instruct them on how to care for their lenses.*

Keywords: *Contact lens, Microbial keratitis, Infection*

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Worldwide, approximately 100 million people use contact lenses as an alternative to spectacles (1.6% of the world's population)[1]. As the contact lens market continues to grow, public health issues associated with contact lens use has become of increasing importance. Infectious keratitis is the most devastating complication of contact lens wear and may result in permanent visual loss from corneal scarring or perforation. Contact lens wear has become the most significant risk factor for corneal ulceration in patients with previously healthy eyes.

With the widespread use of contact lenses for cosmetic and optical advantages in Thailand, the public health risks associated with contact lens is still an area of concern. Despite advances in lens design and materials, infectious keratitis related to contact lens wear remains a vision-threatening problem. Insufficient knowledge of proper lens handling and use may be the important factor. The purpose of the present study was to obtain more information of contact lens related microbial keratitis in Thai patients. The authors conducted a retrospective study to review the clinical and microbiological characteristics of contact lens related microbial keratitis (CLRMK) in patients treated at the department during a 5-years period.

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Material and Method

Medical records of 435 patients with a diagnosis of microbial keratitis seen at Ramathibodi Hospital from January 1998 to December 2002 were reviewed retrospectively to search for individuals associated with contact lens use for enrollment in the present

study. Microbial keratitis was defined as an infection of the cornea characterized by a disruption of the corneal epithelium associated with an underlying inflammatory infiltrate of the corneal stroma. The present study was approved by the Medical Ethics Committee of Ramathibodi Hospital, Mahidol University.

Eighty-one patients with CLRMK were entered in this retrospective study (18.6% of all microbial keratitis). Collecting data included demographic data, history of contact lens wear, presenting signs and symptoms, underlying systemic and ocular disease, microbiologic result, management strategy, and visual outcome. A telephone call to the patient was attempted to complete information.

Details of contact lenses were evaluated for the type of contact lens (conventional, frequent replacement, disposable, rigid gas permeable) and the pattern of lens wear and care. Disposable lenses referred to lenses used for extended wear or daily wear and discarded after only one use. Frequent replacement lenses referred to those used for daily or extended wear and discarded after 2 to 12 weeks. Regarding the lens hygiene practice, patients were classified into standard or substandard lens care. The standard contact lens care regimen was as follows: for daily wear, disinfection and cleaning daily before reinsertion and enzymatic cleaning at least once per week; for extended wear, disinfection and enzymatic cleaning at least once per week; for disposable, discarding lens after length of time recommended by the manufacturer; and for rigid gas permeable, disinfection daily.

Previous ocular disease, history of swimming using contact lens, and a history of previous treatment were recorded. The size of the lesions in the longest meridian was measured in millimeters. Location was judged from diagrams in the hospital notes; peripheral lesions had their center within 1 mm of the limbus, central lesions overlapped the central 4 mm of the cornea, and midperipheral lesions were the remainder. The presence of hypopyon was noted.

Corneal smears and culture were performed for patients with a lesion greater than 1 mm in diameter or when the ulcers were not responding to initial treatment. Cultures were obtained primarily from corneal scraping using a sterile blade or Kimura spatula with topical anesthesia. Contact lenses or the lens-care products were also cultured when available. The collected material was streaked over the surface of a blood agar plate, chocolate agar plate, thioglycolate plate for bacterial growth and Sabourad' s dextrose agar plate for fungal growth. Selective media for Acanthamoeba was used for patients with suggestive clinical characteristics. Culture and sensitivity were reviewed.

The decision to admit patients and the use of antibiotics were influenced by the severity of the keratitis, based on an overall clinical impression and the ability of the patient to instill antibiotic eye drops. Eye drops were administered alternatively every hour or more frequently. The treatment was progressively tapered and/or modified according to the clinical response and the bacteria susceptibility. Best-corrected visual acuity was determined in the affected eye at the initial visit and the last visit. To define the visual outcome, patients were considered to have a poor outcome if they had visual loss of acuity of one or more from the level of initial examination or if a major complication occurred, such as corneal perforation, or if they underwent penetrating keratoplasty. Frequency tables present the results.

Results

Clinical characteristics

There were 54 females and 27 males diagnosed with CLRMK in the present study. The male-to-female ratio was 1:2. The average age was 26 years, ranged from 9 to 67 years. Only four patients had significant medical histories including one of hypertension, two of asymptomatic HIV infection, and one of acne rosacea.

Thirty-nine cases involved the right eye, 38 involved the left, and four were bilateral. All patients had more than one presenting symptom including irritation in 65% of cases, red eye in 60%, ocular pain in 52%, and decreased vision in 51%. The average size of ulcer was 2.5 mm, ranged from 0.5 to 7.5 mm. The diameter of the ulcer was of 1 mm or less in 29%, 1-2 mm in 24%, and over 2 mm in 47%. The lesions were central in 47%, midperipheral in 25%, peripheral in 25%, and discrete in 3%. Hypopyon was presented in 16 cases (20%). Diminished visual acuity at presentation was found in 90% of patients. The degree of visual deficit ranged from 20/30 to light perception. Half of the patients had visual acuity equal or worse than 20/200.

Most of the patients (60%) obtained their contact lenses from a general optical shop. Only 17% of patients were prescribed by ophthalmologists. Twenty-six patients used conventional daily/extended wear soft contact lenses, 52 used disposable/ frequent replacement lenses, and three used rigid gas permeable lenses. Sixty-four patients (90%) used contact lenses for refractive correction, four used them for therapeutic purposes (3 for corneal abrasion and 1 for persistent epithelial defect), two for cosmetic reasons

and one had contact lenses for orthokeratology, a process by which the corneal curvature is flattened by sequentially fitting rigid gas permeable contact lenses of decreasing central curvature.

Information regarding lens care was obtained in 56 of 81 cases (69%). Thirty-four percent of patients (19 of 56) did not practice proper contact lens care. Among these 19 cases, 14 cleaned and disinfected the lenses less often than the standard regimen and five never disinfected their lenses. Of these five patients who never used disinfectant, three used normal saline, one used special mouthwash, and one used drinking water for lens cleaning. Eighty percent of the patients (45 of 56) wore contact lenses more than 12 hours during daytime, two wore their lenses while swimming, and 67% (46 of 69) of patients had a history of overnight lens wearing.

Microbiological characteristics

Cultures were performed in 58 of 81 cases (72%). Identification of the organism by positive culture was obtained in 42 patients (72% identification rate). Micro-organisms were isolated from corneal scraping culture in 79% (33 of 42) and from storage solutions and contact lenses in 57% (24 of 42). In 38% (9 of 24) of the culture positive solutions and contact lenses, corneal scraping was negative. The bacteria isolated from solutions and contact lenses were similar to the organism recovered by corneal scraping in 13 cases (87%).

In total, 63 different organisms were isolated. Of the 63 isolated, 55 (87%) were gram-negative bacteria, four (6%) were gram-positive bacteria, three (5%) were acanthamoeba species, and one (2%) was fungus. The identified causative organisms and their relative frequencies are shown in Table 1. Pseudomonas aeruginos a was the most common isolate, found in 37 cases (59% of all isolates) and Klebsiella pneumoniae was the second most common isolate. Nineteen cases (12%) were mixed infections with 2 or 3 organisms isolated in each culture.

In culture-positive cases, information regarding *in vitro* sensitivity tests was recorded in 31 of 42 (74%). All of the gram-negative bacteria including, Pseudomonas, Klebsiella, Escherichia, Serratia, and Enterobacter species were found to have in vitro susceptibility to gentamicin, amikacin, ofloxacin, and ceftazidime.

Treatment and clinical outcome

Forty-five patients (56%) were admitted to the hospital for therapy, while the other 36 (44%) were treated in the outpatient clinic. The average duration of admission was 13 days, range from 7 to 60 days. Initial therapy consisted of antimicrobial eye drops without corticosteroids in all the cases. It was based on patient history, clinical features, organism identification. Fortified antibiotics (gentamicin or amikacin or ceftazidime and/or cefazolin) were used in 41 cases (50%) whereas commercially available antibiotics (ciprofloxacin and/or tobramycin) were administered in 40 cases (50%). The three acanthamoeba cases were treated with topical biguanide and brolene. The medical treatment was successful for 79 patients, while four patients required additional surgical treatment. Penetrating keratoplasty was needed to control infection in these patients; two had acanthamoeba infection, one had streptococcal Infection and one had culture-negative result.

Ninety percent of the patients had visual acuity better than the level at admission. Half of these patients achieved final best-corrected visual acuity of 20/40 or better. Only 12 patients (15%) had a poor visual outcome. There was no significant difference in median final visual acuity between overnight wearing and non-overnight wearing group (median final visual acuity 20/40 in the two groups). Analysis of the 56 patients who had information of lens care also showed no significant difference in final visual acuity between

Table 1. Microbiologic result (n = 81)

Organism	Number
Gram-negative bacteria	55
Pseudomonas aeruginosa	37
Klebsiella pneumoniae	7
Enterobacter spp.	5
Serratia marcescens	3
Acinetobacter calcoaceticus	2
Escherichia coli	1
Gram-positive bacteria	4
Staphylococcus aureus	1
Staphylococcus coagulase-negative	1
Streptococcus pneumoniae	1
Propionibacterium acnes	1
Fungus	1
Aspergillus	1
Acanthamoeba	3
Total	63*

* Total number is more than 42 because of cases with polymicrobial infection polymicrobial infection

the two groups regarding proper or improper lens care. Thirty-five patients have continued to wear contact lenses after treatment.

Discussion

In the USA, some studies have demonstrated a downward trend in CLRMK[2,3], however it remains an essential problem in Thailand. CLRMK accounted for 11.5% of all microbial keratitis treated at the institute in 1998, 20.6% in 1999, 13.5% in 2000, 17.8% in 2001, and 25.8% in 2002. The overall percentage of CLRMK in this 5 years study (18.6%) was higher than previous reports (5%)[4].

The majority of patients (64%) with microbial keratitis in the present study used disposable or frequent replacement lenses. Disposable contact lenses have been recommended and marketed for their presumed safer and more convenient alternative to the conventional soft contact lens, however this type of lens can not eliminate problems with corneal infections[5]. The incidence of ulcerative keratitis has been shown to be greater in patients who wear disposable or extended-wear soft contact lenses than in those who use conventional daily-wear soft, gas permeable, or hard contact lenses. The potential reasons may be due to poorer compliance with lens care regimens because of the patient's perceived lack of need for cleaning and for disinfecting these disposable products. There may be relatively greater corneal hypoxia and corneal edema or a higher propensity of the diposable contact lens to harbor deposits, bacteria, and biofilm[6]. It is possible that disposable contact lens users will wear their lenses overnight more frequently than conventional lens users. There is possibly a financial incentive to do this.

Sixty-seven percent of the present patients have found evidence of overnight lens wearing. Overnight wear of contact lenses has been shown to be the most significant risk factor associated with microbial keratitis[7,8]. The risk of infection increases 10-20 times in soft lens wearers when the lenses are worn overnight[7]. Pathogenesis of microbial infection during overnight wear is probably caused by a combination of factors including reduced corneal resistance caused by hypoxia, the introduction of large numbers of pathogenic microorganisms, bacterial adherence, marked reduction in tear secretion, and a stagnant tear layer behind the lens that interferes with the eye's normal protective inflammatory mechanism[1,6]. These processes are triggered during periods of prolonged eye closure.

A patient in the present study developed microbial keratitis during the process of overnight orthokeratology, the programmed application of rigid gas-permeable contact lenses that has been proposed as an effective way to temporarily reduce myopia[9]. These contact lenses are worn overnight; allowing the patient to achieve improved uncorrected visual acuity during the day. Over the last five years, there has been a growing number of reports of microbial keratitis in association with overnight orthokeratology[10]. In many of these case reports, the final visual acuity was significantly diminished. Although orthokeratology was not widely promoted in Thailand, it is still used in some contact lens wearers and frequently prescribed to children and teenagers. The potential complications of this treatment can be vision threatening and should not be overlooked.

Although overnight wear is the major risk factor, improper lens care has been frequently associated with microbial keratitis. Several studies demonstrated that 40-70% of patients wearing contact lenses were non-compliant with recommended care regimens[11,12]. Bowden et al stated that 88% of patients with culture-positive CLRMK failed to follow standard lens care instructions[13]. In the present study, the authors observed that 34% of patients did not practice proper lens care whereas 66% of patients who followed proper instructions for lens usage still developed microbial keratitis. This is similar to a recent study[14] by Najjar et al that demonstrated that standard lens care hygiene does not seem to be sufficient in preventing the development of microbial keratitis in patients using soft contact lenses.

Cultures were positive in 72% (42 of 58) of the overall sample in the present study. The identification rate in previous reports varied between 43 and 76%[15-17]. This rate might have been decreased by the application of topical anesthetic before corneal scraping. The authors identified that microorganisms can be isolated from contact lens and storage solutions with high positive yield (57%). In these groups, 38% had negative culture from corneal scraping and the bacteria isolated were similar to the organism recovered by corneal scraping in 87%. It seems important to culture contact lenses and contact lens storage solutions, in addition to corneal scraping.

Although some recent studies have found a high incidence of gram-positive isolates from contact lenses related microbial keratitis and there seemed to have been a decreasing number of Pseudomonas sp infection[2,18,19], only 6% of the presented patients had

culture-positive, gram-positive bacteria. The present findings and many previous published reports confirm that Pseudomonas aeruginosa remains the organism most frequently isolated from [2,15-17]. This may be attributed to the finding that Pseudomonas species can survive in the moist environment offered by the contact lens storage cases and solutions and have affinity to destroy the cornea. The authors found a significant number of polymicrobial infection in the present study. In 37 cases of pseudomonas infection, 17 had other culture-positive, gram-negative bacteria including Escherichia coli, Acinetobacter calcoaceticus, Klebsiella pneumoniae, Serratia marcescens, and Enterobacter. Two cases had pseudomonas and acanthamoeba infection. Although the increasing resistance of Pseudomonas sp isolates to the fluoroquinolones has been documented in several reports[20,21], the authors did not find in vitro or in vivo resistance in the present series.

Although Klebsiella pneumoniae is a common and serious cause of endogenous endophthalmitis, it is a rare cause of microbial keratitis, usually in debilitated or immuno-compromised patients or in corneas with an underlying pathologic condition[22]. There have been a few case reports of Klebsiella keratitis complicating contact lens use[23,24]. The keratitis from this organism may be severe and result in corneal melting and perforation[24]. In contrast to other studies[5,25,26], Klebsiella pneumoniae was the second most common organism, and accounted for 4% of the isolates in the present study. There was no resistance of Klebsiella pneumoniae to aminoglycoside or fluoroquinolone in the vitro study. Six of seven patients (86%) achieved good vision with visual acuity better or equal to 20/70. There were only three biopsy-proven cases of Acanthamoeba keratitis in the present series, nevertheless, acanthamoeba continues to be a pathogen of concern because the presented cases are associated with poor visual outcome. All of these patients had visual acuity worse than 20/200 and two of them underwent therapeutic penetrating keratoplasty.

The issue of refitting contact lens in eyes with previous microbial keratitis is controversial. It may be safe and useful in order to achieve visual rehabilitation[27]. The decision to resume contact lenses was made on an individual basis, taking into account risk factors for the development of previous infection. Corneal irregularity and flattening in the area of the scar also create a problem for contact lens fitting. Daily-disposable lenses, worn a single day and then discarded, should be encouraged in this group of patients. Thirty-five of 81 patients (43.2%) in the present study have continued to wear contact lenses. All patients had an agreement to use contact lenses on a daily-wear basis and conform strictly to recommended contact lens care. However, the authors did not have long-term follow up data in this group of patients.

Conclusion

CLRMK remains a vision-threatening ocular condition. Soft contact lens-wear, and overnight-wearing seem to be the most important risk factors. Although the treatment outcome with medical therapy is good, the keratitits may result in loss of vision. Ophthalmologists should warn contact lens wearers of this potential problem and instruct them on how to care for their lenses.

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ภาวะกระจกตาติดเชื้อจากการใส่เลนส์สัมผัส

พิศิษฐ์ ปรีชาวัฒน์, อุษา รัตนานิคม, รุ่งโรจน์ เลิศวิทยาสกุล, สกาวรัตน์ คุณาวิศรุต

วัตถุประสงค์: *เพื่อศึกษาลักษณะทางคลินิกและจุลชีววิทยาในผู้ป่วยกระจกตาติดเชื้อจากการใส่เลนส์สัมผัส*

วัสดุและวิธีการ: *ศึกษาข้อมูลย้อนหลังจากเวชระเบียนผู้ป่วยที่ได้รับการวินิจฉัยว่าเป็นกระจกตาติดเชื้อ ตั้งแต่เดือนมกราคม พ.ศ. 2541 จนถึง เดือนธันวาคม พ.ศ. 2545 จำนวน 435 ราย เฉพาะผู้ป่วยที่มีประวัติการใช้เลนส์สัมผัสจึงจะนำเข้ามาในการศึกษานี้*

ผลการวิจัย: *ผู้ป่วยจำนวน 81 ราย (18.6 เปอร์เซ็นต์) พบว่า กระจกตาติดเชื้อเกี่ยวข้องกับการใช้เลนส์สัมผัส ชนิดของเลนส์สัมผัสที่พบว่ามีการใช้มากที่สุดเป็นแบบนิ่มชนิดเปลี่ยนเป็นระยะ 34 เปอร์เซ็นต์ของผู้ป่วยพบว่าขั้นตอนในการดูแลรักษาเลนส์สัมผัสไม่ได้มาตรฐาน 67 เปอร์เซ็นต์มีประวัติการใส่เลนส์ขณะนอนหลับในเวลากลางคืน ได้ทำการเพาะเชื้อจากการขูดแผลที่กระจกตาในผู้ป่วย 58 ราย ในจำนวนนี้ 72 เปอร์เซ็นต์สามารถพบเชื้อที่เป็นสาเหตุ Pseudomonas aeruginosa เป็นชนิดของเชื้อที่พบได้บ่อยที่สุด คือ 59 เปอร์เซ็นต์ รองลงมาคือ Klebsiella pneumoniae 11 เปอร์เซ็นต์ พบว่ามีผู้ป่วยจำนวน 19 ราย ที่ผลการเพาะเชื้อพบการติดเชื้อหลายชนิดร่วมกัน ผู้ป่วยโดยส่วนใหญ่ตอบสนองดีต่อการรักษาด้วยยาหยอด มีเพียง 4 รายที่การติดเชื้อลุกลามจนต้องทำการผ่าตัดเปลี่ยนกระจกตา ผลการตรวจความไวของเชื้อแบคทีเรียต่อยาปฏิชีวนะในห้องปฏิบัติการโดยส่วนใหญ่ไม่พบว่ามีการดื้อยา ภายหลังการรักษาสิ้นสุด ผู้ป่วยจำนวน 43 เปอร์เซ็นต์ยังคงเลือกที่จะใช้เลนส์สัมผัสต่อ*

สรุป: *ภาวะกระจกตาติดเชื้อจากการใส่เลนส์สัมผัสยังคงเป็นปัญหาที่สำคัญในประเทศไทย การสวมใส่เลนส์สัมผัสชนิดนิ่ม และใส่เลนส์ขณะนอนหลับในเวลากลางคืน เป็นปัจจัยเสี่ยงที่สำคัญ ถึงแม้ผลการรักษาภาวะกระจกตาติดเชื้อชนิดนี้ด้วยยาหยอดโดยส่วนใหญ่จะได้ผลดี แต่ก็อาจทำให้เกิดการสูญเสียการมองเห็นตามมาได้ จักษุแพทย์ควรมีบทบาทสำคัญในการชี้ ให้เห็นถึงอันตรายของภาวะนี้ และให้คำแนะนำในการดูแลรักษาเลนส์ที่ถูกต้องแก่ผู้ที่ใช้เลนส์สัมผัส*