

Acanthamoeba Keratitis: Character and outcome of treatment in tropical area

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บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาทบทวนอาการแสดงทางคลินิก ปัจจัยเสี่ยง วิธีการ และผลการรักษาผู้ป่วยกระจกตาติดเชื้อ Acanthamoeba (Acanthamoeba keratitis, AK) ในภูมิภาคร้อนชื้น

รูปแบบ: การศึกษารายงานย้อนหลังในกลุ่มศึกษา แบบไม่เปรียบเทียบ

กลุ่มศึกษา: ผู้ป่วยโรคกระจกตาติดเชื้อจาก Acanthamoeba ในโรงพยาบาลรามาริบัติ

วิธีการวิจัย: การศึกษาย้อนหลัง รายงานทางการแพทย์ของผู้ป่วยกระจกตาอักเสบติดเชื้อ Acanthamoeba จำนวน 7 ราย รวม 10 ตา ในช่วงระยะเวลา 10 ปี ตั้งแต่ พ.ศ. 2541-2551 โดยการเก็บและวิเคราะห์ข้อมูลอาการแสดงทางคลินิก ปัจจัยเสี่ยง การรักษาเบื้องต้น ระยะเวลาที่ใช้ในการวินิจฉัย วิธีและผลการรักษา

ผลการวิจัย: ในจำนวนผู้ป่วย 7 ราย ทั้งหมดมีประวัติการใช้เลนส์สัมผัสชนิดนิ่ม โดยพบการเกิดโรคในตาทั้ง 2 ข้าง ถึง 3 ใน 7 ราย โดยในจำนวนนี้ พบ 2 รายมีปัจจัยเสี่ยงร่วมกันที่สำคัญ คือ ใช้น้ำประปาล้างทำความสะอาดเลนส์สัมผัส พบว่าผู้ป่วยมีความรุนแรงของอาการปวดและระคายเคืองได้แตกต่างกันไปในแต่ละราย โดยมีเพียง 2 ใน 7 รายที่มีอาการเจ็บปวดอย่างรุนแรงไม่สัมพันธ์กับลักษณะรอยโรคที่ตรวจพบ

อาการแสดงหลักที่พบ ได้แก่ superficial punctuate keratitis (SPK) และ stromal infiltration ส่วน radial perineuritis พบได้ 2 ราย สายตาเริ่มต้นที่พบมีตั้งแต่ 20/25 ถึง HM ระยะเวลาตั้งแต่เริ่มมีอาการจนพบอาการแสดงแรกตั้งแต่ 3 วัน ถึง 2 อาทิตย์ ระยะเวลาตั้งแต่เริ่มตรวจที่โรงพยาบาลรามาริบัติจนได้รับการวินิจฉัยโรคที่แน่นอน ตั้งแต่ 5 ถึง 50 วัน โดยการวินิจฉัยส่วนใหญ่ได้จากผลการเพาะเชื้อ ยกเว้น 1 รายที่ได้จากผลการตรวจพบ Acanthamoeba cyst ในการตรวจชิ้นเนื้อทางพยาธิวิทยา

การรักษาหลักประกอบด้วย การหยอดตา PHMB (0.02%), Brolene และ กิน Itraconazole 100 mg. 2 ครั้งต่อวัน การรักษาเพิ่มเติมซึ่งแตกต่างกันไปตามผู้ให้การรักษา ประกอบด้วย การหยอด Ketoconazole (2%) Spersapoly myxin และการจี้แผลด้วย Betadine (5%) มีการรักษาด้วยการผ่าตัดเปลี่ยนกระจกตา (Therapeutic penetrating keratoplasty) ใน 3 ราย แต่กระจกตาที่เปลี่ยนไปขึ้นในที่สุตทั้งหมด

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ภาวะแทรกซ้อนที่พบได้แก่ corneal scar (ทุกราย), cataract (3 ราย), secondary glaucoma (1 ราย) และ การกลับเป็นซ้ำหลังการผ่าตัดเปลี่ยนกระจกตา (1 ราย) ภายหลังการรักษาและฟื้นฟูพบว่า ผู้ป่วย 4 ใน 7 ราย มีภาวะสายตาดูดีขึ้นอยู่ในระดับ 20/20 ถึง 20/40 ขณะที่อีก 3 รายที่เหลือมีสายตาแย่งอยู่ในระดับ 20/100 ถึง HM จากแผลเป็นที่กระจกตา และ graft failure ระยะการติดตามจนสิ้นสุดการรักษานานตั้งแต่ 4 ถึง 87 เดือน โดยไม่มีผู้ป่วยรายใดสูญเสียดวงตา

สรุป: กระจกตาดูดเชื้อ Acanthamoeba เป็นหนึ่งในโรคติดเชื้อที่รุนแรงของกระจกตา และนำไปสู่การสูญเสียการมองเห็นได้ หากไม่ได้รับการวินิจฉัยที่รวดเร็ว รวมถึงการรักษาที่เหมาะสม ดังนั้น การตระหนักถึงอาการแสดงและการดำเนินโรคที่หลากหลาย จึงเป็นสิ่งจำเป็น **จักษุเวชสาร 2553; มกราคม-มิถุนายน 24(1): 26-36.**

Acanthamoeba Keratitis: Character and outcome of treatment in tropical area



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Abstract

Aim: To review the clinical manifestations, risk factors, treatment and outcome of patients with *Acanthamoeba* keratitis (AK) represented in a tropical area.

Design: Retrospective, non-comparative case series.

Participants: Seven consecutive patients with AK presented at Ramathibodi Hospital, Faculty of Medicine, Mahidol University.

Methods: Retrospective review of medical records from 10 eyes of 7 patients with AK within 10 years between 1998 to 2008. Clinical manifestation, risk factors, previous treatment, time to diagnosis, treatment and outcome were recorded and analyzed.

Results: Of the 7 patients, there were 3 accountants, 1 pharmacist, 1 missionary, 1 military and 1 student. All had a history of soft contact lenses wear. In 3 of 7 patients who developed bilateral disease, 2 cases reported a significant risk factor from washing the eyes with tap water. Variable severity of ocular pain and irritation were presented. However, characteristic remarkable pain disproportionate to clinical signs was presented in only 2 of the 7 patients. Superficial punctate keratitis (SPK) and stromal infiltration were the main clinical manifestations, while radial perineuritis was present in 2 patients. The presenting visual acuity (VA) ranged from 20/25 to HM. Time from the onset of symptoms to the first presentation ranged from 3 days to 2 weeks. Time from the first presentation at our hospital until the diagnosis was made ranged from 5 days to 50 days. The diagnosis of most patients was based on positive culture specimens (with only one from pathological study of excised cornea which revealed *acanthamoeba* cyst). Main treatment was combined

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instillation of PHMB (0.02%) and Brolene[®] and oral Itraconazole (100 mg twice daily). Additional treatment with topical ketoconazole 2%, Spersapolymyxin and lesion cauterization with Betadine solution[®] (5%) were given depending on the ophthalmologists in charge. Therapeutic penetrating keratoplasty (PK) was performed in 3 eyes followed by graft haziness. Complications related to AK were corneal scars (all eyes), cataracts (3 eyes), secondary glaucoma (1 eye) and recurrent diseases after therapeutic PK (1 eye). After visual rehabilitation, 4 in 7 patients (6 of 10 eyes) had significantly improved BCVA ranging from 20/20-20/40, while 3 in 7 patients had worsened VA of 20/100 to HM due to corneal haze and graft failure. At the end of the study, the duration of therapy ranged from 70 days to 273 days. The follow-up time ranged from 4 months to 87 months. None of the patients lost his/her eye.

Conclusion: Acanthamoeba keratitis is one of the most serious corneal infection which lead to visual disability without early recognition and aggressive management. Awareness in a variety of presentation and course of disease is necessary. **Thai J Ophthalmol 2010; January-June 24(1): 26-36.**

Keyword: Acanthamoeba keratitis

Introduction

Acanthamoeba keratitis (AK) is a rare but potentially devastating infection of the cornea. It was first described in 1974¹, and the reported incidence increased during the 1980s, in association with the rising popularity of contact lens wear. The incidence may vary based on region and contact lens practice. However, it was estimated in a prospective nationwide study in the UK to be 1.13-1.26 per million adults, and 17.53-21.14 per million contact lens wearers², while a study from the USA estimated the rate of 1.65-2.01 per million³. In the recent decade, fifty-five cases of AK were diagnosed in the Chicago area of the United States since June 2003 through the end of 2006. A contact lens cleaning solution (AMO complete moisture Plus multipurpose solution) was identified as risk factor for this outbreak⁴. Because *Acanthamoeba* forms a resilient, dormant, cyst phase in adverse environments, the treatment may be difficult. This led to a dismal prognosis before the development of effective amoebicidal treatment in the mid-1980s⁵ and early 1990s^{6,7}. Despite improvements in diagnosis and treatment, a protracted clinical course and severe visual loss still occur in over 15% of patients⁸. A high index of suspicion remains the most effective strategy in implementing early treatment, and enabling a favorable outcome. Since the 1980s, there have been large clinical series of AK reported worldwide - the majority is from Europe^{2,9}, Australia^{10,11} and America^{4,12-14}. Not many clinical series have been reported from Asian populations¹⁵ until the recent report from Singapore which was parallel to a similar outbreak in the United States¹⁶.

The first 2 cases of AK in Thailand were identified in 1988 and 1990^{17,18}. In this study, we present a retrospective review of patients with a diagnosis of AK treated at Ramathibodi Hospital, Bangkok between January 1, 1998, and January 1, 2008.

Patients and Methods

Ten eyes of seven patients with specific cultured proven AK were included in this study. Medical records of all patients were reviewed for the following features: age, gender, profession, predisposing risk factors, initial diagnosis, duration and treatments before AK diagnosis, duration of onset, clinical presentation, treatment and duration of treatment for AK, complications, surgical interventions, presenting and final visual acuity and length of follow-up. Laboratory data of patients were retrospectively identified by reviewing the microbiology laboratory records. The *Acanthamoeba* laboratory investigation included corneal scrapings, staining with gram and cultures on non-nutrient agar plates covered with *Escherichia coli* that were performed in the Department of Microbiology at the Faculty of Sciences, Mahidol University. Specimens suspected of bacterial or fungal infection were cultured on blood agar, chocolate agar, and/or sabouraud dextrose agar to be excluded from the study. Corneal tissue samples from penetrating keratoplasty were examined with hematoxylin-eosin stains and cultured for *Acanthamoeba*.

After the diagnosis of AK, treatment was hourly topical administration with polyhexamethylene biguanide (PHMB) 0.02% and propamidine isethionate (Brolene[®]; 3M Pharmaceuticals, Pymble, NSW, Australia) and oral administration with itraconazole (100 mg) twice daily. Topical administration with ketoconazole 2%, spersapoly myxin and lesion cauterization with Betadine solution[®] 5% were optional depending on the ophthalmologist in charge. The treatment was gradually tapered according to clinical response. Therapeutic penetrating keratoplasty was performed for poorly medical controlled cases and optical penetrating keratoplasty was done when the disease became quiet for at least 6 months.

Results

Seven patients (10 eyes) were identified with a diagnosis of AK over the 10-year study period (Table 1). The age of patients ranged from 20-52 years (mean, 26 years old), and five cases were female. Different professions were identified: 3 accountants, 1 pharmacist and 1 missionary, 1 military and 1 student. Four patients had unilateral involvement (1 right eye and 3 left eyes), and three patient had bilateral diseases. The follow-up time ranged from 4 to 87 months.

Predisposing factors

All patients were healthy soft contact lens (CL) wearers (2-week disposable lens in 3 patients, monthly disposable lens in 3 patients and one with cosmetic monthly contact lens). The cleaning system was composed of multipurpose and rinsing solution in all cases. An additional risk factor was identified in two of three bilateral patients (cases 1 and 7) who washed the eyes with tap water while wearing CL and finally developed bilateral AK. No other suspicious risk factors from contact lens care procedures were evident.

Presentation

Time from onset of symptoms to first presentation ranged from 3 days to 2 weeks with variable severity of ocular pain and irritation as the most common symptoms. A disproportionate severe pain was notified in just two of them. Of the 5 referral patients, 4 had been treated for SPK and another for bacterial keratitis. The initial BCVA at presentation to our hospital varied from 20/50 to HM. Epithelial defect, superficial punctuate keratitis (SPK), and stromal infiltration was the common signs. At presentation, a characteristic ring infiltration was evident in two of them while the identifiable keratoneuritis which is

strongly suspicious for diagnosis of AK and led to early treatment was recorded in two cases. Bacterial keratitis and herpes simplex keratitis (HSK) had been mistakenly diagnosed as initial diagnosis in 4 cases, while another one was misdirected to fungal keratitis. The interval from first presentation at our hospital to the diagnosis of AK ranged from 5-50 days.

Microbiology

Positive microbiological culture was obtained from the eye in all patients and 2 were also positive for *Acanthamoeba* cyst on smear. In medically refractory patients who received therapeutic penetrating keratoplasty (cases 1, 2 and 6), corneal tissue samples were submitted for pathology and demonstrated *Acanthamoeba* cyst and trophozoites.

Treatment

Initial treatment: Before the diagnosis of AK was made, 2 of 7 patients had been treated with fortified topical antibacterial for suspected bacterial keratitis. They had mainly been given oral acyclovir and topical 1% pred Forte(r) for suspected HSK; one with bilateral atypical clinical finding was misled to fungal treatment with topical amphotericin and natamycin for several weeks. Treatment for AK was initially given to two patients (cases 4 and 7) who presented with characteristic corneal lesions which led to better final outcome.

For AK treatment, all patients received topical treatment with polyhexamethylene biguanide (PHMB) 0.02%, propamidine isethionate and systemic therapy with itraconazole 100 mg twice a day. Five patients also received topical ketoconazole 2%, and four received topical spersapolymyxin. Treatment regimens began on an intensive, alternating hourly basis, continuously over 24 hours with subsequent gradual taper over the following weeks, according to the

Table 1

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7
Age (yrs)/Gender	27/F	25/F	33/F	20/M	25/F	52/M	19/F
Profession	accountant	pharmacist	accountant	missionary	accountant	military	student
Risk factors	CL-2-week, tap water	CL-monthly	CL-2-week	CL-2-week	CL-monthly	CL-monthly	CL-cosmetic, monthly, tap water
Eye involved	both	right	left	left	left	both	both
Rx before our hospital	SPK, Tobrex [*] , tears, steroid-2 months	none	SPK, tears-2 months	bacterial keratitis: ciprofloxacin (0.3%), Spersadexoline [*] -1 wk	none	persistent epithelial defect: Vigamox, tears-1 month	HSK: Flucon, ACV eo, ACV oral-3 weeks
At out hospital							
Presenting Symptoms	pain, irritation-3 days	pain, irritation-1 wk	swollen eye-10 days	pain-2 wks	irritation, decreased VA-4 days	irritation, decreased VA-1 wks	pain, irritation-1 wk
Severity of Pain	+++	+	+	+++	++	+	++
Signs	epithelial defect stromal infiltration	epithelial defect	epithelial defect stromal infiltration	ring filtration, perineuritis	pannus, SPK	epithelial defect ring filtration	SPK perineuritis
Initial diagnosis	bacterial keratitis	corneal abrasion HSK	atypical bacterial keratitis (ruled out AK)	suspected AK	bacterial keratitis HSK	Fungal keratitis	suspected AK
Initial treatment	F,cefazolin/gentamicin	Tobrex [*] , tears Acyclovir, 1% Pred Forte	F,cefazolin/amikacin	(AK treatment)	Cravit [*] Acyclovir, 1% Pred Forte	0.3% Amphotericin B 5% Natamycin, F,Amikacin	(AK treatment)
Initial VA (with glasses)	HM-right eye 20/100-left eye	20/50	20/125	HM	5/200	CF1-right eye 20/160-left eye	20/25-right eye 20/63-left eye
Time to AK diagnosis	8 days	50 days	15 days	5 days	26 days	40 days	5 days
Diagnostic clue	Culture for Acanthamoeba	Culture for Acanthamoeba	Culture for Acanthamoeba	Culture for Acanthamoeba	Culture for Acanthamoeba	Pathology of surgical specimen: cyst	Culture for Acanthamoeba
Treatment							
Medical	P-B-1* Ketoconazole 2%, Spersapolymin 5% Betadine [*] b.i.d.	P-B-1	P-B-1 Ketoconazole 2%	P-B-1 Ketoconazole 2% Spersapolymin	P-B-1	P-B-1 Ketoconazole 2% Spersapolymin	P-B-1 Ketoconazole 2% Spersapolymin
Surgical	therapeutic PKP	therapeutic PKP (3 times)				therapeutic PKP RE	
Duration of treatment	117 days	273 days	118 days	70 days	149 days	243 days for OD, 96 days for OS	122 days
Complications	recurrent ulcer corneal scars	corneal scar, cataract, retinal detachment	corneal scar, cataract, glaucoma	corneal scar	corneal scar	corneal scars cataract	corneal scars
Other procedures**	Optical PKP-right eye	PKP/IOL implantation	Triple procedure, GDD***				
Final BCVA	20/32-right eye 20/25-left eye	CF (graft failure)	CF (graft failure)	20/20	20/40	HM-right eye 20/100-left eye	20/20-right eye 20/32-left eye
Follow-up time	87 months	48 months	24 months	7 months	4 months	12 months	5 months

* P-B-1 : PHMB 0.02%, Brolene^{*}, Itraconazole 100 mg b.i.d.

** Performed in a quiet eye

*** GDD : Glaucoma Drainage Device

clinical response. Twice daily lesion cauterization with betadine solution[®] 5% was performed in 1 patient. Duration of medical treatment ranged from 70 to 273 days.

Complications

Corneal scar was the most common complication related to AK, followed by cataracts in 3 eyes and one each for glaucoma and retinal detachment. Therapeutic penetrating keratoplasty (PKP) was required in three patients because of extensive lesion which responded poorly to medical treatment. One of these (case 2) experienced recurrent diseases and subsequently required additional two therapeutic PKP extending to the limbus and keratoprosthesis.

When the eye was quiet, PKP was performed for optical result in 3 eyes. This was combined with cataract extraction and intraocular lens implantation in 1 eye and separate lens aspiration in others. Among the 3 eyes, one eye had received multiple PKP (case 2) as mentioned above and unfortunately was complicated by endophthalmitis and retinal detachment required par plana vitrectomy and pneumatic retinopexy. One eye received glaucoma drainage device implantation (case 3) for uncontrolled secondary glaucoma related to AK.

Outcome

At last follow-up, best-corrected visual acuity (BCVA) had improved in six eyes and worsened in four eyes due to corneal graft failure, dense corneal scar and cataract. Of the six eyes with visual improvement, the BCVA ranged from 20/20 to 20/40; one was a post PKP eye and the other five were eyes with faint corneal scars. Two eyes with corneal graft failure obtained a VA of CF.

Discussion

Published studies about AK have been reported worldwide, the majority were those reported from the UK. Although the incidence of AK has been reported to be increased dramatically in parallel with the growing popularity of soft CL since the 1980s¹² and subsequently with the introduction and increasing popularity of disposable CL (19, 20), not many studies were reported from Asian populations and the number of cases was relatively small compared to those reported from Europe or the USA.

A Medline search revealed 4 large clinical series in our tropical region; one was a review of 39 non-contact lens related to AK reported from India in 2000 by Sharma S. et al²¹, one was also reported from India in 2007 by Bharathi JM et al including a series of 33AK patients seen at a tertiary eye care referral center in South India²², another was a series of 20 patients reported in 2006 from Beijing, China by Xuguang S et al²³, and another recent one from Singapore which is a seven-year study of 43 eyes including the outbreak presented in 2007 by Por YM et al¹⁶. One remarkable result from these studies was the different risk factors of AK: previous corneal injury related to agricultural work was a significant risk factor in India, while overnight orthokeratology was the main risk factor in China and contact lens care was a principal problem-related factor in Singapore. Few articles have been reported from Thailand to date.

The first two cases of AK in Thailand were identified in 1988 and 1990 and were subsequently reported in May, 2000 by Jongwutiwes S et al from Chulalongkorn University, Bangkok¹⁷. Another case series of 5 AK patients was reported from Siriraj Hospital, Bangkok in 1999¹⁸. However, the purpose was to report treatment outcome of AK with chlor-

hexidine. In our 10-year-retrospective study, 7 cases (10 eyes) were identified. The number was relatively small compared to those from many reports. However, as we did not perform a culture for *Acanthamoeba* routinely except for suspicious cases, we suspected that some patients of AK could have been included among a group of culture-negative keratitis patients.

As mentioned previously, contact lens use is considered as the main risk factor for development of AK. The incidence of AK in CL wearers has been reported to range from 20% to 84%^{9,10,23}, depending on the study region. All patients in our series had been using soft disposable contact lenses, either 2-week or monthly disposable type before the time of infection. This was different from the risk factors identified by the retrospective review from India and China as mentioned previously²¹⁻²³. All patients in our series used multipurpose solutions for soft CL and denied swimming or sleeping with CL. Another significant risk factor was identified in 2 bilateral patients who washed the eyes with tap water while wearing CL. No additional data regarding CL hygiene and wearing habits are available in the medical records.

Data from various reports regarding the efficacy of multipurpose solutions (MPS) against *Acanthamoeba* species have shown consistent result. With no-rub regimen, none of soft CL-MPS could remove all *Acanthamoeba* (cyst/trophozoites) from CL or CL cases, even with 8-hour soaking or following the manufacturer recommended regimen²⁵⁻²⁷. Further, data from a well-conducted study of AK in Scotland have shown that when *Acanthamoeba* infection occurred, the patients' home water system was frequently (54%) found to be colonized by *Acanthamoeba*. Patients also washed their storage cases in tap water more frequently than did controls⁷.

Previous data regarding CL care in our CL-

related microbial keratitis patients have shown that among 81 patients, 34% did not practice proper CL care, and 67% wore CL overnight²⁴. Thus it may be assumed that apart from CL use, improper CL care might have been implicated in the occurrence of AK among our patients. The above data suggested that increased education regarding CL care could help reduce the incidence of AK.

Interestingly, three of seven (42.85%) had bilateral keratitis which was not uncommon^{28,29} but obviously demonstrated higher incidence in our study than most previous series (14, 24). Two of them were the only cases in the series which noticed the contact lens rinsing with tap water. However, the number of the cases is too small to draw conclusions regarding risk factors.

Severe ocular pain disproportionate to the clinical signs has long been recognized as one of hallmarks of AK; however, ocular pain was present variably in different studies which ranged from none to 91% of patients^{21,23,30}. In our series, ocular pain was marked in 2 of 7 patients and minimal in 3 of 7 patients. Previous topical medication use, variability in virulence among strains of *Acanthamoeba*, as well as differences in host immune responses, might have affected the clinical presentation of the disease.

Ring infiltration has been recognized as a characteristic sign of AK. In our series, 6/10 eyes showed stromal infiltration in which only 3 of them had a characteristic ring-shape. SPK has been known to be a sign of epithelial involvement in early disease. Apart from stromal infiltration, SPK was also common in our patients (6/10 eyes) in which 2 of them (cases 1, 3) had been treated for SPK elsewhere for 2 months. This suggests that AK, in early stages of corneal epithelial involvement, can be chronic and may present as SPK for months. Three of our patients had been misdiagnosed with HSK. The diagnosis in a context

of CL wearers of no significant improvement despite acyclovir treatment should also raise a suspicion of AK. Interestingly, perineuritis which was found in our two cases led to diagnosis of suspected AK and early treatment was successful.

Following the standard treatment regimen, all patients received a combination of topical treatment with PHMB 0.02%, Brolene® and systemic anti-amoebic treatment with oral itraconazole 100 mg twice daily. Other medication use was optional depending on the ophthalmologist in charge. There was no difference in outcome among the various treatments. After medical treatment, three eyes required therapeutic penetrating keratoplasty to remove an extensively uncontrolled lesion. This was done successfully in two patients. Another patient experienced recurrences of the disease, and needed two additional penetrating keratoplasty. *Acanthamoeba* cysts and trophozoites were identified pathologically in all corneal tissue samples from both patients to confirm the accuracy of culture process and the diagnosis.

Concerning time to AK diagnosis in our series, patients with an early diagnosis (cases 1, 4, 7) were associated with a more successful outcome. In patients who presented with poor initial VA, however, after receiving treatment and visual rehabilitation, good visual outcome could also be achieved. This result is totally different from a previous study⁴. PKP with or without cataract surgery, for an optical reason, was subsequently performed in a quiet eye of 3 patients. However, two concluded with graft failures - one previously received multiple therapeutic PKP and retinal re-attachment surgery, and another was complicated by secondary glaucoma which developed previously during a course of AK.

In conclusion, AK is a relatively rare corneal infection, presented to our hospital in only 7 patients

(10 eyes) during the 10-year period. However, the results from our study demonstrated the highly preventable nature of the disease; all incidents were related to contact lens wear. The data regarding contact lens care should be obtained from the patient to discover any risk. And the patient should be educated about proper wearing and cleaning regimens. The diagnosis of AK requires a high index of suspicion, since a small number of patients will present with a characteristic lesion and ocular pain can be variable. In early cases, AK may present with chronic SPK and may partially respond to artificial tears and topical steroids treatment. The diagnosis of AK should be kept in mind if the diagnosis of HSK has been made in CL wearers, especially when perineuritis was present. Impression cytology and confocal microscopy are recently considered as newer, noninvasive modalities to recognize AK in questionable circumstances^{31,32}. Although said to be devastating, even in patients who presented with a poor VA, good visual outcome could be achieved if early diagnosis has been made and prompt and proper management, either medically or surgically, has been given.

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