CLINICAL Research

The DANGERS of using TAP WATER To Clean CONTACT LENSES

It is not uncommon to find the busy practitioner and student overwhelmed by research publications. *Vision*, in each edition will present summaries of certain clinical research topics highlighting some of the most salient points. This will aid clinicians and students to keep in touch with the latest developments in eye care and related fields.

Prof. Paul Ramkissoon
BOptom (UDW)
CAS (NECO)
MPhil (RAU)
ACSpVis (RAU)
MOptom (UDW)
OD (NECO)
DPhil (RAU)
FAAO (USA)

PO Box 1097
Newcastle 2940
email:pauleyes
@mweb.co.za

INTRODUCTION

Using tap water to clean contact lenses poses serious vision-threatening problems. Contact lens related infection arising from tap water typically occurs from *Acanthamoeba* keratitis. This potentially blinding infection of the cornea is caused by *Acanthamoeba*, a free-living protozoan that is ubiquitous in nature, found commonly in water, soil, air, cooling towers, heating, ventilating, and air conditioning (HVAC) systems, and sewage systems.

EPIDEMIOLOGY

Acanthamoeba keratitis (AK) was extremely rare before the widespread use of contact lenses. The first report of AK was documented in the United States in 1973, after a farmer scratched his cornea with wire and hay, then washed out the wound with irrigation water. Further reports remained sparse until a number of cases started to increase dramatically in 1984. By 1985, an association with the use of contact lenses was established, especially among individuals who swam while wearing their contact lenses and those who used homemade saline or tap water to clean or store their lenses. Of 208 cases of AK reported in the United States between 1973 and 1988, 85 percent were contact lens wearers. The incidence of the disease in the United States has been conservatively estimated at approximately one to two cases per million contact lens users.

In recent years, the U.S. Centers for Disease Control and Prevention (CDC) and other researchers have noted sporadic outbreaks of *Acanthamoeba* keratitis cases among contact lens wearers, especially within certain communities. The epidemic was believed to be associated with regional flooding and subsequent water supply contamination, Epidemiological research found that around half of all AK patients in the Chicago area had been using the "no-rub" solution Complete Moisture Plus Multi-Purpose (Advanced Medical Optics) for cleaning and storing their contacts. This finding led to a U.S. Food and Drug Administration investigation and a voluntary recall by AMO.
Research regarding commercial "no-rub" contact solutions has shown that these products were not contaminated but have minimal efficacy for killing *Acanthamoeba*. Both one-step hydrogen peroxide and two-step hydrogen peroxide solutions, which involve a second neutralising solution, have been shown to be a safer alternative to a "no-rub" storage solution.

Studies have begun to show that community water storage and treatment may also play a large role in AK outbreaks. In England, where AK incidence is 15 times that of the United States, infrequently flushed-out roof-top water tanks may serve as excellent media for Acanthamoeba growth and may explain the country's bloated AK rates. Investigation after the Chicago area outbreak found that not only did the increase in AK correspond to a lowering of city water chlorination following an Environmental Protection Agency mandate but the exceptionally long distances of municipal water travel in the area may have allowed time for additional dechlorination and *Acanthamoeba* colonisation. Even though many water treatment procedures are noteffective at destroying cysts, disinfectants such as chlorine do effectively destroy the free trophozoites and inhibit protozoan growth and reproduction.

Susceptibility to *Acanthamoeba* infection also depends on what type of contact lens an individual uses. Overnight lenses put users at a drastically greater risk of developing AK, as one review found a 30-percent prevalence of the disease among users. While daily disposable lenses are the type of lens least likely to lead to infection, individuals who wear rigid lenses are less prone to AK than users of soft lenses. Approximately88 percent of contact lens-related AK cases occur in soft contact lens wearers and 12 percent in rigid lens wearers. Increasingly popular continuous-wear silicon hydrogel lenses are also an easier target for *Acanthamoeba* attachment than conventional hydrogels.

SIGNS AND SYMPTOMS OF *ACANTHAMOEBA* KERATITIS

The symptoms of *Acanthamoeba* keratitis can be very similar to the symptoms of other eye infections. These symptoms, which can last for several weeks or months, may include: eye pain, eye redness, blurred vision, photophobia, foreign sensation and excessive tearing. *Acanthamoeba* keratitis will eventually cause severe pain and possible vision loss or blindness if untreated.

The most distinctive clinical feature of AK is a pronounced ring-like stromal infiltrate, believed to be composed of inflammatory cells. Signs of scleritis, corneal inflammation and conjunctival hyperaemia begin to appear as the disease progresses. If left untreated, *Acanthamoeba* can spread back into the retina and cause serious chorioretinitis, and patients are often reduced to a visual acuity of hand movement or blindness in these later stages.
Late diagnosis, a pronounced ring infiltrate and deep stromal infection are all associated with a poorer final visual outcome. Patients who develop stromal keratitis are also more likely to have a poor visual outcome after treatment than those with a more superficial epithelial infection.

AETIOLOGY OF CORNEAL INVOLVEMENT ARISING FROM TAP WATER-INDUCED CORNEAL INFECTION

Acanthamoeba likely invade the cornea through a physical opening, such as a minor abrasion, in the corneal epithelium. Contact lens wear may facilitate direct inoculation of *Acanthamoeba* into the eye and promote infection through mechanical or hypoxic trauma to the cornea. Upon binding to mannose glycoproteins of the corneal epithelium, *Acanthamoeba* secretes proteins cytolytic to the epithelium as well as proteases that facilitate further penetration. IgA antibodies normally protect corneal epithelial cells from *Acanthamoeba* infection; however, certain *Acanthamoeba* species are capable of producing proteases that lead to antibody degradation.

Acanthamoeba exists in two forms: an active, infective trophozoite and a dormant, environmentally hardy cyst. Trophozoites measure approximately 25 to 50 µm in diameter with a single nucleus, dense nucleolus, and filamentous projections called acanthopodia. Trophozoites reproduce by binary fission and feed on a variety of organisms, including cyanobacteria, bacteria, fungi, and other protozoa. In the resilient double-walled cyst form, *Acanthamoeba* can survive for years under adverse conditions, such as extreme temperatures and pH, desiccation, and chemical exposure.

Figure 1.
Early *Acanthamoeba Keratitis* is characterised by a brawny oedema and hazy view into the anterior chamber.

The DANGERS of using TAP WATER To Clean CONTACT LENSES

Figure 2.
Late stages of *Acanthamoeba Keratitis* produces a ring shaped corneal ulcer.

MANAGEMENT

Early diagnosis is essential for effective treatment of *Acanthamoeba keratitis*. The infection is usually diagnosed based on symptoms, growth of the *Acanthamoeba* from a scraping of the eye, and/or seeing the amoeba by a process called confocal microscopy. Proper early stage diagnosis is essential before the *Acanthamoeba* invades more deeply into the cornea and causes permanent tissue damage. Unfortunately, at the initial visit the disease is more commonly diagnosed as herpes simplex keratitis than AK. This misidentification can lead to the use of antiviral medication, which only makes symptoms worse for the patient.

The first step towards proper diagnosis is accurate slit-lamp examination. The lack of bulbous dendrites typical in herpes patients is a good indicator a patient might have AK. Early and accurate slit-lamp examination is important in corneal ulcer patients, since disease stage at the time of AK diagnosis is a strong predictor of final visual outcome.

Recommended guidelines that should be followed by all contact lens users to help reduce the risk of eye infections, including *Acanthamoeba keratitis*: regular eye examinations, wear and replace contact lenses according to the schedule prescribed, remove contact lenses before any activity involving contact with water, including showering, using a hot tub, or swimming, wash hands with soap and water and dry before handling contact lenses, clean contact lenses according to instructions from the optometrist, never reuse or top off old solution. Use fresh cleaning or disinfecting solution each time lenses are cleaned and stored, never use saline solution or rewetting drops to disinfect lenses (neither solution is an effective or approved disinfectant). Be sure to clean, rub, and rinse your lenses each time you remove your lenses. Rubbing and rinsing your contact lenses will aid in removing harmful microbes and residues. Store reusable lenses in the proper storage case. Storage cases should be rubbed and rinsed with sterile contact lens solution (never use tap water), emptied, and left open to dry after each use. Replace storage cases at least once every three months.

The infection can be difficult to treat due to the resilient nature of the cyst form, therefore, early diagnosis is of paramount importance. Current treatment regimens usually include a topical cationic antiseptic agent such as polyhexamethylene biguanide (0.02%) or chlorhexidine (0.02%) with or without a diamidine such as propamidine (0.1%) or hexamidine (0.1%). The duration of therapy may last six months to a year. Pain control can be helped by topical cycloplegic solutions and oral non-steroidal medications. Penetrating keratoplasty may help restore visual acuity. Surgical treatment remains a necessary option when infection has progressed beyond the point of anti-infective viability. Penetrating keratoplasty is used to remove and replace infected tissue, and an antiseptic/ diamidine regimen is continued.

CLINICAL PEARLS

- The clinical presentation of Acanthamoeba keratitis varies greatly. Contact lens wearers should visit their optometrist immediately if they have any of the following symptoms: eye pain or redness, blurred vision, sensitivity to light, foreign body sensation, or excessive tearing.
- Diagnosis requires a high index of suspicion, and early diagnosis can greatly improve treatment efficacy. Affected individuals are at risk for permanent visual impairment and blindness.
- Pain out of proportion to clinical findings is a classic feature of Acanthamoeba keratitis; however, especially early in the disease, lack of pain does not preclude the diagnosis. Because of similarities to the clinical manifestations of viral, fungal, or bacterial corneal infection, individuals may be misdiagnosed and treated with improper antimicrobial or corticosteroid therapy. Such therapy may initially alleviate symptoms and further obscure the clinical picture and diagnosis.
- Certain practises can increase the risk of getting Acanthamoeba keratitis: storing and handling lenses improperly, disinfecting lenses improperly.

CONCLUSION

***Acanthamoeba* eye infections in contact lens wearers are serious, and they often start because of improper lens handling and poor hygiene. To avoid *Acanthamoeba keratitis*, contact lens wearers should strictly follow lens wearing and cleaning instructions from their optometrists.**

REFERENCES

1. Schaumberg DA, Snow KK, Dana MR. The epidemic of Acanthamoeba keratitis: where do we stand? Cornea. 1998;17:3-10.
2. keratitis in the United States. Am J Ophthalmol. 1989;107:331-6.
3. Jaison PL, Cao Z, Panjwani N. Binding of Acanthamoeba to mannose-glycoproteins of corneal epithelium: effect of injury. Curr Eye Res. 1998;17:770-6.
4. Moore MB, McCulley JP, Luckenbach M, Gelender H, Newton C, McDonald MB, Visvesvara GS. Acanthamoeba keratitis associated with soft contact lenses. Am J Ophthalmol 1985;100:3:396.
5. Meier PA, Mathers WD, Sutphin JE, Folberg R, Hwang T, Wenzel RP. An epidemic of presumed Acanthamoeba keratitis that followed regional flooding. Arch Ophthalmol 1998;116:8:1090-4.
6. Thebpatiphat N, Hammersmith KM, Rocha FN, Rapuano CJ, Ayres BD, Laibson PR, Eagle RC, Cohen EJ. Acanthamoeba keratitis: A parasite on the rise. Cornea 2007;26:6:701-6.
7. Hiti K, Walochnik J, Haller-Schober EM, Faschinger C, Aspöck H. Viability of Acanthamoeba after exposure to a multipurpose disinfecting contact lens solution and two hydrogen peroxide systems. Br J Ophthalmol 2002;86:2:144-6.
8. Shoff ME, Joslin CE, Tu EY, Kubatko L, Fuerst PA. Efficacy of contact lens systems against recent clinical and tap water Acanthamoeba isolates. Cornea 2008;27:6:713-9.
9. Joslin CE, Tu EY, McMahon TT, Passaro DJ, Stayner LT, Sugar J. Epidemiological characteristics of a Chicago-area Acanthamoeba keratitis outbreak. Am J Ophthalmol 2006;142:2:212-217.
10. Mathers W. Use of higher medication concentrations in the treatment of Acanthamoeba keratitis. Arch Ophthalmol 2006;124:6:923.
11. Sansanayudh W, Cevallos V, Porco TC, Margolis TP, Lietman TM, Acharya NR. Fusarium and Acanthamoeba keratitis: Can a single center detect outbreaks? Br J Ophthalmol 2008;95:5:720-1.
12. Joslin CE, Tu EY, Shoff ME, Booton GC, Fuerst PA, Mchahon TT, Anderson RJ, Dworkin MS, Sugar J, Davis FG, Stayner LT. The association of contact lens solution use and Acanthamoeba keratitis. Am J Ophthalmol 2007;144:2:169-180.
13. Butcko V, McMahon TT, Joslin CE, Jones L. Microbial keratitis and the role of rub and rinsing. Eye Contact Lens 2007;33:6:421-3.
14. Kilvington S, Gray T, Dart J, Morlet N, Beeching JR, Frazer DG, Matheson M. Acanthamoeba keratitis: The role of domestic tap water in the United Kingdom. IOVS 2004;45:1:165-169.