

# Benzalkonium chloride corneal toxicity post-cataract surgery

Keith Ong<sup>1,2,3,4</sup>, Leonard Ong<sup>4,5,6</sup>

<sup>1</sup>Department of Ophthalmology, Northern Clinical School, University of Sydney, Sydney, Australia; <sup>2</sup>Department of Ophthalmology, Royal North Shore Hospital, Sydney, Australia; <sup>3</sup>Department of Ophthalmology, Sydney Adventist Hospital, Sydney, Australia; <sup>4</sup>Department of Ophthalmology, Chatswood Private Hospital, Sydney, Australia; <sup>5</sup>Ophthalmology Clinic, Macquarie University Hospital, Sydney, Australia; <sup>6</sup>Department of Clinical Medicine, Faculty of Medicine and Health Sciences, Macquarie University, Sydney, Australia

## Abstract

Two patients with presumed benzalkonium chloride (BAK) corneal toxicity after routine cataract surgery are presented. Patient 1 had corneal stroma and Descemet's membrane folds. Patient 2 had moderate superficial punctate epithelial erosions (SPEE). They were on Chlorsig, Maxidex, and Acular eye drops tds postoperatively. The corneas of these two patients improved when BAK was removed or minimized from the postoperative eye drop regimen. Two vials of 1 ml dexamethasone 4mg/ml for injection were added to Chlorsig 10 ml bottle to substitute for Maxidex eye drops.

BAK toxicity should be suspected when the cornea is not as clear as expected postoperatively. A practical way to eliminate BAK from postoperative eye drops is described, and would be useful until pharmaceuticals mass-produce BAK-free steroid eye drops economically.

**Keywords:** benzalkonium chloride (BAK), cataract surgery, corneal toxicity

## Case Report

### Patient 1

A 69-year-old male underwent routine left cataract phacoemulsification and posterior chamber intraocular lens (PCIOL) (Alcon SN60WF). Preoperative endothelial cell count (ECC) was 2880/mm<sup>2</sup> and central corneal thickness (CCT) was 568 microns. Visual acuity (VA) with myopic correction was 6/9 on day 1 postoperative. At 1 week postoperative, (VA) was 6/18, with corneal stroma and Descemet's membrane folds, minimal superficial punctate epithelial erosions (SPEE) fluorescein staining (Fig. 1 and Fig. 2), ECC of 2524/mm<sup>2</sup>, and CCT of 665 microns. There were occasional cells in the anterior chamber and no conjunctival

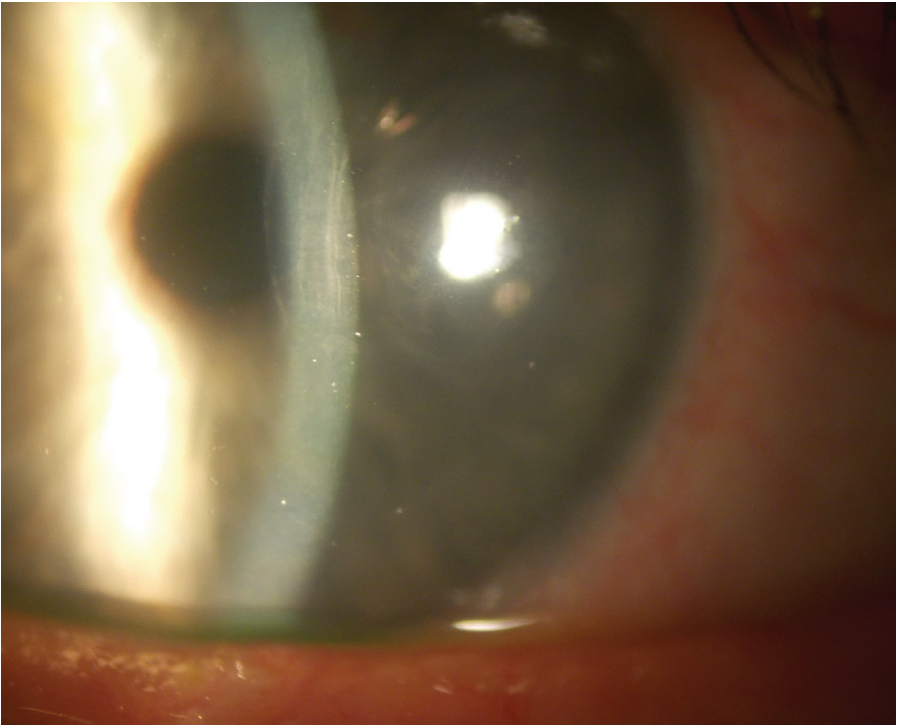
**Correspondence:** Dr. Keith Ong, 2 Railway Avenue, Eastwood NSW 2122, Sydney, Australia.

E-mail: [keithong@optusnet.com.au](mailto:keithong@optusnet.com.au)

inflammation. Intraocular pressure (IOP) was 14 mmHg bilaterally. He was on a postoperative regimen of Chlorsig (chloramphenicol 0.5%, Aspen), Maxidex (dexamethasone 0.1%, Alcon), and Acular (ketorolac 0.5%, Allergan) drops tds. BAK corneal toxicity was suspected.

Two vials of 1 ml Dexamethasone 4mg/ml for injection were added to a Chlorsig 10 ml bottle, and Acular tds was replaced with Ilvoro (nepafenac, Alcon) once daily. At 2.5 weeks, there was no significant improvement in corneal appearance. As Ilvoro contained BAK, Ilvoro was stopped and replaced with Indomethacin 25 mg daily orally. He continued with Chlorsig-Dexamethasone tds. At 6 weeks, he mentioned that he had noticed improvement after a week on the new regimen, and VA was 6/9 with much improvement of corneal stroma and Descemet's membrane folds, ECC of 2882/mm<sup>2</sup>, and CCT of 594 microns.

When he underwent right cataract phacoemulsification and PCIOL, he was prescribed Chlorsig-Dexamethasone tds and Indomethacin 25 mg orally daily. There was no corneal problem. VA was 6/9 on day one and at one month.



**Fig. 1.** Stroma and Descemet's membrane folds in Patient 1.

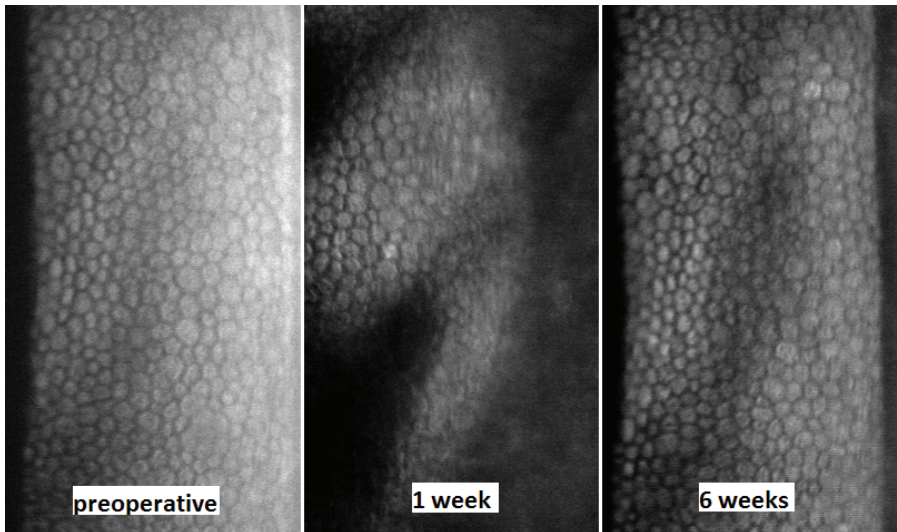


Fig. 2. Specular microscopy in Patient 1.

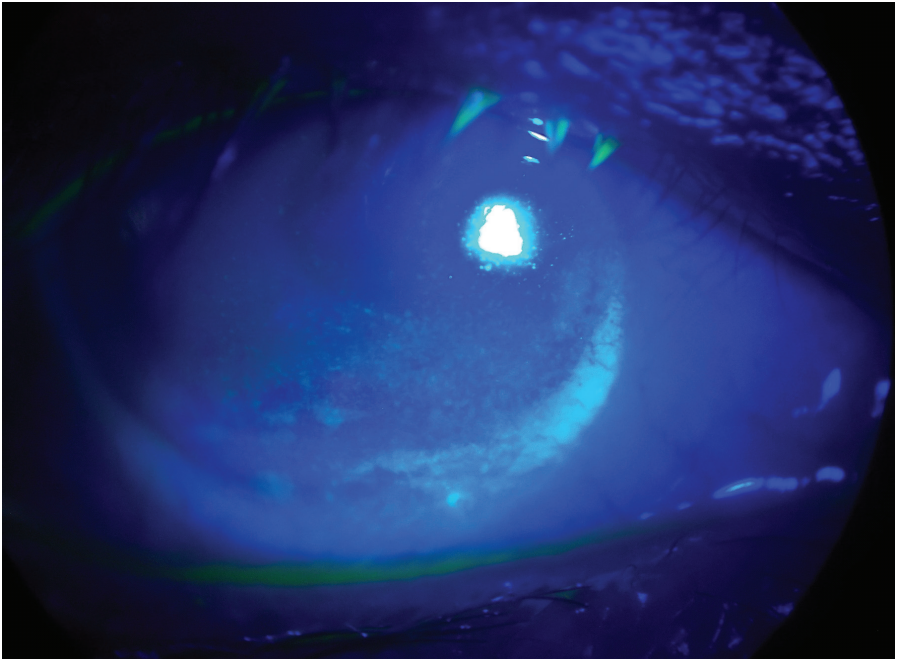
### Patient 2

A 65-year-old female underwent routine right cataract phacoemulsification and PCIOL (Alcon SN 60WF). She has a past history of dry eye controlled with tear supplements. On day 1 postoperative, VA was 6/9 with myopic correction. At 1-week postoperative, VA was 6/12 corrected and IOP was 16 mmHg bilaterally. She had extensive SPEE fluorescein staining of the cornea, with no significant corneal stroma or Descemet's folds (Fig. 3). She was on Chlorsig, Maxidex, and Acular drops tds. She was changed to Chlorsig-Dexamethasone tds and Acular once daily. At 5 weeks, SPEE improved and VA was 6/9 with myopic correction. When she underwent left cataract phacoemulsification and PCIOL, she was on Chlorsig-Dexamethasone tds and Acular once daily. There was no corneal problem and VA was 6/9 on day one and at one month postoperative.

### Discussion

BAK toxicity usually presents as corneal SPEE.<sup>1,2</sup> Corneal edema<sup>3</sup> with corneal stroma and Descemet's folds is uncommon. Mechanisms proposed include damage to corneal epithelial cells by disruption of cell tight junctions and toxicity to the corneal endothelium.<sup>1,2,4</sup> BAK causing mitochondrial dysfunction may play a part in the corneal changes.<sup>5</sup>

Maxidex and Acular contain BAK, and when BAK is instilled six times a day, corneal toxicity is more likely to occur in a shorter time frame. Chlorsig contains polymercuric acetate as preservative. When BAK was eliminated or reduced from



**Fig. 3.** SPEE in Patient 2.

the eye drop regimen, the cornea of these two patients did not have any significant corneal stroma, Descemet's folds, or SPEE.

BAK allergy is less common, and the conjunctiva and eyelid skin are inflamed and itchy. Maxidex eye drops contain BAK, and when used, the dexamethasone steroid often masks the conjunctival inflammation, whereby only the eyelid and lid margin develop inflammation and redness.

Hence, BAK toxicity should be suspected when the cornea is not as clear as expected postoperatively. A practical way to eliminate BAK from postoperative eye drops is described, and would be useful until BAK-free steroid eye drops are easily available and affordable.

## References

1. Gasset AR. Benzalkonium chloride toxicity to the human cornea. *Am J Ophthalmol.* 1977;84(2):169-171.
2. Barki WH, Tahir M. Effects of topical benzalkonium chloride on corneal epithelium. *Biomedica.* 2007;23:65-70.
3. Urrego-Diaz JA, Frias-Ordonez JS, Figueroa-Echandia G, Duran-Silva G. Acute corneal edema without epithelial compromise. A case report and literature review. *Rev Fac Med.* 2017;54(32):513-519.

## BAK corneal toxicity post-cataract surgery

---

4. Lemp MA, Zimmerman LE. Toxic endothelial degeneration in ocular surface disease treated with topical medications containing benzalkonium chloride. *Am J Ophthalmol.* 1988;105(6):670-673.
5. Datta S, Baudouin C, Brignole-Baudouin F, Denoyer A, Cortopassi GA. The eye drop preservative benzalkonium chloride potently induces mitochondrial dysfunction and preferentially affects LHON mutant cells. *Inv Ophthalmol Vis Sci.* 2017;58(4):2406-2412.