Chemical Corneal Burn Secondary to BAK

Opal Amin, O.D.
Cornea and Contact Lens Resident
University of Houston College of Optometry
Abstract

• This is a case of a 63 year old Hispanic female with a chemical corneal burn secondary to an accidental topical application of a 0.05% benzalkonium chloride solution.
Case History

- 63 year old Hispanic female presented for an emergency office visit with complaints of a red, painful, watery eye X 2 weeks

- HPI
  - Burning/pain: 7/10
  - Constant watery discharge
  - Swelling of right upper lid
  - (-) photophobia
  - (-) decrease vision
• HPI continued
  – 2 weeks ago patient instilled 2 gtts “Dr. G’s Clear Nail” (0.05% benzalkonium chloride, pH=7.0) into right eye mistaking it for artificial tears
  – She flushed her eye with tap water X 15 minutes
  – PCP for treatment the following day
    Initial visit: Began prednisolone 1% (Pred Forte 1%) QID OD X 4 days with pressure patching for first 2 days—no improvement in symptoms
    2\textsuperscript{nd} visit: d/c Pred Forte 1%, began erythromycin ung qhs X 1 week showing minimal improvement
Case History

• POH
  – LEE: 9/14/2006 @ University Eye Institute
  – (+) mild cataracts OU

• PMH
  – (+) systemic hypertension X 1 year

• MEDS
  – amlodipine besylate (Norvasc)
  – hydrochlorothiazide
  – telmisartan (Micardis)
Case History

- FOH
  - (-) glc/blindness

- FMH
  - (+) systemic hypertension - mother

- NKDA

- SH: vendor
Exam Findings

- **BVA**
  - OD 20/40<sup>-2</sup>
  - OS 20/20

- **CVF**: FTFC OD & OS

- **EOMs**: unrestricted, smooth, accurate OU

- **Pupils**: (+) APD OD (not confirmed by attending and not noted on subsequent visits)
Exam Findings

BIOMICROSCOPY (OD)

L/L 3+ erythema/chemosis

Conj 3+ chemosis; 4+ injection

Cornea 4+ SPS; epithelial heaping (~3 mm x 4 mm)

(-) Rose Bengal staining

A/C (-) cells/flare

Iris brown, flat

Lens 1+ NS

Vitreous quiet
Exam Findings

• Assessment
  – Chemical Corneal burn OD 2º to BAK

• Plan
  – Corneal debridement OD performed in-office
  – Bandage CL: Focus Night & Day
  – Vigamox QID OD
  – Artificial tears q1h
  – RTC 1 day for follow-up
Day 2

**VA**
20/200 PH: 20/80

**Biomicroscopy**

*L/L: 3 + erythema/chemosis*

**Conj:** moderate chemosis; 4+ injection

**Cornea:** 3 + endothelial folds; epithelial defect (4.2 x 3.1)

**A/C:** 3 + cells

**Iris:** brown, flat

**Lens:** 1+ NS

**Vitreous:** quiet

**Plan**
Continue Vigamox QID, ATs q1h
RTC in 1 day for follow-up
Day 3

VA
20/200+2 PH: 20/60-

Biomicroscopy
L/L: 1+ erythema/chemosis
Conj: moderate chemosis; 4+ injection
Cornea: 2+ endothelial folds; epithelial healing line
A/C: 1+ cells
Iris: brown, flat
Lens: 1+ NS
Vitreous: quiet

Plan
Continue Vigamox QID, ATs q1h
RTC 1 day for follow-up
Day 4

VA
20/100 ph: 20/50

Biomicroscopy
L/L: 1 + erythema/chemosis
Conj: mild chemosis; 4+ injection
Cornea: 2 + endothelial folds; 4+ SPS
A/C: trace cells
Iris: brown, flat
Lens: 1+ NS
Vitreous: quiet

Plan
Remove BCL, Vigamox QID, Lotemax QID, ATs q1h
RTC 1 day for follow-up
Day 5

**VA**

20/70 ph: 20/50-

**Biomicroscopy**

L/L: 1+ erythema/chemosis

Conj: mild chemosis; 4+ injection

Cornea: 2+ endothelial folds; superior temporal epithelial heaping; 4+ SPS

A/C: (-) cells

Iris: brown, flat

Lens: 1+ NS

Vitreous: quiet

**Plan**

Lotemax BID, Vigamox QID, Muro 128 qhs, ATs; pt was educated on recurrent corneal erosions (RCE)

RTC 3 days for follow-up
Days 6 & 7

VA
20/80 ph: 20/50<sup>+</sup><sup>2</sup>

Biomicroscopy
L/L: 1 + erythema/chemosis
Conj: mild chemosis; 1+ injection
Cornea: (-) epithelial folds; 3+ SPS
A/C: (-) cells
Iris: brown, flat
Lens: 1+ NS
Vitreous: quiet

Plan
Lotemax BID, Vigamox BID, d/c Muro 128, Ats
RTC 3 days for follow-up

BVA
20/30<sup>-</sup><sup>2</sup>

Biomicroscopy
L/L: tr erythema/chemosis
Conj: mild chemosis; 1+ injection
Cornea: superior temporal epithelial heaping; 3+ SPS
A/C: (-) cells
Iris: brown, flat
Lens: 1+ NS
Vitreous: quiet

Plan
d/c Vigamox, Lotemax qd, Ats
RTC 1 week for follow-up
Day 8

BVA
20/25

Biomicroscopy
L/L: trace chemosis
Conj: trace injection
Cornea: 1+ SPS
A/C: (-) cells
Iris: brown, flat
Lens: 1+ NS
Vitreous: quiet

Plan
Lotemax qod, RTC 1 month for follow-up
Chemical Burns

Frequency

– Ocular Burns represent 7-18% of all presenting ocular traumas
  • Chemical Burns: 84%
    – Acids: Alkali
      » 1:1 to 1:4 (depending on the study)
  • Thermal Burns: 16%
Diagnosis

• Good history!!!
• Symptoms
  – Pain
  – Photophobia
  – Reduced vision
  – Colored haloes around lights
• Signs
Ocular Signs

• Mild to Moderate
  • Eyelid edema
  • Mild anterior chamber reactions
  • 1\textsuperscript{st} and 2\textsuperscript{nd} degree burns of periocular skin
  • Conjunctiva
    – Chemosis
    – Hyperemia
    – Hemorrhages
  • Corneal epithelial defects
    – Scattered superficial punctate keratitis
    – Focal epithelial loss
    – Sloughing of the entire epithelium
Ocular Signs

• Severe

• Cornea
  – Edema
  – Opacification
  – Moderate to severe AC reaction
  – Stromal haze
• Increased IOP
• 2nd and 3rd degree burns of surrounding skin
• Local necrotic retinopathy (alkali penetration through sclera
• Conjunctiva
  – Pronounced chemosis
  – Blanching
Characteristics

Majority of ocular chemical burns

– Acidic (pH<4)
  • Bind with tissue proteins and coagulate the surface epithelium
  • This bars further penetration and limits the extent of the burn
  • Examples: car batteries (sulfuric acid)

– Alkaline (pH>10)
  • More frequent
  • More severe
  • Destroy the cell structure of the epithelium, stroma, and endothelium
  • Examples: ammonia, lye and lime
Characteristics

• Benzalkonium chloride
  – Most commonly used preservative in ophthalmic solutions
  – Cationic detergent surface action
    • Very rapid and prolonged incorporation into cell lipid membranes
    • Directly causes decreased stability and increased evaporation of precorneal tear film
      – Causes decreased stability indirectly by decreasing the density of goblet cells in the conjunctival epithelium
Pathophysiology

- Studies show that upon application of BAK
  - Superficial epithelial cells appear to peel away exposing the underlying wing cells
  - Loose cell-to-cell junctions due to edema
- Desquamation of the corneal epithelial cells is dependent on BAK concentration
- BAK along with other preservatives are responsible for the induction of ocular surface inflammation, allergies, fibrosis, and dry eye syndrome (DES)
Mechanism of Action

• Theories
  – Apoptosis (accepted theory)
    • Programmed cell death
    • Dose-dependent
  – Cell lysis
Conjunctival Cell Viability
1\textsuperscript{st} Treatment vs. 2\textsuperscript{nd} Treatment
Relative Cell Number

![Graph showing relative cell number over time with absorbance on the y-axis and time after treatment on the x-axis. The graph includes control and treated samples at different concentrations.](image)
Corneal Thickness

Epithelium

A = Tears
B = Moxi
C = Cipro
D = Gati
E = Oflox
F = Levoj

Stroma

A = Tears
B = Moxi
C = Cipro
D = Gati
E = Oflox
F = Levoj
# Common Ocular Drugs Containing BAK

<table>
<thead>
<tr>
<th>Topical Ophthalmic Preparation</th>
<th>% BAK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ofloxacin 0.3% (Ocufox)</td>
<td>0.005%</td>
</tr>
<tr>
<td>Gatifloxacin 0.3% (Zymar)</td>
<td>0.005%</td>
</tr>
<tr>
<td>Ciprofloxacin 0.3% (Ciloxan)</td>
<td>0.006%</td>
</tr>
<tr>
<td>Ofloxacin 0.3% (Ocuflox)</td>
<td>0.005%</td>
</tr>
<tr>
<td>Levofloxacin 0.5% (Quixin)</td>
<td>0.005%</td>
</tr>
<tr>
<td>Moxifloxacin 0.5% (Vigamox)*</td>
<td>0.0%</td>
</tr>
<tr>
<td>Brimonidine purite 0.15% (Alphagan P)*</td>
<td>SOC (Purite)</td>
</tr>
<tr>
<td>Bimatoprost 0.03% (Lumigan)</td>
<td>0.005%</td>
</tr>
<tr>
<td>Dorzolamide 2% (Trusopt)</td>
<td>0.008%</td>
</tr>
<tr>
<td>Timolol maleate 0.5% (Timoptic)</td>
<td>0.01%</td>
</tr>
<tr>
<td>Travoprost 0.004% (Travatan)</td>
<td>0.015%</td>
</tr>
<tr>
<td>Latanoprost 0.005% (Xalatan)</td>
<td>0.02%</td>
</tr>
</tbody>
</table>
Treatment

• Immediate care
  – Prompt, copious fluid irrigation of the affected eye, preferably with sterile saline for 30 minutes
    • It is helpful to instill a topical anesthetic (proparacaine) in the eye before irrigating
  – If initial contact with patient is by phone
    • Tell patient to flush the eye with water for 20 to 30 minutes before coming to the office

• Test with litmus paper 5-10 minutes after ceasing irrigation (to allow equilibrium)
  – Near neutral (pH 6-8): may discontinue
• Sweep the conjunctival fornices for particulate matter
Treatment

• Severe Burns
  – Debride any necrotic corneal or conjunctival tissue
    • Kimura spatula
    • Alger brush
    • Diamond burr
  – Cycloplegic agent (e.g. 0.25% scopolamine)
  – Broad spectrum topical antibiotic
    • With or without pressure patch
  – Oral analgesic
  – Bandage Contact Lens
  – Consider acetazolamide if IOP is increased
  – Frequent use of preservative-free artificial tears or gel
Treatment

• Very severe burns
  – In addition to previously discussed treatment regimen...
  – May require admission to hospital to monitor IOP and corneal healing
  – Topical corticosteroid

• Follow-up
  – Evaluate patients daily
  – Monitor IOP
    • Can be a late complication in chemical burns due to blockage of the trabecular meshwork by inflammatory debris
Differential diagnoses

• Acidic Corneal Burn
• Alkali Corneal Burn
• Recurrent Corneal Erosion
• Corneal Ulcer
• Punctate Keratitis