

Treatment and Management of Ocular Trauma, Ocular Emergencies and Anaphylaxis

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Disclosures

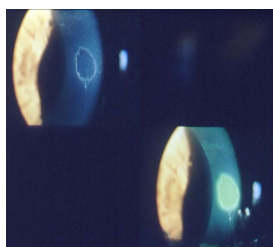
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Maculogix: Honoraria-Advisory Board

Sun: Honoraria: Advisory Board

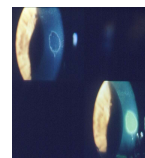
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What is this?



Corneal Abrasion

- history of mild trauma to the eye (fingernail, tree branch, contact lens, make-up brush, or foreign body)
- Photophobia, conjunctival injection, and involuntary lid closure (blepharospasm) are characteristic.
- Pain and foreign body sensation may be quite severe.
- If the abrasion is in the central cornea, visual acuity is decreased (20/80 to 20/200)



Corneal Abrasion: Exam

- Immediate relief is obtained with topical anesthesia (e.g., proparacaine, tetracaine).
 - Topical anesthetics are used only to confirm the diagnosis and are not prescribed for long-term relief.
- Evert eyelids to search for a foreign body, especially if the history is suggestive (e.g., glass from an automobile accident, vegetable matter from bark).
 - Linear corneal abrasions should alert the examiner to flip the upper lid to look for the foreign body on the superior tarsal conjunctiva.

Academic Emergency Medicine
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ORIGINAL CONTRIBUTION

Topical Tetracaine Used for 24 Hours Is Safe and Rated Highly Effective by Patients for the Treatment of Pain Caused by Corneal Abrasions: A Double-blind, Randomized Clinical Trial

Neil Waldman, MD, FACEM, Ian K. Dennis, and Peter Herbison, DSc

Conclusions: Topical tetracaine used for 24 hours is safe, and while there was no significant difference in patient VAS pain ratings over time, patient surveys on overall effectiveness showed that patients perceived tetracaine to be significantly more effective than saline.

Methods: The study was a 12-month, prospective, double-blind, randomized trial of tetracaine versus saline set in the emergency department (ED) of a regional tertiary care teaching hospital. A total of 116 patients presenting with uncomplicated corneal abrasions were included in this study. The intervention was either undiluted, preservative-free, topical tetracaine hydrochloride 1% or saline, applied up to every 30 minutes while awake for 24 hours. Main safety outcome measures were repeat ED examinations at 48 hours with fluorescein staining and slit-lamp examination, 1-week and 1-month telephone interviews with additional examinations as needed, and monitoring of charts for complications. Secondary outcome measures were 100-mm visual analogue scale (VAS) pain scores recorded every 2 hours while awake for 48 hours and patient-perceived overall effectiveness using a numeric rating scale (NRS) of 0 to 10 obtained during telephone interviews.

Treatment

- Remove any loose or jagged tissue
- Topical antibiotic:
 - e.g. moxifloxacin (Vigamox/Moxeza), gatifloxacin (Zymar), tobramycin (Tobrex) QID for prophylactic coverage
 - May consider an antibiotic ointment for prolonged contact time but will also blur vision
 - consider use of antibiotic/steroid combination for prophylactic coverage and management of pain/inflammation e.g. tobradex or zylet
- Consider bandage (therapeutic) CL for comfort and healing:
 - e.g. N&D, PureVision, Oasys
- Pain management:
 - Homatropine qd-bid (very hard to come by so might have to use cyclopentolate or go with atropine) or
 - topical NSAIDs: Acular, Voltaren tid-qid Ilevro or Prolensa qd
- Follow up in 1 day, educate on RCE

Name: WALLY HARRISON Age: 28 Race/Sex: W/M Clinician: J.C.

Staff Doctor: LOWENBERG

Demographic Data Confirmed Yes X

Date: 5/10/2008 No W CONTACT LENSES

Chief Complaint ☐ floaters/flies ☐ blur/double vision ☒ eye discomfort ☐ existing condition ☐ eye injury ☐ field loss ☐ watering/dischage ☐ follow-up

HPI: Eye Pain OD
 • Symptoms: Pain, tearing, swollen lids
 • Location: OD
 • Quality: Severe (9/10)
 • Duration: 1 day
 • Timing: Started yesterday AM.
 • Context: Thinking out CL did not help.

• Allergies: NKDA
 • Medications: None
 • Ocular Hx: CL x 10 years. Extended wear. Last lenses same OD.
 • Medical History & ROS from 5/10/08 reviewed: No changes

• Head/Face: ☒ nl • Psych: Mood/Affect (anxiety/irritation/depression) ☐ nl • Neuro: Oriented (person/time/place) ☒ y ☐ n

Vision: OD 20/20 OS 20/20 Glare: 0 C.F. 0

CVE: ☒ nl ☐ Full ☐ Etc. Phos

Adverse/Episodes: ☒ CL x 10 years. ☐ OD ☐ nl (gonia, Lac. Lac. gland/drain, orbit, eye, Aus. Nodes) ☐ Biphthalmic OD OS ☐ Melanoma OD OS

Pupils: ☒ reactive ☐ no afferent defect ☒ round OU Size: OD 4 OS 4

Cornea: ☒ nl ☐ TBUT ☐ nl ☐ Tear Film ☐ nl ☐ TBUT ☐ nl ☐ Cornea (epith, vessels, endoth) ☐ nl ☐ TBUT ☐ nl ☐ Tear Film ☐ nl ☐ TBUT ☐ nl

Conjunctiva: ☒ nl ☐ Conjunctiva (epith, vessels, endoth) ☐ nl ☐ Conjunctiva (epith, vessels, endoth) ☐ nl ☐ Conjunctiva (epith, vessels, endoth) ☐ nl

Sclera: ☒ nl ☐ Sclera ☐ nl ☐ Sclera ☐ nl ☐ Sclera ☐ nl

Anterior Chamber: ☒ nl ☐ Anterior Chamber (cells or float) ☐ nl ☐ Anterior Chamber (cells or float) ☐ nl ☐ Anterior Chamber (cells or float) ☐ nl

Posterior Chamber: ☒ nl ☐ Posterior Chamber (cells or float) ☐ nl ☐ Posterior Chamber (cells or float) ☐ nl ☐ Posterior Chamber (cells or float) ☐ nl

Optic Disc: ☒ nl ☐ Optic Disc (size, color, margin) ☐ nl ☐ Optic Disc (size, color, margin) ☐ nl ☐ Optic Disc (size, color, margin) ☐ nl

Macula: ☒ nl ☐ Macula (size, color, contour) ☐ nl ☐ Macula (size, color, contour) ☐ nl ☐ Macula (size, color, contour) ☐ nl

Vitreous: ☒ nl ☐ Vitreous (size, color, contour) ☐ nl ☐ Vitreous (size, color, contour) ☐ nl ☐ Vitreous (size, color, contour) ☐ nl

Periphery: ☒ nl ☐ Periphery (size, color, contour) ☐ nl ☐ Periphery (size, color, contour) ☐ nl ☐ Periphery (size, color, contour) ☐ nl

BP: 120/80 @ 5:00 AM (PM)

T: OD 19 / OS 20 @ 5:00 AM (PM) Fluor. ☐ Anesth. Dilat. M: 5%, 1% C: 1%, 2% N: 2.5%, 10% OU @

Corneal Ulcers

- Infective bacterial and fungal corneal lesions cause severe pain and loss of vision
- Signs and Symptoms:
 - Pain, photophobia, tearing
 - Mucopurulent discharge with generalized conjunctival injection
 - Decreased VA (esp if on visual axis)
 - Possible AC reaction and hypopyon
 - Dense infiltrate
 - Satellite lesions around main lesion may indicate fungal infection

Associated Factors

- Contact lens wear, especially soft and extended wear lens
- Recent history of corneal trauma
- Topical steroid use
- History of exposure to vegetative matter (fungal etiology)
- History of topical anesthetic abuse
- the most common causes of bacterial keratitis are Staphylococcus, Pseudomonas, Streptococcus, Moraxella, and Serratia species.

Bacterial Keratitis: Species

- Staphylococcal ulcers typically have a well-defined, gray-white stromal infiltrate that may enlarge to form a dense stromal abscess.
- Streptococcal infiltrates may be either very purulent or crystalline. Acute fulminant onset with severe anterior chamber reaction and hypopyon formation are common in the former, while the latter tends to have a more indolent course and occurs in patients often on chronic topical steroids (e.g., corneal transplant patients).
- Pseudomonas typically presents as a rapidly progressive, suppurative, necrotic infiltrate associated with a hypopyon and mucopurulent discharge in the setting of soft contact lens wear.
- Moraxella may cause infectious keratitis in patients with pre-existing ocular surface disease and in patients who are immunocompromised. Infiltrates are typically indolent, located in the inferior portion of the cornea, have a tendency to be full-thickness, and may rarely perforate.

When to culture?

- 1,2,3 Rule:
 - 1 mm from visual axis
 - 2 infiltrates (or more)
 - 3mm or greater in size
- Nosocomial infections
- Immuno-compromised patient
- Post-surgical

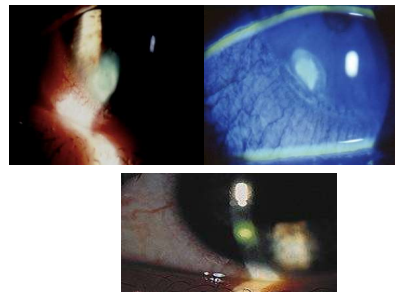
Sterile vs Infectious Infiltrates

Sterile Infiltrates vs. Infectious Infiltrates

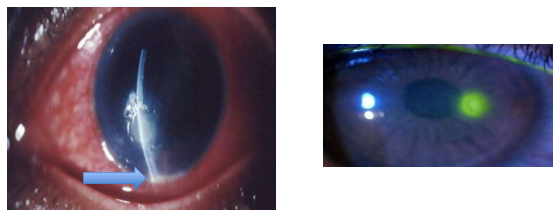
Sterile Infiltrates	Infectious Infiltrates (MK)
Smaller lesion (< 1mm)	Larger lesion (> 1mm)
More peripheral	More central
Minimal epithelial damage (Defect size compared to underlying infiltrate)	Significant epithelial defect (Size of staining defect closely mirrors size of underlying stromal lesion)
No mucous discharge	Mucopurulent discharge
Less pain and photophobia	Pain and photophobia
Little to no anterior chamber reaction	Anterior chamber reaction
No lid involvement	Lid edema

Source: Stein RM, Clinch TE, Cohen EJ, et al. Infected vs. sterile corneal infiltrates in contact lens wearers. Am J Ophthalmol 1988 Jun 15;105(6):632-6.

Peripheral (Sterile) Corneal Ulcer



Infectious Corneal Ulcer



Corneal Ulcers

- The Steroids for Corneal Ulcers Trial (SCUT)
 - Moxifloxacin was administered every hour for 48 hours prior to the initiation of Pred Forte 4 times per day.
- Conclusions:
 - no overall difference in 3-month BSCVA and no safety concerns with adjunctive corticosteroid therapy for bacterial corneal ulcers
 - researchers did find significant vision improvement for one specific subgroup of the study by using steroid therapy on patients with severe ulcers
- Application to Clinical Practice:
 - Adjunctive topical corticosteroid use does not improve 3-month vision in patients with bacterial corneal ulcers unless in the severe category

Management

- Infective ulcers need to be cultured!
- If contact lens wearer, consider culture of contact lens case
- Intensive topical antibiotic regimen, consider fortified preparations (Fortified tobramycin or gentamicin (15 mg/mL) q1h, alternating with fortified cefazolin (50 mg/mL) or vancomycin (25 mg/mL) q1h), subconjunctival injections.
 - loading dose of moxi/gati/besifloxacin (4th Gen Fluoroquinolone) (Vigamox/Moxeza/Zymaxid/Besivance) e.g. 2gtts q 15 min x 1 hour
 - Consider adding additional topical antibiotic e.g. polymyxin B/trimethoprim (Polytrim[®]) depending on severity and associate factors
 - 1gt q 30 min x 6 hours,
 - 1 gt q 1 hr until f/u in 24 hours
 - If on visual axis or sight threatening, may need to consider hospitalization to ensure drops are being administered

ARMOR

- Antibiotic Resistance Monitoring in Ocular Microorganisms (ARMOR)
- Approximately 42% of isolates were determined to be MRSA
- Newer fluoroquinolones have better activity than earlier generations
- Besivance has the lowest MIC values of all the fluoroquinolones
- Vancomycin is drug of choice if MRSA present
- Azithromycin had very poor activity against Staph

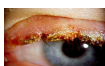
Doxycycline Effects

- Degrade extracellular proteins
- Inhibit MMPs
- Anti-inflammatory



Topical Antibiotics Review

Bacitracin (Bacitin)



- Only available in topical ointment due to instability in solution.
 - **Primarily gram + activity** so usually found in combination with a gram - compound
 - has a low rate of allergy and toxicity
- Bacitracin can sometimes be very difficult to find, so can prescribe Polysporin, AK-Poly-Bac, or the generic equivalent.
 - Polymyxin B is just “along for the ride” which can be a negative.
- Available in 3.5 mg tube.
- Mainstay of treatment for Staph Blepharitis.

Neomycin

- Oldest available aminoglycoside.
 - Available for oral, parenteral, and topical use.
- Found in combination with other antibiotics/steroids
 - **Maxitrol (Dexamethasone 0.1%/Neomycin/Polymyxin B) suspension/ung.**
 - Dosing is 1-2 drops every 3-4 hours, or ½ inch strip every 3-4 hours
 - Cortisporin (Neomycin/Polymyxin B/Hydrocortisone 1%) suspension/ung
- Side Effects: Contact dermatitis in ~ 4% of patients.
 - Classic findings include:
 - Erythema and mild edema of the lids
 - Conjunctival injection
 - Punctate epithelial erosions of the cornea
 - If a patient is allergic to neomycin, they have a 50% chance of also reacting to other aminoglycosides.

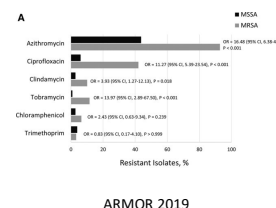


Gentamicin

- Ocular Uses: Conjunctivitis, Keratitis, and Blepharitis.
- Commercially available generically as 0.3% concentration solution (5 mL) and ointment (3.5 g tube).
- Side Effects:
 - Corneal Toxicity
 - Conjunctival Toxicity

Tobramycin

- One of the most commonly prescribed topical antibiotics.
 - Similar efficacy as gentamicin with less toxicity responses.
 - Cannot predict resistance to gentamicin vs. tobramycin
 - Has demonstrated good activity against MRSA
- Recommended for more severe infections after fluoroquinolones.
 - Used more commonly than other topical aminoglycosides.
- Okay for pediatric use > 2 months.



Tobramycin Combination Products

- Available in some of the most widely prescribed AB/Steroid combo.
 - **Tobradex (Tobramycin/Dexamethasone 0.1%) suspension/ung**
 - Available in 2.5 ml and 5 ml suspension and 3.5 g tube
 - indicated for steroid-responsive inflammatory ocular conditions for which a corticosteroid is indicated and where superficial bacterial ocular infection or a risk of bacterial ocular infection exists
 - **Zylet (loteprednol etabonate 0.5% and tobramycin 0.3% ophthalmic suspension)**
 - inflammatory eye conditions that involve bacterial infection or a risk of bacterial infection, including common conditions like blepharitis, nonspecific conjunctivitis, and contact lens-induced acute red eye

Erythromycin

- Erythromycin available in topical ointment form
 - Ilotycin[®] no longer available but generics are
 - For the treatment of superficial ocular infections involving the conjunctiva and/or cornea caused by organisms susceptible to erythromycin.
 - For prophylaxis of ophthalmia neonatorum due to *N. gonorrhoeae* or *C. trachomatis*.



<https://www.cdfhagidnews.com/current-events/hospital-forces-antibiotics-on-newborns-by-calling-security-guards-on-parents/>

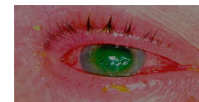
<https://www.webmd.com/drugs/2/drug/8652/erythromycin-ophthalmic-eye/details>

Topical Fluoroquinolones

- 2nd Generation:
 - Ciprofloxacin 0.3% (Ciloxin)
 - Ofloxacin 0.3% (Ocuflox)
- 3rd Generation:
 - Levofloxacin 0.5 and 1.5% (Quixin and Iquix) (not on formulary)
- 4th Generation:
 - Gatifloxacin 0.3% (Zymar)
 - Moxifloxacin 0.5% (Vigamox)
- Chlorinated Fluoroquinolones:
 - Besifloxacin 0.6% (Besivance)

Topical Fluoroquinolone Side Effects

- Exhibit minimal corneal toxicity.
 - Can form white precipitates after using Ciprofloxacin at frequent dosing intervals.
- Common Complaints Include:
 - Ocular burning, itching, & discomfort.
 - Bitter taste
 - Hyperemia, chemosis, and lid edema
 - Photophobia and Blurred Vision



Ofloxacin and Ciprofloxacin

- Only fluoroquinolones currently available in generic formulations.
- Solutions indicated for Bacterial Conjunctivitis and Keratitis by the FDA.
- Concentration dependent so consider loading dose treatment.
- Clinical uses today limited to non-visual threatening conditions (NO MORE ULCERS!) such as conjunctivitis and mild punctate staining of the cornea, etc.
 - This is due to high levels of resistance and newer medications with better efficacy becoming available.

Ciprofloxacin (Ciloxan) 0.3%

- Only fluoroquinolone available in solution and ointment.
- Manufactured by Alcon.
 - Solution is available in generic formulation currently.
 - Available in 2.5, 5, and 10 mL bottles and 3.5 g tube.
- Solution Approved for Patients > 1 year, Ointment > 2 years.

Ciprofloxacin

- Dosage often depends on clinical presentation, but FDA recommends:
 - Conjunctivitis:
 - 1-2 drops q2 hours X 2 days, then QID for 5 days for solution
 - ½ inch strip TID X 2 days, then daily for 5 days for ointment.
 - Keratitis
 - Day 1: Two drops q15 minutes X 6 hours, q30 minutes for the remaining hours and at least q4hours at night.
 - Day 2: Two drops q1hour
 - Days 3 – 14: Two drops q4hours.
- Most common medication involving corneal precipitate formation of all topical fluoroquinolones.
 - Seen on 17% of ulcers treated within 1-7 days.

Ofloxacin (Ocuflox) 0.3%

- Available in brand name and generic options.
 - Manufactured by Allergan.
 - Solution in 5 and 10 mL bottle.
- Approved for patients > 1 year of age.
- SE profile:
 - Much less stinging upon instillation than with fortified antibiotics or ciprofloxacin.
 - Does not cause corneal precipitates like ciprofloxacin.
- Conjunctivitis:
 - 1-2 drops every 2-4 hours X 2 days and QID X 5 days
- Keratitis:
 - Day 1-2: 1-2 drops every 30 minutes while awake and at least every 4 hours while sleeping.
 - Day 3-7: 1-2 drops every hour while awake.
 - Day 7-9: 1-2 drops QID.

Moxifloxacin 0.5% (Vigamox)

- Available from Alcon in 3 mL bottle of solution.
- FDA approved for bacterial conjunctivitis.
 - Dosing: 1 gtt TID x 7 days
- Approved for use in patients > 1 year.
- Designed to prevent resistance:
 - Additional bulky side chain anchors bacteria in the cell further combating resistance.

Moxifloxacin 0.5% (Moxeza) (US Only)

- New formulation of moxifloxacin 0.5% FDA approved January 2011.
 - Same active ingredient as Vigamox.
 - Reformulated with different inactives including xanthan gum and sorbitol.
 - pH of 7.4 and osmolarity of 300 – 370 are both slightly higher than that of Vigamox.
- Indications: Bacterial Conjunctivitis
 - Dosage: 1 drop BID X 7 days
- Approved for children greater than 4 months.

Gatifloxacin 0.3% (Zymar)(Canada Only)

- Oral equivalent removed due to side effects.
 - Caused Hypoglycemia/Hyperglycemia.
 - This is helpful against combating resistance.
- Days 1 and 2: Instill 1 drop into affected eye(s) every 2 hours while awake (maximum: 8 times/day).
- Days 3 to 7: Instill 1 drop into affected eye(s) 4 times/day while awake.

Gatifloxacin 0.5% (Zymaxid[®])

- ZYMAXID[®] (gatifloxacin ophthalmic solution) 0.5% solution is indicated for the treatment of bacterial conjunctivitis caused by susceptible strains of Staph, Strept and Haemophilus.
- Patients 1 year of age or older: Instill one drop every two hours in the affected eye(s) while awake, up to 8 times on Day 1. Instill one drop two to four times daily in the affected eye(s) while awake on Days 2 through 7
 - Generics are now available

Besifloxacin 0.6% (Besivance)

- FDA approved in 2009.
- First chlorinated fluoroquinolone.
 - Inhibits DNA gyrase and topoisomerase IV almost equally and with enhanced levels due to the C-8 chlorine.
 - No oral equivalent exists or is planned at the current time.
- These factors lead to less likelihood of developing resistance.
 - Effectivity against MRSA and other resistant pathogens has been illustrated.
 - Clinical Study of 2690 clinical isolate showed MIC levels 2-4X lower than with other antibiotics.
- Can be used in patients > 1 year
- FDA Approved for Conjunctivitis Only. Available in 5 ml bottle
 - Dosage: 1 drop TID X 7 days

Gramicidin

- Narrow Spectrum bactericidal medication.
 - Effective against Gram + Bacteria.
- Nearly equivalent in effect to Bacitracin.
 - Replaces Bacitracin when solution formulation is desired.
- Available as 0.0025% solution in combination with:
 - Polymyxin B 10,000 U/ml and Neomycin 0.175%
 - Brand Name: Neosporin

Polymyxin B

- Narrow Spectrum against gram negative bacteria including *Haemophilus influenzae*, *Neisseria*, and *Pseudomonas*.
- Ointments Available with Polymyxin B 10,000 U/ml:
 - Polysporin, AK-Poly-Bac, or Generics
 - Polymyxin + Bacitracin 500 U/g
 - Neosporin, AK-Spore, Triple Antibiotic Ointment or Generic
 - + Neomycin 0.35% and Bacitracin 500 U/g
- Solutions with Polymyxin B 10,000 U/ml:
 - Neosporin, Triple-Antibiotic Solution, or Generic formulations
 - Polymyxin + Neomycin 0.175% and Gramicidin 0.025%
 - Polytrim (Allergan) or Generic formulations (has good activity against MRSA and indicated in kids to 2 months of age)
 - Polymyxin + Trimethoprim 0.1%

Recurrent Corneal Erosion: Treatment

- If severe enough to cause vision loss or repeated episodes:
 - oral doxycycline with/without topical corticosteroid
 - Doxy 50 mg bid and FML tid for 4-8 weeks
 - both meds inhibit key metalloproteinases important in disease pathogenesis
 - Azasite (topical azithromycin)
 - Debridement (diamond burr polishing of Bowman's)
 - stromal puncture, or
 - PTK
 - Latest development: amniotic membrane transplant e.g. Prokera. Ambiodisk



Diamond Burr Polishing

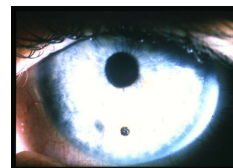
- Removes abnormal basement membrane
- Provides smooth surface for cells to grow



Vo, et al (2014): epithelial debridement with diamond burr polishing was 95% effective after single treatment in preventing recurrence for an average of 32 months follow up time

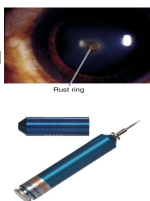
Corneal Foreign Body

- Frequent form of ocular trauma and a common work related injury
- Important to understand circumstance of injury (e.g. high speed projectile? Possible intraocular FB?)
- Glass, stone, organic material and metallic
 - (metallic FB will leave rust ring)
- Exam may have to be done with anesthetic (to obtain VA's, pupils, SLE)
- Evert upper lid to ensure no FB present



Corneal Foreign Body

- Examine with/without NaFl
- Closely examine anterior chamber for iritis
- Remove fb with corneal spud, jeweler's forceps, or small gauge needle
 - Rust ring can be removed with Alger brush
- Once FB is removed, treat like an abrasion
 - Topical antibiotic/AB-steroid combo
 - Bandage CL
 - Cycloplegia
 - Topical NSAID
- Follow up in 1-2 days to ensure abrasion has healed
- Patient may be increased risk of developing RCE's



CLARE

- Overwear of soft lenses or sleep in lenses
- awake early in the morning with symptoms of pain, photophobia and intense perilimbal injection and limbal edema
- Focal or diffuse epithelial and sub-epithelial infiltrates are usually observed in the mid-peripheral cornea



CLARE

- Several causes have been implicated:
 - hypoxia,
 - toxic effects from post-lens tear debris,
 - mechanical irritation,
 - dehydration of the tear lens during closed eye conditions,
 - solution hypersensitivity and
 - an immune response to toxicity or to bacterial toxins
 - Contact lens biofilm containing gram negative bacteria (e.g. *H. influenza*)

CLARE Management

- Treatment of CLARE is aimed at minimizing patient discomfort, recovery of normal function and patient education to prevent future occurrence.
- Consider:
 - Topical NSAID or steroid to reduce inflammation and increase patient comfort
 - Combo product? Tobradex or Zylet for additional antibiotic coverage secondary to CL wear
 - Cycloplegia?

Chemical Burns

- Chemical burns account for a small but significant fraction of ocular trauma.
- Majority of victims are young and exposure occurs at home, work and vehicle accidents (air bags)
- Damage dependent upon nature of chemical and how rapidly irrigation is started
 - Speed of initial irrigation has the greatest influence on the prognosis and outcome of eye burns
- Severity of ocular injury related to type of chemical, volume and pH of solution and the duration of exposure.

Alkali Chemical Burns

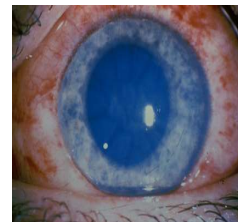
- Occur more frequently than acid injuries
- Tend to cause more severe injury than acids because the hydroxylion (OH) saponifies the fatty acids of cell membranes resulting in cell disruption and cell death. The alkali radical rapidly penetrates deeper into tissue of eye.

Alkali Chemical Burns

- Most common agents are:
 - Calcium hydroxide (lime) [plaster, mortar]
 - Potassium hydroxide [Nair]
 - Sodium hydroxide (lye) [Drano]
 - Ammonia [household cleaners]
- Penetration rate increases from calcium hydroxide (slowest) to ammonium hydroxide (fastest).
- Irreversible damage occurs at a pH above 11.5

Alkali Chemical Burns

- Alkali exposure results in:
 - Loss of corneal and conjunctival epi, stromal keratocytes and endothelium
 - Loss of clarity is secondary to stromal hydration
 - Damage to the vascular endothelium of conjunctival and episcleral vessels
 - Intraocular structures such as iris, lens and ciliary body are rapidly damaged if alkali penetrates cornea.



Acidic Chemical Burns

- Epithelium provides effective barrier to weak acids. Stronger acids cause protein precipitation in epithelium and stroma which creates a barrier to further penetration.
- Very strong acids penetrate as quickly as alkalis



Andrew Doan, MD, PhD
U of Iowa 2004

Chemical Burn Management

- Immediate irrigation is of paramount importance, even bypassing normal exam routine of assessing VA etc
- Most patients are disabled by severe blepharospasm and disorientation so require assistance away from harm and to initiate irrigation
 - Instill topical anesthetic drop and may need to instill every 10-15 minutes during irrigation
- Make sure to remove any solid particulate matter prior to beginning irrigation
 - Consider swabbing the lower fornices and flipping upperlid and swabbing with a cotton swab during irrigation to make sure to remove any retained solid material

Chemical Burn Management

- Minimum of 15 minutes constant irrigation (some recommend 30 minutes)
 - pH should be checked at 15 minute intervals until pH normalizes (7.3-7.6)
- Copious irrigation with water on site should be followed with irrigation with at least 1 to 2 L of normal saline solution (0.9%) or lactated Ringer's solution.

Chemical Burn Management

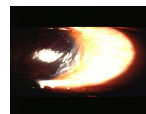
- Consider cycloplegic (e.g., cyclopentolate 1% or 2%, homatropine 5% b.i.d. to t.i.d.) if significant photophobia, pain, or AC inflammation. If limbal ischemia is suspected, avoid phenylephrine because of its vasoconstrictive properties
- Frequent (e.g., q1h while awake) use of preservative-free artificial tears.
- Consider topical steroids (i.e., prednisolone acetate 1% q.i.d.) as adjunctive treatment with topical antibiotic for a week even if epithelial defect is present, especially if alkali injury

Chemical Burn Management

- Oral pain medication (e.g., acetaminophen with or without codeine) as needed.
- If IOP is elevated, acetazolamide 250 mg p.o. q.i.d., acetazolamide 500 mg sequel p.o. b.i.d., or methazolamide 25 to 50 mg p.o. b.i.d. or t.i.d. may be given. Electrolytes, especially potassium, should be monitored in patients on these medications. Add a topical beta-blocker (e.g., timolol 0.5% b.i.d.) if additional IOP control is required. Alpha-agonists should be avoided because of their vasoconstrictive properties, especially if limbal ischemia is present

Thermal Burns

- Typically eye is protected by the lids and blink
- Usually more injury to lids
- Thermal burns are classified the same as chemical burns
- Severe burns may result in necrosis of lower lid, cornea and sclera
 - maybe relatively painless due to extensive destruction of nerve endings
- Thermal injuries tend to penetrate deep
 - have to address deeper tissue inflammation and damage



Thermal Burn: Management

- Remove any ragged or loose tissue
- Consider cycloplegic (e.g., cyclopentolate 1% or 2%, homatropine 5% b.i.d. to t.i.d.)
 - ? Bandage CL for pain management
- Consider topical steroids (i.e., prednisolone acetate 1% q.i.d.) as adjunctive treatment with topical antibiotic for a week
 - Possible antibiotic/steroid combination drop?
- Oral pain medication (e.g., acetaminophen with or without codeine) as needed.

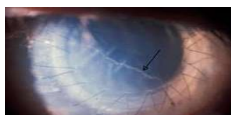
Corneal Transplant Rejection

- Helpful Mnemonic for possible rejection: RSVP
 - R- redness
 - S – sensitivity to light (photophobia)
 - V - blurred vision
 - P - pain



Corneal Transplant Rejection

- Clinical signs of graft rejection:
 - corneal edema
 - keratic precipitates on the corneal graft but not on the peripheral recipient cornea
 - corneal vascularization
 - stromal infiltrates
 - a Khodadoust line
 - an epithelial rejection line
 - subepithelial infiltrates



<https://pdfs.semanticscholar.org/133e/14677188273a0ee13481/62323334e5ed5e.pdf>

Corneal Transplant Rejection

- Management:
 - Heavy topical and possible systemic steroid use
 - Pred Forte 1% every hour (and may have to take drops over-night) with a slow taper
 - Durezol?
 - Addition of an oral steroid in very severe cases e.g. prednisone 40-80 mg per day
 - New Treatment Options: corneal neo is a higher risk for transplant rejection so the pre-treatment with anti-VEGF

The Eye Center

Name: Z. EVANS Age: 14 Race/Sex: BL / M Clinician: DR. LOOSEBERRY

Staff Doctor: DR. LOOSEBERRY OPH. CYL. AXIS. PRISM. ADD. SIGTYPE.

Demographic Data Confirmed: No HAD NONE

Date: 3/11/03 Occupation: STUDENT Date of Ref: _____ condition: _____

Chief Complaint

☐ Blurred/vision ☐ HPTs (at least 4) ☐ Symptoms: SEE INTO RED PAIN Medical History & ROS from 3/11/03 reviewed: no changes

☐ blue ☐ Location: PERIPHERAL - PT. 100 Allergies: NADA

☐ headache ☐ Quality: OD • MEDS: NONE

☐ field loss ☐ Severity: SEES DOUBLE • FORT: LEE HUBER @ TOWN, DULANE - WHEN MOVING EYES

☐ redness ☐ Duration: HAPPENED YESTERDAY • Timing: OD - SINCE BEING HIT

☐ existing condition ☐ Content: PAIN & ANNOY. HA - SWORE • Modifiers: OD - SILENT, SURPRISE

☐ watering/discharge ☐ Adm. YOUTHFUL • Exams & Observations: OD - BULGE - PICTURES @ BROWNS, CORNEA

☐ eye injury ☐ Double vision ☐ PMH: NO. 2 yrs ago DR. SIBBONS - healthy

☐ eye discomfort ☐ lumps/swelling ☐ PAST: OD - TYPE II - PAIN, CATHETER (N.I.)

☐ other ☐ Social: likes sports • Social: likes sports • Social: likes sports

☐ follow-up ☐ Social: likes sports • Social: likes sports • Social: likes sports

Head/Face ☐ al. Psych: Mood/Affect (anxiety/agitation/depression) ☐ al. Neuro: Oriented (person/time/place) ☐ y. ☐ n.

Head/Face ☐ al. Psych: Mood/Affect (anxiety/agitation/depression) ☐ al. Neuro: Oriented (person/time/place) ☐ y. ☐ n.

PERIPHERAL EDEMA

OD: 20 ft OS: 16 ft OD: 20 ft OS: 16 ft

V OD: NI V OS: NI V OD: NI V OS: NI

Acc. Amp OD: NPC OS: NPC

Cover Test Dist: thru Near: thru

Motility: FROM M.B. DULANE, N.I. @ PAIN, DULANE @ PAIN

Pupils: AS DIRECT OD @ COMBINATION OS: AS DIRECT OD @ COMBINATION

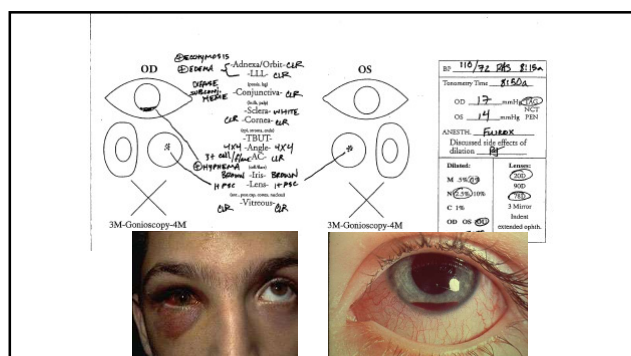
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PC-112 1102



Blow Out Fracture

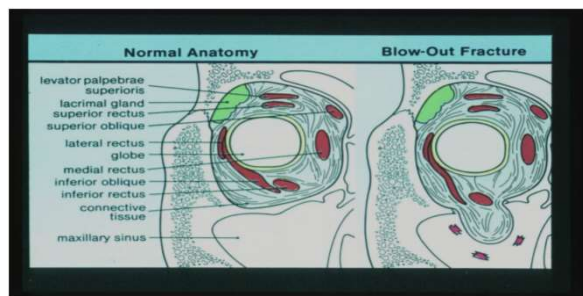
- Medial wall and floor commonly affected
 - Maxillary bone tends to be the most often affected
- Pain in direction of action of muscle, bruised or entrapped
- Diplopia (double vision) with limitation of muscle movement
- Numbness, crepitus, enophthalmos
- If hyphema is present, force of injury maybe sufficient to cause fracture
- May cause prolapse of muscle or surrounding fibrous septa which tethers inferior or medial rectus causing diplopia and restricted movement

Blow Out Fracture

- immediate referral for CT scan of the orbit and head to r/o orbital fracture (send to ER or if can contact PCP arrange through them)
 - educate to not blow their nose, try to minimize eye movement
 - debate on whether prophylactic oral antibiotics are indicated..if patient has sinus infection than may consider
 - if possible, would attempt to do a B-scan to ensure retina is intact but maybe difficult in this situation

Blow Out Fracture

- if confirmed blow out fracture, immediate surgery is considered in patients who have an oculocardiac reflex where the entrapped EOM results in bradycardia, vomiting, syncope or asystole
- Most often repair occurs after 1-2 weeks when inflammation has been reduced, and if there is continued entrapment or persistence of diplopia
- Oral steroids can be used to help reduce inflammation during this time (likely hesitant if a child)
- Pain management: oral pain medication so long as not an NSAID
 - E.g. extra strength Tylenol every 4 hours



Hyphema Management

- cyclopentolate 1% in office and prescribe 2-3 times per day (helps manage pain and prevent synechia formation)
- Pred Forte 1% every 2-3 hours (to treat the AC reaction and been found to help prevent rebleeds)
- Stress patient must be on bed rest with head elevated to 30-45 degrees to allow blood to settle and to help minimize rebleeds. This to occur after CT examination of globe and head.
- RTC 2-3 days to re-evaluate

Traumatic Iritis

- Dull, aching or throbbing pain, photophobia, tearing, onset of symptoms usually within 3 days of trauma.
 - Patients typically have pain in the traumatized eye when light enters either eye;
 - lower (due to ciliary body shock/shutdown) or higher (due to inflammatory debris and/or trabeculitis) IOP;
 - smaller, poorly dilating pupil or larger pupil (often due to iris sphincter tears) in the traumatized eye;
 - perilimbal conjunctival injection;
 - decreased vision
 - Occasionally floaters

Traumatic Iritis Management

- Cycloplegic agent (e.g., cyclopentolate 1% or 2% b.i.d. to t.i.d.).
- May use a steroid drop (e.g. Prednisolone acetate 1% q.i.d-q 2 hrs.)
 - Be careful of topical steroids if an epithelial defect is present.
- Around 1 month after trauma, perform gonioscopy to look for angle recession and indirect ophthalmoscopy with scleral depression to detect retinal breaks or detachment.

Anaphylaxis

- Severe, whole-body allergic reaction that is rapid in onset and may cause death
- 0.05-2% of people are estimated to have anaphylaxis at some point in their lives
- 3 main classifications:
 1. Anaphylactic shock
 2. Biphasic anaphylaxis
 3. Pseudo-anaphylaxis (non-immune anaphylaxis)

Anaphylaxis

- Pathophysiology:
 - IgE mediated (immunologic reaction)
 - Antigen binds to IgE coated mast cells and basophils -> degranulation of mast cells and basophils -> releases of inflammatory mediators such as histamine and cytokines
 - Increase contraction of bronchial smooth muscles
 - Trigger vasodilation
 - Increase the leakage of fluid from bv's
 - Cause heart muscle depression

Anaphylaxis

- Causes:
 - Food allergy
 - Medication allergy
 - Venom from insect bites
 - Less common causes:
 - Physical factors, biological agents (semen), latex, hormonal changes, food additives & food colors, topical meds
 - Idiopathic anaphylaxis -> 25-50% of cases
- Risk factors:
 - Atopy

Anaphylaxis

- Symptoms:
 - Typically present within minutes if exposure is IV within hours for food
 - Most commonly affected areas:
 - Skin (80-90%)
 - Respiratory (70%)
 - GI (30-45%)
 - Heart & vasculature (10-45%)
 - CNS (10-15%)

Anaphylaxis

- Skin involvement:
 - Hives
 - Itchiness
 - Flushing or warm skin
 - Swelling of the lips
 - Swelling of the tongue or throat (up to 20% of cases)
 - Runny nose
 - Itchy eyes



Anaphylaxis

- Respiratory involvement:
 - Shortness of breath
 - Wheezing
 - Stridor
 - Hoarseness
 - Pain with swallowing
 - Cough
- GI involvement:
 - Crampy abdominal pain
 - Diarrhea
 - N&V

Anaphylaxis

- Cardiac involvement:
 - Coronary artery spasm
 - Low BP
 - Tachycardia (rapid, weak pulse)
 - Low BP -> lightheadedness or loss of consciousness
- CNS involvement:
 - Confusion
 - Headaches
 - Anxiety
 - “impending doom”
 - Lightheadedness/dizziness
 - Loss of consciousness

Anaphylaxis

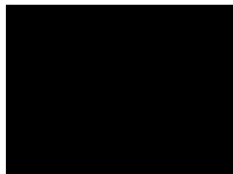
- Diagnosis:
 - Based on clinical criteria
- 1. Involvement of the skin or mucosal tissue plus either respiratory difficulty or low BP
- 2. Two or more of the following:
 - Involvement of the skin or mucosa
 - Respiratory difficulties
 - Low BP
 - GI symptoms
- 3. Low BP after exposure to a known allergen

Anaphylaxis

- Differential Diagnosis:
 - Vasovagal reaction (fainting)
 - Chest/MI
 - Pulmonary embolism
 - Panic attacks

Anaphylaxis

- Treatment:
 - Medical emergency***
 - EpiPen
 - Intramuscularly into the thigh
 - Antihistamines and/or steroids???
 - Airway management
 - IV fluids
 - Supplemental oxygen
 - Most are observed for 2-24 hours afterwards
- Prognosis?



Anaphylactic Shock

- What to do in your office
 - Call 911
 - Administer EpiPen
 - Check the person's pulse and breathing
 - Administer CPR
 - Allergic reaction from a bee sting -> scrape stinger off the skin with something firm
 - Prevent shock
 - Lie flat
 - Raise their feet
 - Cover with a blanket

Anaphylactic Shock

- Do NOT:
 - Assume that one allergy shot is enough
 - Place a pillow under their head if they are having trouble breathing
 - Give them anything by mouth if they are having trouble breathing

Anaphylaxis

- Long-term Management
 - Allergy shots??? (immunotherapy)
 - Avoid known allergens
 - Pre-medications if dye tests are needed
 - Desensitization to problem meds
 - Carry EpiPen
 - Long-term oral antihistamines or prednisone???
 - Medic-Alert bracelet

Summary

- Important points:
 - Prompt recognition of developing condition
 - Calm leadership approach
 - Have someone activate EMS
 - Supportive treatment:
 - CPR
 - Airway meds
 - EpiPen
 - Smooth, informative handoff to EMS
 - Consider implementing regular disaster drills