In-Office Care of the Emergency Patient: Corneal Urgencies and Emergencies

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- Dr. Harthan has no direct financial or proprietary interest in any companies, products or services mentioned in this presentation.
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Overview

- Corneal Abrasions
- Corneal Erosions
- Chemical Injuries
- Corneal Lacerations
- Corneal Foreign Bodies
- Corneal Ulcers
- Corneal Hydrops
- Epidemic Keratoconjunctivitis
- Herpes Simplex Virus Dendritic Keratitis
- Herpes Zoster Ophthalmicus

Format for Today’s Discussion

- Presentation of Case
- Review Etiology of Condition
- Discuss Management Options

Triage

- Emergent Situation
  - Requires immediate action
  - Patient is seen same day

- Urgent Situation
  - Requires patient be seen within 24-36 hours

- Routine Situation
  - Requires patient to be seen within a few days to a week

Symptoms can point you in the right direction...

- Redness
- Discharge
- Foreign body sensation
- Itching
- Burning
- Lid edema
- Photophobia
- Pain
- Changes in vision
Corneal Abrasion Management

- Antibiotic bid to q2hr
- Ointment qid
- Copious Lubrication
- NSAID
- Cycloplegic
- Bandage CL
- Pressure Patch
- Amniotic Membranes
- Follow up every 24 hours

Potential Complications

- Corneal scarring
- Infectious keratitis
- Decreased vision
- Recurrent erosions
Recurrence Corneal Erosion (RCE) Etiology and Pathophysiology

- Previous traumatic corneal abrasion
  - Fingernail, tree branch, paper
- Corneal dystrophies
  - Anterior basement membrane, Lattice, Granular
- Disturbance to Bowman’s layer

- Age: 24-73 (highest prevalence between 3rd and 4th decade)
- M:F (slightly higher female)
- Interval between initial abrasion and first recurrence: 2 days to 16 years
- 10% cases bilateral

RCE Acute Management

- Similar to treatment for abrasions
  - Antibiotics
  - Copious Lubrication
  - Cycloplegics
  - NSAIDs (topical vs oral)
  - Bandage CL
  - Follow up every 24 hours to several days

  May need to debride
  - If not healing in 24-48 hours

RCE Prophylactic/Long-term Management

- Hypertonic therapy
  - Muro 128 drops or ung qid
  - Doxycycline (50-100 mg bid)
  - Vitamin C
  - Azasite
  - Restasis and punctal plugs
  - Bandage and/or scleral lenses

- Amniotic membranes
- Autologous Serum
- Topical corticosteroids
  - Lotemax
- Surgical
  - Anterior stromal puncture
  - Phototherapeutic keratectomy (PTK)
  - Superficial keratectomy

**Most require combination therapy***

61 y/o AAF
24 y/o AAF

Etiology

- Eye injuries account for 4-7% of workplace injuries
  - 84% are chemical burns
- Incidence
  - 30 per 10,000
  - 82-91% men (16-45 y/o)
  - 90% accidental
    - Alkali 2x more common
    - 2/3 occur at work
    - 10% Intentional
    - Assault

Chemical Injuries

- Potentially vision threatening!
- No matter how busy... Chemical burns are seen FIRST!
- By-pass VA, quickly check pH, then begin immediate irrigation
  **IRRIGATE, IRRIGATE, IRRIGATE!!**
- Time and action are critical
- Severity is related to:
  - Properties of the chemical
  - Area of affected surface
  - Duration of exposure

Severity is related to:

- Mild = red eye (good prognosis)
- Severe = white eye (poor prognosis)

Grading of Severity

- Grade I
  - Involves corneal epithelium only
  - Limbal stem cells spared
  - No limbal ischemia
  - Cornea remains clear
  - Prognosis: Excellent

- Grade II
  - Partial loss of limbal stem cells
  - Focal limbal ischemia
    - <1/3 of limbus
  - Hazy cornea
    - Anterior segment structures are visible
  - Prognosis: Good

Chemical Injuries

- Acidic Burns
  - Sulfuric (battery acid), hydrofluoric, hydrochloric
  - Usually a self-limiting burn
  - Low pH: 6.9 or lower

- Alkali Burns
  - Lime, ammonia, sodium hydroxide
  - Very damaging - can easily penetrate all ocular layers
  - High pH: 7.1 or greater
Grading of Severity

- **Grade III**
  - Total loss of corneal epithelium
  - Loss of most limbal stem cells
  - Stromal haze
  - Extensive limbal ischemia
    - 1/3 to ½ of limbus
  - Prognosis: Guarded

- **Grade IV**
  - Complete loss of corneal epithelium and limbal stem cells
  - Opaque cornea
  - No view of iris or pupil
  - “Porcelainization”
  - > ½ Limbal ischemia
  - Prognosis: Extremely poor

Chemical Injuries Management

- Depends upon severity of burn
  - Severe burns (aka significant ischemia, open globe, periocular open wounds) = immediate external referral
  - Mild to moderate = treat the problem
  - Copious irrigation with normal saline for at least 30 min and repeat every 30 minutes until neutral pH is reached

Medical Management

- Double eversion of the upper eyelid
- Debridement of necrotic epithelium
- Artificial tears
- Antibiotic ointment
- Cycloplegic agents

Follow up every 24 hours!

Surgical Management

- Limbal stem cell transplantation
- Amniotic membrane grafting
- Division of conjunctival bands
- Correction of eyelid deformities
- Tarsorrhaphy
- Penetrating Keratoplasty
- Keratoprosthesis

Goals of Treatment: Reduce inflammation, promote epithelial regeneration, and prevent corneal ulceration

- Steroids
- BCL
- Sclerals
- Ascorbic acid (Vitamin C)
- Citric acid
- Doxycycline
- Punctal plugs

Goal: Promote revascularization of the limbus, restore limbal stem cells, re-establish fornices

54 y/o CM
Potential Complications

- Corneal Opacification/Scarring
- Symblepharon
- Dry Eye
- Ocular Ischemia
- Corneal Neovascularization
- Loss of limbal stem cells – irregular corneal surface
- Punctal stenosis or occlusion
- Limbal stem cell deficiency
- Pannus formation
- Cataracts
- Glaucoma

17 y/o AAF
Corneal Lacerations

- Etiology:
  - Industrial accidents
  - Traffic accidents
  - Home accidents
  - Assault
  - Traumatic wound rupture

Corneal Lacerations

- Immediate Referral
  - Small, partial-thickness lacerations may generally be treated as abrasions with patching therapy
  - Larger wounds often require immediate surgery
  - No ointment should be applied to the eye
  - Seidel Test
    - Positive = full thickness
    - Negative = partial thickness
  - Fox shield over eye for protection
    - Need to keep anterior chamber intact

29 y/o CM

Corneal Foreign Body Removal

- ***Accurate assessment of depth of penetration before removal***
  - Pupil irregularities, iris tears, transillumination defects, lens opacities, hyphema, shallow A/C, low IOP
  - Irrigation
  - Sterile cotton swab or sponge
  - Spud
  - Jeweler’s forceps
  - Needles
  - Alger brush
  - May need to remove deeper rust rings at a later date after they have migrated to the surface
Corneal Foreign Body Treatment

- After removal of foreign body
  - Measure size of resultant epithelial defect
  - Treat as for corneal abrasion
- Cycloplegic
- Antibiotic
- Bandage contact lens
- Corticosteroids
  - After re-epithelialization to reduce scarring
- Follow up
  - 24 hours

Look for signs of intraocular FB:
- Corneal laceration, iris tear, lens opacity, collapsed anterior chamber, low IOP

Corneal Ulcer

- INFECTION of the cornea by microbes
- Characterized by excavation of the corneal epithelium, Bowman’s, and stroma
- Infiltration
- Necrosis of tissue
- Ideally all cases should be cultured
- Realistically...
  - >2mm in size
  - <3mm from visual axis
  - >1/4 corneal depth

Corneal Ulcer Etiology

- Bacterial
  - S. aureus
  - S. pneumoniae
  - M. lacunata
  - P. aeruginosa
- Fungal
  - Fusarium
  - Aspergillus
  - Candida
- Acanthamoeba
Corneal Ulcer Risk Factors

- Eyelid disorders
- Chronic corneal disease
- Refractive surgery
- Blepharitis
- Chronic lacrimal drainage obstruction
- Immunosuppression
- Trauma
- Contact lenses
  - Poor personal hygiene
  - Contaminated solutions
  - Lens surface deposits
  - Non-compliance with disinfection
  - Lens manipulation
  - Corneal hypoxia with extended wear
- Poor personal hygiene
- Contact lenses
- Contaminated solutions
- Lens surface deposits
- Non-compliance with disinfection
- Lens manipulation
- Corneal hypoxia with extended wear

Corneal Ulcer Signs/Symptoms

- Clinical manifestations
  - Foreign body sensation
  - Followed by increasing pain and photophobia
  - Decreased VA
  - Marked conjunctival hyperemia and inflammation
  - Ciliary flush
  - Pupillary constriction
  - Mucopurulent discharge
  - Anterior chamber reaction, with or without hypopyon
  - Ragged, irregular epithelial ulceration with underlying necrotic stromal infiltration and surrounding epithelial edema

Signs in Chronological Order

- Infiltrate
- Circum-corneal injection
- Epithelial Defect
- Progressive Ulceration
- Enlargement of infiltrate
- Stromal edema
- Small hypopyon
- Severe infiltration
- Corneal perforation
- Endophthalmitis

Ulcer Vs. Infiltrate

- Discontinue CL wear
- Culture
- Broad spectrum topical antibiotic therapy
  - Consider loading dose of antibiotic
  - One drop q 5 min for 15-30 min
  - One drop q 30-60 min for 24 hrs
- Fortified subconjunctival or IV antibiotics
  - Cefazolin, vancomycin, gentamycin, tobramycin
  - Cycloplegic
  - Topical corticosteroids
  - SCUT study
  - Amniotic Membrane
  - PKP
  - CXL?
Fungal Keratitis Treatment

- Filamentous fungi: Natamycin 5% (Natacyn) q1hr (including during sleep)
- Yeast: Amphotericin B 0.15% q5min x 1 hour, then q1hr
  - Flucytosine orally 150mg/kg/day or topically 1% 1gt q30mins to inhibit fungal growth
- No Steroids
- Consider hospitalization
- Voriconazole

**Natamycin is the only commercially available antifungal for ophthalmic use in the US**

Acanthamoeba Keratitis Treatment

- Topical treatment often includes a combination of agents:
  - **Loading dose** (first 1-3 days)
    - Chlorhexidine 0.02% and/or PHMB (polyhexamethylene biguanide) 0.02%
    - AND
    - Propamidine isethionate 0.1% (BroleneTM)
  - POSSIBLY INCLUDE
    - Neomycin solution or fluoroquinolone
- All meds q1hr (also during sleep)
- Each drug given at the same interval separated by 5 minutes

Corneal Ulcer

- Follow up every 24 hours
- Pain level, inflammation, and size of defect should decrease continually
- Taper medications as needed
- Refer non-compliant patients and worsening ulcers

25 y/o AAF presented to ER

- CC: “bubble on pupil” OD, x 1 day
- (+) tearing, blurred vision, eye rubbing
- (-) pain, photophobia
- Decreased VA, longstanding
- (-) CL wear
- (-) meds
- PMH: (+)HTN, seasonal allergies, developmental disability
- **VAsc:**
  - OD 20/400 @ 2 ft
  - OS 20/70-2
- **PERRL(-)APD**
- **EOMS:** FROM
- **CVF:**
  - Restricted OD
  - FULL OS

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**Pachymetry**

**After 3 months of treatment**

**Pachymetry after 3 months**

**Corneal Hydrops - Signs & Symptoms**

- Decreased vision
- Pain
- Redness
- Photophobia
- Epiphora
- CL Intolerance
- Conjunctival Injection
- Corneal Edema
- Break in Descemet’s
- Bullae
- **Underlying Corneal Ectasia**
Standard Treatment Regimen

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topical Antibiotic</td>
<td>Prevent infection from ruptured bullae</td>
</tr>
<tr>
<td>Topical Hypertonic Solution</td>
<td>Decrease corneal edema</td>
</tr>
<tr>
<td>Cycloplegic</td>
<td>Pain management</td>
</tr>
<tr>
<td>Copious Artificial Tears</td>
<td>Reduce surface irritation</td>
</tr>
</tbody>
</table>

Keratoconus and Inflammation?
- Keratoconus may be a "quasi-inflammatory" disorder
- Tears from keratoconic eyes showed elevated levels of:
  - Pro-inflammatory marker IL-6
  - Pro-inflammatory marker TNFα
  - Tissue degrading MMP-9's
- Keratoconus may be due to an imbalance between pro-inflammatory and anti-inflammatory cytokines

Why Doxycycline?
- Inhibitor of MMP-9's
- Indirect anti-inflammatory properties
- Beneficial in treatment of recurrent corneal erosions
- Promotes corneal healing

Why Vitamin C?
- Excellent anti-oxidant properties
- Decrease apoptosis of corneal tissue
- Decreased scarring when used both orally and intravenously in cases of infectious keratitis

Epidemic Keratoconjunctivitis (EKC)
Pathogenesis
- Occurs in two phases
  - Acute
    - Begins unilaterally, then less severe in fellow eye
    - Follows 7-16 day course
  - Sequelae
    - More severe corneal involvement
- Bilateral in majority of cases
- Preceded by URI
- One week to 10 days after inoculation:
  - Sudden onset of profuse serous discharge
  - Periorbital pain
  - Severe follicular conjunctivitis
  - Chemosis
  - Petechial hemes on palpebrum
  - Moderate to severe eyelid edema
- Pre-auricular lymphadenopathy
- Potential pseudomembrane formation
- Corneal involvement
- SPK
- May appear as early as first or second week
- Virus-infected cells
- May form focal keratitis
Epidemic Keratoconjunctivitis (EKC)
Clinical Manifestations- Sequelae phase

- Variable course
- Subepithelial infiltrates
  - Within 7-14 days after onset of ocular symptoms
  - Early in third week
  - Variable number, location and density
  - Variable affect on VA
  - Delayed hypersensitivity reaction to viral antigen in overlying epithelium.
  - Immunopathologic response to viral infection of keratocytes in the superficial corneal stroma.

**Photophobia and reduced VA from adenoviral subepithelial infiltrates may persist for months to years.**

Epidemic Keratoconjunctivitis (EKC)
Management

- Patient is contagious!
- Patient education
- Hygiene!!!!
- Discard contact lenses
- Supportive therapy
- Peeling of pseudomembrane
- Topical corticosteroids
- Topical NSAID
- Cidofovir? (prophylaxis?)
- Zirgan
- Betadine 5% Sterile Ophthalmic Prep Solution
- Cyclosporine A 0.5-2.0%

Photo courtesy of Dr. Stephanie Klemencic
5% Betadine Ophthalmic Prep Solution

- Used for pre-surgical prep
- Off-label use for moderate to severe EKC
  - 60 second treatment followed by lavage
  - Pre- and post- treatment with topical NSAID
  - Topical steroid qid x 4-6 days

Patient Concerns:

- Am I contagious?
- How long am I contagious for?
- Do I need to stay home from work/school?

Herpetic Eye Disease: Review

- HSV eye disease is a wide spectrum of clinical problems.
- Ranges from dermatitis of eyelid, blepharitis of the lid margin, conjunctivitis, epithelial keratitis, stromal keratitis and iritis.

Herpes Simplex

- HSV I
  - Oral herpes
  - Upper body
  - Affects eye, mouth, skin above the waist and respiratory tract
  - Less commonly affects genitals
  - Transmission by direct contact

- HSV II
  - Genital herpes
  - Lower body
  - Less commonly affects the eye, but tends to be more severe
  - Sexual and neonatal transmission
Herpes Simplex

- Can affect anterior to posterior segment!
- Corneal aesthesiometry
  - Side that has herpetic infection will show reduced sensitivity!
  - Measurement:
    - Cochet-Bonnet aesthesiometer
    - Cotton wisp
    - Dental floss

Herpes Simplex: Dendritic Keratitis

- Symptoms:
  - Foreign body sensation
  - Increased lacrimation
  - Photophobia
  - Pain
- Signs:
  - Conjunctival hyperemia
  - Early SPK that then takes on dendrite pattern
  - Branching (dendritic) epithelial lesion
  - Knob-like end bulbs that stain with fluorescein and lissamine green

Herpes Simplex: Dendritic Keratitis

- Treatment:
  - Topical antivirals
    - Viroptic (Trifluridine) - 9x/day until re-epithelialization; then 5x/day x 7 days
    - Ziran (Ganciclovir) – 5x/day until re-epithelialization; then tid x 7 days
  - Oral antiviral as alternative or in conjunction
    - Acyclovir 400mg 5x/day
    - Valacyclovir 500mg tid
    - Famciclovir 250mg tid

Herpetic Eye Disease

- NEVER PUT A STEROID ON AN ACTIVE DENDRITE
  - But put one on just about every other ocular herpetic sequela
    - Disciform keratitis
    - Stromal keratitis
    - Herpetic iritis
    - Pseudodendrites?

Mechanisms of Ocular Involvement

1. Direct viral invasion → epithelial keratitis or conjunctivitis
2. Secondary inflammation → episcleritis, scleritis, keratitis, uveitis
   - Inflammation and/or degeneration of peripheral nerves, central ganglia or altered CNS signal processing may attribute to PHN
3. Reactivation → necrosis and inflammation in ganglia → neurotrophic keratitis
**Varicella-Zoster Virus (VZV)**

- **Chicken Pox (Varicella)**
- **Shingles (Herpes Zoster)**

**HZV Dendrites vs. HSV Dendrites**

- **HZV Dendrites:**
  - Grayish-white
  - Raised
  - “Painted on” appearance
  - Coarse and fragmented
  - No end bulbs
  - Stain poorly with NaFl
  - Stain well with RB
  - “Nummular Keratitis”

- **HSV Dendrites:**
  - Branching lesion
  - Flat
  - Terminal end bulbs
  - Stain well centrally with NaFl
  - Peripheral cells/ end bulbs stain with RB/LG

**Herpes Simplex vs Herpes Zoster**

<table>
<thead>
<tr>
<th></th>
<th>Herpes Simplex</th>
<th>Herpes Zoster</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dermatomal distribution</strong></td>
<td>Limited</td>
<td>More complete</td>
</tr>
<tr>
<td><strong>Dendrite appearance</strong></td>
<td>Larger, more branching, discrete, delicate pattern, more central</td>
<td>Smaller, less branching, coarse, blunted pattern, usually peripheral</td>
</tr>
<tr>
<td><strong>Epithelium</strong></td>
<td>Ulcerated</td>
<td>Blunted dendrite with slightly raised edges</td>
</tr>
<tr>
<td><strong>End bulbs</strong></td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td><strong>Scarring of skin</strong></td>
<td>Rare</td>
<td>Common</td>
</tr>
<tr>
<td><strong>Postherpetic neuralgia</strong></td>
<td>Rare</td>
<td>Common</td>
</tr>
<tr>
<td><strong>Iris atrophy</strong></td>
<td>Rare</td>
<td>Common</td>
</tr>
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</table>

**Varicella Zoster: Herpes Zoster Ophthalmicus**

- **Management:**
  - Topical antivirals: not effective
  - **Oral antivirals:** dosage is double that for simplex
    - Best if initiated within 48-72 hours
  - Most debilitating sequelae: post-herpetic neuralgia
  - Each case is individual:
    - i.e. if uveitis, treat uveitis appropriately
    - Topical artificial tears
    - Topical erythromycin ointment
    - Can spread over lesions as they crust over

**Recurrent Infection: HZO**

**Clinical Manifestation**

- Headache, malaise, fever, chills
- Neuralgic pain and hyperesthesia/edema of dermatome(s)
- Clear vesicle eruption, followed by yellowing and possible scarring
Hutchinson’s Sign

***Herpes Antiviral Treatment***

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<th>Herpes Simplex</th>
<th>Herpes Zoster</th>
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</thead>
<tbody>
<tr>
<td>Acyclovir (Zovirax)</td>
<td>400 mg 5x/day PO</td>
<td>800 mg 5x/day PO</td>
</tr>
<tr>
<td>Valacyclovir (Valtrex)</td>
<td>500 mg TID PO</td>
<td>1000 mg TID PO</td>
</tr>
<tr>
<td>Famciclovir (Famvir)</td>
<td>250 mg TID PO</td>
<td>500 mg TID PO</td>
</tr>
</tbody>
</table>

- **Goal:** Tx within 72 hours of Sn/Sx to ↓ risk of PHN and risk of ocular complications
- **Ideally** Tx with prodromal Sn/Sx (tingling, numbness along CN V1 dermatome) to achieve maximum benefit of Tx

Oral Antivirals

- **Contraindications:**
  - Caution with renal insufficiency – consult PCP

- **Side effects:**
  - Gastric distress
  - Mild nausea

- **Notes:**
  - Drink more water while taking antivirals
  - Start within 72 hours for best effect
  - Can also be used to prevent recurrence of stromal disease by approximately 50%
    - Acyclovir: 400mg bid x 1 year+
    - Valacyclovir: 500mg qd x 1 year+

Oral Antivirals

- **Effectively treats all expressions of acute herpes simplex disease**
  - i.e. orals expressed in tears, can treat epithelial HSK

- **High efficacy and high safety profile**
  - Very well tolerated
  - Few side effects and little resistance

- **All clinically perform identically**
  - Aim to Rx least dosage, usually valacyclovir
  - However, acyclovir is least expensive

- **Note that acyclovir comes as a liquid suspension**
  - Kids or adults with difficulty swallowing pills

Herpetic Eye Disease Study: HEDS

- **Older HEDS: focused on treatment of active disease**
  - No benefit to adding oral acyclovir in stromal keratitis if the patient is already taking topical steroids and antivirals
  - Topical prednisone is helpful in treating stromal keratitis

- **Newer HEDS: focused on prevention of recurrence**
  - Oral acyclovir 400mg bid reduced rate of recurrence of ANY form of ocular herpes in the following year by 41%
    - Gives 50% reduction in the recurrence of severe forms of ocular herpes
    - If patient already taking trifluridine gives no added benefit in preventing epithelial disease from developing into stromal disease or iritis

Herpetic Prophylactic Treatment

- **All reduce:**
  - Frequent debilitating recurrences
  - Bilateral involvement
  - HSV infection in a monocular patient

- Acyclovir 400mg bid
- Valacyclovir 500mg qd
- Famciclovir 250mg qd
Important Patient Education
...Questions that may arise

Am I contagious?
- Yes
- Lesions contain high concentrations of VZV
- Spread via contact and airborne route
- Can cause primary varicella (chicken pox) in susceptible persons

For how long?
- Once rash appears until lesions crust
- Approximately 14 days

Ocular Complications of HZO
- Conjunctivitis
- Pupil anomalies (Horner Syndrome, tonic pupil)
- Lid scarring
- Lipid filled granulomata
- Keratitis: nummular, stromal, disciform, mucous plaque, neurotrophic
- Episcleritis
- Scleritis
- Uveitis
- Iris atrophy
- Cataracts
- Classification of keratitis:
  - Acute keratitis (CNIII most common)
  - Optic neuretis
  - Chorioretinitis
  - Acute retinal necrotis
  - Progressive outer retinal necrosis

Varicella Zoster
- Primary Infection = Chicken Pox
  - Varivax vaccine
- Secondary Infection = Zoster/Shingles
  - Zostavax vaccine

Ocular manifestations can occur 4 to 6 days after skin vesicles erupt

Make sure to dilate!

Facial lesions healing/starting to crust

Day 7
Clinical Pearls

- Thorough history
- Symptoms can point you in the right direction
- Careful examination
- Treat each case individually
  - Consider newer approaches
- Follow up appropriately
- Refer as necessary

Thank You!
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