Ocular Trauma: Triage & Treatment

COPE ID: 21554-SD
Ernest L. Bowling, O.D., M.S., F.A.A.O., Dipl.
Private Optometric Practice
Gadsden, AL
Chief Optometric Editor
Optometry Times magazine

Significance

- According to Gallup polls, eye injury is the most feared disability
- Approx. 75% of information from the outside world comes from our eyes
- Half of the human cortex is dedicated to vision
- Prevention is much more effective than treatment

Epidemiology of Ocular Trauma

- Socio-economic factors
  - Rural/Agricultural: 32% result in legal blindness
  - Alcohol abuse
- Age
  - Young > Old (Av age 30); blindness greater in old
- Gender
  - Males 80% (4.6:1 males:females)
- Education
  - Inversely proportional

Why Should We Care?

U.S. Eye Injury Registry:
- 2.4 million eye injuries yearly in the U.S.
- Leading cause of monocular blindness
- Second leading cause of visual impairment (cataract 1st)
- One third of eye injuries in children → permanent visual deficit

Epidemiology of Ocular Trauma

- 25% eye injuries occur in the workplace
  - Cost over $450 billion annually
- 2001 workman’s comp claims due to eye injury...
  - $924,840,000
- 90% result from not wearing proper eye protection at the time of injury

Speaker Disclosures

- Alcon Speakers Bureau
- InSpire Speakers Bureau
- Bausch & Lomb Speakers Bureau
- Clinical Investigator, Bausch & Lomb
Cornea
- Small irregularities can result in significant loss of vision function
- Cornea is involved in >50% of all serious ocular trauma reported in the U.S.
- 83% corneal injuries involve males
- 52% corneal injuries involve full-thickness lacerations

Telephone Triage
- Your front office staff MUST be able to "triage" complaints
- Documentation!

What's Our Job?
- Recognize full extent of the injury
- Triage appropriately
- Initiate appropriate care/counsel/referral
  - Correct and complete diagnosis
  - Patient education, prognosis
  - Timely referral

CATAGORIES
- True Ocular Emergencies
  - Requires care in minutes to hours
- Acute Urgencies
  - Requires care within 6-12 hours same day
- Subacute Urgencies
  - Requires care within 12-24 hours
- ASAP
  - Care within 24 hours

TRUE EMERGENCIES!
- Requiring care within minutes to hours to save the eye and/or vision
- Chemical/alkaline burns
- CRAO
- Sudden loss of vision with or w/o trauma
- Flashes and floaters
- Post-surgical red eye/VA loss/pain
- High velocity projectile injury
- Orbital cellulitis

URGENCIES
- Endophthalmitis
- Penetrating injuries
- AACG
- Pupillary block glaucoma
- Orbital cellulitis
- Cavernous sinus thrombosis
- Corneal ulcer
- K foreign body
- K abrasion
- Acute anterior uveitis
- Acute retinal tear
- Acute RD
- Hyphema
- Lid laceration
- Acute vitreous hemorrhage
Acute Urgencies
- Requires care within 6-12 hours same day
- AAGC
- Blunt ocular trauma with or without vision loss
- Severe corneal pain associated with CL wear

Subacute Urgencies
- Requires care within 12 to 24 hours
- K abrasion (vs. K laceration)
- K foreign body
- Must r/o penetrating injury
- Dull aching pain without vision loss

Retinal Detachment
- Macula on or off?
- If macula on, stat refer to retinal surgeon
  - Instruct patient NPO
- If macula off
  - How long has the macula been off?
  - Good outcome for good VA is off <24 h
  - Macula off longer than 1 week – no real sense of urgency
  - Refer within 24 – 48 hours

Ocular Trauma Examination
Careful and complete history!!

ASAP
- Painful lesion
- Insidious painful eye
- New onset diplopia

History
- How did the injury occur?
- What are the circumstances surrounding the injury?
- Has the injured eye had any prior eye surgery?
Ocular Trauma Examination

- Physical Examination
  - Gross exam of head, eyes, ears, nose, face
  - Blood pressure and pulse rate
  - Review of systems
  - Medical History
    - Including tetanus vaccine status
  - HPI
    - Changes in vision, eye pain, swelling, discharge, etc.

Types of Ocular Trauma

- Mechanical
  - Superficial corneal/conj abrasions
  - Corneal/conj/scleral foreign bodies
  - Blunt and penetrating injuries

- Chemical
  - Thermal
  - Combination

Birmingham Eye Trauma Terminology System (BETTS)

- Eyewall: Sclera and cornea

- Closed globe injury: No full-thickness wound of eyewall
  - Lamellar laceration: Partial-thickness wound of eyewall, created by a sharp object
  - Contusion: Tissue damage created by energy of blunt force trauma
  - Superficial foreign body

- Open globe injury: Full-thickness wound of eyewall
  - Laceration: Full-thickness wound of eyewall, caused by sharp object
    - Wound at impact site, "outside-in" mechanism
  - Penetrating injury
    - Entrance wound only – corneal foreign body
  - Perforating injury
    - Entrance and exit wound, both caused by same agent – IOFB

Methods to Reduce Anxiety

- Reassure the Patient you can help him/her
- Explain procedures in advance, esp. to children
- Never patch both eyes unless both eyes are injured
- Place the Patient in a calm, quiet setting
- Be mindful of Patient’s privacy/modesty
- Be realistic, but not overly pessimistic about potential outcomes; impart a sense of hope and optimism (but never lie!)
- Explain in such a way the Patient understands the extent of injury; deliver the message with compassion and candor

BETTS Terminology

- Rupture: Full-thickness wound of eyewall, caused by blunt object
  - Eyewall yields at its weakest point to momentary increase in IOP, "inside-out" mechanism

Classification of Ocular Trauma

4 categories of globe injury at initial examination:

- Type
- Grade
- Presence or absence of APD
- Extent (zone) of injury
Classification of Ocular Trauma

Recommended Timing of Intervention

Corneal Abrasion

- One of the most common globe injuries
  - 15% of new patient ER visits
- Frequently accompanies deeper ocular trauma
- Results when basal epithelial cells are removed from the basement membrane
- Scarring occurs if Bowman’s layer is breached
- Source of corneal epithelial restoration is believed to be limbal stem cells at the corneoscleral junction
  - damage to these cells result in healing problems

Corneal Abrasion

- Symptoms appear out of proportion to the severity of the injury
- Photokeratitis (UV-induced corneal damage, welder’s burn) presents with similar symptomology to abrasion, but symptoms are delayed 6-12 hours post-exposure
- Topical antibiosis (4GFQ), NSAID and cycloplegia the preferred tx. PO analgesia. Bandage CL ?
- RTC 24 h

Mechanical Injuries
Corneal Abrasion
- 7-8% of corneal abrasions result in RCE
- RCE represents abnormal adhesion in the base of the epithelial defect
- Especially common if injury involves:
  - Fingernail
  - Paper cut
- Classic AM syndrome

Recurrent Corneal Erosion
- 7-8% of corneal abrasions result in RCE
- RCE represents abnormal adhesion in the base of the epithelial defect
- Especially common if injury involves:
  - Fingernail
  - Paper cut
- Classic AM syndrome

Corneal Foreign Bodies
- Represent 40% of eye injuries
- Strong association with high-risk activities without safety Rx – hammering, welding, grinding
- R/O any intraocular material
- Remove superficial FB with FB spud or 30-gauge needle, cycloplege, topical Ab and NSAID

Corneal Foreign Bodies
- Symptoms are frequently out of proportion to severity of injury
- Determine depth with thin optic section, esp. for transparent FB – glass or plastic. R/O self-sealing lacerations
- To ensure no corneal perforation/IOFB: Seidel’s, Gonioscopy, DFE
- Deep stromal FB: Leave in place if inert, small, non-toxic/antigenic, non-vegetative
Intraocular Foreign Body
- Intraocularly retained projectiles
- History is crucial diagnostic tool
- Primary purpose in detection is to prevent associated conditions (endophthalmitis, RD)
- MRI safety with metallic foreign bodies is still controversial; CT preferred imaging modality

Corneal Foreign Bodies

Corneal Foreign Bodies

Don’t Forget the Conjunctiva!
Intraocular Foreign Bodies

Corneal Lacerations
- Determine partial or full-thickness
- Check IOP, if possible
- If cannot check IOP, evaluate AC depth compared to fellow eye

Corneal Lacerations
- Small, self-sealing
  - topical antibiotic
- Large, self-sealing
  - bandage CL or corneal glue + Ab
  - suture if high risk of reopening
- Flaps
  - in place → bandage CL + Ab
  - displaced → flap repositioned, sutured in place
- If epithelial ingrowth → flap debridement + BCL

Lent opacification suggests injury to deeper intraocular tissues

Corneal Laceration with Iris Damage

Scleral and Corneoscleral Injuries
- Traumatic corneoscleral defects occur:
  - acutely from traumatic event
  - secondarily from tissue necrosis of post-traumatic inflammation/infection
  - most always require surgical intervention
  - suturing or patching
- Management goals:
  - restore integrity of globe
  - avoid further injury to ocular tissues
  - prevent corneal scarring and astigmatism
Case #1

- 32 year-old mechanic
- Fan belt broke and hit OD 15 min. ago (no safety glasses)
- VA OD 20/200 PHNII, OS 20/20
- SLE: Corneal, scleral and lid lacerations. Distorted pupil OD
- What do you want to know next?
  - Presence or absence of APD OD

Scleral and Corneoscleral Injuries

Role of the O.D.:
- Recognize the full extent of injury
- If questionable, treat as open globe
  - Tissue prolapse is diagnostic
- If appropriate, exclude or confirm presence of IOFB
- Institute medical therapy if indicated prior to surgical evaluation

Open Globe Injury

- Signs that suggest the presence, or possibility of open globe trauma include:
  - Obvious open wound
  - Collapsed or severely distorted eye
  - Prolapsed uveal tissue
  - Peaked pupil
  - SCH with shallowing, or deepening of the AC
  - Ocular hypotony

Global Rupture (Open Globe Injury)

If global rupture is suspected, protect globe and orbital adnexa...Never patch!
Global Rupture (Open Globe Injury)
- Protect the eye with a rigid cover (not a patch!)
- Do not instill any eye medications before evaluation by oculo-plastic specialist
- Oculo-plastic specialist will order imaging studies
  - X-ray with Caldwell, Waters and Lateral views
  - CT scan with axial, coronal and sagittal views

Blunt Force Trauma Eye Injuries
- Eye is struck with a solid object
- Extent of injury is dependent on size and speed of object
  - Smaller the object, greater the velocity
  - Small solid objects traveling at high speeds can cause global rupture (e.g., BB’s, paintballs)

Caldwell (Coronal) View

Waters View

Axial View

Lateral (Sagittal) View

Blunt Force Trauma

Case # 2
- 34-year-old attorney attending New Year’s Eve party
- His law partner shouts, “Watch this!”
- Young attorney turns to “watch this”…

Case # 2
### Case #2

**Sub-Conjunctival Hemorrhages**
- SCH w/ superficial conj abrasion, good VA
- Antibiotics and analgesics
- SCH w/ superficial conj laceration, good VA
- Reorganization of conj, possible suture with topical antibiotic
- Suspect posterior globe rupture if conjunctival abrasion/laceration accompanied by:
  - Lid swelling
  - Extensive SCH ("jelly roll")
  - Deepened AC
  - Poor VA
  - APD

### Mechanisms of Blunt Ocular Trauma

#### Coup
- Initial force produced at point of impact

#### Contracoup
- Shock wave transmission through ocular structures

#### Equatorial expansion
- Equator expands and distorts normal ocular architecture

#### Global repositioning
- Compression and repositioning at moment of impact, damaging internal ocular structures

### Traumatic Iritis
- Inflammatory reaction of the iris or CB
- Commonly seen after blunt trauma
- Pain, photophobia, epiphora
- May not present until 2-3 days post-trauma

### Blunt Force Trauma Eye Injuries
Case # 3

- 12-year-old boy gets paintball gun for Christmas
- Parents ignore Dr. Mason's article in *Southern Medical Journal* and allow Junior to play war games in wooded area behind their home
- Moderate discomfort, photophobia OS
- Entering unaided acuities:
  - OD 20/20
  - OS 20/100 PHN
- SLE OS reveals...

Iridodialysis

Iris Sphincter Rupture

Hyphema
Management Guidelines - Traumatic Hyphema

- Limited activity or bedrest w/ bathroom privileges
- Elevate head 30 degrees. Fox shield r-t-c!
- Atropine 1% t.i.d., or b.i.d. if microhyphema
- No ASA or NSAIDs; mild analgesics only (acetaminophen). No sedatives!
- If traumatic iritis develops (usu. 2-3 days after trauma), add prednisolone acetate 1% 4-8x daily
- For elevated IOP: beta blocker 1st; then alpha agonist. Avoid prostaglandin analogs & miotics

Traumatic Glaucoma

- Early onset
  - TM obstruction, inflammation
  - TM disruption
  - Hyphema
- Delayed onset
  - Angle recession
  - Lens-Associated
    - Phacomorphic, phacolytic, lens particle

Management Guidelines - Traumatic Hyphema

- Office visit daily for 3 days post-trauma/rebleed
  - Check VA, IOP, Slit (check for new bleeds)
- Glasses or eye shield during the day and at night for 2 weeks post-trauma/rebleed
- No strenuous activities (including Valsalva) for 2 weeks after initial trauma/rebleed
- Perform gonioscopy one month post-trauma/rebleed
- Treat increased IOP as indicated

Commonly injured intraocular structures following contusion:
Flowchart for Management of Traumatic Glaucoma

Pathophysiology of Chemical Eye Injury
- Complete corneal epithelial injury requires epithelium from the limbus, where stem cells of corneal epithelium reside
- The recovery of an intact and phenotypically normal corneal epithelium is the most important determinant of a favorable outcome following chemical eye injury
- With extensive corneal and limbal epithelial injury, the surrounding conjunctival epithelium provides the only source of epithelial regeneration

Alkaline Eye Injury
- Chemical Eye Injuries
  - Devastating injuries that may lead to blindness
  - Alkaline agents penetrate ocular tissues rapidly and continue to do so, causing severe damage
  - Acids cause proteins to coagulate on corneal epithelium and stroma, and acids precipitate out quickly, which limits ocular penetration

Alkaline agents commonly associated with eye injuries
- Ammonia*
- Lye*
- Magnesium hydroxide
- Lime

Angle Recession

Pathophysiology of Chemical Eye Injury
- Both alkalines & acids cause ocular surface epithelial cells to die upon contact
- Retained particulate matter in superior fornix can cause continued exposure
- Penetration of alkalines and acids into corneal stroma result in keratocyte death & loss of stromal clarity
- Hydration of collagen fibrils lead to thickening of TM and increase in IOP
- Time of penetration into AC varies (immediate for ammonia) & can result in secondary glaucoma, cataract, CB damage, hypotony, and phthisis bulbi with prolonged pH >11.5

Case SM - unresolved chemical burn s/p 4 weeks

Case SM - s/p 4 weeks chemical burn
Management of Alkaline Eye Injuries

- Prompt and copious irrigation
- Minimize duration of contact between chemical and eye in order to protect limbal stem cells
- Irrigate for 15-30 min; evert upper lid, irrigate fornices
- Check pH after irrigation; continue until pH 7.0
- Remove remnants of agents, double evert
- Debride necrotic corneal and conjunctival epithelium
- Administer topical and oral ABs/steroids, cycloplegics, BCL/patch (relief) and indicated glaucoma agents

Acid agents commonly associated with eye injuries

- Sulfuric
- Industrial cleaners, batteries
- Produces thermal injury also
- Sulfurous
- Fruit/vegetable preservatives
- Hydrofluoric
- Glass polishing, gasoline
- Acetic
- Vinegar
Acid Eye Injury

Management of Acid Eye Injuries
- Prompt and copious irrigation
- Minimize duration of contact between chemical & eye in order to protect limbal stem cells
- Irrigate for 15-30 min; evert upper lid, irrigate fornices
- Check pH after irrigation; continue until pH 7.0
- Remove remnants of agents. Double evert
- Debride necrotic corneal and conjunctival epithelium
- Administer topical & oral Ab's/steroids, cycloplegic, BCL/patch (relief) and indicated glaucoma agents

Management of Chemical Eye Injuries
- Sulfate contact lens
- 4GFQ: 1 gtt 4-6x/day (prevents infection)
- Prednisolone phosphate: 1 gtt q i-2 hr while awake (reduces inflammation)
- Vitamin C: 1-2 gm po qd (reduces corneal thinning/ulceration)
- 10% sodium citrate: 1 gtt q 2 hr while awake (chelates Ca++ and impairs PMN chemotaxis)
- Scopolamine 0.25%: 1 gtt tid (reduces pain/scarring with AC inflammation)
- 10% Mucomyst (n-acetyl-cysteine): 1 gtt 6x/day (mucolytic agent and collagenase inhibitor)
- Doxycycline 100 mg po bid (collagenease inhibitor)
- Glaucoma gtt/oral diamox if IOP elevated

Morgan Lens

Morgan Lens Instrumentation
- Morgan Lens
  - Molded scleral lens with an aqueous lock that is attached to an IV bag
  - IV bag with sterile 0.9% saline/lactated Ringer's
  - Litmus paper
  - Emesis basin or fluid management system
  - Topical anesthetic

Morgan Lens: Procedure
- Have the patient look down and insert the Morgan lens under the upper lid
- Position the lens horizontally as the patient looks straight ahead
- Adjust the flow to the desired rate
- Instill topical anesthetic
- Attach IV infusion tubing to the lens & start a minimal flow
Curling Iron Burn

Corneal Thermal Burn

UV Keratitis
- welder’s flash, tanning booth-eye
- luckily these risk factors seldom co-exist
- sx - pain, tearing, photophobia
  > 6-12 h after exposure
- slit lamp + fluorescein
- superficial punctate keratitis = microdots
- cycloplegia, eryth. ung., pressure patch o/n
- consider oral narcotic. It hurts!

Tissue Prolapse
- Defined as extrusion of intraocular content outside its normal compartment
- Classified as intrabulbar or extrabulbar
- Intraocular tissue prolapse should be suspected in all open globe injuries

Iris Prolapse through Limbal Surgical Wound (Extrabulbar)

Lens Injury

Uveal Prolapse through Corneal Laceration (Extrabulbar)

Vitreous Prolapse into Anterior Chamber (Intrabulbar)
**Lens Injury**

- Blunt trauma can break zonules.
- If 25% or more zonules are broken, the lens produces iridodonesis (trembling of the iris).
- If enough zonules are disrupted, the lens may:
  - Dislocate into the AC.
  - Occlude pupillary space (pupillary block glaucoma).
  - Subluxate into PC.
  - Be expulsed altogether.
- Contusion injuries can cause immediate traumatic cataracts.

**Lens Subluxation into Posterior Chamber**

**Lens Subluxated into Posterior Chamber**

**Penetrating Eye Injuries**

- Eye is pierced by sharp object or high velocity missile (BB, glass, metal-on-metal).
- Patient should be admitted to hospital for broad-spectrum IV antibiotics within 6 hours of injury.
  - Cephaloxin or fortified vancomycin plus
  - Gatifloxacin or moxifloxacin
  - Tetanus update.
- Endophthalmitis may develop, leading to permanent blindness.
- Nearly 25% of eyes that suffer penetrating wounds are eventually enucleated.
Penetrating Eye Injuries

- Nearly 20% of patients with ruptured globes do not have apparent signs of perforation.
- Vision may be excellent and the most important clue to occult rupture may be...
  - what the patient was doing at the time of injury!

Flowchart for Evaluation of Possible Open Globe Injury

Ruptured Globe

- If rupture suspected from clinical presentation, findings or history, apply metal shield or other protective covering.
  - Never patch!
- Slightest manipulation of a ruptured globe may compound an already serious problem.

Ruptured Globe

Orbital Blow-Out Fracture

- A patient presenting with an orbital blow out fracture has a history of blunt trauma to orbit.
  - Example: fist, baseball, beer bottle
Signs of Blow-out Fracture
- Restricted globe movement, esp. on elevation
- Orbital crepitus (subcutaneous emphysema)
- Lid edema & ecchymosis
- Hypoesthesia of the ipsilateral cheek, due to entrapment of the infraorbital nerve

Shaken Baby Syndrome
- 15% mortality rate
- Typical victims are male < 6 moa, who is alone with the perpetrator at the time of injury
- Incidence unrelated to race, socio-economic status or education
- Presenting sign is eye-related in 4 to 6% of cases
- Retinal hemorrhages in 50% - 80% of shaken babies
Predicting Functional Prognosis

- Global rupture and endophthalmitis carry poor prognosis for vision recovery
- Variables such as age, extent of wound, hyphema, initial VA, intraocular FB, lens injury, RD – controversial

Predicting Functional Prognosis - The OTS

<table>
<thead>
<tr>
<th>Score</th>
<th>ONS</th>
<th>TDF</th>
<th>OTS</th>
<th>IORS</th>
<th>IODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>64A</td>
<td>1</td>
<td>759</td>
<td>175</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>64B</td>
<td>2</td>
<td>959</td>
<td>959</td>
<td>95</td>
<td>35</td>
</tr>
<tr>
<td>74B</td>
<td>3</td>
<td>95</td>
<td>959</td>
<td>95</td>
<td>35</td>
</tr>
<tr>
<td>91A</td>
<td>4</td>
<td>15</td>
<td>215</td>
<td>215</td>
<td>715</td>
</tr>
<tr>
<td>91B</td>
<td>5</td>
<td>15</td>
<td>215</td>
<td>215</td>
<td>715</td>
</tr>
</tbody>
</table>

In Conclusion:
- Have a low threshold for an open globe injury
- Never use anesthetics except to examine a patient
- Be extra vigilant with contact lens wearers
- Always do a fundoscopy if you suspect child abuse
- Encourage trauma prevention with safety glasses

Disclosures
- I have no financial interest in any products mentioned in this presentation. I wish I did. I have 2 kids in college ...

References
Thank you !!!