Ocular Trauma and Emergencies

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Epidemiology

• Accidental eye injury is one of the leading causes of visual impairment
• >2.4 million eye injuries in the US per year
• 90% are preventable

• Most common cause of visual loss in persons under age 25
Epidemiology

• Leading causes:
  – Sports accidents
  – Consumer fireworks
  – Household chemicals and battery acid
  – Workshop and yard debris

• 48% of eye injuries occur at home
  – 1 in 5 are due to home repair or power tool use
History

- Age
- Occupation
- Brief history of accident
- Specific symptoms
- Prior condition of eyes
- General health
- Allergies
- Tetanus prophylaxis
Examination - Inspection

- Gross appearance
- Hand held light or penlight
- Slit lamp
- Fluorescein and Wood’s lamp
- Direct ophthalmoscope
Examination

- Visual Acuity
- Motility
- Pupils
- Visual Field
- Inspection
Examination - Acuity
Examination - Motility

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[Images of human eyes depicting various motility conditions]
Pupils

- Direct & Consensual Response
- “Swinging Flashlight” Test
Pupils: RAPD
RAPD

- Optic Neuritis, Optic Nerve compression, Optic Nerve ischemia
- Central Retinal Artery or Vein Occlusion
- Large Retinal Detachment
Eyelid Anatomy

- Lacrimal gland
- Tarsus
- Puncta
- Canaliculi of lacrimal sac
- Ampulla
- Lacrimal duct
- Inferior turbinate
- Valve of Rosenmüller
- Lacrimal sac
- Maxillary sinus
- Valve of Hasner
Anatomy of the Eye

Outside the Eye

- cornea
- iris
- muscles
- optic nerve
- pupil
- sclera

There are six extraocular muscles that work together to move each eye in its socket. One muscle moves the eye to the left, one moves the eye to the right, two move the eye up, and two move it down.
Extraocular Muscles
Review of Anatomy
Timing of Emergent Evaluation

- Within minutes:
  - Retinal artery occlusion
  - Chemical burns

- Within hours:
  - Endophthalmitis
  - Intra-ocular foreign bodies
  - Orbital cellulitis
Methodology

• When evaluating ocular emergencies and ocular trauma think anatomically anterior to posterior.
• Skin
• Orbit
• Nerves
• Globe (cornea, anterior chamber, iris, lens, vitreous, retina)
Emergent Clinical Scenarios

- Splash injury
- Sudden painless atraumatic loss of vision
- Transient atraumatic loss of vision
- Sudden painful atraumatic loss of vision
- Blunt injury

- Penetrating injury
- Atraumatic double vision (diplopia)
- Traumatic double vision
- Acute visual distortion
- Acute visual disturbance in immunocompromised individual
Emergent Clinical Scenarios

- Acute visual disturbance in post-op patient
- Floaters
- Flashes of light
- Acute proptosis
- Acute red eye
- Sudden corneal foreign body sensation
- Acute periocular pruritis
- Acute tearing
- Acute atraumatic periocular pain
- Atraumatic periocular swelling
- Acute eyelid twitching
- Acute eyelid droop
- Anisocoria
- “Blurred” optic nerve head
Eyelids & Orbital Emergencies
Super Glue

- Warm compress to loosen
- May need to trim lashes
- Gently rub to remove
- Remove glue from Cornea – Refer to Ophthalmology
- Treat Corneal Abrasion if present
Eyelid Lacerations
Eyelid Lacerations

• Should always be concerned about underlying open globe

• **Refer to ophthalmologist for**
  – Full-thickness laceration
  – Laceration involving medial $\frac{1}{3}$ of lid
  – Deep lacerations with or without fat prolapse
  – Lacerations with significant tissue loss

• Cover with damp, sterile dressing
Eyelid Lacerations

Full-thickness Lid Laceration
Eyelid Laceration

Canalicular Lacerations

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Acute Eyelid Droop

- Horner’s syndrome
- 3rd Cranial nerve palsy
- Following intra-ocular surgery/trauma
- Myasthenia gravis
- Corneal trauma (cornea abrasion)
- Botulinum toxin
- Aging (chronic)
Horner’s syndrome

• Injury somewhere along the sympathetic autonomic nervous system to the face.
• Caused by interruption somewhere along the sympathetic chain (see diagram)

• Symptoms: ptosis, miosis (constricted pupil).
• Signs: lower IOP, anhidrosis (loss of sweating).

3 important facts – ptosis, miosis, anhidrosis
• Refer to ophthalmologist or neurologist
Horner’s syndrome
Horner’s syndrome
Horner’s syndrome
Horner’s syndrome
3rd Cranial nerve palsy

- Acute onset of double vision, may be horizontal or vertical, disappears when one eye is closed.
- Ptosis, eye is “down and out” (CN IV and VI nl) with limited mobility.
- If pupil involved (dilated relative to other eye) then immediate imaging is required (to rule out mass lesion compressing brain stem).
- Can be painful if diabetes is the etiology
- Consult with an ophthalmologist or neurologist immediately
3rd Cranial nerve palsy

Left 3rd Nerve Palsy

Patient looking to her Right -- Left eye cannot ADduct
Orbital Trauma & Emergencies

- Orbital hematoma
- Orbital fractures
- Orbital Foreign Body
- Proptosis
Acute Proptosis
Acute Proptosis

- Orbital cellulitis
- Orbital pseudotumor
- Vascular abnormalities: carotid-cavernous sinus fistula, varix
- Retrobulbar hemorrhage
- Graves' orbitopathy
- Orbital vasculitis: polyarteritis nodosa, Wegener's granulomatosis, temporal arteritis
- Granulomatous disease: sarcoidosis
- Orbital tumors: primary, secondary, metastatic
Acute Periocular Pain

- Sinusitis
- Dry eyes
- Orbital pseudotumor
- Optic neuritis
- Diabetic cranial nerve palsy
- Orbital cellulitis
- Preseptal cellulitis
- (many others)
Orbital Cellulitis

- Cellulitis posterior to the orbital septum
- Symptoms - Red eye, pain, blurred vision, headache, double vision
- Signs - Eyelid edema, erythema, warmth, tenderness. Proptosis, restricted ocular motility with pain on attempted movement.
- Tx – consult ophthalmologist and obtain orbital CT. Will require oral/IV antibiotics.
- Needs to be differentiated from preseptal cellulitis which has salient features that differentiate the two including no vision changes, no restriction of eye movements.
Orbital Cellulitis vs. Preseptal Cellulitis
Preseptal Cellulitis

Figure 1 - Preseptal cellulitis
Orbital Cellulitis
Orbital Cellulitis
Orbital Hematoma

- If mild, treat with cool compresses
- If large amount of hemorrhage, especially behind the globe (Retrobulbar hemorrhage)
  - may require emergency surgery to reduce intraocular pressure and protect corneal surface
Periorbital Hematoma
Retrobulbar Hemorrhage

- Pain, decreased vision
- Proptosis
- RAPD
- Decreased Color Vision
- Elevated IOP
- May see on CT
- **Immediate** Ophth. consultation
Retrobulbar Hemorrhage

Lateral Canthotomy & Cantholysis
Orbital Fractures

- Diplopia
- Epistaxis
- Decreased facial sensation (infraorbital nerve)
- Crepitus
- Possible palpable bony “step-off”

- If severe, may have restriction of eye movement or enophthalmos
Inferior Rectus Muscle Entrapment

Patient Cannot Elevate Right Eye
Orbital Fracture

Traumatic Enophthalmos
Orbital Fractures

- CT scan – axial and coronal (thin cuts)
- Surgery not required unless persistent diplopia or poor cosmesis
- Surgery is usually delayed for 7-14 days to allow for resolution of swelling
- Nasal decongestants, oral antibiotics, ice packs
- Instruct patient not to blow nose (1-2 days)
Anterior Segment
Acute red eye

- Acute elevation in intra-ocular pressure
  - Acute angle-closure glaucoma
- Infection
  - Iritis/iridocyclitis
  - Conjunctivitis
  - Herpes simplex keratitis
- Inflammation/autoimmune
  - Episcleritis
  - Scleritis
  - Adnexal disease (lids, lacrimal apparatus, orbit)
  - Subconj hemorrhage
  - Pterygium
- Trauma
  - Corneal abrasions and foreign bodies
- Secondary to abnormal lid function
Acute angle-closure glaucoma

- Deep, boring pain unilateral located “in the eye”
- Haloes, nausea and vomiting common
- Acute rise in intra-ocular pressure (normal 12-18 mmHg), can be up to 60’s in angle-closure glaucoma
- Reduced visual acuity
- Red eye, hazy cornea and the iris is not clearly visible
- Pupil is fixed or semi-dilated, unreactive to light
- Requires immediate referral to ophthalmologist for pressure lowering medications or surgery
- Damage occurs to the optic nerve due to the drastically elevated intra-ocular pressure
Acute angle-closure glaucoma
Chemical Burns

Irrigate immediately before anything else
Alkaline (bases)

- Fertilizers
- Cleaning products (ammonia)
- Drain cleaners (lye)
- Oven cleaners
- Bleach (sodium hydroxide)
- Fireworks (magnesium hydroxide)
- Cement (lime)
Alkaline (bases)

- High pH
- Especially damaging – will denature proteins and lyse cell membranes which enhances penetration
Acids

- Battery acid (sulfuric acid)
- Glass polish/etching (hydrofluoric acid)
- Vinegar, nail polish remover (acetic acid)
Acids

• Low pH
• Depth of penetration usually less due to precipitation of proteins
Chemical Burns – Initial Treatment

- Apply topical anesthesia
- Copious irrigation, preferably with saline or lactated Ringer’s for at least 30 minutes
- May use Morgan lens or IV tubing
- Lid speculum may be helpful
- Check pH
Chemical Burns - Treatment

- Careful examination
- Be sure to evert the eyelids
- Cyclogyl 1%
- Antibiotic ophthalmic ointment
- Pressure patch
- Oral pain meds
- Refer to ophthalmology

Irrigation First
Thermal Burn

- Most common – cigarettes and curling iron
- Usually superficial burns
- Treat like chemical burn except no irrigation needed
- May need debridement of burned tissue
Thermal Corneal Burn
Ultraviolet Burn

- Welding or sun lamps without eye protection
- Produces small, diffuse epithelial defects which stain with fluorescein
- Becomes severely painful several hours after exposure
- Treat with Cyclogyl, antibiotic ointment, and pressure patching
Corneal Abrasions

- Usually a defect in superficial layer of cornea
- Can usually be seen without fluorescein
- Glows yellow/green with fluorescein and blue light
- Treat with Cyclogyl (dilating drop), antibiotic ointment or drops, and possibly pressure patch. Needs follow up exam
- **NEVER** prescribe topical anesthetic
Corneal Abrasions

- Non-CTL Wearer
  - Antibiotic ointment/drop (e.g. Emycin/polytrim)
  - Cycloplegic (cyclogyl bid)
  - May consider Pressure Patch (as long as not due to false fingernails or possibility of vegetable matter)

- CTL Wearer (Requires anti-pseudomonal coverage)
  - e.g. Ciloxan, Vigamox, Zymar q2-4hr
  - Cycloplegic
  - DO NOT PATCH
  - NO contact lens wear
Corneal Abrasions

• Follow-up – Refer to Ophthalmology
  – 24 hrs if patched
  – Large/central abrasion – Daily
  – Peripheral/small abrasion – 2-3d
  – CTL wearer—daily (once healed, NO CTL wear for 1 week)
Superficial Foreign Body

- Multiple linear epithelial defects suggests foreign body beneath the eyelid
- Be sure to flip upper eyelid with cotton-tip
- Can be removed if superficial with moist cotton-tip
- If embedded -- can be removed with cotton-tip or 25-gauge needle
  - however would consult ophthalmologist prior to removal

Key Point: Evert the Eyelids
Evert the Eyelids
Metallic FB with Rust Ring
Corneal Ulcer

- Trauma
- Contact Lens Wear
- Exposure

Refer to Ophthalmologist for immediate cultures and antibiotic treatment
Intraorbital/Intraocular Foreign Body

• High-speed projectile foreign body to eye or orbit

• Clinical Scenarios:
  – Weedeating or mowing
  – Grinding metal
  – Hammering or pounding metal
  – Motor vehicle accident
Intraorbital/Intraocular Foreign Body

- Refer to Ophthalmology for complete examination
- Need to rule out injury to globe or intraocular FB -- requires surgery
- CT scan orbits (1mm cuts, Axial & Coronal)
Subconjunctival Hemorrhage

- Very common after blunt trauma
- Superficial blood vessels broken
- May occur spontaneously (Coumadin, aspirin, valsalva)
- Usually self-limited
- Treat with artificial tears and reassurance
- May be suggestive of ruptured globe
Hyphema

- Blood in the anterior chamber (posterior to cornea and anterior to lens)
- Can be diffuse or layered
- Will require very careful ocular examination by ophthalmologist including ruling out ruptured/lacerated globe
- Place metal shield over eye and refer to ophthalmologist for further examination
- Need to know Sickle Cell status
Hyphema
Hyphema
Bloody Chemosis
RETINAL & OPTIC NERVE EMERGENCIES
Optic Neuritis

• Inflammation of the optic nerve in young adults
• Symptoms: unilateral loss of vision over hours to days. Orbital pain with eye movement, acquired loss of color vision, reduced perception of light
• Signs: Relative afferent pupillary defect, decreased color, central, visual field defects, swollen or normal optic disc
• Tx: Ophthalmologic referral – will require MRI and possibly IV steroids
• Can be a risk for multiple sclerosis
Optic neuritis

Normal optic nerve
Optic Neuritis
Optic neuritis

Pale optic nerve (after optic neuritis)
Floaters/Photopsia

- Floaters and photopsias (flashes of light) can represent normal aging process or other pathologies.

- Normal:
  - Floaters in the vitreous as it becomes more liquid as we age. Can cause posterior vitreous detachment (benign by itself but can lead to retinal tear and retinal detachment)

- Abnormal:
  - Posterior vitreous detachment leading to retinal tear and possible retinal detachment
Floaters
Posterior Vitreous Detachment
Retinal Tear
Retinal Tear
Retinal Tear w/ Detachment
Retinal Tear
Retinal Tear
Retinal Tear Treatment

S/p Laser Retinopexy
Retinal Detachment

• Symptoms
  – Sudden onset of new floaters or flashes of light in one eye
  – *Dark curtain* “moving over vision”
  – Blurred images in particular visual field in one eye

• Painless

• Increased risk in myopic patients (near sighted), patients with recent trauma.
Retinal Detachment
Retinal Detachment
Retinal Detachment Repair

Vitrectomy Instrument

Vitreous is removed

Fiberoptic light

Fluid goes into eye to replace vitreous

Vitrectomy
Choroidal Rupture & Retinal Hemorrhage

s/p Blunt Trauma
Endophthalmitis

• Infection throughout the inside of the eye cavity
• Pain, Decreased Vision, Red eye, Hypopyon, Vitreous inflammation
• Etiology:
  – Following trauma or surgery
  – Endogenous (in setting of systemic illness -- e.g. sepsis, pneumonia, endocarditis)
• Requires urgent treatment with injection of Antibiotics & sometimes surgery
Endophthalmitis

Hypopyon

Severe Intraocular Infection
Ruptured or Lacerated Globe
Ruptured or Lacerated Globe

- Be suspicious with blunt trauma, projectile injury, contact with sharp object, or trauma from hammering metal on metal
- CT scan of orbits (thin cuts – axial and coronal) to rule out intraocular foreign body – No MRI (in case of metallic FB)
- NEVER try to remove a penetrating Foreign Body
Ruptured or Lacerated Globe

• “Bloody chemosis” – hemorrhagic swelling of conjunctiva
• Uveal prolapse – brown spot on the sclera or cornea
• Irregularly shaped pupil
• Hyphema
• Lowered intraocular pressure
• If rupture or laceration is suspected, **stop** the examination immediately and place a hard shield (NOT A PATCH) over the eye.
Bloody Chemosis
Bloody Chemosis/Hyphema
Irregular pupil --

Due to iris prolapse through laceration
Corneal Laceration
Corneal Laceration
Traumatic Cataract
Penetrating Ocular Trauma
Ruptured or Lacerated Globe

If rupture or laceration is suspected, stop the examination immediately and cover eye with hard (plastic or metal) shield – not a patch
Protection during Transfer
Eye Injuries

PREVENTION
Prevention

Eye Protection

- None: 78%
- Unknown: 15%
- Other: 2%
- Safety: 2%
- Regular: 3%
THANK YOU!

Ocular Trauma and Emergencies

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Partial Surgery List

- **Retina:**
  - Scleral Buckle; Membrane Removal; Vitrectomy; Endo Laser

- **Lens:**
  - Cataract extraction +/- IOL; Secondary IOL; IOL Exchange

- **Strabismus:**
  - Muscle procedure

- **Cornea:**
  - Penetrating Keratoplasty; Pterygium with conjunctival transplant; Lamellar/patch graft; Conjunctival autograft

- **Oculoplastics:**
  - Dacryocystorhinostomy; Ptosis repair; Ectropion and Entropion repair; Lid laceration; Endoscopic brow lift; Levator procedures; Orbital decompression; Enucleation; Full thickness lid tumor
Partial Surgery List

- **Glaucma:**
  - Trabeculectomy; Seton procedures

- **Cornea:**
  - Radial keratotomy (RK); Pterygium; LASIK; Excimer laser surgeries (PRK, PTK); Automated Lamellar Keratoplasty (ALK); Astigmatic Keratotomy (AK)

- **Oculoplastics:**
  - Blepharoplasty; Tarsorrhaphy; Chalazion; Temporal artery biopsy; Excision of mass - partial thickness lid tumor; Conjunctivoplasty; Canthal plication; Trichiasis; Nasolacrimal duct (NLD) probing; Conjunctival tumors