

EVALUATION

1. Light perception in both injured and uninjured eye.
If a child has trouble with letters, a matching or picture chart can be used.
2. Visual acuity in both injured and uninjured eye, pinhole if needed.
3. Periorbital and eyelids tissues for bruising, lacerations, and ptosis.
4. EOMI- Examine movements of ocular muscles.
5. Anterior surface of the eye.
6. Rule out ruptured globe-
 - Blue, brown, or black material on the surface of eye as iris or choroid plugs the wound (first picture)
 - Teardrop pupil (first picture)
 - circumferential or bullous hemorrhage (second picture)
 - Seidel test with fluorescein- (**stream of aqueous dilutes the fluorescein as it streams down eye** (third picture)
 - Shallow or deep anterior chamber,
 - Afferent pupillary defect.
 - Protrusion of iris at corneoscleral border.
7. Dilate pupils- if no globe rupture, consider use of mydriatics. Tropicamide (Mydriacyl) 1% or Phenylephrine 2.5%.
8. Examine for red reflex.
9. Direct ophthalmoscopy to assess for papilledema or retinal hemorrhages.
10. Measure IOP if hyphema or proptosis and no globe rupture.



CORNEAL ABRASIONS

- Consult ophthalmology if
 - corneal infiltrates,
 - pus in the anterior chamber (hypopyon),
 - signs of traumatic iritis with ciliary spasm (irregular, uneven or fixed pupil)
- Treatment
 - Outpatient topical anesthetics not typically recommended due to corneal toxicity and masking sx.
 - Drop of 1% cyclogyl can relieve ciliary spasm
 - Eye patching no longer recommended for small uncomplicated abrasions after a Cochrane study showed slower healing and no relief of pain., may still be indicated for large abrasion (>50% of the cornea).
 - Antibiotic prophylaxis- limited evidence shows no benefit. Recommended if patient is a contact lens wearer in which case use Moxifloxacin 0.5% (\$10-60) or cipro (ciloxan) 0.3% ointment (\$73) to cover for pseudomonas, otherwise Erythro ointment optional (\$8-13), better than drops to lubricate the new epithelium.
- Prognosis
 - Most abrasions heal within 1-2 days.
 - Follow-up for larger abrasions (.4mm), contact lens wearers, sx lasting > 48 hrs.
 - Corneal abrasions related to agricultural work or infectious material especially high risk for bacterial keratitis

OCULAR BURNS

- 10% of all eye-related ED visits,
- Chemical ocular burns are a true ocular emergency, requiring immediate evaluation and treatment in an ED or urgent care to prevent permanent vision loss.
- Household cleaning products including drain cleaners, lye, and cosmetic agents are frequent offenders.
- Alkali substances are generally more dangerous than acidic compounds because of their ability to cause liquefaction necrosis of the cornea and rapidly penetrate into the deeper layers of the surface of the eye and anterior chamber.
- Concentrated ammonia and lye are particularly dangerous, causing ocular injury in less than 1 minute and 3 to 5 minutes, respectively.
- Fortunately, most household cleaning products are dilute and tend to result in chemical irritation rather than true chemical burns.
- Hydrofluoric acid, found in glass polish and rust removal agents, is especially dangerous with the potential to cause progressive tissue damage and lead to similar outcomes as alkali substances.
- Treatment
 - Pain relief
 - Irrigation with water, NS or LR with goal pH 6.8-7.4
 - Poor data on optimal duration of eye irrigation for chemical burns, especially in children.
 - Many ophthalmologists recommend continuous irrigation for 30 minutes and then every 15 to 30 minutes until the pH returns to the normal range.
 - The ocular pH should be rechecked 30 minutes after the eye is restored to a normal pH to confirm that the neutral pH is maintained.
 - Ocular irrigation can be particularly challenging in young patients and may require additional sedatives, papoose restraints, and the assistance of a child life specialist to ensure the safety and efficacy of the procedure.
 - After irrigation is complete, a thorough eye examination is necessary to look for any particulate matter and to evaluate the extent of ocular burn.
 - Most sources recommend treatment with topical antibiotic ointment such as erythromycin or tetracycline following an ocular burn.
 - Cycloplegic eye drops are indicated for pain relief and prevention of iris adhesion to the cornea and lens.
 - Ophthalmology consult for severe ocular burns

TRAUMATIC HYPHEMA

- Sign of severe blunt trauma with entry of blood into anterior chamber
- (between cornea and iris).
- At risk for delayed rebleeding into the anterior chamber, typically at 2-7 days after the initial injury and indicates a poor prognosis.
- Most hyphemas visible without a slit-lamp.
- Clinical signs to suggest a hyphema:
 - Pain with pupil constriction
 - Decreased visual acuity
- Grade 1- $<1/3$, 2- $<1/2$, 3- $>1/2$, 4- complete.
- Screen for sickle cell disease and trait, hemophilia, von Willebrand.
- Coag studies, CBC to check platelet, Sick cell testing in African Americans.
- Treatment
 - Initial emergency management of traumatic hyphema focuses on minimizing secondary hemorrhage and reducing



the incidence of secondary glaucoma.

- HOB elevated 30° to 45° to promote settling of the blood away from the visual axis.
- This improves the dx of secondary hemorrhage, promotes clearance of the hyphema.
- A recent Cochrane review concluded that the effect of ACA was not significant.
- Eye shielding, which increases patient comfort, should be done as soon as possible to reduce further injury and continued until the hyphema resolves.
- Topical analgesics, such as proparacaine, can be effective for acute pain control during examination. If additional pain control is necessary, narcotics can be considered.
- No NSAIDs hyphemas because of platelet inhibition and risk of rebleeding.
- Treatment with antiemetics is recommended to prevent increases in IOP from vomiting.
- Cyclogyl 1% TID assist with pain control and also assist with posterior chamber exam.
- Prednisolone eye drops 1%, 1 drop QID x 7d, ophtho f/u next day.
- Treat elevated IOP

Elevated IOP (greater than 22-24 mm Hg) can be treated with topical β -blockers; topical, oral, or intravenous carbonic anhydrase inhibitors (except in sickle hemoglobinopathies); and intravenous mannitol after consultation with an ophthalmologist. Acetazolamide promotes sickling of red blood cells, so methazolamide or humidified transcorneal oxygen is preferred in pediatric patients with sickle cell trait or anemia.

- Admission criteria

- Admission preferred for pediatric hyphema if
 - Penetrating ocular trauma
 - Secondary hemorrhage
 - Suspected child abuse
 - Hyphema > 50%
 - Risk of noncompliant family
 - Patients with Sickle cell disease

- **If no admission criteria then outpatient follow-up with ophthalmologist**

ORBITAL FRACTURES

- The clinical examination for orbital injuries in children can be difficult because it may be hard to distinguish a periorbital contusion (“black eye”) from an orbital fracture.
- Orbital dystopia (orbits in different planes) and enophthalmos (posterior displacement of the eyeball) are suggestive of an orbital fracture, as are flattening of the nasal complex and tele-canthus (increased distance between medial canthi of eyelids).
- Fractures of the floor of the orbit, also known as blowout fractures, are the most common orbital fracture in children older than 5 years.
- They typically occur when a medium-sized, hard object such as a baseball strikes the eye at high speed. Typically, the object deforms the eye, causing increased pressure of the intraorbital contents (Figure 12). The periorbital fat is forced through the floor of the orbit, which can lead to enophthalmos and inferior displacement of the eye.
- When the orbital floor fractures, it often breaks in a linear pattern, causing a “trap door” appearance. This can lead to entrapment of the inferior rectus muscle, clinically appearing as a limited upward gaze. The patient will often complain of pain with eye movement. Practitioners may appreciate restricted eye movement, subcutaneous or conjunctival emphysema, and hypesthesia (decreased sensation) in the distribution of the infraorbital nerve (ipsilateral cheek and upper lip).
- CT scans should not be reflexively obtained for all pediatric patients with facial trauma. Providers should use discretion and consider deferring CT imaging unless there are signs of severe injury or true signs of muscle entrapment.

- In children, the general indications for surgical repair include entrapment of extraocular muscles, early enophthalmos, persistent restrictive strabismus, and diplopia of central gaze.
- For conservatively managed orbital fractures, antibiotic administration is indicated if the patient has a history of sinusitis or diabetes or is immuno-compromised.
- In the absence of these risk factors, the use of antibiotics is at the discretion of the treating physician. The patient should be instructed not to blow their nose, and the use of nasal decongestants should be limited to 3 days. Oral steroids should be considered if there is extensive periorbital swelling.

TRAUMATIC IRITIS AND TRAUMATIC UVEITIS

- (inflammation of the larger uveal tract including the iris, choroid, sclera, and optic nerve) generally occur **24 to 72 hours after blunt trauma to the eye.**
- Classically, the patient is a young male complaining of unilateral symptoms of dull, aching eye pain, **redness, and light sensitivity a few days after an eye injury.**
- Diagnosis requires slit lamp microscopy to evaluate for the presence of white blood cells and protein that have leaked into the anterior chamber and aqueous humor due to inflammation of the ocular blood vessels.⁴ Management includes discussion with an ophthalmologist for possible dilating drops and/or topical steroids if the patient has significant symptoms.
- Children tend to develop more complications of uveitis, and there is an increased tendency for corticosteroids to lead to increased IOP and cataracts. Therefore, uveitis in the pediatric patient requires close ophthalmologic follow-up, and steroid drops should only be pre-scribed under their direction.^{4,52}
- Vision loss following a trauma may be suggestive of injury to the retrobulbar or posterior segment, especially when there is an absence of obvious findings on anterior and orbit examination. Examples of these subacute injuries include retrobulbar neuritis, choroidal rupture, retinal detachment, and commotion retinae.

RETROBULBAR NEURITIS

- Form of optic neuritis in which the optic nerve becomes inflamed and requires urgent intervention. In addition to traumatic causes, retrobulbar neuritis can be caused by infectious, inflammatory, allergic, and exposure etiologies. Vision loss can range from minimal to complete blindness. Patients typically complain of blurry vision, central vision loss, dull-appearing colors, pain with eye movement, or eye tenderness. Subjects may also have decreased pupillary response to light. Emergency consultation with an ophthalmologist is required to aid with the diagnosis and management, including treatment with steroids.

CHOROIDAL RUPTURE

- can occur in conjunction with an open globe injury, most are associated with closed globe injuries.
- They can occur from any type of traumatic injury, including forceps utilization during delivery in neonates. Blunt trauma at the site of injury, or from a location opposite to the injury site due to contrecoup forces, may also result in choroidal rupture. Patients present with decreased vision and white or yellow crescent-shaped streaks, usually concentric to the optic disc on fundoscopic examination. Overlying blood concealing the rupture often delays visualization of the injury until days after the trauma has occurred (Figure 15).^{8,55}
- Traumatic retinal detachment after blunt trauma can present with symptoms such as flashes of light, floaters, and curtains moving over the field of vision with or without vision loss. Prompt evaluation with a dilated fundus examination is required by an ophthalmologist to confirm the diagnosis, especially because the pediatric population may not be able to verbalize the symptoms above. The

location of the detachment and whether or not it involves the macula will guide timing of surgical repair.⁸

- Commotio retinae occurs when blunt trauma to the globe causes shock waves that travel posteriorly into the orbit and disrupt the photoreceptors. Patients may complain of decreased vision. On fundoscopic examination, there is a confluent area of retinal whitening from the edema and fragmentation of the photoreceptor outer segments (Figure 16).⁸ Visual acuity does not always correlate with the degree of retinal whitening. No treatment is required because the condition clears without therapy.⁸
- Iridodialysis, or disinsertion of the iris from the sclera, can occur with blunt trauma or penetrating injuries (Figure 17). Patients are usually asymptomatic unless symptoms of glaucoma develop. Patients should be encouraged to wear sunglasses or contact lenses with an artificial pupil. Surgical correction is reserved for large iridodialysis and/or symptomatic patients. Patient needs to be closely monitored for development of open-angle glaucoma.