Chapter 8
Trauma

The Eyes Have It by Tim Root

Take one pill now …

… and another if you wake up in the morning.
Eye Trauma
by Tim Root, M.D.

When I picked ophthalmology as a career, I never dreamed there would be so many midnight emergency room consults. Little did I know the number of people out there punching each other in the face and slamming their heads into airbags. Armies of welders, construction workers, and industrial cleaners ply their trade without proper eye-protection. Repeated exposure to this trauma can change your world outlook, such that I now dread baseball season, pellet guns, and fireworks. As odd and random as some of these injuries seem, it’s our duty to help these people and save those eyes!

**Famous Quotes**

I thoroughly disapprove of duels. If a man should challenge me, I would take him kindly and forgivingly by the hand and lead him to a quiet place and kill him.

*Mark Twain*

Here are some of the common traumas you’ll likely see coming into an emergency room.

**Corneal Abrasions:**

The surface of the cornea is covered by a thin layer of epithelium. This “rug” of clear skin is only loosely adherent and is easily scraped off. These surface
abradions are common and we see them daily. The cornea contains more nerve innervation (per surface area) than any other place in the body so these abrasions “hurt like the dickens,” with patients complaining of excruciating pain and intense photophobia. Abrasions are easy to see, even without a microscope, as the raw surface will uptake floresceine and glow bright green under a blue light.

Fortunately, abrasions recover quickly and will often completely heal within 24 hours. Until complete epithelial healing you treat with aggressive lubrication and follow these eyes closely to insure the raw wound doesn’t become infected. Many physicians will treat an abrasion with empiric erythromycin ointment as well, reserving more aggressive antibiotics like ciprofloxacin for contact lens wearers and “dirty wounds” caused by tree branches, etc. We talked about this in the infection chapter, so hopefully it sounds familiar!

If an abrasion does become infected, you’ll see a white infiltrate at the wound. Any abrasion with an infectious infiltrate is officially called a “corneal ulcer.” Depending upon the size and location of an ulcer, you may need to culture the wound and tailor your antibiotic coverage accordingly.

**Corneal Lacerations:**

Most corneal scratches only involve the surface epithelial layer. If the injury goes deeper into the stroma, then you have a laceration. With any laceration you want to insure that the cornea hasn’t perforated. You can check corneal integrity with the “Seidel test.” You wipe a strip of fluorescein paper over the wound and see if dye flows down the corneal surface, indicating leaking aqueous fluid.

If a patient is “Seidel positive” than you have an open-globe injury - time to call in your ophthalmologist for possible surgical repair!

**Orbital Wall Fractures:**

The bony orbital walls are thin and tend to break with blunt impact to the eye. This is especially true of the orbital floor and medial wall. These orbital fractures are common and you will see them often (they tend to occur at two in the morning).
Most of the time these orbital bones heal fine with no long-term problems, with patients merely having a great deal of orbital and periorbital swelling that resolves over a few weeks. However, sometimes the broken bone creates a “hinge” or “trapdoor” that entraps fat or extraocular muscles. If there is significant entrapment or enophthalmos, we need to repair the break. During surgery we can release the muscle and bolster the floor to keep orbital contents from herniating back through the defect. This surgery is usually performed by an oculoplastics specialist.

When evaluating orbital fractures, focus on the following exam findings:

1. **Vision, color**: Make sure the optic nerve isn’t involved.

2. **Extraocular movements**: Usually decreased from swelling or muscle contusion, but make sure there isn’t any gross muscle entrapment. If concerned, you can perform forced ductions. This involves pulling on the eye with forceps to see if the eye is mobile.

3. **Proptosis**: Measure the degree of proptosis or enophthalmos using the Hertel exophthalmometer (a fancy ruler).

4. **Palpate**: Feel along the orbital rim for step-off fractures and subcutaneous emphysema (air crepitus).

5. **Sensation**: Check sensation of the V1 and V2 sensation on the forehead and cheek. V2 runs along the orbital floor and can be damaged with floor fractures.

Most of these patients do fine and we see them a week later with marked improvement in swelling and motility. In the meantime, you treat empirically with Keflex or Augmentin, advise Afrin nasal spray, and recommend “no nose blowing” (you don’t want to blow air from the sinuses into the orbit).
Lid Lacerations:

When evaluating lid lacerations, you need to determine if the laceration involves the lid margin and how close the cut is to the canalicular (tear drainage) system. Most of these lid lacerations are straightforward to repair, though special effort is made to align the lid margins to avoid lid notching and misdirected eyelashes.

If the laceration is medial (near the nose) you need to worry about the canalicular tear system - repair of this drain is much more involved and involves threading silicone tubes down into the nose to keep the canaliculus patent.

Metal on Metal:

Small pieces of metal can fly into the eye – an unfortunate event occurring primarily in welders or construction workers. Particles of metal stick onto the cornea causing small abrasions and discomfort. Metal rusts quickly and will form a rust ring within a day. You can remove metal objects and rust rings at the slit-lamp using a needle. You can also use a small dremel-like drill to drill off the rust-ring. If the rust is deep, or aggressive pursuit seems to be making the situation worse, you can leave the residual rust in place as most of it will eventually migrate to the surface by itself.

Anytime you have metal-striking-metal injuries, you must entertain the possibility of an intraocular foreign body. Small metal fragments can enter the eye at high speed and leave little or no signs of injury. Metal is very toxic to the retina and can kill the retinal cells if not detected. If you have a suspicion for penetrating injury, you should order a thin-slice CT scan of the head to look for metal pieces not obvious on exam. You want to avoid MRI in this setting to avoid creating a moving projectile inside the eye.

Chemical Injuries:

Household cleaners contain abrasive solvents like bleach and ammonia that are extremely dangerous when splashed into the eye. The first thing you do with any chemical injury is:

Irrigate, Irrigate, Irrigate, Irrigate, Irrigate, Irrigate, Irrigate!

The final visual outcome for a chemical burn is going to depend upon how quickly the chemical is washed out of the eye. If a patient calls you with a chemical conjunctivitis, tell them to immediately wash their eyes out! If the ER calls you with a chemical burn, tell them to start irrigating immediately -
several liters in each eye. Then grab your equipment and pH paper and head on down there!

Acids are less dangerous than bases as acids tend to precipitate denatured proteins and this limits tissue damage. Bases, on the other hand, just keep on going like the proverbial Energizer Bunny so you need to continually irrigate and check the pH until it normalizes.

On exam you want to carefully check the state of the cornea – hopefully, it is still clear. A red, inflammed conjunctiva is actually a good finding: if the conjunctiva is white, that means its blanched out from extreme damage. Be sure to flip the lids and irrigate/sweep the fornices to remove any material that may be retaining chemicals.

Chemical injuries can lead to significant scarring that may require corneal transplant if bad enough, so you want to be very aggressive with that irrigation!! The emergency room has access to a simple device called a Morgan lens to help irrigate via a suspended saline bag. Little kids hate this thing and have to be restrained when using it.

**Fun Fact**

Speaking of abrasives: early Romans used human urine as a mouthwash to brush their teeth. The ammonia has strong cleaning powers. In fact, urine was an important component of toothpaste well into the 1700’s.

**Traumatic Iritis:**

Blunt trauma can create swelling and inflammation in the front half of the eye. Because the cornea is clear, we have a direct window through which to view the inflammatory cascade. On exam you can actually see “cell and flare” in the anterior chamber. Cells are individual inflammatory cells floating within the aqueous fluid while “flare” is diffuse protein that has escaped through inflamed blood-vessel walls.

Patients will complain of painful sensitivity to light secondary to iris/ciliary spasm. Individual cells can be difficult to detect at the slit lamp … and it doesn’t help when the photophobic patient is squeezing their eyes shut and yelling at you. You’ll find it helpful to turn the lights completely off and to make your light beam narrow, bright, and at an angle (like in this drawing).
Fortunately, traumatic iritis generally runs a benign course with resolution of symptoms within a week of treatment. We give these patients topical steroids to decrease inflammation and a cycloplegic to dilate the eye. I generally use a medium-duration dilator like Cyclogyl several times a day – the induced paralysis of the ciliary muscle makes the patient less photophobic. Also, daily dilation forces the inflamed iris to move and keeps it from sticking to the underlying lens.

**Hyphema:**

A hyphema describes blood floating in the anterior chamber, a common finding after blunt eye trauma. If the bleed is large, the blood will settle out in a layer at the bottom of the anterior chamber. If the entire AC is filled with blood, you'll see an “8-ball hyphema.” Most of the time, however, the bleeding is microscopic and can only be seen as “red cells” floating in the aqueous fluid.

Blood typically clears well, though you can get staining of the cornea if the blood is persistent or coexists with high eye-pressure. Encourage your patient to sleep with their head elevated (to help the blood settle) and to avoid straining. I typically give steroids (to decrease the inflammatory response) and a cycloplegic dilating drop to help with photophobia. As with iritis, this dilation also keeps the iris from sticking to the underlying lens and forming synechia. With African Americans, consider checking for sickle cell disease. If they do have sickle cell, avoid carbonic anhydrase inhibitors as they cause a local acidosis that worsens sickling.

Follow these patients daily, as the bleeding can get worse. The main danger time is days 3 to 5 because this is when clots can contract and rebleed. You need to monitor their pressure, as blood can clog the trabecular meshwork. After the blood has completely resolved and the eye is quiet, perform a thorough gonioscopy exam to access for “angle recession.” This is when the ciliary body splits from the blunt trauma -- this is a sign (but not a causative factor) that the patient has also likely suffered trabecular meshwork damage and may eventually develop glaucoma in that eye sometime in the future.

Speaking of fluid layering …
Open Globe Injuries:

The eye can be perforated many ways ... I've seen firecracker explosions, gunshot wounds, car wrecks, and domestic accidents that have perforated the eye. Visual outcome is usually terrible and a blind, painful eye may later need enucleation.

If you suspect an open globe injury you need to evaluate the eye in the operating room. One thing to remember - if you suspect an open globe injury, cover the eye with a shield and don't push on it. You could extrude the eye contents (pop it like a grape) if you push too hard.

"Thought I was a goner ... but it was just a paintball!"

Real World Application

The “black and tan” tradition of beer mixing originated over a thousand years ago when Viking explorers raided the Celtic islands. The Vikings would mix their lighter northern beer with the local dark beers. Later, the term “black and tan” came in use to describe the uniforms worn by cruel British soldiers sent to Ireland in the early 1920’s to suppress uprisings.

A black and tan is most commonly constructed with Bass Ale (an English bitter) and Guinness (an Irish Dry Stout). The Guinness is poured over the lighter colored beer using an inverted spoon to disperse the Guinness and decrease mixing. The beers have different densities and so will remain “layered.”

The “black and tan” is enjoyed by beer enthusiasts who find a straight stout too harsh. However, you may want to avoid ordering one in Ireland because of its historical relevance.
1. You have a contact lens wearer with a small corneal abrasion. He is in excruciating pain and requests that you pressure-patch his eye for comfort. Will this speed up healing?

Patching may speed healing by keeping the eye immobile and lubricated - but you should never patch an abrasion that might fester an infection. Thus, you don’t patch contact lens wearers as you don’t want a pseudomonas infection brewing under that patch! If you decide to patch a patient, you should really follow them closely to make sure they don’t develop an ulcer.

2. What’s the easiest way to see a corneal abrasion? How often do you need to follow simple, non-infected abrasions?

Abrasions are easiest seen with fluorescein under the slit-lamp microscope, though large abrasions can be detected with only a handlight as the edges of the abrasion create a circular shadow on the iris underneath. You’ll want to measure the epithelial defect and see the patient often (sometimes daily), until it heals to make sure they don’t become infected.

3. What is the Seidel test?

This is a method to see if a laceration has penetrated completely through the cornea. Basically, you’re using fluorescein to look for leaking aqueous fluid.

4. What findings would prompt you to take a patient with an orbital floor fracture to surgery?

If the patient has muscle entrapment or significant enophthalmos. Most patients have some degree of EOM restriction from soft-tissue swelling. Entrapment causing reflexive bradycardia would also push you toward surgery.

5. What portion of the eyelid do you worry about with lid lacerations?

If the laceration is medial (near the nose) it could involve the tear drainage pathway. These canalicular tears are more complicated to repair.
6. A patient accidentally splashes a large amount of bleach-based cleaner in her eye. What should she do?
Wash it out immediately - the faster, the better!!!! If an ambulance picks her up, have the EMTs irrigate in route, and alert the ER to irrigate her eyes as soon as she hits the door.

7. What is the best way to test the pressure in an eye with a likely open-globe injury: with slit-lamp applanation or with the hand-held tonopen?
If you suspect open globe, you don’t want to be mashing on the eye, so neither of these is correct. This is a trick question … hahahahaha! Seriously, though, don’t push on the eye.

8. How often should a patient with a hyphema be seen and why?
These patients need to be seen almost daily for the first week to check for pressure. This is especially important on post-trauma days 3 – 5 as this is when clots begin to retract and rebleed.

9. An African American presents with hyphema after trauma. What additional workup might you consider? Are there any medications you would avoid?
You may consider getting basic coagulation labs and a sickle prep. Avoid CAIs as these promote acidosis and can worsen sickling of blood in the anterior chamber and worsen glaucoma.

10. What two beers are most commonly used when making a “black and tan.” Which beer goes on top?
A black-and-tan is made with Bass Ale and Guinness Stout - the Guinness goes on top and is usually poured over a spoon to keep it from mixing.