Learning Objectives

1. Utilize several different types of eye examination (e.g., slit lamp examination, and ophthalmoscope) methods and how to interpret the results accurately.
2. Recognize globe rupture, avoid complications.
3. Distinguish the signs and symptoms of hyphema and how to treat it in an urgent care setting.
4. Identify possible etiologies of acute red eye.
5. Diagnose complications associated with diabetes and diabetic eye disease.
6. Identify and treat retinal detachment.

Ocular Emergencies in ED

Most Common

- Trauma
- Retinal detachment
  - flashes, floaters, visual field defect
- Central retinal artery occlusion
  - CRAO

True ocular emergencies

- Glaucoma
  - Acute angle closure
- Infection
  - Orbital cellulitis
- Ischemia
  - Central retinal artery occlusion
- Visual field defect
  - Acute retinal detachment
- Trauma: chemical, blunt

AUDIENCE RESPONSE SYSTEM

Which clinical diagnosis does not require immediate eye referral?

a. Acute angle closure glaucoma
b. Orbital cellulitis
c. Central retinal artery occlusion
d. Acute retinal detachment
e. Trauma: chemical, blunt
1. Utilize several different types of eye examination methods (e.g., slit lamp examination, and ophthalmoscope) and how to interpret the results accurately.

**GENERAL EYE EXAM / TOOLS**

**Eight-part Eye Exam**

1. Visual Acuity / Color Vision
2. External Examination
3. Ocular Motility
4. Pupils
5. Visual Fields
6. Tonometry
7. Anterior Segment Examination
   - Slit-lamp
8. Fundus Examination
   - Ophthalmoscopes

**Preparation**

- History
- Focused physical exam
  - Eye exam bills at level 3
- Comfort of patient
  - Anesthesia
  - Clean instruments

**Pain Management**

**PROPARACAINE**
- Onset 15 seconds
- Duration 20 minutes

**TETRACAINE**
- Onset delayed
- Duration > 1 hour

(COCAIN) *SOFTENS CORNEAL EPITHELIAL* EOL

**Eye Drops**

- Have patient look up
  - Keep tip off eye

- Treat **both** eyes
  - Avoids blepharospasm

**Eye Drops**

- Alternative Method
  - Create small lake
  - Allow to warm up

- Topical anesthesia if
  - Blepharospasm
  - Tonometry
  - Prior to fluorescein

Photo courtesy of Theodor Pesch, MD, PhD
**Eye Drops**

- Open eyes:
  - Automatic inoculation
- Keep tip off eye
- Single use containers
  - Avoid *P. aeruginosa*

**Medical Mydriasis**

**Caveats:**

- Vision blurs
- Accommodation impaired
- Threatened **Acute Glaucoma**
- Must not operate machines, drive
  - Bring sun shades, driver

**Medical Mydriasis**

Avoid dilating pupils if:

- Flat anterior chamber
- Narrow anterior chamber angle
- Can precipitate **acute glaucoma (NAG)**

**Medical Mydriasis**

Quick tests to exclude Narrow A/C Angle

- Slit Lamp Exam
- Penlight Test
  - Illuminate cornea *tangentially*
  - If the light extends over more than 1/3 of the iris, refer to an ophthalmologist

**Abnormal Penlight Test**

Visual Acuity, Color Vision, Visual Fields, Ocular Motility, IOP

**INITIAL DATA COLLECTION**
**Visual Acuity**

- Should be **20/20** for all
  - Enter written order for billing
  - Obtain pre- and post procedure documents pre-existing condition

- **PIN-HOLE test**
  - blocks aberration
  - If VA improves → refract

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**Pinhole Visual Acuity**

- Hypoacmic Eye
- Myopic Eye
- Near sighted: myopic
- Normal sighted: emmetropic
- Far sighted: hyperopic

**Stenopaeic filters:** only most central beams pass through the pinhole aperture, blocking aberration from the lens periphery: better acuity.

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**Causes of Traumatic Visual Loss**

1. **Refractive Error** - pinhole test!
2. **Media Opacities** -
   - subluxed lens, corneal scar, vitreous hemorrhage, hyphema
3. **Macular Disease** -
   - choroidal rupture, retinal detachment, commotio (retinal concussion)
4. **Optic Nerve Disease** -
   - traumatic optic neuropathy, CN2 avulsion

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**Myopia**

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**Corrected Refraction**
PERRLA?

- Test accommodation
- Headaches
- Arms too short to read

- If not done, it is PERRL!

VISUAL FIELD SCREENING

Eyesight with Glaucoma

Kestenbaum Test

Kestenbaum Test
**Kestenbaum Test**

- Test 360°
- Retest randomly

**Near Visual Fields**

**Amsler Grid Tests Macula**

- Focus on the central dot with one eye covered.
- Am I able to see the corners and sides of the square?
  - Do I see any wavy lines?
  - Are there any holes or missing areas?
- If the lines of grid do not look straight or areas appear to be missing and/or distorted, you should inform a retinal specialist.

**Peripheral Visual Field > 30°**

**Landmark: Optic Disc Size**

- ≈ 1.5mm across
- ≈ 1500 microns
- ≈ 5.5 degrees
- ≈ 1 disc-diameter (1DD)

The smallest aperture in the direct ophthalmoscope projects a spot of light = surface area of a normal optic nerve head.

**COLOR VISION & IOP**
**Opthalmology**

**Color Vision**

- *Ishihara Test* for screening
  - Only test red/green opponent colors

- *Velhagen Panel D-50 Test*
  - Also tests blue/yellow system
  - Saturated
  - Desaturated

**Acute Angle Closure Rx**

**IMMEDIATE** home remedies

- Bright lights
- Hot soaks
- *Double shot Booze*

**Quick Digital Tonometry**

- Palpate globe with index fingers:
  - One senses shockwave
  - One feels for ocular compliance

**Digital Tonometry**

- Tonopen
  - Sterile disposable diaphragm
**Schiøtz Tonometry - avoid**

- Plunger indents anesthetized cornea
- Use average read outs of 3 weights
- To calibrate scale, adjust plunger on reference cornea

**Goldmann Applanation Tonometer**

- Gold standard tonometer
- Slit lamp mounted
- Sterilizable tip.
- Prions take exception

**Goldmann Applanation Tonometer**

Goldmann Mires aka Semicircles

**SLIT LAMP**

- A slit lamp serves to view the anterior segment of the eye in high magnification

**Portable Slit Lamp (Heine)**

- Ocular / Objective @ 45° to beam
- Helpful in determining anterior chamber depth
Reversal of acute NAG

- Lost anterior chamber in narrow angle glaucoma.
  - Rx: serial Pilocarpine eye drops, IV Diamox, IV Mannitol

Glaucoma - NAG

Acute Narrow Angle Glaucoma
- 10% of all glaucoma - 2nd commonest
  - Apposition of the anterior chamber angle
    - a.k.a. synechial closure
    - aqueous drainage site
    - anterior displacement of lens-iris diaphragm
  - Resultant high IOP rapidly damages CN2

The sun must not set over an acute NAG*

Facial Soft Tissue Injuries

- Ca. 2.4 million traumatic eye injuries each year in the US
- up to 15% of these occur in the workplace

On SUSPICION of Rupture

- DO NOT
  - instill eye drops or ointments
  - evert the eyelid
  - put any pressure on the globe

- DO:
  - Boost tetanus / diphtheria immunity
  - Place orbital shield

2. Recognize globe rupture, avoid complications.
GLOBE RUPTURE

Ruptured Globe

- Maintain high level of suspicion
  - history, mechanism, exam
    - Subconjunctival hemorrhage, Chemosis
  - Conjunctival/scleral laceration
    - Seidel test
    - Irregular pupil
    - Acute lens opacity, dislocated lens
    - Hyphema
    - Soft globe

Eye Trauma - Globe Rupture

Suspect in the setting of trauma.
- Badminton player!
  - Avoid palpation
  - Shield eye
  - Refer immediately
  - IV Antibiotics

Urgency of intervention

- ACLS / ATLS take precedence over eye trauma
- Globe trauma takes precedence over lid repair

Ruptured Globe

- More likely due to blunt trauma
  - Acute pressure causes rupture
    - at limbus
    - at insertions of extraocular muscles

Refer if any suspicion of penetrating injury or rupture
Seidel Test

- Fluorescein stain
  - washed off by aqueous leakage
  - indicates the site of perforation

*Hallmark of Perforating Injury*

Seidel Test

- Leak
- Aqueous
- Fluorescein pool

Peaked Pupil: Open Globe

Blow-out Orbital Fractures

- Possible edema, ecchymosis, fractures
  - Floor & medial walls are most vulnerable

- **CLASSIC SIGNS:**
  - Diplopia (upward gaze!)
  - Hypesthesia - infraorbital CN V₂
  - Enophthalmos
  - Palpable bony step-off
  - Epistaxis

Blow-Out Fracture
3. Distinguish the signs and symptoms of hyphema and how to treat it in an urgent care setting.

**HYPHEMA**

- **Eye Emergencies - Trauma**

**Hyphema**

- Highly suspicious for
  - ruptured globe
  - other deeper trauma
- Place protective shield and refer

**Acute Eye Trauma - Hyphema**

- Blood in the anterior chamber
  - Look for air-fluid level
- Consider possible complications
  - globe rupture
  - retinal detachment

**Hyphema scale**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No layered blood, circulating RBCs</td>
</tr>
<tr>
<td>I</td>
<td>&lt; 1/3</td>
</tr>
<tr>
<td>II</td>
<td>1/3 to 1/2</td>
</tr>
<tr>
<td>III</td>
<td>1/2 to subtotal</td>
</tr>
<tr>
<td>IV</td>
<td>total a/c filled</td>
</tr>
</tbody>
</table>

**Hyphema?**

- No: subconjunctival hemorrhage
  - a.k.a. hyposphagma
**Eye Trauma Care:** *Watch TV!*

Restrict activity!

- 45° head elevation
  - avoid rebleed
- Eye shield
- Avoid NSAIDS
  - try APAP

**Acute Red Eye**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Differential Diagnoses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Itching</td>
<td>Allergy</td>
</tr>
<tr>
<td>Scratching, burning</td>
<td>Dry eye, foreign body, trichiasis, conjunctivitis</td>
</tr>
<tr>
<td>Focal lid tenderness</td>
<td>Chalazion, hordeolum</td>
</tr>
<tr>
<td>Deep, intense pain</td>
<td>Corneal abrasion, simulitis, episcleritis, glaucoma*</td>
</tr>
<tr>
<td>Photophobia</td>
<td>Corneal abrasion, infl, acute glaucoma*</td>
</tr>
<tr>
<td>Halos around light</td>
<td>Corneal edema from acute glaucoma*, CL overwear</td>
</tr>
</tbody>
</table>

**Ocular Foreign Bodies**

- **Diagnosis**
  - a. *Always* flip both lids
  - b. Fluorescein with blue light to reveal subtle corneal abrasions
  - c. Document Seidel status
  - d. H/o driving nail, grinding or drilling metal: dilated fundoscopy

- **Removal of Corneal FB**
  - Visual acuity pre and post
  - Anesthetize both eyes
    - a. Try quick pass with Q-tip
    - b. Burr or 30 gauge needle helpful
    - c. No success: call ophthalmologist

**Lid Eversion Technique**

- Relax M. levator palpebrae in down ward gaze
- Place lever at proximal rim of tarsal plate
- Pull lashes down then towards you and up.

**Corneal Rust FB Narrow Beam**

http://webeyes.upth.allen.edu/eyeforum/atlas/pages/Ferrous-foreign-body-Rust-Ring.html
Corneal rust FB broad beam

Pingueculitis

- Small yellow conjunctival patches
- Symptoms: Redness/irritation
  - Inflammation vs. infection
- Etiology mixed
  - UV exposure, wind, dust, dry climate
  - Asthenopia - visual strain
    - “Over-minused” distance refraction
    - Undercorrected near addition

Pingueculitis - Treatment

Eye protection
- Artificial tears
- NSAID ophthalmic solutions
- Check eyeglass Rx, UVA/B filter
- Pterygium:
  - excise if threatens central cornea
- Optional:
  - topical steroids

Viral Conjunctivitis

- Signs & Symptoms
  - Watery discharge
  - Palpable pre-auricular nodes
  - Often associated with URI
- Rx:
  - Artificial tears, cool compresses

Keratitis (Adenovirus)
Keratitis (Adenovirus)

Keratitis (Aspergillus)

Corneal abrasion

Corneal abrasion

Corneal Pannus (CL wear)

Bullous Episcleritis
**Episcleritis**
- Subconjunctival inflammation (Tenon’s)
- Idiopathic
  - rarely systemic disease association
- **Episcleritis vs. scleritis:**
  - Topical vasoconstrictors **blanch injection**
  - Topical anesthetics **relieve pain**
- Rx: Topical steroids
  - PredForte 1%
    - shake well

**Iritis / anterior Uveitis**
- Conjunctivitis:
  - all conjunctiva is red
- Iritis:
  - Pericorneal ciliary injection

**Preseptal cellulitis**
- Orbital septum: continuation of periosteum of orbital bones
  - Chemosis, erythema, min. proptosis
  - Vision & ocular motility intact
- Treatment: systemic antibiotics
- Complication:
  - **orbital cellulitis** if left untreated

**Orbital cellulitis**
- Signs & Symptoms
  - Impaired ocular motility ± pain
  - Chemosis, erythema, ± ↓ vision, proptosis
  - Decreased acuity and **color vision**
  - Afferent pupillary defect (APD)
    - **Swinging Flashlight Test**
- Treatment: IV antibiotics, admit
  - Blood Cultures; orbital CT: sinusitis? Abscess?
- Complications:
  - Meningitis, cavernous sinus thrombosis

Abnormal screening tests suggest location of pathology:
Consider Slit Lamp exam and Ophthalmoscopy

**OPHTHALMOSCOPY**
**Direct ophthalmoscopy**

- Real, upright retinal image
  - 15X magnified
  - Limited to central 30° of retina

Useful for screening of
- the posterior pole
- the red reflex and its symmetry
- focal anterior segment exam

---

**Direct Ophthalmoscopes**

- Welch Allyn® PanOptic™ hand-held direct illuminating direct ophthalmoscope
  - incorporates Axial PointSource™ Optics
  - easier to enter small pupils
  - wider, panoramic view of the fundus
    - 5X larger than achieved with a standard ophthalmoscope in an undilated eye

---

**Direct Ophthalmoscopes**

- Modern ophthalmoscope design
  - light, a prism and a mirror, and lenses mounted in the head of the instrument
    - Prism and mirror illuminate the retina
    - Lenses can be selected to focus image
    - Filters: neutral-gray, cobalt blue, red free, polarized; various apertures
  - **Handle** contains the battery
Systematic Fundus Exam

- Use a technique for thorough overlapping examination
- Have the patient look in all different directions of gaze
- Follow excursions of eye with ophthalmoscope

Hollenhorst Plaque BRAO

Ophthalmology

Systematic Fundus Survey

5 Key Items of CN2 Exam

1. Scleral ring: delineates the optic disk
2. Neural retinal rim
3. Retinal nerve fiber layer
4. Region of parapapillary atrophy
5. Retinal and optic disk hemorrhage?

Cup/Disc Ratio

<table>
<thead>
<tr>
<th>Normal cup/disc ratio ≤ 0.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1-0.2</td>
</tr>
</tbody>
</table>

‘Doughnut Rule: more dough is better.'
Normal Cup/Disc Ratio

Cup/Disc Ratio Samples

1. Normal C/D 0.1
2. Borderline C/D 0.4 - 0.5
3. Glaucoma C/D 0.8
   - Vessels undermine optic rim
   - Temporal myopic conus

Abnormal C/D ratio: Glaucoma

Cup/Disc Ratio

Oblique Optic Nerve Head

0.4-0.5

... can be a normal variant

DDx: Tilted Disc

Arteriosclerotic Changes

Width
- Grade I: 3/4 normal caliber
- Grade II: 1/2 normal caliber
- Grade III: 1/3 normal caliber
- Grade IV: thread-like or invisible
- "AV nicking"
  - Arterio-venous crossing changes
  - with venous constriction and banking

... can be a normal variant
**Ophthalmoscopy Filters**

The ‘red-free’ filter shines ‘green’ light.

- The retinal blood vessel walls and the retinal pigment epithelium (RPE) act like a red filter
- Red-free light - (i.e., green light) – blocks out the choroid
  - red and ‘green’ cancel each other out
  - enhances details of retinal blood columns

**Arteriosclerotic Changes**

**Arteriolo / Venular Width Ratio**

<table>
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<tr>
<th>Grade</th>
<th>Description</th>
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<tr>
<td>A/V Nicking</td>
<td>• Arterio-venous crossing changes • Venous constriction and banking</td>
</tr>
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**Color of Light Reflex**

- **Copper wire arterioles** – the central light reflex occupies most of the width
- **Silver wire arterioles** – the central light reflex occupies all of the width of the arteriole
- **Sclerotic vessels**

<table>
<thead>
<tr>
<th>Copper wire arterioles</th>
<th>Light reflex occupies most of the width</th>
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<tbody>
<tr>
<td>Silver wire arterioles</td>
<td>Light reflex occupies all of the width</td>
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**Arteriosclerotic Changes**

- Ischemia, e.g. “cotton wool spots”
- Hemorrhages: pre-, intra-, subretinal
- Central Edema: Ring of exudates around the fovea (aka macular star)
- **Papilledema** or optic disc prominence
  - HTN, elevated intracranial pressure
- Visual acuity loss
  - typically due to macular involvement
HTN Retinopathy

http://webeye.ophth.uiowa.edu/eyeforum/atlas/pages/hypertensive-retinopathy.html

Malignant Hypertension

http://webeye.ophth.uiowa.edu/eyeforum/atlas/pages/malignant-hypertension.html

Binocular Indirect Ophthalmoscope (Schepens type)

Binocular Indirect Ophthalmoscope (Schepens type)

Papilledema Grade I

http://webeye.ophth.uiowa.edu/eyeforum/cases-i/images/PE/Slide6.jpg

Papilledema Grade II

http://webeye.ophth.uiowa.edu/eyeforum/cases-i/images/PE/Slide7.jpg
Papilledema Grade III

Papilledema Grade IV

Papilledema Grade V

BRVO

CRVO

Branch Artery Occlusion
5. Diagnose complications associated with diabetes and diabetic eye disease.

DIABETES

5. Diagnose complications associated with diabetes and diabetic eye disease.

Diabetes & Eye

Vascular changes
- Iris
  - Neovascularization glaucoma
- Retina
  - Diabetic retinopathy (DR)
  - Retinal detachment (RD)
- Complication: Blindness

Diabetic Retinopathy DR

- 4 years post initial DM diagnosis
  - 20-25% incidence of DR
- 15 years post initial DM diagnosis
  - ~98% DR incidence in DM-1
  - ~60-80% DR incidence in DM-2
- Screen with dilated eye exam
  - DM-1 within 3 years
  - DM-2 immediately (unknown onset!)

Sorry Folks: No Slides

- The listed references can be utilized to review and understand the tenets of dilated eye examination for patients with a history of Diabetes mellitus.
- Mastery of the previously reviewed techniques is required to perform a meaningful exam
- Refer to opthalmologist
**Ophthalmology**

**DR Screening**
- No retinopathy: q 3 years
- Mild NPDR*: q 1 year
- Mod/severe NPDR*: q 2-4 months
- PDR: as indicated by progress

*more frequently if macular edema

**Images:** see [http://cgeye.org](http://cgeye.org)

**DR Therapy**
- Control of underlying disease
- DM, HTN, other
- PDR:
  - Photocoagulation
  - Vitrectomy
  - Secondary glaucoma management

**DR Stages**

**Non-Proliferative DR - **
- Microaneurysms: 1st sign of disease
- Intraretinal hemorrhage
- Following nerve fiber layer
- Hard exudates
- Macular Edema

**Non-Proliferative DR – mod/severe**
- 4:2:1 rule
- Hemorrhages in 4 quadrants
- Venous bleeding in 2 quadrants
- IRMA (intraretinal microvascular abnormalities) in 1 quadrant
- Severe NPDR progresses to PDR
- 50% in 1 year

**Proliferative DR – PDR**
- Neovascularization of disk NVD
- Neovascularization elsewhere NVE
- Neovascularization of iris NVI
  - Risk of neovascularization glaucoma

**RETINAL DETACHMENT - RD**

6. Identify and treat retinal detachment.
Sorry Folks: No Slides

- The listed references can be utilized to review and understand the tenets of dilated eye examination for patients with a history of Diabetes mellitus.
- Mastery of the previously reviewed techniques is required to perform a meaningful exam.
- Refer to ophthalmologist.

Retinal Detachment

- Rhegmatogenous (intrinsic)
  - Retinal breaks
  - Myopia
- Non-Rhegmatogenous (extrinsic)
  - Exudative (serous)
  - Traction
- Retinopathy of Prematurity (ROP)

RD - Signs & Symptoms

- Floaters
- Photopsia (light flashes)
  - Due to tugging on retina
- Visual field loss
  - Shadow or veil
- Vision loss
  - Suggests macular involvement

RD - Differential Diagnosis

- Retinal Detachment RD
  - Retina separates from retinal pigment epithelium RPE
- Posterior Vitreous Detachment PVD
  - Vitreous detaches from retina
- Consult ophthalmology
  - Needs dilated eye exam
  - Urgent therapy if confirmed

Ocular Emergencies References

- Keeler, R Br. J Ophthalmol 2002;86:602-603; Figure 4 Galezowski ophthalmoscope 1892.

Online Resources

- Online Atlas of Ophthalmology
  - www.eyetlas.com
  - www.eyerrounds.org
  - http://webeye.ophth.uiowa.edu/eyeforum/picosearch.htm
- Wisconsin Retinopathy Standards
  - www.eyephoto.ophth.wisc.edu/ResearchAreas/Diabetes/DiabStds.htm
- Glaucoma images
  - www.eyesearch.com/glaucoma.images.htm
- Sickle cell disease
  - sickle.bwh.harvard.edu/outpatient.html
Future Topic Options

• Want More? Request what you need!

• Examples:
  – Slit Lamp Workshop
  – Direct Ophthalmoscopy Workshop
  – Indirect Ophthalmoscopy Workshop
  – Neuroophthalmology for Primary Care
  – Color Vision
  – Contact Lenses