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Peer reviewed

The Acute Red Eye

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ABSTRACT:

Audience: This modified team-based learning (mTBL) exercise is appropriate for junior or senior emergency medicine learners.

Introduction: The acute red eye is a common chief complaint in the emergency department. It is essential that the emergency physician be knowledgeable about the differential diagnosis for the acute red eye and be able to distinguish between benign and sinister causes of the acute red eye.

Objectives: By the end of this educational session, the learner will: 1) list 10 major causes for an acute red eye; 2) describe historical features that help distinguish between benign and serious causes of the acute red eye; 3) describe physical examination features that help distinguish between benign and serious causes of the acute red eye; and 4) use historical and physical examination features to distinguish between the 10 different causes of the acute red eye.

Method: This is an mTBL session.

Topics: The acute red eye, eye pain, conjunctivitis, scleritis, episcleritis, acute angle closure glaucoma, corneal abrasion, endophthalmitis, anterior uveitis, infectious keratitis, corneal ulcer, corneal foreign body, bacterial keratitis, viral keratitis, herpes keratitis, varicella zoster keratitis, team-based learning.



USER GUIDE

List of Resources:

Abstract	1
User Guide	2
Learner Materials	5
iRAT	5
gRAT	6
GAE	11
Post Test	12
Instructor Materials	14
iRAT Key	15
gRAT Key	16
GAE Key	23
Post Test Key	24

Learner Audience:

Medical Students, Interns, Junior Residents, Senior Residents, Other: Family Medicine Residents

Time Required for Implementation:

Instructor Preparation: 60 minutes
Learner Responsible Content: 30 minutes
In Class Time: 1.5-2 hours

Recommended Number of Learners per Instructor:

Up to 100 learners per instructor

Topics:

The acute red eye, eye pain, conjunctivitis, scleritis, episcleritis, acute angle closure glaucoma, corneal abrasion, endophthalmitis, anterior uveitis, infectious keratitis, corneal ulcer, corneal foreign body, bacterial keratitis, viral keratitis, herpes keratitis, varicella zoster keratitis, team-based learning.

Objectives:

By the end of this educational session, the learners will be able to:

1. List 10 major causes for an acute red eye
2. Describe historical features that help distinguish between benign and serious causes of the acute red eye
3. Describe physical examination features that help distinguish between benign and serious causes of the acute red eye
4. Use historical and physical examination features to distinguish between the 10 different causes of the acute red eye

Linked objectives and methods:

In the individual readiness assessment test, the learners are asked to match each condition with the appropriate definition and picture; this test ensures that they can list each major

cause for an acute red eye. Learners then participate in the group readiness assessment test and give answers during the review portion. Learners will be able to describe historical features and physical examination features that help to distinguish between benign and serious diagnoses and then apply this to distinguish between each diagnosis in the group application exercise.

Recommended pre-reading for instructor:

- Gilani C, Yang A, Yonkers M, Boysen-Osborn. Differentiating urgent and emergent causes of acute red eye for the emergency physician. *West J Emerg Med*. 2016 (in press).
- Jacobs D. Overview of the red eye. In: Givens J, ed. *UpToDate*. Waltham, MA: UpToDate Inc. <https://www.uptodate.com/contents/overview-of-the-red-eye>. Updated December 2015. Accessed July 24, 2016.
- Consider reading any chapter on the acute red eye in an emergency medicine textbook.

Learner responsible content (LRC):

Any chapter on the acute red eye:

Suggestions:

- Bhatia K, Sharma R. Eye Emergencies. In: Adams JG, Barton ED, Collings JL, DeBlieux PM, Gisondi MA, Nadel ES, eds. *Emergency Medicine: Clinical Essentials*. 2nd ed. Philadelphia, PA: Elsevier; 2013:210-219.
- Friedman FD. Red eye. In: Schaidler JJ, Barkin RM, Hayden SR, et al. eds. *Rosen & Barkin's 5-Minute Emergency Medicine Consult*. 4th edition. Philadelphia, PA: Lippincott Williams & Wilkins; 2011:948-949.
- Wright JL, Wightman JM. Red and painful eye. In: Walls RM, Hockberger RS, Gausche-Hill M, et al. eds. *Rosen's Emergency Medicine: Concepts and Clinical Practice*. 8th ed. Philadelphia, PA: Elsevier; 2014:184-197.
- Altevener JG, McCans K. Eye disorders. In: Wolfson AB, ed. *Harwood-Nuss' Clinical Practice of Emergency Medicine*. 5th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2010:1227-1230.

Results and tips for successful implementation:

This mTBL was first implemented during two separate residency conferences; the first was a conference of 40 learners (senior residents to medical students); the second was at a conference of approximately 30 learners (mainly junior residents). The exercise was well received in both venues: learners felt it was enjoyable and high yield.

After the session, we sought the expertise of a content expert (Dr. Yonkers), to ensure that all content was accurate and made appropriate modifications.



USER GUIDE

Prepare:

1. Read all instructor pre-reading
2. Post on a learning management system or e-mail the pre-reading (one of the following articles) for your learners, one week in advance.
 - o Any chapter on the acute red eye
3. You will need a computer with PowerPoint, projector/screen, and speakers for this session. The session is best run in a classroom with round or square tables.
4. The post-test can be done in any format (paper or online), but we recommend having learners take the post-test as a Kahoot!
<https://play.kahoot.it/#/?quizId=5e16583d-ad32-48f6-841c-f4d26f43eb7f>. You may also program the Kahoot! yourself www.getkahoot.com (sign up for free account) or use a different audience response system. If the link does not work, log in to Kahoot! and search public kahoots for: The Acute Red Eye, JETem.
5. If using a Kahoot! post-test, each learner will need a device (android, iPhone, tablet, or laptop) to play the Kahoot!

For the in classroom didactic session, you will also need to prepare the following:

1. One copy of team numbers (one number per team)
2. One copy of the iRAT for each learner
3. One copy of the gRAT for each team (4 learners per team), using scratch off stickers (available at www.amazon.com)
4. One copy of the GAE for every two learners.
5. One copy of the gRAT key and GAE key for each instructor (usually one instructor per session).
6. One copy of the post-test for each learner (not necessary if using Kahoot!).

In class implementation:

1. Use the PowerPoint with presenter's notes to guide you through the presentation. You will start by describing the importance of the acute red eye in the emergency department.
2. Learners then take iRAT. They will need to view the slide with pictures of the 10 different red eyes in order to complete the iRAT. Give your learners 5-10 minutes to complete the iRAT. Learners should not be allowed to use the article or other material during the iRAT.
3. Continue to advance the PowerPoint slides. Once learners have completed the iRAT, break learners up into groups of four. We recommend evenly distributing the number of senior and junior learners in each group. The instructor should assign the groups, rather

than having the learners self-select. If faculty members are present, place one faculty member at each table.

4. The session is best implemented in small round or square tables, with four learners at each table.
5. Give each group one copy of the gRAT and a team number. Give the groups 30 minutes to complete the gRAT. This may be done "open book," but advise learners that they should not reference any articles from the Western Journal of Emergency Medicine (WestJEM). This article can be emailed to learners after the session. They may, however, use textbooks, UpToDate, e-medicine, or other online resources. Walk around the room to ensure learners are on task and do not have any questions.
6. Go over the gRAT answers as a group. Call on one leader (by calling their team number) from each group to provide the condition for each definition given (on the PowerPoint slides). Also, go over the answers to the other gRAT questions (risk factors, treatment, anterior chamber, visual acuity, etc.). Answer any questions and provide teaching pearls; other faculty members may weigh in. Use the PowerPoint slides to guide you through this portion. Make sure you have a copy of the gRAT key. (20 minutes)
7. Now break up the learners into groups of two and have them work on the group application exercise. Give groups 10-15 minutes to complete the GAE. Go over possible answers together. Instruct the learners that you will email them a sample key. Groups may use any resource they wish during this portion (including the WestJEM article).
8. After you have discussed all GAE answers, have each learner complete a post-test:
<https://play.kahoot.it/#/?quizId=5e16583d-ad32-48f6-841c-f4d26f43eb7f> or this can be done on paper. (At our residency we have paper "medals" for the Kahoot! winner; these medals go on the residency bulletin board.) If the link does not work, log in to Kahoot! and search public kahoots for: The Acute Red Eye, JETem.
9. After the session, email the gRAT key and the GAE key to your learners.

Content:

- iRAT
- gRAT
- GAE
- Post-test
- iRAT Key
- gRAT Key
- GAE Key
- Post-test Key
- Acute Red Eye TBL Slides



USER GUIDE

References/suggestions for further reading:

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19. Alfonso SA, Fawley JD, Lu AX. Conjunctivitis. *Prim Care*. 2015;42(3):325-345. doi: 10.1016/j.pop.2015.05.001



The Acute Red Eye: Individual Readiness Assessment Test (iRAT)

Answer choices:

Acute angle closure glaucoma
 Anterior uveitis
 Conjunctivitis
 Endophthalmitis
 Subconjunctival hemorrhage

Anterior scleritis
 Bacterial keratitis
 Corneal abrasion
 Episcleritis
 Viral keratitis

Condition	Definition	Picture
	Closure (or narrowing) of the anterior chamber angle, causing elevated intraocular pressure and eventual optic nerve damage.	
	Bacterial or fungal infection involving the vitreous and/or aqueous humor. Eye surgery is a risk factor.	
	Inflammation of the iris, ciliary body, or both causing redness and pain.	
	Heme under the conjunctiva, secondary to ruptured conjunctival blood vessel, which may be caused by coughing or straining.	
	Painful, sight-threatening cause of the acute red eye, causing deep destructive inflammation, frequently associated with autoimmune systemic diseases.	
	Corneal inflammation caused by herpes simplex, varicella zoster, or adenovirus characterized by pain, tearing, photophobia, and corneal epithelial defects.	
	Defect of the corneal epithelium, causing irritation, pain, tearing, and photophobia.	
	Corneal epithelial defect with stromal haze due to microorganisms.	
	Inflammation of the episclera, which is the vascularized tissue between conjunctiva and sclera.	
	Infectious or non-infectious inflammation of the bulbar and palpebral conjunctiva.	



The Acute Red Eye: Group Readiness Assessment Test (gRAT)

Table 1: The differential diagnosis for the acute red eye in the emergency department

Condition	Definition	Risk factors and demographics	Associated symptoms	Pain? Photophobia? Response to proparacaine? Phenylephrine use?	Redness is focal or diffuse?	Treatment? Ophthalmology referral (urgent vs. emergent)?	Anterior chamber (AC)? Pupils? Visual acuity (VA)? Fluorescein?	Additional Notes
<p>Condition:</p> <p>Picture:</p>	Closure (or narrowing) of the anterior chamber angle, causing elevated intraocular pressure and eventual optic nerve damage.		Headache, nausea, vomiting, halos around lights, photophobia, blurred vision.	Pain: Photophobia: Proparacaine: Phenylephrine:	Diffuse, with characteristic ciliary flush.	Treatment: Referral:	AC: Pupil: VA: Fluorescein:	Elevated IOP, can be > 60 mm Hg. Can have permanent vision loss within hours.
<p>Condition:</p> <p>Picture:</p>	Bacterial or fungal infection involving the vitreous and/or aqueous humor. Eye surgery is a risk factor.		Pain and decreased vision.	Pain: Photophobia: Proparacaine: Phenylephrine:	Diffuse	Treatment: Referral:	AC: Pupil: VA: Fluorescein:	Usually occurs 2-7 days post-operatively or 12-24 hours after trauma.



LEARNER MATERIALS

Condition	Definition	Risk factors and demographics	Associated symptoms	Pain? Photophobia? Response to proparacaine? Phenylephrine use?	Redness is focal or diffuse?	Treatment? Ophthalmology referral (urgent vs. emergent)?	Anterior chamber (AC)? Pupils? Visual acuity (VA)? Fluorescein?	Additional Notes
<p>Condition:</p> <p>Picture:</p>	Inflammation of the iris, choroid, and/or ciliary body causing redness and pain.		Pain, redness, photophobia, consensual photophobia, tearing, decreased vision.	Pain: Photophobia: Proparacaine: Phenylephrine:	Diffuse, pronounced at the limbus (ciliary flush).	Treatment: Referral:	AC: Pupil: VA: Fluorescein:	If a specific diagnosis is suspected can start workup and treat underlying condition.
<p>Condition:</p> <p>Picture:</p>	Heme under the conjunctiva, secondary to ruptured conjunctival blood vessel, which may be caused by coughing or straining.		None	Pain: Photophobia: Proparacaine: Phenylephrine:	Usually focal (in one sector) but may spread before it resolves.	Treatment: Referral:	AC: Pupil: VA: Fluorescein:	One should have high suspicion for globe rupture if there is trauma and/or diffuse or 360-degree bullous hemorrhage.



LEARNER MATERIALS

Condition	Definition	Risk factors and demographics	Associated symptoms	Pain? Photophobia? Response to proparacaine? Phenylephrine use?	Redness is focal or diffuse?	Treatment? Ophthalmology referral (urgent vs. emergent)?	Anterior chamber (AC)? Pupils? Visual acuity (VA)? Fluorescein?	Additional Notes
<p>Condition:</p> <p>Picture:</p>	<p>Painful, sight-threatening cause of the acute red eye, causing deep destructive inflammation, frequently associated with autoimmune systemic diseases.</p>		<p>Gradual onset, severe boring pain.</p>	<p>Pain:</p> <p>Photophobia:</p> <p>Proparacaine:</p> <p>Phenylephrine:</p>	<p>May be diffuse or localized, depending on the type, sclera may have a typical bluish hue (visualizing uvea under thinned sclera).</p>	<p>Treatment:</p> <p>Referral:</p>	<p>AC:</p> <p>Pupil:</p> <p>VA:</p> <p>Fluorescein:</p>	<p>There are three forms of anterior scleritis: diffuse, nodular, and necrotizing (Diaz). Necrotizing scleritis usually causes the most severe pain and the worst outcome.</p> <p>Inflamed vessels cannot be moved with cotton tipped applicator.</p>
<p>Condition:</p> <p>Picture:</p>	<p>Corneal inflammation caused by herpes simplex, varicella zoster, or adenovirus characterized by pain, tearing, photophobia, and corneal epithelial defects.</p>		<p>VZV: Hutchinson's sign (vesicular lesion on the nose, VZV), although this is not sensitive or specific. (Adam)</p> <p>HSV: vesicular rash. Can have high IOP in HSV induced uveitis.</p>	<p>Pain:</p> <p>Photophobia:</p> <p>Proparacaine:</p> <p>Phenylephrine:</p>	<p>Diffuse, with ciliary flush.</p>	<p>Treatment:</p> <p>Referral:</p>	<p>AC:</p> <p>Pupil:</p> <p>VA:</p> <p>Fluorescein:</p>	



LEARNER MATERIALS

Condition	Definition	Risk factors and demographics	Associated symptoms	Pain? Photophobia? Response to proparacaine? Phenylephrine use?	Redness is focal or diffuse?	Treatment? Ophthalmology referral (urgent vs. emergent)?	Anterior chamber (AC)? Pupils? Visual acuity (VA)? Fluorescein?	Additional Notes
<p>Condition:</p> <p>(Also Corneal Foreign Bodies)</p> <p>Picture:</p>	Defect (or foreign body) of the corneal epithelium, causing irritation, pain, tearing, and photophobia. (Ahmed)		- Photophobia, watering, tearing, foreign body sensation.	Pain: Photophobia: Proparacaine: Phenylephrine:	Diffuse	Treatment: Referral:	AC: Pupil: VA: Fluorescein:	
<p>Condition:</p> <p>Also: Corneal Ulcer, Fungal Keratitis)</p> <p>Picture:</p>	Corneal epithelial defect with stromal haze due to microorganisms. (Keay)		Significant pain, tearing, and discharge.	Pain: Photophobia: Proparacaine: Phenylephrine:	Diffuse	Treatment: Referral:	AC: Pupil: VA: Fluorescein:	

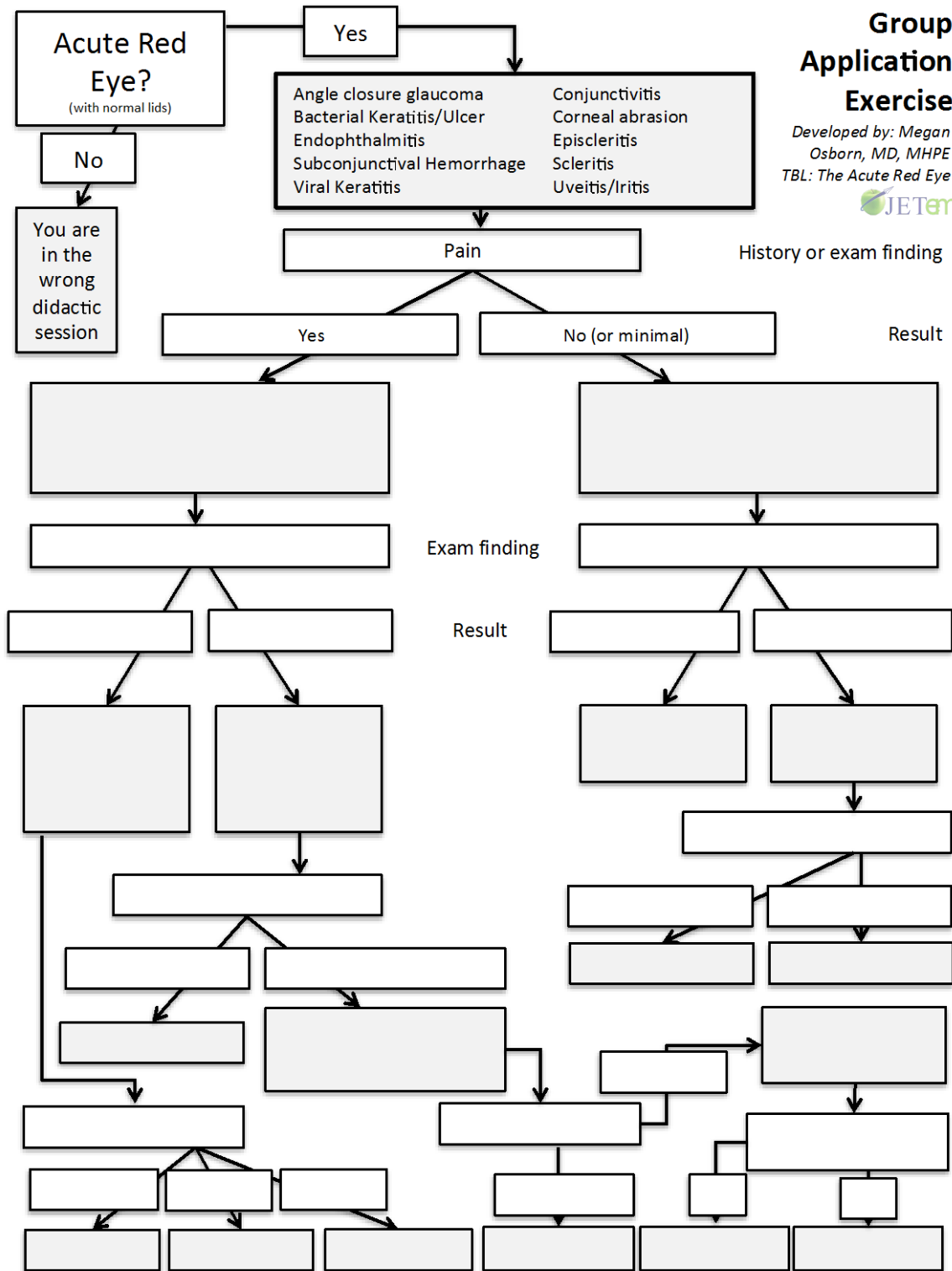


LEARNER MATERIALS

Condition	Definition	Risk factors and demographics	Associated symptoms	Pain? Photophobia? Response to proparacaine? Phenylephrine use?	Redness is focal or diffuse?	Treatment? Ophthalmology referral (urgent vs. emergent)?	Anterior chamber (AC)? Pupils? Visual acuity (VA)? Fluorescein?	Additional Notes
<p>Condition:</p> <p>Picture:</p>	<p>Inflammation of the episclera, (which is the vascularized tissue between conjunctiva and sclera). (Diaz, Sobol, Gritz)</p>		<p>Ocular redness without irritation or slight tenderness.</p>	<p>Pain: Usually mild irritation, but chronic or nodular can have pain. (UTD)</p> <p>Photophobia: No</p> <p>Proparacaine: May have improvement of irritation.</p> <p>Phenylephrine: Resolution of episcleral redness after 10-15 minutes.</p>	<p>Most commonly focal in interpalpebral zone, can be diffuse.</p>	<p>Treatment:</p> <p>Referral:</p>	<p>AC:</p> <p>Pupil:</p> <p>VA:</p> <p>Fluorescein:</p>	<p>Most are idiopathic.</p> <p>Inflamed vessels can be moved with cotton tipped applicator.</p>
<p>Condition:</p> <p>Picture:</p>	<p>Infectious or non-infectious inflammation of the bulbar and palpebral conjunctiva.</p>		<p>Tearing, discharge, or associate viral symptoms.</p>	<p>Pain: May have a mild burning sensation.</p> <p>Photophobia: No.</p> <p>Proparacaine: Improvement in irritation.</p> <p>Phenylephrine: Can have mild improvement of redness.</p>	<p>Usually diffuse.</p> <p>Tarsal/palpebral conjunctiva SHOULD be involved in the redness.</p>	<p>Treatment:</p> <p>Referral:</p>	<p>AC:</p> <p>Pupil:</p> <p>VA:</p> <p>Fluorescein:</p>	<p>Patients should not have photophobia (this should raise suspicion for a more serious condition). Patients will commonly have discharge.</p> <p>Viral conjunctivitis is highly contagious 1-2 weeks from onset. Recommend contact precautions and sterilization of patient encounter room after visit.</p>



The Acute Red Eye: Group Application Exercise (GAE)



Group Application Exercise

Developed by: Megan Osborn, MD, MHPE
TBL: The Acute Red Eye





The Acute Red Eye: Post-test

<https://play.kahoot.it/#/?quizId=5e16583d-ad32-48f6-841c-f4d26f43eb7f>

If the link does not work, log in to Kahoot! and search public kahoots for: The Acute Red Eye, JETem.

1. This patient's redness does not improve with phenylephrine. What is the most likely diagnosis (see Powerpoint slide #1)?
 - a. Acute angle closure glaucoma
 - b. Bacterial conjunctivitis
 - c. Episcleritis
 - d. Scleritis
2. What is the most appropriate treatment for this patient who is two days status post cataract surgery (see Powerpoint slide #2)?
 - a. Intravitreal vancomycin
 - b. Intravenous vancomycin
 - c. Topical gatifloxacin
 - d. Topical steroids
3. What type of medication would you give this patient (see Powerpoint slide #3)?
 - a. Topical antibiotic
 - b. Topical beta-blocker
 - c. Topical lubricant
 - d. Topical sympathomimetic
4. What is the most appropriate treatment for this patient (see Powerpoint slide #4)?
 - a. Reassurance
 - b. Topical antibiotics
 - c. Topical antivirals
 - d. Topical steroids
5. Which one of these conditions generally has a clear anterior chamber?
 - a. Anterior uveitis
 - b. Bacterial keratitis
 - c. Endophthalmitis
 - d. Episcleritis
6. Which of the following conditions is NOT associated with photophobia?



LEARNER MATERIALS

- a. Anterior uveitis
 - b. Bacterial keratitis
 - c. Conjunctivitis
 - d. Corneal abrasion
7. Which of the following is not a common cause of viral keratitis?
- a. Adenovirus
 - b. Herpes simplex virus 1
 - c. Rhinovirus
 - d. Varicella zoster virus



INSTRUCTOR MATERIALS

Answer keys to all exercises with explanations, are on the following pages.

Learners: please do not proceed.



The Acute Red Eye: Individual Readiness Assessment Test Key (iRAT Key)

Condition	Definition	Picture
Acute angle closure glaucoma	Closure (or narrowing) of the anterior chamber angle, causing elevated intraocular pressure and eventual optic nerve damage.	H
Endophthalmitis	Bacterial or fungal infection involving the vitreous and/or aqueous humor. Eye surgery is a risk factor.	C
Anterior uveitis	Inflammation of the iris, ciliary body, or both causing redness and pain.	J
Subconjunctival hemorrhage	Heme under the conjunctiva, secondary to ruptured conjunctival blood vessel, which may be caused by coughing or straining.	I
Anterior scleritis	Painful, sight-threatening cause of the acute red eye, causing deep destructive inflammation, frequently associated with autoimmune systemic diseases.	B
Viral keratitis	Corneal inflammation caused by herpes simplex, varicella zoster, or adenovirus characterized by pain, tearing, photophobia, and corneal epithelial defects.	G
Corneal abrasion	Defect of the corneal epithelium, causing irritation, pain, tearing, and photophobia.	A
Bacterial keratitis	Corneal epithelial defect with stromal haze due to microorganisms.	F
Episcleritis	Inflammation of the episclera, which is the vascularized tissue between conjunctiva and sclera.	D
Conjunctivitis	Infectious or non-infectious inflammation of the bulbar and palpebral conjunctiva.	E



The Acute Red Eye: gRAT Key

Table 1: The differential diagnosis for the acute red eye in the emergency department

Condition	Definition	Risk factors and demographics	Associated symptoms	Pain? Photophobia? Response to proparacaine? Phenylephrine use?	Redness is focal or diffuse?	Treatment? Ophthalmology referral (urgent vs. emergent)?	Anterior chamber (AC)? Pupils? Visual acuity (VA)? Fluorescein?	Additional Notes
Acute angle closure glaucoma Picture: H	Closure (or narrowing) of the AC angle, causing elevated intraocular pressure and eventual optic nerve damage. ^{1,2}	<ul style="list-style-type: none"> -Increasing age -Female gender (Three times more common) -Asian ethnicity -Shallow anterior chamber -Hyperopia (farsightedness / "plus" glasses prescription), medication-induced (topiramate or sulfa).² 	Headache, nausea, vomiting, halos around lights, photophobia, blurred vision.	<p>Pain: Yes, often with headache, nausea, and vomiting.</p> <p>Photophobia: Yes.</p> <p>Proparacaine: No improvement.</p> <p>Phenylephrine: should be avoided, may exacerbate attack.³</p>	Diffuse, with characteristic ciliary flush.	<p>Treatment: Lower IOP in preparation for definitive treatment by ophthalmology (usually laser iridotomy).</p> <p>IOP medications: -Topical parasymphomimetics (pilocarpine 2%; avoid anything higher than 2%).</p> <p>-Topical beta-blocker (0.5% timolol) (caution in asthmatics, COPD patients, and patients with heart block).</p> <p>-Carbonic anhydrase inhibitors (acetazolamide 500mg IV) (Avoid in sickle cell patients and possibly in sulfa-allergic patients).</p> <p>-Alpha agonists (brimonidine 0.1%) (Avoid use in patients on monoamine oxidase inhibitors) (Avoid apraclonidine as it can dilate and cause iris ischemia – has more alpha-1 adrenergic activity).</p> <p>Referral: Emergent.</p>	<p>AC: Shallow.</p> <p>Pupil: mid-sized or dilated, non-reactive pupil. (Shields)</p> <p>VA: Decreased.</p> <p>Fluorescein: No uptake.</p>	<p>Elevated IOP, can be > 60 mm Hg.</p> <p>Can have permanent vision loss within hours.</p>



INSTRUCTOR MATERIALS

Condition	Definition	Risk factors and demographics	Associated symptoms	Pain? Photophobia? Response to proparacaine? Phenylephrine use?	Redness is focal or diffuse?	Treatment? Ophthalmology referral (urgent vs. emergent)?	Anterior chamber (AC)? Pupils? Visual acuity (VA)? Fluorescein?	Additional Notes
Endophthalmitis Picture: C	Bacterial or fungal infection involving the vitreous and/or aqueous humor. ⁴ Eye surgery is a risk factor.	<ul style="list-style-type: none"> -Eye surgery (cataract surgery has 0.1% risk) -Penetrating ocular trauma -Corneal infection -Intravitreal injections -(Fungal) hospitalization with central venous access, total parenteral nutrition, or broad spectrum antibiotics.⁴ -Microorganisms: Coagulase-negative staphylococcus, viridans streptococci (post-procedure), <i>Bacillus cereus</i> (post-traumatic), <i>Staphylococcus</i>, <i>Streptococcus</i>, <i>Candida</i> (endogenous), <i>Klebsiella pneumoniae</i> (East Asia, associated with liver abscess), 	Pain and decreased vision.	Pain: Yes. Photophobia: Yes. Proparacaine: No improvement. Phenylephrine: May have some improvement.	Diffuse.	Treatment: -If vision “hand motion” or better, then intravitreal injection of antibiotics. -If vision “light perception” or worse, then surgery. Referral: Emergent.	AC: Commonly associated with hypopyon. ⁴ Visual acuity: Decreased. Pupils: Severe cases may have afferent pupillary defect. ⁵ Fluorescein: May diagnose the inciting penetrating injury or corneal abrasion.	Usually occurs 2-7 days post-operatively or 12-24 hours after trauma.
Anterior uveitis Picture: J	Inflammation of the iris, choroid, and/or ciliary body causing redness and pain.	<ul style="list-style-type: none"> -Idiopathic systemic diseases (spondyloarthropathies), infectious (syphilis, tuberculosis, Lyme disease, toxoplasmosis, herpes viruses, cytomegalovirus), drug-induced (rifabutin, cidofovir, sulfas, moxifloxacin).⁶ 	Pain, redness, photophobia, consensual photophobia, tearing, decreased vision.	Pain: Yes. Photophobia: Yes. Proparacaine: No improvement. Phenylephrine: No improvement in redness.	Diffuse, pronounced at the limbus (ciliary flush).	Treatment: -Topical steroids, dilating drops (to prevent scarring of iris to lens); do not start steroids without ophthalmology consultation. Referral: Urgent (within 24 hours).	AC: Cells and flare. Pupil: Constricted or irregular pupil. VA: Normal or decreased. Fluorescein: +/- (dendrites if HSV underlying cause).	-If a specific diagnosis is suspected can start workup and treat underlying condition.



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Subconjunctival hemorrhage Picture: I	Heme under the conjunctiva, secondary to ruptured conjunctival blood vessel, which may be caused by coughing or straining. ⁷	-Trauma, straining (coughing, sneezing, vomiting, Valsalva), conjunctivitis, chronic health conditions (diabetes, hypertension, coagulopathy). ⁸	None.	Pain: No. Photophobia: No. Proparacaine: N/A Phenylephrine: No improvement of redness.	Usually focal (in one sector) but may spread before it resolves.	Treatment: -Supportive care / topical lubrication. Referral: Primary care follow up as needed.	AC: Clear. Pupils: Normal. VA: Normal. Fluorescein: No uptake.	One should have high suspicion for globe rupture if there is trauma and/or diffuse or 360-degree bullous hemorrhage.
Anterior Scleritis Picture: B	Painful, sight-threatening cause of the acute red eye, causing deep destructive inflammation, frequently associated with autoimmune systemic diseases.	-50% autoimmune systemic disease (rheumatoid arthritis, Wegener's granulomatosis), 4%-10% infectious (<i>Borrelia burgdorferi</i> , tuberculosis, <i>Nocardia asteroides</i> , <i>Pseudomonas aeruginosa</i> , <i>Serratia marcescens</i> , <i>Staphylococcus</i> , <i>Streptococcus</i> , syphilis, varicella zoster virus, CMV, <i>Aspergillus flavus</i> , <i>Pseudallescheria boydii</i> , protozoa <i>Acanthamoeba</i> , <i>Toxoplasma gondii</i>). ⁹	Gradual onset, severe boring pain.	Pain: Severe boring / piercing pain is typically worse at night and with extraocular movements, and may radiate to the face. ^{9,10} Photophobia: Possible. Proparacaine: No improvement. Phenylephrine: No improvement in scleral redness (episclera may still improve).	May be diffuse or localized, depending on the type; sclera may have a typical bluish hue (visualizing uvea under thinned sclera). ¹¹	Treatment: Systemic treatment with NSAIDs or immunosuppressive therapy. ¹¹ Eye shield if there is a perforation risk. Referral: Emergent. ⁸	AC: Many will have associated anterior uveitis. ⁹ Pupils: Normal. VA: Normal or decreased, depending on the extent of disease. Fluorescein: Occasionally will have peripheral keratitis, more common in necrotizing form. ⁹	There are three forms of anterior scleritis: diffuse, nodular, and necrotizing. ⁹ Necrotizing scleritis usually causes the most severe pain and the worst outcome. Inflamed vessels cannot be moved with cotton tipped applicator.



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Viral Keratitis Picture: G	Corneal inflammation caused by herpes simplex, varicella zoster, or adenovirus characterized by pain, tearing, photophobia, and corneal epithelial defects.	-HSV-1 (most commonly), HSV-2, varicella zoster virus, adenovirus 8, 19, 37. ¹²	VZV: Hutchinson's sign (vesicular lesion on the nose, VZV), although this is not sensitive or specific. ¹³ HSV: vesicular rash. Can have high IOP in HSV induced uveitis.	Pain: Yes. Photophobia: Yes. Proparacaine: Improvement in pain. Phenylephrine: May improve redness.	Diffuse, with ciliary flush.	Treatment: -Topical (trifluridine 1% q2h) and/or oral antivirals (acyclovir, valacyclovir). -Topical steroids may be added in treatment of VZV ophthalmicus, but this should ONLY be done in consultation with ophthalmology. Referral: Emergent.	AC: Possible cells and flare. VA: Normal or decreased. Pupils: Normal. Fluorescein: HSV: branching pattern with terminal bulbs; VZV: branching with tapered ends; EKC: diffuse fine keratitis.	
Corneal Abrasions (Also Corneal Foreign Bodies) Picture: A	Defect (or foreign body) of the corneal epithelium, causing irritation, pain, tearing, and photophobia. ¹⁴	-History of trauma, contact lens use, male gender, young adults, construction or manufacturing job without eye protection (foreign body).	-Photophobia, watering, tearing, foreign body sensation.	Pain: Yes, usually lasting less than 24- 48 hours. ¹⁴ Photophobia: Yes. Proparacaine: Improves symptoms. Phenylephrine: Redness improves.	Diffuse.	Treatment: Corneal abrasion: -Lid eversion to exclude foreign body -Lubricating ointment or drops -Topical antibiotics (polymixin B/trimethoprim or polysporin; quinolones for contact lens wearers). Corneal foreign body: -Removal by ophthalmology or ED physician, depending on location, size, and presence of rust ring -Topical antibiotics. Referral: Contact lens wearers: urgent (however, emergent if concern for corneal ulcer—presence of ulcer or hypopyon, pain not improving within 24 hours).	AC: Clear. Pupil: Normal VA: May be decreased if the abrasion/FB is in the visual axis; however, this should raise concern for alternative diagnosis. Fluorescein: Uptake at the corneal abrasion or foreign body.	



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<p>Bacterial keratitis</p> <p>(Also: Corneal Ulcer, Fungal Keratitis)</p> <p>Picture F</p>	<p>Corneal epithelial defect with stromal haze due to microorganisms.¹⁵</p>	<p>-Contact lens use¹⁶</p> <p>-Agricultural work¹⁷</p> <p>-Eye trauma</p> <p>-Use of corticosteroids</p> <p>-Systemic diseases (diabetes)</p> <p>-Prior ocular surgery</p> <p>-Chronic ocular surface disease.¹⁷</p> <p>-Microorganisms (<i>Streptococcus pneumoniae</i>, <i>Staphylococcus aureus</i>, <i>Mycobacterium fortuitum</i>, <i>M. chelonae</i>, <i>Nocardia</i> spp., <i>Pseudomonas aeruginosa</i>, Enterobacteriaceae, <i>Moraxella</i>, <i>Haemophilus</i>, <i>Neisseria gonorrhoeae</i>; fungi: <i>Fusarium</i>, <i>Aspergillus</i>, <i>Curvularia</i>, <i>Candida</i>, <i>Cryptococcus</i>; protozoa: <i>Acanthamoeba</i>).</p>	<p>Significant pain, tearing, and discharge.</p>	<p>Pain: Yes.</p> <p>Photophobia: Yes.</p> <p>Proparacaine: May improve pain.</p> <p>Phenylephrine: May improve redness.</p>	<p>Diffuse.</p>	<p>Treatment: Fortified topical antibiotics.</p> <p>Referral: Emergent.</p>	<p>AC: Possible cells and flare.</p> <p>Pupil: Normal.</p> <p>VA: Decreased if involving visual axis.</p> <p>Fluorescein: Large uptake over area of ulceration.</p>	



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Episcleritis Picture: D	Inflammation of the episclera, which is the vascularized tissue between conjunctiva and sclera). ⁹	-70% female ⁹ -Fifth decade of life ⁹ -One-third related to systemic autoimmune conditions. ⁹	Ocular redness without irritation or slight tenderness.	Pain: Usually mild irritation, but chronic or nodular can have pain. ⁹ Photophobia: No. Proparacaine: May have improvement of irritation. Phenylephrine: Resolution of episcleral redness after 10-15 minutes.	Most commonly focal in interpalpebral zone, can be diffuse.	Treatment: -Topical lubricants ¹⁸ -Oral non-steroidal anti-inflammatory drugs -Return precautions for symptoms of scleritis. Referral: Primary care follow up.	AC: Clear. Pupils: Normal. VA: Normal. Fluorescein: No uptake.	Most are idiopathic. Inflamed vessels can be moved with cotton tipped applicator.
Conjunctivitis Picture: E	Infectious or non-infectious inflammation of the bulbar and palpebral conjunctiva. ¹⁹	-Exposure to adenovirus or enterovirus, <i>Staphylococcus aureus</i> , <i>Streptococcus pneumoniae</i> , <i>Haemophilus influenzae</i> , <i>Neisseria gonorrhoea</i> , <i>Chlamydia trachomatis</i> , Diphtheria, or history of allergy.	Tearing, discharge, or associate viral symptoms.	Pain: May have a mild burning sensation. Photophobia: No. Proparacaine: Improvement in irritation. Phenylephrine: Can have mild improvement of redness.	Usually diffuse. Tarsal/palpebral conjunctiva SHOULD be involved in the redness.	Treatment: Artificial tears 4-8x per day, consider topical antibiotics. Referral: Primary care follow up as needed.	AC: Clear. Pupils: Normal. VA: Normal. Fluorescein: No uptake.	Patients should not have photophobia (should raise suspicion for a more serious condition). Patients commonly have discharge. Viral conjunctivitis is highly contagious 1-2 weeks from onset. Recommend contact precautions and sterilization of patient encounter room after visit.

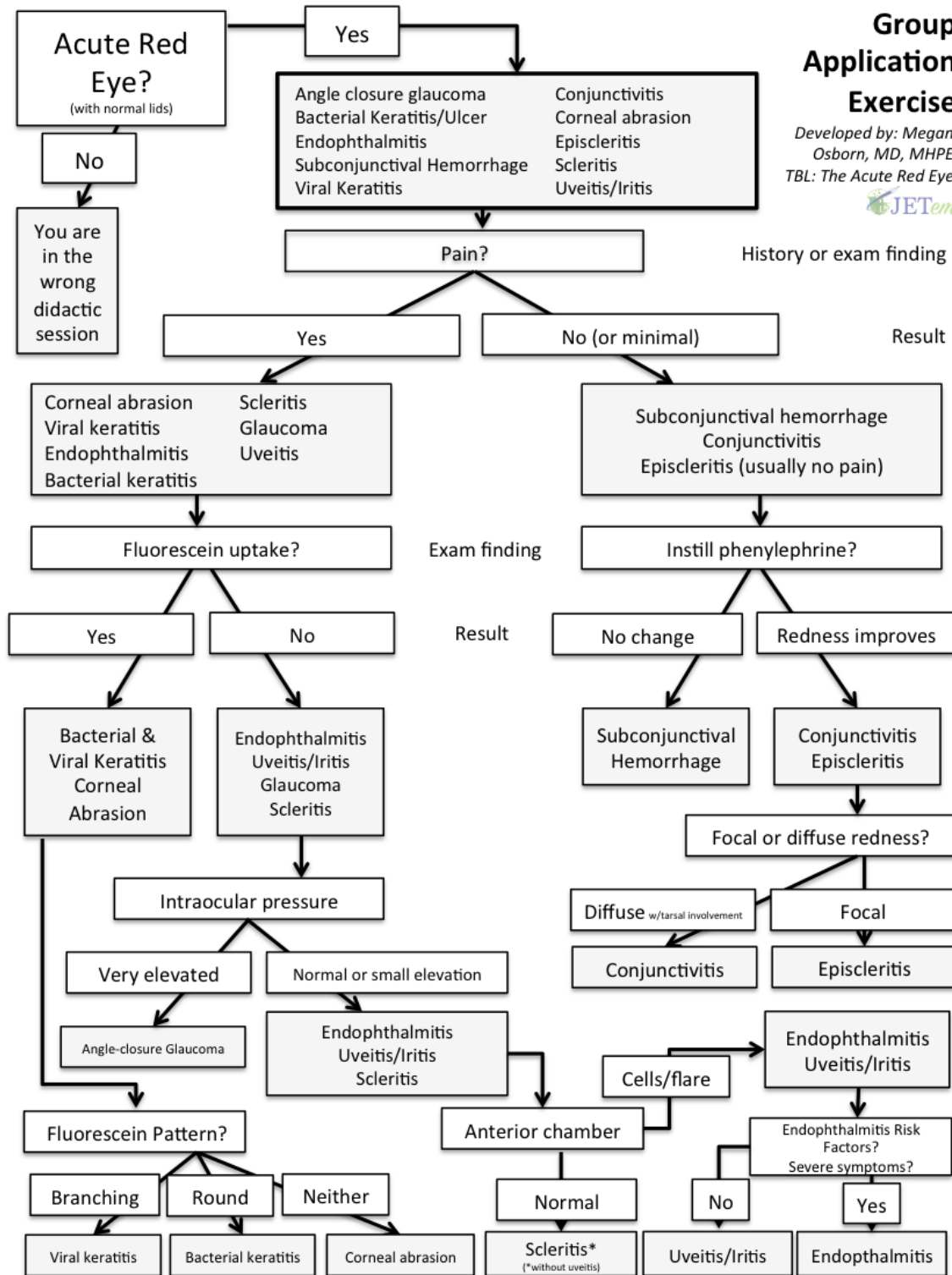


INSTRUCTOR MATERIALS

The Acute Red Eye: Group Application Exercise Key (GAE Key)

Group Application Exercise

Developed by: Megan Osborn, MD, MHPE
TBL: The Acute Red Eye





The Acute Red Eye: Post-test Key

1. This patient's redness does not improve with phenylephrine. What is the most likely diagnosis (see Powerpoint slide #1)?
 - a. Acute angle closure glaucoma
 - b. Bacterial conjunctivitis
 - c. Episcleritis
 - d. Scleritis**

The patient's redness is most consistent with episcleritis vs scleritis. The redness of episcleritis should improve with phenylephrine, while the redness of scleritis does not.

2. What is the most appropriate treatment for this patient who is two days status post cataract surgery (see Powerpoint slide #2)?
 - a. Intravitreal vancomycin**
 - b. Intravenous vancomycin
 - c. Topical gatifloxacin
 - d. Topical steroids

Given the recent surgery and the patient's presentation, he most likely has endophthalmitis, the treatment of which is intravitreal antibiotics. IV antibiotics are sometimes, but not always, indicated. Vitrectomy is the treatment in more severe cases of endophthalmitis.

3. What type of medication would you give this patient (see Powerpoint slide #3)?
 - a. Topical antibiotic
 - b. Topical beta-blocker**
 - c. Topical lubricant
 - d. Topical sympathomimetic

The patient has acute angle closure glaucoma. Treatment options include: topical parasympathomimetics, beta-blockers, alpha-agonists, and systemic carbonic anhydrase inhibitors.



INSTRUCTOR MATERIALS

4. What is the most appropriate treatment for this patient (see Powerpoint slide #4)?
- Reassurance**
 - Topical antibiotics
 - Topical antivirals
 - Topical steroids

The patient has a subconjunctival hemorrhage and no further treatment is indicated.

5. Which one of these conditions generally has a clear anterior chamber?
- Anterior uveitis
 - Bacterial keratitis
 - Endophthalmitis
 - Episcleritis**

Anterior uveitis, bacterial keratitis, and endophthalmitis commonly have cells and flare in the anterior chamber.

6. Which of the following conditions is NOT associated with photophobia?
- Anterior uveitis
 - Bacterial keratitis
 - Conjunctivitis**
 - Corneal abrasion

Photophobia should raise suspicion for a more serious condition. Conjunctivitis does not typically cause photophobia.

7. Which of the following is not a common cause of viral keratitis?
- Adenovirus
 - Herpes simplex virus 1
 - Rhinovirus**
 - Varicella zoster virus

Rhinovirus is not a common cause of viral keratitis.