

# Red and Painful Eye

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## PERSPECTIVE

### Epidemiology and Pathophysiology

Most eye complaints are not immediately sight-threatening and can be managed by an emergency clinician; however, some require immediate recognition, emergent intervention, and consultation. Ocular injuries are one of the leading causes of visual impairment and blindness worldwide.<sup>1</sup> More patients with postoperative complications can be expected to present to the emergency department (ED) as more outpatient ophthalmological surgeries are performed. Nontraumatic diseases, such as glaucoma and peripheral vascular disease leading to retinal ischemia, are more common with advancing age.

The external and internal anatomy of the eye is depicted in [Figure 19.1](#). The globe has a complex layer of blood vessels in the conjunctiva, sclera, and retina. Redness reflects vascular dilation and may occur with processes that produce inflammation of the eye or surrounding tissues. Eye pain may originate from the cornea, conjunctiva, iris, vasculature, or optic nerve. Each is sensitive to processes causing irritation or inflammation.

## DIAGNOSTIC APPROACH

Rapid and accurate triage is the most critical consideration in the approach to the red and painful eye. A few problems should be considered critical, because they can rapidly lead to progressive visual loss without immediate intervention in the ED. Emergent conditions require expeditious triage and treatment. Urgent conditions should be managed in the ED before discharge. The remainder of conditions are those, such as conjunctivitis and spontaneous subconjunctival hemorrhage, where time to treatment has little effect on patient comfort or outcome.

Visual acuity has been called “the vital sign of the eye.” Only a few situations preclude early and accurate visual acuity testing. Patients with complaints of contamination with an acid, alkali, or other caustic substance; sudden visual loss, especially if unilateral and painless; and significant trauma, especially with retrobulbar hematoma causing orbital compartment syndrome, should have only a gross visual acuity examination performed as interventions are simultaneously prepared. When not being actively examined or treated, injured eyes should be protected with a rigid shield to prevent inadvertent pressure that could cause additional damage.

### Differential Diagnosis Considerations

The diagnostic approach to the red or painful eye typically begins with categorization into traumatic and nontraumatic causes. Patients almost always can report whether or not their eye was injured, even indirectly, such as injury from reflected sunlight.

Traumatic pain and redness can be caused by caustic fluids and solid materials, low-velocity contact with a host of materials that can fall or be rubbed into the eye, higher velocity blunt-force impacts to the orbit or globe, or potentially penetrating injuries.

Caustic contamination is discussed elsewhere. Other traumatic complications that must be considered early in the course of care include retrobulbar hematoma, abscess, or emphysema with orbital compartment syndrome and suspicion of an open globe from either blunt or penetrating trauma.

The first triage question for any eye complaint should be, “Did anything get in your eye?” If so, attempt to identify the nature of the substance or foreign body. Specifically, this question seeks to quickly identify eyes that may have been exposed to a caustic substance. Patients exposed to acids, alkalis, and other caustic substances require rapid decontamination before additional evaluation to potentially prevent permanent loss of visual acuity.

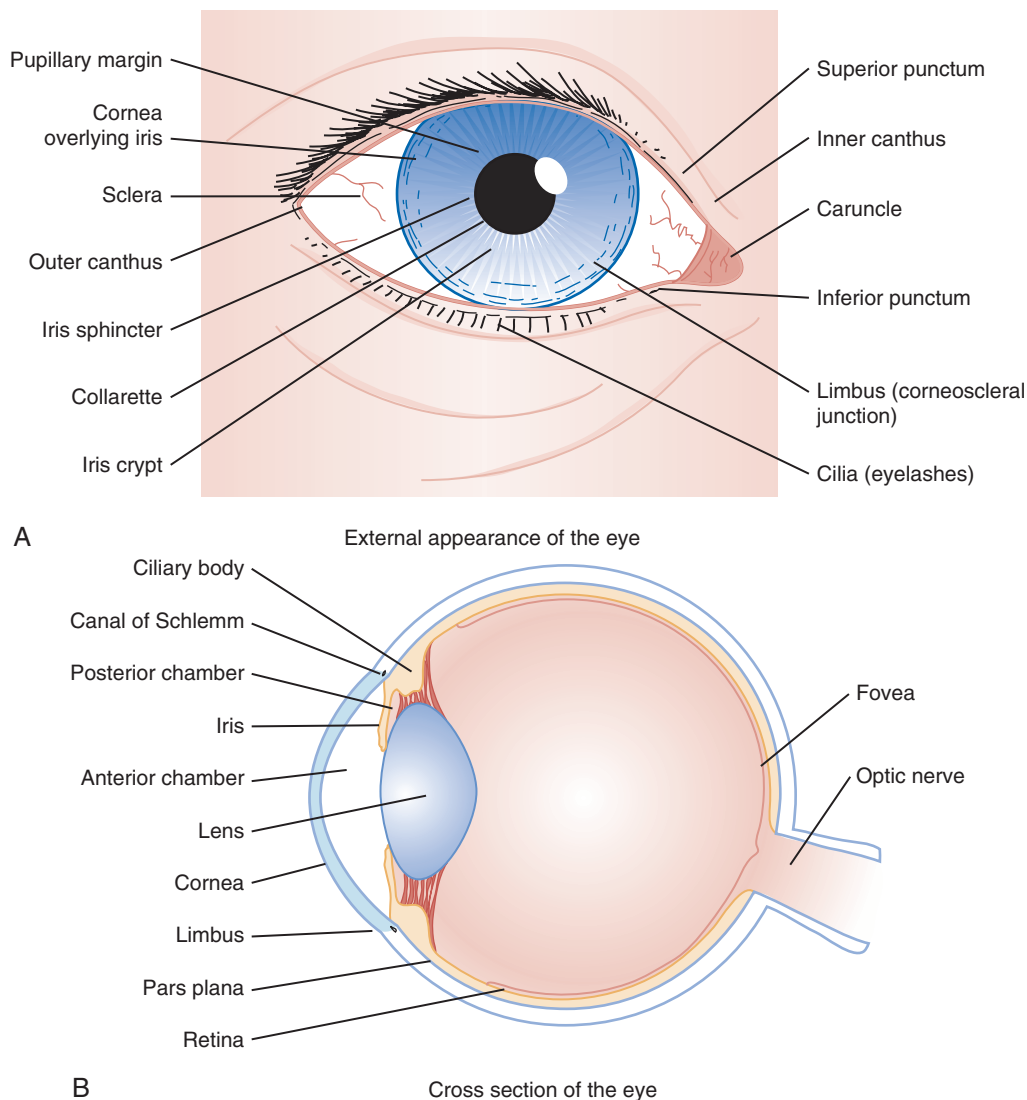
The possibility of an open globe must be considered following any traumatic injury regardless of the mechanism. Findings may be obvious, subtle, or occult. Blunt trauma may frankly rupture the globe. Penetrating trauma can result from obvious causes identified through determining the events leading to injury, but it can also be unknown to the victim, such as walking near a person hammering metal or using a high-speed grinder yet not realizing a tiny ballistic metal fragment may have penetrated the eye.

Causes of nontraumatic pain and redness are diverse but are mostly infectious and inflammatory, although these may be due to processes intrinsic to the globe and adjacent structures or be due to ocular manifestations of systemic illness (eg, giant-cell arteritis). Exposure history and review of systems may be helpful when infection is suspected (eg, concomitant upper respiratory tract infections making a viral etiology of conjunctivitis more likely). Questions related to recent surgery and contact lens wear and cleaning practices should not be overlooked. Therefore, nontraumatic eye complaints typically require a more detailed history than would be necessary following a known injury.

Not all visual disturbances are due to conditions that cause ocular inflammation resulting in pain or redness. One that is critical to identify in the triage process is central or branch retinal artery occlusion. Only a rapid funduscopic examination to identify the problem and immediate intervention will afford even a chance to restore sight. This condition is readily apparent as a diffusely pale retina with indistinct or unseen retinal arteries ([Fig. 19.2](#)). Because it does not typically present with either pain or external signs (such as, redness), diagnosis and treatment are detailed in [Chapter 61](#). Diplopia is covered in [Chapter 18](#).

### Pivotal Findings

Measurement of the patient’s best corrected visual acuity (ie, with glasses on if available) with each eye individually provides vital information when evaluating eye complaints and may be prognostic in some situations. Only a few situations discussed earlier preclude obtaining visual acuity using a chart. Decreased visual acuity caused by abnormal refraction (eg, chronic myopia) can be detected by using a pinhole device during acuity testing, because central vision remains intact in refraction conditions. If there is a non-refractory problem, such as retinal edema or aqueous hemorrhage causing the acuity deficit, pinhole testing will show no improvement in the (poor) visual acuity.



**Fig. 19.1.** External (A) and internal (B) anatomy. (From Ragge NK, Easty DL: Immediate eye care, St Louis, 1990, Mosby-Year Book.)

Symptoms and signs that are more likely to be associated with a serious diagnosis in patients with a red or painful eye are listed in [Box 19.1](#).

## Symptoms

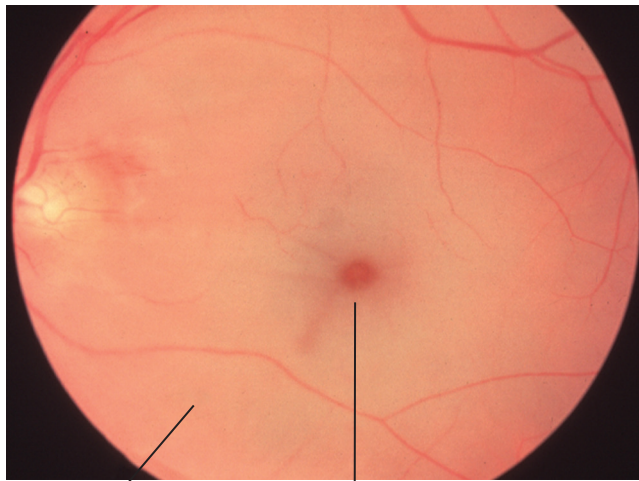
When the presenting complaint is pain, the first step is to characterize it: itching, burning, dull pain, sharp pain, diffuse, or localized. Two historical factors are particularly important: suddenness of onset and perception of a foreign body. Itching tends to be more often due to irritation by blepharitis, conjunctivitis, or dry eye syndrome. Burning is associated with these conditions and with other mostly superficial problems, such as irritation of a pterygium or pinguecula, episcleritis, or limbic keratoconjunctivitis. A foreign-body sensation, particularly when it can be localized, is a strong indicator of corneal origin to the pain (foreign body, corneal abrasion, ulcer, or viral or ultraviolet keratitis). Sharp pain generally results from abnormalities of the anterior eye, such as corneal origin pain and uveitis. Dull pain, which may be severe, is usually generalized throughout the eye (and may be reported as “headache”). It is typically a manifestation of increased intraocular pressure (IOP) (such as, with acute angle closure glaucoma), vitreous infection (such as, endophthalmitis), or the pain is referred from an extra orbital process (such as, sinusitis,

migraine headache, or temporal arteritis). Acute orbital compartment syndrome, caused by retro-orbital hematoma, presents with intense pain and progressive visual loss. These patients often present with head trauma that precludes them reporting pain, emphasizing the importance of physical examination.

Rarely is there a chief complaint of redness that is not accompanied by pain, itching, irritation, or foreign body sensation. Completely asymptomatic “red eye” is almost always a spontaneous subconjunctival hemorrhage, which is benign but often alarming to the patient. Spontaneous subconjunctival hemorrhage may follow coughing or straining, but it most often occurs without any identifiable precipitating event and is simply noticed by the patient when looking in a mirror.

Symptomatic red eye commonly causes bulbar or limbal injection of the conjunctiva. Free blood noted behind the bulbar conjunctiva (ie, subconjunctival hemorrhage) or in the anterior chamber (ie, hyphema) may be spontaneous or post-traumatic. Spontaneous subconjunctival hemorrhage is painless, and the presence of pain raises concern for a more serious cause of the hemorrhage, such as direct globe injury or a retrobulbar process. Hyphema of sufficient size to be noted by the patient or bystander usually presents with pain and blurred vision.

Other subjective findings may be transient and detected only by a thorough history. The patient may have symptoms of lid



Retinal edema Cherry-red spot

**Fig. 19.2.** Key funduscopic findings in acute central retinal artery occlusion include general pallor of the retina (except for a characteristic cherry-red spot where the perfused choroid shows through the thinner fovea) and attenuation of retinal arteries (possibly with retinal veins preserved as in the photograph). (From Kaiser PK, Friedman NJ, Pineda R II: *The Massachusetts Eye and Ear Infirmary illustrated manual of ophthalmology*, ed 2, Philadelphia, 2004, WB Saunders, p 297.)

### BOX 19.1

#### Pivotal Findings More Likely Associated With a Serious Diagnosis in Patients With a Red or Painful Eye

- Severe ocular pain
- Persistently blurred vision
- Exophthalmos (proptosis)
- Reduced ocular light reflexion
- Corneal epithelial defect or opacity
- Limbal injection (also known as, ciliary flush)
- Pupil unreactive to a direct light stimulus
- Wearer of soft contact lenses
- Neonate
- Immunocompromised host
- Worsening signs after 3 days of pharmacologic treatment

Adapted and reprinted with permission from Trobe JD: *The physician's guide to eye care*, San Francisco, 2001, Foundation of the American Academy of Ophthalmology.

swelling, tearing, discharge, crusting, discomfort on blinking, or sensitivity to light. Lid swelling can be caused by inflammatory and noninflammatory processes. Concurrent erythema and tenderness of the lid favors the former. In the absence of trauma or other external irritant (eg, contact dermatitis from eye makeup), inflammatory processes include primary lid problems, such as hordeolum (ie, stye) or blepharitis, as well as extension from concomitant conjunctivitis or cellulitis in orbital or periorbital structures. When pain is present, tearing is usually secondary. Discharge and crusting are most commonly associated with conjunctivitis, whether allergic, chemical, viral, or bacterial. Blepharitis, dacryocystitis, and canaliculitis are other inflammatory processes that may create a discharge and subsequent crusting.

A history of eyelids sticking together, particularly in the morning, is commonly cited as clinical evidence of bacterial, as opposed to viral, conjunctivitis, but this is unreliable. Even when lid sticking is combined with absence of itch and lack of history of conjunctivitis, large studies have failed to show diagnostic

### BOX 19.2

#### Past Ocular History Questions

1. Are contact lenses used? If so, what type, how are they cleaned, and how old are the lenses? How often is the lens solution changed?
2. Are glasses worn? If so, when was the last assessment for adequate refraction? Does the patient endorse a subjective change in vision?
3. Has previous eye injury or surgery occurred?
4. What is the patient's usual state of health? Does the patient have any systemic diseases that may affect the eye?
5. What medications are being taken?
6. Are there any known or suspected allergies?

### BOX 19.3

#### Complete Eye Examination

Visual acuity (best possible using correction)

Visual fields (tested by confrontation)

External examination

Globe position in orbit

Conjugate gaze

Periorbital soft tissues, bones, and sensation

Extraocular muscle movement

Pupillary evaluation (absolute and relative)

Pressure determination (tonometry)

Slit-lamp examination

Funduscopic examination

Adapted from Wightman JM, Hurley LD: Emergency department management of eye injuries. *Crit Decis Emerg Med* 12:1-11, 1998.

correlation between lid sticking and bacterial infection. Similarly, in the pediatric population (younger than 18 years old), lid sticking plus mucoid or purulent discharge show only fair correlation with proven bacterial infection. The hazards of equating lid sticking with bacterial infection are underscored by the fact that viral conjunctivitis, particularly caused by subtypes of adenovirus, can cause dramatic symptoms with mucopurulent discharge, lid sticking, keratitis symptoms, and lid inflammation. In many studies, lack of viral cultures precludes consideration of copathogens or bacterial culture of nonpathogenic flora.

Additional past ocular history questions are listed in [Box 19.2](#).

#### Signs

A complete eye examination usually includes eight components, although many patients require only a limited or directed eye examination, depending on the presentation. The mnemonic *VVEEPP* (pronounced "veep") plus slit-lamp and funduscopic examinations represent these components ([Box 19.3](#)). We recommend slit-lamp examination for any complaint involving trauma and for any medical presentation involving foreign-body sensation or alteration of vision. Funduscopic examination is usually pursued if there is visual loss, visual alteration, clouding of vision, or suggestion of serious pathology in the history and initial physical examination. A thorough physical examination can be conducted in the following order.

#### Visual Acuity

The initial determination of a patient's visual acuity provides a baseline from which deterioration or improvement may be



followed. It is also predictive of functional outcome after ocular trauma. Visual acuity is quantitatively assessed by use of a Snellen chart test at a distance of 20 feet (6 m) or a Rosenbaum chart at a distance of 14 inches. Young patients who cannot yet read letters and numbers should be tested with an Allen chart that depicts easily recognizable shapes. Each eye is tested separately with the opposite eye carefully covered. Patients who present without their prescribed corrective lenses may be evaluated by having them view the chart through a pinhole eye cover, which improves most refractive errors in vision.

If the patient cannot distinguish letters or shapes on a chart, visual acuity must be determined qualitatively. Any printed material suffices. The result may be recorded as, for example, “patient able to read newsprint at 3 feet.” If this is not possible, visual acuity is recorded as:

- Unable/able to count fingers (CF)
- Unable/able to perceive hand motion (HM)
- Unable/able to perceive light (LP)

### Visual Field Testing

Confrontation is the most common method of testing visual fields in the ED, but it is unreliable for detection of anything short of an extensive field deficit. On the other hand, visual field examination rarely adds useful information in the evaluation of the acutely red and painful eye. Detection of a scotoma usually represents a retinal problem. However, glaucoma may cause scotomata that can be crescent-shaped, involve just the binasal visual fields, or affect all peripheral vision. Hemi- or quadrantanopia is more commonly a problem of the neural pathways to the brain.

### External Examination

Gross abnormalities are assessed by a visual inspection of both eyes simultaneously. Findings may be more apparent if compared with the opposite side. Fractures of maxillofacial bones are associated with ocular injuries, some of which require immediate intervention by an ophthalmologist.<sup>2</sup>

Globe position is part of the external examination. Subtle exophthalmos and enophthalmos are rare and best detected by looking inferiorly, tangentially across the forehead, from over the patient’s scalp. Exophthalmos may have traumatic or nontraumatic causes but is due to increased pressure or a space-occupying lesion within the orbit, which may manifest as pain. Medical causes include cellulitis or intraorbital or lacrimal tumors. Hypertrophy of the thyroid gland may cause enlargement of extraocular muscles.

The most important cause of exophthalmos in the ED is orbital compartment syndrome, which pushes the globe forward, stretching the optic nerve and retinal artery and increasing IOP. The resulting microvascular ischemia is sight-threatening if sufficiently severe and persistent. Orbital emphysema and inflammation caused by a retained foreign body behind the eye are other causes of exophthalmos. Other signs of orbital compartment syndrome include limited eye movement and a relative afferent pupillary defect (RAPD) described under ancillary testing. If retrobulbar hemorrhage is the cause, blood often dissects anteriorly to fill the subconjunctival potential spaces.

The discovery of exophthalmos should prompt ocular tonometry measurements to determine the urgency of intervention. Trauma, particularly penetrating globe injury with extrusion of vitreous, can cause the globe to recede into the orbit, but the most common cause of enophthalmos is actually pseudo-enophthalmos when the contralateral globe is proptotic.

Inspection also involves examination of the upper and lower palpebral sulci for foreign bodies or other abnormalities. The lower sulcus is easily viewed after manual retraction of the lower lid toward the cheek and having the patient gaze upward. The



**Fig. 19.3.** Injection of the palpebral and bulbar conjunctiva plus hypertrophy of Bruch’s glands in the lower eyelid. (Photograph courtesy of Dr. John Wightman.)

upper sulcus is inspected by pulling its lashes directly forward and looking under the lid with white light. The lid can then be everted by pressing a cotton-tipped applicator in the external lid crease and folding the lid margin over the applicator.

Conjunctivitis, with conjunctival injection and discharge, is a common diagnosis following evaluation of patients with red and painful eyes. The presence of punctate “follicles” (ie, hypertrophy of lymphoid tissue in Bruch’s glands) along the conjunctival surfaces of one or both lower lids has been touted to be relatively specific for a viral etiology (Fig. 19.3). Indeed, the “typical” viral “pink eye” used to be called *acute follicular conjunctivitis*.<sup>3</sup> Trachoma, a chronic keratoconjunctivitis caused by *Chlamydia trachomatis*, is one notable nonviral cause of this follicular hypertrophy.

Any discharge present is assessed as serous, mucoid, or purulent. Both viral and bacterial infection can cause mucoid or purulent discharge, so it is not possible to clinically distinguish viral from bacterial conjunctivitis on this basis alone.

A red eye in a neonate or infant is always abnormal. It is usually caused by corneal abrasion or infection. Corneal abrasions can also be a cause of inconsolable crying in an infant. Fluorescein examination helps to identify traumatic abrasions and herpes keratitis acquired from the birth canal or transmitted from a caregiver’s fingers.

### Extraocular Muscle Function

Limitation of ocular movement in one eye may be detected by having the patient follow the examiner’s finger or a bright light through the cardinal movements of gaze. The eyes may move in a disconjugate fashion, or the patient may admit to diplopia if asked. Diplopia on extreme gaze in one direction may indicate entrapment of one of the extraocular muscles within a fracture site, but more often is caused simply by edema or hemorrhage related to the injury and is functional rather than actual entrapment. In the absence of trauma, diplopia is rarely associated with redness or pain.

### Pupillary Evaluation

The pupils are inspected for abnormalities of shape, size, and reactivity. These examinations are conducted with light specifically directed into the pupil and by means of the swinging flashlight test.

Blunt or penetrating trauma, previous surgery (eg, iridotomy for cataract extraction), and synechiae from prior iritis or other inflammatory condition are the most common causes of irregularly shaped pupils.

Asymmetrically sized pupils may represent normal or pathologic conditions. Physiological anisocoria is a slight difference in pupil size that occurs in up to 10% of the population. Topical or systemic medications, drugs, and toxins may cause abnormal pupillary constriction or dilation.

Pathologic reasons for failure of one pupil to constrict with a direct light stimulus include globe injury, abnormalities of afferent or efferent nerves, and paralysis of the ciliaris or sphincter pupillae muscles in the iris. Potentially serious problems, which also cause pain and redness, include uveitis and acute angle-closure glaucoma.

While examining the pupils, the anterior chambers can be visually inspected for hyphema or hypopyon. Blood in the anterior chamber is usually the result of direct ocular trauma and may be associated with traumatic mydriasis or an obvious tear of the iris. If penetration and rupture can be reasonably excluded, the hyphema should be graded and IOP determined. Inability to view posterior structures through the anterior blood may necessitate radiologic or ultrasonographic imaging.

### Ancillary Testing

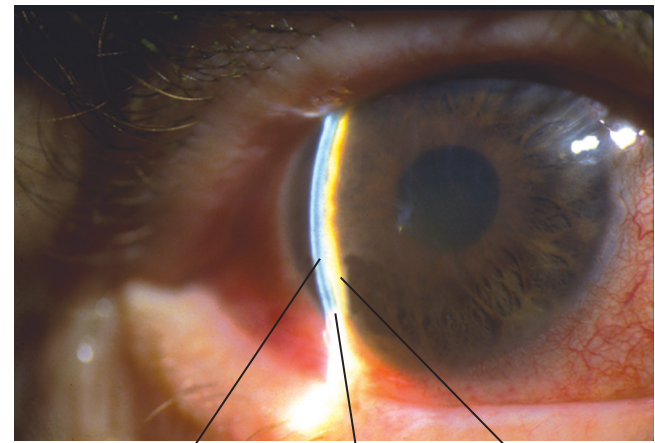
Physical examination can be augmented by a number of additional tests to assess the relative amount of light reaching the retina or being converted into neural signals, determine the IOP, and visually inspect the anterior and posterior globe with magnification. Imaging of internal anatomy and pathology can be accomplished at the bedside or in the radiology suite.

### Swinging Flashlight Test

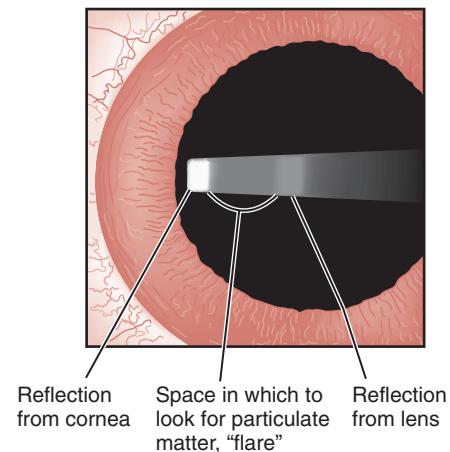
The swinging flashlight test is used to determine whether a RAPD exists (see <https://youtu.be/soiKbngQxgw>). It is described in Chapter 61. A RAPD may be partial or complete and due to inhibition of light transmission to the retina because of vitreous hemorrhage, loss of some or all of the retinal surface for light contact because of ischemia or detachment, or the presence of lesions affecting the prechiasmatic optic nerve (eg, optic neuritis).

### Pressure Determination

Ocular tonometry is usually the last examination performed in the ED. Common methods of determining the IOP in the ED include use of electronic, manual (eg, Schiøtz), or applanation tonometers. IOPs in the 10 to 20 mm Hg range are considered normal. Causes of intraocular hypertension include glaucoma in its many forms, suprachoroidal hemorrhage, and space-occupying retrobulbar pathology. Acute angle-closure glaucoma is a relatively rare but an important critical diagnosis to make in the ED. Patients present with pain, the onset of which is often sudden in low-light conditions causing pupillary dilation through contraction and thickening of the iris peripherally. The iris becomes immobile and often irregular, and the pupil is commonly fixed at 5 to 6 mm in diameter. Inability of the pupil to constrict may result in photophobia, and accommodation may be affected. These reactions and the increased IOP can lead to frontal headache, nausea, and vomiting. As inflammation progresses, limbal injection of the conjunctiva is almost universally seen. **Figure 19.4** demonstrates many of these findings. Patients presenting with IOPs exceeding 20 mm Hg should have ophthalmological consultation. Rapid treatment is usually not necessary unless the pressure exceeds 30 mm Hg.



**Fig. 19.4.** Primary angle-closure glaucoma with very shallow anterior chamber and iridocorneal touch (no space between slit-beam views of cornea and iris). (From Kaiser PK, Friedman NJ, Pineda R II: *The Massachusetts Eye and Ear Infirmary illustrated manual of ophthalmology*, ed 2, Philadelphia, 2004, WB Saunders.)



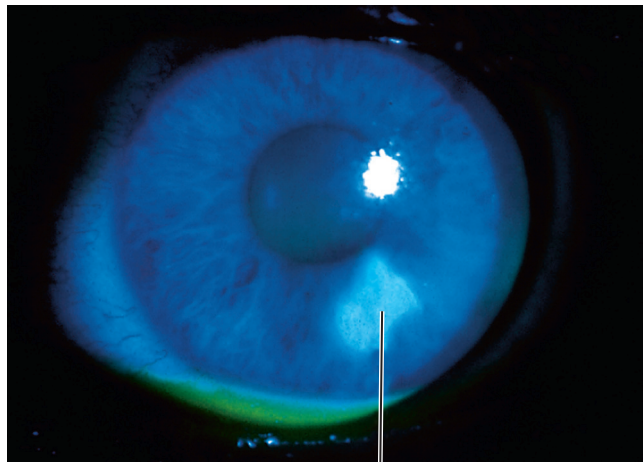
**Fig. 19.5.** Technique of slit-lamp examination with a short, narrow light beam projected from an extreme temporal angle across the contrasting black pupil to better find cells or "flare" indicative of acute anterior uveitis. (From Ragge NK, Easty DL: *Immediate eye care*, St Louis, 1990, Mosby-Year Book.)

### Slit-Lamp Examination

The slit lamp is used to examine anterior eye structures. It permits a magnified, binocular view of the conjunctivae and anterior globe for diagnostic purposes and to facilitate delicate procedures. It allows depth perception in otherwise clear structures, such as the cornea, aqueous humor, and lens. **Figure 19.5** shows the typical appearance of an angled slit beam reflecting from and passing through the cornea. Components of the slit-lamp examination are found in **Box 19.4**.

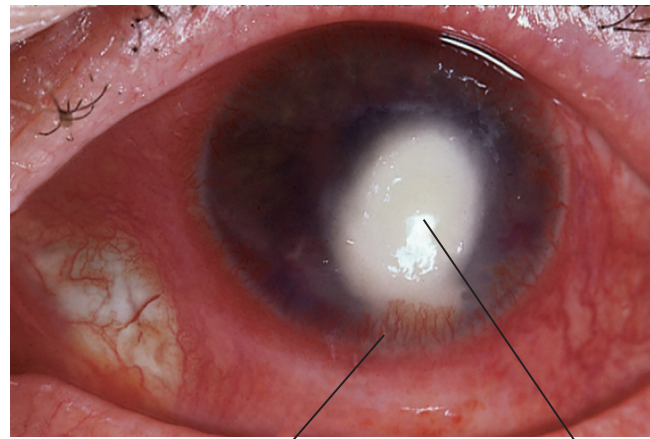
Fluorescein examination with cobalt blue light from the slit lamp identifies corneal defects. Fluorescein is not taken up by intact corneal epithelium but concentrates in areas where corneal epithelium is breached by abrasion, foreign body, or ulcer (**Fig. 19.6**). If the patient cannot sit in front of a slit lamp, a Wood's lamp may be used for magnification and an alternative light source instead. When corneal perforation is suggested, Seidel's test can be used as described in Chapter 61 (see <https://www.youtube.com/watch?v=GIFcAv0DR4c>).





Corneal abrasion

**Fig. 19.6.** Corneal abrasion demonstrating fluorescein pooling of a small inferior epithelial defect. (From Kaiser PK, Friedman NJ, Pineda R II: The Massachusetts Eye and Ear Infirmary illustrated manual of ophthalmology, ed 2, Philadelphia, 2004, WB Saunders.)



Neovascularization

Corneal ulcer

**Fig. 19.7.** Bacterial keratitis demonstrating a large, central *Streptococcus pneumoniae* corneal ulcer. Note the dense, white corneal infiltrate and the extreme conjunctival injection. (From Kaiser PK, Friedman NJ, Pineda R II: The Massachusetts Eye and Ear Infirmary illustrated manual of ophthalmology, ed 2, Philadelphia, 2004, WB Saunders.)

#### BOX 19.4

##### Slit-Lamp Examination

1. **Lids and lashes** inspected for blepharitis, lid abscess (ie, hordeolum) and internal or external pointing, and dacryocystitis.
2. **Conjunctiva and sclera** inspected for punctures, lacerations, and inflammatory patterns.
3. **Cornea** (with fluorescein in some cases) evaluated for abrasions, ulcers, edema, foreign bodies, or other abnormalities.
4. **Anterior chamber** evaluated for the presence of cells (eg, red and white blood cells) and “flare” (diffuse haziness related to cells and proteins suspended in aqueous humor) representing deep inflammation. Hyphema from surgery or trauma, hypopyon, or foreign bodies may also be noted.
5. **Iris** inspected for tears or spiraling muscle fibers noted in acute angle-closure glaucoma.
6. **Lens** examined for position, general clarity, opacities, and foreign bodies.

Ulcers can be large and easy to visualize (Fig. 19.7) or small and difficult to detect. They are best identified under slit-lamp examination by noting a denuding of epithelium with surrounding edema. Edema, in the form of increased interstitial water, is seen as whitish clouding of the normally clear tissue in the base of and adjacent to the lesion. This is best identified without fluorescein staining.

##### Direct Funduscopy Examination

Funduscopy is used to examine posterior eye structures. Emergency physicians most commonly perform a nondilated funduscopy examination, because there are several eye conditions in which dilation may be harmful (eg, angle-closure glaucoma). Iridodialysis, lens dislocation, and conditions requiring early intervention are usually identifiable along the visual axis. Inability to obtain a red reflex or visualize the fundus of the eye can be due to the causes listed in Box 19.5.

In the absence of trauma, few posterior findings are associated with chief complaints of external redness. Findings associated

#### BOX 19.5

##### Causes of Inability to Visualize a Red Reflex or the Otic Fundus

1. Opacification of the cornea, most commonly by edema secondary to injury or infection
2. Hyphema or hypopyon within the anterior chamber
3. Extremely miotic pupil
4. Cataract of the lens
5. Blood in the vitreous or posterior eye wall
6. Retinal detachment

with visual loss include pallor of the retina indicating ischemia, “cupping” of the optic disk indicating glaucoma, indistinctness of disk margins indicating papilledema or optic neuritis or neuropathy, air or plaque emboli in retinal arteries, and a host of other signs indicating more chronic ocular or systemic pathology not normally amenable to management in the ED.

##### Topical Anesthetics

Relief of discomfort after instillation of a topical anesthetic can be used as a diagnostic test for a superficial source of pain. In general, abolition of pain by local anesthetic drops indicates pain of corneal origin. Modest but incomplete relief suggests a conjunctival process. Intraocular pain, including pain associated with uveitis, is not diminished by local anesthetic solution.

##### Imaging

A penetrating wound that violates the sclera may be immediately obvious. In other cases, the penetration may have occurred elsewhere in the head or neck then reach the orbit posterior to the orbital septum to injure the globe. In these cases, computed tomography (CT) or plain radiography is used to determine the presence of an intraocular or intraorbital foreign body.

Ultrasonography can be used in the ED when patient condition may preclude movement to the radiology suite, and it can be

highly accurate in identifying ocular foreign bodies. In experienced hands, ultrasonography is an excellent bedside modality for evaluating pathology of the globe. Ultrasonography can be used to evaluate abnormalities of the anterior chamber, iris, ciliary body, lens, vitreous, retina, choroid, posterior wall, and optic nerve.

Although plain radiography may directly identify facial fractures, or indirectly suggest fractures by detecting an air-fluid level in the orbit or fluid in the paranasal sinuses, CT is now considered the preferred modality for evaluating orbital trauma. Magnetic resonance imaging (MRI) clearly delineates orbital and retro-orbital structures but is less rapidly obtained with no advantages over CT in trauma, is contraindicated in cases of suspected metallic foreign body, and is reserved for ocular issues felt to be of neurological origin.<sup>4,5</sup> All imaging modalities should be considered complementary to each other when employed in appropriate settings.

### Laboratory Testing

Laboratory tests, such as a complete blood count, are generally not necessary in the evaluation of the red and painful eye. One notable exception is the evaluation of temporal arteritis. Temporal arteritis may present with eye pain and decreased visual acuity, but there may be no injection or other physical alteration of the eye. An erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are generally elevated in the acute phase, although one or both may be normal in up to 5% of biopsy-proven cases of temporal arteritis.<sup>6</sup> We do recommend obtaining CRP and ESR in cases of suspected temporal arteritis.

Microbiologic cultures are rarely ordered in the ED, but an ophthalmologist may request them in select circumstances.

### DIAGNOSTIC ALGORITHM

A recommended algorithmic approach to the patient with an acutely red or painful eye is provided in Fig. 19.8.

### Critical Diagnoses

Critical diagnoses require immediate intervention in the ED. Ophthalmological consultation is mandatory but should not delay potentially sight-saving procedures. Critical ophthalmologic diagnoses that do not present with redness or pain are discussed in Chapter 61. Because of its prognostic value, a quick visual acuity should be obtained while the patient is being triaged and subsequently managed.

Caustic injury to the eye can rapidly lead to a destructive keratoconjunctivitis if the agent is not removed immediately (Fig. 19.9). Intervention is initiated on history alone, before any other examination is performed. Early and copious irrigation is indicated. Many patients have already undergone extensive irrigation at the job site, but when the exposure has occurred in the home, irrigation prior to arrival in the ED is uncommon. Alkaline caustic agents cause a liquefactive necrosis of the cornea by progressively reacting with the corneal layers, and destruction is severe and relentless. Acid injury causes coagulation necrosis, which tends to limit the depth of injury. Both types require copious irrigation with any clean, relatively neutral fluid (eg, tap water, normal saline, and so on). Continuous irrigation until the pH of the tears is neutral is the only effective method to terminate these chemical reactions. A normal pH and post-irrigation examination (except expected conjunctival injection) does not mandate that an ophthalmologist respond to the ED. Any other post-treatment abnormalities do necessitate the presence of an ophthalmologist.

Orbital compartment syndrome can occur whenever intraorbital pressure increases to the point of causing dysfunction of the

optic nerve. IOP can be used as a surrogate measure of intraorbital pressure when this can be safely measured. Retrobulbar hematoma is usually caused by orbital trauma, but it can also occur spontaneously in patients with coagulopathy. Retrobulbar abscess or emphysema can also occur. Elevated IOP in any of these conditions implies an orbital compartment syndrome and constitutes a surgical emergency.<sup>7</sup> Intervention in the ED requires decompressing the orbit by performing lateral canthotomy and cantholysis (see [https://youtu.be/bUAagMd\\_Q8A](https://youtu.be/bUAagMd_Q8A)) to relieve the pressure on the optic nerve, and should be performed within 2 hours of injury for the best chance of sight recovery.<sup>7</sup> These patients should be examined by an ophthalmologist as soon as possible afterward.

Patients with acute angle closure glaucoma (see earlier) require prompt medical intervention to decrease IOP in the ED and urgent ophthalmologic consultation (see Chapter 61). Follow-up can be decided based on the patient's response to therapy and discussion with the ophthalmologist.

### Emergent Diagnoses

Most emergent diagnoses involve some kind of inflammation secondary to trauma, infection, or systemic disease. These include keratitis, anterior uveitis, scleritis, and endophthalmitis. Any of these may be complications of surgical procedures, and an appropriate ophthalmological history must be obtained. Consultation with an ophthalmologist is appropriate for all emergent diagnoses.

If penetrating ocular trauma is confirmed, or if the possibility persists after evaluation, an ophthalmological consultation is indicated.

Keratitis is treated with topical anesthesia, which provides immediate (but temporary) relief of pain, thus reinforcing the corneal origin of the process and facilitating examination and definitive diagnosis.

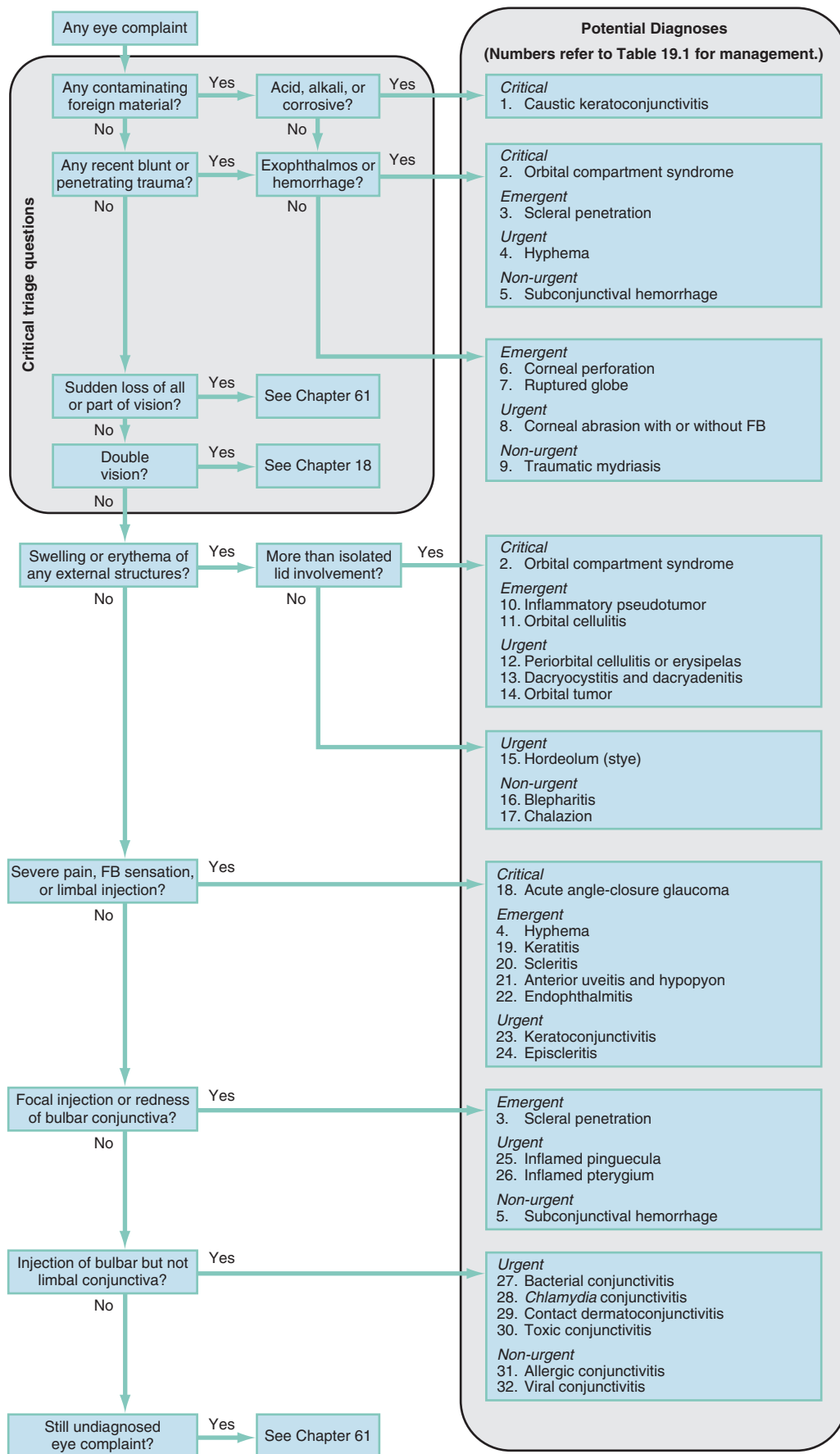
Following thorough irrigation, thermal and chemical burns must receive a careful slit-lamp examination for potential full-thickness injury. If this is not found, superficial corneal burns may be treated similarly to abrasions. If full-thickness injury is identified, immediate ophthalmological consultation is indicated.

Corneal ulcerations caused by overuse of contact lenses are treated with prophylactic antibiotics and avoidance of the lenses for at least 72 hours. We recommend follow-up with an ophthalmologist or optometrist before contact lens use is resumed.

Infections of the cornea with herpes simplex virus can rapidly lead to opacification and significant visual loss. It is most commonly recognized by a characteristic dendritic pattern of fluorescein pooling under blue light (Fig. 19.10). Anterior uveitis, which includes iritis and iridocyclitis, often occurs secondary to a traumatic injury or infectious process or can be associated with serious systemic immune diseases, such as adult and juvenile rheumatoid arthritis, sarcoidosis, and ankylosing spondylitis. We recommend urgent ophthalmologic evaluation, either in the ED or by immediate evaluation in an ophthalmological clinic, for these conditions.

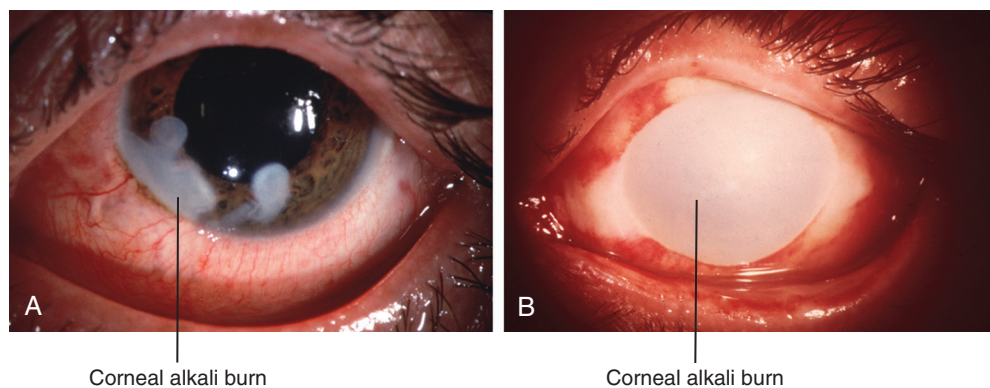
Scleritis is commonly idiopathic, but may be associated with a systemic inflammatory process, such as a connective tissue disease, gout, or infection (eg, Lyme disease, syphilis, tuberculosis). Episcleritis is a somewhat more common, superficial, and more benign inflammation. Both are discussed in Chapter 61.

Endophthalmitis usually results from an infection of structures inside the globe. It is most common following penetrating trauma but may begin after hematogenous seeding from a remote or systemic infection, particularly in immunocompromised hosts. Unless it is detected early and is responsive to antimicrobial therapy, endophthalmitis is a devastating process that frequently requires enucleation.



**Fig. 19.8.** Diagnostic algorithm for red and painful eyes. Numbers next to diagnoses correspond to Table 19.1 for management of each condition. *FB*, Foreign body.





**Fig. 19.9.** **A**, Alkali burn demonstrating corneal burns and conjunctival injection on the day of the accident. **B**, Complete corneal tissue destruction 7 days after alkali burn. (From Kaiser PK, Friedman NJ, Pineda R II: *The Massachusetts Eye and Ear Infirmary illustrated manual of ophthalmology*, ed 2, Philadelphia, 2004, WB Saunders.)

## Urgent Diagnoses

Foreign bodies on the cornea or under the lid are removed, as described in Chapter 61.

Superficial corneal abrasions, once universally patched, are now known to heal spontaneously without need for patching, prophylactic antibiotics, or prophylactic tetanus immunization.

Patients with hyphema are placed with head of bed elevated to 30 degrees, and they receive systemic analgesia and, if required, antiemetics, with emergent ophthalmologic consultation (see Chapter 61). Medications affecting platelet function should be avoided. If the iris is not injured, a long-acting cycloplegic agent (eg, topical homatropine) may be recommended to prevent repetitive motion of the iris. After consultation by ophthalmology, outpatient therapy and follow-up often are sufficient for management with simple (eg, acetaminophen) analgesia for pain. We recommend a rigid shield to protect the eye during sleep, but this should not be worn during the day. Patching is not otherwise needed. The patient should see the ophthalmologist or return to the ED if the patient experiences an increase in pain or decrease in visual acuity.

## EMPIRICAL MANAGEMENT

Management of the specific entities listed in the diagnostic algorithm presented in [Figure 19.8](#) is presented in [Table 19.1](#). Specific management of ophthalmologic conditions is also discussed in Chapter 61.

Critical and emergent conditions are treated as described earlier. All other ocular emergencies are generally diagnosable in the ED, and treatment is initiated based on the diagnosis made. Caustic exposures receive copious irrigation, but all chemical or liquid exposures should undergo irrigation unless 1 hour has passed since exposure and the patient is completely asymptomatic at the time of evaluation.

Foreign bodies are removed, along with all fine particulate matter. Irrigation is advisable after foreign body removal if there is suspicion of remaining, very fine, foreign substance. After irrigation, conjunctival injection is common, but symptoms are expected to be mild. Patching is not indicated. Patients with significant symptoms after foreign body removal or with corneal abrasion may benefit from a topical nonsteroidal antiinflammatory analgesic solution or dilute topical local anesthetic drops for 24 hours.<sup>8,9</sup>

An algorithm for the treatment of acute conjunctivitis is presented in [Figure 19.11](#). We do not recommend topical antimicrobial or corticosteroid treatment for conjunctivitis or keratoconjunctivitis (see Chapter 61). This is an area in which antibiotic



Herpes simplex virus dendrite

**Fig. 19.10.** Fluorescein pooling in the dendritic-shaped lesions of herpes simplex keratitis. (From Kaiser PK, Friedman NJ, Pineda R II: *The Massachusetts Eye and Ear Infirmary illustrated manual of ophthalmology*, ed 2, Philadelphia, 2004, WB Saunders.)

misuse is widespread. There is no good medical evidence to support the requirements of most daycare and school facilities to mandate antibiotic treatment for acute conjunctivitis before returning to activities with other children. First, some causes of “pink eye” are not infectious. Second, in patients enrolled in clinical trials for acute infectious conjunctivitis, bacteria continue to be cultured many days after treatment is started, and viruses continue to be shed for 2 weeks or more with or without antibiotics. Unless a patient with conjunctivitis might potentially expose an immunocompromised individual, there is no medical reason not to return to daycare or school with or without treatment. If bacterial, only direct eye-to-hand-to-eye exposure will result in transmission. If viral, others have likely already been exposed. Finally, regardless of etiology, complications in healthy children are extraordinarily rare.<sup>10</sup>

Topical acyclovir, 3% ointment, is indicated for herpes keratitis, in conjunction with ophthalmologic or infectious disease consultation. Azithromycin is indicated for trachoma, again with consultation.

Topical antimicrobial prophylaxis is similarly not indicated for superficial epithelial defects of the cornea, although this also is

*Text continued on p. 182*

TABLE 19.1

## Management Algorithm for Red Eyes Extended from Diagnostic Algorithm in Figure 19.8\*

POTENTIAL DIAGNOSIS	MANAGEMENT	CONSULTATION	DISPOSITION
1. Caustic keratoconjunctivitis	Immediate and copious irrigation with tap water or sterile normal saline until tear-film pH = 7. Solids: Lift particles out with dry swab before irrigation Acids: Minimum of 2 L and 20 minutes Alkalis: Minimum of 4 L and 40 minutes	Ophthalmologist must come to ED if there is any abnormal visual acuity or objective finding on examination after sufficient irrigation, with exception of expected injection of conjunctiva secondary to treatment.	May discharge only if tear film pH = 7 and no findings on examination except conjunctival injection, then ophthalmologist can reevaluate next day.
2. Orbital compartment syndrome: Exophthalmos (proptosis), decreased visual acuity, painful or limited ocular mobility, and increased IOP	Measure IOP unless possibility of ruptured globe. IOP >30 mm Hg may require emergent needle aspiration or lateral canthotomy and cantholysis in ED.	IOP >20 mm Hg may be surgical emergency, may add medications used in glaucoma #18 to decrease IOP before decompression in ED. Obtain axial CT of brain and axial and coronal CT of orbits and sinuses.	Admit all cases of retrobulbar pathology causing increased IOP. Others might be candidates for discharge depending on cause of problem.
Retrobulbar hematoma: Occurs due to trauma, coagulopathy, or thrombocytopenia and associated with possible dissection of blood to potential space under bulbar conjunctiva	Hematoma: Correct any coagulopathy or thrombocytopenia.		
Retrobulbar emphysema: Occurs with forceful sneeze or occasionally happens spontaneously and associated with possible dissection of air to potential space under bulbar conjunctiva	Emphysema: Antibiotic prophylaxis to cover sinus flora.		
Retrobulbar abscess: Occurs with contiguous or occasionally hematogenously disseminated infection and associated with possible dissection of pus to potential space under bulbar conjunctiva	Abscess: Antibiotics as in orbital cellulitis (see #11).		
3. Scleral penetration: Localized redness at site of entry plus possible teardrop pupil, blood in anterior chamber or loss of red reflex	Protect eye from further pressure, provide pain relief, and prevent vomiting. Parenteral antibiotic and tetanus prophylaxis.	Ophthalmologist must come to ED if there is any concern for globe penetration.	Admit for continuation of antibiotics and possible procedural intervention.
4. Hyphema: Pain, decreased visual acuity, gross or microscopic blood in anterior chamber, may be associated with dilated and fixed pupil following blunt trauma Graded by amount of blood: <ul style="list-style-type: none"> <li>Percentage of vertical diameter of anterior chamber when blood layers with patient in upright position</li> <li>Microhyphema shows no layering and only suspended red blood cells</li> </ul>	First rule out open globe. May require ultrasound if cannot visualize posterior structures. Measure IOP unless possibility of ruptured globe. IOP >30 mm Hg may require acute treatment as in glaucoma (see #18). If IOP >20 mm Hg and no iridodialysis, may use cycloplegic to prevent iris motion.	Discuss findings and use of $\epsilon$ -aminocaproic acid and steroids, other medical therapy, best disposition, and follow-up examination by ophthalmologist within 2 days. Some patients may be admitted for observation, bed rest, head elevation, and frequent medication administration.	Most patients can be discharged with careful instructions to return for any increased pain or change in vision. Patients should decrease physical activity and sleep with an eye shield in place. Eyes should be left open while awake so that any change in vision can be immediately recognized. PO NSAIDs or narcotics should be given for analgesia.
5. Subconjunctival hemorrhage: Red blood beneath clear conjunctival membrane	Exclude coagulopathy or thrombocytopenia if indicated by history.	None required if no concerns for underlying ocular pathology and no acute complications.	Reassure patient that discoloration should resolve over 2 to 3 weeks.
6. Corneal perforation: Direct visualization of full-thickness injury or positive Seidel's test	Protect eye from further pressure, provide pain relief, and prevent vomiting. Parenteral antibiotic and tetanus prophylaxis.	Ophthalmologist must come to ED to evaluate.	Admit for continuation of antibiotics and procedural intervention.

TABLE 19.1

## Management Algorithm for Red Eyes Extended from Diagnostic Algorithm in Figure 19.8\*—cont'd

POTENTIAL DIAGNOSIS	MANAGEMENT	CONSULTATION	DISPOSITION
7. Ruptured globe: Misshaped cornea or globe following trauma	Protect eye from further pressure, provide pain relief, and prevent vomiting. Parenteral antibiotic and tetanus prophylaxis.	Ophthalmologist must come to ED to evaluate.	Admit for continuation of antibiotics and procedural intervention.
8. Corneal abrasion: History of direct trauma or foreign body plus direct visualization of defect in the corneal epithelium using white light, or fluorescein and blue light; any surrounding corneal edema indicates a concomitant keratitis (see #19)	Antibiotic prophylaxis with polymyxin-B/trimethoprim solution 1 drop every 3 hours while awake and erythromycin ointment while sleeping.	Discuss plan for follow-up in 1 to 3 days.	May discharge if no other findings. No patch.
9. Traumatic mydriasis: Nonreactive dilated pupil without any other identifiable eye abnormalities following blunt trauma	None once other abnormalities of the eye, cranial nerves, and brain have been reasonably excluded.	Discuss plan for follow-up evaluation of slowly developing hyphema and ensure resolution.	May discharge if no other findings.
10. Inflammatory pseudotumor: Nonspecific idiopathic retrobulbar inflammation with eyelid swelling, palpebral injection of conjunctiva, chemosis, proptosis, blurred vision, painful or limited ocular mobility, binocular diplopia, edema of optic disk, or venous engorgement of retina	Measure IOP. Evaluate for infection, diabetes mellitus, and vasculitis with CBC, BMP, UA, and CRP or ESR. Obtain axial CT of brain and axial and coronal CT of orbits and sinuses.	IOP >20 mm Hg may be surgical emergency, may add medications used in glaucoma #18 to decrease IOP before decompression in ED.	May discharge if no systemic problems, no findings of particular concern on CT, and IOP ≤20 mm Hg. Start high-dose PO steroids after discussion with ophthalmologist, and ensure reevaluation in 2 to 3 days.
11. Orbital cellulitis: Eyelid swelling, redness and warmth of skin overlying orbit, tenderness of skin overlying bone palpebral injection of conjunctiva, and chemosis; differentiated from periorbital cellulitis by <i>presence</i> of any finding of fever, ill appearance, blurred vision, proptosis, painful or limited ocular mobility, binocular diplopia, edema of optic disk, or venous engorgement of retina	Measure IOP and rule out orbital compartment syndrome. Start parenteral antibiotics with second-generation cephalosporin (eg, cefuroxime, cefoxitin, or cefotetan) or with ampicillin/sulbactam to cover sinus and skin flora. Alternatives are ticarcillin/clavulanate, piperacillin/tazobactam, vancomycin, or clindamycin + third-generation cephalosporin (eg, cefotaxime or ceftriaxone).	IOP >20 mm Hg may be surgical emergency, may add medications used in glaucoma #18 to decrease IOP before decompression in ED. Obtain blood cultures and start antibiotics. Axial and coronal CT of orbits and sinuses to rule out FB, retrobulbar abscess, orbital gas, subperiosteal abscess, osteomyelitis, and changes in cavernous sinus. Consider LP.	Admit all cases of orbital cellulitis.
12. Periorbital cellulitis or erysipelas: Eyelid swelling, redness and warmth of skin overlying orbit, tenderness of skin overlying bone, palpebral injection of conjunctiva, and chemosis; differentiated from orbital cellulitis by <i>absence</i> of any other finding listed in #11	First rule out orbital cellulitis (see #11). PO antibiotics for sinus and skin flora if not admitting.	Ophthalmologist may admit if systemically ill, case is moderate or severe, or no social support for patient.	May discharge mild cases with PO antibiotics. Ophthalmologist must reevaluate next day to ensure no orbital extension.
13. Dacryocystitis and dacryadenitis: Eye tearing and inflammation of lower eyelid inferior to lacrimal punctum finding redness and tenderness over nasal aspect of lower lid and adjacent periorbital skin	First rule out orbital cellulitis (see #11) and periorbital cellulitis (see #12). Inspect for obstruction of punctum by SLE, may express pus by pressing on sac, PO antibiotics for nasal and skin flora if not admitting.	Ophthalmologist may admit if systemically ill, case is moderate or severe, or no social support for patient. Ask about culturing before prescribing medications if admitting, and then may add medications used in glaucoma #18 to decrease IOP before decompression.	May discharge mild cases with PO analgesics and antibiotics (eg, amoxicillin/clavulanate), and instructions to apply warm compresses to eyelids for 15 minutes and gently massage inner canthal area four times a day.
14. Orbital tumor: Blurred vision, proptosis or other displacement of globe, painful or limited ocular mobility, or binocular diplopia (but can be asymptomatic)	Measure IOP. Evaluate for extraocular signs of malignancy. Obtain axial CT of brain and axial and coronal CT of orbits and sinuses.	IOP >20 mm Hg may be surgical emergency, prescribe to decrease IOP in ED. Ophthalmologist may want MRI, MRA, or orbital ultrasonography.	Based on findings and discussion with consultant.

Continued



TABLE 19.1

## Management Algorithm for Red Eyes Extended from Diagnostic Algorithm in Figure 19.8\*—cont'd

POTENTIAL DIAGNOSIS	MANAGEMENT	CONSULTATION	DISPOSITION
15. Hordeolum (stye): Abscess in eyelash follicle or modified sebaceous gland at lid margin: <i>external</i> or <i>internal</i> based on side of lid margin that abscess is pointing	External: Warm compresses often all that is needed, may prescribe anti- <i>Staphylococcus</i> ointment twice daily. Internal: PO antibiotics for $\beta$ -lactamase-positive <i>Staphylococcus</i> such as amoxicillin/clavulanate	Outpatient referral only for treatment failure after 2 weeks.	Discharge with instructions to apply warm compresses to eyelids for 15 minutes and gently massage abscess four times a day.
16. Blepharitis: Inflammation of eyelid margins often associated with crusts on awakening, FB sensation, and tearing	None except artificial tears for dry eye.	Outpatient referral only for treatment failure after 2 weeks.	Discharge with instructions to apply warm compresses to eyelids for 15 minutes four times a day and scrub lid margins and lashes with mild shampoo on washcloth twice daily.
17. Chalazion: Inflammation of meibomian gland causing subcutaneous nodule within the eyelid	None.	Outpatient referral only for treatment failure after 2 weeks.	Discharge with instructions to apply warm compresses to eyelids for 15 minutes and gently massage nodule four times a day.
18. Acute angle-closure glaucoma: Sudden-onset eye pain and blurred vision that may be associated with frontal headache, nausea, and vomiting; anterior eye may manifest shallow or closed angle between iris and cornea, pupil fixed at midsize, or limbal injection of conjunctiva	Administer medications below in ED if IOP >30 mm Hg. Decrease production of aqueous humor: <ul style="list-style-type: none"> <li>• Timolol 0.5% 1 drop</li> <li>• Apraclonidine 1% 1 drop q8hr</li> <li>• Dorzolamide 2% 1 drops or if sickle cell disease or trait, then methazolamide 50 mg PO</li> </ul> Decrease inflammation: <ul style="list-style-type: none"> <li>• Prednisolone 1% 1 drop every 15 minutes four times</li> </ul> Constrict pupil: <ul style="list-style-type: none"> <li>• Pilocarpine 1%–2% 1 drop after IOP &lt;50, then repeat in 15 minutes</li> </ul> Consider establishing osmotic gradient: <ul style="list-style-type: none"> <li>• Mannitol 2 g/kg IV</li> </ul>	Discuss any IOP >20 mm Hg with ophthalmologist.	Based on findings and discussion with consultant, which primarily depends on speed of onset and response to treatment.
19. Keratitis (abrasion or UV injury): Pain, FB sensation, blepharospasm, tearing, photophobia, epithelial disruption on inspection under white light, or fluorescein pooling under blue light; SPK appears as stippling of corneal surface (often lower two thirds of cornea if due to light exposure); if neglected for a time, may have surrounding edema appearing as white "cloudiness" in clear tissue	First rule out corneal penetration either grossly or employing Seidel's test. Relieve pain and blepharospasm with topical anesthetic. Inspect all conjunctival recesses and superficial cornea for any foreign material that can be removed by irrigation or manually lifted from surface.	Ophthalmologist must come to ED if there is any concern for globe penetration. Otherwise consult for follow-up examination in 1 to 2 days.	May discharge cases not infected or ulcerated. May provide topical antibiotic prophylaxis using polymyxin B combinations with bacitracin (ointment) or trimethoprim (solution). Erythromycin, gentamicin, and sulfacetamide are less desirable single-agent alternatives. PO NSAIDs or narcotics for analgesia. No patch.

TABLE 19.1

## Management Algorithm for Red Eyes Extended from Diagnostic Algorithm in Figure 19.8\*—cont'd

POTENTIAL DIAGNOSIS	MANAGEMENT	CONSULTATION	DISPOSITION
Keratitis (ulceration): Symptoms and signs as described above; ulceration from complications of contact wear has “scooped out” epithelium with surrounding edema appearing as white “cloudiness” in clear tissue	Relieve pain and blepharospasm with topical anesthetic. <i>Staphylococcus</i> and <i>Streptococcus</i> species still most common organisms, but <i>Pseudomonas</i> greater percentage in existing infections (especially contact lens wearer), so prescription with topical fluoroquinolone is preferred.	Discuss with ophthalmologist any potential need to débride or culture before starting antibiotic.	Based on findings and discussion with consultant. Typical ciprofloxacin dosing is 2 drops q15min for 6 hours, then 2 drops q30min day and night for remainder of day 1 until seen by consultant the next day. Typical moxifloxacin dosing is 1 drop q15min for 1 hr, then 1 drop q1hr day and night until seen by consultant the next day. For large ulcerations or ulcers near the visual axis, a fortified antibiotic, such as tobramycin, may be added.
Keratitis (herpetic infection): Symptoms and signs as described above Look for other signs of herpes, varicella, zoster (or CMV infection in immunocompromised patient) Look for “dendritic” defects of cornea with fluorescein under blue light	Relieve pain and blepharospasm with topical anesthetic. Prescribe acyclovir 3% ointment, trifluridine 1% solution, or vidarabine ointment. Varicella-zoster and CMV not normally given antivirals if immunocompetent.	Discuss with ophthalmologist any potential need to débride or culture before starting antiviral.	Based on findings and discussion with consultant. Typical vidarabine or acyclovir dosing is five times a day for 7 days, then taper over 2 more weeks. Typical trifluridine dosing is 1 drop every 2 hours for 7 days, then taper over 2 more weeks. PO NSAIDs or narcotics for analgesia. No patch.
20. Scleritis: Progressively increasing eye pain with radiation to ipsilateral face and decreasing vision, photophobia, tearing, and possible pain with eye motion	Decrease inflammation with PO NSAIDs.	Discuss findings and use of topical or PO steroids.	May discharge patient with medications recommended by ophthalmologist and ensure reevaluation in 2 to 3 days.
21. Anterior uveitis and hypopyon: Eye pain, photophobia, tearing, limbal injection of conjunctiva, and cells or flare in anterior chamber; hypopyon is layering of white cells (pus) in anterior chamber	First rule out glaucoma with IOP measurement. Prescribe in ED if IOP >20 mm Hg. Otherwise okay to dilate pupil with 2 drops of cyclopentolate 1%.	Discuss findings and use of prednisolone acetate 1% (frequency determined by ophthalmologist but range is every 1 to 6 hours).	May discharge patient with medications recommended by ophthalmologist and ensure reevaluation in 2 to 3 days. Patients with hypopyon are generally admitted.
22. Endophthalmitis: Progressively increasing eye pain and decreasing vision, diminished red reflex, cells and flare (and possibly hypopyon) in anterior chamber, chemosis, and eyelid swelling	Empirical parenteral antibiotic administration with vancomycin and ceftazidime to cover <i>Bacillus</i> , <i>enterococcus</i> , and <i>Staphylococcus</i> spp. Ciprofloxacin or levofloxacin are used when others contraindicated.	Ophthalmologist must admit for parenteral and possibly intravitreal antibiotics.	Admit all cases of endophthalmitis.
23. Keratoconjunctivitis: Conjunctivitis with subepithelial infiltrates in cornea causing pain and decreased vision, possibly with halos reported	Treat for conjunctivitis by likely etiologic category (see #25 to #30).	Discuss findings and use of prednisolone acetate 1% (frequency determined by ophthalmologist).	May discharge patient with medications recommended by ophthalmologist and ensure reevaluation in 2 to 3 days.
24. Episcleritis: Rapid onset of localized pain, injection of episcleral vessels, and localized tenderness	Relieve irritation with artificial tears and decrease inflammation with ketorolac drops.	Outpatient referral only for treatment failure after 2 weeks.	May discharge patient with PO NSAIDs alone or in combination with topical ketorolac drops.
25. Inflamed pinguecula: Inflammation of soft yellow patches in temporal and nasal edges of limbal margin	Decrease inflammation with naphazoline or ketorolac drops.	Outpatient referral only for treatment failure after 2 weeks.	Discharge to follow-up with ophthalmologist for possible steroid therapy or surgical removal.
26. Inflamed pterygium: Inflammation of firmer white nodules extending from limbal conjunctiva onto cornea			

Continued

TABLE 19.1

## Management Algorithm for Red Eyes Extended from Diagnostic Algorithm in Figure 19.8\*—cont'd

POTENTIAL DIAGNOSIS	MANAGEMENT	CONSULTATION	DISPOSITION
27. Bacterial conjunctivitis: Hyperpurulent discharge not typical of common "pink eye" and more commonly unilateral in adults; inflammation of eyelid margins associated with lid edema, chemosis, and possibly subconjunctival hemorrhage, but usually little or no follicular "cobblestoning"	Topical polymyxin-B/trimethoprim in infants and children, because more <i>Staphylococcus</i> spp. Topical sulfacetamide or gentamicin clinically effective in 90% of uncomplicated adult cases. Use topical fluoroquinolone if <i>Pseudomonas</i> possible.	Culture drainage and ophthalmology consult in all neonates and those at risk for vision loss or systemic sepsis. <i>Neisseria gonorrhoeae</i> can be rapidly sight-threatening.	Discharge uncomplicated cases with 10 days of topical antibiotics in both eyes, regardless of laterality of apparent infection. Use ointments in infants and drops in others.
28. <i>Chlamydia</i> conjunctivitis: Often bilateral palpebral injection of conjunctiva in neonate or other individual at risk for sexually transmitted disease	Empirical PO azithromycin for <i>Chlamydia</i> . Consider empirical parenteral ceftriaxone for concurrent <i>N. gonorrhoeae</i> .	Culture drainage and consult ophthalmology in all neonates and those at risk for vision loss or systemic sepsis.	Discharge uncomplicated cases on 5 days of PO azithromycin.
29. Contact dermatitis: Localized lid and conjunctival redness and swelling	Irrigation with tap water or sterile normal saline. Decrease irritation with naphazoline drops.	Outpatient referral only for severe cases or treatment failure after 2 weeks.	Identify offending agent and avoid subsequent exposure. Discharge uncomplicated cases on continued naphazoline.
30. Toxic conjunctivitis: Diffuse conjunctival injection, chemosis, and lid edema			
31. Allergic conjunctivitis: Often bilateral palpebral injection of conjunctiva and chemosis that may be seasonal and associated with other allergic symptoms, such as rhinitis	Decrease irritation with naphazoline drops.	Outpatient referral only for treatment failure after 2 weeks.	Identify antigen if possible. Consider treating other allergic symptoms with PO antihistamines.
32. Viral conjunctivitis: Often bilateral palpebral injection of conjunctiva and follicular cobblestoning of inner surface of lower lid; inflammation of eyelid margins often associated with crusts on awakening, FB sensation, and tearing	Decrease irritation with artificial tears, naphazoline, or ketorolac drops.	Culture drainage, and consult ophthalmology in all neonates and those at risk for vision loss or systemic sepsis.	Ask about pregnant mothers, infants, and immunocompromised individuals in close contact. Discharge uncomplicated cases with instructions on respiratory and direct-contact contagion for 2 weeks.

BMP, Basic metabolic profile (includes electrolytes, glucose, and renal function tests); CBC, complete blood count; CMV, cytomegalovirus; CRP, C-reactive protein; CT, computed tomography; ED, emergency department; ESR, erythrocyte sedimentation rate; FB, foreign body; IOP, intraocular pressure; IV, intravenous; LP, lumbar puncture; MRA, magnetic resonance angiography; MRI, magnetic resonance imaging; NSAID, nonsteroidal antiinflammatory drug; PO, per os (by mouth); SLE, slit-lamp examination; SPK, superficial punctate keratitis; spp., species; UA, urinalysis; UV, ultraviolet.

\*Antibiotic choices should be based on current practice.

common practice despite an absence of supporting evidence. There is also no evidence supporting the practice of administering tetanus immunization to patients with superficial corneal abrasions, other than as a general public health measure. On the other hand, true open wounds of the adnexa or globe do require tetanus prophylaxis if the patient's immunization status is not up to date.

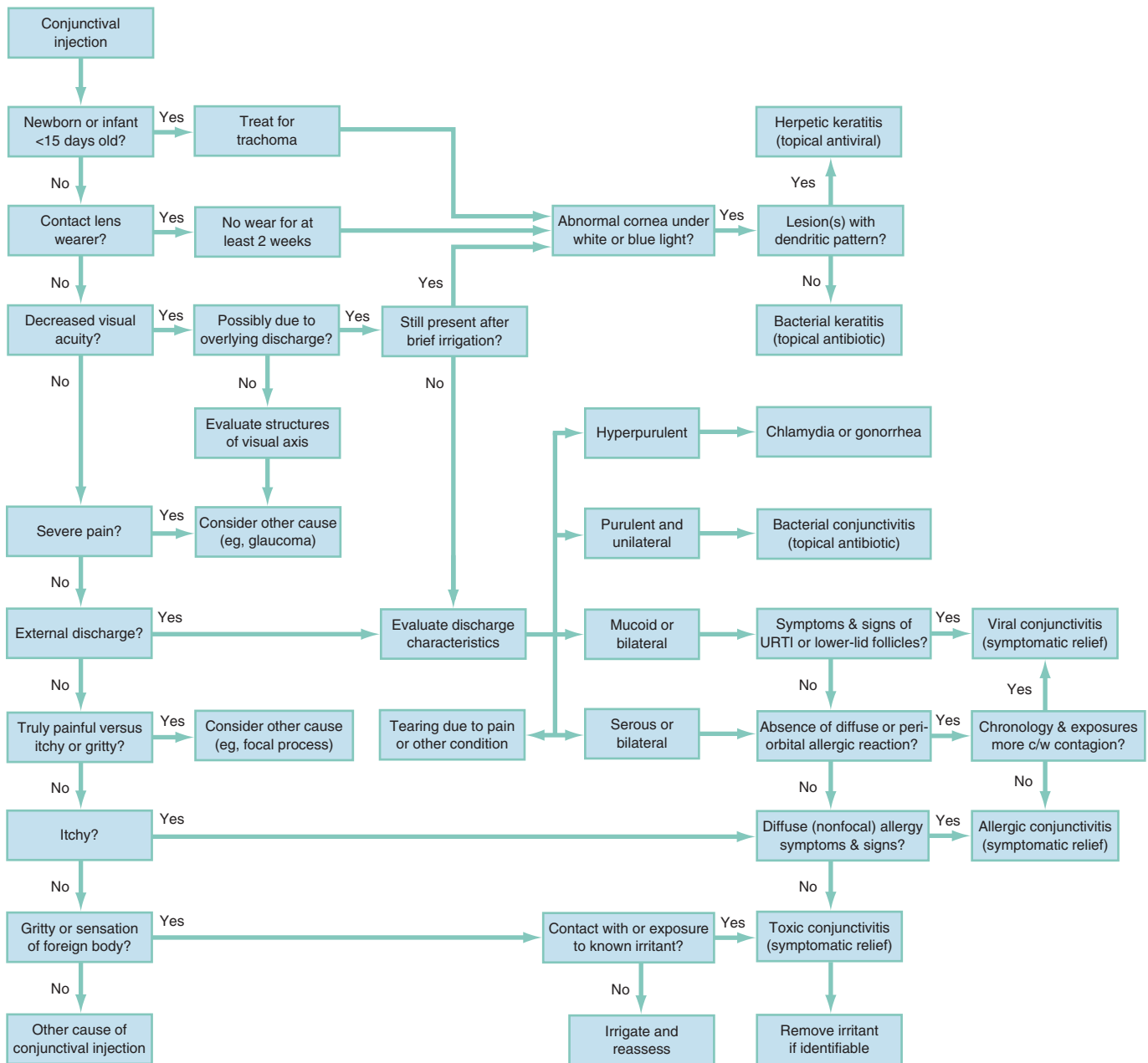
Mydriatic and cycloplegic agents are also commonly prescribed but rarely are indicated. Their use is discussed in Chapter 61. Mydriatic agents are contraindicated in patients with narrow-angle glaucoma. Larger corneal lesions sometimes require a cycloplegic agent for pain relief, but this should be prescribed only for

the few patients experiencing refractory iris spasm and not prophylactically.<sup>11</sup>

Treatment of bacterial keratitis and endophthalmitis is described in Chapter 61.

Most ED patients with eye complaints are candidates for discharge and, if indicated, follow-up in the ED or with an ophthalmologist in 1 to 2 days. Others may require referral only if there is lack of resolution or treatment fails. A few patients require admission for procedural intervention, parenteral antibiotic regimens, management of intractable pain, or further diagnostic evaluation. General consultation and disposition considerations for the most important entities are outlined in Table 19.1.





**Fig. 19.11.** Diagnostic algorithm for suspected acute conjunctivitis. *c/w*, Consistent with; *URTI*, upper respiratory tract infection.

## KEY CONCEPTS

- Critical diagnoses, such as caustic injury, orbital compartment syndrome, and acute angle closure glaucoma, require immediate treatment and ophthalmology consultation.
- Prompt and prolonged irrigation is advised for patients who experience caustic injury to the eye.
- Headache and nausea may be prominent symptoms in patients with acute angle-closure glaucoma.
- Complete abolition of a foreign body sensation after instillation of local anesthesia solution indicates a high likelihood of a superficial corneal lesion.
- Keratitis, inflammation of the cornea, is most commonly caused by a viral infection, but may also be caused by recent ultraviolet light exposure, chemical injury, or hypoxic injury from contact lens use.
- A localized corneal defect with edematous, inflammatory changes may signal corneal ulceration.
- A corneal dendritic pattern may signal a herpetic infection, which can progress to corneal opacification and visual loss.
- Pain, consensual photophobia, peri-limbal conjunctival injection, and a miotic pupil that is caused by ciliary spasm could signal iritis, which is inflammation of the iris and ciliary body, or uveitis, inflammation of the iris, ciliary body, and also choroids. The cause may be trauma or underlying autoimmune disease. The presence of cells and flare in the anterior chamber can help identify these conditions.
- Conjunctivitis is usually self-limited and rarely requires antibiotic treatment.

The references for this chapter can be found online by accessing the accompanying Expert Consult website.

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## CHAPTER 19: QUESTIONS &amp; ANSWERS

- 19.1. Cupping of the optic disk is most commonly seen in which of the following?
- Glaucoma
  - Graves' disease
  - Pseudotumor
  - Retinal detachment
  - Retrobulbar hematoma

**Answer: A.** Cupping of the optic disk results from increased intraocular pressure (IOP) and is seen quite frequently in patients with glaucoma, especially those with long-standing, uncontrolled disease.

- 19.2. A patient who normally wears contact lenses is diagnosed with bacterial conjunctivitis. Which of the following is the preferred treatment in this patient?
- Bacitracin
  - Chloramphenicol
  - Erythromycin
  - Moxifloxacin
  - Sodium sulfacetamide

**Answer: D.** Patients who wear contact lenses are at increased risk for infections with *Pseudomonas* and, in the setting of bacterial conjunctivitis, should be prescribed a quinolone (eg, ciprofloxacin or moxifloxacin) barring any contraindications.

- 19.3. Which of the following provides the longest maximum duration of cycloplegia?
- Atropine
  - Cyclopentolate
  - Homatropine
  - Scopolamine
  - Tropicamide

**Answer: A.** Atropine has a maximum duration of action of 14 days. This is followed by scopolamine with a maximum duration of 7 days, homatropine with 3 days, cyclopentolate with 24 hours, and tropicamide with 6 hours.

- 19.4. A 15-year-old boy presents to the ED after having been shot in the face with a BB gun. He has a solitary penetrating wound just inferior to his left eye. His visual acuity in the left eye is limited to light perception, but he reports having normal vision prior to the injury. He has significant proptosis of his left eye, and his fundus is clearly seen with direct ophthalmoscopy. Intraocular pressure (IOP) of the affected eye is 50 mm Hg. His mental status is normal. What is the most appropriate next step in the management of this patient?
- CT scan of the head and face
  - ED observation with repeated neurologic examinations
  - Lateral canthotomy and inferior cantholysis

- Next-day referral to ophthalmology
- Plain radiography of the face

**Answer: C.** The described patient likely has a retrobulbar hematoma with visual acuity changes and an elevated IOP. The elevated IOP with a clear funduscopy are findings consistent with no penetration into the globe. Although CT scan of the head and face is indicated to further delineate specific injuries, lateral canthotomy and inferior cantholysis is emergently necessary for orbital decompression in an attempt to salvage visual function. This sight-saving procedure should not be delayed more than 2 hours after injury when severe findings (decreased visual acuity and significantly increased IOP) are present. Likewise, ophthalmology consultation would be indicated emergently. Plain films of the face would prove of little use in the evaluation of this patient, as would prolonged ED observation.

- 19.5. A 68-year-old woman presents with a sudden, painless, and complete vision loss in her right eye. Upon funduscopic examination of her right eye, she is noted to have a diffusely pale retina with indistinct vessels and a cherry-red fovea centralis. Her left eye is normal. Which of the following is the most likely diagnosis?
- Acute angle closure glaucoma
  - Central retinal artery occlusion
  - Retinal detachment
  - Tay-Sachs disease
  - Temporal arteritis

**Answer: B.** Acute central retinal artery occlusion is characterized by a diffusely pale retina with indistinct or unseen retinal arteries in a patient with sudden, painless, and usually complete visual loss in one eye. Although temporal arteritis can precipitate an occlusion of the retinal artery as one mechanism leading to visual loss and therefore manifest the same findings on funduscopy, this condition is not painless. Patients with temporal arteritis typically have excruciating pain over or in the region of their temporal arteries. Acute angle closure glaucoma is also typically associated with severe pain and has ocular manifestations unlike the ones presented in this case. The funduscopic examination in a patient with retinal detachment reveals a translucent retina that has lifted away from the underlying pigment epithelium. Finally, although patients with Tay-Sachs disease do have a cherry-red fovea, the remainder of the retina is not diffusely pale with poorly visualized vessels. Moreover, Tay-Sachs disease is manifested in the early part of life and would not first be coming to clinical attention in a 68-year-old patient.

- 19.6. A professional boxer presents to the ED after having been punched in the right eye during a boxing match 1 hour ago. He complains of decreased vision in the affected eye and is noted to have significant periorbital swelling and

proptosis. Intraocular pressure (IOP) is 35 mm Hg in his right eye. Which of the following is the most likely diagnosis?

- A. Orbital cellulitis
- B. Orbital compartment syndrome
- C. Periorbital cellulitis
- D. Post-traumatic glaucoma
- E. Traumatic iritis

**Answer: B.** The most important cause of post-traumatic proptosis in the ED is the development of retrobulbar hematoma. This is characterized by hemorrhage within the bony orbit and behind the globe. With significant bleeding, an orbital compartment syndrome can occur in which the globe is pushed forward, the optic nerve and retinal artery are stretched and compressed, and the IOP is increased. This is a potentially sight-threatening condition that requires expedient diagnosis and management if the vision is to be salvaged.

- 19.7. A collection of pus in the anterior chamber of the eye is known as which of the following?
- A. Cotton-wool spot
  - B. Dacryocystitis
  - C. Hyphema
  - D. Hypopyon
  - E. Keratitis

**Answer: D.** A collection of layered pus in the dependent portion of the anterior chamber is called a *hypopyon*.

- 19.8. Which of the following results from inflammation of a meibomian gland?
- A. Blepharitis
  - B. Chalazion

- C. Dacryocystitis
- D. Erysipelas
- E. Hordeolum

**Answer: B.** Inflammation of a meibomian gland with the subsequent formation of a subcutaneous nodule within the eyelid is known as a *chalazion*. This condition typically resolves spontaneously over several days. Authorities often recommend warm compress application and gentle massage of the nodule several times a day, although there is no evidence supporting this. If complete resolution does not occur with 2 weeks, the patient should be referred to an ophthalmologist.

- 19.9. Which of the following pathogens causes a characteristic dendritic lesion on the cornea?
- A. *Chlamydia trachomatis*
  - B. Coxsackievirus
  - C. Herpes simplex virus
  - D. *Neisseria gonorrhoeae*
  - E. *Pseudomonas aeruginosa*

**Answer: C.** Herpes simplex virus causes a characteristic corneal dendritic lesion that is readily seen during slit-lamp examination under blue light as fluorescein stain pools in the defect. The importance of recognizing this lesion and diagnosing HSV infection of the eye is tremendous, because infections of the cornea with HSV can rapidly lead to corneal opacification and permanent loss of vision.