CHAPTER 22

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 physician. Nontraumatic diseases, such as glaucoma and peripheral vascular disease leading to retinal ischemia, are more common with advancing age. Ocular injuries are the leading cause of visual impairment and blindness in the United States.[1] More patients with postoperative complications can be expected to visit the emergency department (ED) as more vision correction surgeries are performed.

The external and internal anatomy of the eye is depicted in Figure 22-1A and B. 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, or vasculature. 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. The first question should be, "Did anything get in your eye?" If so, the second question should be, "What do you think it was?" This helps separate trauma from nontrauma, but, more important, seeks to identify quickly eyes that may have been exposed to a caustic substance. Patients exposed to caustic substances require rapid decontamination to prevent permanent loss of visual acuity.

Differential Considerations

Diagnoses are classically divided into traumatic and nontraumatic. 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. Causes of nontraumatic pain and redness require a more detailed history, including contact lens use and questions directed toward determining the likelihood of systemic illnesses.

Pivotal Findings

Measurement of the patient's best corrected visual acuity (i.e., with glasses on, if available) with each eye individually and with both eyes together provides vital information in evaluation of eye complaints. Only a few situations preclude early and accurate visual acuity testing. Eyes exposed to caustic materials should be irrigated as soon as possible. Patients with sudden and complete visual loss in one eye require prompt funduscopic examination to determine the possibility of acute central retinal artery occlusion. This condition is readily apparent as a diffusely pale retina with indistinct or unseen retinal arteries (Fig. 22-2).

Other pivotal findings, which are more likely to be associated with a serious diagnosis, in patients with a red or painful eye are listed in Box 22-1.

History

Chief complaints of pain can be manifestations of a variety of sensations. When carefully questioned, some patients may differentiate among itching, burning, dull pain, sharp pain, and perception of a foreign body. Itching tends to be more often caused 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 is more typical of corneal irritation (abrasion, ulcer) or inflammation (keratitis). Sharp pain generally results from abnormalities of the anterior eye, such as keratitis, uveitis, and acute angle–closure glaucoma. Dull pain may be a manifestation of increased intraocular pressure (IOP) or referred from an extraorbital process, such as sinusitis, migraine headache, or temporal arteritis.

A chief complaint of redness commonly results from palpebral or limbal injection of the conjunctiva. However, free blood can be noted behind the bulbar conjunctiva (i.e., subconjunctival hemorrhage) or in the anterior chamber (i.e., hyphema). Both of these can be spontaneous or post-traumatic. Spontaneous subconjunctival hemorrhages may follow coughing or straining. 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. Often, it occurs without any identifiable precipitating incident and is simply noticed by the patient when looking in a mirror. Hyphema of sufficient size to be noted by the patient or bystander usually arises with pain and blurred vision.

Other subjective findings may be transient and detected only by history. The patient may relate lid swelling, tearing, discharge, crusting, or sensitivity to light. Lid swelling can be caused by inflammatory and noninflammatory processes. Concurrent erythema of the lid favors the former. In the absence of trauma or other external irritant (e.g., contact dermatitis), inflammatory processes include primary lid problems, such as hordeolum (i.e., 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, viral, or bacterial. Blepharitis, dacryocystitis, and

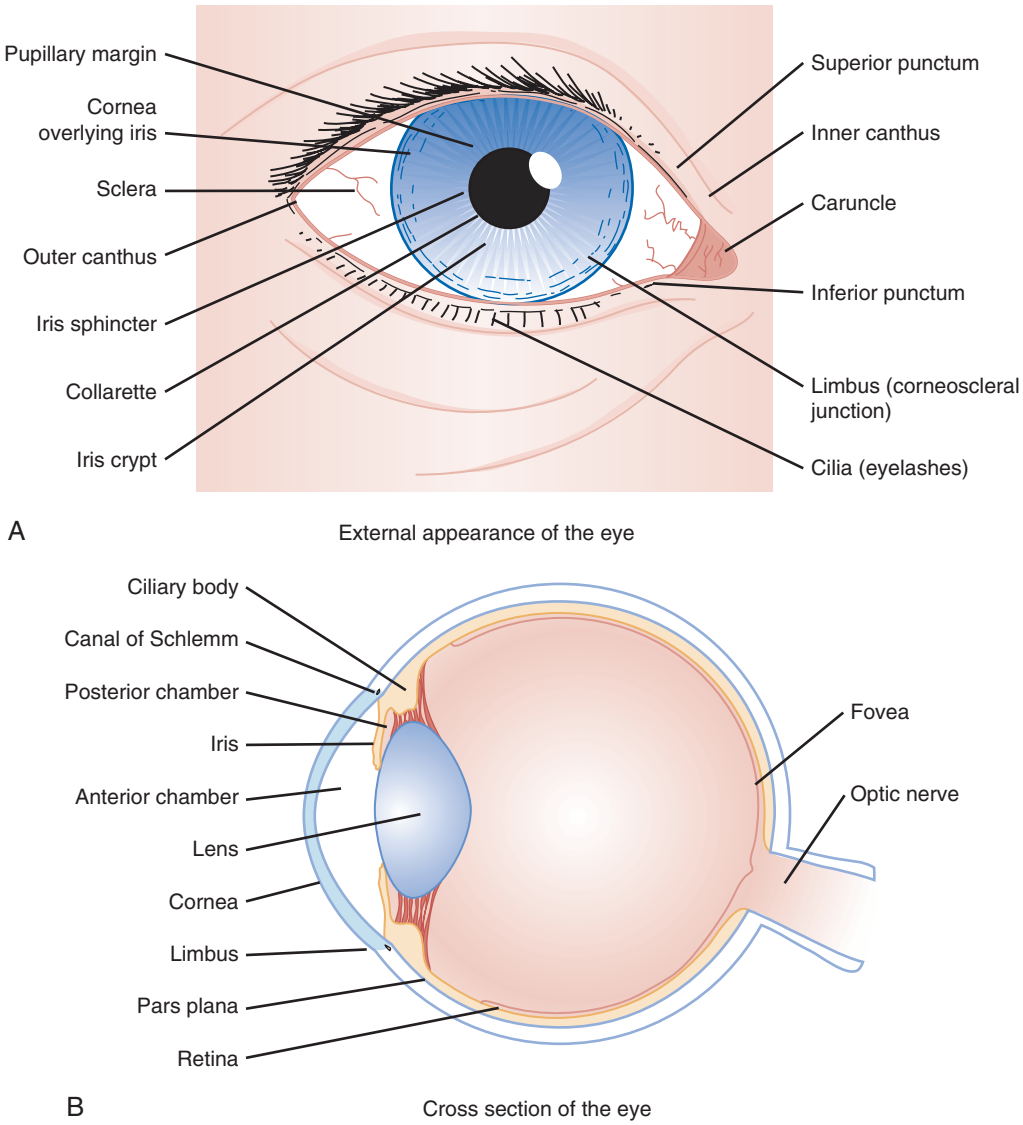

Figure 22-1. External **(A)** and internal **(B)** anatomy. (From Ragge NK, Easty DL: Immediate Eye Care. St Louis: Mosby-Year Book; 1990.)

canaliculitis are other inflammatory processes that may create a discharge and subsequent crusting.

Other eye status review questions include the following:

- Are contact lenses used? If so, what type, how are they cleaned, and how old are the lenses? Has there been a change in the pattern of use (especially increased use)? Were the lenses worn for a particularly long period recently? Are there problems with the lenses drying out? Does insertion of the lenses worsen or relieve the symptoms? Contact lenses alter the physiology of the cornea, making it relatively hypoxic, drier, and more susceptible to bacterial infection with subsequent ulceration.
- Are glasses worn? If so, when was the last assessment for adequate refraction? When the patient is examined for objective abnormalities in visual acuity, the patient's subjective interpretation of changes from his or her baseline may be all that is available when corrective lenses are not available or their prescription is out of date.
- Has previous injury or eye surgery occurred? Abnormal examination findings, such as an eccentric or irregularly shaped pupil, may be the patient's baseline. Pain and redness are expected shortly after eye surgery, but many surgical complications also manifest with a red and painful eye.
- What is the patient's usual state of health? Several systemic diseases may cause symptoms and signs in and around the eye. Giant-cell arteritis is a vasculitis with subacute systemic manifestations but often acute eye complaints.
- What medications are being taken? Medications that affect the sympathetic or parasympathetic nervous systems may affect ocular physiology, such as aqueous production, or pupil size and reactivity. Bleeding may be potentiated by anticoagulant or antiplatelet medications.
- Are there any known or suspected allergies? Environmental allergens are a common cause of conjunctivitis. Other superficial manifestations can be from chemicals (e.g., contact lens-cleaning solution) or other materials (e.g., makeup).

Physical Examination

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 22-2). Slit-lamp examination is recommended 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, 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 do not have their prescribed corrective lenses may be evaluated by having them view the chart through a pinhole eye cover, which negates most refractive errors in vision.

If the patient cannot distinguish letters or shapes on a chart, visual acuity is 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 or able to count fingers (CF)
- Unable or able to perceive hand motion (HM)
- Unable or able to perceive light (LP)

Visual Field Testing

Confrontation is the most common method of testing visual fields in the ED but is unreliable for detection of anything short of an extensive field deficit. Fortunately, 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. Hemianopia 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 facial bones are associated with ocular injuries, some of which require immediate intervention by an ophthalmologist.[2]

Globe position is part of the external examination. Subtle exophthalmos and enophthalmos are rare and are best detected by looking inferiorly, tangentially across the forehead, from over the patient's scalp. Exophthalmos (proptosis) may have traumatic or nontraumatic causes but is a result of increased pressure or a space-occupying lesion within the orbit, which may manifest as pain. Medical causes include cellulitis or intraorbital or lacrimal tumors. Hyperthyroidism may cause enlargement of extraocular muscles. The most important cause of exophthalmos in the ED is retrobulbar hematoma, a condition characterized by hemorrhage within the bony orbit, behind the globe. Orbital compartment syndrome 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. The discovery of exophthalmos should prompt ocular tonometry measurements to determine the urgency of intervention. Trauma,

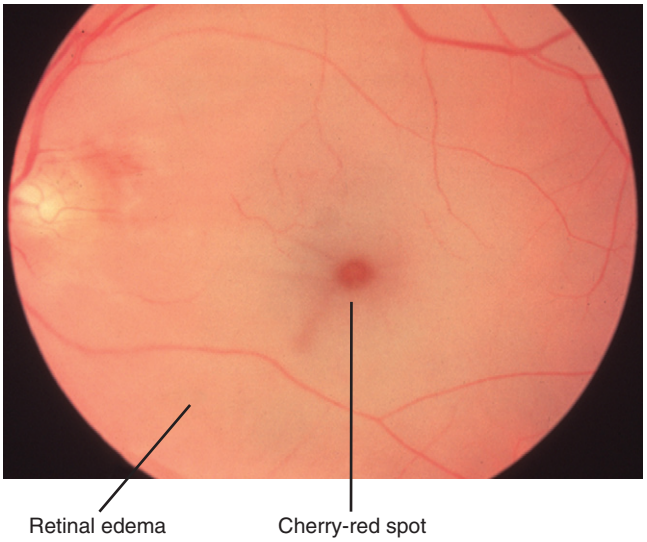

Figure 22-2. Key funduscopic findings in acute central retinal artery occlusion include general pallor of the retina (except for a characteristic cherry-red spot where the perfused choroid shows through the thinner fovea) and attenuation of retinal arteries (possibly with retinal veins preserved as in the photograph). (From Kaiser PK, Friedman NJ, Pineda R II: The Massachusetts Eye and Ear Infirmary Illustrated Manual of Ophthalmology, 2nd ed. Philadelphia: WB Saunders; 2004.)

Box 22-1 Pivotal Findings More Likely Associated with a Serious Diagnosis in Patients with a Red or Painful Eye

Severe ocular pain
Persistently blurred vision
Proptosis
Reduced ocular light reflection
Corneal epithelial defect or opacity
Limbal injection (i.e., 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: Foundation of the American Academy of Ophthalmology; 2001.

Box 22-2 Complete Eye Examination

*V*isual acuity (best possible with use of correction)
*V*isual fields (tested by confrontation)
*E*xternal examination
  Globe position in orbit
  Conjugate gaze
  Periorbital soft tissues, bones, and sensation
*E*xtraocular muscle movement
*P*upillary evaluation (absolute and relative)
*P*ressure determination (tonometry)
Slit-lamp examination
  Lids and lashes
  Conjunctiva and sclera
  Cornea (with fluorescein in some cases)
  Anterior chamber
  Iris
  Lens
Funduscopic examination

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

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 pseudoenophthalmos 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 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 is a common diagnosis after evaluation of patients with red and painful eyes, but determination of cause is much more difficult on clinical grounds. Patients may be unaware of exposures that could cause a chemical conjunctivitis. Without a known history of environmental allergies or other symptoms and signs to suggest an allergic reaction, allergic conjunctivitis may be mistaken for an infection. However, these are usually managed with removal of any known offending agent and symptomatic relief only. On the other hand, acute infectious conjunctivitis can be bacterial or viral, and management should ideally be directed toward the specific microbiologic cause. The acute management of infectious conjunctivitis accounts for over one-half billion dollars in indirect lost productivity and direct costs of antibiotic prescriptions,[3] when many patients do not need them.[4]

The presence of punctate "follicles" (i.e., 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 nonbacterial (i.e., viral or toxic) cause—though one notable exception is trachoma, a chronic keratoconjunctivitis caused by *Chlamydia trachomatis*. Indeed, the "typical" viral "pinkeye" has been called *acute follicular conjunctivitis*.[5] Some authorities also believe that the mucoid discharge associated with viral conjunctivitis can be clinically differentiated from the purulent discharge associated with bacterial infection.[6] However, most research studying the association of symptoms and signs with positive bacterial cultures have grouped "mucoid or purulent" discharges into one finding, not requiring primary care physician participants to discriminate between the two during data collection.[7,8] Thus no experimental evidence supports or refutes these expert opinions.[9]

Eyelids sticking together, particularly in the morning, is commonly cited as clinical evidence of bacterial, as opposed to viral, conjunctivitis, but this is unreliable. One multicenter primary care study in the Netherlands used logistic regression analysis to conclude that its presence plus the absence of itch and a prior history of conjunctivitis was associated with bacterial conjunctivitis; however, the 95% confidence intervals for the area under the receiver operating characteristic curve ranged from 0.63 to 0.80, thus making it a poor to only fair clinical prediction rule.[7] In a single U.S. pediatric ED spanning ages from 1 month to 18 years, a similar analysis found sticky eyelids and either mucoid or purulent discharge to have a positive likelihood ratio of 3.1, and a post-test probability of 96% for positive bacterial cultures in their population; however, this likelihood ratio also indicates only a poor-to-fair test.[8] Viral cultures were not performed in either of these studies, so the possibilities of copathogens or bacterial culture of nonpathogenic flora was not assessed. Therefore no good evidence exists for differentiating bacterial from viral causes on clinical grounds.

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 (e.g., iridotomy for cataract extraction), and synechiae from prior iritis or another inflammatory condition are the most common causes of irregularly shaped pupils.

Asymmetrically sized pupils may represent normal or pathologic conditions. Physiologic 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 that also cause pain and redness include uveitis and acute angle–closure glaucoma.

The swinging flashlight test is used to determine whether a relative afferent pupillary defect (RAPD) exists. The patient fixes the gaze on a distant object, and the examination room is darkened. The size of the pupils in lowered light is noted, and unless there is physiologic anisocoria, the pupils should be equal in size. The direct and consensual light responses of the eyes are compared as a light source, angled into the pupil from in front of the cheeks, is swung back and forth between the two. When the light source shines into an eye with an RAPD, the pupil dilates because the consensual response from withdrawal of light from the opposite eye with normal afferent activity is stronger than the direct constrictive response to light in the affected eye with inhibited afferent activity. It is termed "relative" because the response is compared with that of the opposite side as the light source is alternated between eyes. An RAPD may be partial or complete and may result from 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 prechiasmal optic nerve (e.g., 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 (e.g., 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.[10] Patients with IOPs exceeding 20 mm Hg should undergo ophthalmologic consultation. Rapid treatment is usually not necessary until the pressure exceeds 30 mm Hg.

Slit-Lamp Examination

The slit lamp 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

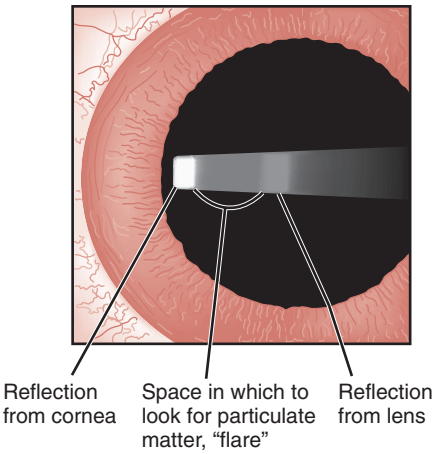

Figure 22-3. Technique of slit-lamp examination with a short, narrow light beam projected from an extreme temporal angle across the contrasting black pupil to better find cells or "flare" indicative of acute anterior uveitis. (From Ragge NK, Easty DL: Immediate Eye Care. St Louis: Mosby-Year Book; 1990.)

structures, such as the cornea, aqueous humor, and lens. The slit-lamp examination can include the following:

- Lids and lashes may be inspected for blepharitis and pointing of a lid abscess (i.e., hordeolum). The inner canthus and lacrimal punctum may be better viewed for evidence of dacryocystitis.
- Punctures, lacerations, and inflammatory patterns of the conjunctiva or sclera may be discovered with magnification.
- Corneal abrasions, ulcers, foreign bodies, and other abnormalities may be seen. The depth of these lesions may be accurately assessed with an angled beam. Edema, which appears as a white haze or cloudiness within clear structures, can be differentiated within the epithelium or deeper stroma.
- The anterior chamber may be examined for cells (e.g., red and white blood cells) and "flare." Cells are seen as small floating objects caught in the beam of a highly angulated slit-lamp light, as dust floating in the movie theater glows from the reflected light of the projector beam. Flare is a diffuse haziness, is related to cells and proteins suspended in the aqueous humor, is often visible only when illuminated directly (Fig. 22-3). It usually represents deep inflammation of the eye and is often seen in iritis. Collections of layered blood or pus in the dependent portions of the anterior chamber are called *hyphema* or *hypopyon,* respectively, and are graded by the percentage of the vertical diameter of the visible iris when the head is upright. Foreign bodies that have penetrated the cornea may be found floating in the anterior chamber.
- The trabeculated pattern of the iris can be seen in detail. Spiraling muscle fibers may be seen in acute angle–closure glaucoma. If the beam is shown almost coaxially with the examiner's line of sight such that the red reflex is elicited, tears in the iris may be seen by light returning through the iris itself instead of just through the pupil.
- The lens should be examined for position, general clarity, and the presence of opacities or foreign bodies. The type and position of any lens implants can also be better assessed during a slit-lamp examination.

Direct Funduscopic Examination

Emergency physicians most commonly perform a nondilated funduscopic examination because there are several eye conditions in which dilation may be harmful (e.g., 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 caused by the following:

- Opacification of the cornea, most commonly from edema secondary to injury or infection
- Hyphema or hypopyon within the anterior chamber
- Extremely miotic pupil
- Cataract of the lens
- Blood in the vitreous or posterior eye wall
- Retinal detachment

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

Bedside Testing

Fluorescein solution and slit-lamp examination with use of the cobalt blue light source are the best means for identifying damage to the corneal epithelium, including damage that cannot be seen with conventional slit-lamp examination. Fluorescein is not taken up by intact corneal epithelium but is absorbed into corneal defects, making them easy to identify. When doubt exists as to whether the fluorescein in an area of interest is on or in the corneal epithelium, absence of movement on blinking confirms corneal absorption and hence a corneal lesion. Use of fluorescein may reveal corneal abrasions and ulcers as well as damage from keratitides related to chemicals, ultraviolet light, or infections (e.g., herpes).

Relief of discomfort after instillation of a topical anesthetic can be used as a diagnostic test for an external 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 is not diminished by local anesthetic solution. When ocular penetration is suggested, Seidel's test can be used. This test involves placing a fluorescein strip directly over an area of possible corneal disruption. The highly localized concentration of fluorescein may facilitate identification of the corneal defect with a slit lamp by allowing visualization of leaking aqueous fluid diluting the fluorescein. This test does not work on the conjunctiva overlying the sclera, and a negative test result does not rule out a full-thickness corneal injury.

Ancillary Testing

Temporal arteritis may manifest with eye pain and decreased visual acuity. Use of an erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) can be helpful tools in the acute phase if they are elevated; however, temporal arteritis can occur with normal levels of ESR and CRP if the clinical history and examination findings are typical.[11]

Infections are usually evident on examination, and laboratory tests such as a complete blood count are not necessary. Microbiologic cultures are rarely ordered in the ED.

Plain radiography may be used to identify facial fractures associated with facial or ocular trauma or indirectly by detecting an air-fluid level in the orbit or fluid in the paranasal sinuses, but use of this simple ancillary study is waning rapidly, likely because of consultants' desires for computed tomography (CT). CT, through use of 1.5-mm axial and coronal cuts, does provide superior imaging that affects definitive care decisions.[12-14]

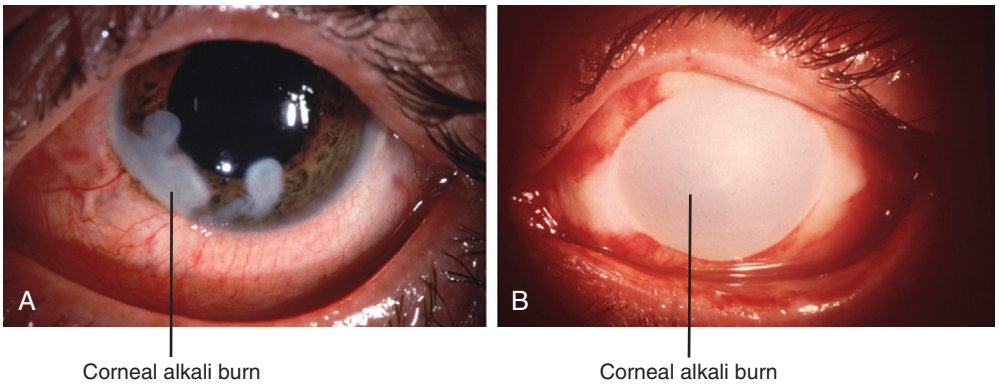

Figure 22-4. **A,** Alkali burn demonstrating corneal burns and conjunctival injection on the day of the accident. **B,** Complete corneal tissue destruction 7 days after alkali burn. (From Kaiser PK, Friedman NJ, Pineda R II: The Massachusetts Eye and Ear Infirmary Illustrated Manual of Ophthalmology, 2nd ed. Philadelphia: WB Saunders; 2004.)

CT also reliably localizes metal and many nonradiopaque foreign bodies in the globe and orbit. It can also detect small amounts of intraocular air after penetrating trauma. Ultrasonography is more sensitive for detecting intraocular foreign bodies, but CT is better at delineating the damage caused by them, so they are complementary tests. Magnetic resonance imaging (MRI) clearly delineates the orbital and retro-orbital structures but cannot be used unless ferromagnetic foreign bodies can first be definitively excluded by CT.[12-16]

DIFFERENTIAL DIAGNOSIS

Clinical findings most indicative of serious eye disorders are listed in Box 22-1.

Critical Diagnoses

Caustic injury to the eye can rapidly lead to a destructive keratoconjunctivitis (Fig. 22-4A and B) if the agent is not removed immediately. The diagnosis is made on history alone, before any other examination is performed. Early and copious irrigation is indicated. Many patients will have already undergone extensive irrigation at the job site, but when the exposure has occurred in the home, irrigation before 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. Continuous irrigation is the only effective method to terminate the reaction and should be continued for at least 30 minutes. Acid injury is much less severe and requires less irrigation than alkaline exposures. Both types require irrigation until the pH of the tears is neutral and the patient is essentially asymptomatic.

Acute angle–closure glaucoma is a relatively rare but important critical diagnosis to make in the ED. Patients report pain, the onset of which is often sudden in low-light conditions requiring 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 22-5 demonstrates many of these findings. Immediate medical intervention in the ED and urgent ophthalmologic consultation are warranted.

Retrobulbar hematoma (blood) is usually caused by orbital trauma, but it can also occur spontaneously in patients with coagulopathy. Retrobulbar abscess (pus) or emphysema (air) can also occur. Elevated IOP in any of these conditions constitutes orbital compartment syndrome and a surgical emergency.[17,18] Emergency intervention requires decompressing the orbit by performing lateral canthotomy and inferior cantholysis.[17,18]

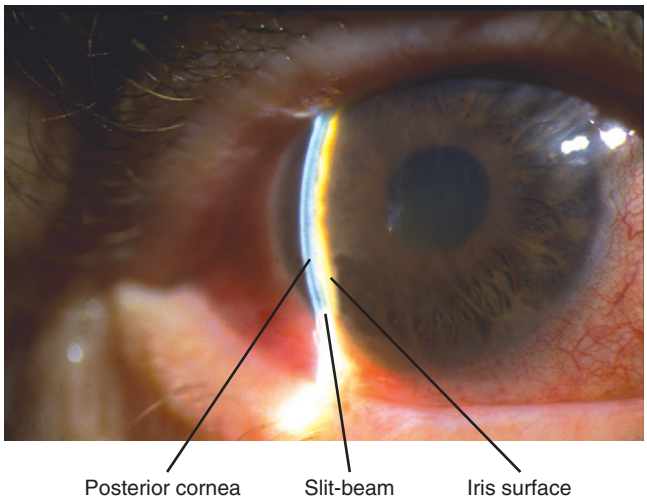

Figure 22-5. Primary angle–closure glaucoma with very shallow anterior chamber and iridocorneal touch (no space between slit-beam view of cornea and iris). (From Kaiser PK, Friedman NJ, Pineda R II: The Massachusetts Eye and Ear Infirmary Illustrated Manual of Ophthalmology, 2nd ed. Philadelphia: WB Saunders; 2004.)

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 ophthalmologic history should be obtained.

Keratitis, or inflammation of the cornea, is most commonly viral in origin but can also be caused by exposure to intense ultraviolet light (e.g., snow blindness, arc welder's blindness), various chemicals, or ischemia related to contact lens use. Patients report an intense foreign-body sensation, ciliary spasm causes photophobia that is often severe, and the affected eyes are often clenched shut. Topical anesthesia provides immediate (but temporary) relief of pain, thus reinforcing the corneal origin of the process and facilitating examination and definitive diagnosis. Corneal abrasions are very common and may be identified by white light or fluorescein-facilitated blue light with use of a slit lamp or any

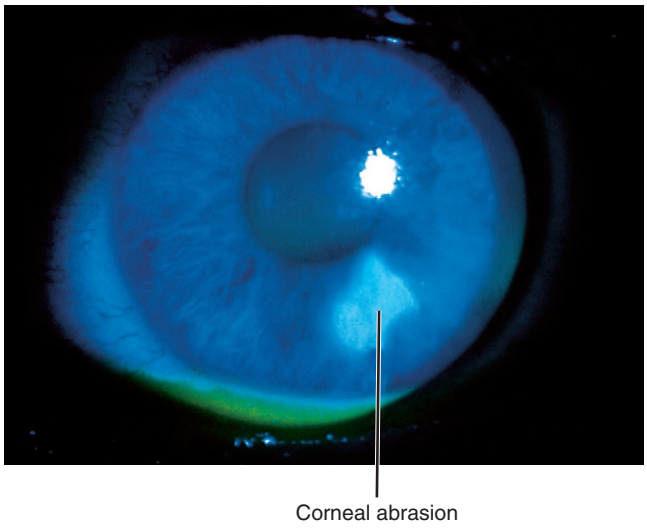

Figure 22-6. Corneal abrasion demonstrating fluorescein pooling of a small inferior epithelial defect. (From Kaiser PK, Friedman NJ, Pineda R II: The Massachusetts Eye and Ear Infirmary Illustrated Manual of Ophthalmology, 2nd ed. Philadelphia: WB Saunders; 2004.)

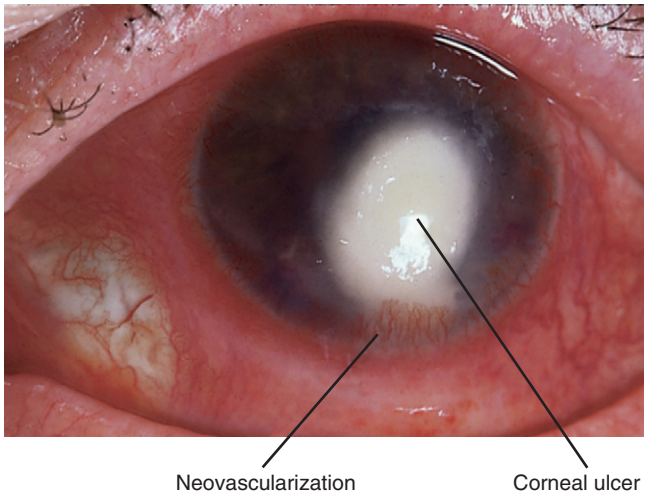

Figure 22-7. Bacterial keratitis demonstrating large, central *Streptococcus pneumoniae* corneal ulcer. Note the dense, white corneal infiltrate and the extreme conjunctival injection. (From Kaiser PK, Friedman NJ, Pineda R II: The Massachusetts Eye and Ear Infirmary Illustrated Manual of Ophthalmology, 2nd ed. Philadelphia: WB Saunders; 2004.)

other magnification (Fig. 22-6). After thorough irrigation, thermal and chemical burns 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.

In immunocompetent hosts, corneal ulcerations are most commonly caused by overuse of contact lenses.[19] Ulcers can be large and easy to visualize (Fig. 22-7) or small and difficult to detect. They are best identified under slit-lamp examination by noting a denuding of epithelium with surrounding edema, the increased interstitial water of which is seen as whitish clouding of the normally clear tissue. Almost all ulcerations require evaluation by an ophthalmologist within 24 hours. 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. 22-8). Anterior uveitis, which includes iritis and iridocyclitis, often

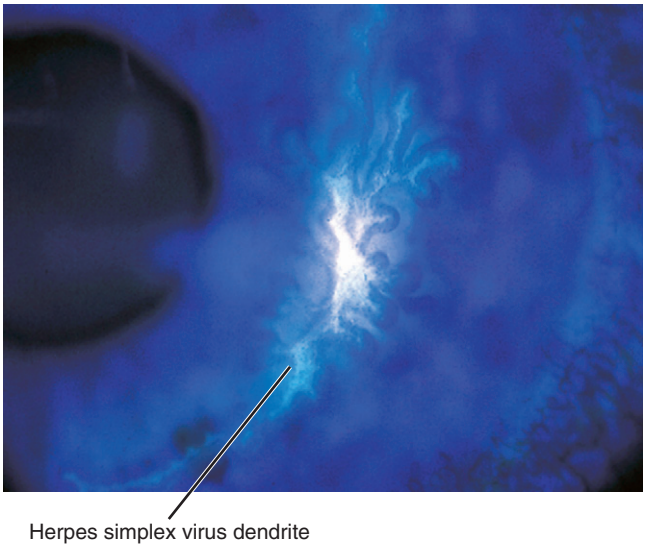

Figure 22-8. Patient demonstrating fluorescein pooling of herpes simplex virus dendrite. (From Kaiser PK, Friedman NJ, Pineda R II: The Massachusetts Eye and Ear Infirmary Illustrated Manual of Ophthalmology, 2nd ed. Philadelphia: WB Saunders; 2004.)

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.

Scleritis is rare and may be difficult to differentiate from episcleritis, which is a somewhat more common and more benign inflammation. The former is commonly idiopathic but may be associated with a systemic inflammatory process, such as a connective tissue disease, gout, or infection (e.g., Lyme disease, syphilis, tuberculosis). Eye redness in episcleritis results from dilation of the episcleral blood vessels just underneath the conjunctiva, usually in a small sector of the visible portion of the globe. If the location of the involved layer is in doubt, administration of topical phenylephrine 2.5 to 10% can help to differentiate episcleritis from scleritis by causing blanching of the superficial episcleral vessels while not affecting the deeper scleral vessels.[20,21] The pain of scleritis is typically slower in onset but is often described as a severe "boring" pain that radiates to the ipsilateral forehead, cheek, or jaw. Engorgement of scleral vessels is usually more prominent and more diffuse than that of the episcleral vessels in episcleritis. A bluish hue may be seen as the underlying pigmented epithelium shows through the edematous, and hence more translucent, sclera (Fig. 22-9). Scleritis may be associated with anterior uveitis, cataract, and secondary glaucoma.

Endophthalmitis usually results from an infection of structures inside the globe. It is most common after 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 aggressive antimicrobial therapy, endophthalmitis is a devastating process that frequently necessitates enucleation.

Urgent Diagnoses

Penetrating ocular trauma is evaluated by history (e.g., working with high-speed grinding equipment), examination (extrusion of aqueous humor or other globe content; direct visualization of a foreign body in the anterior chamber, vitreous, or retina), or identification of the offending object by biplanar plain radiography, thin-cut CT, or ultrasonography. MRI should not be used if there is any possibility that the foreign object may be metallic. Indirect indicators of globe penetration are hyphema, an irregularly shaped

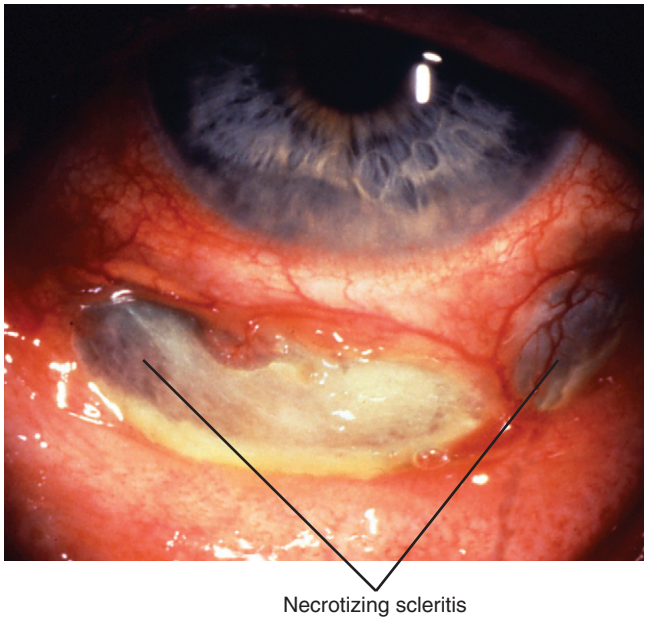

Figure 22-9. Diffuse scleritis with slight bluish region in addition to injection of scleral, episcleral, and conjunctival vessels. (From Kaiser PK, Friedman NJ, Pineda R II: The Massachusetts Eye and Ear Infirmary Illustrated Manual of Ophthalmology, 2nd ed. Philadelphia: WB Saunders; 2004.)

pupil from traction on or injury to the iris's attachments, or lack of a red reflex. If penetrating ocular injury is confirmed or if the possibility persists after evaluation, an ophthalmologic consultation is indicated.

Spontaneous or traumatic hyphema is often managed conservatively. 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. Intraocular hypertension (or hypotension in the case of occult globe rupture) after trauma is also evaluated by an ophthalmologist urgently. Inability to view posterior structures through the anterior blood may necessitate radiologic or ultrasonographic imaging.

Diagnostic Algorithm

A recommended algorithmic approach to the patient with an acute red eye is provided in Figure 22-10.

EMPIRICAL MANAGEMENT

Irrigation

Any clean water is appropriate for irrigation, and prompt initiation takes precedence over procurement of a particular irrigating solution. The most important principles are *rapid and copious* dilution and removal of the offending material. An eyewash station or faucet with tap water may be employed. Normal saline may be instilled through the cut end of a liter bag of normal saline or through the end of macrodrip intravenous administration tubing. If there is no gross eye injury, a Morgan lens may be attached to this tubing so the ED staff does not have to help the patient hold the eye open. Quickly administering two drops of topical anesthetic and allowing 30 seconds or so for the anesthetic to become effective greatly facilitates patients' tolerance of the prolonged irrigation required. It is recommended that the first 500 to 1000 mL of irrigation fluid be administered while the eye is being examined; then the Morgan lens may be placed.

Table 22-1 Duration of Action for Common Mydriatic and Cycloplegic Medications

NAME	CONCENTRATION (%)	COMMON DURATION	MAXIMUM DURATION
Ephedrine*	5.0	0.5-1 hr	3 hr
Phenylephrine*	2.5	0.5-1 hr	3 hr
Tropicamide	0.5	3-4 hr	6 hr
Cyclopentolate	0.5	12-18 hr	24 hr
Homatropine	1.0	1-2 days	3 days
Scopolamine	0.5	2-5 days	7 days
Atropine	0.5	5-10 days	14 days

*Mydriatic action only; no cycloplegic effect. Combination products such as Cyclomydril, which is cyclopentolate 0.2% and phenylephrine 10%, are also available.

Pain Relief

Pain often interferes with obtaining an adequate assessment. A topical anesthetic, such as proparacaine 0.5%, may facilitate cooperation in patients with possible injury or inflammation of the anterior eye by reducing pain and blepharospasm long enough for a targeted history to be obtained and a focused examination to be performed. Topical anesthetic agents should not be given to patients to use at home. Parenteral or oral analgesics can be used for severe deep pain not amenable to topical relief in the ED, or for outpatient management of discomfort after discharge.

Mydriatic and Cycloplegic Agents

Dilation of the pupil is not usually necessary in the ED for funduscopic examination but may relieve pain associated with ciliary spasm in anterior uveitis. Mydriatic agents (e.g., phenylephrine, tropicamide) merely prevent constriction of the pupil by paralyzing the sphincter pupillae muscle of the iris. Cycloplegic agents (e.g., cyclopentolate, homatropine) paralyze the ciliaris muscle, with an accompanying mydriatic effect. The agent chosen should be guided by the desired duration of mydriasis for the particular condition being treated (Table 22-1). Mydriatic agents are contraindicated in patients with narrow-angle glaucoma.

Antimicrobial Agents

Most conjunctivitis of viral origin does not require antiviral treatment. Important exceptions are viruses in the Herpesviridae family. Trachoma has been the most common infectious cause of blindness and can be treated with azithromycin.[22] The most common causes of bacterial conjunctivitis are nontypable *Haemophilus influenzae, Streptococcus pneumoniae,* and *Staphylococcus aureus.*[8,23]

The use of broad-spectrum topical antibiotics in cases of proven bacterial conjunctivitis has been associated with benefit, showing significantly higher clinical remission rates. When used for empirical treating for presumed bacterial conjunctivitis, inexpensive combination products such as polymyxin B plus trimethoprim solution or polymyxin B plus bacitracin ointment are good initial choices. Many other antibiotics have been tested. Chloramphenicol is the most frequently prescribed ophthalmic antibiotic in Europe.

Empirical treatment of all common acute infectious conjunctivitis with topical antibiotics is quite controversial from both

clinical and societal perspectives. As discussed in the physical examination section of this chapter, distinguishing bacterial from viral causes is clinically difficult, and no good clinical prediction rules exist to assist decision-making. Nonetheless, acute infectious conjunctivitis from all causes is usually mild, resolves on its own, and very rarely leads to serious complications.[23] Therefore treating all patients is expensive, potentially risky, and generally unnecessary.[24] However, one meta-analysis of five relatively heterogeneous clinical trials not including ED populations found that almost two thirds of cases resolved with placebo, but it also found an increase in bacterial eradication and clinical cure with antibiotics (number needed to treat was 6 if treated in the first 5 days after symptom onset, and was 13 if treated in the second 5 days).[23]

One study interviewed a small sample of patients seen in a primary care setting in the United Kingdom. The researchers found that most patients knew that conjunctivitis was a minor illness yet believed that it would not resolve without treatment, though they were open to alternative management approaches after a brief education.[25] Consistent with several authors, we recommend a delayed treatment strategy wherein patients are educated on the normally self-limiting nature of the process but are not prescribed antibiotics and are given advice to seek follow-up evaluation by their primary care physician if symptoms are not improving after 72 hours. Alternatively, an antibiotic prescription can be provided at the initial visit, but the patient is told not to fill the prescription or use the medication unless symptoms are not improving after 72 hours.[4,26,27] In one randomized controlled trial, time to resolution of symptoms was about the same between groups starting antibiotics immediately and those given antibiotics to use only if not improved—3.3 and 3.9 days, respectively—suggesting that many of the latter group would have resolved spontaneously. Furthermore, patients given delayed antibiotics returned within 2 weeks for reevaluation at a lower rate than either the immediate-antibiotic or no-antibiotic groups.[26]

Topical antibiotics used to treat bacterial conjunctivitis have been used for prophylaxis of bacterial keratitis after corneal abrasions, though there is no convincing evidence that it prevents infection or facilitates uncomplicated healing.[28,29]

Bacterial keratitis is usually seen in contact lens wearers, particularly those who wear them overnight.[30] In descending order of frequency of cultured organisms, these microbial keratitides are caused by *Pseudomonas aeruginosa,* streptococcal or staphylococcal species, filamentous fungi, nonpseudomonal gram-negative rods, *Acanthamoeba,* other bacteria, and yeast.[31] Topical fluoroquinolones are typically recommended for empirical treatment.[19]

The most common organisms cultured from deeper eye structures, particularly after open-globe injuries, are *Bacillus cereus, Propionibacterium acnes,* and various species of *Bacillus, Streptococcus,* and *Staphylococcus*.[32] While awaiting emergent ophthalmologic consultation, prophylactic or empirical parenteral antibiotic combinations that may be used include cefazolin plus gentamicin or vancomycin plus cefotaxime, ceftazidime, or ceftriaxone. Possible cases of mycotic endophthalmitis have historically been treated with amphotericin B, though voriconazole has been shown to have good intraocular penetration, broad-spectrum activity, and relatively low systemic toxicity.[33]

Open wounds also necessitate tetanus prophylaxis if the patient's immunization status is not up to date. There is no current evidence supporting the practice of administering tetanus immunization to patients with superficial corneal abrasions.[34]

Other Protective Interventions

Significantly increased IOP should be reversed as rapidly as possible, often before the specific cause is known. After placement of the patient in at least a 30-degree head-up position, two drops of

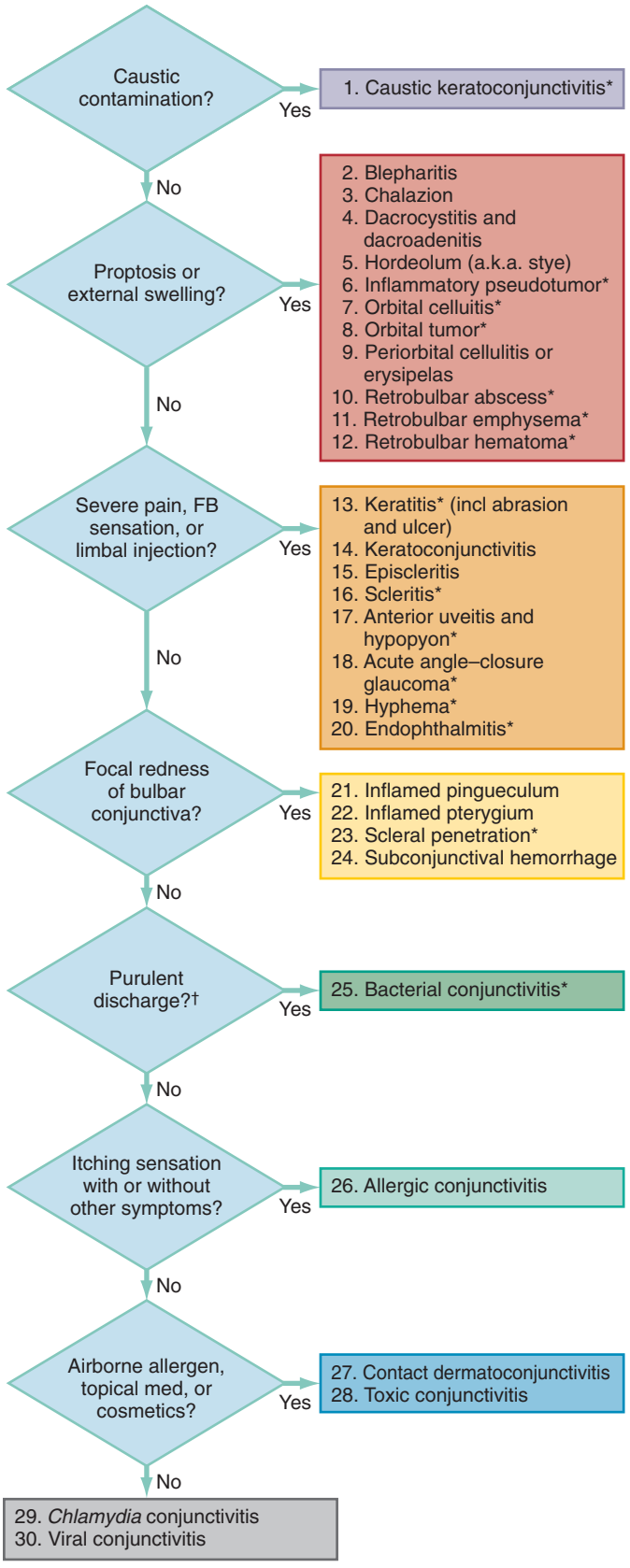

Figure 22-10. Diagnostic algorithm for red eyes. *a.k.a.,* also known as; *FB,* foreign body; *incl,* including; *med,* medicine.
*Indicates potentially serious diagnoses if not identified on initial emergency department evaluation.
†Purulent implies true pus, as opposed to the mucoid discharge more commonly associated with nonbacterial causes of conjunctivitis.
(Modified from Trobe JB: The Physician's Guide to Eye Care. San Francisco: Foundation of the American Academy of Ophthalmology; 2001.)

timolol 0.5%, a topical beta-adrenergic receptor antagonist, are administered to decrease the production of aqueous humor. This may be followed by two drops of dorzolamide 2%, a topical carbonic anhydrase inhibitor, to reduce aqueous humor production further. If not available, 500 mg of acetazolamide may be given orally or intravenously. If the patient has sickle cell disease or trait, oral methazolamide 50 mg is used instead. Patients with suspected intraocular hypertension who also have nausea or vomiting should receive a parenteral antiemetic so that they do not gag or vomit, which may further increase IOP.

Specific Management

Management of the specific entities listed in the diagnostic algorithm presented in Figure 22-10 is presented in Table 22-2. Specific management of ophthalmologic conditions is also discussed in Chapter 71.

SPECIAL CONSIDERATIONS

Pediatrics

A red eye in a neonate or infant is 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 abrasions, and herpes keratitis acquired from the birth canal. *Chlamydia* infections may also be acquired during vaginal deliveries but may not arise for weeks. These infections should be treated with oral azithromycin as well as parenteral ceftriaxone to cover *Neisseria gonorrhoeae.* Open wounds also necessitate tetanus prophylaxis if the patient's immunizations are not up to date. Conjunctivitis associated with respiratory symptoms or infiltrates on a chest radiograph in an infant younger than 3 months should be treated with an oral macrolide. Oral antibiotics are also indicated for conjunctivitis associated with otitis media. *Mycoplasma* has been a common infectious agent in these cases, but *H. influenzae* accounted for 82% of isolates in a more recent study, and 29% of those were resistant to β-lactam antibiotics.[35]

There is no good medical evidence to support the requirements of most daycare and school facilities for antibiotic treatment for acute conjunctivitis before the child may return to activities with other children. First, some causes of pinkeye 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. Therefore return after 1 to 3 days of treatment (depending on policy) might actually

Table 22-2 Management Algorithm for Red Eyes Extended from Diagnostic Algorithm in Figure 22-10

DIAGNOSIS FROM FIGURE 22-10	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 min. *Alkalis*: minimum of 4 L *and* 40 min.	Ophthalmologist comes 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. Blepharitis Inflammation of eyelid margins often a/w crusts on awakening, FB sensation, and tearing.	None except artificial tears for dry eye.	Outpatient referral only for treatment failure after 2 wk.	Discharge with instructions to apply warm compresses to eyelids for 15 min qid and scrub lid margins and lashes with mild shampoo on washcloth bid.
3. Chalazion Inflammation of meibomian gland causing subcutaneous nodule within the eyelid.	None.	Outpatient referral only for treatment failure after 2 wk.	Discharge with instructions to apply warm compresses to eyelids for 15 min and gently massage nodule qid.
4. Dacryocystitis and dacryoadenitis Eye tearing and inflammation of lower eyelid inferior to lacrimal punctum with redness and tenderness over nasal aspect of lower lid and adjacent periorbital skin.	First r/o periorbital cellulitis (#9) and orbital cellulitis (#7). Inspect for obstruction of punctum by SLE, may express pus by pressing on sac, oral Rx 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 Rx if admitting, then Rx as for periorbital cellulitis (#9).	May discharge mild cases with oral analgesics and antibiotics (e.g., amoxicillin/clavulanate), and instructions to apply warm compresses to eyelids for 15 min and gently massage inner canthal area qid.
5. Hordeolum (i.e., stye) Abscess in eyelash follicle or modified sebaceous gland at lid margin: *external* or *internal* based on side of lid margin to which abscess is pointing.	*External*: warm compresses often all that is needed, may Rx anti-*Staph* ointment bid. *Internal*: oral Rx for β-lactamase *Staph.*	Outpatient referral only for treatment failure after 2 wk.	Discharge with instructions to apply warm compresses to eyelids for 15 min and gently massage abscess qid.
6. 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 ESR. Obtain axial CT scan of brain and axial and coronal CT scan of orbits and sinuses.	IOP > 20 mm Hg may be surgical emergency, Rx to decrease IOP in ED.	May discharge if no systemic problems, no findings of particular concern on CT, and IOP < 20 mm Hg. Start high-dose oral steroids after discussion with ophthalmologist and ensure reevaluation in 2-3 days.

Continued

Table 22-2 Management Algorithm for Red Eyes Extended from Diagnostic Algorithm in Figure 22-10—cont'd

DIAGNOSIS FROM FIGURE 22-10	MANAGEMENT	CONSULTATION	DISPOSITION
7. 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 presence 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. Start intravenous therapy with second-generation cephalosporin (e.g., cefuroxime, cefoxitin, or cefotetan) or with ampicillin/sulbactam to cover sinus and skin flora. Alternative Rx is ticarcillin/clavulanate, piperacillin/tazobactam, vancomycin, or clindamycin + third-generation cephalosporin (e.g., cefotaxime or ceftriaxone).	IOP > 20 mm Hg may be surgical emergency, Rx to decrease IOP in ED. Obtain blood cultures and start antibiotics. Axial and coronal CT of orbits and sinuses to r/o FB, retrobulbar abscess, orbital gas, subperiosteal abscess, osteomyelitis, and changes in cavernous sinus. Consider LP.	Admit all patients with orbital cellulitis.
8. 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, Rx to decrease IOP in ED. Ophthalmologist may want MRI, MRA, or orbital US.	Based on findings and discussion with consultant.
9. 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 absence of any other finding listed in #7.	First r/o orbital cellulitis (#7). Oral Rx 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 oral antibiotics. Ophthalmologist reevaluates next day to ensure no orbital extension.
10. Retrobulbar abscess* Findings of orbital cellulitis (#7) but a/w increased IOP. **11. Retrobulbar emphysema*** Findings of pseudotumor (#6) but a/w increased IOP. **12. Retrobulbar hematoma*** Findings of pseudotumor (#6) but occurs because of trauma, coagulopathy, or thrombocytopenia and a/w diffuse subconjunctival hemorrhage anteriorly and extending posteriorly as well as increased IOP.	Measure IOP unless possibility of ruptured globe. IOP > 30 mm Hg may require emergent needle aspiration or lateral canthotomy and inferior cantholysis in ED. *Abscess*: antibiotics as in orbital cellulitis (#7). *Emphysema*: prophylaxis with antibiotics to cover sinus flora. *Hematoma*: correct any coagulopathy or thrombocytopenia.	IOP > 20 mm Hg may be surgical emergency, Rx to decrease IOP in ED. Obtain axial CT scan of brain and axial and coronal CT scan of orbits and sinuses.	Admit all cases of retrobulbar pathology causing increased IOP. Others might be candidates for discharge depending on cause of problem.
13. 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 caused by light exposure].	First r/o corneal penetration either grossly or through 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 comes to ED if there is any concern for globe penetration. Otherwise consult for follow-up examination in 1-2 days.	May discharge cases not infected or ulcerated. May provide topical antibiotic prophylaxis with polymyxin B combinations with bacitracin (ointment) or trimethoprim (solution). Erythromycin, gentamicin, and sulfacetamide are less desirable single-agent alternatives. Oral NSAIDs or narcotics for analgesia. No patch.
Keratitis (ulceration)* Symptoms and signs as above. Ulceration from complications of contact wear or neglected corneal abrasion has "scooped out" epithelium with surrounding edema appearing as white "cloudiness" in clear tissue.	Relieve pain and blepharospasm with topical anesthetic. *Staph* and *Strep* species still most common organisms, but *Pseudomonas* greater percentage in existing infections (especially contact lens wearer), so Rx with topical fluoroquinolone is preferred.	Discuss any potential need to débride or culture before starting antibiotic.	Based on findings and discussion with consultant. Typical ciprofloxacin or moxifloxacin dosage is 2 gtt q15min × 6 hr, then 2 gtt q30 for the next 18 hours until seen by consultant the same or next day. PO NSAIDs or narcotics for analgesia. No patch.

Table 22-2 Management Algorithm for Red Eyes Extended from Diagnostic Algorithm in Figure 22-10—cont'd

DIAGNOSIS FROM FIGURE 22-10	MANAGEMENT	CONSULTATION	DISPOSITION
Keratitis (herpetic infection)* Symptoms and signs as 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. Rx with trifluridine 1% solution, vidarabine ointment, or acyclovir ointment. Patients with 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 trifluridine dosage is 1 gtt q2h while awake for 7 days, then taper over 2 more wk. Typical vidarabine or acyclovir dosage is five times a day for 7 days, then taper over 2 more wk. Oral NSAIDs or narcotics for analgesia. No patch.
14. Keratoconjunctivitis Conjunctivitis with subepithelial infiltrates in cornea causing pain and decreased vision, possibly with halos reported.	Treat for conjunctivitis by likely causative category (#25-30).	Discuss findings and use of prednisolone acetate 1% (frequency determined by ophthalmologist).	May discharge patient with medications recommended by ophthalmologist and ensure reevaluation in 2-3 days.
15. Episcleritis Rapid onset of localized pain, injection of episcleral vessels, and localized tenderness.	Relieve irritation with artificial tears and decrease inflammation with ketorolac gtt.	Outpatient referral only for treatment failure after 2 wk.	May discharge patient with oral NSAIDs alone or in combination with topical ketorolac gtt.
16. Scleritis* Progressively increasing eye pain with radiation to ipsilateral face and decreasing vision, photophobia, tearing, and possible pain with eye motion.	Decrease inflammation with oral NSAIDs.	Discuss findings and use of topical or PO steroids.	May discharge patient with medications recommended by ophthalmologist and ensure reevaluation in 2-3 days.
17. 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 r/o glaucoma with IOP measurement. Rx in ED if IOP > 20 mm Hg. Otherwise dilate pupil with 2 gtt of cyclopentolate 1%.	Discuss findings and use of prednisolone acetate 1% (frequency determined by ophthalmologist but range is q1-6h).	May discharge patient with medications recommended by ophthalmologist and ensure reevaluation in 2-3 days. Patients with hypopyon are generally admitted.
18. Acute angle–closure glaucoma Sudden-onset eye pain and blurred vision that may be a/w frontal headache, nausea, and vomiting. Anterior eye may manifest shallow or closed angle between iris and cornea, pupil fixed in mid-dilation, or limbal injection of conjunctiva.	Decrease production of aqueous humor. Timolol 0.5% 1 gt, then repeat in 30 min. Apraclonidine 1% 1 gt once. Dorzolamide 2% 2 gtt *or if sickle cell disease or trait* then methazolamide 50 mg PO. Decrease inflammation. Prednisolone 1% 1 gt every 15 min four times.	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.
Rx in ED if IOP > 30 mm Hg.	Constrict pupil. Pilocarpine 4% 1 gt, then repeat in 15 min. Consider establishing osmotic gradient. Mannitol 2 g/kg IV.		
19. Hyphema* Pain, decreased visual acuity, gross or microscopic blood in anterior chamber, may be a/w dilated and fixed pupil following blunt trauma. Graded by amount of blood. Percentage of vertical diameter of anterior chamber when blood layers with patient in upright position. Microhyphema shows no layering and only suspended red blood cells.	First r/o globe rupture. 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 (#18). If IOP > 20 mm Hg and no iridodialysis, may use cycloplegic to prevent iris motion.	Discuss findings and use of ε-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 any change in vision can be immediately recognized. Oral NSAIDs or narcotics for analgesia.
20. 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 cefazolin + gentamicin *or* vancomycin + cefotaxime, ceftazidime, *or* ceftriaxone to cover *Bacillus, Enterococcus*, and *Staphylococcus* species.	Ophthalmologist admits for parenteral and possibly intraocular antibiotics.	Admit all patients with endophthalmitis.

Continued

Table 22-2 Management Algorithm for Red Eyes Extended from Diagnostic Algorithm in Figure 22-10—cont'd

DIAGNOSIS FROM FIGURE 22-10	MANAGEMENT	CONSULTATION	DISPOSITION
21. Inflamed pinguecula Inflammation of soft yellow patches in temporal and nasal edges of limbal margin. **22. Inflamed pterygium** Inflammation of firmer white nodules extending from limbal conjunctiva onto cornea.	Decrease inflammation with naphazoline or ketorolac gtt.	Outpatient referral only for treatment failure after 2 wk.	Discharge to follow-up with ophthalmologist for possible steroid therapy or surgical removal.
23. Scleral penetration* Localized redness at site of entry, teardrop pupil, blood in anterior chamber or loss of red reflex.	Protect eye from further pressure, provide pain relief, and prevent vomiting. Tetanus prophylaxis.	Ophthalmologist comes to ED if there is any concern for globe penetration.	Admit for intravenous antibiotics and possible procedural intervention.
24. 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 2-3 wk.
25. Bacterial conjunctivitis* Hyperpurulent discharge not typical of common "pinkeye" and more commonly unilateral in adults. Inflammation of eyelid margins a/w lid edema, chemosis, and possibly subconjunctival hemorrhage, but usually little or no follicular "cobblestoning."	Topical polymyxin B trimethoprim in infants and children because more *Staph* species. Topical sulfacetamide or gentamicin clinically effective in 90% of uncomplicated adult cases. Use topical fluoroquinolone if *Pseudomonas* possible.	Culture drainage and ophthalmology consultation in all neonates and those at risk for vision loss or systemic sepsis. *Neisseria gonorrhoeae* can be rapidly sight-threatening.	Discharge patients with uncomplicated cases with 10 days of topical antibiotics in both eyes, regardless of laterality of apparent infection. Use ointments in infants and gtt in others.
26. Allergic conjunctivitis Often bilateral palpebral injection of conjunctiva and chemosis that may be seasonal and a/w other allergic symptoms such as rhinitis.	Decrease irritation with naphazoline gtt.	Outpatient referral only for treatment failure after 2 wk.	Identify antigen if possible. Consider treating other allergic symptoms with oral antihistamines.
27. Contact dermatoconjunctivitis Localized lid and conjunctival redness and swelling. **28. Toxic conjunctivitis** Diffuse conjunctival injection, chemosis, and lid edema.	Irrigation with tap water or sterile normal saline. Decrease irritation with naphazoline gtt.	Outpatient referral only for severe cases or treatment failure after 2 wk.	Identify offending agent and avoid subsequent exposure. Discharge uncomplicated cases on continued naphazoline.
29. *Chlamydia* conjunctivitis Often bilateral palpebral injection of conjunctiva in neonate or other individual at risk for sexually transmitted disease.	Empirical oral azithromycin for *Chlamydia.* Consider empirical parenteral ceftriaxone for concurrent *Neisseria gonorrhoeae.*	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 oral azithromycin.
30. Viral conjunctivitis Often bilateral palpebral injection of conjunctiva and follicular cobblestoning of inner surface of lower lid. Inflammation of eyelid margins often a/w crusts on awakening, FB sensation, and tearing.	Decrease irritation with artificial tears, naphazoline, or ketorolac gtt.	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 wk.

a/w, associated with; *bid,* twice daily; *BMP,* basic metabolic profile (includes electrolytes, glucose, and renal function tests); *CBC,* complete blood count; *CMV,* cytomegalovirus; *CT,* computed tomography; *ED,* emergency department; *ESR,* erythrocyte sedimentation rate; *FB,* foreign body; *gt,* drop; *gtt* drops; *IOP,* intraocular pressure; *IV,* intravenously; *LP,* lumbar puncture; *MRA,* magnetic resonance angiography; *MRI,* magnetic resonance imaging; *NSAIDs,* nonsteroidal anti-inflammatory drugs; *PO,* orally; *q,* every; *qid,* four times a day; *r/o,* rule out; *Rx,* prescribe; *SLE,* slit-lamp examination; *SPK,* superficial punctuate keratitis; *Staph., Staphylococcus; Strep., Streptococcus; UA;* urinalysis; *US,* ultrasonography; *UV,* ultraviolet.

*Potentially serious diagnoses if not identified on initial emergency department evaluation. Antibiotic choices should be based on current practice.

expose more children owing to the false sense of security antibiotics provide.

Trauma

Blunt trauma is a common cause of a red and painful eye. Patients with large hyphemas and hyphemas with clots are likely to require hospitalization for bed rest with 30 degrees of head elevation. Systemic analgesia and, if required, antiemetics are indicated. Medications affecting platelet function should be avoided. Treatment may be indicated when the IOP exceeds 30 mm Hg, as it is in acute angle–closure glaucoma. If the iris is not injured, a long-acting cycloplegic agent (e.g., topical homatropine) may be recommended to prevent repetitive motion of the iris. Some reliable adult patients may be discharged with daily follow-up by a specialist. Strong analgesia and patching are not indicated, so that the patient may immediately identify increases in pain or decreases in visual acuity, though a rigid shield to protect the eye during sleep is prudent.

Corneal abrasions are common problems in the ED. When the emergency physician is convinced that the cornea has not received a full-thickness laceration or penetration by a foreign

body, management is relatively simple. Foreign bodies (on or in the epithelium only) should be removed when possible. These frequently adhere to a saline-moistened cotton-tipped applicator. Ones that do not may sometimes be lifted off with a blunt-tipped tool ("spud") under the binocular magnification of a slit lamp. The common use of hypodermic needle removal may damage surrounding cornea and is not recommended. Whether or not the object can be successfully removed, management is the same as for corneal abrasions. Rust staining of the corneal epithelium does not require removal in the ED, but patients are referred to a specialist for examination within 3 days. Antimicrobial prophylaxis with topical antibiotics for all superficial epithelial defects of the cornea is common practice but not supported by evidence.[28,29] Larger lesions may necessitate use of a cycloplegic agent for the pain associated with secondary iritis, but administration prophylactically is also not supported in the literature.[29,36] Systemic analgesia appropriate to the patient's level of pain should be provided. Topical anesthetics should not be given to the patient for home use. Patching is not necessary and may be harmful.

DISPOSITION

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 22-2.

KEY CONCEPTS

- 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 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, perilimbic conjunctival infection, 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.

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

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