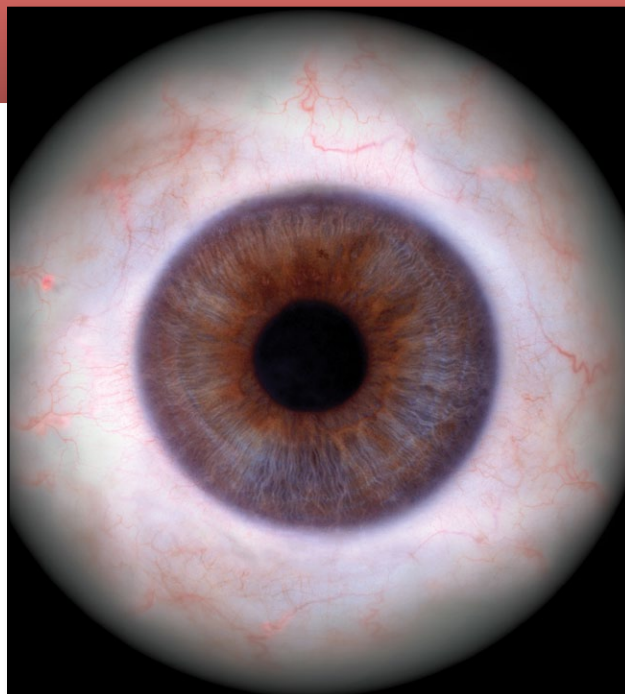


# Common Ocular Emergencies

Krista M. Greene, MD  
Francis L. Counselman, MD, CPE, FACEP



Ocular emergencies cause considerable morbidity. In some cases, they pose risk to sight, and they may be associated with other serious injuries or conditions. This article summarizes the types of eye conditions that present frequently to the ED, including those from traumatic and nontraumatic injuries and infectious etiologies. Key elements of appropriate history-taking, examination, treatment, and disposition are reviewed, and important reminders regarding dosing of ophthalmologic medications are noted.

A variety of ocular disorders present to the ED on a routine basis, and a detailed history and physical exam are crucial for diagnostic and management purposes. There are more than 2 million visits to the ED annually for eye-related conditions. Nearly half are for injuries, two-thirds of which occur in males. While the majority of visits are for minor problems, such as corneal abrasion or conjunctivitis, approximately 3% of patients require hospitalization.<sup>1</sup>

A thorough history and physical exam are essential to proper management and disposition of any patient with an ocular emergency. This article reviews the fea-

tures of common eye-related emergencies and essential aspects of their evaluation and management.

## HISTORY AND PHYSICAL EXAMINATION

The history should include prior ocular or visual disturbances, ocular surgeries, the use of contact lenses or glasses, and comorbid conditions that affect the eyes. Patients should also be asked about onset and timing of symptoms, which may include foreign body sensation, pain, burning, itching, and changes in vision. Additionally, tearing, swelling, discharge, and photosensitivity are important signs that must be documented.

The physical exam can provide valuable information. The VVEEPP mnemonic is a useful device for remembering the components of the ocular exam: visual acuity, visual fields, external examination, extraocular movements, pupillary evaluation, and pressure determination.<sup>2</sup> If a patient reports a foreign body sensation, traumatic event, or visual changes, a slit-lamp exam is required. Funduscopy exam is indicated in patients

**Dr. Greene** is a resident in the department of emergency medicine at Eastern Virginia Medical School in Norfolk. **Dr. Counselman** is a distinguished professor of emergency medicine and chairman of the department emergency medicine at Eastern Virginia Medical School. He is also an attending physician with Emergency Physicians of Tidewater in Norfolk and associate editor-in-chief of EMERGENCY MEDICINE.

reporting vision change or loss and in those who have other comorbidities, such as diabetes, coronary artery disease or other vascular diseases, or hypertension. Visual acuity can be considered the vital sign of the eyes and may be assessed with a Snellen or Rosenbaum chart. Children who are unable to assess letters may be evaluated with an Allen chart, which requires identification of shapes. Ideally, acuity should be measured at the optimal correction for each patient, and if the patient does not have his or her corrective lenses or glasses, the pinhole eye cover may be used. If the patient is unable to read these charts, then the physician should test the ability to count fingers, identify hand motion, or perceive light.

### CAUSTIC KERATOCONJUNCTIVITIS

Chemical injuries of the eye are true ocular emergencies. They account for the majority of occupational injuries<sup>3,4</sup> and can lead to vision loss, glaucoma, and retinal or corneal injury and scarring. Often, patients require multiple reconstructive and corrective surgeries. Nearly one-third of corneal transplants in the 1990s were performed in patients who sustained chemical burns to the eye.<sup>5</sup> Tuft and Shortt refer to a “window of opportunity” within the first 7 to 10 days of a chemical burn, during which the immediate treatment and initial surgical intervention (if needed) can prevent blindness or minimize the potential for this outcome.<sup>6</sup> Immediate and copious irrigation is essential—and should be performed before the history and physical exam.<sup>7</sup> Topical anesthesia (proparacaine 0.5% or tetracaine 0.5%) should be used prior to irrigation.

Alkali burns lead to liquefaction necrosis, in which the membrane proteins are saponified and are denatured by the alkaline chemical. Until the offending agent is removed, this penetration of the eye will continue, leading to globe perforation. It is thought that irreversible damage occurs at a pH of 11.5.<sup>5</sup> Alkali burns can penetrate the anterior chamber in as little as 15 minutes.<sup>5</sup> Common agents include sodium hydroxide, calcium hydroxide, potassium hydroxide, and ammonia. When deployed, air bags release aerosolized sodium hydroxide, which can lead to alkali keratitis.<sup>8</sup> Acid burns result in coagulation necrosis, and the coagulum produced usually limits the depth of penetra-

tion of these burns. Common agents include battery acid (most common), bleach, and toilet cleaners. Hydrofluoric acid is found in several home rust removers and cleaners, and ocular insult may result from gaseous or liquid exposure.<sup>9</sup>

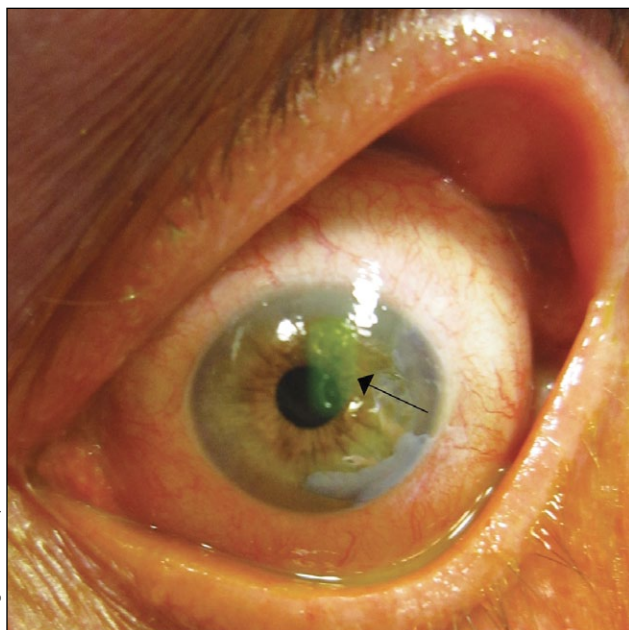
Regardless of the offending agent, irrigation should be performed without delay. Lactated Ringer solution is preferred, but normal saline or even tap water is acceptable. At least 1 to 2 L should be used before pH is checked. Irrigation should be guided by repeated evaluation of the pH of the eye until it returns to normal. This may require up to 8 to 10 L of solution. The use of a Morgan lens, Desmarres retractors, or lid retractors should be considered to promote direct irrigation across the surface of the eye. The pH of the tears should be assessed and irrigation continued until a pH of 7 is obtained. The fornices of the eye should be inspected, and if particulate is identified, it should be removed. If the caustic agent contained calcium oxide, it may be beneficial to soak the swab in EDTA.<sup>5</sup>

Once initial management has been completed, visual acuity is assessed and an exam performed. The eye should be examined for particulate matter or foreign bodies. If epithelial defects or anterior chamber injuries are not found, erythromycin ophthalmic ointment should be prescribed for application 4 times daily. In the case of an epithelial injury, cycloplegics (“red tops”) may be added for pain control. These agents control ciliary spasm; in addition, they are thought to reduce inflammation by limiting the permeability of blood vessels.<sup>5,10</sup> Tropicamide 0.5%, which has a 3- to 6-hour duration of action, is used more frequently than homatropine and atropine, which have much longer durations of action. Cycloplegics, which dilate the pupil, cause patients to lose the ability to focus on nearby objects. They can burn or sting for several seconds when instilled into the eye. A single dose of tropicamide given in the ED will frequently provide sufficient relief until the patient is seen by an ophthalmologist. Prophylactic antibiotics should be prescribed; erythromycin ophthalmic ointment 4 times daily is usually sufficient. If examination reveals chemosis without corneal or anterior chamber injury, erythromycin ointment should be prescribed and ophthalmologic follow-up should

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Image courtesy of James Heilman, MD



**FIGURE 1.** Corneal abrasion after staining with fluorescein.

take place within 48 hours. All patients require ophthalmologic follow-up; immediate referral or consult is mandatory for patients with clouding of the cornea or epithelial defects.<sup>5,9</sup>

## CORNEAL ABRASION

Corneal abrasions result from trauma, infection, or contact lens use. They manifest with pain, photophobia, and tearing, which hinder examination of the eye and assessment of visual acuity. Often, application of a topical anesthetic is required before the exam can proceed. If pain relief is immediate upon application of topical analgesia, a corneal abrasion or injury is highly likely.<sup>9</sup> (It should be noted that topical anesthetics [“white tops”] should never be prescribed for home use, as most cause corneal toxicity with repeated dosing and can lead to worse injury or loss of vision.) The defect is best visualized under cobalt blue light after fluorescein staining (Figure 1). The examiner should also look for foreign bodies, taking care to evert the eyelids during inspection. In addition, optical sectioning with the slit lamp is useful in determining the presence of a full-thickness injury. If possible, the size of the abrasion should be documented. For large abrasions, placing a drop of a cycloplegic agent (eg, tropicamide 0.5%) will

help with pain relief. Oral narcotics are not generally needed. Topical NSAIDs (eg, diclofenac 0.1%, 1 drop 4 times daily) have also been proven effective as an adjunct for pain control.<sup>11</sup> Use of topical NSAIDs allows patients to return to normal daily activities without the sedation caused by oral narcotics.

Determining the source of the abrasion is key to the selection of appropriate therapy. Injuries that are the result of organic causes carry increased risk for fungal infection, while abrasions from contact lens use are at increased risk for *Pseudomonas* infection. If an organic source is identified, a topical ophthalmic fluoroquinolone (eg, ciprofloxacin 0.3%, 1 drop 4 times daily) should be prescribed. Injuries associated with contact lens use require pseudomonal coverage with tobramycin ophthalmic ointment 4 times daily. All patients should receive formal ophthalmologic evaluation within 24 hours. Traditionally, an eye patch was used for injuries not related to contact lens use; however, recent evidence suggests that a patch may actually interfere with healing, and patching is no longer recommended.<sup>12-14</sup> Patients must be instructed not to wear contact lenses until the abrasion is completely healed.

## HYPHEMA

Hyphema, or blood in the anterior chamber (Figure 2), generally results from trauma, though it can occur spontaneously. Blunt and penetrating trauma can lead to hyphema via rupture of the blood vessels of the root of the iris. Spontaneous hyphema may be seen in the setting of sickle cell disease or a coagulopathy, but is more often seen in the setting of neovascularization, as in diabetes.<sup>15</sup> Given the traumatic nature of the majority of hyphema injuries, examination for other traumatic injuries is paramount.

The cells suspended in the anterior chamber can obstruct outflow of the aqueous humor through the trabecular meshwork, resulting in increased intraocular pressure (IOP). Treatment is aimed at preventing these sequelae. Elevation of the head allows the red blood cells to settle in the inferior portion of the anterior chamber and helps to prevent obstruction of the trabecular meshwork. Because dilation and constriction of the pupil create tension on the fragile vasculature of the iris, the pupils should be dilated.<sup>2,9</sup> Initial

treatment consists of atropine 1% (1 drop 3 times daily) and prednisolone acetate 1% (1 drop 4 times daily). Topical steroids can raise the IOP and cause glaucoma or cataracts; thus, they should be prescribed only in consultation with an ophthalmologist. If the globe is intact, the IOP should be measured. For pressures greater than 30 mm Hg, a topical  $\beta$ -blocker, such as timolol maleate 0.5% (1 drop), should be given, in addition to a carbonic anhydrase inhibitor, such as acetazolamide (500 mg PO or IV). If these measures do not decrease the IOP, mannitol (1 to 2 g/kg IV) should be added. IOP may also be controlled with topical  $\alpha$ -adrenergic agents (eg, apraclonidine). Use of carbonic anhydrase inhibitors should be avoided in patients with spontaneous hyphema or sickle cell disease, as these drugs decrease the pH in the anterior chamber, which can lead to sickling of the red blood cells, increasing IOP and obstructing the trabecular meshwork.<sup>9</sup> Rebleeding is common; it typically occurs within 3 to 5 days and may require surgical drainage of the anterior chamber.

Most ophthalmologists recommend that patients with hyphemas occupying less than one-third of the anterior chamber (the majority of hyphemas) and normal IOP be managed on an outpatient basis, with close follow-up with an ophthalmologist. However, the on-call ophthalmologist should be consulted to advise regarding disposition. It is important to instruct patients to avoid use of aspirin and NSAIDs, since they can increase the risk of rebleeding.

### BLOWOUT FRACTURE

Blowout fractures alone or in conjunction with other facial fractures are the second most common midfacial fractures after nasal bone fractures.<sup>16</sup> The orbit consists of seven bones of the skull: the frontal bone, which contributes the superior orbital ridge and upper medial orbit; the zygoma, which makes up the lateral orbital rim; the maxilla, which comprises the inferior and lower medial rim; the lacrimal bone, which separates the orbit from the nares; the ethmoid bone, which comprises the medial wall and a portion of the posterior wall; and the sphenoid, lacrimal, and palatine bones, which complete the posterior wall. The weakest point in the orbit is the floor, which is made up of the maxillary bone inferiorly and the lamina papyracea ("paper wall") of



Image courtesy of Rakesh Ahuja, MD

**FIGURE 2.** Hyphema occupying half of anterior chamber.

the ethmoid bone inferiorly and medially. A blow to the orbit increases IOP, which compresses the orbital floor or medial wall, resulting in a fracture. Entrapment of periorbital fat or extraocular muscles complicates these fractures: fractures of the medial wall may involve entrapment of the medial rectus muscle, which manifests as lateral gaze disruption, whereas orbital floor fractures of the maxillary sinus may entrap the inferior rectus muscle, leading to upward gaze dysfunction.

Approximately 22% of orbital blowout fractures have related ocular injuries.<sup>17</sup> Detailed examination may reveal corneal injury, hyphema, retinal detachment, or lens disruption. Other ocular injuries associated with blowout fractures include traumatic uveitis or traumatic optic neuropathy (manifested as pupillary dysfunction). Subcutaneous emphysema may be identified, particularly with medial wall fractures, which can be worsened by sneezing or coughing. Enophthalmos (ie, sunken eye) of more than 2 mm can result in significant asymmetry. Patients may describe diplopia, particularly on upward gaze, or decreased visual acuity. In addition, they may exhibit hypoesthesia or dysesthesia in the infraorbital nerve distribution. A subset of these fractures may present with symptoms such as nausea, vomiting, headache, and irritability, which are





Image courtesy of Keith D. Hentel, MD

**FIGURE 3.** Axial CT demonstrating globe rupture of the right eye.



Image courtesy of Indiana University, Dept. of Ophthalmology

**FIGURE 4.** Acute external hordeolum.

suggestive of head trauma and may delay diagnosis of the fracture.<sup>18</sup> These fractures can be identified on the Water's view radiograph, which may demonstrate an air-fluid level, a "tear drop sign," or opacification of the maxillary sinus. However, CT of the orbits is the preferred imaging study in the evaluation of ocular trauma (Figure 3).<sup>16,19</sup>

From an ED standpoint, oral antibiotics should be given if the fracture communicates with a sinus; cephalexin 250 to 500 mg orally 4 times a day for 10 days is sufficient. The patient must be advised to avoid creat-

ing or worsening subcutaneous air by sneezing, coughing, or nose blowing; decongestants may be helpful in this regard. If exam findings are normal and there is no evidence of entrapment, outpatient referral to an ophthalmologist, oral maxillofacial surgeon, or plastic surgeon is appropriate. Close ophthalmologic follow-up is mandatory in all patients for dilation of pupils and examination to rule out detachment or tearing of the retina. If entrapment is identified, immediate consultation is required for surgical decompression.

## HORDEOLUM

An external hordeolum, or sty (Figure 4), is an infection of an oil gland (Zeis glands) while an internal hordeolum involves the meibomian gland.<sup>20</sup> *Staphylococcus* or *Streptococcus* species are usually the pathogens responsible. It presents as a small pustule at the lid margin. Uncommonly, these infections can extend into surrounding tissues, leading to preseptal cellulitis. Persistent infections may progress into a chronic chalazion. Treatment consists of erythromycin ophthalmic ointment applied twice daily for 7 to 10 days,<sup>21</sup> in addition to application of a warm compress 4 times daily.<sup>22</sup>

## CHALAZION

Occurring within the eyelid tarsus, a chalazion is a focal, inflamed area resulting from obstruction of a meibomian gland.<sup>20</sup> A tender, erythematous nodule develops, either at the lid margin or within the lid itself (Figure 5). These infections may be acute or chronic and produce a cystic wall and discrete nodule. Acute treatment includes warm compresses, which should be used 3 times daily, and erythromycin ophthalmic ointment applied to the lid margins 4 times daily. For chronic or recurrent infections, doxycycline 100 mg orally twice daily for 2 to 3 weeks may be added.<sup>9,21</sup> Ophthalmology referrals for surgical excision are warranted for recurrent or worsening chalazia or those that persist for more than 4 weeks.

## CONJUNCTIVITIS

The conjunctiva consists of connective tissue covering the inner surface of the eyelid and the surface of the

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eye. It contains accessory lacrimal glands and goblet cells that keep the eye lubricated. Conjunctivitis refers to any process of inflammation of the conjunctiva and is one of the leading ocular complaints in the ED.<sup>23</sup> Infectious agents, whether viral or bacterial, adhere to the conjunctiva, producing the clinical signs of conjunctivitis, such as erythema, irritation, and discharge (Figure 6). Patients describe burning or itching of the affected eye. As with most infections, those of viral etiology are more common than those of bacterial origin. However, since the clinical appearances of both etiologies cannot be distinguished reliably, most cases are treated with topical ophthalmic antibiotics.<sup>9</sup>

### Viral conjunctivitis

Viral conjunctivitis is often linked to adenovirus, coxsackievirus, and enterovirus.<sup>22</sup> Patients presenting with viral conjunctivitis often describe a preceding upper respiratory infection. Symptoms begin in a single eye and usually move to the other eye within several days.<sup>9</sup> These patients often describe a foreign body sensation; they also report waking from sleep with a crust on and around the affected eye(s). Physical exam reveals chemosis of the conjunctiva. Watery discharge and palpable preauricular nodes make this diagnosis more likely.<sup>23</sup> Slit-lamp exam with fluorescein staining should be performed to evaluate for dendritic keratitis and corneal ulceration, and it may reveal punctate staining on an otherwise clear cornea. It is useful to note that the length of the light beam on some slit-lamps can be adjusted with a measuring dial, which allows for measurement of corneal ulcers and other injuries. Treatment consists of a cool compress applied up to 4 times daily as well as antihistamine eye drops 3 to 4 times daily as needed. Since it is difficult to distinguish viral from bacterial infection, a topical ophthalmic antibiotic is usually prescribed, such as erythromycin 0.5%, sulfacetamide 10%, or polymyxin B/trimethoprim. The preferred practice patterns suggested by the American Academy of Ophthalmology recommend treating the root cause as identified.<sup>24</sup> Hygiene is extremely important in these cases; measures such as frequent handwashing and separating linens are necessary to prevent spread of infection.



Images courtesy of Indiana University, Dept. of Ophthalmology

**FIGURE 5.** Two views of chalazion.

### Bacterial conjunctivitis

Bacterial conjunctivitis typically affects a single eye. Patients describe waking with a purulent discharge and a sensation that the eyelids are stuck together. Visual acuity remains intact, and photophobia does not occur. If either is present, corneal involvement should be suspected.<sup>22</sup> Slit-lamp exam with fluorescein staining demonstrates a clear cornea without uptake. Treatment requires a broad-spectrum topical ophthalmic antibiotic such as polymyxin B/trimethoprim or erythromycin; the latter is preferred in the pediatric population.<sup>22</sup> For those who wear contact lenses or require cover-



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**FIGURE 6.** Swollen, pus-filled eye with conjunctivitis.

Image courtesy of Lori J. Wood, COMT



**FIGURE 7.** Dendritic lesions visible on the cornea after fluorescein staining in a patient with herpes keratitis.

age for *Pseudomonas*, topical ophthalmic fluoroquinolone<sup>22</sup> or aminoglycoside<sup>9</sup> drops are indicated. (It should be noted that aminoglycosides delay healing, due to their toxic effect on the epithelium.<sup>23</sup>) Treatment should be prescribed for 7 to 10 days. Supportive care (ie, eye irrigation, warm compresses) is also essential.<sup>22</sup> Patients presenting with single-eye involvement should be instructed to begin treating the second eye immediately with onset of symptoms (eg, redness, itching).

High-risk populations must be treated accordingly. Infants with conjunctivitis or sexually active adolescents who present with conjunctivitis should have cul-

tures for *Neisseria gonorrhea* and *Chlamydia trachomatis*. These infections are characterized by a thick, yellow discharge and significant chemosis. Neisserial conjunctivitis can be very aggressive and is sight-threatening<sup>2,9,22</sup>; it presents within the first days of life, although it can be seen in sexually active adolescents as well. Treatment should include parenteral ceftriaxone in addition to erythromycin ophthalmic drops or ointment. Chlamydial conjunctivitis remains a leading cause of preventable blindness worldwide. Transmitted through the birth canal, this infection may not manifest for several weeks and may be associated with chlamydial pneumonia.<sup>22</sup> Treatment requires systemic antibiotics in the form of oral erythromycin for children (erythromycin, doxycycline, or tetracycline in adults) as well as topical ophthalmic erythromycin. In some cases, admission for IV antibiotics may be required.

## KERATITIS

Keratitis consists of inflammation of the cornea, with or without violation of its epithelium. Most often, it is a result of viral or bacterial infection, but it may also be the result of ultraviolet light exposure, such as in snow blindness, exposure to sun tanning lights, or welder's flash. Other causes of this condition include ischemic injury due to contact lens use or chemical exposure. The classic presentation is a red, painful eye with increased tearing. Patients report a foreign body sensation and demonstrate severe photophobia, which results from ciliary spasm. Instillation of a topical ophthalmic anesthetic immediately relieves pain; this corroborates the corneal origin of this process.

## Viral Keratitis

Viruses that are implicated as causal agents of this entity include herpes simplex viruses (HSV), cytomegalovirus (CMV), and Epstein-Barr virus.<sup>22</sup> Primary HSV infection occurs during passage through the birth canal or due to inoculation from saliva in infants around 6 months of age. Vesicular lesions may be visible on the eyelid or surrounding tissue. Staining of the cornea reveals a dendritic lesion or ulcer (Figure 7). Once this process is recognized, antiviral therapy must be initiated immediately. Systemic treatment with acyclovir is a must; ophthalmic antivirals, such as acyclovir

or idoxuridine, may be added, although there is some concern for corneal toxicity. Immediate referral to an ophthalmologist is imperative.

Reactivation of zoster may also lead to keratitis, should it arise in the V1 distribution of the trigeminal nerve. The typical prodromal symptoms of malaise, fever, and neuralgia will precede onset of the characteristic dermatomal vesicular rash that does not cross the midline. During the physical exam, it should be noted whether the rash involves the tip of the nose (ie, Hutchinson sign), as this finding predicts ocular involvement. If the finding is present, the cornea should be examined for dendritic ulceration.

Keratitis due to Epstein-Barr virus or CMV is more likely to be seen in immunocompromised patients. Definitive diagnosis of these infections is made by polymerase chain reaction; therefore, empiric initiation of acyclovir is warranted.<sup>9,22</sup>

### Bacterial Keratitis

Bacterial keratitis, often caused by *Streptococcus* species, is a true ophthalmologic emergency that can lead to visual impairment and blindness. Contact lens use has increased the incidence of this entity, with pseudomonal

infections predominating.<sup>22</sup> In sexually active patients, *Neisseria* or *Chlamydia* must be considered as potential causes, especially if a concomitant conjunctivitis is present. Examination with slit-lamp and fluorescein staining should be done to evaluate for corneal injury and ulceration. Broad-spectrum antibiotics should be started, using two antibiotics, such as an aminoglycoside and a cephalosporin, in rapid succession; 2 drops of the first should be placed in the affected eye(s) followed by 2 drops of the other every 5 minutes for the first hour. This regimen may then be decreased in frequency to every 15 minutes to 1 hour.<sup>22</sup> Admission and immediate ophthalmologic evaluation are required.

### Photokeratitis

Exposure to ultraviolet light can produce a noninfectious keratitis or keratoconjunctivitis. Symptoms may begin immediately following exposure but can appear several hours later. Purulent drainage is absent. Fluorescein staining on slit-lamp exam reveals punctate staining of the corneal surface.<sup>9,22</sup> Treatment includes topical cycloplegics, such as tropicamide 0.5%, and erythromycin ophthalmic ointment 4 times daily. Oral narcotics may also be required for pain control.



## CONCLUSION

Ocular emergencies are a common occurrence, and the emergency physician is in a unique position to intervene and prevent serious sequelae. Knowledge of ocular anatomy and familiarity with use of the ophthalmoscope and slit lamp, as well as with IOP measurement, can greatly increase the emergency physician's ability to diagnose ocular disorders.

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