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Author Disclosure
Drs Richards and Guzman-Cottrill have disclosed no financial relationships relevant to this article. This commentary does contain a discussion of an unapproved/investigative use of a commercial product/device.

Objectives

After completing this article, readers should be able to:

1. Establish the definition of conjunctivitis, differentiating it from other causes of a red eye.
2. Discuss the most common etiologic agents of conjunctivitis in various age groups.
3. Describe the clinical manifestations for various types of conjunctivitis.
4. Determine appropriate treatment and whether ophthalmology referral is indicated.
5. Know specific methods to prevent infectious conjunctivitis, including antibiotic prophylaxis and judicious hand hygiene.

Introduction

This review addresses the differential diagnosis and management of a common pediatric chief complaint, conjunctivitis (often called "pink eye"). Knowledge of the various causes of conjunctivitis is important for pediatric clinicians to determine if the child requires specific treatment and if referral to an ophthalmologist is warranted. This review provides an update on the evaluation and management of infectious and noninfectious causes of conjunctivitis.

Definitions

Inflammation of the conjunctiva, commonly known as conjunctivitis, often presents with hyperemia or injection of the conjunctiva, resulting in a so-called "red eye" or "pink eye." Conjunctivitis varies in severity from mild hyperemia with epiphora (tearing) to subconjunctival hemorrhage or chemosis (conjunctival edema) with copious purulent discharge and concomitant eyelid edema. The differential diagnosis for red eye is broad because many ophthalmic conditions masquerade as conjunctivitis (Table).

Because of its location (Fig. 1), the conjunctiva is exposed to numerous microorganisms, potential irritants, and allergens, all of which can cause conjunctivitis. The pathogenesis of conjunctivitis typically involves a disruption of the eye's natural defense mechanisms. The eyelids are the first line of defense. Normal eyelid position and function prevent desiccation of the ocular surface and promote tear turnover by periodic closure. The tear film dilutes and removes microbes from the ocular surface. In addition, several components of the tears are involved in the defense of the eye, including tear lysozyme, lactoferrin, immunoglobulins (particularly IgA), and cytokines. Mucin from the goblet cells of the conjunctiva inhibits attachment of microbes to the ocular surface epithelium. Lipid from the meibomian glands along the eyelid margin help reduce evaporation and prevent desiccation of the ocular surface. In addition, the conjunctiva contains a complete spectrum of immunologically competent cell types.

Symptoms of conjunctivitis are numerous, including foreign body sensation, itching, burning, and photophobia. Associated signs may include hyperemia, epiphora, exudation (watery to purulent discharge, often with matting of the lids), chemosis, papillae, follicles or granulomas, membranes or pseudomembranes, and preauricular as well as submandibular lymphadenopathy.

Conjunctivitis typically is classified by its microscopic appearance of forming either follicles or papillae in the conjunctiva. Follicles are small, translucent, avascular mounds of plasma cells and lymphocytes (Fig. 2). They are essentially a well-circumscribed focus of

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Table. Differential Diagnosis for Conjunctival Hyperemia (Red Eye)

- Infectious conjunctivitis (bacterial, viral, parasitic)
- Allergic or vernal (seasonal) conjunctivitis
- Drug, toxin, or chemical exposure
- Trichiasis (inward turning of eyelashes irritating the eye)
- Nasolacrimal duct obstruction
- Congenital glaucoma
- Preseptal or orbital cellulitis
- Blepharitis (inflammation of the eyelids, especially the margins)
- Iritis/uveitis
- Episcleritis or scleritis
- Foreign body
- Trauma (corneal abrasion/infection, subconjunctival hemorrhage)

lymphoid hypertrophy. Follicular conjunctivitis usually indicates infection with a viral or intracellular microorganism (ie, *Chlamydia trachomatis*) or less commonly, a drug reaction (medicamentosa). Papillae are fibrovascular mounds that have a central vascular tuft (Fig. 3). Initially, they are small, but they may coalesce in severe or chronic conjunctivitis, creating giant papillae. A papillary reaction of the conjunctiva usually indicates an extracellular bacterial infection.

Papillae have a predilection for the superior palpebral conjunctiva, and follicles are seen more frequently in the inferior fornix. Among children and adolescents, follicles may be seen normally in the interior fornix location, which is known as benign lymphoid folliculosis.

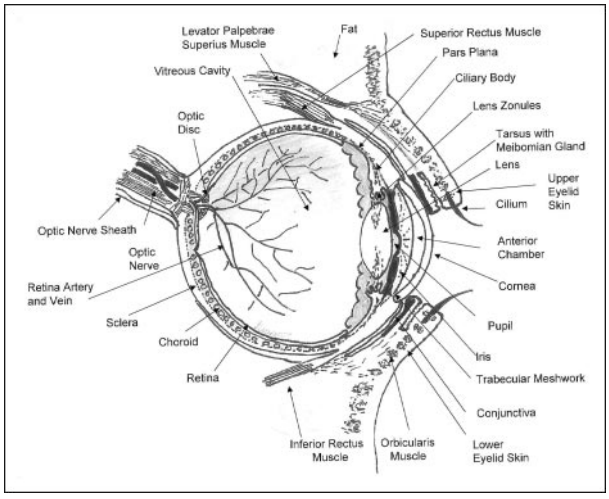

Figure 1. Anatomy of the eye.

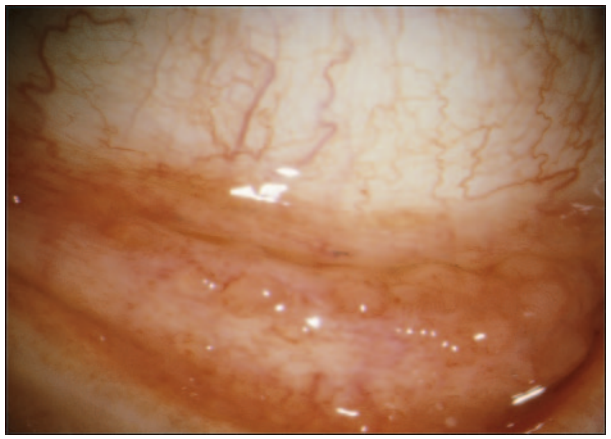

Figure 2. Follicular conjunctivitis.

Bacterial Infectious Conjunctivitis

Hyperacute

Hyperacute conjunctivitis refers to acute conjunctivitis that has a rapid onset. Conjunctivitis due to *Neisseria gonorrhoeae* or *N meningitidis* is a rare but serious disease characterized by severe, hyperpurulent discharge and pseudomembrane formation (Fig. 4), marked conjunctival injection, often frank subconjunctival hemorrhage, chemosis, eyelid edema, and preauricular lymphadenopathy. If the clinician suspects *Neisseria* infection, a bacterial Gram stain and culture should be obtained immediately. If intracellular gram-negative diplococci are identified, urgent referral to an ophthalmologist is recommended because *Neisseria* may penetrate an intact

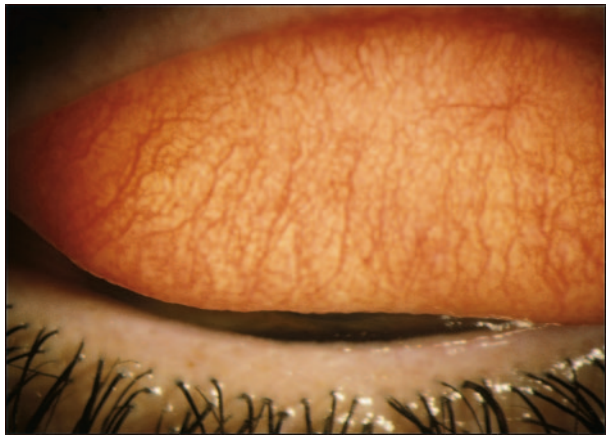

Figure 3. Papillary conjunctivitis.

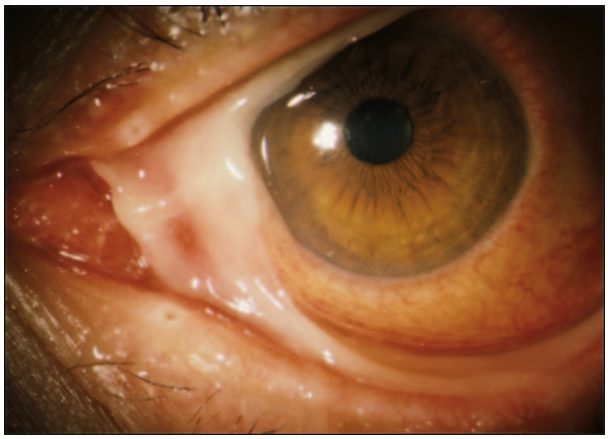

Figure 4. Gonococcal conjunctivitis with pseudomembrane.

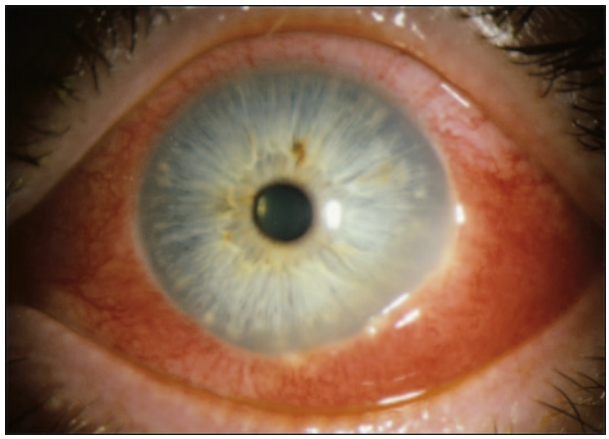

Figure 5. Acute bacterial conjunctivitis.

corneal epithelium. Within 24 to 48 hours, there may be corneal perforation resulting in permanent vision loss. Both *N gonorrhoeae* and *N meningitidis* conjunctivitis should be treated with parenteral antibiotics, such as intramuscular or intravenous ceftriaxone. Hospital admission typically is recommended. Topical antibiotic therapy may include a fluoroquinolone. Frequent lavage of the conjunctival fornices with balanced saline solution is recommended to remove the exudate and inflammatory cells and to improve penetration of the topical antibiotics.

Concomitant infection with *Chlamydia trachomatis* must be considered because this sexually transmitted disease often is seen with gonococcal infections. Any conjunctivitis caused by gonococcus or *Chlamydia* outside of the age range for ophthalmia neonatorum indicates child sexual abuse and must be reported to the proper authorities.

For patients who have *N gonorrhoeae* disease, sexual partners must be evaluated and treated for both gonorrhea and *Chlamydia*. Patients who have *N meningitidis* conjunctivitis should be evaluated for systemic disease such as meningococcemia or meningitis and treated accordingly.

Acute

Acute bacterial conjunctivitis (Fig. 5) may be caused by various organisms, including *Staphylococcus aureus, S epidermidis, Streptococcus pneumoniae, Moraxella catarrhalis,* and *Pseudomonas.* Before routine immunization, *Haemophilus influenzae* type b also was a frequent cause of acute conjunctivitis in children. The clinical presentation can range from mild hyperemia with scant purulent discharge to significant conjunctival injection with moderate purulent discharge. Acute bacterial nongonococcal conjunctivitis usually is benign and self-limited. Empiric topical antibiotic agents (eg, fluoroquinolone or polymyxin B/trimethoprim) can be initiated to shorten the duration and reduce the amount of contagion of the disease. In most cases, bacterial conjunctival culture is not required prior to starting antibiotic therapy, unless the infection occurs during the ophthalmia neonatorum period. For severe, recurrent, or refractory disease, conjunctival swabs should be sent for bacterial Gram stain and culture.

Chronic

Chronic bacterial conjunctivitis consists of conjunctival hyperemia, discharge, and foreign body sensation of greater than 4 weeks in duration. Organisms frequently isolated in true chronic bacterial conjunctivitis include *Staphylococcus*, *M catarrhalis,* and most commonly, *Chlamydia* (ie, trachoma or inclusion conjunctivitis).

Conjunctival injection and irritation often occur in patients who have chronic eye conditions, including, but not limited to, nasolacrimal duct obstruction (congenital or acquired), dacryocystitis, blepharitis, floppy eyelid syndrome, and epiblepharon. These conditions must be ruled out when evaluating chronic conjunctivitis in children. In addition, conjunctival and eyelid malignancies, more commonly seen in adults, must be considered in the differential diagnosis.

Ophthalmia Neonatorum (Neonatal Conjunctivitis)

Ophthalmia neonatorum is defined as conjunctivitis within the first 4 weeks after birth. The most frequent causes of neonatal conjunctivitis in the United States are

S aureus, S epidermidis, S pneumoniae, and *M catarrhalis.* Ophthalmia neonatorum also can be caused by *C trachomatis*, *N gonorrhoeae,* and herpes simplex virus (HSV). Infants whose mothers have untreated chlamydial infections have a 30% to 40% chance of developing conjunctivitis and a 10% to 20% chance of developing pneumonitis. (1)

Chlamydial conjunctivitis typically develops 5 to 14 days after delivery and may be unilateral or bilateral. Initially, infants have watery discharge that often progresses to mucopurulent discharge; other signs include eyelid edema, papillary conjunctivitis, and pseudomembrane formation. Fortunately, the risk of developing chlamydial conjunctivitis is reduced dramatically if erythromycin or tetracycline (no longer available in the United States) ointment is applied within 1 hour of delivery. (2)

Previously, laboratory diagnosis was made by identifying basophilic intracytoplasmic inclusion bodies from a conjunctival scraping with the use of Giemsa stain or by isolating the organism in culture. Unfortunately, the Giemsa test lacks sensitivity (especially in mild disease) and requires a well-trained technician for accurate interpretation. Cell cultures also lack sensitivity and are not available in all laboratories. Nucleic acid amplification tests, including polymerase chain reaction, are available for diagnosing chlamydial infection and offer improved sensitivity compared with cell culture, direct fluorescent antibody tests, or enzyme immunoassays, although specificity varies compared with tissue cell culture. (3) It is important to note that not all of these tests have been approved by the United States Food and Drug Administration for use with conjunctival secretion specimens.

Chlamydial conjunctivitis frequently is accompanied by infantile pneumonitis. More than 50% of infants who have chlamydial conjunctivitis have concomitant infection at other sites, such as the nasopharynx, genital tract, or lungs. (4) For these reasons, all infants who have chlamydial conjunctivitis should be treated systemically. The recommended treatment is oral erythromycin base or ethylsuccinate for a minimum of 14 days; additional topical therapy is not needed. The infant's mother and her sexual partners also should be evaluated and treated for sexually transmitted infection.

N gonorrhoeae is a much more virulent organism than *C trachomatis* and is one of the few bacteria that has the ability to penetrate an intact corneal epithelium. Fortunately, gonococcal ophthalmia can be prevented readily with antibiotic prophylaxis immediately after birth. For newborns, topical 1% silver nitrate aqueous solution (no longer available in the United States), 1% tetracycline ophthalmic ointment (no longer available in the United States), and 0.5% erythromycin ointment are considered equally effective prophylaxis. (3) However, although silver nitrate is effective against *N gonorrhoeae*, it is ineffective against *Chlamydia*. (5) In fact, silver nitrate may injure epithelial cells, thus rendering them more susceptible to other infectious agents. Therefore, erythromycin or tetracycline ointments are recommended for routine prophylaxis.

If an infant is born to a mother known to have gonorrhea, the newborn should receive a single 125-mg dose of parenteral ceftriaxone (25 to 50 mg/kg for low-birthweight and preterm newborns) because topical prophylaxis alone is insufficient. Clinically, gonococcal ophthalmia presents as a hyperacute conjunctivitis occurring within 24 to 48 hours after birth. Infants have significant diffuse eyelid edema, profound conjunctival chemosis, and copious purulent discharge. Systemic antibiotic therapy is recommended (parenteral ceftriaxone 25 to 50 mg/kg, not to exceed 125 mg); topical therapy is unnecessary but can be added to the treatment regimen to reduce the degree of copious purulent discharge. Frequent saline lavage is recommended to promote resolution of the conjunctival inflammation. Infants in whom gonococcal conjunctivitis is diagnosed during the ophthalmia neonatorum period should be evaluated for disseminated infection, which involves rehospitalization if they have been discharged.

HSV is another important cause of ophthalmia neonatorum; the diagnosis frequently is delayed because the practitioner initially treats empirically for gonococcal or chlamydial conjunctivitis. Conjunctivitis may be the only manifestation of neonatal HSV skin, eye, and mouth disease and typically presents 6 to 14 days after birth. However, herpetic infection may present shortly postpartum if there was spontaneous rupture of membranes with a delayed delivery. Classic herpetic vesicles may be present on the eyelid margins, aiding in a more rapid diagnosis, but often vesicles are absent. Consultation with an ophthalmologist is recommended to assist with definitive diagnosis (conjunctival or corneal cultures) and management. All neonates who have ocular HSV disease require readmission (if previously discharged) for a full evaluation for disseminated and central nervous system (CNS) herpes infection. Even if disseminated and CNS herpes infection is ruled out, intravenous acyclovir (60 mg/kg per day in three divided doses for 14 days)

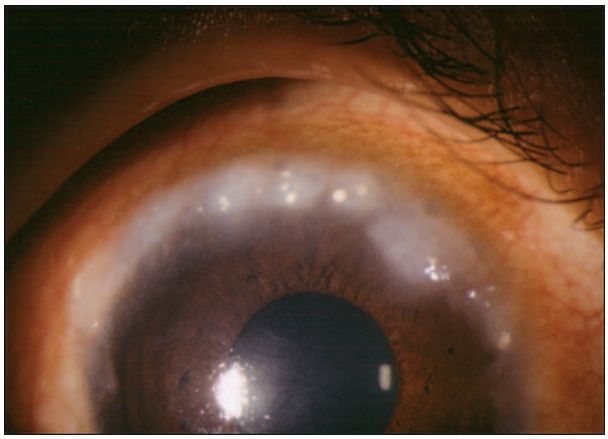

Figure 6. Follicles associated with active trachoma.

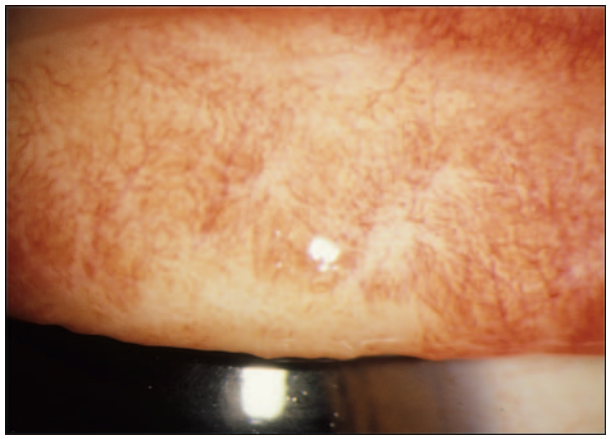

Figure 7. Arlt line.

and topical antiviral therapy (eg, trifluridine drops nine times per day) are required.

C trachomatis Trachoma

In addition to being one of the causes of ophthalmia neonatorum, *C trachomatis* also causes two other clinical ocular syndromes beyond the neonatal period: trachoma and adult (or adolescent) inclusion conjunctivitis. Serotypes A through C cause trachoma, which remains endemic in parts of Africa, Asia, the Middle East, Latin and South America, and Australia. It is rare in the United States but is a major cause of blindness elsewhere.

Infection often occurs in infancy or childhood and becomes chronic. The initial conjunctival inflammation is called "active trachoma," characterized by white lumps in the undersurface of the upper lid (conjunctival follicles or lymphoid germinal centers). Follicles also may form at the junction of the cornea and the sclera (limbus) (Fig. 6). Such limbal follicles later resolve, leaving shallow pits at the limbus called Herbert pits. Active trachoma often has a watery discharge. Bacterial secondary infection may occur and cause a purulent discharge.

The later structural changes of trachoma are referred to as "cicatricial trachoma." These include cicatrization of the conjunctiva (tarsal or palpebral conjunctiva). Scarring of the tarsal conjunctiva progresses to a thick white line called an Arlt line (Fig. 7). The conjunctival cicatrization eventually causes the eyelid to turn inward (entropion), causing the eyelashes (cilia) to abrade the cornea, which is known as trichiasis. This abrasion results in chronic discomfort as well as scarring of the ocular surface, with ultimate corneal opacification and vision loss. "End-stage trachoma" often leads to blindness, typically during the third through fifth decades of life. Treatments include prolonged courses of oral azithromycin, erythromycin, or doxycycline (in children older than 8 years) or topical antibiotics (erythromycin or sulfacetamide ointments). In addition, relief of dry eyes and epilation of trichitic or misdirected lashes is helpful.

Chlamydial Inclusion Conjunctivitis

Adult (or adolescent) inclusion conjunctivitis or chlamydial inclusion conjunctivitis is a sexually transmitted, chronic follicular conjunctivitis caused by serotypes B and D through K. Chlamydial inclusion conjunctivitis is most prevalent in sexually active adolescents and young adults and often is associated with urethritis in males and cervicitis or vaginitis in females. The eye usually is infected by direct or indirect contact with infected genital secretions, although other modes of transmission are possible, including sharing of makeup. Sexual abuse must be ruled out for younger children who have this disease. This infection usually presents as unilateral red eye with a mucopurulent discharge, marked conjunctival hyperemia with follicles, and preauricular lymphadenopathy. Symptoms appear about 1 to 2 weeks after ocular inoculation. Treatment includes both oral antibiotics (eg, azithromycin or erythromycin) and topical antibiotics (eg, erythromycin ointment) for both the patient and sexual partners.

Parinaud Oculoglandular Syndrome

Unilateral granulomatous conjunctivitis (Fig. 8) that has visibly swollen ipsilateral preauricular or submandibular lymphadenopathy characterizes a relatively rare condition known as Parinaud oculoglandular syndrome. This condition results from an infection, most frequently by *Bartonella henselae* (cat-scratch disease). Neuroretinitis,

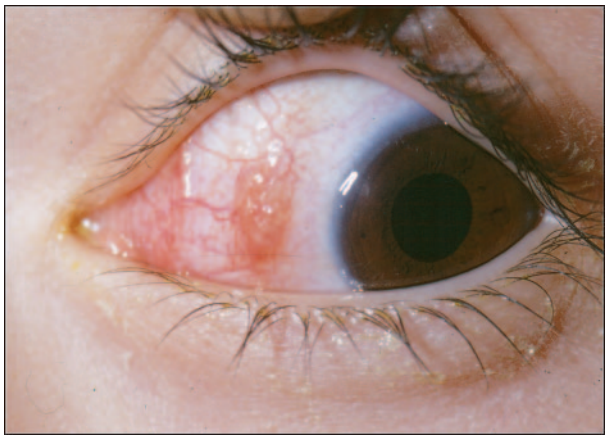

Figure 8. Granulomatous conjunctivitis of Parinaud oculoglandular syndrome.

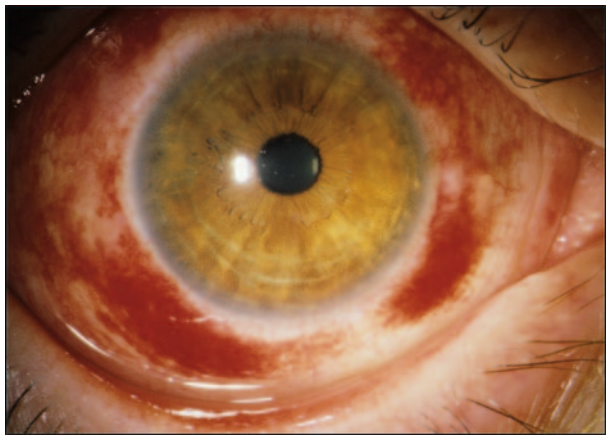

Figure 9. Enteroviral acute hemorrhagic conjunctivitis.

which involves swelling of the optic nerve head and retina, is another ophthalmic manifestation of cat-scratch disease and causes decreased vision. Other reported causes of Parinaud oculoglandular syndrome include *C trachomatis*, *Francisella tularensis*, *Mycobacterium tuberculosis, Sporothrix schenckii*, *Treponema pallidum*, *Actinomyces*, Epstein-Barr virus, and *Coccidioides immitis.* Serologic investigation may be useful, including *B henselae* serology (IgM and IgG). Conjunctival bacterial cultures, other serologic testing, and biopsy also may be indicated. Treatment for Parinaud oculoglandular syndrome is disease-specific.

Viral Infectious Conjunctivitis

The most common viral cause of acute conjunctivitis is adenovirus. Conjunctival cultures usually are not needed unless discharge is copious or the condition becomes chronic; in such cases, bacterial cultures may assist in ruling out a secondary bacterial infection. Symptomatic treatment can be provided with cool compresses and preservative-free artificial tears several times a day for comfort. (Note: When artificial tears are used more than four times daily, preservative-free tears are recommended.) Routine use of topical antibiotics is strongly discouraged, and corticosteroid drops are contraindicated. If symptoms persist or worsen, referral to an ophthalmologist should be considered.

It is important to counsel the patient that the conjunctivitis typically worsens for the first 4 to 7 days from onset and may take up to 2 weeks or longer to resolve completely if there is no corneal involvement. It also is important to educate patients that acute viral conjunctivitis is highly contagious. Patients should avoid touching their eyes, shaking hands, and sharing towels and other sources of viral contamination. They should be counseled to wash their hands frequently to avoid viral transmission. It is wise to restrict work and school activities until eye discharge has resolved.

Acute Hemorrhagic Conjunctivitis

Acute hemorrhagic conjunctivitis is a highly contagious disease associated with coxsackievirus A24 and enterovirus 70 and presents with a large subconjunctival hemorrhage (Fig. 9). Patients also may present with fever and headache. Treatment is supportive, and complications are rare.

Pharyngoconjunctival Fever

Pharyngoconjunctival fever is caused by adenovirus types 3, 4, 5, and 7. This infection often affects young children and may lead to community outbreaks. It is characterized by fever, pharyngitis, and follicular conjunctivitis and may cause punctate lesions in the epithelium of the cornea that warrant an ophthalmologic referral. Treatment is supportive; the conjunctivitis is self-limited, usually lasting no more than 10 days.

Epidemic Keratoconjunctivitis

Epidemic keratoconjunctivitis (EKC), caused by adenovirus types 8, 19, and 37, is a highly contagious follicular conjunctivitis lasting 2 to 3 weeks or longer. Signs may include preauricular lymphadenopathy, follicular conjunctivitis, eyelid edema, watery discharge, pseudomembrane, subconjunctival hemorrhage, and subepithelial infiltrates in the cornea. EKC is associated with pharyngitis and rhinitis in 50% of cases. Characteristic small, white, punctate subepithelial infiltrates may develop in

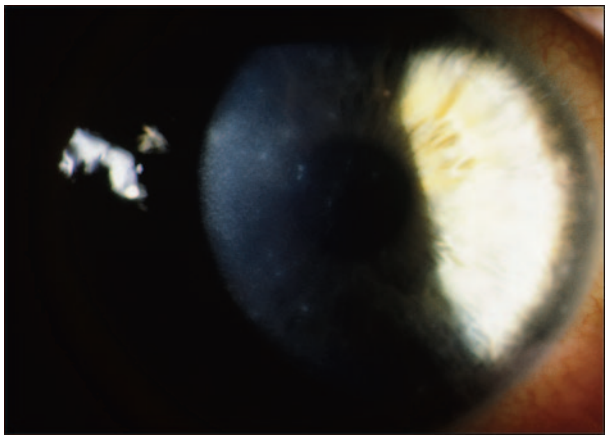

Figure 10. Adenoviral epidemic keratoconjunctivitis.

the cornea, with an occasional yellow pseudomembrane in the inferior fornix. Subepithelial infiltrates (Fig. 10) are small nummular collections of inflammatory cells in the anterior cornea, which typically occur 2 weeks after the onset of EKC and can last for months after the infection has resolved. These cells may cause decreased vision, glare, and photophobia. EKC is bilateral in 75% to 90% of cases.

Herpes Simplex Virus Conjunctivitis

HSV conjunctivitis generally presents with concurrent herpetic skin vesicular eruption, usually somewhere on the face (Fig. 11), and is characterized by a unilateral follicular conjunctivitis and palpable preauricular node. If HSV conjunctivitis is suspected, immediate referral to an ophthalmologist is recommended because corneal involvement is not uncommon and can threaten sight. HSV keratitis may be missed without slitlamp examination and the use of fluorescein stain (Fig. 12). Treatment depends on the absence or presence of corneal involvement and which layer of the cornea is affected. HSV ocular disease must be treated in collaboration with an ophthalmologist. Treatment includes oral antivirals (eg, acyclovir), topical antiviral therapy (eg, trifluridine 1% drops), and topical corticosteroids. The use of steroids alone in herpetic infections is contraindicated. Recurrence rates of HSV conjunctivitis are high. Any child who has had an HSV infection in the past and presents with a red eye must be considered to have a recurrence until proven otherwise.

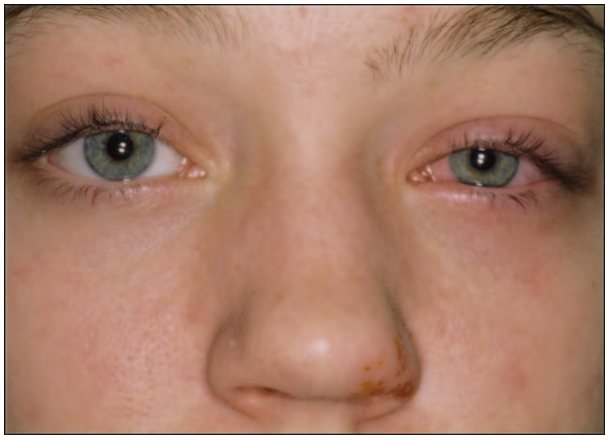

Figure 11. Herpes simplex virus conjunctivitis.

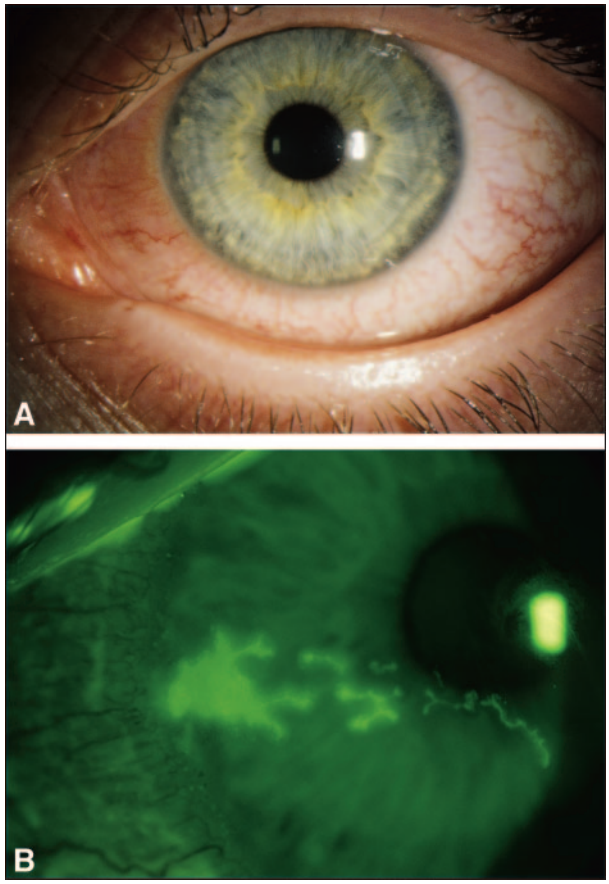

Figure 12. A. Herpes simplex virus keratitis (no stain). B. Herpes simplex virus keratitis (with stain).

Molluscum Contagiosum

Molluscum contagiosum is a poxvirus that can cause a chronic conjunctivitis. It manifests as singular or multiple dome-shaped, umbilicated, shiny papules on the eyelid or eyelid margin (Fig. 13). Follicular conjunctivitis from molluscum results from viral shedding from the eyelid

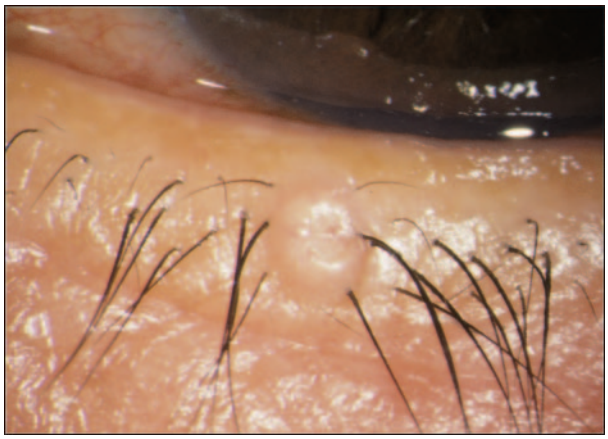

Figure 13. Molluscum contagiosum lesions and conjunctivitis.

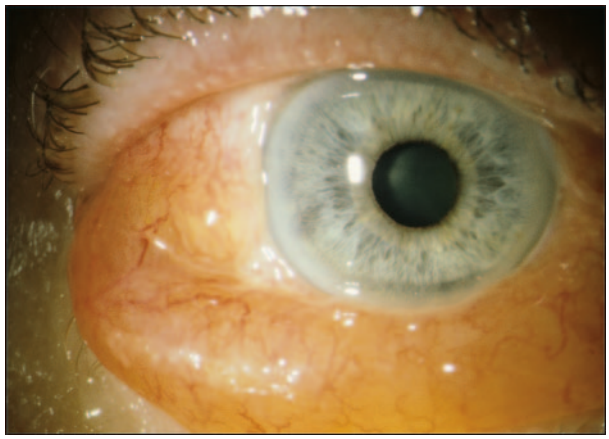

Figure 14. Atopic/seasonal allergic conjunctivitis.

lesions onto the surface of the eye. Immunocompromised patients may have more lesions and less conjunctival reaction; if multiple lesions are present, an underlying immunodeficiency should be considered. Molluscum lesions may resolve spontaneously, but they also may persist for months to years. Removal of the lesions is indicated in symptomatic patients. Treatments include incision and curettage, simple excision, excision and cautery, and cryotherapy. The conjunctivitis may require weeks to resolve after the lesion has been eliminated.

Parasitic Conjunctivitis

Pediculosis may cause a follicular conjunctivitis through infestation of adult pubic lice (*Phthirus pubis*) and nits in the cilia (eyelashes). Symptoms include intense itching of the eyelids, with conjunctival and lid margin injection. The condition may be unilateral or bilateral. Referral to an ophthalmologist is indicated for management, which includes removing the lice and nits with a jeweler's forceps and coating the lashes with an ophthalmic ointment (eg, erythromycin, or a bland ophthalmic ointment) to smother the lice. The ointment usually is applied three times daily for 10 days. Pediculicide lotions and shampoos also should be applied, as directed, to nonocular areas for patients and their close contacts.

Allergic Conjunctivitis and Immune-mediated Disorders of the Conjunctiva

Atopic Conjunctivitis/Seasonal Allergic Conjunctivitis

Atopic/seasonal allergic conjunctivitis is largely an IgE-mediated immediate hypersensitivity reaction. The allergens typically are airborne and include dust, molds, spores, pollens, and animal dander. Conjunctival mast cells degranulate to release histamine and various other inflammatory mediators that result in vasodilation, edema, and recruitment of inflammatory cells such as eosinophils. Symptoms include itching; conjunctival chemosis, which manifests as pale edema; eyelid edema; and watery or mucoid discharge (Fig. 14). This reaction typically occurs within minutes of exposure to the allergen. Treatment should be based on severity of symptoms and includes cold compresses, artificial tears, topical antihistamines, mast cell stabilizers, topical nonsteroidal anti-inflammatory agents, and selective use of topical corticosteroids for severe cases treated by an ophthalmologist. It is important to remember that other atopic conditions, such as allergic rhinitis and asthma, often are present as well and must be treated accordingly.

Vernal Keratoconjunctivitis

Usually a seasonally recurring, bilateral inflammation of the conjunctiva and cornea, vernal (springtime) keratoconjunctivitis occurs predominantly in male children who frequently have a personal or family history of atopy. This noninfectious conjunctivitis is characterized by high concentrations of histamine and IgE in the tear film. It occurs most commonly in the warm months (spring and summer; hence, the name vernal) and goes into remission during the cooler months. Thus, the highest prevalence of vernal conjunctivitis is in warm, temperate climates. The disease is self-limited in children and has an average duration of 4 to 10 years.

Patients present with itching; blepharospasm; photophobia; blurred vision; and copious thick, ropy mucoid discharge. On examination, they demonstrate large cobblestone papillae on the superior tarsal conjunctiva and limbal conjunctiva (Fig. 15). In addition, a noninfectious

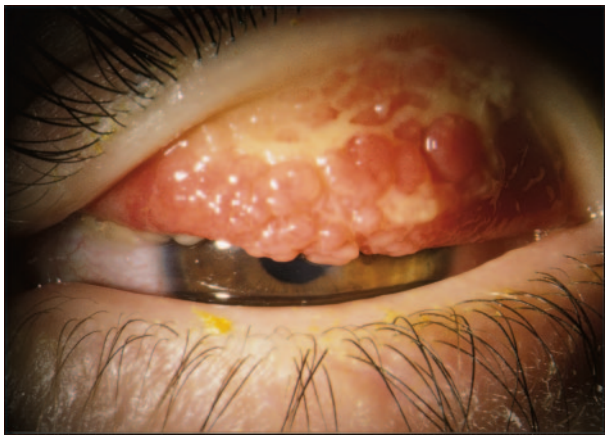

Figure 15. Vernal keratoconjunctivitis.

corneal ulcer that has an oval or "shield-like" shape with opacification may develop, which may threaten sight; this lesion is referred to as a shield ulcer (Fig. 16). Patients should be referred to an ophthalmologist for management, especially if a shield ulcer is present. Treatment for vernal conjunctivitis without a shield ulcer is similar to that for allergic conjunctivitis, with the addition of prophylactic use of a mast cell stabilizer or antihistamine 2 to 3 weeks prior to the warm season. If a shield ulcer is present, the patient requires treatment by an ophthalmologist. In addition, a topical antibiotic drop to prevent infection and later a topical corticosteroid drop may be required. Patients who have vernal conjunctivitis also may have atopic dermatitis of the eyelids, which can be treated with low-dose topical ophthalmic corticosteroid ointment (eg, fluorometholone 0.1%), 0.03% to 0.1% tacrolimus, or pimecrolimus.

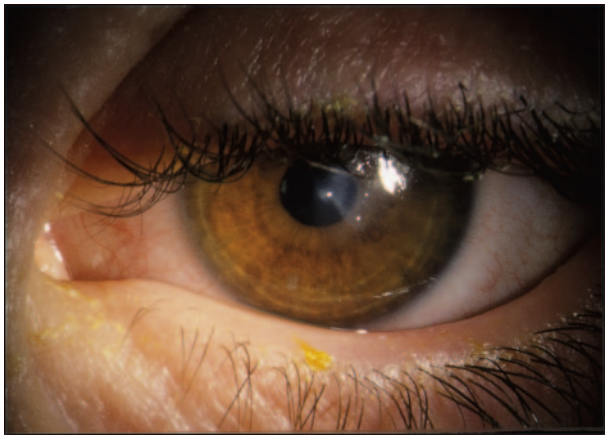

Figure 16. Shield ulcer due to vernal conjunctivitis.

Drug, Toxin, or Chemical Exposure

Chemical Conjunctivitis

For pediatric practitioners, a classic example of chemical conjunctivitis is caused by silver nitrate drops when used for ophthalmia neonatorum prophylaxis. The chemical conjunctivitis typically begins a few hours after administration of the drop and lasts for 24 to 36 hours. Approximately 90% of infants who receive silver nitrate develop mild, transient conjunctival injection with epiphora. (6) This effect, along with damage to the corneal epithelium, led to widespread discontinuation of its use as an ocular prophylaxis immediately postpartum in the United States. (7)

Toxic Conjunctivitis and Conjunctivitis Medicamentosa

Toxic conjunctivitis follows chronic exposure of the conjunctiva to a variety of foreign substances, from eye cosmetics to prolonged use of various eye medications (prescription or over-the-counter). Frequently, in the case of eye drops, the preservatives are the toxin. They can incite a type IV delayed hypersensitivity reaction presenting with periocular erythema, sometimes causing a mild contact dermatitis as well as a follicular conjunctivitis in chronic cases. Treatment is discontinuation of the offending agent. For comfort, the addition of preservative-free artificial tears, as needed, should be considered.

Other Forms of Conjunctivitis

Kawasaki Disease

Kawasaki disease (KD) is a systemic inflammatory disease of unknown cause. Because no specific diagnostic test exists, clinical criteria are used to establish the diagnosis. The clinical criteria for classic KD include fever for at least 5 days, plus four of the five following clinical findings: conjunctivitis, oropharyngeal changes (eg, strawberry tongue, red fissured lips), cervical adenopathy (usually unilateral), extremity changes of the hands or feet, and a polymorphous rash. The conjunctivitis seen in KD is not purulent and is bilateral. Classically, there is absence of conjunctival injection perilimbally. If there is associated purulent discharge or crusting, conjunctival swabs for viral culture may be useful to rule out adenoviral disease. The treatment for acute KD is beyond the scope of this review.

Ligneous Conjunctivitis

Ligneous conjunctivitis is a rare, bilateral, chronic pseudomembranous conjunctivitis. The condition is

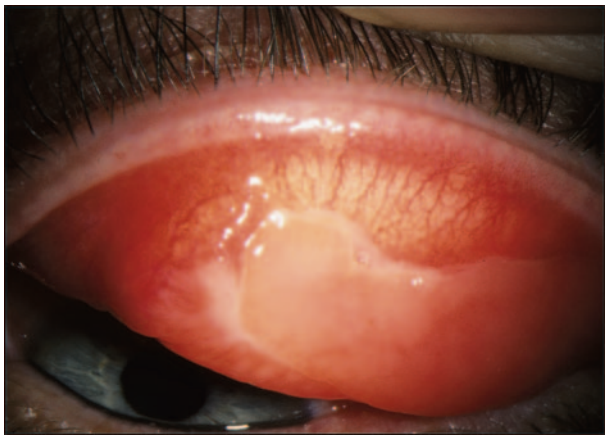

Figure 17. Pseudomembrane due to ligneous conjunctivitis.

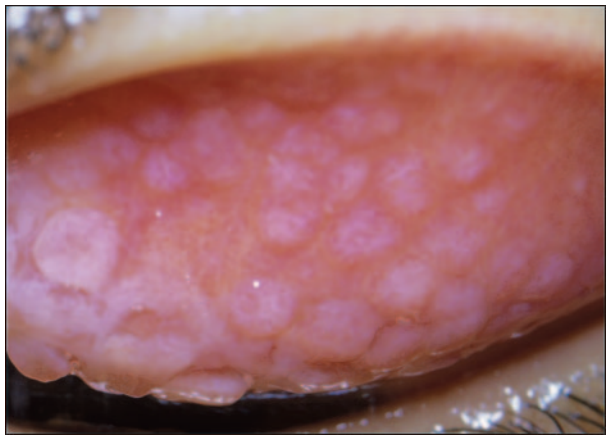

Figure 18. Cobblestone-like papillae due to contact lens-induced conjunctivitis.

linked to plasminogen deficiency, both homozygous and heterozygous, resulting in multiorgan pseudomembranous disease of mucous membranes in the mouth, nasopharynx, trachea, and female genital tract. Ocular signs are characterized by a "woody" induration of the tarsal conjunctiva associated with a yellowish, fibrinous, plate-like pseudomembrane that can be seen readily on eversion of the eyelids (Fig. 17). These membranes are composed of a mixture of fibrin, epithelial cells, and inflammatory cells and often adhere firmly to the conjunctival surface. They can be removed, but they frequently recur. More recently, successful treatment with intravenous lys-plasminogen (8) or topical plasminogen drops (9) has been reported.

Contact Lens-induced Conjunctivitis (Giant Papillary Conjunctivitis)

Giant papillary conjunctivitis is an inflammatory condition of the upper palpebral conjunctiva related to prolonged contact lens wear. Patients complain of itching, often after removal of the contact lenses; discharge; or increased mucus on the lenses and in the nasal canthus on awakening if they wear their lenses overnight. Eventually, patients complain of increased awareness of their lenses, blurred vision after hours of lens wear, and general intolerance of the contact lenses. On eversion of the upper lids, the examiner finds extensive large cobblestone-like papillae (Fig. 18). Treatment initially requires discontinuation of contact lens use. Lens wear may resume once inflammation subsides, but limited daytime-only use helps to prevent recurrence. Some individuals are unable to tolerate contact lenses again.

Masquerades

As mentioned, many ocular conditions can cause conjunctival injection, which can be confused with a true conjunctivitis. It is important for the pediatrician to be familiar with common pediatric conditions that may result in a "red eye," including, but not limited to, corneal abrasions and ulcers, phlyctenule, staphylococcal marginal keratitis, epiblepharon, nasolacrimal duct obstructions, dacryocystitis, preseptal or orbital cellulitis, floppy eyelid syndrome, blepharitis (including meibomitis), distichiasis, trichiasis, congenital tarsal kink, entropion (congenital and acquired), ectropion (congenital and acquired), iritis/uveitis, congenital glaucoma, foreign body, dry eye, subconjunctival hemorrhage, keratitis, episcleritis, and scleritis. In general, if any of these conditions is suspected, referral to an ophthalmologist for evaluation is recommended.

A few of the less commonly known conditions, with which it is important for pediatricians to become familiar, are discussed further.

Phlyctenule

Phlyctenule represents a type IV hypersensitivity reaction, most commonly to staphylococci. The condition also is associated with coccidiomycosis, *Candida*, HSV, lymphogranuloma venereum, and tuberculosis. This painful condition classically causes a sectoral bulbar perilimbal conjunctival hyperemia, with slitlamp findings of a round, elevated, sterile infiltrate on the limbal bulbar conjunctiva. The epithelium can break down in this region, forming a small limbal ulcer that stains with fluorescein. If untreated for some time, regional corneal vascularization may occur. Patients who have a painful

eye and sectoral conjunctival injection should be referred to an ophthalmologist. Treatment for this condition is a topical corticosteroid and antibiotic.

Epiblepharon

Epiblepharon is an eyelid variation seen commonly in Asian individuals. It consists of pretarsal skin and orbicularis oculi muscle overriding the lower lid margin. Such anatomy results in an extra horizontal fold of skin that pushes up vertically, causing the cilia to be in constant contact with the cornea and conjunctiva. Frequently seen in infants, this condition often is benign and is outgrown. Rarely, it may cause corneal abrasion and chronic conjunctival irritation. In these cases, surgical correction can prevent the cilia from rubbing on the ocular surfaces.

Practical Considerations

When approaching a pediatric patient who has acute conjunctivitis, the practitioner must first decide if the cause is a bacterial or viral infection or other, less common condition. Admittedly, it is difficult to distinguish bacterial from viral conjunctivitis. Four studies have demonstrated that bacterial pathogens are the most common cause of acute pediatric conjunctivitis. (10)(11)(12)(13) In these studies, some clinical clues suggesting a bacterial process included bilateral involvement, purulent ocular discharge, and concurrent otitis media. If these symptoms are noted, antimicrobials can be prescribed to shorten the duration of illness. However, as mentioned, most bacterial conjunctivitis is self-limited. This situation is different if a concurrent otitis media is present (conjunctivitis-otitis media syndrome). (14) In conjunctivitis-otitis media syndrome, the offending organism usually is *H influenzae* or *Streptococcus*, and systemic treatment for *H influenzae* should be initiated. (15)(16) Viral conjunctivitis more often is unilateral on initial presentation, and the ocular discharge may be serous or watery (often described as "excessive tearing"). Concurrent viral symptoms (rhinorrhea, pharyngitis, bilateral cervical adenopathy) are helpful in making the distinction. If viral infection is suspected, symptomatic relief is recommended.

Cool compresses may help relieve discomfort and decrease inflammation. If there is copious discharge, some suggest a warm compress to remove debris. Patients must be reminded to use a fresh, clean cloth every time and to wash the compress cloths appropriately after use to avoid transmission to others in the household.

In all situations, children should be able to return to school or child care when the eye discharge either has resolved completely or is visible only on morning waking and the discomfort has subsided so the child is not repeatedly touching or rubbing his or her eyes throughout the day.

Summary

- The spectrum of pediatric conjunctivitis ranges from a benign, self-limited process to a serious infectious disease necessitating hospitalization and ophthalmologic consultation.
- The pediatric clinician should be familiar with the various causes of conjunctivitis. Consideration of the child's age, exposures (both medications and close contacts), and additional medical conditions are helpful in formulating a differential diagnosis.
- Because certain conjunctival conditions may threaten sight, referral to an ophthalmologist is imperative if the condition is severe, worsens, or does not respond readily to initial therapy.

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Suggested Reading

American Academy of Ophthalmology. *Conjunctivitis. Preferred Practice Pattern*. San Francisco, Calif: American Academy of Ophthalmology; 2003. Accessed February 2010 at: http://one.aao.org/CE/PracticeGuidelines/PPP.aspx

PIR Quiz

Quiz also available online at: http://pedsinreview.aappublications.org.

11. You are seeing an 8-day-old infant who developed a watery discharge from the right eye yesterday. Today, you note a mucopurulent discharge, eyelid edema, papillary conjunctivitis, and a pseudomembrane. Which of the following is the *best* method to detect the most probable offending organism?

    A. Cell culture.
    B. Direct fluorescent antibody.
    C. Enzyme immunoassay.
    D. Giemsa stain.
    E. Polymerase chain reaction.

12. Infection with which of the following organisms is considered an ophthalmologic emergency?

    A. *Moraxella catarrhalis.*
    B. *Neisseria meningitidis.*
    C. *Pseudomonas.*
    D. *Staphyloccus aureus.*
    E. *Streptococcus pneumoniae.*

13. The *most* common viral cause of acute conjunctivitis is:

    A. Adenovirus.
    B. Coxsackievirus.
    C. Enterovirus.
    D. Herpes simplex virus.
    E. Parvovirus.

14. A patient complains of itching of the eyes and mucus in the nasal canthus on awakening. Which of the following questions is *most* pertinent to the diagnosis?

    A. Are you allergic to pollens or molds?
    B. Do you get these symptoms every spring?
    C. Do you wear contact lenses overnight?
    D. Does anyone else in the family have this problem?
    E. Have you been using eye drops recently?

15. A 7-year-old child presents with erythema of the conjunctiva and excessive tearing of the left eye for 2 days. The history and physical findings are most consistent with viral conjunctivitis. As initial therapy, you are *most* likely to prescribe:

    A. A compress.
    B. Oral decongestants.
    C. Systemic antibiotics.
    D. Topical antibiotic drops.
    E. Topical steroid drops.

Conjunctivitis

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