

# TOPICS IN Ocular Antiinfectives

## An Ounce of Prevention: Minimizing the Risk of Bacterial Keratitis in ContactLens Wearers

Elmer Tu, MD

*Contact lens wear is a major risk factor for bacterial keratitis. However, understanding the risk factors and providing sound patient counseling can mitigate these risks.*

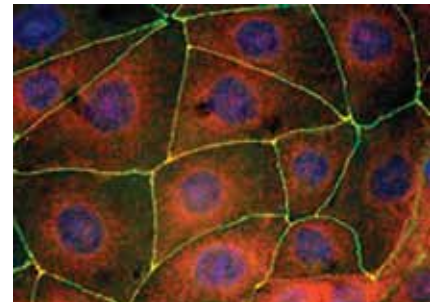
As an increasing number of patients become contact lens wearers, it is important for clinicians to be able to discern the factors that elevate the risk of bacterial keratitis in these individuals. Most important is being aware of the steps we can take to mitigate these risks. This begins with a careful look at how contact lens wear affects the natural defenses of the eye.

### Natural Defenses of the Eye

Healthy eyes have a multilayered defense system that protects against microbial invasion. The lids and lashes form the first barrier to entry, followed

by the tears. In addition to flushing foreign bodies from the eye, tears contain antimicrobial enzymes, proteins, and peptides—including lactoferrin, lysozyme, beta-lysin, and defensins.<sup>1,2</sup> Tears also contain immunoglobulins that hinder bacterial adherence to the ocular surface.<sup>1</sup> In laboratory studies, human tears were able to inhibit strains of *Pseudomonas aeruginosa*, a bacterial pathogen often associated with ocular infection in contact lens wearers, from invading or killing cultured corneal epithelial cells.<sup>3</sup>

Beyond the tear film, the tight junctions between cells of the corneal epithelium form a physical barrier that blocks the entry of microorganisms (Figure 1). Any organisms that manage to penetrate this wall will encounter the basal lamina. Although the basal lamina is porous, its pores are too small to permit passage of bacteria.<sup>3</sup> Thus, invading bacteria must breach multiple lines of physical, chemical, and immunologic defenses before



**FIGURE 1** The transmembrane protein MarvelD3 is visualized by indirect immunofluorescence (red) in human corneal epithelial cells, and shown to co-localize with the tight junction protein occludin (green) at sites of cell contact.(Source: Reference 4)

they can reach the corneal stroma and cause corneal ulceration.

The constant turnover of epithelial cells provides an additional line of defense by dislodging dead or infected cells and harmful pathogens from the ocular surface.<sup>3</sup> Moreover, epithelial cells have two known active defense

**TARGET AUDIENCE** This educational activity is intended for ophthalmologists and ophthalmologists in residency or fellowship training.

#### LEARNING OBJECTIVES

Upon completion of this activity participants will be able to:

1. Describe two mechanisms by which contact lens wear may increase risk of infection.
2. Discuss the importance of educating patients on the risks of contact lens wear and strategies to reduce those risks.
3. List the signs and symptoms of gonococcal neonatal conjunctivitis and state the accepted protocol for its management.
4. State two means of diagnosing adenovirus conjunctivitis and discuss its management.

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mechanisms against bacterial invasion: They produce cytokines that regulate immune responses, and they release factors that exert a variety of defensive actions, including the active destruction of bacteria or inhibition of their growth.<sup>5</sup>

### Contact Lenses: Impact on the Eye

Contact lens wear alters the tear film in ways that can compromise ocular defense mechanisms. In a normally functioning eye, secretions from the lacrimal system, meibomian glands, conjunctival goblet cells, and other sources combine to form the aqueous, lipid, and mucin components of the tear film. As the patient blinks, the eyelid distributes this mixture over the ocular surface. Placing a foreign body, such as a contact lens,

onto the surface of the eye inhibits this normal tear circulation and distribution and can lead to an increased rate of evaporation, dry eye, and the formation of “mucin balls” (accumulations of mucin underneath the lens).<sup>6-8</sup> Additionally, tear proteins that normally protect the eye can be absorbed into the lens, affecting their biological activity.<sup>9</sup>

The decreased corneal sensitivity associated with long-term contact lens wear can lead to reduced reflex tearing, allowing infectious or inflammatory debris to remain longer on the eye.<sup>10</sup> Biofilms that develop on the lens surface inhibit the antimicrobial properties of contact lens disinfectant systems and lead to increased virulence of the bacteria brought in daily contact with the corneal surface.<sup>11</sup> Also, prolonged contact lens wear is associated

with a lowered sloughing rate, suggesting that infected cells may be expelled from the eye more slowly.<sup>12,13</sup>

Overnight lens wear is a particularly significant risk. A prospective, 12-month, population-based surveillance study by Stapleton and coworkers found an annualized incidence of microbial keratitis of 19.5 cases per 10,000 among patients who wear non-silicone hydrogel soft contact lenses overnight, vs 1.9 cases per 10,000 among patients wearing similar lenses on a daily-wear basis.<sup>14</sup>

In the same study, poor storage case hygiene was found to raise the risk of microbial keratitis by a factor of roughly 3.7.<sup>14</sup> Noncompliance among contact lens wearers contributes significantly to lens-related complications and failure.<sup>15</sup> A recent survey of frequent re-

## Topics in Ocular Antiinfectives, Issue 20

### STATEMENT OF NEED

Ophthalmologists face numerous challenges in optimizing their competencies and clinical practices in the realm of preventing, diagnosing, and treating ocular infections and their sequelae; these challenges include:

- The widespread “off-label” use of topical ophthalmic antibiotics to prevent and treat serious and sight-threatening infections—given the reality that the most widely used topical antibiotics in ophthalmology have FDA approvals restricted to bacterial conjunctivitis.
- The escalating levels of multi-drug resistance in common ocular pathogens.<sup>1</sup>
- The emergence and increasing prevalence of once-atypical infections that may require diagnostic and treatment techniques relatively unfamiliar to comprehensive ophthalmologists.<sup>2</sup>
- The introduction of new and potentially more efficacious and/or safe ophthalmic antiinfectives.<sup>3</sup>
- The introduction of new and potentially more accurate diagnostic techniques for ophthalmic infections.<sup>4</sup>
- Widespread discussion over the efficacy and safety of novel or alternative delivery techniques and vehicles for prophylactic ophthalmic antibiotics (including but not limited to intracameral injection and topical mucoadhesives).<sup>5,6</sup>
- Increased understanding of the inflammatory damage caused by ocular infections and the best ways to prevent/alleviate inflammation without fueling the growth of pathogenic organisms.

Given the continually evolving challenges described above, *Topics in Ocular Antiinfectives* aims to help ophthalmologists update outdated competencies and narrow gaps between actual and optimal clinical practices. As an ongoing resource, this series will support evidence-based and rational antiinfective choices across a range of ophthalmic clinical situations.

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## CORE CONCEPTS

- ▶ Healthy eyes have a multilayered, redundant defense system that protects against microbial invasion.
- ▶ Contact lens wear can compromise the natural defenses of the eye.
- ▶ *P. aeruginosa* is the most prevalent pathogen in contact lens associated keratitis.
- ▶ *P. aeruginosa* can form a protective biofilm that allows it to persist on surfaces, including contact lenses and cases.
- ▶ Patients should be counseled on the dangers of noncompliance and should be educated on critical issues such as topping off and proper hand and storage hygiene.

placement contact lens wearers revealed that noncompliance with case hygiene, lens replacement schedule, and lens care steps are all significant problems.<sup>16</sup> These findings highlight the importance of the clinician's role in regularly and repeatedly counseling patients on proper lens care and hygiene.

### The Threat of Bacterial Keratitis

Bacterial keratitis is one of the most feared complications of contact lens wear and can be vision-threatening even if treated promptly. Symptoms include photophobia, foreign body sensation, blurred vision, swollen lid(s), and watery discharge (Figure 2).<sup>17</sup> More serious cases involve corneal ulcers, permanent scarring, and vision loss.<sup>18</sup>

The Gram-negative bacterium *P. aeruginosa* is the most prevalent pathogen in contact lens associated keratitis.<sup>19</sup> This ubiquitous organism can form a biofilm on contact lenses, storage cases, and other surfaces; the biofilm helps *P. aeruginosa* adhere to surfaces and shields it from chemical disinfectants. Suci and coworkers found, for example, that it took 40 seconds for ciprofloxacin to sterilize a biofilm-free surface,

whereas a biofilm-covered surface required more than 21 minutes.<sup>20</sup> In a separate study, Hoyle and coworkers found that disseminated bacterial cells were 15 times more susceptible to tobramycin than those preserved inside intact biofilms.<sup>21</sup> This protective strategy allows *P. aeruginosa* to persist on storage cases and contact lenses, which, in turn, may become vectors for infection when patients insert the lenses into their eyes.

Once *P. aeruginosa* comes into contact with the eye, it has various strategies for attaching to the corneal epithelium. Its cell surface contains small protein structures (pili) that interact with surface receptors on corneal epithelial cells. Another protein on the surface of *P. aeruginosa* (exoenzyme S) is believed to assist with adherence. Also, the carbohydrate constituent of the lipopolysaccharide on the surface of a *P. aeruginosa* cell is thought to play a role in adhesion. Once *P. aeruginosa* attaches to the cornea, it synthesizes alginate, a polysaccharide that protects it from phagocyte attack, thus reducing the effects of the host immune response.<sup>22</sup>



FIGURE 2 Bacterial keratitis in a contact lens wearer.

After attaching to the cornea, *P. aeruginosa* releases an array of toxins that enable it to inhabit the cornea and generate a significant inflammatory response.<sup>23</sup> Some strains of *P. aeruginosa* possess the *exoU* gene, which encodes the potent exoenzyme U toxin. These “cytotoxic strains” can cause swift death of corneal epithelial cells by simply injecting them with toxins, without having to invade them.<sup>3,22</sup> Corneal attachment and infection by *P. aeruginosa* ignites an array of host-responses, including inflammation, humoral and cellular immune responses, neovascularization, and degradation of the stroma.<sup>23</sup>

### Diagnosis and Treatment

Bacterial keratitis requires a rapid diagnosis and treatment—the longer the infection persists in the eye, the more likely it is to cause permanent damage that can compromise vision. Therefore, the first step for clinicians is to make sure that contact lens wearers are familiar with the symptoms of microbial keratitis so that they see an ophthalmologist immediately at the onset of symptoms.

Clinical judgment often forms the basis of diagnosis for these patients. Initial treatment consists of broad-spectrum antibiotics, such as fourth generation fluoroquinolones, to stop the infection as quickly as possible and limit corneal damage. If the infection persists, this may be an indication that a less common causal organism is responsible (eg, fungus, *Acanthamoeba*).

Another possibility is that the causal organism is a resistant bacterium. A number of clinical reports have documented cases of bacterial keratitis that were resistant to fourth generation fluoroquinolones.<sup>24-26</sup> In some animal studies, besifloxacin, the newest fourth generation fluoroquinolone, showed greater potency than moxifloxacin and gatifloxacin against ciprofloxacin/levofloxacin-resistant *P. aeruginosa* and methicillin-resistant *Staphylococcus aureus*.<sup>27,28</sup> As resistant bacteria continue to inevitably develop against available topical antibiotics, this will more frequently become a diagnostic consideration in keratitis patients when initial antibiotic treatment fails.

### Minimizing Infection Risk

Patient compliance is, of course, essential for preventing the development of bacterial keratitis. Ophthalmologists should reinforce to their patients the importance of careful hand washing—making sure that hands are not only clean, but also dry, when manipulating the lens. Patients should also be advised not to wear contact lenses while swimming.

As noted earlier, overnight wear is a major risk factor for microbial keratitis. Wearing lenses longer than the recommended time schedule can increase the risk of infection, as can “topping off” solutions—taking the lenses out of the case

and then, at night, adding more solution to the case until the level is high enough to cover the lens. (The correct procedure is to empty the case of all solution after inserting the lenses; the case should then be rinsed, allowed to air dry, and refilled at night with fresh solution.) Topping off has been associated with both *Fusarium* and *Acanthamoeba* outbreaks, and patients should be warned of the potential hazards associated with this dangerous practice.<sup>29-31</sup>

Lastly, ophthalmologists should reinforce the importance of replacing contact lens cases on a regular basis, given the frequency with which bacteria colonize these items. Many contact lens disinfection solutions include a complementary contact lens case to encourage patients to throw out the old lens case each time a new package of solution is opened. At a minimum, we need to remind patients that they are wearing a medical, not a cosmetic, device.

## Conclusion

Contact lens wear establishes a predisposing environment for the development of bacterial keratitis. These risks can be reduced through patient counseling and compliance. On a larger scale, ongoing research into the effects of varying lens materials, disinfection solutions, and other variables on infection risk may also help to lower these risks among contact lens wearers.

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- Is There a Value to Preoperative Prophylaxis?
- Special Issues in Prophylaxis with Keratoplasty

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# Neonatal and Pediatric Infections: What Ophthalmologists Need to Know

Gerhard Cibis, MD

*When ocular pathogens attack our youngest patients, the outcomes can range from mild to vision-threatening. Being able to differentiate the signs, symptoms, and timing of important neonatal and pediatric infections can lead to prompt diagnosis and treatment, and better results for our patients.*

Infection in patients up to 1 month old are typically contracted during passage through the birth canal. However, nosocomial infection is also possible, as evidenced in a study by Hass and associates that showed that 5% (154 of 2,935) of infants in two neonatal intensive care units developed hospital-acquired conjunctivitis.<sup>1,2</sup>

Neonatal conjunctivitis can be infectious (eg, caused by bacteria, viruses, or other pathogens) or non-infectious (eg, caused by chemical irritation).<sup>1-4</sup> Infectious conjunctivitis affects roughly 1% to 2% of all neonatal patients in the United States, the most prevalent pathogen being *Chlamydia trachomatis*, a common cause of sexually transmitted disease.<sup>4,5</sup> Chlamydial infections are extremely common in the United States. The Centers for Disease Control and Prevention received reports of 1,210,523 of these infections in 2008 alone; the actual number is estimated to be substantially higher, especially because most *Chlamydia* infections are asymptomatic.<sup>5</sup>

*Chlamydia* can come into contact with newborns as they pass through an infected birth canal; once this occurs, the signs and symptoms usually become apparent in 5 to 12 days.<sup>6</sup> This timing can be useful for diagnosis, as a number of other forms of neonatal conjunctivitis manifest more quickly. (Chemical conjunctivitis, for example, typically presents within 1 or 2 days.)

Patients with chlamydial conjunctivitis usually present with swollen lids, eye redness, and significant mucopurulent discharge (Figure 1).<sup>6</sup> A Giemsa stain of conjunctival swabs will reveal intracytoplasmic inclusion bodies in these patients. Direct immunofluorescent antibody assay is more reliable and has been shown to have high sensitivity.<sup>7</sup> However,

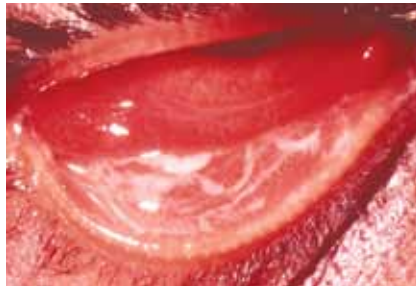


FIGURE 1 Chlamydial neonatal conjunctivitis. (Image courtesy of Gerhard Cibis, MD)

it also requires special facilities, and the clinician must wait longer for the results. Administering erythromycin ointment 4 times per day, along with an oral elixir (eg, doxycycline, two times per day for 7 days), is an effective standard treatment for neonatal chlamydial conjunctivitis.

## Gonococcal Neonatal Conjunctivitis

*Neisseria gonorrhoeae* is another sexually transmitted organism that commonly causes neonatal conjunctivitis. It is passed on to newborns via an infected birth canal and usually presents within 2 to 5 days following childbirth.<sup>8</sup> The effects of gonococcal conjunctivitis are severe—*N. gonorrhoeae* is able to attach to and invade an intact corneal epithelium; if the infection is not treated promptly, it can lead to ulceration, perforation of the cornea, and permanent vision loss.<sup>8,9</sup>

Gonococcal neonatal conjunctivitis is usually bilateral; symptoms include lid edema, chemosis, and a mucopurulent discharge that is often copious (Figure 2). Diagnosis can be made based on clinical signs and symptoms and Gram staining of conjunctival scrapings, which will show typical Gram-negative intracellular diplococci within polymorphonuclear leukocytes.<sup>10</sup>

## CORE CONCEPTS

- ▶ Neonates usually contract eye infections from the birth canal but nosocomial infection is also possible.
- ▶ *C. trachomatis* is the most common cause of neonatal infectious conjunctivitis.
- ▶ Gonococcal neonatal conjunctivitis has severe symptoms that must be treated promptly to avoid vision loss.
- ▶ An in-office immunoassay enables adenovirus detection within 10 minutes.

While culture can be useful in these cases, this condition demands treatment before culture results become available. If therapy initiated based on clinical judgment does not yield significant symptomatic improvement within a day or so, the clinician may then culture for a definitive diagnosis.



FIGURE 2 Gonorrhoeal neonatal conjunctivitis. (Image courtesy of Gerhard Cibis, MD)

The rapid progression and severity of gonococcal ocular infection demand aggressive treatment. Infants with an uncomplicated infection can be treated with a single intramuscular or intravenous dose of ceftriaxone (25 to 50 mg/kg, not to exceed 125 mg).<sup>11</sup> Additionally, these patients should be hospitalized and assessed for any indication

that the infection has disseminated (eg, meningitis or sepsis).<sup>11</sup>

### Neonatal Conjunctivitis: Other Bacterial Pathogens

Other bacterial agents as a group make up the bulk of etiologies for neonatal bacterial conjunctivitis. These include the Gram-positive organisms *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Streptococcus pneumoniae*, and *Streptococcus viridans*, as well as the Gram-negative *Escherichia coli*, *Klebsiella pneumoniae*, *Serratia marcescens*, and various species of *Proteus*, *Enterobacter*, and *Pseudomonas*.<sup>12</sup> These bacteria can be identified with a simple Gram stain and respond to standard antibiotics.

### Herpetic Neonatal Conjunctivitis

Neonatal herpes simplex virus infections are rare but can have devastating effects. The infection usually manifests within 2 weeks after birth and is characterized by edema, moderate injection, and non-purulent, serous discharge;<sup>13</sup> in addition, patients often present with corneal keratitis and periocular skin vesicles (Figure 3). These symptoms may be unilateral or bilateral.

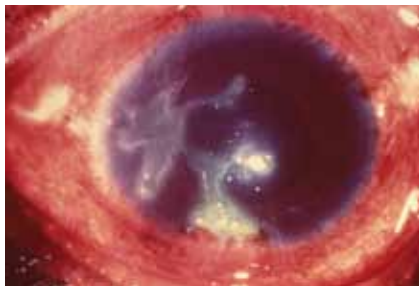


FIGURE 3 Herpetic neonatal conjunctivitis.

Other indicators of neonatal herpes include systemic signs and symptoms, including fever, fluctuating temperature, and seizures.<sup>14</sup> Due to the severity of the symptoms, a delay in diagnosis can have serious consequences for these patients. Giemsa staining may reveal lymphocytes, giant cells with multiple nuclei, and plasma cells in patients with neonatal herpetic conjunctivitis.<sup>13</sup> Also, if the mother has vaginal herpes, this is an obvious risk factor to be taken into consideration.

I typically treat these patients with trifluridine 1% eye drops five times per day and acyclovir 20 mg/kg four times per day for 7 to 10 days.

### Neonatal Chemical Conjunctivitis

As noted earlier, some cases of neonatal conjunctivitis are non-infectious. Chemical conjunctivitis presents early—day 1 or 2 of life—usually as a reaction to the silver nitrate used for prophylaxis against *N. gonorrhoeae*.<sup>15</sup> With an almost universal shift in prophylaxis to 0.5% erythromycin or 1% tetracycline, chemical conjunctivitis is now much less common. Patients with this condition normally present with minimal edema and minor redness, which are self-limited and typically resolve within a few days without therapy.

### Prevention

The prevention of neonatal ocular infection hinges largely on prenatal diagnosis of maternal vaginal infection. As a preliminary measure, obstetricians should check for *Chlamydia* in the birth canal of pregnant patients; if detected, this condition is treatable with systemic antibiotics. In situations where an expectant mother is known to have genital herpes, having a cesarean section can help prevent the passage of the infection to the newborn.

## PEDIATRIC PATIENTS

### Bacterial Conjunctivitis

Conjunctivitis, better known as “pink eye,” is the scourge of school nurses and is very common among children—in many cases, a child with unwashed hands merely needs to rub his or her eyes to initiate infection. Etiologies can be bacterial, viral, or noninfectious; the latter category includes hay fever conjunctivitis and other forms caused by allergies.<sup>16</sup>

Bacterial conjunctivitis typically presents in one eye initially, with symptoms that include mucopurulent discharge, lid edema, and conjunctival hyperemia; these symptoms usually spread to the second eye within 1 to 2 days.<sup>17</sup> Fourth generation fluoroquinolones gatifloxacin, moxifloxacin, and

besifloxacin provide broad-spectrum coverage, are generally well tolerated, and have been shown to achieve antibiotic levels in the conjunctiva that exceed the MIC<sub>90</sub>s of methicillin-sensitive *S. aureus* and *S. epidermidis* for at least 2 hours.<sup>18</sup> The newest fluoroquinolone, besifloxacin, received FDA approval for the treatment of bacterial conjunctivitis in 2009. In a multicenter, randomized, double-masked, parallel-group, active-controlled, noninferiority study involving patients age 1 or older with clinical manifestations of bacterial conjunctivitis, clinical resolution was similar at day 5 following treatment with besifloxacin vs moxifloxacin (58.3% vs 59.4%, respectively) and was also similar on day 8 (84.5% with besifloxacin vs 84.0% with moxifloxacin); microbial eradication was similar on day 5 (93.3% with besifloxacin vs 91.1% with moxifloxacin) and on day 8 (87.3% vs 84.7%, respectively); and both antibiotics were well tolerated. The cumulative frequency of ocular adverse events was comparable between the two antibiotics (12% with besifloxacin vs 14% with moxifloxacin), although the eyes treated with moxifloxacin experienced a greater frequency of ocular irritation (1.4% vs 0.3% in the besifloxacin-treated eyes;  $P = 0.0201$ ).<sup>19</sup> As antibiotic resistance becomes increasingly prevalent, the development of new drugs will continue to be valuable in expanding our armamentarium of effective ocular anti-infective medications.

### Viral Conjunctivitis

Viral conjunctivitis most commonly results from adenoviruses. The incubation period for pediatric adenovirus infection is 5 to 12 days, with patients usually contagious for up to 2 weeks.<sup>17</sup> In some cases, this is prolonged when an infection that began in one eye is spread to the other; and then the first eye becomes re-infected by the second.

The most serious form of adenovirus conjunctivitis, epidemic keratoconjunctivitis (EKC), causes small subepithelial corneal infiltrates, which lead to increased lacrimation, photophobia, scarring of the conjunctiva, and decreased vision.<sup>20,21</sup> These infiltrates can persist for months, diminishing visual acuity even when the

patient is no longer infectious.<sup>17</sup>

A variety of diagnostic methods can be used identify viral conjunctivitis, including viral cell cultures and polymerase chain reaction (PCR). However, these options can be costly, and the results may take days to obtain. Therefore, clinicians typically rely on clinical judgment for the diagnosis.

An in-office immunoassay is now available that can detect all 53 known serotypes of infectious adenovirus in approximately 10 minutes.<sup>22</sup> This prompt diagnosis allows for the immediate isolation of these patients from school or work to limit the spread of infection (and prevents the pointless treatment of adenovirus with antibiotics).

Presently, there is no known cure for viral conjunctivitis. Although steroids do not resolve or shorten the course of the infection, they ameliorate the symptoms and make them more tolerable for the patient. I typically put these patients on tobramycin and dexamethasone, four times per day, for 2 weeks.

### Pediatric Herpetic Conjunctivitis

It is thought that children acquire herpes simplex conjunctivitis through contact with infected adults (eg, being kissed by someone with an active lip chancre). Typically, children exposed in this manner don't develop clinical symptoms until later in life, if at all. When they present, symptoms take the form of corneal dendrites or skin chancres.

When herpes manifests on the eye as a primary infection, patients typically present with periocular skin lesions and possible conjunctival and corneal involvement. Because these skin lesions become ulcerated and can become infected with bacteria, I often use oral acyclovir on these patients to treat the herpetic symptoms (20 mg/kg, 4 times per day, for 1 week), as well as prophylactic topical antiviral drops, plus ointment, to protect against secondary bacterial infection.

### Bacterial Keratitis

A number of factors can lead to the development of bacterial keratitis in children, including trauma, contact lens wear, ocular dryness, and immunosuppression.<sup>23</sup> Species of *Staphylococcus*,

*Streptococcus*, and *Pseudomonas* are most commonly associated with this infection.<sup>24</sup>

If a patient with bacterial keratitis fails to receive treatment, irreversible damage to the eye may result.<sup>24</sup> Fortunately, these patients usually respond well to antibiotics. An antibiotic/steroid combination can be used as a first-line therapy, as this regimen normally eliminates both the bacteria and the corneal keratitic reaction. If the patient remains nonresponsive to older antibiotics (eg, tobramycin or neomycin/polymyxin B combination), culture plus a switch to a fourth generation fluoroquinolone may be appropriate.

### Conclusion

From the birth canal to the playground, neonatal and pediatric patients may encounter a wide variety of ocular pathogens throughout their development. Although not all of these encounters are preventable, being able to diagnose these infections promptly can prevent damage to the eye, reduce the spread of infection, and preserve vision in these patients.

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## EXAMINATION QUESTIONS TOPICS IN OCULAR ANTIINFECTIVES, ISSUE 20

This CME program is sponsored by the University of Florida College of Medicine and supported by an unrestricted educational grant from Bausch + Lomb, Inc. **DIRECTIONS:** Select the one best answer to each question in the Exam (Questions 1-10) and in the Evaluation (Questions 11-16) below by circling one letter for each answer. Participants must score at least 80% on the questions and complete the entire Evaluation section on the form below. The University of Florida College of Medicine designates this activity for a maximum of 1.0 AMA PRA Category 1 Credit™. There is no fee to participate in this activity. You can take the test online at <http://cme.ufl.edu/ocular>.

- Which of the following is not a mechanism by which the eye is protected from microbial invasion?
  - Lids and lashes form physical barriers
  - Tears flush organisms from the ocular surface
  - Bacteria are deprived of oxygen when eyes are closed during sleep
  - Antibacterial proteins such as lysozyme are present in the tear film
- The basal lamina presents a potential barrier against bacterial invasion because it
  - Is regularly sloughed off
  - Elaborates bactericidal proteins
  - Contains pores that are notably smaller than a bacterium
  - Has anti-biofilm properties
- In the study by Suci and coworkers, ciprofloxacin sterilized a biofilm-free surface in 40 seconds, whereas sterilization of a biofilm-covered surface required
  - More than 20 minutes
  - Less than 20 seconds
  - 2 minutes
  - 5 minutes
- "Cytotoxic strains" of *P. aeruginosa*
  - Kill by invading and replicating inside epithelial cells
  - Lack the *exoU* gene
  - Kill corneal epithelial cells by injecting them with toxins
  - Penetrate the epithelium by bypassing the tight junctions
- Contact lens wear has been associated with
  - Formation of mucin balls
  - Decreased corneal sensitivity
  - Increased tear film evaporation
  - All of the above
- Symptoms of gonococcal neonatal conjunctivitis
  - Typically include copious mucopurulent discharge
  - Can be safely managed by watchful waiting
  - Are almost always unilateral
  - Usually resolve without treatment
- The most common cause of neonatal infectious conjunctivitis is
  - S. epidermidis*
  - S. aureus*
  - C. trachomatis*
  - N. gonorrhoeae*
- Which of the following is *not* an indicator of herpetic neonatal conjunctivitis?
  - Presentation within 2 weeks after birth
  - Non-purulent, serous discharge
  - Periocular skin vesicles
  - Absence of systemic signs
- Epidemic keratoconjunctivitis
  - Despite its name, is rarely contagious
  - Is the most serious form of adenovirus conjunctivitis
  - Shows intracytoplasmic inclusion bodies on Giemsa staining
  - Can be cured with steroid treatment
- In patients with chlamydial conjunctivitis, a Giemsa stain of conjunctival swabs will reveal
  - Gram-negative intracellular diplococci
  - Chlamydial antigens on conjunctival scrapings
  - Intracytoplasmic inclusion bodies
  - Giemsa staining is not appropriate for these organisms

## EXAMINATION ANSWER SHEET TOPICS IN OCULAR ANTIINFECTIVES, ISSUE 20

This CME activity is jointly sponsored by the University of Florida and Candeo Clinical/Science Communications, LLC, and supported by an unrestricted educational grant from Bausch + Lomb, Inc. Mail to: University of Florida CME Office, PO Box 100233, Gainesville, FL 32610-0233. **DIRECTIONS:** Select the one best answer for each question in the exam above (Questions 1–10). Participants must score at least 80% on the questions and complete the entire Evaluation (Questions 11-16) to receive CME credit.

### ANSWERS:

- |            |             |
|------------|-------------|
| 1. A B C D | 6. A B C D  |
| 2. A B C D | 7. A B C D  |
| 3. A B C D | 8. A B C D  |
| 4. A B C D | 9. A B C D  |
| 5. A B C D | 10. A B C D |

### EVALUATION:

1=Poor 2=Fair 3=Satisfactory 4=Good 5=Outstanding

- Extent to which the activity met the identified
  - Objective 1: 1 2 3 4 5
  - Objective 2: 1 2 3 4 5
  - Objective 3: 1 2 3 4 5
  - Objective 4: 1 2 3 4 5
- Rate the overall effectiveness of how the activity:
  - Related to my practice: 1 2 3 4 5
  - Will influence how I practice: 1 2 3 4 5
  - Will help me improve patient care: 1 2 3 4 5
  - Stimulated my intellectual curiosity: 1 2 3 4 5
  - Overall quality of material: 1 2 3 4 5
  - Overall met my expectations: 1 2 3 4 5
  - Avoided commercial bias/influence: 1 2 3 4 5
- Will the information presented cause you to make any changes in your practice? Yes No
- If yes, please describe: \_\_\_\_\_
- How committed are you to making these changes? 1 2 3 4 5
- Are future activities on this topic important to you? Yes No

If you wish to receive credit for this activity, please fill in the following information. Retain a copy for your records —

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