A CONTINUING MEDICAL EDUCATION PUBLICATION

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TOPICS IN Ocular Antiinfectives

Issues in Prophylaxis with Keratoplasty

Natalie Afshari, MD, FACS

Corneal transplants present a number of challenges to antimicrobial prophylaxis, as the risk of postoperative infection is increased by both the invasive nature of these procedures and the need for long-term immunosuppressive therapy. The good news is that new antibacterials and antivirals continue to enrich our prophylactic armamentarium.

FIGURE 1 Penetrating keratoplasty's relatively high risk of postoperative infection stems, in part, from the placement of full-thickness sutures. This *Staphylococcus* keratitis was associated with a broken running suture. (Image courtesy of Natalie Afshari, MD.)

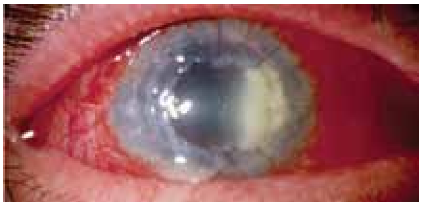

FIGURE 2 The prevention of graft rejection demands the long-term use of topical steroids, which can induce epitheliopathies vulnerable to opportunistic infections such as this *Pseudomonas* keratitis. (Image courtesy of Natalie Afshari, MD.)

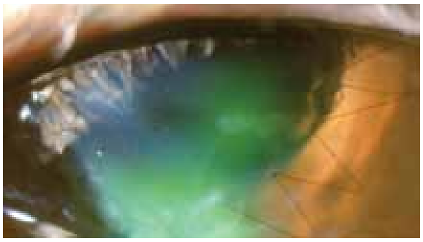

FIGURE 3 Keratoplasty is infamous for triggering reactivation of latent herpes virus among patients with a history of HSV keratitis. (Image courtesy of Natalie Afshari, MD.)

Keratoplasty is the most frequently performed and successful tissue transplantation procedure, with US corneal surgeons performing more than 40,000 partial and full-thickness corneal transplants each year (Table 1, page 3). The last decade has been a particularly exciting time in the field, with advances that include dramatic refinements in surgical techniques and more effective immunosuppressive, antibacterial, and antiviral drugs.[1,2]

Nonetheless, postoperative infection remains a significant cause of graft failure. In part, the high rate of infection reflects the invasive nature of corneal transplants, particularly that of penetrating keratoplasty (PK), which requires the placement of full-thickness penetrating sutures (Figure 1).

In addition, the prevention of graft rejection demands the long-term use of topical steroids, which leaves the eye locally immunosuppressed and can directly induce epitheliopathies that predispose to secondary infection (Figure 2). Further exacerbating the risk of infection-related complications, many patients come to keratoplasty with a history of longstanding corneal disease. Finally, keratoplasty is infamous for triggering reactivation of ocular herpes infection in the latently infected (Figure 3).

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. Apply peer-reviewed research findings to maximize the efficacy of perioperative antibiotic and antiviral prophylaxis for patients undergoing corneal transplant.
2. Assess the appropriateness and risks of keratoplasty for patients with corneal scars due to viral infection.
3. Assemble a useful smear-and-culture kit for in-office diagnosis of external ocular infections.
4. Improve the reliability of cultures and smears sent out for laboratory analysis.

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Opportunistic Infections

In 2006, we reported on our review of 44 corneal graft infections treated at Duke University Eye Center from 1999 to 2005.[3] Among the predisposing conditions we identified were broken or loose sutures (10 cases; 22.7%) and topical corticosteroids (34 cases; 77.3%). Staphylococci were isolated from 12 eyes (21%), *Pseudomonas* from seven (12%), and fungal species from eight (18%); and 12 patients had polymicrobial infections. The mean interval between corneal transplant and the diagnosis of microbial keratitis was 26.4 months—a contrast to the situation with other common ocular surgeries, where infection risk peaks during the immediate postoperative period.

Others have reported a similar array of bacterial and fungal infections following Descemet stripping endothelial keratoplasty (DSEK).[4,5] These and related findings demonstrate that the opportunities for post-transplant infection are as diverse as the types of organisms involved. For example, pathogens present on the ocular surface have the potential to be introduced into the eye through the venting incisions we make at the time of transplant. Additionally, the sutures we leave in place sometimes afford access to organisms during the extended postoperative period. Additionally, we have the infection risk associated with the epitheliopathies that can result from the long-term use of topical steroids.

Less often, donor tissue can be the source of infection. For example, a number of case reports have described corneal graft transmission of *Candida* and herpes simplex virus (HSV) infections.[6-10]

It is generally accepted that PK poses a higher risk of endophthalmitis than partial-thickness transplants. By comparison, anterior lamellar procedures avoid full thickness penetration of the cornea. DSEK preserves the ocular surface. And both anterior lamellar surgery and DSEK avoid the placement of full-thickness sutures. In addition, PK demands relatively longer exposures to immunosuppressive steroids.

Antibiotic Prophylaxis

Unfortunately, we lack large multicenter studies on antibiotic prophylaxis in keratoplasty, and any such study would be difficult to design without a control group of untreated patients. Consequently, the corneal transplant surgeon—like the cataract surgeon—must choose a prophylactic

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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.[1]
- The emergence and increasing prevalence of once-atypical infections that may require diagnostic and treatment techniques relatively unfamiliar to comprehensive ophthalmologists.[2]
- The introduction of new and potentially more efficacious and/or safe ophthalmic antiinfectives.[3]
- The introduction of new and potentially more accurate diagnostic techniques for ophthalmic infections.[4]
- 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).[5,6]
- 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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OFF-LABEL USE STATEMENT This work discusses off-label uses of antiinfective medications.

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System requirements for this activity are: *For PC users:* Windows® 2000, XP, 2003 Server, or Vista; Internet Explorer® 6.0 or newer, or Mozilla® Firefox® 2.0 or newer (JavaScript™ and Java™ enabled). *For Mac® users:* Mac OS® X 10.4 (Tiger®) or newer; Safari™ 3.0 or newer, Mozilla® Firefox® 2.0 or newer; (JavaScript™ and Java™ enabled).

Internet connection required: Cable modem, DSL, or better.

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CORE CONCEPTS

- Corneal graft surgery creates a high risk of postoperative infection due to the invasive nature of the procedures and the use of long-term immunosuppressive therapy.
- Corneal transplantation to resolve herpetic scarring has a particularly high rate of complications that can result in graft failure.
- Oral antiherpetic drugs have a proven track record for reducing the risk of postoperative reactivation of latent herpes infection.
- Trifluridine should be avoided after graft surgery due to its known toxicity.
- Topical ganciclovir is a more effective and less toxic alternative to trifluridine.
- Large multicenter trials are needed to further guide our choice of prophylactic antibiotics and antivirals.

TABLE 1

2010 US Eye Banking statistics: Indications for corneal transplant reported by 79 US banks

Indications for penetrating keratoplasty or keratoprosthesis	2010		2009	
Post-cataract surgery edema	3,104	13.9%	3,622	15.4%
Keratoconus	4,731	21.2%	5,092	21.7%
Fuchs' dystrophy	1,766	7.9%	1,387	5.9%
Repeat corneal transplant	4,025	18.0%	4,085	17.4%
Other degenerations or dystrophies	1,899	8.5%	2,779	11.8%
Microbial changes	662	3.0%	637	2.7%
Mechanical or chemical trauma	935	4.2%	919	3.9%
Congenital opacities	647	2.9%	498	2.1%
Post-refractive surgery	88	0.4%	116	0.5%
Other causes of corneal opacification or distortion	4,455	20.0%	4,358	18.6%
Total	**22,312**		**23,493**	
Indications for anterior keratoplasty	**2010**		**2009**	
Corneal degenerations	262	25.2%	91	10.7%
Ulcerative keratitis or perforation	101	9.7%	68	8.0%
Unspecified anterior stromal scarring	202	19.4%	272	31.9%
Keratoconus	419	40.2%	330	38.7%
Trauma	19	1.8%	42	4.9%
Reis-Buckler's dystrophy	1	0.1%	14	1.6%
Post-keratectomy	12	1.2%	25	2.9%
Pterygium	2	0.2%	5	0.6%
Post-refractive surgery	23	2.2%	6	0.7%
Total	**1,041**		**853**	
Indications for endothelial keratoplasty	**2010**		**2009**	
Post-cataract surgery edema	3,783	19.7%	3,589	20.5%
Fuchs' dystrophy	9,843	51.4%	8,604	49.1%
Other causes of endothelial dysfunction	3,766	19.7%	3,791	21.7%
Repeat transplant (endothelial failure)	1,767	9.2%	1,519	8.7%
Total	**19,159**		**17,503**	

antibacterial largely based on efficacies against bacterial conjunctivitis.

When choosing a topical antibiotic for prophylaxis, I look for a number of factors. In the immediate perioperative period, I want to maximize broad spectrum activity, and so, I use a current generation fluoroquinolone. Maximizing broad spectrum coverage may be particularly important for nursing home patients and those with a history of recent or frequent hospitalization, as this puts them at elevated risk of carrying drug-resistant ocular microflora such as methicillin-resistant *Staphylococcus aureus* (MRSA).[11] However, no topical fluoroquinolone achieves intraocular concentrations consistently above the minimum inhibitory concentrations (MIC_{90}s) of MRSA.[12]

I begin antibiotic prophylaxis with a current generation fluoroquinolone on the day of surgery. While in the holding area, the patient receives three, one-drop applications in the affected eye, spaced every 5 minutes immediately before surgery.

In the operating room, I prep by placing two or three drops of a 50/50 mixture of povidone-iodine and balanced salt solution in the fornix and then cleaning the lids and lashes with full strength povidone iodine, leaving the disinfectant on the skin for several seconds before removal.

I conclude surgery with a subconjunctival injection of cefazolin (or, in the case of penicillin allergy, vancomycin) with dexamethasone. I follow this with topical instillation of a fluoroquinolone and steroid eye drops as well as an antibiotic/steroidal ointment. On postoperative day 1, I remove the patch and instill one drop of a current generation fluoroquinolone at the time of examination. I then send the patient home with instructions to continue the fluoroquinolone four times per day. Before bedtime I have the patient use a lubricating antibiotic or antibiotic/steroid ointment.

Given normal healing, I will discontinue the antibiotics 1 week following lamellar keratoplasty or 2 weeks following PK. If, however, I note the persistence of epithelial defects, I will continue the administration of the antibiotic ointment, with or without the topical fluoroquinolone regimen. I may address a large or particularly sight-threatening defect with use of a bandage contact lens.

Similarly, I will use a longer regimen of topical fluoroquinolone with any patient who received amniotic membrane on top of the corneal transplant—continuing the antibiotic until the amniotic membrane has fully dissolved.

Antiviral Prophylaxis

Corneal scarring stemming from chronic herpetic keratitis remains a leading cause of corneal blindness in developed countries.[13] The American Eye Bank does not differentiate between the types of "microbial changes" that are indications for keratoplasty (Table 1). However, epidemiological studies in Europe suggest that herpetic scarring accounts for an estimated 5% to 11% of corneal transplants.[14,15] No doubt this figure would be higher save for the general reluctance corneal surgeons have about performing keratoplasty in a herpetically scarred patient if that patient has good vision in the fellow eye.

This reluctance stems from the fact that, as a group, patients with a history of herpetic keratitis have a high rate of post-transplant complications, including recurrent ocular herpes and associated epithelial defects, secondary infections, and eventual graft rejection. Of particular note: A history of chronic herpetic keratitis is associated with neurotrophic keratopathy, which dramatically increases the risk of graft failure.[16] In addition, the trauma of ocular surgery is itself a reactivation trigger of latent herpes infection, and topical steroids can exacerbate both the risk and the severity of the resulting keratitis.[17]

Fortunately, we have good research demonstrating the efficacy of antiviral prophylaxis. In particular, we have an abundance of studies demonstrating that oral antivirals can significantly reduce the incidence of herpes keratitis in patients prone to recurrence and also provide antiherpetic coverage when ocular steroids must be used. Chief among these studies are the large, multi-center trials of the Herpetic Eye Disease Study (HEDS), which demonstrated that long-term use of oral acyclovir (400 mg BID) can halve the annual recurrence rate of vision-threatening herpetic stromal keratitis (14% with acyclovir vs 28% with placebo).[18]

My current antiviral regimen for keratoplasty patients with a history of herpes is to prescribe oral prophylaxis beginning at least two weeks prior to surgery and to continue oral prophylaxis for a minimum of 1 year after surgery.

TABLE 2

Prevalence of herpes simplex virus in excised and donor corneas

Source of cornea	Positive for HSV-1
Corneal transplant patients with history of HSV keratitis	40 of 83 (48%)
Corneal transplant patients with no history of HSV keratitis	15 of 367 (4%)
Eye bank corneas	0 of 84 (0%)

Data source: Reference 24.

Until the recent introduction of ganciclovir ophthalmic gel, trifluridine was the only topical antiviral available for ophthalmic use in the United States. Unfortunately, trifluridine's action is not limited to infected cells and so can interfere with wound healing.[19] Moreover, Goodfellow and colleagues recently looked at trifluridine's ability to prevent graft failure following PK for herpetic scarring and found no significant risk reduction over placebo.[1] By contrast, these researchers found that patients on oral acyclovir prophylaxis were less than a third as likely to experience graft failure at the 5 year mark.

Meanwhile, many European corneal surgeons have begun using topical ganciclovir gel or acyclovir ointment in combination with oral antiherpetics following corneal transplantation.[20] Though we lack large, multicenter trials with keratoplasty patients, Tabbara recently reported the results of a small, non-randomized clinical study in which topical ganciclovir (without oral acyclovir) prevented herpetic keratitis in six patients prone to chronic recurrence, including three patients who had undergone penetrating corneal grafts.[21-22] While ganciclovir has long been known as a potent inhibitor of herpes virus, controlled clinical trials are needed to assess the efficacy and safety of long-term use.

Studies have demonstrated that antivirals in the acyclovir family of drugs not only block replication of active herpes virus, but also help prevent latent virions from reactivating.[23] While topical antivirals are unlikely to reach the trigeminal ganglia (the primary sites of ocular herpes virus latency), research has demonstrated the prevalence and clinical consequences of latent herpes virus in the human cornea.[24]

Remeijer and colleagues, for example, documented the presence of herpes simplex type 1 virions in 40 of 83 (48%) excised corneas of keratoplasty patients with a history of herpetic keratitis.[24] By contrast, the virus's DNA fingerprint showed up in just 15 of 367 (4%) excised corneas from keratoplasty patients without a history of ocular herpes (Table 2). More importantly, perhaps, the researchers found that viral load directly correlated with steroid treatment before PK, the frequency and severity of postoperative infection, and graft failure—findings that emphasize the need to protect these patients with antiviral coverage. On a reassuring note, the researchers found *no* signs of herpetic virus DNA in 84 eye bank corneas, and concluded that routine screening of donor corneas for herpes virus is unnecessary.

Conclusion

It is heartening to see the continuing improvements in keratoplasty success rates that we associate with advances in surgical technique. However, we still lack the large, multicenter trials that can scientifically demonstrate the efficacy of our prophylactic regimens and further guide our choice of antibiotic and antiviral drugs.

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In-office Diagnostic Microbiology

Henry D. Perry, MD, FACS

Although in-office microscopy is no longer widespread in ophthalmology, a basic smear-and-culture kit enables the clinician to resolve many diagnostic challenges in minutes as well as significantly improve the reliability of laboratory cultures.

Until very recently, the ability to discriminate Gram-positive from Gram-negative organisms was of critical importance in treating ocular infections. As a result, ophthalmologists regularly collected, stained, and viewed smears to guide the initial treatment of corneal ulcers and other external ocular infections.

With the introduction of broad spectrum fluoroquinolones, in-office smears and microscopy largely fell by the wayside. Even the collection of culture specimens is no longer standard practice except when an infection is clearly sight-threatening.

Yet smears can be of tremendous value in managing complicated cases, particularly in discriminating bacterial from nonbacterial disease. Moreover, the right supplies—ready at hand—will enable the clinician to collect, stain, and view smears in less than 5 minutes, as well as greatly improve the reliability of specimens collected for laboratory culture.

A simple smear-and-culture kit is inexpensive and requires little office space. In addition, smears and cultures are billable procedures with significant reimbursement rates. The Medicare reimbursement for doing a combined smear and culture is approximately half that of a cataract removal.

The Basic Tool Kit

A basic office microbiology kit has six key components: a Kimura spatula; a set of cytology slides; an alcohol lamp; a Coplin jar filled with methyl alcohol (Figure 1); stains (Gram for bacteria; KOH and lactophenol blue for fungi; and Papinicolau for viral inclusions and *Acanthamoeba*); and culture media (blood and chocolate agar, a Sabouraud glucose agar slope, and thioglycolate broth, kept refrigerated). (See Table 1.)

When sending specimens for laboratory analysis, inoculating and sending all four of the above-mentioned culture

CORE CONCEPTS

- In-office smears can resolve diagnostic challenges in minutes.
- Smears can identify some organisms even in the presence of topical antibiotics.
- Staining can reveal atypical bacteria, fungi, *Acanthamoeba*, and viral inclusions.
- Low-power microscopy of a plucked lash can reveal *Demodex* infestation.
- Proper supplies and collection technique significantly improve the reliability of cultures.
- A basic smear-and-culture kit is inexpensive and takes little office space.

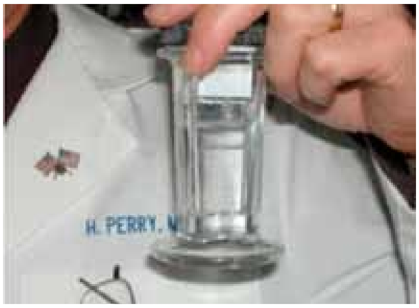

FIGURE 1 Smears are fixed once submerged in methyl alcohol inside the Coplin jar. (Image courtesy of Henry Perry, MD.)

TABLE 1

Media and materials required for preparation of smears and cultures

- Compound microscope
- Kimura spatula
- Alcohol lamp
- Cytology slides
- Blood/chocolate agar plates
- Sabouraud glucose agar slope
- Thioglycollate broth
- Stains†

† For more detail on stains, see Reference 4.

media greatly reduces the chance of a false negative result. Often times, culture media can be obtained directly from the laboratory that performs a practice's cultures, and the laboratory's microbiologists can provide useful guidance, including product recommendations. Our laboratory, for example, sends us a monthly supply of plates. As the plates are quite inexpensive, we discard any that remain unused after 3 months.

The Kimura spatula is particularly useful for obtaining scrapings that yield significant amounts of viable microorganisms. Its angled edge also facilitates specimen placement on cytology slides and culture media. Finally, a quality used compound microscope can be purchased in good condition for as little as $300 to $500. (I find it convenient to keep mine on my office desk.) In all, the initial investment for in-house diagnostic microscopy and specimen collection should total well under $1,000.

The Microbial Investigation

In cases of relatively mild disease, an in-house evaluation (with or without smear) may be sufficient to guide treatment. When the infection is sight-threatening, however, a confirmatory laboratory culture should always be pursued.

The complete microbiologic evaluation of a smear, from anesthetizing and scraping the patient's eye to viewing the stained smear, can be done in 5 minutes or less, and in tandem with plating a specimen for laboratory culture (Table 2). The key is to have all materials organized and readily accessible.

In my opinion, the taking of a smear and culture specimen is always appropriate for sight-threatening corneal infections as well as for ulcers that fail to respond to standard care. Of course, if the patient is being treated with antibiotics, the likelihood of obtaining a positive bacterial culture plummets. It is precisely in these cases that the smear comes into its own, as it can reveal the presence of *Acanthamoeba*, fungal organisms, or atypical bacteria—all of which become visible with appropriate staining. Although relatively uncommon, these infections are often misdiagnosed as herpes keratitis on slit lamp examination and the resulting delay in treatment can lead to significant scarring and vision loss.

TABLE 2

Performing a corneal scrape and smear

Step 1. Position patient
- Sit patient behind slit lamp microscope
- Apply topical anesthetic to affected eye
- Insert speculum

Step 2. Scrape and smear
- Use Kimura spatula to gently but firmly scrape ulcer base and edges
- Before each scraping, flame sterilize spatula with alcohol lamp
- Take samples in the following order:
  - Smear one or more slides
  - Inoculate one or more plates and/or broth

Step 3. Stain†
- Gram for bacteria
- KOH and lactophenol blue for fungi
- Papinicolau for viral inclusions and *Acanthamoeba*

Step 4. Fix slides for possible outsourced cytology by immersing in methyl alcohol (Coplin jar)

† For more detail on stains, see Reference 4.

In particularly challenging cases, I will prepare several smears, perform a Pap smear and Gram stain, and hold two or more additional smeared glass slides in the Coplin jar. Should the initial stains prove indeterminate, the other smears can be sequentially evaluated with stains specific for *Acanthamoeba*, fungi, and/or viral inclusions. In this way the clinician can perform a remarkably sophisticated cytological evaluation in minutes.

In addition, the smears are fixed once submerged in methyl alcohol inside the Coplin jar. The clinician then has the option of sending the fixed specimen to a trained cytologist for expert evaluation. And thanks to the fixation, this does not have to be done immediately. Rather the slide can be held for days, weeks, or even a month while monitoring the patient's response to treatment.

Over the years, I have had a number of corneal ulcer cases where this cytology approach has proven invaluable in discovering etiologies that I would not have otherwise associated with the presenting signs and symptoms.

Beyond corneal scrapings, smears and stains can help the clinician distinguish between viral conjunctivitis and ocular allergy and can help in evaluating the etiology of recalcitrant blepharitis. The latter, for example, can be due to an infestation of *Demodex follicularum* mites—invisible to the naked eye but often obvious when viewing a plucked lash under a low-power microscopic magnification (Figure 2).

FIGURE 2 *Demodex* mites on lash follicles become obvious on microscopic examination. (Image courtesy of Vadrevu Raju, MD.)

Expanding Office Microbiology

A large group or referral practice may want to invest in some additional diagnostic materials, such as the rapid assay for adenovirus infections, which provides results in less than 10 minutes (Figure 3).[1] In the next year or two, we have reason to hope for a similar rapid in-office diagnostic for herpetic viral infections.[2,3] Although slightly less common than adenovirus infections, ocular herpes is rightly feared within ophthalmology; and I would expect a rapid, accurate herpes test to be adopted by both comprehensive ophthalmologists and corneal specialists.

FIGURE 3 The readout window of the rapid-assay adenovirus detector displays two lines (control and result) to indicate a positive result. (Image courtesy of Shachar Tauber, MD.)

Within our referral practice, we also make good use of confocal microscopy, which allows us to noninvasively examine minute sections of the cornea, layer by layer. This gives us many of the diagnostic benefits of a biopsy—enabling us, for example, to spot subepithelial *Acanthamoeba* cysts and fungal organisms that have insinuated themselves into the corneal stroma.

Conclusion

In summary, I believe that both clinicians and patients can be well served by the modest investment in time and equipment necessary to perform in-office smears and to optimize the collection of specimens for laboratory culture. Indeed, the reimbursement rates for these diagnostic procedures can make them financially as well as clinically rewarding.

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EXAMINATION QUESTIONS TOPICS IN OCULAR ANTIINFECTIVES, ISSUE 22

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**.

1. Penetrating keratoplasty's relatively high postoperative infection rate stems, in part, from which of the following?
   A. The invasiveness of the procedure and the need for full-thickness sutures
   B. The frequency of preexisting corneal disease
   C. The need for long-term topical steroids
   D. All of the above

2. Reports show which of the following to be commonly associated with post-keratoplasty keratitis?
   A. Staphylococci and *Pseudomonas*
   B. *Acanthamoeba*
   C. *Klebsiella* and *Enterobacter*
   D. *Eschericia coli*

3. In Afshari and coworkers' review of 44 corneal graft infections, the mean interval between corneal transplant and diagnosis of microbial keratitis was approximately:
   A. 2 days
   B. 3 days
   C. 3 weeks
   D. 26 months

4. Epidemiological studies suggest that herpetic scarring is the indication for approximately what percentage of corneal transplants?
   A. 1% to 5%
   B. 5% to 11%
   C. 22% to 55%
   D. 70%

5 Which of the following is associated with the highest risk of postoperative endophthalmitis?
   A. Anterior lamellar keratoplasty
   B. Posterior lamellar keratoplasty
   C. Penetrating keratoplasty
   D. Descemets stripping automated keratoplasty

6 With the right supplies, about how long does it typically take to collect, prepare, and view a smear from a corneal scraping?
   A. 30 seconds
   B. 5 minutes
   C. 20 minutes
   D. 1 hour or more

7. In-office corneal scrapings and smears fell into disuse because:
   A. They were unreimbursed
   B. They were unreliable
   C. Broad-spectrum fluoroquinolones made them less useful
   D. Patients feared them

8. A Coplin jar filled with methyl alcohol is used for which of the following?
   A. Sterilization of the Kimura spatula
   B. Fixation of cytology slides
   C. Preservation of culture media
   D. All of the above

9. Once a smear has been fixed, it can remain useful for:
   A. Several hours
   B. Up to 1 week
   C. 1 to 2 weeks
   D. At least a month

10. A simple smear and culture kit should cost approximately:
   A. $1,000 *including* the cost of the microscope
   B. $1,000 *plus* the cost of the microscope
   C. $200 or less
   D. $3,000 or more

EXAMINATION ANSWER SHEET TOPICS IN OCULAR ANTIINFECTIVES, ISSUE 22

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. CME exam expires July 31, 2012.

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

11. 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

12. 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

13. Will the information presented cause you to make any changes in your practice? Yes No

14. If yes, please describe: ____________________

____

15. How committed are you to making these changes? 1 2 3 4 5

16. 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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