Ocular Flora and Their Antibiotic Resistance Patterns in the Midwest: A Prospective Study of Patients Undergoing Cataract Surgery

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• PURPOSE: To determine the spectrum of conjunctival flora and the antibiotic susceptibility profiles of patients undergoing cataract surgery at a Midwestern university.
• DESIGN: Prospective in vitro laboratory investigation of a patient cohort.
• METHODS: Conjunctival cultures were obtained from patients undergoing cataract surgery at a single ambulatory center on the day of surgery before the instillation of any ophthalmic medications. Isolates and antibiotic susceptibility profiles were identified using standard microbiological techniques.
• RESULTS: A total of 183 eyes were cultured, yielding 225 isolates. Twenty-seven eyes (14.8%) showed no growth. Coagulase-negative staphylococci (CNS) were the most commonly isolated organisms (74.8%). Overall susceptibility was highest for gentamicin (94%), which was also true of the CNS isolates (95.0%). A total of 64.5% of CNS isolates were sensitive to ciprofloxacin; 30.1% of CNS isolates were resistant to ≥3 classes of antibiotics; 46.6% of CNS isolates were oxacillin-resistant, and they were more resistant to antibiotics than their oxacillin-sensitive counterparts ($P < .001$), including fluoroquinolones ($P < .001$). Among eyes with multiple CNS strains, 41.4% had different antibiotic susceptibility profiles even though they were the same species.
• CONCLUSIONS: Our cohort harbored organisms with similar rates of antibiotic resistance as elsewhere in the country, including oxacillin resistance; however, the rate of fluoroquinolone resistance was less than in other reports. A surprisingly large proportion of different CNS strains from the same eye harbored different antibiotic susceptibility profiles. Our in vitro results, along with those of other investigators, should prompt further dialogue regarding antibiotic of choice for perioperative surgical prophylaxis in ophthalmic surgery. (Am J Ophthalmol 2013;155:36–44. © 2013 by Elsevier Inc. All rights reserved.)

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CATARACT EXTRACTION IS ONE OF THE MOST COMmon surgical procedures performed—certainly in the United States—yet there is still much to be learned about the pathophysiology of postsurgical infections such as endophthalmitis and effective measures of prophylaxis against said infections.[1,2] While newer evidence suggests the efficacy of intraoperative, intracameral antibiotics,[2] topical, perisurgical antibiotic prophylaxis is still the mainstay of preventive treatment employed in the United States.[3–6]

The source of microbial pathogens in endophthalmitis is nearly always the patient's native ocular surface and adnexal flora.[7–9] Therefore, empiric perioperative antibiotic prophylaxis assumes that the antibiotic used would be efficacious against the patient's flora. While thankfully rare, endophthalmitis is an extreme, blinding consequence; therefore, resistance among common causal pathogens of endophthalmitis is of significant concern. However, bacterial flora and their antibiotic susceptibility vary from region to region as well as over time.[10–12] Therefore, for empiric perioperative antibiotic use to be successful, periodic—if not continuous—surveillance is advocated.[9,13]

There have been several studies examining the antimicrobial susceptibility and resistance of the ocular flora of patients undergoing anterior segment surgeries and endophthalmitis isolates.[10,14–27] Most of these studies collected data from outside the United States or along the coasts of the United States. More recently, with the advent of intravitreal injections for macular degeneration, attention has been focused on the ocular flora of patients undergoing repeat injections.[28,29] Collectively, these papers report a range of antimicrobial susceptibility and resistance rates for the most commonly isolated organisms specific to the individual reporting institutions. Additionally, nationwide surveillance programs are in place and have been published, giving a more "global" picture of ocular flora and antibiotic susceptibility patterns.[11,30]

Data and knowledge of local, regional, and national antibiotic susceptibility patterns are important for health care providers, hospitals, researchers, pharmaceutical companies, and various government organizations such as

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public health agencies. For health care providers, including ophthalmologists, the knowledge is important for guiding antibiotic therapy, directing empiric antibiotic use, and monitoring the impact of such usage.[11,31] Both local and broader geographic surveillances are recommended for clinical care. The ability to predict antibiotic resistance or to gauge the effectiveness of empiric antibiotic usage for individual patients depends on the resistance profile of likely pathogens in the individual's local community. However, local data are oftentimes limited in terms of mere availability, sample size, and selection bias and may therefore not apply to a specific patient setting. In these situations, broader regional and national data may provide needed information as well as better project susceptibility trends and thereby place local data into perspective.

Therefore, under the aforementioned context, the purpose of the present study is to elucidate the spectrum of ocular flora and their antimicrobial susceptibility profiles in patients undergoing routine cataract surgery at an ophthalmic institution in the Midwest section of the United States. Given a dearth of data from this part of the country, we hope these local data will provide information to educate clinicians in this part of the country to help guide empiric, perioperative antibiotic usage for their patients. Additionally, we hope this report will join the national dialogue for comparison with results from other parts of the country for contemporary and future clinical care and research.

METHODS

PATIENTS SCHEDULED TO HAVE EXCLUSIVELY CATARACT surgery at the Saint Louis University ambulatory surgery center in Saint Louis, Missouri were approached and asked to participate in this prospective study. Patients over age 18, irrespective of sex, ethnic background, or health status, who could provide their own consents were considered, and all participating subjects consented to the study.

Upon arrival at the surgery center but prior to surgery and before preoperative ophthalmic medications of any kind were administered, a conjunctival swab of the inferior fornix of the eye undergoing surgery was performed using transport media (CultureSwab; Besse Medical, West Chester, Ohio, USA; or TransPorter; Eye Care and Cure, Tucson, Arizona, USA) following the administration of preservative-free tetracaine hydrochloride 0.5% (Alcon Laboratories, Inc, Ft. Worth, Texas, USA) to the subject's eye. The lag time between the application of preservative-free tetracaine and the conjunctival swab was within 1 minute.

The transport media were sent overnight to the Bascom Palmer Ocular Microbiology Laboratory in Miami, Florida for processing. Upon receipt, each swab was plated onto chocolate and 5% sheep blood agars. Plates were incubated at 35 C in a CO_2 incubator and observed for growth. Isolates were identified using standard microbiological protocols. In vitro susceptibility was determined using a combination of breakpoint minimal inhibitory concentrations (Vitek; BioMerieux, Durham, North Carolina, USA) and disk diffusion in accordance with Clinical Laboratory Standards Institute protocols. Note that these protocols and breakpoint concentrations are based on safe, achievable serum concentrations from systemic administration of antibiotics. There are no standards for ocular tissue concentration of topically applied antibiotics. Systemic serum concentrations and breakpoints have been used routinely in ophthalmic antibiotic and microbiological studies such as the current study. Quality control strains *Staphylococcus aureus* ATCC 29213 (Vitek) and *S. aureus* ATCC 25923 (disk diffusion) were included as controls to validate and monitor results. Results were recorded as susceptible, intermediate, or resistant.

With regard to fluoroquinolone susceptibility testing, isolates susceptible to older drugs (ciprofloxacin and levofloxacin) were not all additionally tested against newer

TABLE 1. Microbial Isolates From the Conjunctiva of Cataract Patients in Saint Louis (2007–2009)

Conjunctival Isolates	Percent of Total	Number (N = 225)
Gram-positive bacteria	89.3%	201
Staphylococcus epidermidis	56.4%	127
Coagulase-negative *Staphylococcus* (other)[a]	17.3%	39
Staphylococcus aureus	4.9%	11
Streptococcus species[b]	0.9%	2
Enterococcus faecalis	1.8%	4
Corynebacterium	7.6%	17
Micrococcus species	0.4%	1
Gram-negative bacteria	9.4%	21
Pseudomonas species[c]	1.8%	4
Other gram-negative species[d]	7.6%	17
Fungi	1.3%	3
Candida albicans	0.4%	1
Fungus (other)[e]	0.9%	2

[a]Coagulase-negative *Staphylococcus* (other): *S. auricularis* (17), unspeciated (8), *S. haemolyticus* (4), *S. simulans* (4), *S. warneri* (2), *S. xylosus* (1), *S. capitis* (1), *S. cohnii* (1), *S. lugdunensis* (1).

[b]*Streptococcus* species: *Peptostreptococcus* (1), *Streptococcus mitis* (1).

[c]*Pseudomonas* species: *Brevudimonas vesicularis* (2), *Pseudomonas aeruginosa* (1), *Delftia acidovorans* (1).

[d]Gram-negative species: *Proteus mirabilis* (3), *Acinetobacter species* (3), *Strenotrophomonas maltophilia* (2), *Moraxella catarrhalis* (1), *Citrobacter koseri* (1), *Enterobacter gergoviae* (1), *Klebsiella oxytoca* (1), *Enterobacter aerogenes* (1), *Serratia liquefiaciens* (1), *Aeromonas hydrophilia* (1), *Rhizobium radiobacter* (1), *non-glucose-fermenting bacilli* (1).

[e]Fungus (other): *Basidiobilis* (1), *Rhodoturula glutinis* (1).