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Original Research Article

Bacterial Eye Infections and Their Antibiogram in a Tertiary Eye Care Centre: A Descriptive Study

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Abstract

Background: Bacterial ocular infections are important causes of ocular morbidity and may lead to severe visual impairment when diagnosis and antimicrobial treatment are delayed. The spectrum of organisms causing ocular infections and their antimicrobial susceptibility varies geographically, making local microbiological surveillance important for rational empirical therapy.

Objectives: To determine the bacteriological profile of patients with ocular infections attending a tertiary eye care centre and to evaluate the antimicrobial susceptibility pattern of bacterial isolates.

Materials and Methods: This descriptive study was conducted at Sankara Eye Hospital, Shimoga, Karnataka, over one year from July 2020 to June 2021. The planned sample size was 100 ocular specimens collected by convenience sampling. Patients with bacterial keratitis, conjunctivitis, endophthalmitis and postoperative endophthalmitis were included, while fungal, viral and parasitic ocular infections were excluded. Corneal scrapings, conjunctival swabs, vitreous samples, corneal buttons and debrided tissue were subjected to Gram staining, culture, biochemical identification and antimicrobial susceptibility testing.

Results: Review of the available photographed laboratory register showed that a substantial proportion of specimens had "no growth" on bacterial culture, while Staphylococcus aureus was documented among culture-positive specimens. The available susceptibility records show testing against commonly used ocular/systemic antibacterial agents including fluoroquinolones and other antibiotics. Because the uploaded photographs represent only a portion of the full 100-sample register, a definitive overall culture-positivity rate and complete organism-wise susceptibility percentages cannot be calculated reliably from the currently available material.

Conclusion: Bacterial ocular infections require prompt microbiological evaluation, particularly in keratitis and endophthalmitis. The available study records demonstrate recovery of Staphylococcus aureus and illustrate the value of culture-directed antimicrobial therapy. Complete analysis of the 100 study samples would permit preparation of a definitive local antibiogram to guide empirical antibiotic selection.

Keywords: Ocular Infection; Bacterial Keratitis; Conjunctivitis; Endophthalmitis; Staphylococcus Aureus; Antimicrobial Susceptibility; Antibiogram.

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Introduction

Ocular infections represent an important group of potentially sight-threatening disorders encountered in ophthalmological practice. They range from relatively superficial infections such as bacterial conjunctivitis to severe infections involving the cornea and intraocular structures, including microbial keratitis and endophthalmitis.

The study protocol notes that ocular infections are significant vision-threatening conditions and that invasive pathogens such as Pseudomonas aeruginosa and Staphylococcus aureus may cause rapidly progressive corneal destruction. Bacterial keratitis is particularly important because delayed or inappropriate treatment may result in corneal ulceration, perforation, scarring and permanent loss of vision. The causative bacterial spectrum is influenced by geographic location, environmental exposure, ocular trauma, contact lens use, previous ocular surgery, topical medication and underlying ocular surface abnormalities. [1-4]

Gram-positive organisms, particularly Staphylococcus species and Streptococcus pneumoniae, as well as Gram-negative organisms such as Pseudomonas aeruginosa, have been implicated in ocular infections. [3,4] Microbiological investigation plays a central role in establishing the etiological diagnosis. Direct microscopy can provide an early indication of the probable pathogen, while culture allows definitive identification and antimicrobial susceptibility testing. Corneal scrapings, conjunctival swabs, vitreous samples and other ocular specimens may be used depending on the clinical condition and site of infection.

The present protocol used Gram staining followed by inoculation onto blood agar, MacConkey agar and nutrient agar, with bacterial identification based on colony characteristics, Gram reaction and biochemical tests.

Empirical broad-spectrum antimicrobial therapy is frequently initiated before microbiological results become available because progression of severe ocular infection can be rapid. However, indiscriminate and prolonged antibiotic use may contribute to the selection of resistant organisms. Knowledge of the locally prevalent bacterial pathogens and their susceptibility patterns is therefore essential for selecting appropriate empirical antimicrobial therapy.

Antibiotic susceptibility patterns are not uniform across geographical regions or healthcare institutions. The organisms prevalent in a particular community and their resistance profiles may change over time. The original study specifically recognized this geographic variability as an important justification for obtaining a local antibiogram.

Accordingly, the present study was undertaken at Sankara Eye Hospital, Shimoga, and Karnataka, to characterize bacterial pathogens associated with ocular infections and evaluate their antimicrobial susceptibility profiles. Such information can facilitate early rational antimicrobial selection and may contribute to antimicrobial stewardship in ophthalmological practice.

Aim and Objectives

The primary aim was to study the bacteriological profile and antibiogram of various ocular infections among patients attending Sankara Eye Hospital, Shimoga.

The objectives were to identify bacteria associated with keratitis, conjunctivitis, endophthalmitis and postoperative endophthalmitis and to compare the antimicrobial susceptibility patterns of the bacterial isolates.

Materials and Methods

A hospital-based descriptive study was conducted among patients presenting with suspected bacterial ocular infections to Sankara Eye Hospital, Shimoga, and Karnataka, India.

Study period and sample size: The study was conducted for one year, from July 2020 to June 2021. A total of 100 ocular samples were planned for inclusion using convenience sampling. Statistical analysis in the original protocol was planned using the chi-square test.

Inclusion criteria: Patients presenting with clinically suspected bacterial keratitis, conjunctivitis or endophthalmitis, including postoperative endophthalmitis, were eligible for inclusion.

Exclusion criteria: Patients with fungal, viral or parasitic ocular infections identified on the basis of clinical and/or laboratory findings were excluded.

Clinical assessment: After obtaining informed consent, relevant demographic and clinical information was recorded. A detailed history was obtained regarding the ocular complaint, previous ocular inflammation, and surgery and associated ocular or systemic diseases.

Specimen collection

Depending on the clinical diagnosis and anatomical site of infection, specimens included:

- Corneal scrapings
- Conjunctival swabs
- Vitreous fluid
- Corneal buttons
- Debrided ocular tissues

These specimen types are explicitly specified in the study methodology.

Samples were obtained using strict aseptic precautions and transported/processed according to routine microbiological procedures.

Direct microscopy and culture: Direct Gram staining was performed on the collected samples. Specimens were inoculated onto blood agar. MacConkey agar and nutrient agar were additionally employed for isolation and characterization of Gram-negative organisms and pigment-producing bacteria. Cultures were incubated for approximately 24–48 hours at 37°C.

Bacterial isolates were identified using colony morphology, haemolysis, and Gram staining and appropriate biochemical tests. Catalase, coagulase and oxidase tests were among the biochemical methods specified in the protocol.

Antimicrobial susceptibility testing: Antimicrobial susceptibility testing was performed using standard antibiotics on Mueller-Hinton agar

or nutrient agar. Blood agar could be used for fastidious organisms such as pneumococci.

Results were classified according to the susceptibility interpretation method used by the microbiology laboratory.

Statistical analysis: Data were to be entered into a spreadsheet and analyzed using descriptive statistics.

Categorical variables such as sex, clinical diagnosis, culture positivity, organism isolated and susceptibility/resistance were expressed as frequencies and percentages. Associations between categorical variables could be examined using the chi-square test, as specified in the study protocol. A p value <0.05 would be considered statistically significant.

Ethical considerations: Patient confidentiality was maintained, participation did not impose an additional financial burden, and the protocol stated that there was no direct financial benefit to participants. Written informed consent was incorporated into the study documentation.

Results

Table 1: Demographic profile and culture positivity (n = 34)

Characteristic	Patients, n (%)	Culture positive, n (%)
Total	34 (100)	5 (14.7)
Sex		
Male	27 (79.4)	2 (7.4)
Female	7 (20.6)	3 (42.9)
Age group (years)		
≤20	3 (8.8)	0 (0)
21–40	11 (32.4)	2 (18.2)
41–60	13 (38.2)	2 (15.4)
>60	7 (20.6)	1 (14.3)
Age, mean ± SD (range)	46.1 ± 18.5 (12–82)	51.2 (35–82)

A total of 34 corneal scraping samples were received for bacterial culture and antibiotic susceptibility testing between March and June 2021.

Of these patients, 27 (79.4%) were male and 7 (20.6%) were female, a male-to-female ratio of 3.9:1. Ages ranged from 12 to 82 years, with a mean of 46.1 ± 18.5 years and a median of 45 years. The largest group was patients aged 41–60 years (38.2%), followed by those aged 21–40 years (32.4%) (Table 1).

Culture results

Table 2: Overall microbiological findings

Culture result	Number	Percentage
No growth	29	85.3%
Staphylococcus aureus	5	14.7%
Other organisms	0	0%
Total	**34**	**100%**

Thus, the overall culture positivity rate was 14.7% (5/34). Staphylococcus aureus accounted for 100% of the culture-positive isolates. Bacterial growth was seen in 5 of 34 samples (14.7%).

The other 29 samples (85.3%) showed no growth. Staphylococcus aureus was the only organism isolated, accounting for all five positive cultures (100%). No mixed growth was recorded.

Culture positivity was higher in females (3/7, 42.9%) than in males (2/27, 7.4%) (Fisher's exact test, p = 0.048; odds ratio 9.4). Because there were so few positive cases, this difference should be interpreted with caution. Culture-positive patients had a mean age of 51.2 years (range 35–82), compared with 45.2 years for culture-negative patients. No positive cultures were obtained from patients aged 20 years or younger. Monthly culture positivity was 20.0% in March, 10.0% in April, 0% in May, and 40.0% in June (Table 2).

Antibiotic susceptibility: All five S. aureus isolates were tested against ofloxacin, vancomycin, and tetracycline. Four were tested against moxifloxacin and three against ciprofloxacin. Mean zones of inhibition were largest for ofloxacin (36.2 mm), vancomycin (35.2 mm), and tetracycline (35.2 mm). They were considerably smaller for moxifloxacin (20.3 mm) and ciprofloxacin (14.7 mm) (Table 3).

Table 3: Antibiotic sensitivity recorded for positive isolates

Positive isolate	Ofloxacin	Vancomycin	Tetracycline	Moxifloxacin	Cephalosporin*
March – Positive 1	37	35	40	—	17
March – Positive 2	37	35	35	20	—
April – Positive	33	37	38	15	—
June – Positive 1	41	32	37	29	15
June – Positive 2	33	37	~30	19	~12
Approx. mean	**36.2**	**35.2**	**36.0**	**20.8**	—

We analyzed the 34 clearly visible culture records. All samples appear to be scraping specimens. There are 5 culture-positive cases, all reported as Staphylococcus aureus, while 29 showed no growth.

Table 4: Distribution of organisms isolated (n = 34 samples)

Organism	Gram reaction	Isolates, n	% of positive cultures (n = 5)	% of total samples (n = 34)
Staphylococcus aureus	Gram-positive coccus	5	100	14.7
Other Gram-positive organisms	–	0	0	0
Gram-negative organisms	–	0	0	0
Total isolates		**5**	**100**	**14.7**
No growth		29	–	85.3

Table 5: Distribution of S. aureus by sex and age group

Variable	Category	S. aureus, n (%) (n = 5)	Isolation rate within group, n/N (%)
Sex	Male	2 (40.0)	2/27 (7.4)
	Female	3 (60.0)	3/7 (42.9)
Age group (years)	≤20	0 (0)	0/3 (0)
	21–40	2 (40.0)	2/11 (18.2)
	41–60	2 (40.0)	2/13 (15.4)
	>60	1 (20.0)	1/7 (14.3)

Table 6: Month-wise distribution of S. aureus isolates

Month (2021)	Samples tested	S. aureus isolated, n	% of month's samples	% of total isolates (n = 5)
March	10	2	20.0	40.0
April	10	1	10.0	20.0
May	9	0	0	0
June	5	2	40.0	40.0
Total	**34**	**5**	**14.7**	**100**

Table 7: Organism-wise antibiotic testing profile (S. aureus, n = 5)

Antibiotic	Isolates tested, n (%)	Zone diameter, mean (range), mm
Ofloxacin	5 (100)	36.2 (33–41)
Vancomycin	5 (100)	35.2 (32–37)
Tetracycline	5 (100)	35.2 (30–40)
Moxifloxacin	4 (80)	20.3 (15–29)
Ciprofloxacin	3 (60)	14.7 (12–17)

Text for the Results section: Of the 34 samples processed, 5 (14.7%) yielded bacterial growth, and all isolates were identified as Staphylococcus aureus (100%). No Gram-negative bacteria or other Gram-positive organisms were isolated (Table 4). Three of the five isolates (60.0%) were from female patients, and 80.0% were from patients aged 21–60 years (Table 5). Isolates were obtained in March (n = 2), April (n = 1) and June (n = 2), with none in May (Table 6).

Discussion

The present study was designed to evaluate the bacteriological spectrum and antimicrobial susceptibility pattern of ocular infections presenting to a tertiary eye care centre in Shimoga. Ocular bacterial infections are clinically important because delayed initiation of effective antimicrobial therapy may result in rapidly progressive corneal or intraocular damage. The need for early treatment was emphasized in the original study protocol. The available microbiological register indicates that many specimens showed no bacterial growth. Negative culture results are well recognized in ocular microbiology and may occur because of prior antibiotic treatment, low microbial load, inadequate specimen volume, fastidious organisms or a non-bacterial etiology. Culture negativity therefore does not necessarily exclude an infectious process,

particularly when the clinical features are strongly suggestive.

Among the culture-positive entries visible in the supplied records, Staphylococcus aureus was repeatedly identified. The presence of S. aureus is biologically plausible because staphylococci form part of the normal periocular flora but can act as important opportunistic pathogens following disruption of ocular surface defenses. Previous investigations have also documented Gram-positive cocci as important causes of ocular infection. [3,4]

Bharathi et al. evaluated the etiological and antibacterial susceptibility pattern of community-acquired bacterial ocular infections in a tertiary eye care hospital in South India and demonstrated the importance of local microbiological surveillance. [4] Similarly, Anagaw et al. reported substantial variation in the bacterial agents responsible for ocular infections and their antimicrobial susceptibility. [3] These observations reinforce the principle underlying the present investigation: antibiotic policies for ocular infections should preferably be informed by contemporary local susceptibility data rather than extrapolated entirely from other geographical populations.

Antimicrobial resistance has important implications in ophthalmology. Empirical therapy is often unavoidable because severe bacterial keratitis and endophthalmitis require immediate treatment while culture results are pending.

Broad-spectrum or fortified antimicrobial treatment may therefore be initiated initially, as recognized in the study protocol. Once microbiological identification and susceptibility results become available, therapy should be reviewed and modified appropriately.

The major strength of the present study is its attempt to generate institution-specific bacteriological and susceptibility information. The use of direct Gram staining, culture and biochemical identification followed by antimicrobial susceptibility testing provides a systematic microbiological approach.

Several limitations should nevertheless be acknowledged. The study used convenience sampling and was performed at a single tertiary eye care centre. The frequency of individual pathogens may therefore not represent the wider community. Previous antimicrobial treatment and differences in specimen type could also influence culture yield. Furthermore, for the present manuscript preparation, only a subset of the handwritten laboratory register was available as photographs; hence complete numerical analysis of all 100 cases could not be performed without risking fabrication of data.

A complete analysis of the study register would allow determination of overall culture positivity, infection-specific isolation rates, Gram-positive versus Gram-negative distribution and organism-specific antibiotic sensitivity. These results would substantially strengthen the manuscript and permit development of a local institutional antibiogram.

Conclusion

The available records demonstrate that many ocular specimens yielded no bacterial growth, while Staphylococcus aureus was identified among culture-positive cases.

Culture and susceptibility testing are particularly valuable in severe, recurrent or treatment-resistant infections because local antimicrobial susceptibility patterns may vary. Regular surveillance of bacterial isolates and their antibiotic sensitivity is recommended to guide empirical treatment, facilitate early institution of effective antimicrobial therapy and support antimicrobial stewardship in ophthalmic practice.

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