



## Original Research Article

# EVALUATION OF CONJUNCTIVAL FLORA IN PREOPERATIVE AND POSTOPERATIVE PATIENTS UNDERGOING ANY OCULAR SURGERY AND USING TOPICAL ANTIBIOTIC FOR 2 WEEKS AND STEROID FOR 6 WEEKS

Chatti Ramakrishna<sup>1</sup>, Chodipelli Gurumurthy<sup>2</sup>, K Ramalakshmi<sup>3</sup>, Pavani Inapa<sup>4</sup>, Srujana Thota<sup>5</sup>

<sup>1</sup>Assistant Professor, Department of Ophthalmology, Government Medical College, Srikakulam, Andhra Pradesh, India.

<sup>2</sup>Assistant Professor, Department of Ophthalmology, Government Medical College, Srikakulam, Andhra Pradesh, India.

<sup>3</sup>Associate Professor, Department of Microbiology, Government Medical College, Srikakulam, Andhra Pradesh, India.

<sup>4</sup>Junior Resident, Department of Microbiology, Government Medical College, Srikakulam, Andhra Pradesh, India.

<sup>5</sup>Junior Resident, Department of Ophthalmology, Government Medical College, Srikakulam, Andhra Pradesh, India.

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### Corresponding Author:

**Dr. Chatti Ramakrishna,**  
Assistant Professor, Department of  
Ophthalmology, Government Medical  
College, Srikakulam, Andhra Pradesh,  
India.  
Email: rama93krishna@gmail.com

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### ABSTRACT

**Background:** The conjunctival sac harbours resident microorganisms that may act as opportunistic pathogens during ocular surgery. Perioperative topical medications can alter this microbial milieu and influence culture positivity. **Objectives:** To characterize preoperative conjunctival bacterial and fungal flora and to assess postoperative culture status at six weeks following elective ocular surgery along with their antimicrobial susceptibility patterns.

**Materials and Methods:** This prospective observational study enrolled 100 adults posted for elective ocular surgery at a tertiary care hospital. Conjunctival swabs were collected from the inferior fornix on Day 0 (preoperatively, before instillation of any topical drops) and repeated at six weeks postoperatively (Day 42). Samples underwent bacterial and fungal culture with organism identification and antimicrobial sensitivity testing.

**Results:** The mean age was 59.8 ± 11.6 years (range 38–78 years), with females comprising 58% (n = 58) and males 42% (n = 42). Cataract surgery constituted 90% (n = 90) of procedures (SICS 86; phacoemulsification 4), and pterygium excision 10% (n = 10). Preoperative bacterial cultures were positive in 18% (n = 18) of the study participants. *Acinetobacter baumannii* was the most frequent bacterial isolate (7/18; 38.9%), followed by *Staphylococcus aureus* (5/18; 27.8%); coagulase-negative staphylococci (*Staphylococcus epidermidis*) and *Enterococcus faecalis* were each 11.1% (2/18), while *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* were each 5.6% (1/18). Preoperative fungal culture was negative in all the cases. All the bacteria isolated in preoperative cultures showed sensitivity to fluoroquinolone group of antibiotics (Gatifloxacin, Moxifloxacin, Ciprofloxacin) and showed resistance to Erythromycin. At six weeks postoperatively, all 100 cases were sterile on both bacterial and fungal cultures.

**Conclusion:** Preoperative conjunctival colonization was detected in a minority of cases, with *Acinetobacter baumannii* as the leading isolate in this cohort. Universal culture sterility at six weeks indicates substantial postoperative reduction in microbial growth, supporting the efficacy of the antibiotic policy being followed at the institute. Conduction of similar studies at regular intervals will serve as surveillance studies which in turn will help in tailoring rational perioperative prophylaxis in ocular surgery. Preoperative Conjunctival swabs would offer an extra edge of protection in medicolegal cases if any arise in an event of postoperative endophthalmitis.

**Keywords:** Conjunctival flora; ocular surgery; cataract surgery; conjunctival culture; *Acinetobacter*; ocular surface microbiome; medicolegal aspects.

## INTRODUCTION

Postoperative endophthalmitis is an uncommon yet vision-threatening complication of intraocular surgery. In most cases, the causative organisms originate from the patient's own ocular surface, particularly the conjunctival sac and eyelid margin flora, which can enter the anterior chamber during surgery despite aseptic precautions.<sup>[1,2]</sup> Coagulase-negative staphylococci, especially *Staphylococcus epidermidis*, are frequently implicated as commensals that become opportunistic pathogens when surgical barriers are breached.<sup>[3]</sup> Consequently, understanding local conjunctival colonization and antimicrobial susceptibility is clinically relevant for infection prevention strategies.

Preoperative antisepsis using povidone-iodine is widely regarded as a cornerstone measure for reducing bacterial load on the ocular surface.<sup>[4,5]</sup> Alongside antisepsis, topical antibiotics are often used to further suppress conjunctival flora, although practices vary by region and institutional protocols. Fluoroquinolones, including Gatifloxacin and Moxifloxacin, are commonly selected because of their broad spectrum and favorable ocular tissue penetration.<sup>[6]</sup> However, antimicrobial exposure can select for resistant strains, and rising fluoroquinolone resistance among ocular surface isolates has been described in multiple settings.<sup>[3,7]</sup> In addition, systemic comorbidities such as Diabetes Mellitus have been associated with altered conjunctival bacterial patterns and higher colonization rates, emphasizing that host factors also shape microbial ecology.<sup>[2,8]</sup>

After ocular surgery, topical corticosteroids are routinely prescribed to control inflammation, reduce pain, and limit scarring. Prednisolone acetate is frequently used in tapering regimens over several weeks, particularly after cataract, trabeculectomy, and pterygium surgeries. While corticosteroids are valuable anti-inflammatory agents, prolonged topical steroid exposure can influence the ocular surface environment by modifying local immune responses and tear film dynamics, potentially affecting microbial persistence and recolonization.<sup>[9,10]</sup> Additionally, when antibiotics are used for a short duration and steroids continue for longer periods, the net effect on conjunctival flora at follow-up can differ from the immediate perioperative effect.

Most published work has focused on preoperative conjunctival flora and susceptibility patterns in cataract surgery cohorts.<sup>[1-3]</sup> Data describing postoperative conjunctival flora after completion of a typical antibiotic course followed by several weeks of topical steroids remain limited in many Indian tertiary care settings. Local epidemiology is important because flora composition and resistance patterns differ across geographies, antibiotic availability, and prescribing behaviors.<sup>[3,7]</sup>

The objectives of this study were to characterize the preoperative conjunctival bacterial and fungal flora

and associated antimicrobial susceptibility patterns among adults undergoing elective ocular surgery, and to assess the postoperative conjunctival culture status at six weeks following two weeks of topical Gatifloxacin and six weeks of tapering topical Prednisolone therapy.

## MATERIALS AND METHODS

### Study Setting and Design

The study was conducted in the Department of Ophthalmology in collaboration with the Department of Microbiology, Government Medical College/Government General Hospital, Srikakulam, India, over a six-month period from June 2025 to November 2025, using a prospective observational study design.

**Study population:** Adults aged  $\geq 18$  years posted for primary elective ocular surgery at the Department of Ophthalmology were screened and enrolled after written informed consent. In the present dataset, the elective procedures included cataract surgery (SICS-Small Incision Cataract Surgery or phacoemulsification), Trabeculectomy and Pterygium excision.

**Eligibility criteria:** Patients aged  $\geq 18$  years undergoing elective ocular surgery for the first time and willing to comply with the institutional postoperative topical regimen were included. Exclusion criteria were pre-existing ocular surface infections or significant ocular surface disease, chronic topical antimicrobial or steroid use, history of any prior ocular surgery, current systemic or ocular antibiotic/steroid therapy, and immunocompromised states such as HIV (Human Immunodeficiency Virus) infection or ongoing chemo-radiotherapy.

**Sample size:** A total of 100 eyes from 100 patients were included. Sample size estimation was based on a presumed conjunctival culture positivity prevalence of 40% from prior studies, with 95% confidence and 10% absolute precision, yielding 96 using the formula  $N = 4pq/L^2$  ( $p = 0.40$ ;  $q = 0.60$ ;  $L = 0.10$ ), which was rounded up to 100.

**Preoperative evaluation:** All participants underwent standardized ophthalmic assessment including best-corrected visual acuity, slit-lamp biomicroscopy, intraocular pressure measurement, and fundus examination as feasible. Additional investigations (e.g., A-scan, B-scan, Keratometry, IOL Power Calculation, Syringing of the Lacrimal Sac) were performed as clinically indicated according to surgical requirement.

**Conjunctival swab collection and transport:** Conjunctival sampling was performed from the eye to be operated using a sterile cotton-tipped applicator. On Day 0 (preoperatively), the swab was gently rubbed over the inferior conjunctival fornix before instillation of any topical agents such as anaesthetics, mydriatics or antimicrobials. Two swabs were obtained from each participant—one for bacterial culture and one for fungal culture—and transported

to the microbiology laboratory within one hour of collection. Moist cotton tipped applicators were used for sample to be sent for bacterial culture and dry cotton tipped applicator was used for sample to be sent for fungal culture.

**Microbiological processing:** Swabs were processed in the Department of Microbiology using standard culture methods for isolation and identification of bacterial and fungal organisms. Antimicrobial susceptibility testing was performed for bacterial isolates by disc diffusion method as per CLSI (The Clinical and Laboratory Standards Institute) guidelines.

**Postoperative regimen and follow-up sampling:**

All participants received topical Gatifloxacin 0.3% eye drops six times daily for two weeks. Topical prednisolone acetate 1% eye drops were administered for six weeks in a tapering schedule: 6 times/day for week 1, 5 times/day for week 2, 4 times/day for week 3, 3 times/day for week 4, 2 times/day for week 5, and 1 time/day for week 6. Repeat conjunctival swabbing was performed at Day 42 (six-week follow-up) using the same technique done preoperatively,

and samples were processed similarly for bacterial and fungal cultures and susceptibility testing.

**Data management and statistical analysis:** Data were entered into a master sheet and summarized using descriptive statistics. Categorical variables were presented as frequency and percentage, and continuous variables as mean  $\pm$  SD (Standard Deviation) and range. Preoperative and postoperative culture positivity and organism distribution were compared descriptively to characterize temporal changes.

**RESULTS**

A total of 100 eyes from 100 patients were analysed. The mean age of the cohort was  $59.8 \pm 11.6$  years (range: 38–78 years). Females constituted 58% (n = 58) and males 42% (n = 42) (Table 1).

Regarding the distribution of surgical procedures, cataract surgery accounted for 90% (n = 90) of operations, with SICS performed in 86 cases and phacoemulsification in 4 cases. Pterygium excision represented the remaining 10% (n = 10). [Table 1]

**Table 1: Baseline demographic and surgical characteristics (n = 100)**

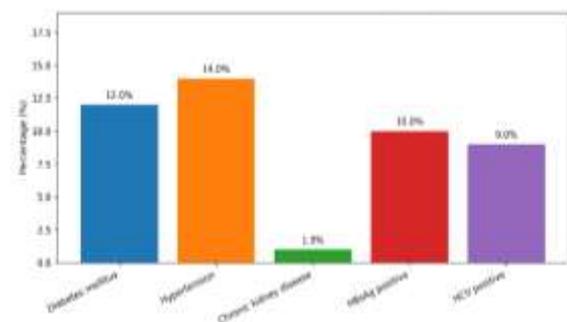
Variable	Category	Frequency (n)	Percentage (%)
Age (years)	Mean $\pm$ SD	59.8 $\pm$ 11.6	—
	Range	38–78	—
Gender	Female	58	58.0
	Male	42	42.0
Type of surgery	Cataract surgery (total)	90	90.0
	SICS	86	86.0
	Phacoemulsification	4	4.0
	Pterygium excision	10	10.0

Systemic comorbidities were documented in a subset of participants, including hypertension (n = 14; 14.0%), diabetes mellitus (n = 12; 12.0%), and chronic kidney disease (n = 1; 1.0%). Viral coinfections were also noted, with HBsAg positivity in 10 patients (10.0%) and HCV positivity in 9 patients (9.0%) (Table 2, Figure 1).

**Table 2: Comorbidities and viral coinfections (n = 100)**

Parameter	Frequency (n)	Percentage (%)
Diabetes mellitus	12	12.0
Hypertension	14	14.0
Chronic kidney disease	1	1.0
HBsAg positive	10	10.0
HCV positive	9	9.0

**Note:** Comorbidities/coinfections may overlap in the same individual.



**Figure 1: Comorbidities and Viral Coinfections**

Preoperatively (Day 0), conjunctival bacterial culture was sterile in 82 cases (82.0%) and culture-positive in 18 cases (18.0%) (Table 3). Among the culture-positive isolates (n = 18), Acinetobacter baumannii was the most frequently recovered organism (7/18; 38.9%), followed by Staphylococcus aureus (5/18; 27.8%). Coagulase-negative Staphylococcus (Staphylococcus epidermidis) and Enterococcus faecalis species were each identified in 2 cases (11.1% each), while Pseudomonas aeruginosa and Klebsiella pneumoniae species were isolated in 1 case each (5.6% each) (Table 3, Figure 2).

**Table 3: Preoperative bacterial culture results and organism distribution (Day 0)**

Parameter / Organism	Frequency (n)	Percentage (%)
Bacterial culture: Sterile	82	82.0
Bacterial culture: Positive growth	18	18.0
<b>Organisms isolated among bacterial culture-positive cases (n = 18)</b>		
Acinetobacter baumannii	7	38.9
Staphylococcus aureus	5	27.8
Coagulase-negative Staphylococcus (Staphylococcus epidermidis)	2	11.1
Enterococcus faecalis	2	11.1
Pseudomonas aeruginosa	1	5.6
Klebsiella pneumoniae	1	5.6

Preoperative fungal culture (Day 0) demonstrated no growth in all 100 cases (100%). [Table 4]

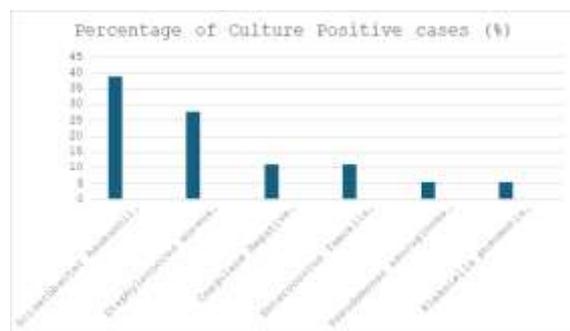
**Table 4: Preoperative fungal culture results (Day 0)**

Parameter	Frequency (n)	Percentage (%)
Fungal culture: No growth	100	100

**Table 5. Postoperative culture profile at 6 weeks (Day 42)**

Parameter	Frequency (n)	Percentage (%)
Bacterial culture: Sterile	100	100.0
Fungal culture: No growth	100	100.0

At the 6-week postoperative assessment (Day 42), all bacterial and fungal conjunctival cultures were sterile

**Figure 2: Distribution of Bacterial Isolates Among Culture Positive Cases**

## DISCUSSION

This prospective observational study characterized conjunctival flora before elective ocular surgery and at six weeks after a standardized course of topical Gatifloxacin and tapering Prednisolone regimen. The key findings were low preoperative culture positivity (18%), isolation of a mixed bacterial spectrum with *Acinetobacter baumannii* as the most frequent organism. Bacterial cultures done at 6 weeks postoperative period were completely sterile. Cultures for Fungi done preoperatively and 6 weeks postoperatively were completely sterile.

In many settings, Gram-positive cocci particularly coagulase-negative staphylococci dominate the conjunctival sac and are well-recognized as potential source organisms for postoperative endophthalmitis.<sup>[9]</sup> Large series evaluating

(100%; n = 100), indicating complete microbiological clearance at follow-up. [Table 5]

All the bacteria isolated in the culture showed sensitivity to Fluoroquinolone group of Antibiotics (Ciprofloxacin, Gatifloxacin, Moxifloxacin and Levofloxacin), Aminoglycosides (Amikacin) and other higher group of antibiotics (Ureidopenicillin-Piperacillin, Cephalosporins-Cefopodoxime, Carbapenems-Imipenem, Monobactams-Aztreonam, Glycopeptide Antibiotic-Vancomycin). Resistance was seen to lower antibiotics of the macrolide group (Erythromycin).

preoperative ocular surface flora similarly describe Gram-positive predominance, while also highlighting that culture positivity rates and organism profiles vary with local epidemiology, sampling methods, and patient-level factors.<sup>[10]</sup> In contrast, our isolate pattern showed an equal distribution of Gram-positive and Gram-negative bacteria among positive cultures, with *Acinetobacter baumannii* emerging as the leading isolate. This divergence is plausibly attributable to regional or hospital-specific microbial ecology, reinforcing the concept that conjunctival flora is geographically heterogeneous and should not be assumed to mirror patterns reported elsewhere.<sup>[10]</sup> The transition from 18% preoperative positivity to universal sterility at six weeks is biologically plausible. All the bacteria isolated in our study showed sensitivity to Fluoroquinolone group of antibiotics and other higher antibiotics. Topical fluoroquinolones can suppress susceptible conjunctival commensals and reduce ocular surface bacterial load, with prior work demonstrating meaningful reductions in conjunctival and eyelid bacterial counts after topical Gatifloxacin or Moxifloxacin exposure.<sup>[6]</sup> Although our study did not include early serial postoperative cultures to map the trajectory of recolonization, the Day 42 findings indicate that culture positivity remained absent at the end of the steroid taper. At the same time, interpretation should consider that conventional culture methods detect only cultivable organisms; subclinical recolonization below culture thresholds or shifts in uncultured taxa cannot be excluded.

Because postoperative cultures were uniformly sterile, a direct within-subject comparison of antimicrobial susceptibility patterns over time was not feasible in the updated dataset. Nevertheless, antimicrobial stewardship remains relevant in ocular surgery practice. Increasing fluoroquinolone resistance among ocular surface isolates—especially staphylococci—has been repeatedly reported, and selection pressure from topical antibiotic exposure is a recognized concern.<sup>[7,11]</sup> These observations support continued local surveillance of preoperative isolates and resistance profiles to guide rational prophylaxis and therapeutic choices.<sup>[10,11]</sup>

Infection prevention in cataract and other ocular surgeries remains multifactorial. Preoperative povidone-iodine antiseptics has robust evidence for lowering conjunctival bacterial load and reducing endophthalmitis risk.<sup>[4,5]</sup> Intracameral antibiotics have also demonstrated benefit in reducing postoperative endophthalmitis in large studies, although uptake and protocols vary across institutions.<sup>[12-14]</sup> Against this backdrop, the prominence of *Acinetobacter baumannii* in our preoperative cultures and the complete postoperative sterility emphasize the value of center-specific microbiological data to refine perioperative strategies in line with local epidemiology and stewardship principles.<sup>[10,12-14]</sup>

#### Limitations

This study primarily used descriptive analyses without inferential testing, and conjunctival flora patterns were not stratified by individual comorbidities (e.g., diabetes mellitus, hypertension, viral coinfections) or by procedure type (SICS, phacoemulsification, pterygium excision). Postoperative sampling was performed only at six weeks; therefore, early postoperative microbial dynamics and the short-term effect of the two-week antibiotic course could not be evaluated. Because all postoperative cultures were sterile, postoperative organism-specific comparisons and longitudinal antimicrobial susceptibility assessment were not feasible. Anaerobic cultures and molecular microbiome profiling were not performed, which may have limited detection of fastidious or non-cultivable organisms and precluded assessment of broader community shifts in the ocular surface microbiota.

### CONCLUSION

In adults undergoing elective ocular surgery, preoperative conjunctival bacterial cultures were positive in 18%. Among culture-positive samples, *Acinetobacter baumannii* was the most frequent isolate, followed by *Staphylococcus aureus*. After two weeks of topical Gatifloxacin and six weeks of tapering Prednisolone, all conjunctival cultures were sterile at six weeks for both bacterial and fungal growth. All the bacteria isolated were sensitive to

Fluoroquinolone group of antibiotics and other higher antibiotics.

*Acinetobacter baumannii* was the most common organism observed in the conjunctival flora in this geographical region of Srikakulam District of Andhra Pradesh in India.

Post Operative cultures of the conjunctiva were Sterile in all the patients enrolled in the study. There were no cases of acute postoperative endophthalmitis and other ocular infections in the first 6 weeks postoperative period indicating that the antibiotic policy currently being followed at our institute is efficacious in controlling ocular infections arising in the perioperative and postoperative period of ocular surgeries. This study served as a surveillance study supporting the efficacy of the current antibiotic policy being followed at our institute.

Periodic conduction of similar studies will serve as surveillance studies and will also help us in identifying emerging pathogens of the ocular surface and their antimicrobial resistance patterns which will aid in periodic modifications of the antibiotic policy of the institute.

This study also shows that topical prednisolone eye drops did not cause colonization of any new bacteria or fungi in the conjunctiva despite its usage for 6 weeks showing that topical prednisolone acetate 1% is safe in this postoperative period with respect to the alterations in the ocular surface microbiome.

This study can also be used as a baseline study for the study participants. If any of the participants of this study develop any ocular infections in the future, the results of this study could provide a clue to the possible causative microorganism and also could help in guiding the antimicrobial therapy.

Last, but not the least, and an important aspect in the current scenario of clinical practice is the medicolegal part. Preoperative culture of Conjunctival sac can be done before every ocular surgery if the surgeon desires which will give the surgeon an extra edge of protection in Medicolegal cases if any arise due to occurrence of postoperative endophthalmitis or any other postoperative ocular infections.

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