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COMPARATIVE EFFICACY OF INTRACAMERAL 0.5% MOXIFLOXACIN VERSUS 0.1% CEFUROXIME IN PREVENTING POSTOPERATIVE ENDOPHTHALMITIS FOLLOWING PHACOEMULSIFICATION CATARACT SURGERY: A RANDOMIZED CONTROLLED TRIAL

Original Research (ID: 1680)

Dr Saima Khalid[1]*, Dr Bahadur Iftikhar[2], Dr. Muhammad Qasim Yazar[3], Dr. Wazir Muhammad Hasan[4]
[1]FCPS Resident Ophthalmology, Mayo Hospital Lahore
[2]Senior Registrar Ophthalmology, Allied Hospital-II, Faisalabad
[3]PGR FCPS Ophthalmology, Mayo Hospital Lahore
[4]Consultant Ophthalmology, RHQ Hospital Skardu
Corresponding Author: Dr Saima Khalid, FCPS Resident Ophthalmology, Mayo Hospital Lahore, saimakhalid096@gmail.com
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ABSTRACT

Background: Postoperative endophthalmitis is an uncommon but vision-threatening complication of cataract surgery that can result in serious ocular morbidity if not prevented or treated promptly. Intracameral antibiotic prophylaxis has become an important preventive strategy in modern phacoemulsification surgery. Cefuroxime and moxifloxacin are commonly used agents, but comparative local evidence remains limited. This study was conducted to compare their prophylactic efficacy in preventing postoperative endophthalmitis after cataract surgery.

Objective: To compare the efficacy of intracameral 0.5% moxifloxacin and intracameral 0.1% cefuroxime in preventing postoperative endophthalmitis following phacoemulsification cataract surgery.

Methods: This randomized controlled trial was conducted at the Institute of Ophthalmology, Mayo Hospital, Lahore, over six months from 27 June 2022 to 27 December 2022. A total of 60 patients aged 50–70 years undergoing phacoemulsification cataract surgery were enrolled through non-probability consecutive sampling and randomly allocated into two equal groups by lottery method. Group A received intracameral cefuroxime 1 mg in 0.1 mL saline, while Group B received intracameral moxifloxacin 100 µg in 0.1 mL saline at the end of surgery. Patients were followed for six weeks postoperatively to assess prophylactic efficacy. Data were analyzed using SPSS version 25, with $p \leq 0.05$ considered statistically significant.

Results: The mean age was 60.13 ± 5.84 years in the cefuroxime group and 59.56 ± 5.41 years in the moxifloxacin group. Mean disease duration was 2.33 ± 0.80 weeks and 2.36 ± 0.72 weeks, respectively, with no significant difference (p=0.866). In the cefuroxime group, 11 patients were male and 19 were female, while in the moxifloxacin group, 16 were male and 14 were female (p=0.299). Efficacy was achieved in 20 patients in the cefuroxime group and 28 patients in the moxifloxacin group, showing a statistically significant difference (p=0.021).

Conclusion: Intracameral moxifloxacin demonstrated higher prophylactic efficacy than intracameral cefuroxime in preventing postoperative endophthalmitis after phacoemulsification cataract surgery. These findings support its potential use as an effective intracameral antibiotic option in routine cataract surgery.

Keywords: Anti-Bacterial Agents; Cataract Extraction; Cefuroxime; Endophthalmitis; Moxifloxacin; Phacoemulsification; Postoperative Complications.

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INTRODUCTION

Postoperative endophthalmitis remains one of the most feared complications of cataract surgery because, although uncommon, it can lead to severe and sometimes irreversible visual loss. Cataract surgery is among the most frequently performed ophthalmic procedures worldwide, and phacoemulsification has made the procedure safer, faster, and more predictable. However, even with modern surgical techniques, strict aseptic measures, and postoperative topical medications, the possibility of intraocular infection cannot be completely eliminated. Endophthalmitis involves inflammation of the intraocular tissues and fluids, usually due to microbial contamination, and may progress rapidly if not recognized and treated in time. Visual damage may occur through several mechanisms, including bacterial toxins, retinal necrosis, vascular occlusion, retinal detachment, and structural injury to delicate intraocular tissues. Nevertheless, early diagnosis and timely management can preserve useful vision in many cases, particularly when significant anatomical damage has not yet occurred (1, 2). The global incidence of postoperative endophthalmitis after cataract surgery is low, commonly reported between 0.02% and 0.08%, but its clinical importance is much greater than its frequency suggests (3, 4). A single case may result in profound visual disability, emotional distress, repeated hospital visits, additional treatment costs, and loss of confidence in surgical care. Patients usually present with reduced vision, ocular pain, redness, hypopyon, eyelid swelling, and corneal edema, features that often require urgent intervention (5). For this reason, prevention remains the most practical and valuable strategy. Alongside povidone-iodine antisepsis, careful wound construction, sterile surgical technique, and postoperative topical antibiotics, intracameral antibiotic administration at the end of cataract surgery has gained considerable attention as a direct method of reducing bacterial contamination within the anterior chamber.

Intracameral antibiotics are increasingly used because they deliver a high concentration of antimicrobial drug directly into the eye at the time when contamination is most likely to occur. Among these agents, cefuroxime and moxifloxacin are among the most commonly used options in cataract surgery prophylaxis (6). Cefuroxime has been widely adopted in many clinical settings and has shown important benefit in reducing postoperative endophthalmitis. However, concerns remain regarding dilution errors, preparation-related complications, spectrum of coverage, and emerging bacterial resistance. Cefazoline has also been used in some settings, while vancomycin and moxifloxacin have been considered in response to changing bacterial sensitivity patterns (7, 8). The use of vancomycin, however, is limited by safety concerns, particularly the risk of hemorrhagic occlusive retinal vasculitis, making it less suitable for routine prophylaxis. These limitations have increased interest in moxifloxacin, a fourth-generation fluoroquinolone with broad-spectrum antibacterial activity, good ocular penetration, and convenient availability in preservative-free preparations. Existing literature suggests that intracameral moxifloxacin may be at least comparable, and possibly superior, to cefuroxime in reducing the risk of acute postoperative endophthalmitis. One study reported a preventive efficacy of 66.67% with intracameral cefuroxime and 74.74% with intracameral moxifloxacin in cataract surgery (9). Similarly, Melega et al. reported a lower incidence of endophthalmitis within six weeks among eyes receiving intracameral moxifloxacin, with 1 case among 1818 eyes in the moxifloxacin group compared with 7 cases among 1822 eyes in the control group, showing a statistically significant difference (10). These findings support the potential role of moxifloxacin as an effective prophylactic agent, but the choice of intracameral antibiotic may still vary according to local practice patterns, bacterial profile, availability, cost, safety concerns, and surgeon preference.

Despite international evidence supporting the use of intracameral antibiotics, local data comparing intracameral moxifloxacin and cefuroxime after phacoemulsification cataract surgery remain limited. This gap is important because antimicrobial effectiveness may be influenced by regional microbial patterns, resistance trends, clinical protocols, and healthcare resources. A locally conducted randomized controlled trial can therefore provide more relevant evidence for ophthalmic practice in the target population. The central research question of the present study is whether intracameral 0.5% moxifloxacin is more effective than intracameral 0.1% cefuroxime in preventing postoperative endophthalmitis following phacoemulsification cataract surgery. It is hypothesized that intracameral moxifloxacin may demonstrate superior or at least comparable efficacy to cefuroxime in reducing postoperative endophthalmitis. Therefore, the objective of this study is to compare the efficacy of intracameral 0.5% moxifloxacin versus 0.1% cefuroxime in preventing postoperative endophthalmitis following phacoemulsification cataract surgery, with the aim of supporting evidence-based selection of a safe and effective prophylactic antibiotic for the local population.

METHODS

This randomized controlled trial was conducted at the Institute of Ophthalmology, Mayo Hospital, Lahore, over a six-month period from 27 June 2022 to 27 December 2022. The study was designed to compare the efficacy of intracameral moxifloxacin and intracameral cefuroxime in preventing postoperative endophthalmitis among patients undergoing phacoemulsification cataract surgery. Ethical

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approval was obtained from the Institutional Review Board/Ethical Review Committee of the hospital before the commencement of data collection. Written informed consent was obtained from all participants after explaining the purpose of the study, surgical procedure, possible benefits, potential risks, confidentiality of information, and the voluntary nature of participation. A total of 60 patients diagnosed with cataract and planned for phacoemulsification surgery with intraocular lens implantation were enrolled. Participants were recruited through non-probability consecutive sampling and were subsequently randomized into two equal groups using the lottery method, with 30 patients allocated to each group. Group A received intracameral cefuroxime at the end of surgery, while Group B received intracameral moxifloxacin as prophylactic antibiotic therapy. Patients aged 50 to 70 years with clinically diagnosed cataract and fitness for routine phacoemulsification surgery were included. Patients were excluded if they had a history of previous ocular surgery, active ocular infection or inflammation, traumatic cataract, known hypersensitivity to cefuroxime or moxifloxacin, immunocompromised status, uncontrolled systemic illness, or any ocular condition that could independently increase the risk of postoperative infection or interfere with postoperative assessment.

Baseline demographic and clinical information, including age, gender, duration of cataract-related symptoms, relevant systemic history, ocular history, and preoperative clinical findings, was recorded on a structured proforma. All patients underwent standard preoperative ophthalmic evaluation according to institutional protocol. The surgeries were performed under strict aseptic conditions using a standardized phacoemulsification technique. At the completion of surgery, patients in the cefuroxime group received intracameral cefuroxime 1 mg in 0.1 mL saline, whereas patients in the moxifloxacin group received intracameral moxifloxacin as per the allocated study protocol. Postoperative management and follow-up were carried out according to the same clinical protocol in both groups to minimize performance bias. Patients were followed for six weeks after surgery to assess the occurrence of postoperative endophthalmitis and to determine treatment efficacy. Postoperative assessment included clinical evaluation for reduced vision, ocular pain, redness, corneal edema, anterior chamber reaction, hypopyon, vitreous haze, or any other sign suggestive of intraocular infection. The primary outcome was the prevention of postoperative endophthalmitis during the follow-up period. Efficacy was recorded as a qualitative outcome based on the absence of clinically diagnosed postoperative endophthalmitis within six weeks after phacoemulsification surgery.

The collected data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 25. Quantitative variables, including age and duration of disease or symptoms, were presented as mean and standard deviation. Qualitative variables, including gender, study group, and efficacy status, were expressed as frequencies and percentages. The independent sample t-test was used for comparison of quantitative variables between the two groups where appropriate, while the chi-square test was applied for comparison of categorical variables. A p-value of ≤0.05 was considered statistically significant.

Table: Distribution of Study Participants

Study Group	Number of Patients	Percentage (%)
Cefuroxime Group	30	50.0
Moxifloxacin Group	30	50.0
Total	60	100.0

RESULTS

A total of 60 patients undergoing phacoemulsification cataract surgery were included in the study and were equally allocated into two treatment groups. The cefuroxime group included 30 patients, and the moxifloxacin group also included 30 patients, representing 50.0% of the total sample in each group. The mean age of patients in the cefuroxime group was 60.13 ± 5.84 years, while the mean age in the moxifloxacin group was 59.56 ± 5.41 years. The difference in mean age between both groups was not statistically significant, indicating comparable age distribution at baseline. The mean duration of disease was also similar between the two groups. Patients in the cefuroxime group had a mean disease duration of 2.33 ± 0.80 weeks, whereas patients in the moxifloxacin group had a mean duration of 2.36 ± 0.72 weeks. The difference between the groups was statistically insignificant, with a p-value of 0.866. This showed that both groups were comparable with respect to the reported duration of disease before surgery.

Regarding gender distribution, the cefuroxime group included 11 male patients and 19 female patients, corresponding to 36.7% and 63.3% within the group, respectively. In the moxifloxacin group, 16 patients were male and 14 were female, corresponding to 53.3% and 46.7% within the group, respectively. Overall, the study population included 27 males and 33 females. The difference in gender distribution between the cefuroxime and moxifloxacin groups was not statistically significant, with a p-value of 0.299. The prophylactic efficacy differed between the two treatment groups. In the cefuroxime group, treatment was effective in 20 out of 30 patients, giving an efficacy rate of 66.7%, while 10 patients, or 33.3%, were categorized as not effective. In the moxifloxacin group, treatment was effective in 28 out of 30 patients, giving an efficacy rate of 93.3%, while 2 patients, or 6.7%, were categorized as not effective. Overall, efficacy was observed in 48 out of 60 patients, representing 80.0% of the total sample, while 12 patients, representing 20.0%, were recorded as

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not effective. The difference in efficacy between both groups was statistically significant, with a p-value of 0.021. These findings showed that both study groups were comparable at baseline in terms of age, duration of disease, and gender distribution. However, the recorded prophylactic efficacy was higher in the moxifloxacin group than in the cefuroxime group, with a statistically significant difference between the two groups.

Table: Comparison of Mean Age Between Groups

Group	Mean Age (Years)	Standard Deviation
Cefuroxime Group	60.13	5.84
Moxifloxacin Group	59.56	5.41

Table: Duration of Disease in Study Groups

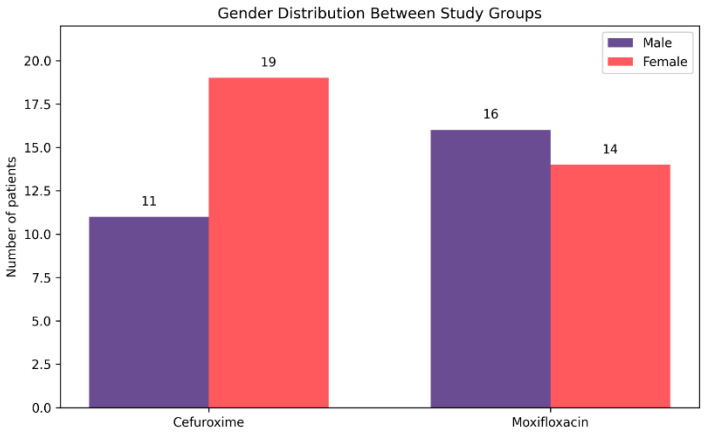
Group	Mean Duration (Weeks)	Standard Deviation	P-value
Cefuroxime Group	2.33	0.80	0.866
Moxifloxacin Group	2.36	0.72	

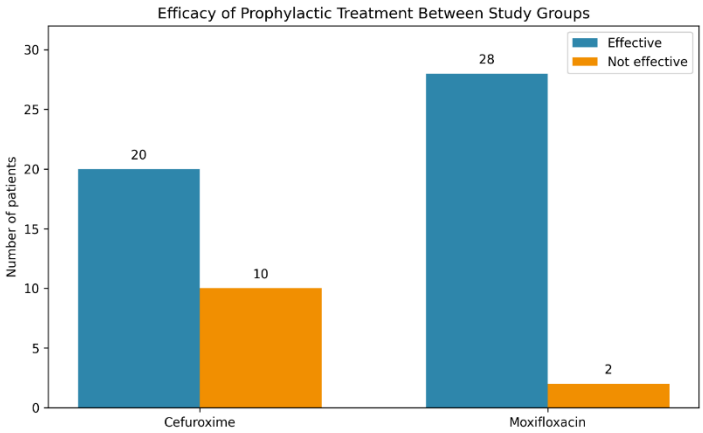
Table: Gender Distribution of Participants

Gender	Cefuroxime Group n (%)	Moxifloxacin Group n (%)	P-value
Male	11 (40.7%)	16 (59.3%)	0.299
Female	19 (57.6%)	14 (42.4%)	

Table: Comparison of Efficacy Between Study Groups

Outcome	Cefuroxime Group n (%)	Moxifloxacin Group n (%)	P-value
Effective	20 (41.7%)	28 (58.3%)	0.021
Not Effective	10 (16.7%)	2 (3.3%)	





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DISCUSSION

Postoperative endophthalmitis remained a clinically important concern after cataract surgery because, despite its low frequency, it carried a serious risk of irreversible visual impairment. The present randomized controlled trial compared intracameral 0.5% moxifloxacin with intracameral 0.1% cefuroxime for the prevention of postoperative endophthalmitis following phacoemulsification cataract surgery. The findings showed that prophylactic efficacy was higher in the moxifloxacin group than in the cefuroxime group. Based on group-wise analysis, efficacy was observed in 28 out of 30 patients in the moxifloxacin group, giving an efficacy rate of 93.3%, compared with 20 out of 30 patients in the cefuroxime group, giving an efficacy rate of 66.7%. This difference was statistically significant, with a p-value of 0.021. These findings suggested that intracameral moxifloxacin provided better prophylactic performance than intracameral cefuroxime in the studied population. The present findings were consistent with previous evidence supporting the role of intracameral antibiotics in reducing the risk of postoperative endophthalmitis after cataract surgery. Intracameral prophylaxis has been increasingly adopted because it delivers the antibiotic directly into the anterior chamber at the end of surgery, where a high local drug concentration may reduce the survival of microorganisms introduced during the operative procedure. Earlier studies also reported favourable outcomes with intracameral moxifloxacin and suggested that its broader antimicrobial coverage may make it a useful alternative to cefuroxime in selected clinical settings (11, 12). The results of the present study therefore added local clinical evidence to the growing body of literature supporting intracameral moxifloxacin as an effective prophylactic option after phacoemulsification.

The findings were also comparable with a previous study in which intracameral cefuroxime showed 66.67% efficacy, while intracameral moxifloxacin showed 74.74% efficacy in preventing acute postoperative endophthalmitis after cataract surgery (13). Similarly, another clinical investigation reported a lower incidence of postoperative endophthalmitis among patients who received intracameral moxifloxacin compared with those who did not receive it as part of the prophylactic protocol (14, 15). Although differences in study design, sample size, antibiotic concentration, case selection, surgical protocols, and outcome definitions may affect direct comparison, the overall direction of evidence favoured the protective role of intracameral moxifloxacin in cataract surgery. The greater efficacy observed with moxifloxacin may have been related to its broad-spectrum antibacterial activity against many gram-positive and gram-negative organisms commonly associated with postoperative ocular infections. As a fourth-generation fluoroquinolone, moxifloxacin has good intraocular penetration and provides concentration-dependent bacterial killing. Its activity against common ocular pathogens may be clinically relevant in cataract surgery, where even minimal microbial contamination can lead to serious infection. Cefuroxime has been widely used and remains an established option for intracameral prophylaxis; however, concerns related to dilution errors, preparation requirements, variable antimicrobial coverage, and emerging bacterial resistance have encouraged evaluation of alternative agents. In this context, moxifloxacin has practical appeal, particularly when preservative-free formulations are available and preparation steps are simpler than those required for reconstituted cefuroxime (16-18).

The baseline characteristics of the participants were largely comparable between the two groups, which strengthened the internal validity of the efficacy comparison. Mean age, duration of disease or symptoms, and gender distribution did not differ significantly between the groups. This comparability reduced the likelihood that demographic differences substantially influenced the observed difference in prophylactic efficacy. The statistically significant difference in efficacy was therefore more likely to be associated with the study intervention rather than imbalance in basic patient characteristics. However, this interpretation remained dependent on the adequacy of randomization, similarity of surgical technique, consistency of postoperative care, and uniformity of follow-up assessment (19). The clinical relevance of these findings was important because cataract surgery is one of the most commonly performed ophthalmic procedures, and even a rare complication such as postoperative endophthalmitis can have a major impact on visual outcome and patient quality of life. A safe, effective, and easily administered intracameral antibiotic may reduce postoperative infectious complications and improve surgical confidence. The present findings supported the use of intracameral moxifloxacin as a potentially valuable prophylactic option in phacoemulsification cataract surgery, especially in settings where broad antimicrobial coverage, simpler preparation, and reduced risk of dilution-related error are important considerations (20).

The study had several strengths. It used a randomized controlled design, included equal allocation of patients into both treatment groups, and applied the same follow-up duration for assessment of postoperative outcomes. The study was conducted in a tertiary care ophthalmology setting, where cataract surgeries were performed under standardized aseptic conditions. The use of predefined inclusion and exclusion criteria also helped reduce clinical heterogeneity among participants. In addition, the study provided local data on a topic where regional evidence remained limited, and this was relevant because bacterial profiles, resistance patterns, surgical environments, and routine prophylactic practices may vary between healthcare settings. Despite these strengths, the findings needed to be interpreted with caution. The sample size was small, with only 30 patients in each group, whereas postoperative endophthalmitis is a rare outcome that usually requires a much larger sample to detect true differences with confidence. The single-center design also limited generalizability to other hospitals, surgical settings, and patient populations. The follow-up period of six weeks was appropriate for detecting early postoperative endophthalmitis, but it did not provide information about delayed complications or long-term safety. Another important limitation was that the term “efficacy” needed a clear operational definition. If “not effective” represented confirmed postoperative endophthalmitis, the number of cases appeared high for a rare complication and required careful verification. If it

represented suspected infection, inflammation, or another postoperative clinical outcome, this should have been clearly defined to avoid misinterpretation of the results.

Another methodological consideration was the need to ensure accuracy in drug dose and concentration reporting. Intracameral cefuroxime is commonly described as 1 mg in 0.1 mL, while 0.5% moxifloxacin contains 5 mg/mL, meaning that 0.1 mL contains 500 µg. Any mismatch between concentration, dose, and injected volume could affect reproducibility and should be clarified before final manuscript submission. Future studies should report antibiotic preparation, dilution method, preservative status, injected volume, surgeon protocol, diagnostic criteria for endophthalmitis, and adverse events in greater detail. Larger multicenter randomized trials with adequate power, microbiological confirmation, standardized outcome definitions, and longer follow-up would provide stronger evidence regarding comparative efficacy and safety. Overall, the present study found that intracameral moxifloxacin was associated with higher prophylactic efficacy than intracameral cefuroxime after phacoemulsification cataract surgery. The findings supported the potential role of intracameral moxifloxacin as an effective prophylactic antibiotic in local cataract surgery practice. However, because postoperative endophthalmitis is uncommon and the present study had a limited sample size, the results should be considered supportive rather than definitive. Further large-scale studies were needed to confirm these findings and to guide evidence-based selection of intracameral antibiotic prophylaxis in cataract surgery.

CONCLUSION

The present study concluded that intracameral moxifloxacin was more effective than intracameral cefuroxime in preventing postoperative endophthalmitis following phacoemulsification cataract surgery. These findings support the potential use of moxifloxacin as a practical and effective prophylactic option in cataract surgery, particularly because of its broad antimicrobial coverage, good intraocular penetration, and convenient clinical use. The study contributes useful local evidence for guiding antibiotic selection in routine cataract surgery; however, larger multicenter trials with standardized protocols and longer follow-up are recommended to further validate these findings and support the development of clear prophylactic guidelines.

AUTHOR CONTRIBUTION

Author	Contribution
Dr Saima Khalid	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision
Dr Bahadur Iftikhar	Methodology, Investigation, Data Curation, Writing - Review & Editing
Dr. Muhammad Qasim Yazar	Investigation, Data Curation, Formal Analysis, Software
Dr. Wazir Muhammad Hasan	Software, Validation, Writing - Original Draft

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