

# Endophthalmitis prophylaxis study. Report 1: Intracameral cefuroxime and moxifloxacin prophylaxis for the prevention of postcataract endophthalmitis in rural India

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**Purpose:** Intracameral antibiotics are known to reduce the incidence of acute endophthalmitis. Various drugs are available for intracameral use. This prospective study was carried out to compare the efficacies of intracameral cefuroxime and moxifloxacin prophylaxis in reducing the incidence of acute endophthalmitis after cataract surgery in rural India. **Methods:** This was a prospective, nonrandomized, comparative, interventional study. Between October 2016 and March 2018, 15 eye care facilities spread over four Indian states were preselected to use either of the intracameral antibiotics, cefuroxime or moxifloxacin, following cataract surgery (phacoemulsification or manual small incision cataract surgery, SICS). The main outcome measure was the occurrence of acute clinical endophthalmitis within six weeks of the surgery. This was compared with the earlier rate of endophthalmitis in the same locations. **Results:** The study was done in 42,466 eyes. Of the total, 42.2% received intracameral cefuroxime and 57.8% received intracameral moxifloxacin. SICS was performed more often. Clinical acute endophthalmitis occurred in 15 eyes. This accounted to a 72.22% reduction, from the earlier 0.126% to 0.035%, of postcataract surgery acute endophthalmitis. The reduction in the incidence of endophthalmitis after intracameral cefuroxime was 0.017% and that after intracameral moxifloxacin was 0.049%. With either intracameral antibiotics, the reduction in incidence was statistically significant ( $P < 0.001$ ), but not between the molecules. Intracameral cefuroxime showed 66.67% reduction and intracameral moxifloxacin showed 74.74% reduction. **Conclusion:** A 3.6-fold decrease in postcataract surgery endophthalmitis was observed upon the use of intracameral antibiotics in rural India. Both intracameral cefuroxime and moxifloxacin proved efficacious.

**Key words:** Acute endophthalmitis, antibiotic prophylaxis, cataract surgery, intracameral cefuroxime, intracameral moxifloxacin, rural India

Acute postcataract surgery endophthalmitis, though rare, is a dreaded complication of cataract surgery, that may result in poor visual and anatomical outcomes. Worldwide, the incidence ranges from 0.03 to 0.2%.<sup>[1]</sup> Prophylaxes remain the most important strategy to reduce morbidity associated with this disease. Povidone-iodine (PI) preparation of the eye and surrounding skin is currently the standard of care for endophthalmitis prophylaxis.<sup>[2,3]</sup>

Prior to the European study, the preparation of the eye with PI was the only technique to achieve category II evidence and score over perioperative topical and/or systemic antibiotics. The European Society of Cataract and Refractive Surgeons (ESCRS) study documented the benefit of intracameral cefuroxime in the reduction of postcataract surgery endophthalmitis.<sup>[4]</sup> This achieved a category I evidence.<sup>[5]</sup> An Indian study documented the benefit of intracameral moxifloxacin in the reduction of postcataract surgery endophthalmitis.<sup>[6]</sup> Despite some

reservations on the routine use of intracameral antibiotic in cataract surgery,<sup>[7,8]</sup> increasing number of cataract surgeons are either using or are nudged to the routine use of intracameral antibiotic in cataract surgery either for all patients or for patients having intraoperative complications such as the breach in the posterior capsule or dehiscence of zonules.<sup>[9-12]</sup>

While commercial preparation of cefuroxime is not available in India, moxifloxacin is commercially available (AuroLab, Madurai, India). Since one of the reasons for not using intracameral antibiotic (chiefly, cefuroxime) is the commercial nonavailability,<sup>[13]</sup> we prospectively compared the efficacies of intracameral cefuroxime and moxifloxacin in preventing acute endophthalmitis after cataract surgery in rural India where a large number of cataract surgeries are performed.<sup>[14]</sup> The rural eye centers in India typically offer comprehensive eye care and primarily operate patients with cataract.<sup>[15]</sup> The Institute (where the study was undertaken) treats a sizeable

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population of the patients at no cost. The purpose of the study was to compare the efficacies of intracameral cefuroxime and moxifloxacin postcataract surgery in reducing the rate of acute endophthalmitis in rural India.

## Methods

The Institutional Review Board (IRB)/Ethics Committee has approved this prospective interventional study (LEC 08-16-066). The described research adhered to the tenets of the Declaration of Helsinki. The study population comprised of patients who underwent cataract surgery between October 2016 and March 2018 at 15 rural eye centers of the Eye Institute in India. All patients who were above 18 years of age and had surgery either by phacoemulsification or by manual small incision cataract surgery (SICS) were included in the study. The study excluded patients who received cataract surgery combined with any other intraocular procedures, and planned intracapsular or extracapsular cataract extraction.

The division of 15 rural eye centers was preselected at the time of study design and it was based on the distance from the Eye Institute tertiary centers (up to 350 kms and 2–8 hours of journey; Fig. 1). The tertiary centers have full-fledged vitreoretinal and ocular microbiology facilities, and continuity of care of patients was maintained when patients were referred for definite management of endophthalmitis.

The eye centers were spread over four states of India—Andhra Pradesh, Karnataka, Odisha, and Telangana. The centers in Karnataka and Telangana (five centers) were selected to use intracameral cefuroxime and the centers in Andhra Pradesh and Odisha (10 centers) were selected to use intracameral moxifloxacin [Fig. 1]. We compared the clinical acute endophthalmitis rate in this study with that of the earlier (unpublished) postcataract surgery acute endophthalmitis that precedes 21 months (January 2015 to September 2016) at the same settings.

Uniform preoperative comprehensive eye examination included measurement of uncorrected visual acuity (UCVA) and best-corrected visual acuity (BCVA), slit lamp examination,

grading of lens opacity, Goldmann applanation intraocular pressure, and dilated fundus examination when possible. The cataract surgeries were performed either by phacoemulsification or by manual SICS by the second year ophthalmology-fellow (3-year program, postophthalmology residency) and the third year resident-in-training (3-year program) or by comprehensive ophthalmology faculty.

The eye for surgery was prepared with application of 5% PI on the conjunctival cul-de-sac and the skin around the eye was prepared with 10% PI. The study medications consisted of the following: intracameral cefuroxime (prepared from Altacef, Glenmark, Mumbai, India), intracameral moxifloxacin (Aurolab, Madurai, India), topical prednisolone acetate, and topical fluoroquinolones. Following cataract surgery, intracameral cefuroxime 1 mg in 0.1 ml or moxifloxacin 0.1 ml of 0.5% w/v was injected.

### Preparation of Intracameral antibiotic in operating room

*Cefuroxime*—dispensed as power.

250 mg vial + 12.5 ml normal saline = 20 mg/ml

1 ml (20 mg) reconstituted + 1 ml normal saline = 10 mg/ml

0.1 ml = 1 mg cefuroxime

*Moxifloxacin* - dispensed as solution

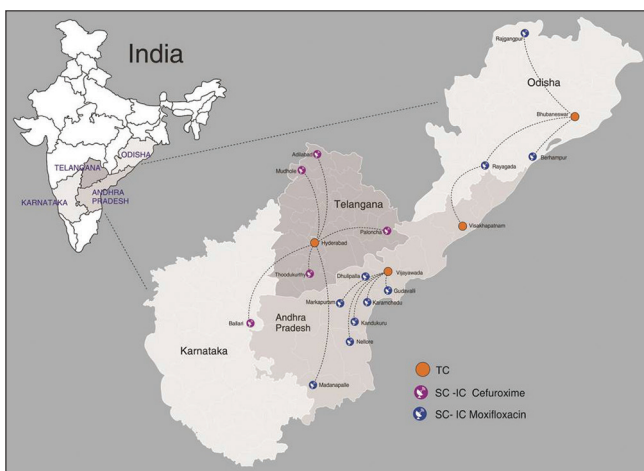
0.1 ml of moxifloxacin 0.5% w/v direct from the vial.

Each reconstituted cefuroxime vial was used for five consecutive patients in the same operating room and same day and each vial of moxifloxacin was used for three consecutive patients in the same operating room and same day; every time new needles (23 g for withdrawal and 30 gauge for injection) and new tuberculin syringe were used and the intracameral drug was injected through the side port behind the iris. No patient received preoperative antibiotics. Topical 5% PI was instilled at the end of the surgery. Topical corticosteroids (prednisolone acetate 1%) were prescribed to all patients and tapered over 4 to 6 weeks. The decision to administer postoperative topical antibiotic (typically a fluoroquinolone) was left to the discretion of the treating physician. All patients were examined on postoperative day 1, between day 4–10, and between weeks 3–11. This examination consisted of uncorrected and best-corrected visual acuity, slit-lamp examination, Goldmann applanation tonometry, and funduscopy.

All patients provided informed consent for cataract surgery and for any subsequent interventions.

We analyzed the data of the patients who developed clinical acute endophthalmitis within six weeks of surgeries. The diagnosis of the endophthalmitis was based on the clinical findings—reduction/no improvement of vision, congestion of eye, anterior chamber cells/flare and/or hypopyon, presence of vitreous exudates on indirect ophthalmoscopy or detected by B-scan ultrasonography, and the clinical judgment of the treating surgeon. When in doubt, the diagnosis was confirmed by one of the authors (VMR) by teleconsultation and appropriate treatment was instituted.

Treatment in the rural centers consisted of injection of the Endophthalmitis Vitrectomy Study (EVS) recommended intravitreal antibiotics—ceftazidime 2.25 mg in 0.1 ml and vancomycin 1.0 mg in 0.1 ml,<sup>[16]</sup> topical cycloplegics,



**Figure 1:** Map of India showing the four states and the secondary centers (SCs) and the tertiary centers (TCs). The connecting lines show the nearest referral centers for the secondary centers. IC – Intracameral

and intensive topical fluoroquinolone and corticosteroids (Prednisolone acetate 1%). A 0.3–0.5 ml of vitreous was aspirated manually from the midvitreous cavity using a 23 g needle mounted on a 2-ml syringe before intraocular antibiotics were injected. In absence of the microbiology facility, the vitreous sample collected in the rural eye care facility was not subjected to any microbiological investigation. These patients were referred to the nearest tertiary eye center of the Institute (up to 350 kms and 2–8 hours of journey; Fig. 1). Further therapy at the tertiary centers consisted of either close observation or repeat intravitreal antibiotic(s), with/without intravitreal dexamethasone and with/without vitrectomy. In an event of surgical intervention, the vitrectomy aspirate was sent for microbiology investigation [microscopy, culture, and polymerase chain reaction (PCR) test for eubacterial, panfungal, and *Propionibacterium acnes* DNA].

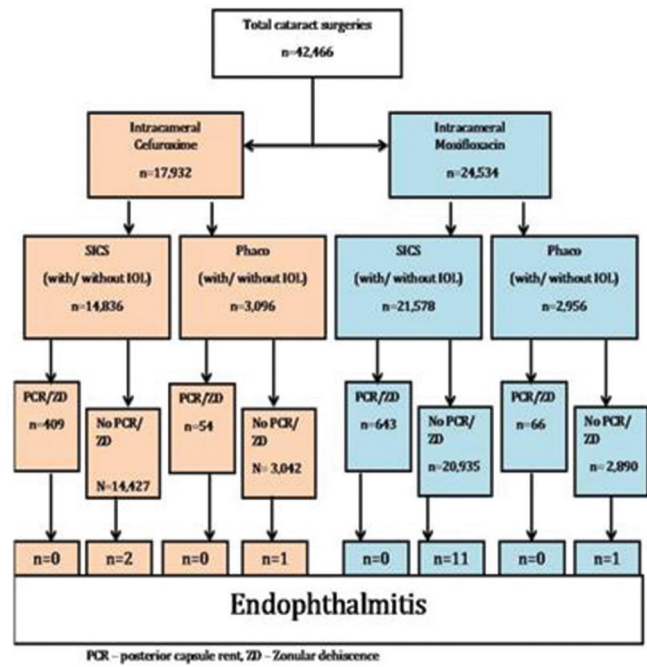
**Statistical analysis:** We assessed the incidence of acute endophthalmitis that occurred within six weeks of surgery – overall incidence and the incidence between the two groups. Chi square test was used to analyze the association between the categorical data—the endophthalmitis rate before and in the study period and between the two intracameral antibiotics. Statistical analysis was done using STATA software version 13.1 (StataCorp, Texas). Logistic regression analysis was used to assess the risk factors for endophthalmitis. This included age, gender, paying for service versus no cost to the patients, complications, surgeon category, and surgical technique. A *P* value of <0.05 was considered statistically significant.

### Results

A total of 42,582 cataract surgeries were performed during the 18-month study period (October 2016 to March 2018) at 15 rural centers of the Institute network. Of these, 116 surgeries were excluded as these were either combined with glaucoma filtration surgery, or techniques other than SICS/phacoemulsification (such as the intracapsular cataract extraction, ICCE and extracapsular cataract extraction, ECCE) were used. Thus, this analysis included 42,466 eyes of 40,006 patients [18,350 males (45.9%)]. Cataract surgery was performed free of cost to 29,895 (70.4%) eyes. The surgical techniques used were SICS in 36,414 (85.7%) eyes and phacoemulsification in 6,052 (14.3%) eyes. The ophthalmology fellows, ophthalmology faculty, and residents-in-training performed 31,717 (74.7%), 7,984 (18.8%), and 2,765 (6.5%) surgeries, respectively. Intracameral cefuroxime was injected into 17,932 (42.23%) eyes and intracameral moxifloxacin was injected into 24,534 (57.77%) eyes.

Table 1 shows the baseline demographics of the two groups of eyes that received intracameral moxifloxacin and cefuroxime. Fig. 2 shows the flow of the assigned patients and complications. The posterior capsule rent or zonular dehiscence occurred during surgery in 2.76% eyes; it was 2.58% (463/17,932) in eyes receiving intracameral cefuroxime and 2.89% (709/24,534) in eyes receiving intracameral moxifloxacin.

Postcataract surgery acute endophthalmitis rate was 0.126% (95% CI = 0.122–0.129, unpublished data) in the preceding 21 months (January 2015–September 2016) in the same locations. This data was collected from the electronic medical records and from the minutes of Hospital Infection Control Committee wherein all case of



**Figure 2:** Flowchart of the patients in the two groups, intraoperative complications, and occurrence of endophthalmitis

suspected endophthalmitis are reported and discussed. There were no cases of cluster endophthalmitis noted. The endophthalmitis rate of the five centers located in Karnataka and Telangana was 0.051% (95% CI = 0.047–0.054) prior to the initiation of study. These five centers were selected to inject intracameral cefuroxime. The endophthalmitis rate was 0.194% (95% CI = 0.188–0.200) in the 10 eye centers located in Andhra Pradesh and Odisha. These 10 centers were selected to administer intracameral moxifloxacin. In the current series, 15 patients developed clinical endophthalmitis—an incidence of 0.035% (15/42,466, 95% CI = 0.033–0.037). This was a 72.2% reduction (from 0.126% to 0.035%) of postcataract surgery endophthalmitis and was statistically significant (*P* < 0.001).

The distribution of 15 eyes with acute endophthalmitis was as follows: it occurred in nine female patients; in 12 people who did not pay for their service; in three eyes (3/17,932 = 0.017%; 95% CI = 0.015–0.019) that had received intracameral cefuroxime and in 12 eyes (12/24,534 = 0.049%, 95% CI = 0.046–0.052) that had received intracameral moxifloxacin. Microbiology was positive in nine of the 15 (60%) instances and was distributed as follows: microscopy (n=1) positive; culture (n=7) positive; and PCR (n=2) positive. The microscopy positive was not culture positive and one of the two PCR positives was also culture positive. Six of seven culture-positive endophthalmitis were due to bacteria. The following organisms were identified as Gram positive bacillus in microscopy; seven growths in culture- *Streptococcus pneumoniae* (n=2), one each *Staphylococcus* species, *Pseudomonas aeruginosa*, *Nocardia* species, *Morganella morganii*, and *Aspergillus* species; and two eubacteria PCR positive. Three of the four bacterial culture-positive cases were resistant to moxifloxacin of which one was sensitive to cefuroxime in the intracameral moxifloxacin group. One of the culture-positive cases that was sensitive to both the drugs was present in intracameral cefuroxime group. The other culture-positive case that was resistant to moxifloxacin was present in intracameral cefuroxime

**Table 1: Basic demographics in the two groups of intracameral moxifloxacin and cefuroxime**

Variable	Details	Intracameral Moxifloxacin	Intracameral Cefuroxime	P
Number of eyes	n (%)	24,534 (57.77%)	17,932 (42.23%)	
	Mean age	63.14±9.21	62.42±8.98	
Age	Range	18-101 years	19-98 years	
Gender	Male	10,970 (44.71%)	7,380 (41.16%)	<0.001
	Female	13,564 (55.29%)	10,552 (58.84%)	
Type of surgery	SICS	21,578 (87.95%)	14,836 (82.73%)	<0.001
	Phacoemulsification	2,956 (12.05%)	3,096 (17.27%)	
All intraoperative complications	No	23,638 (96.35%)	17,343 (96.72%)	0.044
	Yes	896 (3.65%)	589 (3.28%)	
Complications	No PCR/ZD	23,825 (97.10%)	17,469 (97.42%)	0.046
	PCR/ZD	709 (2.89%)	463 (2.58%)	
Paying vs no cost to patients	Paying	5,839 (23.8%)	6,732 (37.54%)	<0.001
	No cost surgeries	18,695 (76.2%)	11,200 (62.46%)	
Surgeon category	Faculty	2,493 (10.16%)	5,491 (30.62%)	<0.001
	Fellow	19,973 (81.41%)	11,744 (65.49%)	
	Resident	2,068 (8.43%)	697 (3.89%)	

SICS=Small incision cataract surgery, PCR=Posterior capsule rent, ZD=Zonular dehiscence

group. Further microbiological results would be discussed in a subsequent report.

None of these patients who developed endophthalmitis had any major perioperative complications including posterior capsule break, except one patient in the intracameral moxifloxacin group who needed suturing for wound leak after SICS. The reduction of endophthalmitis in the cefuroxime group was 66.67% (from 0.051% to 0.017%) and the reduction of endophthalmitis in the moxifloxacin group was 74.74% (from 0.194% to 0.049%) compared to the preintracameral antibiotic period at the same location; the difference in the quantum of reduction in the incidence of endophthalmitis with intracameral cefuroxime and moxifloxacin (66.67% vs 74.74%) was statistically not significant ( $P = 0.9$ ). These 15 patients were treated in the tertiary center as per the practiced institutional protocol.<sup>[17]</sup> The details would be described in another report. Two eyes had corneal edema immediately after injection of intracameral cefuroxime which cleared on postoperative day 1. No cases of TASS were reported.

None of the factors (gender, paying status, surgeon, surgical technique, and type of intracameral antibiotic) were significant upon both uni- and multivariate regression analysis [Table 2].

## Discussion

This study showed a 3.6-fold reduction in the incidence of endophthalmitis with the use of intracameral antibiotics compared to our earlier data when intracameral antibiotics were not used. The categorical reduction in endophthalmitis by antibiotic was 3-fold (from 0.051% to 0.017%) in the cefuroxime group and 3.95-fold (from 0.194% to 0.049%) in the moxifloxacin group. There was no statistical difference between the two antibiotics in the rate of reduction of infection. Others have shown similar reduction in the incidence of acute postcataract surgery endophthalmitis—from 0.38% to 0.07%, a reduction of 5-fold in the European study<sup>[18]</sup> using intracameral cefuroxime and from 0.07% to 0.02%—a reduction of 3.5 fold in the Indian study using intracameral moxifloxacin.<sup>[6]</sup>

The reported incidence of postcataract surgery endophthalmitis in India between 2005 and 2015 without intracameral antibiotic use was 0.04% to 0.15%.<sup>[7,19-23]</sup> The average rate of endophthalmitis, 0.126%, of the eye care facilities in the four Indian states included in this study was within these Indian reports, though it was higher in two Indian states (0.194% in Andhra Pradesh and Odisha) compared to the other two Indian states (0.051% in Karnataka and Telangana).

The current study addressed two questions: (1) is there a reduction in the incidence of acute postcataract surgery endophthalmitis with the routine use of intracameral antibiotic? and (2) which of the two currently advocated intracameral antibiotics, cefuroxime and moxifloxacin, is more efficacious in preventing endophthalmitis? Similar to the European study,<sup>[4]</sup> the incidence of endophthalmitis significantly reduced from 0.126% to 0.035% with intracameral antibiotics in this study cohort. The vitreous was cultured at the tertiary level eye care facility after one-time intravitreal antibiotic injection at the rural center and, hence, ideally the culture should be negative if the infecting microorganisms were sensitive to the injected intravitreal antibiotics (ceftazidime and vancomycin), although PCR could be positive. In this study, the culture was positive in seven instances (five in intracameral moxifloxacin group and two in intracameral cefuroxime group) and the PCR was positive in two instances. The antibiotic susceptibility pattern in the six culture-positive bacterial endophthalmitis cases showed more often resistance to moxifloxacin (4 of 6) than cefuroxime (1 of 6). The fungal infection in this series was 0.002% (1/42, 466); this lies in the reported series of postcataract surgery endophthalmitis in India.<sup>[20,24-26]</sup>

Cataract surgery is the commonest intraocular surgery performed anywhere in the world. In India, 6.481 million cataract surgeries were performed in year 2016–2017 (April 2016 to March 2017).<sup>[27]</sup> At the reported rates, the annual incidence of postcataract surgery endophthalmitis could be from 2592 (0.04% incidence) to 9721 (0.15% incidence). Direct surgical cost of vitrectomy and intravitreal antibiotics in

**Table 2: Univariate and multivariate regression analysis for risk factors for endophthalmitis between two groups**

	Univariate analysis odds ratio (95% CI)	P	Multivariate analysis odds ratio (95% CI)	P
Gender				
Male	Reference		Reference	
Female	1.14 (0.406-3.207)	0.802	1.12 (0.395-3.168)	0.831
Paying vs no cost to patient				
Paying	Reference		Reference	
No cost	5.89 (0.774-44.791)	0.087	5.37 (0.692-41.724)	0.108
Surgeon				
Faculty	Reference		Reference	
Fellow	0.839 (0.231-3.049)	0.790	0.582 (0.151-2.172)	0.425
Resident	1.926 (0.322-11.531)	0.473	1.042 (0.166-6.523)	0.954
Intracameral antibiotics				
Cefuroxime	Reference		Reference	
Moxifloxacin	2.92 (0.825-10.365)	0.096	2.75 (0.741-10.217)	0.126
Complications				
No	Reference		Reference	
Any	1.97 (0.259-15.005)	0.512	1.90 (0.248-14.583)	0.536

CI=Confidence interval

managing these cases would be INR 45.3 million (US\$ 697,846) to INR 170 million (US\$ 2.6 million). With use of intracameral antibiotics, the incidence of endophthalmitis could reduce to a maximum of 2268 (at the rate of 0.035%) and the cost of direct surgical cost of vitrectomy and intravitreal antibiotics would be INR 39.6 million (US\$ 601,363), an annual reduction of US\$ 96,483 to US\$ 2 million. (The surgical cost is calculated as per the latest Government of India Ayushman Bharat—National Health Protection Mission—“AB-NHPM.”<sup>[28]</sup>).

The current study was done in rural India where vitreous surgery and ocular microbiology facilities are nearly nonexistent. These patients need referral to the nearest tertiary care center. One study from India has shown a 5-day delay by patients in reporting to the primary physician and a 11-day delay by the patients in reporting to the tertiary center.<sup>[29]</sup> These authors reported that only 10% of the patients had received intravitreal antibiotics before the referral and 66.6% of the patients who had received intravitreal antibiotics prior to the referral, regained vision of  $\geq 20/200$  after additional treatment in the tertiary center compared to 31.8% of patients who had not received intravitreal antibiotics at the primary care level.<sup>[29]</sup> We believe that an intracameral antibiotic as a part of the routine cataract surgery helps reduce the incidence of endophthalmitis; however, it is not a substitute to the meticulous preparation of the patient and the surgical site in addition to the strict aseptic environment of the operating room.

The microbiology of endophthalmitis in India is different from the ones reported in the EVS and ESCRS studies<sup>[4,16,30]</sup>; the Gram-negative infection accounts for at least a quarter of times. The spectrum of infection (specifically bacteria) has not changed much.<sup>[31]</sup> In this sense, a fourth-generation fluoroquinolone such as moxifloxacin that has a broader spectrum of activity should be more suitable for Indian environment.<sup>[32,33]</sup> The categorical reduction compared to the prior incidence of endophthalmitis in these two clusters of eye care facilities was similar—3-fold

where intracameral cefuroxime was used and 3.95-fold where intracameral moxifloxacin was used.

**Strength of the study:** This prospective study was performed in rural India. Thus, this data is close to the real-world data from India. The intraoperative breach of the posterior capsule is one of the risk factors for endophthalmitis.<sup>[4]</sup> In this study, none of the eyes with posterior capsule rent or zonular dehiscence (overall n = 1,172) developed endophthalmitis. Therefore, the beneficial effect is attributed to the use of intracameral antibiotics. All operating surgeons adhered to a uniform institutional surgical protocol.

**Weakness of the study:** The study centers were preselected for use of one of the two intracameral antibiotics and the patients were not randomized to the antibiotic in the same location.

An earlier meta-analysis of published papers has inferred similar efficacy of both intracameral cefuroxime and moxifloxacin in reducing the incidence of postcataract surgery acute endophthalmitis.<sup>[34]</sup> In our prospective study, we used these intracameral antibiotics in a similar geographical environment. We demonstrated that both intracameral cefuroxime and moxifloxacin reduce the incidence of endophthalmitis following cataract surgery in rural India. Clinically, both appeared similar though there are two factors to consider: (1) unlike moxifloxacin, cefuroxime is not commercially available in India for intracameral use and (2) cefuroxime needs to be prepared from powder while moxifloxacin is dispensed as a solution. Commercial nonavailability increases the cost of care and the act of preparation increases the chance of contamination and dilution error.

## Conclusion

Intracameral cefuroxime and moxifloxacin resulted in a 3.6-fold decrease in post-cataract surgery endophthalmitis in rural

India, with comparable efficacy. The evidences gained in this study could help the cataract surgeons make an informed choice of cataract surgery prophylaxis.

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### Conflicts of interest

There are no conflicts of interest.

## References

- Pathengay A, Khera M, Das T, Sharma S, Miller D, Flynn HW Jr. Acute postoperative endophthalmitis following cataract surgery: A review. *Asia Pac J Ophthalmol (Phila)* 2012;1:35-42.
- Speaker MG, Menikoff JA. Prophylaxis of endophthalmitis with topical povidone-iodine. *Ophthalmology* 1991;98:1769-75.
- Wu PC, Li M, Chang SJ, Teng MC, Yow SG, Shin SJ, *et al.* Risk of endophthalmitis after cataract surgery using different protocols for povidone-iodine preoperative disinfection. *J Ocul Pharmacol Ther* 2006;22:54-61.
- Endophthalmitis Study Group ESOC. Refractive S Prophylaxis of postoperative endophthalmitis following cataract surgery: Results of the ESCRS multicenter study and identification of risk factors. *J Cataract Refract Surg* 2007;33:978-88.
- Gower EW, Lindsley K, Tulenko SE, Nanji AA, Leyngold I, McDonnell PJ. Perioperative antibiotics for prevention of acute endophthalmitis after cataract surgery. *Cochrane Database Syst Rev* 2017;2:CD006364.
- Haripriya A, Chang DF, Ravindran RD. Endophthalmitis Reduction with Intracameral Moxifloxacin Prophylaxis: Analysis of 600 000 Surgeries. *Ophthalmology* 2017;124:768-75.
- Sharma S, Sahu SK, Dhillon V, Das S, Rath S. Reevaluating intracameral cefuroxime as a prophylaxis against endophthalmitis after cataract surgery in India. *J Cataract Refract Surg* 2015;41:393-9.
- Schwartz SG, Flynn HW Jr, Grzybowski A, Relhan N, Ferris FL 3<sup>rd</sup>. Intracameral antibiotics and cataract surgery: Endophthalmitis rates, costs, and stewardship. *Ophthalmology* 2016;123:1411-3.
- Javitt JC. Intracameral antibiotics reduce the risk of endophthalmitis after cataract surgery: Does the preponderance of the evidence mandate a global change in practice? *Ophthalmology* 2016;123:226-31.
- Barry P. Adoption of intracameral antibiotic prophylaxis of endophthalmitis following cataract surgery: Update on the ESCRS Endophthalmitis Study. *J Cataract Refract Surg* 2014;40:138-42.
- Chang DF, Braga-Mele R, Henderson BA, Mamalis N, Vasavada A; ASCRS Cataract Clinical Committee. Antibiotic prophylaxis of postoperative endophthalmitis after cataract surgery: Results of the 2014 ASCRS member survey. *J Cataract Refract Surg* 2015;41:1300-5.
- Maharana PK, Chhablani JK, Das TP, Kumar A, Sharma N. All India Ophthalmological Society members survey results: Cataract surgery antibiotic prophylaxis current practice pattern 2017. *Indian J Ophthalmol* 2018;66:820-4.
- Han DC, Chee SP. Survey of practice preference pattern in antibiotic prophylaxis against endophthalmitis after cataract surgery in Singapore. *Int Ophthalmol* 2012;32:127-34.
- Marmamula S, Khanna RC, Shekhar K, Rao GN. Outcomes of cataract surgery in urban and rural population in the South Indian State of Andhra Pradesh: Rapid Assessment of Visual Impairment (RAVI) Project. *PLoS One* 2016;11:e0167708.
- Rao GN. The Barrie Jones Lecture-Eye care for the neglected population: Challenges and solutions. *Eye (Lond)* 2015;29:30-45.
- Results of the Endophthalmitis Vitrectomy Study. A randomized trial of immediate vitrectomy and of intravenous antibiotics for the treatment of postoperative bacterial endophthalmitis. Endophthalmitis Vitrectomy Study Group. *Arch Ophthalmol* 1995;113:1479-96.
- Das T, Sharma S, Hyderabad Endophthalmitis Research Group. Current management strategies of acute post-operative endophthalmitis. *Semin Ophthalmol* 2003;18:109-15.
- Barry P, Seal DV, Gettinby G, Lees F, Peterson M, Revie CW, *et al.* ESCRS study of prophylaxis of postoperative endophthalmitis after cataract surgery: Preliminary report of principal results from a European multicenter study. *J Cataract Refract Surg* 2006;32:407-10.
- Jambulingam M, Parameswaran SK, Lysa S, Selvaraj M, Madhavan HN. A study on the incidence, microbiological analysis and investigations on the source of infection of postoperative infectious endophthalmitis in a tertiary care ophthalmic hospital: An 8-year study. *Indian J Ophthalmol* 2010;58:297-302.
- Das T, Hussain A, Naduvilath T, Sharma S, Jalali S, Majji AB. Case control analyses of acute endophthalmitis after cataract surgery in South India associated with technique, patient care, and socioeconomic status. *J Ophthalmol* 2012;2012:298459.
- Ravindran RD, Venkatesh R, Chang DF, Sengupta S, Gyatsho J, Talwar B. Incidence of post-cataract endophthalmitis at Aravind Eye Hospital: Outcomes of more than 42,000 consecutive cases using standardized sterilization and prophylaxis protocols. *J Cataract Refract Surg* 2009;35:629-36.
- Lalitha P, Rajagopalan J, Prakash K, Ramasamy K, Prajna NV, Srinivasan M. Postcataract endophthalmitis in South India incidence and outcome. *Ophthalmology* 2005;112:1884-9.
- Haripriya A, Chang DF, Reena M, Shekhar M. Complication rates of phacoemulsification and manual small-incision cataract surgery at Aravind Eye Hospital. *J Cataract Refract Surg* 2012;38:1360-9.
- Kunimoto DY, Das T, Sharma S, Jalali S, Majji AB, Gopinathan U, *et al.* Microbiologic spectrum and susceptibility of isolates: Part I. Postoperative endophthalmitis. Endophthalmitis Research Group. *Am J Ophthalmol* 1999;128:240-2.
- Anand AR, Therese KL, Madhavan HN. Spectrum of aetiological agents of postoperative endophthalmitis and antibiotic susceptibility of bacterial isolates. *Indian J Ophthalmol* 2000;48:123-8.
- Gupta A, Gupta V, Gupta A, Dogra MR, Pandav SS, Ray P, *et al.* Spectrum and clinical profile of post cataract surgery endophthalmitis in north India. *Indian J Ophthalmol* 2003;51:139-45.
- Available from: [www.npcb.nic.in](http://www.npcb.nic.in). [Last accessed on 2018 May 02].
- Available from: <https://www.abnhpm.gov.in/>. [Last accessed on 2018 Oct 02].
- Verma L, Patil R, Talwar D, Tewari HK, Ravi K. First contact management of postoperative endophthalmitis. A retrospective analysis. *Indian J Ophthalmol* 2004;52:65-6.
- Lalitha P, Sengupta S, Ravindran RD, Sharma S, Joseph J, Ambiya V, *et al.* A literature review and update on the incidence and microbiology spectrum of postcataract surgery endophthalmitis over past two decades in India. *Indian J Ophthalmol* 2017;65:673-7.
- Das T. Redefining evidence in the management of acute post-cataract surgery endophthalmitis in India-The 2014 Adenwalla Oration, All India Ophthalmological Society. *Indian J Ophthalmol* 2017;65:1403-6.
- Caeiro JP, Iannini PB. Moxifloxacin (Avelox): A novel fluoroquinolone with a broad spectrum of activity. *Expert Rev Anti Infect Ther* 2003;1:363-70.
- Ambiya V, Das T, Sharma S, Chhablani J, Dave V, Jalali S, *et al.* Comparison of clinico-microbiological profile and treatment outcome of in-house and referred post cataract surgery endophthalmitis in a tertiary care center in South India. *J Ophthalmic Inflamm Infect* 2016;6:45.
- Bowen RC, Zhou AX, Bondalapati S, Lawyer TW, Snow KB, Evans PR, *et al.* Comparative analysis of the safety and efficacy of intracameral cefuroxime, moxifloxacin and vancomycin at the end of cataract surgery: A meta-analysis. *Br J Ophthalmol* 2018;102:1268-76.