

Comparison of different endophthalmitis prophylactic measures in cataract surgery - An analysis of 2.4 lakh cases

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Purpose: To compare different endophthalmitis prophylaxis methods adopted in cataract surgery (manual small-incision cataract surgery and phacoemulsification) between the years 2013 and 2021 in the community eye care section of a tertiary eye care hospital in South India and report their outcomes. **Methods:** All cataract surgeries performed from January 2013 to December 2021 (2,46,874 surgeries) at a single center were included in this retrospective study. The different endophthalmitis rates with each regimen were analyzed and evaluated. **Results:** 70,081 surgeries were performed from January 2013 to February 2015, where Tobramycin was added to Balanced Salt Solution (BSS) (Group A). From March 2015 to January 2017, 63,245 surgeries were performed when intracameral Moxifloxacin was given (Group B). From February 2017 to December 2021, 1,13,548 surgeries were performed where Amikacin was added to BSS (Group C). In total, 42 cases of postoperative endophthalmitis were reported during the study period (0.02%). There was no significant difference in the endophthalmitis rates between groups A and B ($P = 0.4152$); however, there was a significant decrease in endophthalmitis rates in group C when compared with group A ($P = 0.04$) and group B ($P = 0.006$). **Conclusion:** There was a significant reduction in the rates of endophthalmitis following the addition of amikacin in irrigating BSS. Nocardia was one of the predominant organisms isolated from these endophthalmitis patients. This is the first single-center study to report a comparative analysis of different endophthalmitis prophylactic measures in a community eye care set up with a high incidence of Nocardia endophthalmitis prevented with amikacin in BSS irrigating solution.

Key words: Amikacin, endophthalmitis, manual small-incision cataract surgery, moxifloxacin

Endophthalmitis is a rare but devastating complication of intraocular surgery.^[1] In developing countries like India, community eye care surgeries play a very important role in treating blindness. An increasing volume of cataract surgeries is being performed in the community eye care centers of tertiary eye care hospitals. With the large volume of surgeries being performed every day, it is vital to take adequate precautions to prevent endophthalmitis. Cataract surgery is the most common intraocular surgery performed in these centers; thus, most of the endophthalmitis prophylaxis studies that have been reported are post-cataract surgery.^[2,3] Here we compare the various endophthalmitis prophylaxis adapted in our community eye care section over a period of 8 years in approximately 2.4 lakh cases and their outcomes.

Methods

This is a retrospective study done at a tertiary care referral eye hospital in South India. The community eye care section of the institute caters to patients from the lower socioeconomic strata to provide quality eye care free of cost. Patients who underwent cataract surgery in the community eye care section of the hospital from April 2013 to December 2021 were included

in the study. The data for the study were obtained from the patient records in the institute.

All patients underwent comprehensive eye examination preoperatively, including uncorrected and best-corrected visual acuity using Snellen's chart, intraocular pressure recording via non-contact tonometry, assessment of nasolacrimal duct patency, anterior segment examination using slit-lamp biomicroscopy, and posterior segment examination via slit-lamp biomicroscopy or B-scan ultrasonography. Automated keratometry and A-scan ultrasonography were done for intraocular lens power calculation.

All the cataract surgeries were performed either via manual small-incision cataract surgery (MSICS) or phacoemulsification with implantation of a polymethyl methacrylate (PMMA) intraocular lens. Furthermore, 85.12% of cases were performed by MSICS and the rest by phacoemulsification. The surgeries were performed by consultants, fellows, and post-graduate residents. The periocular area and conjunctival sac were prepared using topical povidone-iodine solution preoperatively.

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From the year 2013 to 2015, tobramycin 0.1 mL was used in 500 mL of balanced salt solution (BSS) of irrigating solution.^[4] From 2015 to 2017, preservative-free moxifloxacin 0.5% was injected intracamerally at the end of all cataract surgeries.^[5] From January 2017 onwards, 0.1 mL of amikacin (12.5%) was added to every 500 mL of BSS bottle used intraoperatively, thereby achieving an effective concentration of 0.025%. This dose was calculated based on a target concentration of amikacin in the anterior chamber that would exceed the minimum lethal dose for susceptible organisms.^[6] The same surgical and sterilization techniques were adopted throughout the entire study period.

The eye patch was removed in all patients on the first postoperative day and replaced with a pair of protective goggles. All patients were examined for visual acuity testing and slit-lamp examination on day 1 and 1 month postoperatively. During the study period, all patients undergoing cataract surgery were started on topical ofloxacin and dexamethasone eye drops on postoperative day 1 at a frequency of six times per day, which was tapered over 50 days.

We analyzed the records for patients diagnosed with postoperative endophthalmitis, sectional wound infiltrates, and iris nodules presenting up to 12 weeks postoperatively. Patients undergoing combined procedures, such as trabeculectomy or penetrating keratoplasty, were excluded from the study. The diagnosis of postoperative endophthalmitis was supported by relevant history such as redness, pain, decrease in vision with slit-lamp evidence of AC cells, hypopyon, vitritis, and vitreous exudates. B scan was done in all cases.^[7] Samples collected from these patients for microbiological examination included vitreous tap and aqueous tap, and corneal scraping was done in patients with wound infiltrates. Samples were mounted for Gram-stain, KOH, blood agar, and Sabouraud's dextrose agar. Patients with endophthalmitis underwent appropriate surgical management via 3-port pars plana vitrectomy with administration of intravitreal antibiotics. Patients with wound infiltrates were treated with intensive topical antibiotics according to culture sensitivity and therapeutic keratoplasty was performed in non-responding cases. In addition, patients received topical cycloplegics and topical steroids under the cover of antibiotics in cases where fungal infection was not suspected.

Statistical analysis

Statistical analysis was done using IBM SPSS20 (SPSS Inc., Chicago USA). A Chi-square test was used to compare the different variables. $P < 0.05$ was considered significant.

Results

A total of 2,46, 874 cataract surgeries were performed during the study period. The study cases were divided into three groups according to the specific endophthalmitis prophylaxis adopted during the corresponding study period as shown in Table 1. Forty-two cases of postoperative endophthalmitis were reported during the study period (0.02%). There was no significant difference in the endophthalmitis rates between

groups A and B ($P = 0.4152$); however, there was a significant improvement in the endophthalmitis rates in group C when compared with group A ($P = 0.04$) and group B ($P = 0.006$) as shown in Table 2. The average age of patients who were diagnosed with endophthalmitis was 66 years, including 23 males and 20 females as shown in Table 3. The mean interval between the surgery and presentation of endophthalmitis was 32 days for cases in group A, 15 days for cases in group B, and 26 days in group C. As seen in Table 4, the microbiological evaluation did not show any significant difference in the species of causative organisms or rates of culture negativity among the three groups. We found the rates of Nocardial infections to be comparable to that of Gram-positive organisms, with a significant decrease in the rate of Nocardial infections in Group C. Among these endophthalmitis cases, 14 cases had been performed by consultants and 14 cases each by residents and fellows. One of the 42 cases had undergone surgery via phacoemulsification with a scleral section. The remaining cases were done via manual SICS. Only two out of the 43 cases of endophthalmitis had intraoperative complications: one was a case of posterior capsular rent with vitreous loss, and the other was a case of zonular dialysis with vitreous loss. Twenty nine of these cases underwent pars plana vitrectomy with injection of intracameral antibiotics, five patients underwent therapeutic penetrating keratoplasty, five patients underwent patch grafts, and three patients underwent evisceration due to impending panophthalmitis as shown in Table 5.

Discussion

The European Society of Cataract and Refractive Surgeons (ESCRS) first put forward the use of intracameral (IC) cefuroxime as a prophylactic measure to prevent endophthalmitis following the results obtained in a multicenter trial.^[8] Haripriya *et al.* reported a 3.5-fold decrease in the incidence of postoperative endophthalmitis with the use of IC preservative-free moxifloxacin in a large single institution study.^[5,9,10] Over the years, cefuroxime was replaced with IC moxifloxacin owing to better availability and ease in preparation.^[6] In all the above studies, negative culture sensitivity was most commonly reported followed by Gram-positive cocci such as Coagulase-negative Staphylococcus, *Staphylococcus aureus*, and Pneumococci. Similarly, in our study, culture negativity was most commonly noticed among the three groups.^[7,10] However, Nocardia was the second most common organism seen in groups A and B and had significantly reduced following the addition of amikacin in BSS in group C patients. Hence, amikacin in BSS can be an option where Nocardia endophthalmitis is predominant. Atul *et al.* also reported this particular dose of amikacin in BSS to be safe to corneal endothelium and macula as there was no significant change in corneal endothelial count on specular microscopy and optical coherence tomography of the macula pre and postoperatively.^[11] With intracameral moxifloxacin use, it is imperative to adhere to correct dilution protocol to prevent toxic anterior segment syndrome, severe anterior chamber inflammation, and macular edema.^[5] In our study, we

Table 1: Endophthalmitis rates among the three groups

Groups	Years	Antibiotics	Surgeries done	No. of endophthalmitis cases
Group A	Jan 2013-Feb 2015	N-Toba	70081	15 (0.021%)
Group B	March 2015-Jan 2017	IC Moxifloxacin	63245	17 (0.026%)
Group C	Feb 2017-Dec 2021	BSS with Amikacin	113548	10 (0.01%)

Table 2: Comparison between endophthalmitis rates of the three groups

Groups	P
Group B vs. Group A	0.4152
Group C vs. Group A	0.04
Group C vs. Group B	0.006

Table 3: Endophthalmitis patients and their demographic distribution within the groups

Groups	Mean Age (years)	Male: Female ratio
Group A	67±7.6 (range: 55-85)	7:8
Group B	66.7±7.6 (range: 55-85)	10:7
Group C	64.1±6.5 (range: 56-75)	6:4

Table 4: Comparison between microbiological results among the three groups

Organisms	Group A (n=15)	Group B (n=17)	Group C (n=10)	P
Culture negative	6 (40%)	9 (52.9%)	8 (80%)	0.67
Gram-positive cocci	3 (20%)	3 (17.7%)	2 (20%)	0.99
Nocardia	3 (20%)	5 (29.4%)	0	0.009
Fungal	3 (20%)	0	0	-

The microbiological evaluation did not show any significant difference in the rates of culture negativity or Gram-positive cocci among the three groups. However, there was a significant reduction in Nocardia endophthalmitis in group C on comparison with the other groups

Table 5: Comparison between management techniques required for endophthalmitis cases in the three groups

Surgery	Group A	Group B	Group C
Pars plana vitrectomy	7 (46.7%)	13 (76.5%)	9 (90%)
Therapeutic keratoplasty	3 (20%)	1 (5.9%)	1 (10%)
Patch graft	3 (20%)	2 (11.8%)	0
Evisceration	2 (13.3%)	1 (5.9%)	0

did not encounter any of the abovementioned complications. Amikacin has been proven to be effective against resistant Gram-negative bacilli such as *Acinetobacter baumannii* and *Pseudomonas aeruginosa* and it is considered the first-line drug of choice in Nocardia infection and atypical mycobacteria.^[12-14] The typical first-line prophylactic preoperative application of ocular antibiotics, such as fluoroquinolones, was frequently reported to resist this pathogen.^[13] Thus, it is important to analyze the microbiological spectrum in a particular area prior to administering endophthalmitis prophylaxis.^[14,15] Adding amikacin also turns out to be a cost-effective prophylaxis in centers performing a large number of surgeries as one vial of amikacin can be used for 20 bottles of BSS. This method also offers an added advantage of continuous infusion of antibiotic containing BSS throughout the entire surgery. To the best of our knowledge, this is the first single-center study to report comparative analysis of different endophthalmitis prophylactic measures in a community eye care set up and high incidence of Nocardia endophthalmitis being prevented with amikacin in BSS irrigating solution.

Conclusion

This study is one of the largest retrospective studies comparing the different endophthalmitis protocols and showing the efficacy of amikacin added to BSS with a significant reduction in the overall rate of endophthalmitis despite using the same standardized topical antibiotic regimen in all patients.

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Conflicts of interest

There are no conflicts of interest.

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