

# Effects of intracameral cefuroxime on corneal endothelial cell counts and its morphology after cataract surgery

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**Abstract:** *Background:* Endophthalmitis is one of the most important complications after cataract surgery and in case event can cause many symptoms, such as severe decrease in eyesight and/or even the loss of vision. Employing methods to reduce this problem is very important. The aim of this study was to evaluate the effect of intracameral cefuroxime after cataract surgery on corneal endothelial cell counts and its morphology. *Methods:* In this study, 32 eyes of 30 patients underwent endothelial cell count and morphology assessment by ConfoScan III device before and 1 month after cataract surgery. All patients undertaken cataract surgery by one surgeon and by one method. Intracameral cefuroxime (1 mg/0.1 ml) was used as prophylaxis of postoperative endophthalmitis at the end of operation. *Results:* In this study, the rate of corneal endothelial cell loss 1 month after cataract surgery was 8.4%, and the rate of endothelial cells polymegathism before and after cataract surgery did not differ statistically. During the follow-up period, there were no cases of endophthalmitis or other complications. *Conclusion:* With regard to the importance of the intracameral cefuroxime in a reduction in the rate of endophthalmitis after cataract surgery and that harmful effects on the endothelial cells were not seen, this method can be considered as a suitable method for endophthalmitis prophylaxis.

**Keywords:** cefuroxime, endothelium, corneal, polymorphism, genetic, cataract, endophthalmitis

## Introduction

Endophthalmitis is an inflammation of the vitreous and anterior chambers of the eye. The occurrence of endophthalmitis accounts for all ophthalmologists is a serious complication that can lead to severe vision loss and even blindness. The types of endophthalmitis include endophthalmitis following surgery (acute and chronic), endophthalmitis following filtering surgery, traumatic endophthalmitis, endogenous endophthalmitis, and non-infectious endophthalmitis (sterile). The most common effect of endophthalmitis, acute endophthalmitis after

surgery, is usually caused by invading bacteria or fungi. The overall prevalence of acute endophthalmitis after surgery is about 0.093. The most common factors of this condition are microorganisms in the superficial structures of the eye, such as eyelids, conjunctiva, and lacrimal sac, which include Gram-positive bacteria (90%), Gram-negative bacteria (7%), and fungi (3%). In addition to the pathogens in superficial structures of the eye, operating equipment, eye wash solutions, donor cornea in corneal graft, intraocular lens (IOL), air particles, and unclean viscoelastic solutions can be considered as the factors of this condition [1–3]. The clinical findings of acute endophthalmitis after surgery

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include eye redness, chemosis, eyelid edema, decreased vision, impaired afferent pupillary reflex, corneal edema and infiltration, fibrin reaction in the anterior chamber, vitreous inflammation, retinitis, and retinal periphlebitis. Intraoperative risk factors include incomplete disinfection of the conjunctiva and eyelids, surgery longer than 60 min, vitreous loss, and unwanted entry into the eye during extraocular surgery, local anesthesia, dysfunctioning in the sores, leakage of wound and dehiscence, improper burial stitches, trapping the vitreous in the wound, the scleral tunnel, and unwanted conjunctival filtering bleb [1]. Wounds without sutures in cataract surgery can cause the organism gets into the eye after surgery. Since absolute sterility of surgery site is not possible to be perfect, the lids and conjunctiva are the main sources of infection in the postoperative endophthalmitis, and organisms responsible for postoperative endophthalmitis usually are the same normal flora in the surface of the eye, such as species of coagulase-negative staphylococci [3]. There are, however, questions about the ideal and optimal methods for antibiotic prophylaxis in cataract surgery, use of 5% povidone-iodine solution, by pouring it into the fornix before surgery reduces the number of bacterial colonies in the eye during surgery. This method also reduces the risk of culture-positive endophthalmitis [3]. The use of intraocular antibiotics either injected into the anterior chamber or into the irrigation solution is also recommended. In general, the effects of these prophylactic methods in real prevention of endophthalmitis are unknown. Recently, numerous studies have been reported the use of intracameral antibiotics after the operation showing an obvious decrease in the rate of endophthalmitis in three to five times to other methods of prophylaxis including subconjunctival injection of antibiotics [4–6].

Cefuroxime is a bactericidal antibiotic. It is a second-generation cephalosporin, which is used to measure the 1 mg intraocular concern that exists about intraocular medication, including intracameral cefuroxime is a possibility of them toxic effects on ocular tissue including corneal endothelial cells. Therefore, we decided to study the effects of intracameral cefuroxime after cataract surgery on corneal endothelial cell counts and its morphology.

## Materials and Methods

In this interventional study, 32 eyes of 30 patients who admitted to the Alzahra Eye Center of Zahedan University of Medical Sciences enrolled in the study with a random sampling and informed consent and permission were obtained from all of them. Patients aged greater than or equal to 30 years and less than or equal to 85 years, and patients with nuclear and posterior subcapsular cataract and their opacities in LOCS III classification system that was less than or equal of IV were included in the study. Patients with diabetes, any previous surgery on

the eye, corneal dystrophy or any corneal degenerative disease or any corneal opacity, and any eye diseases such as uveitis and glaucoma, and patients who experienced complications during surgery were excluded from the study. The study was carried out in accordance with the principles of Declaration of Helsinki.

All patients after filling out the consent form first examined for the endothelial cell count by ConfoScan III (NIDEK Co., Ltd., Aichi, Japan) and then underwent the clinical examination, VA (vigilance) IOP (intraocular pressure), fundoscopic examination, and preoperative refraction. These examinations were also performed at the first day, first week, and first month after surgery, and recorded in data form. For counting endothelial cells in every phase, three photos for every patient had been prepared from central corneal part with at least 40 cells and 0.25–0.40 mm<sup>2</sup> area. Then by means of Navis program that is placed in device in the default, cell evaluation was carried out with an automated method. And the average of the three frames was recorded for each patient. Lens determination was performed by a biometric method using EZ Scan AB5500+ ophthalmic ultrasound scanner (Sonomed Inc., Lake Success, NY, USA) with SRK formula for all patients.

In all patients, general or local anesthesia is used and no patient will operate under topical anesthesia alone. All surgeries were performed by one and anterior segment fellowship professor with clear corneal incision method as much as 2.8 mm. In all cases, methylcellulose (Coatell) was used to form the anterior chamber and was used during the whole surgery in cases of necessity. Phaco tip used for all the phacoemulsification surgeries was 45°, and adrenaline (1:10000) was used for mydriasis in all cases. In all patients, capsulorhexis and hydrodissection were performed after incision, and all of the phacoemulsification procedures were performed with the divided and conquer method.

All of the phacoemulsification was performed by torsional method using infinite device manufactured by Alcon, TX, USA. And in all cases, a foldable posterior chamber lens, Alcon, was used. After phacoemulsification and lens implantation (IOL), anterior chamber was irrigated to remove residual methylcellulose.

Each vial of cefuroxime (750 mg) was diluted using 7.5 cc sterile normal saline (N/S); 1 cc of this diluted solution contains 100 mg of cefuroxime. Then, 1 cc of this solution was diluted again with N/S and titrated up to 10 cc volume, so that eventually every 1 cc of this solution contains 10 mg of cefuroxime. Then, 0.1 cc of solution containing 1 mg of cefuroxime was injected at the end of cataract surgery in the anterior chamber. At the end of the operation, the eye was patched up to the day after surgery. And F/U examination of patients was performed at the first day, first week, and the first month, and the results were recorded in the clinical records. After surgery, all patients received eye drops as follows:

Betamethasone eye drops: one drop every 2 h up to 1 week, one drop every 4 h up to 1 week, one drop every 6 h up to 1 week, one drop every 8 h up to 1 week, one drop every 12 h up to 1 week, and then stopped.

All the evaluations were performed by the same surgeon with similar methods: one type of IOL, one type of intraocular irrigation solution, one type of viscoelastic material were used. Irrigation solution (Irrigation) and an identical intraocular viscoelastic material used in the case of any complications during surgery were excluded; the observance of the above issues can lead to high accuracy of the results. In case of any complications during surgery, the patient was excluded from the study. The observance of the above issues can lead to high accuracy of the results.

Ciprofloxacin eye drops: one drop every 4 h up to 1 week, then every 6 h up to 1 week, and then stopped. As was noted, corneal endothelial cell count was performed and recorded again in all patients after 1 month with the same basic technique by ConfoScan III system. The patient's refraction and best-corrected visual acuity (BCVA) with correction was achieved. At the end, collected information before and after the operation was analyzed with program SPSS 19 and with statistical method (*t*-test).

## Results

In this study, 32 eyes of 30 patients were studied. About 48.4% of the left eyes and 51.6% of the right eyes were assessed. Of these, 13 (43.4%) were males and 17 (56.6%) were females, respectively. The mean age of patients was  $58.15 \pm 12.9$  years. The minimum age was 30 years and maximum age was 81 years (Table I).

The preoperative mean corneal endothelial cell count (endothelial cell density) in patients was  $2,515 \pm 406$  and the mean number 1 month after phacoemulsification was  $2,259.9 \pm 384$ . That the number was significantly (statistically) reduced compared with the number of cells before surgery ( $p=0.001$ ). The levels of endothelial cell loss during surgery (1 month after cataract surgery) were an average of 8.4% (Table I).

Compared with the endothelial cell count, the average of polymegathism was  $36.73 \pm 7.62\%$  preoperatively

which reach  $41.78 \pm 8.01\%$  first month after cataract surgery. Polymegathism after phacoemulsification had increased significantly (statistically) than polymegathism before the operation ( $p=0.008$ ). The average rate of polymegathism increase was 28.2% postoperatively.

In comparison, the average of polymorphism was  $46.78 \pm 8.17\%$ , whereas the average of phacoemulsification was  $46.48 \pm 11.3\%$  after first month. The polymorphism of preoperative and postoperative difference was not statistically significant ( $p=0.892$ ). The mean BCVA before surgery was  $0.13 \pm 0.9$ , whereas the mean BCVA one month after phacoemulsification was  $0.78 \pm 0.12$ , which is significantly higher than that seen in patients before surgery ( $p=0.001$ ) (Table I).

## Discussion

The effectiveness of intracameral cefuroxime as prophylaxis of endophthalmitis after cataract surgery has been shown in many studies. The results from a large, multi-center study of European Society Cataract and Refractive Surgery on 16,211 patients showed that the rate of endophthalmitis after cataract surgery with the use of intracameral cefuroxime was declined 4.9 times [7].

A prospective study in Spain, over 13,652 patients who had cataract, was indicated the efficacy of intracameral cefuroxime as prophylaxis of endophthalmitis after cataract surgery [8]. The selection of cefuroxime (second-generation cephalosporin) was based on the spectrum of microbiology in a study that performed in Sweden by Montan et al. [4] was about endophthalmitis after cataract surgery. In its report of 59 isolated pathogens, 55 strains were susceptible to cefuroxime.

Cephalosporin compounds commercially available (e.g., cefuroxime) in pharmacies are not prepared for intracameral use. Prepared solution for intraocular injection (intracameral) of these antibiotics is produced from powder form that use for intramuscular (IM) or intravenous (IV) injection. Although productive companies of these compounds recommended the use of sterile distilled water to dissolve the powder for IV or IM injection, we used, on the basis of previous studies, sterile N/S to prepare an antibiotic solution for intracameral injection (to prevent intraocular hypotonicity) [5, 9, 10].

The wrong way of diluting or error in dosage or type of solvent used to dilute the drug solution may even lead to the risk of drug toxicity and even toxic anterior segment syndrome [11]. Of course, this issue was not observed in any of the patients in this study.

In a study conducted in rabbits by Koul et al. [12], it was observed that intracameral cefuroxime did not have significance in intraocular toxicity. In another study, Montan et al. [4], in Sweden, studied the patient's safety (health) for the use of intracameral cefuroxime on

**Table I** | A comparison of the factors measured before and after surgery in patients

	Preoperative	Postoperative	<i>p</i> value
Endothelial cell count	$2,515 \pm 406$	$2,259 \pm 384$	0.001
Polymegathism	$36.73 \pm 7.62\%$	$41.78 \pm 8.01\%$	0.008
Polymorphism	$46.78 \pm 8.17\%$	$46.48 \pm 11.3\%$	0.892
Visual acuity	$0.13 \pm 0.9$	$0.78 \pm 0.12$	0.001

The data are presented as mean  $\pm$  SD

45 patients who undertaken cataract surgery and used intracameral cefuroxime at the end of the operation as prophylaxis of endophthalmitis, and also observed that this drug makes no endothelial cell toxicity and have no effect on the final visual acuity.

In the study by Yu-Wai-Man et al. [6] in Sunderland, England on 36,743 patients that was performed to compare the efficacy of intracameral cefuroxime with subconjunctival cefuroxime in reducing postoperative endophthalmitis, it was found that the incidence of endophthalmitis was higher obviously in the subgroup that used subconjunctival cefuroxime at the end of surgery compared with the subgroup that used intracameral cefuroxime.

In this study, the rate of endothelial cell loss after cataract surgery was an average of 8.4%, which is acceptable in comparison with the literature [13]. Also the rate of endothelial cell loss compared with Matsuda et al.'s [14] study that reported the rate of endothelial cell loss after phacoemulsification an average 18.1% was significantly lower.

Also, compared with the study of Liu et al. [15], which reported the rate of endothelial cell loss after phacoemulsification with the method of torsional 12.5% and with the method of longitudinal (pulse) 19.1%, the rate of endothelial cell loss was significantly lower. In this study, all cases of surgeries were performed by a fellowship of anterior segment and with the uses of a similar technique that was mentioned previously.

The rate of endothelial cell loss in our study compared with Lam et al. [11] (in Hong Kong; for the evaluation of intracameral cefuroxime in cataract surgery that published in *Clinical Ophthalmology* in 2010) reported the rate of endothelial cell loss in the use of intracameral cefuroxime after surgery, 9% is comparable.

In this study, polymorphism 1 month after cataract surgery was increased statistically significantly, which according to some studies that suggested endothelial cell enlargement could be a sign of reduced capacity of endothelial cells, as for the 8.4% endothelial loss in this study, increase in polymegathism is justified [14]. The above is confirmed in a study that performed by Kiss et al. [16] and it has been reported that the process of restoration of lost cells leading to increase in mean cell size and damage to 6 shaped model of them.

In this study, the time period of 1 month (4 weeks) after cataract surgery for renewed ConfoScan and re-analysis of data was selected based on previous studies on the use of intracameral cefuroxime and vancomycin and cefotaxime [5, 17, 18]. Kramann et al. [17] reported that more than 4 weeks after cataract surgery, endothelial cells losing were not observed. During the follow-up period to this study, no cases of endophthalmitis- or drug-related adverse reactions were observed.

## Conclusion

In this study, the rate of endothelial cell loss after surgery was not more than the other cases of cataract surgery that performed routinely, and no special effects that can be attributed to intracameral cefuroxime were observed. Based on the above issues and that intracameral cefuroxime as prophylaxis of endophthalmitis after cataract surgery reduces the risk of endophthalmitis in the amount of 1 mg/0.1 ml, it is suggested that the study with a vast volume of more and more long-term follow-up to be performed in terms of complications, the exact dosage of medication, how to dilute it, even it is possible, to design and develop an intracameral form of the drug commercials.

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## References

1. Shirzadi K, Amirdehi AR, Makateb A, Shahraki K, Khosravifard K: Studying the effect of tropicamide various concentrations on routine dilation of the pupil. *Biomed Pharmacol J* 8, 885–889 (2015)
2. Steven I, Mark H, James C, American Academy of Ophthalmology (2008): *Lens and Cataract*. American Academy of Ophthalmology, San Francisco, CA
3. Sutphin JE, American Academy of Ophthalmology (2007): *External Disease and Cornea*. American Academy of Ophthalmology, San Francisco, CA
4. Montan PG, Wejde G, Setterquist H, Rylander M, Zetterström C: Prophylactic intracameral cefuroxime. Evaluation of safety and kinetics in cataract surgery. *J Cataract Refract Surg* 28, 982–987 (2002)
5. Ramana S, Moorthy JD, American Academy of Ophthalmology (2008): *Intraocular Inflammation and Uveitis*. American Academy of Ophthalmology, San Francisco, CA
6. Yu-Wai-Man P, Morgan SJ, Hildreth AJ, Steel DH, Allen D: Efficacy of intracameral and subconjunctival cefuroxime in preventing endophthalmitis after cataract surgery. *J Cataract Refract Surg* 34, 447–451 (2008)
7. Lundström M, Wejde G, Stenevi U, Thorburn W, Montan P: Endophthalmitis after cataract surgery: A nationwide prospective study evaluating incidence in relation to incision type and location. *Ophthalmology* 114, 866–870 (2007)
8. García-Sáenz MC, Arias-Puente A, Rodríguez-Caravaca G, Bañuelos JB: Effectiveness of intracameral cefuroxime in preventing endophthalmitis after cataract surgery ten-year comparative study. *J Cataract Refract Surg* 36, 203–207 (2010)
9. Lockington D, Flowers H, Young D, Yorston D: Assessing the accuracy of intracameral antibiotic preparation for use in cataract surgery. *J Cataract Refract Surg* 36, 286–289 (2010)
10. Romero P, Méndez I, Salvat M, Fernández J, Almena M: Intracameral cefazolin as prophylaxis against endophthalmitis in cataract surgery. *J Cataract Refract Surg* 32, 438–441 (2006)

11. Lam PT, Young AL, Cheng LL, Tam PM, Lee VY: Randomized controlled trial on the safety of intracameral cephalosporins in cataract surgery. *Clin Ophthalmol* 4, 1499–1504 (2010)
12. Koul S, Philipson A, Philipson BT, Kock E, Nylén P: Intraocular levels of cefuroxime in uninflamed rabbit eyes. *Acta Ophthalmol (Copenh)* 68, 455–465 (1990)
13. Baradaran Rafie A: Quantitative and qualitative analysis of specular microscopy images. *Negah Ophthalmol J* 4, 9–12 (2003)
14. Matsuda M, Miyake K, Inaba M: Long-term corneal endothelial changes after intraocular lens implantation. *Am J Ophthalmol* 105, 248–252 (1988)
15. Liu Y, Zeng M, Liu X, Luo L, Yuan Z, Xia Y, Zeng Y: Torsional mode versus conventional ultrasound mode phacoemulsification: Randomized comparative clinical study. *J Cataract Refract Surg* 33, 287–292 (2007)
16. Kiss B, Findl O, Menapace R, Petternel V, Wirtitsch M, Lorange T: Corneal endothelial cell protection with a dispersive viscoelastic material and an irrigating solution during phacoemulsification: Low-cost versus expensive combination. *J Cataract Refract Surg* 29, 733–740 (2003)
17. Kramann C, Pitz S, Schwenn O, Haber M, Hommel G, Pfeiffer N: Effects of intraocular cefotaxime on the human corneal endothelium. *J Cataract Refract Surg* 27, 250–255 (2001)
18. Matsuura K, Miyoshi T, Suto C, Akura J, Inoue Y: Efficacy and safety of prophylactic intracameral moxifloxacin injection in Japan. *J Cataract Refract Surg* 39, 1702–1706 (2013)