Eye (2010) 24, 619–623

www.nature.com/eye

CLINICAL STUDY

Effect of intracameral triamcinolone acetonide on postoperative intraocular pressure after cataract surgery

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Abstract

Purpose **To evaluate the effect of 1 mg intracameral triamcinolone acetonide (TA) on postoperative intraocular pressure (IOP) after routine cataract surgery.**

Patients and methods **This prospective, randomized, placebo-controlled study comprised 120 eyes of 120 patients with uncomplicated cataract surgery. The patients were randomized into two groups. Eyes in group 1 (60 eyes) received an injection of 1 mg TA into the anterior chamber at the end of the surgery, but eyes in group 2 (60 eyes) did not. The biomicroscopic evaluation, visual acuity (VA), and IOP measurements were done at baseline (preoperatively) and 6, 20–24 h, 1 week, and permonthly until 6 months postoperatively.**

Results **Mean IOP at 6 and 20–24 h postoperatively were significantly higher than baseline measurements in both groups ($P<0.001$). Also, the mean IOP values at postoperative 6 and 20–24 h were slightly higher in group 1 than in group 2 ($P>0.05$ for both). The mean IOPs at week 1 and 1–6 months after surgery were not significantly different from baseline values in both groups ($P>0.05$ for both time periods). At 6 and 20–24 h postoperatively, the number of eyes with an IOP increase >5 and 10 mm Hg with respect to baseline were not statistically different between the two groups ($P>0.05$). There were no statistically significant differences in mean VA and the amount of anterior chamber cells and flare between the two groups at any postoperative visit ($P>0.05$).**

Conclusion **Intracameral injection of 1 mg TA after uncomplicated phacoemulsification surgery had no significant effects on postoperative IOP.**

Eye (2010) **24,** 619–623; doi:10.1038/eye.2009.182; published online 10 July 2009

Keywords: intraocular pressure; phacoemulsification; postoperative inflammation; triamcinolone acetonide; visual acuity

Introduction

Recent advances in cataract surgery, such as techniques, instrumentation, and foldable intraocular lenses (IOLs), have resulted in a decrease in the physical trauma associated with the surgery. Nevertheless, most patients still exhibit postoperative ocular inflammation after cataract surgery.[1]

Steroids have traditionally been used topically and subconjunctivally to treat postoperative inflammation. Subconjunctival steroid injections can be painful and can cause subconjunctival haemorrhage and chemosis. To prevent these side effects and to obtain better anterior chamber concentrations, intracameral application of 1 mg triamcinolone acetonide (TA) at the end of the cataract surgery has been risen in practice.[2,3]

The long-term effect of intracameral TA on postoperative intraocular pressure (IOP) has not been studied earlier within the literature. The aim of this prospective clinical trial was to evaluate whether intracameral injection of 1 mg/0.1 ml TA at the end of uncomplicated

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Received: 22 March 2009
Accepted in revised form: 14 June 2009
Published online: 10 July 2009

Conflict of interest: None

phacoemulsification surgery has any adverse effect on postoperative IOP.

Materials and methods

This prospective, randomized, placebo-controlled study comprised 120 eyes of 120 patients scheduled for routine cataract surgery by phacoemulsification with implantation of a foldable IOL in each eye.

A comprehensive questionnaire was completed, which included items on the patient's age, family, medical, and ocular history. Inclusion criteria were the presence of a cataract that was suitable for topical phacoemulsification and an IOP of 21 mm Hg or lower 1 day before surgery. Exclusion criteria were earlier ocular surgery, ocular hypertension (IOP > 21 mm Hg), pigment dispersion syndrome, pseudoexfoliation syndrome, uveitis, and any form of glaucoma.

All operations were performed by the same surgeon (AK) under topical anaesthesia in the morning session and completed before 11:00 a.m. Approximately 1–2 h before surgery, phenylephrine 2.5%, tropicamide 1%, and cyclopentolate 1% eye drops were instilled. After topical anaesthesia, a 3.2-mm clear corneal temporal incision was made, after which sodium chondroitin sulphate 4%—sodium hyaluronate 2% (Viscoat**,** Alcon, TX, USA) was injected and 5.0 mm capsulorhexis was performed. Using the divide-and-conquer technique, the surgeon performed standard phacoemulsification. The capsular bag was expanded with sodium hyaluronate 1% (Biolon, Abdi Ibrahim Biotechnology General, Israel), and a foldable IOL was implanted in the capsular bag. The incision was not sutured.

The viscoelastic substance was removed from the bag, the capsular fornix, and the anterior chamber in a standard fashion using an irrigation/aspiration (I/A) system. First, the proximal optic edge was tilted up with a spatula, and the I/A tip inserted behind the optic. After that the central portion of the viscoelastic substance was removed and the I/A tip was swept across and along the capsule equator to capture any peripheral residuals. The I/A tip was then guided into the anterior chamber and the optic was repositioned. Although the aspiration opening was rotated right, left, and posteriorly, the viscoelastic substance was circumferentially removed from the prelental, retroiridal, and preiridal spaces. The surgeon was careful not to approach the endothelium and the chamber angle too closely. As a consequence of this, the residual film coating these structures often persisted. Finally, the I/A tip was positioned on the centre of the optic. Although the aspiration opening was directed upward and the tip was pressed down on the optic, the anterior chamber was rinsed before the I/A tip was retracted.

At the end of the surgery, patients were randomly allocated to one of two groups and the IOP was measured with a Schiotz tonometer in each patient. Randomization was accomplished by using a list created by a random number generator. The IOP was adjusted to a target pressure of 10 mm Hg by exchanging balanced saline solution through the paracentesis puncture. In group 1 ($n = 60$ eyes of 60 patients), TA 1 mg (0.025 cc Kenocort-A, Bristol-Myers Squibb, NY, USA) was injected into the anterior chamber through a paracentesis using a 27-gauge cannula. Group 2 ($n = 60$ eyes of 60 patients) received a similar amount of balanced salt solution as placebo. All eyes were patched with topical antibiotic (Tobrex, Alcon, Switzerland) ointment. After the postoperative examination 20–24 h later, ofloxacin 0.3% (Exocin, Allergan, Pharmaceuticals Ltd, Ireland) and prednisolone acetate 1% (Pred Forte, Allergan, Pharmaceuticals Ltd, Ireland) eyedrops were prescribed four times a day.

Visual acuity (VA) in the study eye was measured using the Snellen VA chart and values were converted to logMAR for statistical analysis.

Anterior chamber cell and flare scores were determined using the narrowest slit beam (0.5 mm) at a height of 8 mm, with maximal luminance and magnification of the slit lamp. Anterior chamber cells were graded as 0 = <5 cells, 1 = mild, 5–10 cells, 2 = moderate, 10–20 cells, 3 = marked, 21–50 cells, 4 = severe, >50 cells, and 5 = hypopyon. The aqueous flare scale was scored as 0 = none, 1 = mild (just detectable), 2 = moderate (iris details clear), 3 = marked (iris details hazy), and 4 = severe (heavy with fibrin deposits and clots).

The preoperative IOP was measured using a Goldmann applanation tonometry 1 day before surgery. The IOP was measured with the same Goldmann applanation tonometer at 6 h and then 20–24 h after cataract surgery. Routine follow-up including IOP measurement was performed at week 1 and permonthly until 6 months after surgery.

IOP was analysed using several criteria: a change of 5 and 10 mm Hg or more from baseline[4,5] and mean change from baseline. Statistical analysis was performed using SPSS software (Statistical Package for the Social Sciences, version 9.0, SPSS Inc., Chicago, III, USA). Ordinal variables (anterior chamber cells and flare) were evaluated by Mann–Whitney *U*-test. Group comparisons of the preoperative and postoperative IOPs and VA (logMAR) were done using independent samples test. Mean IOP changes in each group from preoperatively to 6, 20–24 h, 1 week, 1–6 months were compared using paired *t*-tests. The proportion of patients with an IOP elevation >5 and 10 mm Hg with respect to baseline at 6 and 20–24 h postoperatively and categoric variables,

such as age and sex, were compared using the χ^2 test. A P-value <0.05 was considered statistically significant.

We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research.

Results

Group 1 included 29 women and 31 men with an average age of 67.3 ± 9.5 years. Group 2 included 23 women and 37 men with an average age of 65.8 ± 7.8 years. There were no significant differences between the groups in terms of age or sex ($P>0.05$). There were no intraocular complications such as capsule rupture or zonular dialysis in any eye.

Table 1 shows the preoperative and postoperative mean IOPs and mean IOP changes from preoperatively to 6, 20–24 h, 1 week, 1–6 months postoperatively in both groups. There was no significant 'between-group' difference in preoperative IOP ($P>0.05$). At 6 and 20–24 h postoperatively, the mean IOP was slightly higher in group 1 than in group 2, but the difference was not statistically significant ($P>0.05$) and the mean IOP increased significantly in both groups with respect to baseline ($P<0.001$, for both). At 1 week and 1–6 months postoperatively, there was no significant between-group difference and no significant change from the mean preoperative IOP was observed in either groups ($P>0.05$ for both).

Table 2 shows the number of eyes with an IOP elevation >5 and 10 mm Hg with respect to baseline at 6 and 20–24 h postoperatively. There was no statistically significant difference between groups ($P>0.05$).

None of the eyes in this study had an IOP higher than 30 mm Hg or an IOP elevation of 20 mm Hg or greater with respect to baseline levels and no antiglaucomatous medications were required to reduce postoperative IOP spikes.

Preoperative mean VA (logMAR) values were similar in both groups. There were no statistically significant differences in mean VA (logMAR) between the two groups at any postoperative visit ($P>0.05$) (Table 3).

Injection of TA into the anterior chamber resulted in a 'snow-globe effect' of various densities at slit-lamp examination. Despite the suspension of TA crystals, it was easy to assess cell and flare between crystals. The treatment modalities used in the two groups reduced anterior chamber cells and flare equally and effectively, and no statistically significant differences were observed at any postoperative visits ($P>0.05$) (Table 4).

Discussion

Advanced cataract surgery techniques, equipment, and pharmacologic agents have raised the bar for both surgeons and patients. Contemporary practices have resulted in these procedures being quick, with minimal

Table 2 Number of eyes with postoperative IOP elevation above 5 and 10 mm Hg with respect to baseline in both groups

IOP	*Group 1* n *(%)*	*Group 2* n *(%)*	P-*value*
6 h postoperatively			
>5 mm Hg	13	11	0.644
>10 mm Hg	4	4	1.0
20–24 h postoperatively			
>5 mm Hg	6	4	0.236
>10 mm Hg	2	1	0.685

Abbreviation: IOP, intraocular pressure.

Table 1 Preoperative and postoperative mean IOPs and mean IOP changes from preoperatively to 6, 20–24 h, 1 week, 1–6 months postoperatively in both groups

Time	*Group 1* (n = *60*)	*Group 2* (n = *60*)	P-*value*[a]	*Mean IOP change from baseline group 1* (n = *60*)	P-*value*[b]	*Mean IOP change from baseline group 2* (n = *60*)	P-*value*[b]
Preoperative	13.9 ± 1.8 (10–18)	14.1 ± 2.1 (11–19)	0.578	—	—	—	—
6 h postoperatively	18.1 ± 3.4 (12–24)	17.6 ± 2.5 (13–24)	0.406	4.1 ± 3.7 (−2–12)	<0.001	3.4 ± 3.1 (−3–11)	<0.001
20–24 h postoperatively	16.4 ± 3.2 (9–24)	16.1 ± 2.1 (10–22)	0.571	2.4 ± 3.4 (−5–12)	<0.001	1.9 ± 2.6 (−6–11)	<0.001
1 week postoperatively	14.0 ± 2.1 (10–18)	13.9 ± 1.6 (10–17)	0.848	0.0 ± 2.1 (−4–6)	0.856	−0.2 ± 2.3 (−5–5)	0.474
1 month postoperatively	14.3 ± 1.7 (10–18)	14.2 ± 1.6 (10–18)	0.871	0.3 ± 1.6 (−3–4)	0.153	0.0 ± 2.0 (−4–4)	0.799
2 months postoperatively	13.7 ± 1.4 (11–17)	13.9 ± 1.2 (11–17)	0.381	−0.2 ± 1.4 (−3–3)	0.192	−0.2 ± 1.7 (−3–4)	0.309
3 months postoperatively	13.9 ± 1.5 (11–17)	13.8 ± 1.6 (11–19)	0.820	−0.1 ± 1.7(−4–3)	0.885	−0.3 ± 1.6 (−3–4)	0.159
4 months postoperatively	13.6 ± 1.5 (10–18)	13.7 ± 1.3 (11–17)	0.666	−0.3 ± 1.5 (−4–3)	0.088	−0.4 ± 1.8 (−4–3)	0.079
5 months postoperatively	13.6 ± 1.6 (10–18)	13.8 ± 1.4 (10–18)	0.564	−0.3 ± 1.4 (−3–3)	0.068	−0.3 ± 2.0 (−4–5)	0.145
6 months postoperatively	13.9 ± 1.5 (11–18)	13.7 ± 1.6 (10–18)	0.687	−0.1 ± 1.5(−3–3)	0.686	−0.4 ± 1.9 (−4–4)	0.109

[a]Differences between groups.
[b]Difference from preoperatively.
Data are presented in mean IOP (mm Hg), SD, and range.

Table 3 Mean ± SD visual acuity (logMAR) values for both groups.

	Group 1 (n = *60*)	*Group 2* (n = *60*)	P-*value*
Preoperative	0.78 ± 0.41	0.80 ± 0.43	0.21
6 h postoperatively	0.38 ± 0.34	0.40 ± 0.26	0.12
20–24 h postoperatively	0.18 ± 0.12	0.16 ± 0.22	0.16
1 week postoperatively	0.07 ± 0.04	0.08 ± 0.02	0.60
1 month postoperatively	0.07 ± 0.05	0.08 ± 0.04	0.67
2 months postoperatively	0.07 ± 0.02	0.07 ± 0.03	0.75
3 months postoperatively	0.08 ± 0.02	0.07 ± 0.04	0.35
4 months postoperatively	0.07 ± 0.02	0.08 ± 0.02	0.41
5 months postoperatively	0.08 ± 0.03	0.08 ± 0.02	0.68
6 months postoperatively	0.08 ± 0.02	0.08 ± 0.01	0.77

Table 4 Comparison of inflammation scores (anterior chamber cells, flare) between the two groups

	Group 1 (n = *60*)	*Group 2* (n = *60*)	P-*value*
Cells			
6 h postoperatively	1.43 ± 0.54 (0–2)	1.41 ± 0.55 (0–2)	0.72
20–24 h postoperatively	1.24 ± 0.34 (0–2)	1.18 ± 0.41 (0–2)	0.31
1 week postoperatively	0.50 ± 0.46 (0–1)	0.48 ± 0.55 (0–1)	0.54
Flare			
6 h postoperatively	1.37 ± 0.68 (0–2)	1.38 ± 0.57 (0–2)	0.64
20–24 h postoperatively	1.12 ± 0.25 (0–1)	1.14 ± 0.38 (0–1)	0.45
1 week postoperatively	0.26 ± 0.26 (0–1)	0.25 ± 0.33 (0–1)	0.76

Data are presented in mean ± SD (range).

time necessary for patient recovery, and few or no complications. Although topical corticosteroid drops are the most commonly used anti-inflammatory agents after cataract surgery, they have several disadvantages: the intraocular levels of topically applied preparations are low and unreliable, with concentrations fluctuating between instillations and reaching peak concentrations approximately 1 h after application.[2,6,7] In addition, topical medications have an undesirable effect on the cornea, causing disruption of the tear film and subsequent irritation. Therefore, this procedure may prevent the side effects of corneal melts, conjunctival irritation, and dry eye that occur with frequent use of multiple numbers of topical eyedrops.

The intraocular injection of TA has been used for many years for the treatment of the posterior segment pathologies in which inflammation has a pivotal function. Likewise, intraocular injection of TA is helpful in visualizing the vitreous during ocular surgeries.[8] Oh *et al*[9] applied TA intracamerally into rabbit eyes to investigate the effect of TA on the corneal endothelium and showed reduced microvilli, although no statistically significant differences in endothelial counts and central corneal thickness were observed at 2 h after the experimental procedure. Chang *et al*[10] showed toxicity of TA on cultured endothelium in their experimental study. Despite the evidence of *in vitro* toxicity of intracameral TA on corneal endothelium, the use has been risen in practice to suppress postoperative inflammation after cataract surgery. Gills and Gills[3] added TA to an anterior chamber solution for controlling inflammation after cataract surgery. As they did not find the appropriate dose, they began conservatively with 0.25 mg and gradually increased doses to 3.0 mg and up to 4.0 mg in diabetes patients. The authors suggested that, as the TA dose was gradually increased, the number of eyes requiring postoperative steroid treatment fell from 45% at the lowest dose to 2% at a dose of 1.8–2.1 mg. We reported in an earlier study[2] that 1 mg TA injected intracamerally at the end of the surgery effectively suppressed postoperative inflammation. The findings of this study support those of our earlier work. Jonas[11] found detectable concentrations of TA in aqueous humour samples obtained from eyes, which had undergone intravitreal TA injection 6 months before sampling. In this study, we used topical steroid eyedrops at the same frequency in two groups to make the groups similar and measured IOP until 6 months postoperatively to investigate if intracameral TA had any additive effect on postoperative IOP.

There was no uniformity in the way the TA cleared from the eye. In younger patients, it cleared faster; in

older patients, glaucoma patients, and hyperopes, it remained for days, sometimes weeks, but the exact cleaning time of TA crystals from the eye is unknown. The TA crystals spread throughout the eye, the iris, the wound sites, the capsular bag, and into the vitreous. Much of the TA may progress through different channels of access to the anterior chamber such as the trabecular meshwork and the iris itself.[3]

Ocular hypertension is a common complication after treatment with corticosteroids, especially if higher intraocular or periocular dosages are used, and can occur in 30–77% of patients after posterior sub-Tenon TA[12,13] and in around 40% after intravitreal TA.[14,15] The relationship between the corticosteroid treatment and ocular hypertensive response is complex, and its incidence is higher in those with a family history of glaucoma. In this study, at 6 and 20–24 h postoperatively, the mean IOP was slightly higher in group 1 than in group 2, but the difference was not statistically significant ($P > 0.05$). In both groups, IOP values at 6 and 20–24 h postoperatively were higher than preoperative values ($P < 0.001$), but IOP values at 1 week and permonthly until 6 months after surgery were not significantly different from baseline values ($P > 0.05$). This might be because we used a very small amount of TA (1 mg) intracamerally and carefully excluded patients with a known family history of glaucoma or any earlier ocular hypertensive response to systemic or topical corticosteroids from the study. To the best of our knowledge, this is the first study to evaluate the effect of 1 mg injection of TA intracamerally at the end of routine phacoemulsification on postoperative IOP in the literature.

This study should be evaluated in the light of one limitation. It was not a masked study: surgery and observation were carried out by the same person and which might affect the measured outcomes. On the other hand, being a prospective, randomized, placebo-controlled clinical trial and having the operations performed by the same surgeon on similar age and sex-matched groups strengthens the credibility of the findings.

In conclusion, our results indicate that intracameral injection of 1 mg TA after uncomplicated phacoemulsification surgery has no significant effects on postoperative IOP. It can be used safely at the end of the routine cataract surgery to control postoperative inflammation.

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