ORIGINAL ARTICLE

The Effect of Intracameral Triamcinolone Acetonide Application on Postoperative Inflammation and Intraocular Pressure After Phacoemulsification

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ABSTRACT

Purpose: To evaluate effects of intracameral 2mg/0.1ml triamcinolone acetonide administered at the end of uncomplicated phacoemulsification surgery on postoperative inflammation and intraocular pressure (IOP).

Materials and Methods: This prospective study included 50 eyes of 50 patients who underwent uncomplicated phacoemulsification surgery. At the end of surgery, 2 mg/0.1ml of triamcinolone was injected into the anterior chamber in 26 eyes (Group A) while balanced salt solution was administered to 24 eyes as placebo (Group B). Topical prednisolone acetate 1% treatment was given to the Group B postoperatively while Group A did not receive any topical steroid therapy. Best corrected visual acuity, spherical and cylindrical refraction and IOP values as well as degree of corneal edema and anterior chamber reaction were compared between groups on the postoperative day 1and week 1.

Results: There was no significant difference in IOP measured on postoperative day and week 1 between groups ($p>0.05$). In both groups, mean IOP was higher on postoperative day 1 than preoperative IOP. The IOP increase was 1.6±6.0 mmHg in group A and 4.1±6.7 mmHg in group B on postoperative day 1. There was no significant difference in IOP change on postoperative day 1 between groups ($p=0.120$). No significant difference was found in degree of corneal edema and anterior chamber cell on postoperative day 1 and week 1 between groups ($p>0.05$).

Conclusion: After uncomplicated cataract surgery, 2mg/0.1ml intracameral triamcinolone injection was found to be as effective as topical 1% prednisolone acetate in controlling postoperative inflammation.

Keywords: phacoemulsification, intraocular pressure, inflammation, triamcinolone acetonide.

INTRODUCTION

Surgical removal remains to be single treatment option in cataract which one of the major caused of impaired vision and blindness worldwide.[1] The cataract surgery is one of the most common surgical procedures worldwide. Currently, phacoemulsification surgery is standard treatment due to advantages including shorter surgical duration, closed surgery with small incision and rapid postoperative visual rehabilitation.[2,3] The innovations in phacoemulsification techniques, use of modern phacoemulsification devices and phacoemulsification via smaller incision has decreased surgery-related trauma. Despite advanced surgical technique and innovations, postoperative inflammation is one of the most common complications at postoperative period.[4,5] The impairment in blood-aqueous barrier during surgery leads leakage of proteins and inflammatory cells into anterior chamber. The uncontrolled and excessive postoperative inflammation may cause intraocular pressure (IOP) elevation, adhesions between lens and iris, cystoid macular edema formation and prolonged recovery.[6]

Steroids are used to prevent and suppress postoperative inflammation after cataract surgery.[6,7] Although postoperative topical steroids are effective in controlling inflammation, they have some potential disadvantages. The number of drops needed at postoperative period generally leads compliance issues; frequent topical use and preservatives may lead disruption in tear film and corneal toxicity.[8,9] Thus, subconjunctival, subtenon and intracameral routes can be preferred in order to decrease amount of topical eye drop required at postoperative period.

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In this clinical study, it was aimed to assess effects of intracameral triamcinolone acetonide administration (2 mg/0.1 ml) (Kenacort - A; Bristol - Myers Squibb Co, New York, USA) at end of uncomplicated phacoemulsification surgery on postoperative inflammation and IOP.

MATERIAL AND METHOD

This prospective, clinical trial included 50 eyes of 50 patients who underwent uncomplicated, elective phacoemulsification surgery and foldable intraocular lens implantation for senile cataract. The study was approved by Institutional Ethics Committee. The study was conducted in accordance with tenets of Helsinki Declaration. All patients gave written informed consent. The patients included randomly assigned in two groups. The randomization was achieved using a list of number produced by random number generator (simple random sampling). The study included only one eye of ach patient. If the patient had bilateral cataract, one of the eyes was randomly selected for inclusion.

The study included cases with uncomplicated senile cataract which led impaired visual acuity. The cataract was rated using Lens Opacity Classification System III (LOCS III).[10] The study included cases with grade 2 and 3 cataract according to LOCS III. The exclusion criteria were as follows: previous history of ocular surgery, trauma and infection; oral or topical anti-inflammatory drug (steroid and/or non-steroidal agents) use; ocular hypertension; ocular pseudoexfoliation, pigment dispersion syndrome or other glaucomatous conditions; history of steroid response; active or previous uveitis, corneal diseases (corneal ectasia and dystrophy, corneal opacity); severe dry eye; previous history of cystoid macular edema and diabetes mellitus.

Demographic characteristics were recorded in all patients. Again, all patients underwent a comprehensive ophthalmological examination before surgery, including best-corrected visual acuity (BCVA) measurement by Snellen chart, IOP measurement by Goldmann applanation tonometry, biomicroscopic examination dilated fundus examination. The BCVA was measured by Snellen chart using letters or symbols based on compliance of the patient and recorded as decimals. In all patients, refractive errors were measured using same autorefractor keratometer device (Canon, Tokyo, Japan). Refractive errors were calculated as spherical equivalent [(SE)=(spherical component + 1/2 cylindrical component)

All cataract surgeries were performed under topical anesthesia by same surgeon using same procedure. Phacoemulsification and foldable intraocular lens implantation were performed as surgical procedure. Anterior chamber access was achieved by transparent corneal incision using 2.8 mm keratome and was filled using viscoelastic material. Two lateral corneal access was established using 20-gauge MVR blade. Then, capsulorhexis was performed by creating anterior capsule flap. Standard phacoemulsification was performed after hydro-dissection. Residual cortex and epinucleus particles were completely removed using bimanual method. Anterior chamber was re-filled by viscoelastic material and hydrophobic acrylic intraocular lens was implanted in capsular sac. Using bimanual method, viscoelastic material was completely removed after implantation by access to posterior aspect of intraocular lens. The anterior and lateral port accesses were distended using stromal hydration and moxifloxacin (Vigamox 0.5%, Novartis, USA) was injected into anterior chamber. Finally, 2 mg/0.1ml of triamcinolone (Kenacort - A; Bristol - Myers Squibb Co, New York, USA) was injected into the anterior chamber in 26 eyes (Group A) while same amount of balanced salt solution (balanced salt solution, BSS) was administered to 24 eyes as placebo (Group B) at the end of surgery. At postoperative period, topical prednisolone acetate 1% (5 times daily in the first week and 3 times daily in the second week) (Pred Forte®; Allergan Pharmaceuticals Ltd., Ireland) was given to patients in group B while no topical steroid treatment was given to patients in group A. In both groups, topical moxifloxacin 0.5% (5 times daily for one week) (Vigamox, Novartis, USA) was given as prophylaxis. No additional treatment was allowed in the study.

In all patients, a thorough ophthalmological examination including BCVA measurement by Snellen chart, measurement of spherical and cylindrical refractive values, IOP measurement by Goldmann applanation tonometry, biomicroscopic examination dilated fundus examination was performed on postoperative day 1 and week 1. The corneal edema and anterior chamber reaction were recorded in biomicroscopic examination. The corneal edema was rated using Oxford Cataract Treatment and Evaluation Team (OCTET) criteria.[11,12] Based on these criteria, corneal edema was defined as increased corneal thickness with descemet membrane folds. In addition, corneal edema is classified as transient corneal edam (1+), transient corneal edema with descemet membrane folds of <10 (2+), transient corneal edema with descemet membrane folds of >10 (3+).[11,12] Anterior chamber reaction was rated based on number of cells per mm in anterior chamber according to Standardization of Uveitis Nomenclature (SUN) study group classification.[13] Based on SUN classification, number of cells in anterior chamber was rated as follows: grade 0, <5 cells; grade 1, 6-15 cells; grade 2, 16-25 cells; grade 3, 25-50 cells; and grade 4, >50 cells. Postoperative assessment on day 1 and week 1 were performed by same clinician. All scores were compared between groups.

Statistical analysis

Data were analyzed using SPSS version 22.0 (SPSS Inc, Chicago, USA). Descriptive statistics are presented as count, percent, mean and standard deviation. Normal distribution of data were tested by Kolmogorov-Smirnov test. Categorical variables were tested using Chi-square test. Independent sample t test was used to compare quantitative data with normal distribution while Mann Whitney U test was used to compare data with skewed distribution. A p value<0.05 was considered as statistically significant.

RESULTS

In the study, we analyzed 50 eyes of 50 patients who underwent uncomplicated, elective phacoemulsification surgery and foldable intraocular lens implantation for uncomplicated cataract. Of the patients included, 26 (11 women, 15 men) were assigned to group A while 24 (16 women, 8 men) were assigned into group B. Mean age was 68.3±9.5 years (49-82 years) in group A and 67.0±11.2 years (48-86 years) in group B. No significant difference was observed in age and gender between group A and B (p=0.673 and p=0.082, respectively).

Table 1 presents BCVA values and refractive errors (as spherical equivalent) before surgery and on day 1 and week 1 after surgery in group A and B. Mean BCVA before surgery was 0.18±0.10 and 0.20±0.11 decimals in group A and B, respectively. Mean refractive error before surgery was calculated as 2.63±3..31 and -2.3±3.10 diopters in group A and B, respectively. The mean preoperative BCVA and refractive error values were comparable between groups (p=0.339 and p=0..435, respectively). No significant difference was detected between groups regarding BCVA and refractive error values obtained in any control visits after surgery (p>0.05 for each; Table 1).

Table 2 presents IOP values obtained before surgery and on day 1 and week 1 after surgery in group A and B. The mean

Table 1: *Preoperative and postoperative best-corrected visual acuity and refractive values in groups.*

	Group A (n=26) Mea n±SD (min/max)	Group B (n=24) Mean±SD (min/max)	P value
Preoperative BCVA (decimal)	0.18±0.10 (0.04 / 0.4)	0.20±0.11 (0.04 / 0.5)	0.339*
BCVA on postoperative day 1(decimal)	0.65±0.29 (0.3 / 1.0)	0.68±0.27 (0.4 / 1.0)	0.527*
BCVA on postoperative week 1(decimal)	0.88±0.10 (0.8 / 1.0)	0.89±0.11 (0.8 / 1.0)	0.880*
Preoperative SE, diopter	-2.63±3.31 (+1.67 / -6.00)	-2.32±3.10 (+1.50 / -5.25)	0.435*
SE on postoperative day 1, diopter	-0.53±1.10 (+0.67 / -1.75)	-0.69±1.31 (+0.75 / -2.12)	0.167*
SE on postoperative week 1, diopter	-0.52±1.08 (+0.63 / -1.67)	-0.63±1.23 (+0.67 / -1.87)	0.239*

*BCVA: Best-corrected visual acuity; SE: Spherical equivalent, *Independent samples t-test, SD, Standart devination*

Table 2: *Comparison of preoperative and postoperative IOP values between groups.*

	Group A (n=26) Mean±SD (min/max)	Group B (n=24) Mean±SD (min/max)	P value
Preoperative IOP (mmHg)	14.7±4.5 (7 / 21)	13.7±4.4 (8 / 21)	0.496*
IOP on postoperative day 1 (mmHg)	16.3±8.2 (6 / 33)	17.8±7.88 (7 / 34)	0.538*
IOP on postoperative week 1 (mmHg)	13.3±3.8 (7 / 22)	13.5±4.2 (7 / 24)	0.848*

IOP: Intraocular pressure, *Independent samples t-test, SD, Standard deviation

IOP value before surgery was measured as 14.7±4.5 mmHg in group A and 13.7±4.4 mmHg in group. No significant difference was detected in mean preoperative IOP values between group A and B (p=0.496). No significant difference was observed between groups regarding IOP values obtained on day 1 and week 1 after surgery (p>0.05 for each; Table 2).

Table 3 presents changes in IOP values on day 1 and week 1 when compared to preoperative values in group A and B. In both groups, mean IOP value on day 1 was higher than mean preoperative IOP value. On day 1, mean increase in IOP was 1.6±6.0 mmHg in group A and 4.1±6.7 mmHg in group B. There was no significant difference in IOP change on postoperative day 1 between groups (p=0.120; Table 3). In both groups, it was found that IOP value on postoperative week 1 was slightly lower than preoperative IOP value. No significant difference was detected between groups regarding change in IOP value on postoperative week 1 compared to preoperative values (p=0.235; Table 3).

Table 4 presents corneal edema and anterior chamber inflammation ratings on day and week 1 after surgery. No significant difference was detected between group A and B regarding degree of corneal edema and anterior chamber cell on postoperative day 1 and week 1 (p>0.05 for each; Table 4).

In addition, no ocular complication such as severe anterior chamber inflammation and hypopyon, persistent IOP elevation, severe and/or persistent corneal edema, toxic anterior segment syndrome and endophthalmitis was observed in group A and B.

DISCUSSION

Postoperative inflammation is a normal response occurring after routine cataract surgery. The surgical ocular trauma triggers ocular inflammation and phospholipase A2 activation following tissue injury leads degradation of membrane phospholipase to arachidonic acid, which is, in turn, converted to prostaglandins by cyclooxygenase or leukotriene by lipoxygenase.[14,15] The resultant prostaglandins causes miosis and increased vascular permeability in blood-aqueous barrier, resulting in IOP elevation.[15] The postoperative inflammatory response is generally mild and can be controlled readily, it may lead several complications such as corneal edema, IOP elevation ad secondary glaucoma, posterior synechia, posterior

Table 3: *Comparison of IOP change on postoperative day 1 and week 1 with preoperative IOP values in groups.*

	Group A (n=26) Mean±SD (min/max)	Group B (n=24) Mean±SD (min/max)	P value*
IOP change on postoperative day 1 (mmHg)	1.6±6.0 (-7 / 18)	4.1±6.7 (-6 / 20)	0.120°
IOP change on postoperative week 1 (mmHg)	-1.4±4.2 (-8 / 5)	-0.2±4.4 (-9 / 7)	0.235°

IOP: Intraocular pressure, °Mann Whitney U test, SD, Standard deviation

Table 4: *Comparison of groups regading postoperative corneal edema and anterior chamber inflammation.*

	Group A (n=26) Mean±SD (min/max)	Group B (n=24) Mean±SD (min/max)	P value
Corneal edema on postoperative day (grade)	0.76±0.90 (0 / 3+)	0.92±0.93 (0 / 3+)	0.573*
Corneal edema on postoperative week 1 (grade)	0.19±0.46 (0 / 2+)	0.20±0.50 (0 / 2+)	0.910*
Anterior chamber cell on postoperative day 1 (grade)	1.30±0.47 (1+ / 3+)	1.50±0.65 (1+ / 3+)	0.238*
Anterior chamber cell on postoperative week 1 (grade)	0.05±0.19 (0 / 1+)	0.16±0.30 (0 / 1+)	0.137*

*Independent samples t-test, SD, Standard deviation, *Corneal edema was rated by OCTET criteria while anterior chamber cell was rated by SUN criteria.*

capsule opacification and cystoid macular edema in case of severe and prolonged inflammation.[6,16] The severity of postoperative inflammation after cataract surgery depends on surgical factors such as surgical technique and type of intraocular lens as well as patient-related factors such as history of inflammatory disorder and degree of iris pigmentation.[16] Cataract surgery via smaller incision, more rapid and effective surgical techniques and advanced phacoemulsification devices and modes are among factors effective in diminishing postoperative inflammation.[17] In addition, postoperative use of anti-inflammatory agents allows faster regression of inflammatory symptoms and better patient comfort. However, persistent and severe inflammation may develop despite all measures, predisposing above-mentioned ocular complications.[17]

Steroids exert anti-inflammatory effect through inhibition of phospholipase A2 which plays role in arachidonic acid metabolism. In ophthalmology practice, topical steroids are used to control postoperative inflammation in many anterior and posterior segment ocular surgeries. Although the topical steroid drops used after surgery are potent anti-inflammatory agents which can act on inflammation at varying levels, they have some potential disadvantages. Intraocular levels can be lower for topical preparations; passage to anterior chamber may vary across acetate and phosphate forms of steroid preparations; need for frequent use at postoperative period is generally associated with compliance issues; and elder individuals may particularly have compliance problems due to comorbid cognitive and functional disorders and dementia and may require a caregiver/relative for administration of drops. In addition, frequent topical use and preservative materials in topical preparations may impair tear film and corneal toxicity. Thus, Thus, subconjunctival, subtenon and intracameral routes can be considered in order to decrease amount of topical eye drop required at postoperative period.

Subconjunctival and subtenon steroid injection, which are particularly preferred in uveitic patients, can also be used after cataract surgery. Paganelli et al. reported that single dose triamcinolone injection given via subtenon route after cataract surgery was associated with clinically equivalent therapeutic response in controlling postoperative inflammation and ocular tolerance when compared to topical prednisolone 1%.[18] However, subtenon injection may be associated with serious complications such as globe perforation, scleral melting, inadvertent injection of drug into retinal or choroidal circulation, central retinal artery occlusion, orbital fat atrophy, chemosis, subconjunctival hemorrhage and infection.[19, 20]

Intracameral triamcinolone administration to control postoperative inflammation after cataract surgery was first reported by Gills et al.[21] Since the appropriate dose of triamcinolone for controlling inflammation after cataract surgery was unknown, authors initially administered conservative dose of 0.25 mg and gradually increased the intracameral triamcinolone doses up to 3.0 mg and even 4.0 mg in diabetic patients. The study showed that the number of eyes requiring topical steroid therapy was decreased at postoperative period by increasing triamcinolone dose.[21] Authors reported no additional topical steroid therapy was required in eyes received intracameral triamcinolone at doses ≥2.8 mg and that there was a reduction in clinically relevant cystoid macular edema incidence by increasing triamcinolone doses.[21] In their study, Coronel and Co performed uncomplicated cataract surgery and intraocular lens implantation to 18 patients and administered intraoperative triamcinolone acetonide (0.4 mg/ml) in one group without topical steroid at postoperative period while they prescribed postoperative topical prednisolone acetate 1% without intraoperative steroid administration in the second group. Authors compared groups regarding anterior chamber cell, corneal edema and IOP and reported that intracameral triamcinolone acetonide was a safe alternative to topical prednisolone acetate 1% for controlling postoperative inflammation.[22] Similarly, Karalezli et al. administered intraoperative triamcinolone injection (1 mg/0.1 ml) to anterior chamber without topical steroid therapy in one group while they prescribed topical prednisolone acetate 1% without intracameral steroid injection in the second group of patients who underwent cataract surgery and intraocular lend implantation. Authors compared groups by biomicroscopy regarding anterior chamber cell, anterior chamber flares and conjunctival hyperemia on days 1, 7 and 30 after surgery and reported no significant difference between groups. Again, in another study, Karalezli et al. investigated the effect of same triamcinolone dose on IOP and showed that intracameral triamcinolone injection at a dose of 1 mg/0.1 ml had no significant effect on postoperative IOP after uncomplicated phacoemulsification surgery.[24] In our study, intracameral 2 mg/0.1 ml triamcinolone acetonide was administered and no topical steroid was recommended after uncomplicated cataract surgery in group A while topical prednisolone acetate 1% was administered with gradual tapering but no intracameral triamcinolone acetonide was given in group B. The group A and B were compared regarding IOP, anterior chamber cell and corneal edema on postoperative day 1 and week 1. No significant difference was detected between groups regarding IOP, anterior chamber cell and corneal edema in postoperative control visits. In addition, no ocular complication such as severe anterior chamber inflammation, persistent IOP elevation, severe and/or persistent corneal edema, toxic anterior segment syndrome and endophthalmitis in the group A and B.

This study has some limitations. Firstly, sample size was relative small. Secondly, no comparison was performed at long-term since the patients were assessed on postoperative day 1 and week 1. On the other hand, the study also has some strengths including prospective, randomized, placebo-controlled design and surgery performed in age- and sex-matched groups by same surgeon.

In conclusion, intracameral triamcinolone acetonide injection at a dose of 2 mg/0.1 ml was found as effective and safe as topical prednisolone acetate 1% in controlling postoperative inflammation after uncomplicated cataract surgery and can be preferred as an alternative to topical steroid administration. In particular, triamcinolone acetonide injection can be preferred in selected patients living alone and/or those may have experience compliance problems. However, larger studies with longer follow-up are needed to confirm these results.

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