

Intraocular Pressure Changes Two-Six Hours, One Day, and One Week after Phacoemulsification Cataract Surgery and Implantation of Intraocular Lens

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ABSTRACT

Background: This study was conducted to evaluate the status of eye and intraocular pressure (IOP), two-six hours, one day, and one week after cataract surgery and implantation of the intraocular lens.

Methods: In a longitudinal study, 159 patients with senile cataracts were evaluated. Phacoemulsification surgery and intraocular lens (IOL) implantation in the capsular bag was done. The examinations including visual acuity measurement, slit-lamp examination, and measurement of IOP were done preoperatively, and three times after the surgery.

Results: The mean±standard deviation (range) age of the patients was 65.8 ± 10.5 (40-90) years. Preoperatively the IOP was 12.8 ± 3.5 mmHg, it increased to 20.8 ± 10.7, 2-6 hours after surgery ($P < 0.0001$), and then reached 13.7 ± 4.4 mmHg on the first postoperative day ($P < 0.0001$), then it decreased to 12.4 ± 2.9 mmHg one week after the surgery ($P=0.02$). The IOP was 28.6 ± 12.2 mmHg in eyes with epithelial edema which was significantly higher than those with stromal edema (17.3 ± 7.5 mmHg), and those without edema (16.5 ± 7.1 mmHg) 2-6 hours after surgery.

Conclusion: Since the IOP spike can damage the structure and function of the eye and cause pain, discomfort, and corneal edema that in turn prolongs recovery of vision, especially in those previously damaged, early postoperative examination on the same day after cataract surgery is strongly advised. IOP spikes can be managed safely by aqueous paracentesis without oral, parenteral, or topical drugs. Elevated IOP is more prevalent in eyes with postoperative epithelial corneal edema and in individuals whose cornea is totally edematous.

Keywords: Phacoemulsification; Intraocular Pressure, Corneal Edema

Citation: Sharifi A, Tahmooresi V, Sharifi M, Nasiri N, Sharifi H. Intraocular pressure changes two-six hours, one day, and one week after phacoemulsification cataract surgery and implantation of the intraocular lens. Journal of Kerman University of Medical Sciences 2022; 29(4): 411-417. doi: 10.22062/JKMU.2022.92017

Received: 12. 02. 2022

Accepted: 03. 05. 2022

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Published by Kerman University of Medical Sciences

Introduction

Cataract is the leading cause of blindness worldwide (1, 2), and cataract surgery is the most common surgical procedure in ophthalmology (3,4). Phacoemulsification in conjunction with implantation of intraocular lens (IOL) is the best method of treatment that is increasing over time. The procedure is accomplished through 2.2 to 3.2 mm incisions (5,6). Postoperative events are very important in the early and late postoperative periods. Intraocular pressure (IOP) change is one of these events and must be noted by surgeons in all cases of cataract extraction procedures (7,8-11).

Most studies reported a trend toward a significant reduction in IOP weeks to months after the surgery (7-10). In the early postoperative examinations, one day after the surgery, there must be peaks of IOP elevation (11). Limited studies have been done to evaluate IOP a few hours after cataract surgery (11,12). The most common time for the first postoperative examination is the first day after the procedure (10). In the interval between surgery and this first examination, the eye is usually patched, and the probable IOP elevation can cause problems such as ocular pain, headache, corneal edema, and retinal vascular accidents as well as additional optic nerve head damage in glaucomatous (GL) eyes. In the present study, two to six hours after cataract surgery and on the first day after the surgery, the status of eye and IOP was evaluated by researchers

Materials and Methods

In a longitudinal study, 159 consecutive eyes of 159 patients with senile cataracts were evaluated. Complete preoperative evaluations were done, and IOP was measured one day before surgery and also one to three hours before surgery.

Phacoemulsification surgery and IOL implantation in the capsular bag were done. All surgeries were done by an experienced surgeon (the first author) under general anesthesia through 3.2 mm temporal clear corneal incisions. Two incisions were made to allow the use of the second instrument. Dispersive viscoelastic (Viscoat, Alcon, TX, USA) was used to fill the anterior chamber (AC), and continuous curvilinear capsulorrhexis (CCC) was done. In mature, hypermature, and dense brunescant cataracts, diluted trypan blue was used to stain the anterior capsule before performing

capsulorrhexis. The stop-and-chop technique was used to do the surgery. The capsule was filled with viscoelastic, and a single-piece hydrophobic foldable posterior chamber intraocular lens (PCIOL model) was implanted in the capsular bag. Viscoelastic was removed from AC and behind the IOL via irrigation/aspiration (I/A) cannula. The wounds were left unsutured.

The first examination after the surgery was done with the details including visual acuity, slit-lamp examination, and Goldman applanation tonometry (GAT) between two to six hours. Patients with an IOP of 21 mmHg or less attended two follow-up appointments (one day and one week after the surgery) and then were discharged. If IOP was more than 21 mmHg, a closer follow-up examination was done on two consecutive days after the surgery.

Paracentesis was done through the main incision (wound) in order to lower the IOP level to 5-10 mmHg if the following conditions existed: IOP was more than 30 mmHg; the patients complained of ocular pain; there was significant corneal epithelial edema, or IOP was more than 21 mmHg. No medication was prescribed to reduce IOP. The second and third examinations were done on the first postoperative day (POD1) at the end of the first week. If IOP was more than 21 mmHg on POD1, an additional exam was done on the second postoperative day (POD2) to evaluate ocular condition and IOP.

Patients with previous ocular surgery, glaucoma, and old uveitis were excluded from the study. Complicated and combined cataract surgeries were also excluded. None of the patients received prophylactic antiglaucoma or antibiotic medications before the surgery.

Ethical considerations

Informed consent was obtained before the operation. The ethics committee of Kerman University of Medical Sciences reviewed and approved the study (Ethical code: IR.KMU.97000324).

Statistical analysis

Data were described using descriptive statistics for continuous variables (mean, standard deviation (SD), min, and max) and categorical data (number and percent). The dependent t-test was used to compare the difference between the IOP of the operated eye and the other eye at each stage. One-way

analysis of variance was used to compare IOP among different edema type groups, edema areas, and cataract types. Data were analyzed using Stata version 14.1.

Results

Among 159 patients recruited in this study, 85 (53.5%) were female. The mean \pm SD age of

the participants was 65.8 ± 10.5 years (range 40-90). Dominant types of cataract were nuclear sclerosis (NS) (49.1%), cortical cataract (CC) (18.8%), posterior subcapsular (PS) (12.6%), mature (12.6%), hypermature, and brunescant cataract. The most frequent type of edema was stromal (34%) and epithelial (32.7%) (Table 1).

Table 1. Demographic status of the participants in the intraocular pressure changes after phacoemulsification cataract surgery

Variable	Number	Percent
Gender		
Female	85	53.5
Male	74	46.5
Eye		
Left	81	50.1
Right	78	49.1
Cataract Type		
Nuclear sclerosis	78	49.1
Cortical cataract	30	18.8
Posterior subcapsular	20	12.6
Mature	20	12.6
Hypermature	7	4.4
Brunescant	4	2.5
Edema Type		
Stromal	54	34.0
Epithelial, subepithelial	52	32.7
Descemet Fold	5	3.1
None	48	30.2
Edema area		
Total	56	35.2
Subtotal	39	24.5
Localized	16	10.1
None	48	30.2
Total		
	159	100
	Mean (SD*)	Range
Age (Years)	65.8 (10.5)	40; 90
Surgery time (Minutes)	6.7 (1.1)	4; 11
EPT** (Seconds)	71.4 (49.8)	3; 300

*Standard deviation, ** Effective phaco time

At the first postoperative examination, 64 eyes (40.3%) and at the second examination six eyes (3.8%) had a pressure of more than 21 mmHg. At the third examination, all of the eyes had normal pressure. Of 95 eyes with normal IOP, two eyes (2.1%) had IOP of more than 21

mmHg at the second postoperative examination ($P = 0.179$). Surgery time and effective phaco time were not related to postoperative IOP and the occurrence of corneal edema ($P > 0.05$) (Table 2 & Figure 1).

Table 2. Intraocular pressure changes after phacoemulsification cataract surgery

Time	Variable	n	Range IOP*	Mean IOP	SD**	P-value
Before surgery	Operated eye	159	5-27	12.8	3.5	0.06
	The other eye	159	5-24	12.6	3.2	
First examination (2-6 h postoperation)	Operated eye	159	5-62	20.8	10.7	<0.0001
	The other eye	159	5-25	12.5	3.4	
Second examination (first day postoperation)	Operated eye	159	6-33	13.7	4.4	<0.0001
	The other eye	159	6-24	12.3	3.0	
Third examination (first week postoperation)	Operated eye	107	6-19	12.4	2.9	0.02
	The other eye	107	8-19	12.7	2.7	

*Intraocular pressure, **Standard deviation

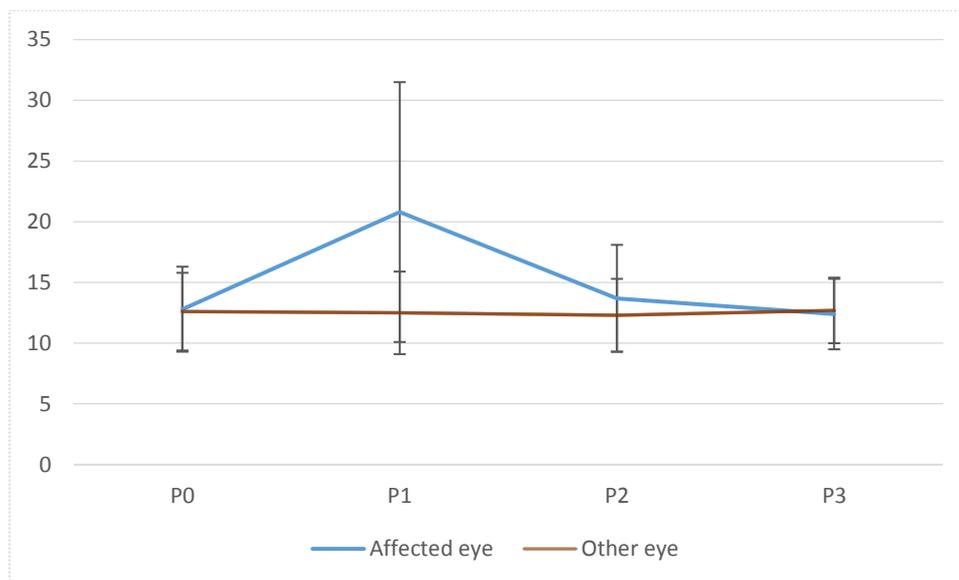


Figure 1. Intraocular pressure changes after phacoemulsification cataract surgery (P0= preoperative, P1=1st exam, P2=2nd exam, P3=3rd exam) [Error bars show standard deviation].

At the first postoperative examination, the IOP was higher among patients with epithelial and sub-epithelial edema than those with stromal edema ($P < 0.001$) and those without edema ($P < 0.001$). There was no significant difference between eyes with stromal edema and those without edema ($P = 0.99$). Patients with total (diffuse) edema also had the highest IOP in

comparison to patients without edema ($P < 0.001$), subtotal edema (0.004), and localized edema ($p < 0.001$). However, the IOP in eyes with cortical cataracts was higher than that of other types of cataracts, and there was no significant difference between these types ($P > 0.05$) (Table 3).

Table 3. Association between intraocular pressure with edema type, edema area, and cataract type at the first postoperative examination.

Variable	Mean IOP*	SD**	Range
Edema Type			
Stromal	17.5	7.6	9-41
Descemet fold	15.2	6.2	11-26
Epithelial, sub-epithelial	28.6	12.2	6-62
None	16.5	7.1	5-35
Edema area			
None	16.5	7.1	5-35
Total	26.9	12.6	6-62
Subtotal	19.9	8.7	9-43
Localized	14.3	4.2	10-26
Cataract Type			
Nuclear sclerosis (NS)	21.4	10.8	5-62
Cortical cataract (CC)	22.4	12.0	6-62
Posterior subcapsular (PSC)	21.8	8.8	11-43
Mature, Hyper mature Brunescant	17.0	9.7	8-50

*Intraocular pressure, **Standard deviation

Immediately after paracentesis of the AC, all patients experienced a reduction of ocular pain, a significant reduction of epithelial edema was evident in the slit-lamp examination, and vision was improved as the epithelial edema was reduced. Stromal edema was not reduced with aqueous paracentesis.

Discussion

Using a longitudinal study, the researchers evaluated the IOP after the cataract surgery and implantation of the intraocular lens. About 40% of eyes had IOP more than 21 mmHg 2-6 hours after the surgery. Using paracentesis of AC, the IOP of the majority of the eyes was controlled and only 3.8% of them had an IOP of more than 21 mmHg at the first POD. One week after the surgery, the IOP was reduced to a level below the preoperative IOP baseline, and it was significantly less than IOP in the contralateral (fellow) eye. Tranos *et al.* reviewed IOP in 4-6 hours and the first day after uneventful phacoemulsification cataract extraction and IOL implantation; they concluded that the mean IOP level was 22.85 ± 9.56 mmHg and 19.44 ± 7.04 mmHg at four to six hours and on the first day after surgery, respectively. The IOP spikes greater than 30 mmHg were more likely on the same day after surgery (13). Shingleton *et al.* analyzed IOP 30 minutes and one day after temporal posterior limbal phacoemulsification surgery with IOL implantation; it was lower than 5 mmHg in 6.1% 30 minutes postoperatively. IOP greater than 30 mmHg was found in 8.1% of normal eyes, 15.6% of glaucoma eyes, and 5% of glaucoma-suspect eyes on the first day after surgery (14).

In this study, paracentesis of aqueous humor through main corneal incision was effective and could be safe to reduce IOP without consumption of IOP-lowering medications among those eyes with IOP elevation (spike) immediately after phacoemulsification surgery. In these eyes, the IOP increase is low in the following postoperative visits. Ahmed *et al.*

evaluated 465 eyes (396 of which were non-glaucomatous (NGL)) after phacoemulsification and IOL implantation. Postoperative follow-up was done three to seven hours and at four days postoperatively. Seventy-three patients (18.4%) with IOP elevations greater than 28 mmHg three to seven hours postoperatively were NGL and 32 (46.4%) GL. Fourteen NGL (3.6%) and 13 GL (18.8%) eyes had IOP elevations greater than 40 mmHg. Significant IOP elevations were managed effectively with AC paracentesis with or without antiglaucoma medications on the day of surgery. The number of patients who needed IOP intervention was 114, of whom 75 were NGL (18.9%) and 39 GL (56.5%). None of the eyes showed IOP elevations greater than 21 mmHg within one-day or four-day postoperatively (15).

The present study showed IOP lower than preoperative baseline one week after the surgery. This is compatible with the findings of most studies in which cataract surgery is considered an IOP-lowering procedure (8,16). Muge Coban-Karatas *et al.* studied 812 eyes with uncomplicated clear corneal incision phacoemulsification surgery. They reported that the mean IOP was 15.6 ± 4.3 mmHg preoperatively, 19.7 ± 9.0 mmHg on the first day, 12.7 ± 4.5 mmHg on the seventh day, and 12.8 ± 3.7 mmHg on the 30th day after the surgery. They concluded that the preoperative diagnosis of glaucoma is the only risk factor that affects postoperative IOP elevation. In a study on 122 GL and NGL eyes, authors found that the IOP was 25.7 ± 7.79 mmHg preoperatively, reached 20.87 ± 4.1 mmHg postoperatively after one day, 18.30 ± 2.89 mmHg after one week,

18.08 ± 2.94 mmHg after one month, 17.33 ± 2.78 mmHg after three months, and 17.44 ± 2.81 mmHg one year after phacoemulsification surgery and implantation of IOL (17). Moghimi *et al.* studied 33 NGL eyes with pseudoexfoliation syndrome (PXS). The mean IOP was 18.1 ± 3.4 mmHg preoperatively and decreased to 14.8 ± 3.6 mmHg three months postoperatively (9).

In our study postoperative IOP was higher in eyes with cortical cataracts in comparison with other types of cataracts such as NS or PSC. Eyes with advanced mature and hypermature cataracts had the lowest IOP levels. The reason why postoperative IOP levels in eyes with these types of lens opacity are different is not clear to us, and we did not find any reason in the literature. Since IOP measurement is underestimated in eyes with corneal edema, indeed the IOP is higher than what is measured by the Goldmann applanation tonometer (18); every increase in IOP must be strongly noted postoperatively, especially in cases with epithelial and stromal corneal edema.

The present study had some limitations: first, there was no parallel control group to compare clinical findings and IOP in cases where the first

exam was done postoperatively on the same day versus the first day after surgery; second, there was no comparison between eyes with and without PXS.

Conclusion

In summary, since an IOP spike can damage the structure and function of the eye, especially among previously damaged patients, and cause pain, discomfort, and corneal edema that in turn prolongs recovery of vision, early postoperative examination on the same day after cataract surgery is strongly advised. This is especially recommended for patients with compromised optic discs or predisposed to retinal or optic nerve pathology. IOP spikes can be managed safely by aqueous paracentesis without oral, parenteral, or topical drugs. Elevated IOP is more prevalent in eyes with postoperative epithelial corneal edema and in whom cornea is totally edematous.

Author's contributions

All authors contributed to the whole process of the study.

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