Intraocular Pressure Changes Following Phacoemulsification

Fakoemülsifikasyon Sonrasında Göz İçi Basınç Değişimleri

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ABSTRACT Objective: To analyze the effect of phacoemulsification on intraocular pressure (IOP) and to evaluate the management for high postoperative IOP. **Material and Methods:** Data of 812 eyes of 584 consecutive patients (330 males and 254 females) who underwent uneventful phacoemulsification in Department of Ophthalmology, Başkent University Adana Research Center were investigated retrospectively. The ages ranged between 26 and 89 years (65.5±9.8 years). Intraocular pressure values of preoperative and postoperative first day, first week and first month visits were recorded. Intraocular pressures over 22 mm Hg were considered as high IOP. Either anterior chamber decompression or antiglaucomatous medication was used to decrease the postoperative rise in IOP. Changes in IOP were analyzed using ANOVA. **Results:** The mean preoperative IOP was 15.6±4.3 mmHg, which increased to 19.7±9.0 mmHg on the 1st day ($p<0.001$). The IOP decreased significantly to 12.7±4.5 mmHg at 1st week, and 12.8±3.7 mmHg at 1st month ($p<0.001$, both). In 249 (30.7%) eyes, high IOP was detected on the first day. In 114 (45.8%) of these eyes, IOP was reduced by anterior chamber decompression while in 73 (29.3%) eyes glaucoma medication was prescribed. At first month 13 (1.6%) eyes had high IOP. **Conclusion:** Although, a rise in IOP remains a problem in the postoperative first day; both anterior chamber decompression and glaucoma medication seem to be effective and safe to overcome thiscondition. In short term, uneventful phacoemulsification and intraocular lens implantation results in a decrease in IOP.

Key Words: Phacoemulsification; intraocular pressure; glaucoma

ÖZET Amaç: Fakoemülsifikasyonun göz içi basıncı (GİB) üzerindeki etkisinin ve cerrahi sonrası yüksek GİB olgularına yaklaşımın değerlendirilmesi. **Gereç ve Yöntemler:** Başkent Üniversitesi Adana Araştırma ve Uygulama Merkezi'nde komplikasyonsuz fakoemülsifikasyon cerrahisi geçiren 584 (330 erkek, 254 kadın) hastanın 812 gözüne ait veriler retrospektif olarak incelendi. Hastaların yaşları 26 ile 89 (65,5±9,8) arasında değişmekteydi. Ameliyat öncesi ve ameliyat sonrası 1. gün, 1. hafta ve 1. ay vizitlerindeki GİB değerleri kaydedildi. Yirmi iki üzerindeki değerler yüksek GİB olarak kabul edildi. Ameliyat sonrasında yüksek GİB değerlerini düşürmek için ön kamaradan boşaltma veya antiglokomatöz ilaç kullanımı tercih edildi. Göz içi basıncındaki değişimleri karşılaştırmak için ANOVA kullanıldı. **Bulgular:** Ameliyat öncesi ortalama GİB değeri 15,6±4,3 mmHg bulundu ve ameliyat sonrası 1. günde 19,7±9,0 mmHg'ya yükseldi ($p<0,001$). Göz içi basıncı, ameliyat sonrası 1. haftada 12,7±4,5 mmHg ve 1. ayda 12,8±3,7 mmHg olarak bulundu (her ikisi için de $p<0,001$). Ameliyat sonrası 1. günde 249 (%30,7) olguda yüksek GİB ölçüldü. Bu olguların 114'ünde (%45,8) GİB, ön kamaradan boşaltma yoluyla düşürülürken, 73 (%29,3) olguya antiglokomatöz ilaç reçete edildi. Birinci ayda 13 (%1,6) olguda yüksek GİB tespit edildi. **Sonuç:** Ameliyat sonrası 1. günde göz içi basıncında tespit edilen yükselme sık görülen bir sorun olmakla beraber, hem ön kamaradan boşaltma, hem de antiglokomatöz ilaç kullanımı bu durumun üstesinden gelmek için etkin ve güvenli yöntemlerdir. Komplikasyonsuz fakoemülsifikasyon, ameliyat sonrasında kısa vadede GİB'de azalma sağlar.

Anahtar Kelimeler: Fakoemülsifikasyon; intraoküler basınç; glokom

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The rise in intraocular pressure (IOP) remains a common problem after cataract surgery.[1-4] Several studies have reported an early increase in IOP following phacoemulsification.[5-7] The amount of this increase is related to several factors including the type of the viscoelastic agent and different surgical techniques.[8] Increase in IOP may generally cause ocular pain and discomfort and even sight-threatening complications like retinal vascular occlusion or anterior ischemic optic neuropathy.[9]

The aim of this study was to evaluate the incidence of early increase in IOP after phacoemulsification in normal and glaucomatous eyes, and the effect of different interventions such as anterior chamber decompression and antiglaucomatous medication on the IOP.

MATERIAL AND METHODS

Data of patients who underwent phacoemulsification and foldable intraocular lens implantation in Baskent University Adana Research Center between May 2004 and July 2008 were reviewed retrospectively. The patient population included the ones with senile cataracts as well as traumatic and complicated cataracts. However, combined surgical procedures, presence of any peroperative complications and postoperative positive Seidel's test were the criteria for exclusion. Patient demographics including age, gender, presence of pseudoexfoliation and/or preexisting glaucoma were recorded.

All procedures were performed by two surgeons (RAY, SS) in a similar fashion under peribulbar block. Two side-port incisions were made. The anterior chamber was filled with dispersive viscoelastic (Viscoat, Alcon, TX, USA). Clear corneal tunnel incision of 2.85 mm was performed. Following continuous curvilinear capsulorhexis, standard phacoemulsification by either stop and chop or phaco-chop technique was performed. The capsular bag and the anterior chamber were filled with cohesive viscoelastic (Provisc, Alcon, TX, USA) and the incision was enlarged to 4.0 mm. Foldable hydrophilic acrylic intraocular lens (IOL) (HQ-201, Hexavision, Paris, France) was implanted. The viscoelastic material in the anterior chamber and in the capsular bag behind the IOL was aspirated by rock and roll technique. The watertightness of all incisions was checked. None of the patients were given prophylactic antiglaucomatous medication before the surgery if they were not using them routinely. All patients were examined at the postoperative first day, first week and first month. IOP was measured by non-contact tonometer (Full Auto Tonometer, TX-F, Canon Inc, USA). Corneal edema was graded as mild, if no more than Descemet fold was observed; moderate if several Descemet folds were observed, and severe in case of diffuse edema resulting in ground glass appearance.

Preoperative, postoperative first day, first week and first month IOP values were recorded. An IOP over 22 mmHg was considered as high IOP, equal to or lower than 22 mmHg was accepted as normal IOP. In case of high IOP in the postoperative first day, either the pressure was lowered by anterior chamber decompression or antiglaucomatous medication was prescribed. The decision of of the treatment method was based mainly on randomization. Besides, patient compatibility was also cared for selection bias. For anterior chamber decompression, at the outpatient unit, pressure by a bent sterile 27 gauge needle was applied to the posterior lip of the side-port incision and a controlled release of the aqueous humor was provided. Complications of anterior chamber decompression were accepted as loss in anterior chamber depth, infection and inflammation.

The data were analyzed using SPSS software (Statistical Package for the Social Sciences, version 10.0, SPSS Inc, Chicago, Ill, USA) and the changes in IOP due to glaucoma and non-glaucoma patients were compared with ANOVA. The level of significance was set at <0.05.

RESULTS

Eight hundred twelve eyes of 584 patients were enrolled in the study. There were 330 men and 254 women, ranging between the ages of 26 and 89 years (mean 65.5±9.8 years). A history of glaucoma was present in 60 (7.4%) eyes, all of which were re-

ceiving glaucoma medication. Seventy seven (9.5%) eyes had pseudoexfoliation and 21 (2.6%) of these eyes had glaucoma. Of the cataract cases 741 (91.3%) were senile, 48 (5.9%) were complicated, 12 (1.5%) were presenile and 11 (1.4%) were traumatic. The surgical procedures were performed by 2 surgeons (n=497 by RAY, and n=315 by SS).

At the first postoperative day, corneal edema was mild in 253 (31.2%) eyes and moderate in 35 (4.3%) eyes, respectively. In 99 (39.1%) eyes with mild edema and in 20 (57.1%) eyes with moderate edema, high IOP was evident. No corneal edema was detected in 524 (64.5%) cases. In none of the cases, corneal edema persisted at the first postoperative week. We found no relationship between corneal edema and high IOP (p=0.246).

The mean preoperative IOP was 15.6±4.3 mmHg (range from 7 to 36 mmHg). There was a significant increase to 19.7±9.04 mmHg (range 6-58 mmHg) at the postoperative first day (p<0.001, 95% CI -4.68--3.52). The mean IOP at the postoperative first week and month significantly decreased when compared to the postoperative first day, as 12.7±4.5 mmHg (range 6 and 37 mmHg) and 12.8±3.7 mmHg (ranged between 6 and 34 mmHg), respectively (p<0.001 for both). The postoperative 1st week and 1st month IOP results were also significantly lower compared to the preoperative values (p<0.001, %95 CI 2.54-3.17 for 1st week and 2.47-3.03 for 1st month comparison).

High IOP on the first postoperative day was detected in 249 (30.7%) eyes. In 114 (45.8%) of these eyes, the IOP was lowered by anterior chamber decompression; in 73 (29.3%) eyes glaucoma medication was prescribed and in 23 (9.2%) eyes glaucoma medication was prescribed besides anterior chamber decompression. In 39 (15.7%) eyes the IOP was ranging between 23-25 mmHg, and no procedure was used to lower the pressure. In 16 patients although the IOP was below 22 mmHg, antiglaucomatous medication was continued due to the preoperative diagnosis of glaucoma. Timolol 0.50% was the preferred medication for eyes with IOP values between 22 and 30; in eyes with IOP over 30, timolol was combined with brimonidine. Dorzolamide and prostaglandine analogues were avoided because of the negative effect on the corneal endothelial pump of the former and possible cystoid macular edema inducing effect of the latter.

Both anterior chamber decompression and antiglaucomatous medication were able to control high IOP effectively, as a minority of eyes had high IOP at the first month (Table 1). No adverse effects were noted due to anterior chamber decompression.

There was a significant decrease in IOP at the first month (12.8±3.7 ranging between 6-34 mmHg), when compared to the first day (19.7±9.04, ranging between 6-58 mmHg) (p<0.001). Postoperative IOP changes in eyes with and without glaucoma are given in Table 2. The preoperative IOP values were higher in the glaucomatous eyes. The postoperative rise at the first day was marked in glaucomatous eyes and was significantly higher compared to non-glaucomatous eyes (p= 0.001). In both

TABLE 1: Course of postoperative high IOP in eyes with and without glaucoma after anterior chamber decompression, anti-glaucomatous medication or both.

			n	High IOP at week 1 n (IOP)	High IOP at month 1 n (IOP)
Non-glaucoma eyes	High IOP on day	AC decompression	105	4, (23-27)	3, (23)
n=752	n=219 (29.1%)	Antiglaucomatous medication	63	2 (24-25)	2, (24-25)
		Both	13	8, (23-37)	1, (25)
		None	38	2, (23-25)	0
Glaucoma eyes	High IOP on day	AC decompression	9	0	0
n=60	n=30 (50%)	Antiglaucomatous medication	11	3, (23-28)	3, (24-34)
		Both	10	2, (27-32)	1, (24)
		None	0		

IOP: Intraocular pressure; AC: Anterior chamber; n: number of eyes.

TABLE 2: Mean ± standard deviation IOP values in eyes with and without glaucoma. The difference between these two groups at particular visits was evaluated with ANOVA test.

	Preop IOP	Postop day 1	Postop week 1	Postop month 1
With glaucoma	19.0±6.5	24.2±10.3	14.3±6.5	13.7±5.9
Without glaucoma	15.3±4.0	19.3±8.8	12.6±4.3	12.8±3.4
p	**< 0.001**	**< 0.001**	**0.005**	**0.029**
F	45.122	15.200	7.945	4.759

IOP: Intraocular pressure; Preop: Preoperative; Postop: Postoperative; p: Probability value; F: Statistical value of ANOVA test.

groups, postoperative first week and first month mean IOP values were lower than both preoperative and postoperative first day values. This decrease was statistically significant in patients without glaucoma (Table 2).

In only 13 (1.6%) eyes, IOP was higher than 22 mmHg at the postoperative first month visit. Six of these patients had preoperative glaucoma and an additional glaucoma medication was prescribed. Other six patients started antiglaucomatous medication postoperatively. Three patients were followed without medication since their IOP was 23 mmHg and no other glaucomatous change was observed.

Among 60 eyes with previous history of glaucoma, 42 (70%) continued to receive glaucoma medication and good IOP control was maintained. In 12 (20%), glaucoma medication was discontinued since the IOP was lower than 15 mmHg, and in 6 (10%), high IOP was evident despite glaucoma medication. An additional glaucoma drug was prescribed for these 6 patients.

DISCUSSION

IOP rise in the early postoperative period may occur following uneventful phacoemulsification surgery. It has been reported that IOP increase occurs within the first 24 hours following cataract surgery in 10-55% of normal eyes and in 70-100% of glaucomatous eyes. While this increase is usually well-tolerated in normal eyes, eyes with glaucoma do have the risk of developing visual function loss during this episode.[10-13]

In the present study, we found a significant increase in IOP on the first postoperative day from 15.6 to 19.7 mmHg. Approximately 31% had high IOP on the first postoperative day. To our opinion, this might be related to several factors such as viscoelastic material, inflammation and retained lenticular debris. These factors have been questioned for postoperative IOP rise; however, the exact mechanism has not been identified.[14] Our population consisted of not only age-related cataracts, but also presenile, traumatic or complicated cataracts. Even though these cases were few in number in our series, postoperative IOP profile of different types of cataracts might differ. These cases are frequently challenging and tend to be associated with increased postoperative inflammation.

The ophthalmic viscosurgical device (OVD), when remained in the anterior chamber at the end of the surgery, is a major cause of this postoperative rise in IOP.[15] In our study group of uneventful phacoemulsification cases, the surgeons did meticulously remove the OVD from the anterior chamber, as described previously.[16] However, any residual OVD-even in small amounts-might have caused early rise in postoperative IOP. Rainer and coworkers found high IOP with dispersive viscoelastics.[17] In this study, the authors found an increase in IOP at 6 hours following phacoemulsification and this increase was significant with Viscoat when compared to Ocucoat. According to their results, at 24 hours after surgery, IOP returned normal limits with both viscoelastic agents. In that study, the authors excluded from the 24 hour data eyes with IOP values over 30 mm Hg at postoperative six hours since they gave glaucoma medication to these eyes. To our opinion, this might explain the difference of this study from our study for postoperative IOP values at 24 hours.

We found a significant decrease in IOP starting from the first postoperative week. This lowering effect of cataract surgery was attributed to increased anterior chamber depth; as well as flattened iris diaphragm resulting in extension of the trabecular meshwork.[18] Similar to our results, Tong and Miller also reported a significant decrease in IOP throughout the postoperative course, for at least 6 months.[19] On the other hand, the authors found a significant IOP rise in glaucoma eyes, at the postoperative 1st week. Both the present study and Tong and Miller's study consisted of a small subset of glaucoma eyes (7.4 and 5.36 respectively). This could explain the variation in postoperative IOP course. Another finding of the current study is that, IOP lowering effect of cataract surgery was slightly less in glaucomatous eyes. Similarly, Yasutani et al. also found that, the mean IOP decrease was less in eyes with glaucoma.[8] They found that the mean decrease in IOP from preoperative level in the eyes with open angle glaucoma was less than that in the control group. The difference was significant during the first week. Although a difference was still evident, the significance disappeared after the first week. According to a recent report by Poley et al., phacoemulsification provides a significant IOP reduction in long term.[20] The authors found the greatest decrease in eyes with highest preoperative IOP.

Anterior chamber decompression is reported to provide a transient decrease in postoperative high IOP. Hildebrand et al. measured the IOP four to six hours following surgery, and if it was above 40 mmHg, the authors performed anterior chamber decompression until a level below 10 mmHg was achieved.[9] Although a rapid IOP rise particularly at the first hour was observed following decompression, IOP was normal at the postoperative first week.[9] Our study is different from the aforementioned one at two points. We performed anterior chamber decompression 24 hours after the surgery and aimed a slight decrease in IOP, generally around 16 mmHg. Both anterior chamber decompression and glaucoma medication effectively lowered IOP, indicating that very few patients had high IOP at the first month. On the other hand, most glaucoma eyes were given anti-glaucoma medication. Because, IOP lowering effect of cataract surgery is limited in glaucomatous eyes, we believe that these patients must continue to use their medications. However, a randomized trial would better compare anterior chamber decompression and anti-glaucoma medication to lower the high IOP on the 1st postoperative day.

To our opinion, postoperative first day IOP spike also depends on the IOP at the end of the surgery. At the end of the surgery, an optimum IOP, which would be high enough to provide the efficiency of check-valve mechanism of the clear corneal tunnel incision, must be maintained. Hence, as Shingleton et al. suggested, the length of the corneal incision would be another important risk factor for postoperative high IOP.[21]

In conclusion, early postoperative IOP rise is a common problem following phacoemulsification. Anterior chamber decompression is a safe and effective way to control early high IOP. Phacoemulsification reduces IOP following surgery, even in glaucomatous eyes. Larger prospective randomized controlled series with longer follow-up are necessary to confirm the effect of both methods and analyze the long term effect of cataract surgery on IOP and potential glaucoma progression.

REFERENCES

1. Tan JH, Newman DK, Klunker C, Watts SE, Burton RL. Phacoemulsification cataract surgery: is routine review necessary on the first post-operative day? Eye (Lond) 2000;14(Pt 1): 53-5.
2. Tufail A, Foss AJ, Hamilton AM. Is the first day postoperative review necessary after cataract extraction? Br J Ophthalmol 1995;79(7):646-8.
3. Whitefield L, Crowston J, Little BC. First day follow up for routine phacoemulsification? Br J Ophthalmol 1996;80(2):148-50.
4. Zamvar U, Dhillon B. Postoperative IOP prophylaxis practice following uncomplicated cataract surgery: a UK-wide consultant survey. BMC Ophthalmol 2005;5:24.
5. Lagreze WD, Bomer TG, Funk J. Effect of surgical technique on the increase in intraocular pressure after cataract extraction. Ophthalmic Surg Lasers 1996;27(3):169-73.
6. Calissendorff BM, Hamberg-Nyström H. Intraocular pressure after extracapsular cataract extraction with implantation of posterior chamber lenses. Acta Ophthalmol (Copenh) 1993; 71(3):377-81.

7. Pohjalainen T, Vesti E, Uusitalo RJ, Laatikainen L. Intraocular pressure after phacoemulsification and intraocular lens implantation in nonglaucomatous eyes with and without exfoliation. J Cataract Refract Surg 2001;27(3): 426-31.
8. Yasutani H, Hayashi K, Hayashi H, Hayashi F. Intraocular pressure rise after phacoemulsification surgery in glaucoma patients. J Cataract Refract Surg 2004;30(6):1219-24.
9. Hildebrand GD, Wickremasinghe SS, Tranos PG, Harris ML, Little BC. Efficacy of anterior chamber decompression in controlling early intraocular pressure spikes after uneventful phacoemulsification. J Cataract Refract Surg 2003;29(6):1087-92.
10. Fang EN, Kass MA. Increased intraocular pressure after cataract surgery. Semin Ophthalmol 1994;9(4):235-42.
11. Naeser K, Thim K, Hansen TE, Degn T, Madsen S, Skov J. Intraocular pressure in the first days after implantation of posterior chamber lenses with the use of sodium hyaluronate (Healon). Acta Ophthalmol (Copenh) 1986;64 (3):330-7.
12. McGuigan LJ, Gottsch J, Stark WJ, Maumenee AE, Quigley HA. Extracapsular cataract extraction and posterior chamber lens implantation in eyes with preexisting glaucoma. Arch Ophthalmol 1986;104(9):1301-8.
13. Martinez JA, Brown RH, Lynch MG, Caplan MB. Risk of postoperative visual loss in advanced glaucoma. Am J Ophthalmol 1993;115(3): 332-7.
14. Unal M, Yücel I. Effect of bimatoprost on intraocular pressure after cataract surgery. Can J Ophthalmol 2008;43(6):712-6.
15. Güveli AK, Mavi E, Adaş A, Coşar B, Acar S. [Factors influencing early postoperative intraocular pressure after phacoemulsification]. Turk J Ophthalmol 2003;33(5):697-702.
16. Zetterström C, Wejde G, Taube M. Healon5: comparison of 2 removal techniques. J Cataract Refract Surg 2002;28(9):1561-4.
17. Rainer G, Menapace R, Findl O, Kiss B, Petternel V, Georgopoulos M, et al. Intraocular pressure rise after small incision cataract surgery: a randomised intraindividual comparison of two dispersive viscoelastic agents. Br J Ophthalmol 2001;85(2):139-42.
18. Steuhl KP, Marahrens P, Frohn C, Frohn A. Intraocular pressure and anterior chamber depth before and after extracapsular cataract extraction with posterior chamber lens implantation. Ophthalmic Surg 1992;23(4):233-7.
19. Tong JT, Miller KM. Intraocular pressure change after sutureless phacoemulsification and foldable posterior chamber lens implantation. J Cataract Refract Surg 1998;24(2):256-62.
20. Poley BJ, Lindstrom RL, Samuelson TW. Long-term effects of phacoemulsification with intraocular lens implantation in normotensive and ocular hypertensive eyes. J Cataract Refract Surg 2008;34(5):735-42.
21. Shingleton BJ, Rosenberg RB, Teixeira R, O'-Donoghue MW. Evaluation of intraocular pressure in the immediate postoperative period after phacoemulsification. J Cataract Refract Surg 2007;33(11):1953-7.