The Effect of Phacoemulsification on Intraocular Pressure in Glaucoma with Cataract Patient, occurring in One of the Hospitals under Medical Service Department, Bangkok Metropolitan Administration

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Abstract

Objectives: To evaluate the effect of phacoemulsification on intraocular pressure (IOP) at one week after surgery among glaucoma patients with cataracts. A further aim was to investigate whether there was a correlation between axial length (AL), anterior chamber depth (ACD) and K-readings with pre- and postoperative IOP.

Methods: A retrospective analysis was performed on 212 eyes of 212 glaucoma patients with cataracts who had undergone uncomplicated phacoemulsification and foldable intraocular lens implantation. The measurements were obtained preoperatively and 1 week postoperatively. AL, ACD, and K-reading were measured by Zeiss IOL Master Version 5, and IOP was measured by Noncontact tonometer Nidex NT-530P. The relationships between IOP change and ocular biometric parameters were evaluated.

Results: The mean age of the patients was 70.7 ± 8.6 years; 72 patients were male, and 140 patients were female. The difference between pre- and postoperative IOP was 2.95 ± 2.52 mmHg. The mean AL, ACD, and K-reading were 23.4 ± 1.1 mm, 2.98 ± 1.89 mm, 44.2 ± 3.9 Diopter, respectively. There was a significant correlation ($p < 0.05$) between the difference of pre- and postoperative IOP >3 mmHg, and AL and preoperative IOP, whereas there was no significant correlation with ACD and K-reading.

Conclusion: Phacoemulsification induces a reduction in IOP in glaucoma patients with cataracts. Preoperative IOP > 15mmHg, AL > 23.42mm and ACD ≤ 2.72 mm were also significantly associated positively with reduced IOP after cataract surgery.

Keywords: phacoemulsification, cataract surgery, glaucoma, intraocular pressure, axial length, anterior chamber depth, K-reading

ผลการผ่าตัดต้อกระจกด้วยคลื่นเสียงความถี่สูงต่อความดันตาในผู้ป่วยโรคต้อหินที่มีต้อกระจกร่วมที่โรงพยาบาลแห่งหนึ่งในสังกัดสำนักการแพทย์ กรุงเทพมหานคร

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บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาผลของการผ่าตัดต้อกระจกด้วยคลื่นเสียงความถี่สูงต่อความดันตาในผู้ป่วยโรคต้อหินที่มีต้อกระจกร่วมด้วย 1 สัปดาห์หลังการผ่าตัด และศึกษาความสัมพันธ์ของความดันตาที่เปลี่ยนแปลงหลังการผ่าตัดกับความยาวลูกตา ความลึกของช่องหน้าลูกตา และความโค้งของกระจกตา

วิธีดำเนินการวิจัย: การวิจัยนี้เป็นการศึกษาย้อนหลัง โดยรวบรวมข้อมูลผู้ป่วยต้อหินที่เป็นต้อกระจกซึ่งได้รับการผ่าตัดต้อกระจกด้วยคลื่นเสียงความถี่สูงและใส่เลนส์แก้วตาเทียมชนิดนิ่มพับได้ที่ไม่มีภาวะแทรกซ้อน จำนวน 212 ข้าง โดยตรวจวัดก่อนผ่าตัดและหลังผ่าตัด 1 สัปดาห์ ค่าความยาวลูกตา ความลึกของช่องหน้าลูกตาและความโค้งกระจกตาถูกวัดด้วยเครื่อง Zeiss IOL Master Version 5 และค่าความดันตาวัดด้วยเครื่อง Noncontact tonometer Nidex NT-530P และนำค่าดังกล่าวนำมาหาความสัมพันธ์กับความความดันตาที่เปลี่ยนแปลง

ผลการวิจัย: ค่าอายุเฉลี่ย 70.7 ± 8.6 ปี เป็นผู้ชาย 73 ราย ผู้หญิง 140 ราย ความดันตาหลังการผ่าตัดลดลงเฉลี่ย 2.95 ± 2.52 มม.ปรอท ค่าเฉลี่ยความยาวลูกตา ความลึกของช่องหน้าลูกตา และความโค้งกระจกตา คือ 23.4 ± 1.1 มม., 2.98 ± 1.89 มม. และ 44.2 ± 3.9 ไดออปเตอร์ ตามลำดับ พบว่ามีความสัมพันธ์ทางสถิติระหว่างความดันตาหลังการผ่าตัดลดลงมากกว่า 3 มม.ปรอท กับความยาวลูกตาและความดันตาก่อนการผ่าตัด ไม่พบความสัมพันธ์ทางสถิติกับความลึกของช่องหน้าลูกตาและความโค้งกระจกตา

สรุป: การผ่าตัดด้วยคลื่นเสียงความถี่สูงสามารถลดความดันตาลงในผู้ป่วยต้อหินที่มีต้อกระจกร่วม โดยที่พบความสัมพันธ์ดังนี้ ความดันตาก่อนผ่าตัดมากกว่า 15 มม.ปรอท, ความยาวลูกตามากกว่า 23.42 มม. และความลึกของช่องหน้าลูกตา น้อยกว่าหรือเท่ากับ 2.72 มม.

Cataract surgery is one of the most effective ways to control intraocular pressure (IOP) and reduce the number of antiglaucoma medications required to treat cataract-induced glaucoma, including phacolytic and phacomorphic glaucoma. Recently, cataract surgery has been shown to have many benefits related to the control of IOP, regardless of the type of glaucoma. Cataract surgery using phacoemulsification with intraocular lens (IOL) implantation was effective in reducing IOP among patients with glaucoma, ocular hypertension, or normal tension glaucoma and led to a decrease in the number of antiglaucoma medications required. However, few studies have examined the relationship between a reduction in IOP and ocular biometric. The purpose of this study was to evaluate whether there is an effect from cataract surgery with phacoemulsification on IOP after one week of surgery. We also investigated whether there was a correlation between Axial length (AL), Anterior chamber depth (ACD) and K-readings (curvature of the cornea) with preoperative and postoperative IOP.

Methods

This study obtained approval from the hospital's ethics committee for research. The subjects for this study were extracted from the records of hospitals under the Medical Service Department, Bangkok Metropolitan Administration from an already existing data file with 212 Eyes. The patient's age, gender, Axial length (AL), K-readings, Anterior chamber depth (ACD), preoperative IOP and postoperative IOP were noted. The number of men included was 72. And the number of females was 140. The mean age of the subjects was 70.7 years.

Inclusion criteria were senile cataract with glaucoma and scheduled for elective phacoemulsification. The diagnosis of glaucoma was based on elevated IOP (≥ 20 mmHg), glaucomatous optic disc changes with or without visual field defects. The optic disc changes included asymmetric cupping between the eyes of greater than 0.3 or cup elongation with excavation of the neuroretinal rim. All the subjects had undergone cataract surgery with phacoemulsification and IOL implantation between May 2016 and June 2017. The surgeries were performed by the same technique. After making a 3.0 mm incision in the temporal cornea, phacoemulsification was performed. This was followed by the implantation of an acrylic intraocular lens. After surgery, each patient was treated with ophthalmic 0.3% gatifloxacin, Dexamethasone Sodium Phosphate combined with Chloramphenicol for 2 weeks. Glaucoma medication therapy, if any, was maintained until 1 month postoperatively and then, was gradually tapered on the basis of changes in IOP. Exclusion criteria were complications related to cataract surgery, corneal pathology, previous ocular surgery or trauma, and posterior segment pathology. The IOP measurements were performed, on two occasions, with a Noncontact tonometer Nidex NT-530P at pre-examination 1-3 days before surgery. The second and final measurement was performed 5-7 days after the patient had undergone the surgery. The measurements to estimate the Axial length (AL), anterior chamber depth (ACD) and K-readings of the eyes were performed with Zeiss IOL Master Version 5.

The statistical analyses were performed with SPSS version 14 (SPSS, Chicago, IL) to look for statistical significance. A value of $p<0.05$ was considered statistically significant, and $p<0.01$ was considered statistically highly significant. Preoperative and postoperative IOP was analyzed and compared to look for any statistical differences. To look for correlations the pre- and post-operative IOPs were compared to anterior chamber depth, K-readings and axial length.

Results

From the records of hospitals under the Medical Service Department, Bangkok Metropolitan Administration, 212 eyes were identified during the study period. Of these, 72 were male and 140 were female. The mean age of the subjects was 70.7 ± 8.6 years. The mean preoperative and postoperative IOPs were 15.1 ± 3.4 and 12.8 ± 2.8 mmHg. The difference between pre- and postoperative IOP was 2.95 ± 2.52 mmHg. The mean axial length, anterior chamber depth (ACD), and K-reading were 23.4 ± 1.1 mm, 2.98 ± 1.89 mm, 44.2 ± 3.9 diopter (Table 1).

Table 1:

Factors of phacoemulsification in glaucoma with cataract patients in hospitals under the Medical Service Department, Bangkok Metropolitan Administration

Factors		Number	Mean	SD
Age (years)		212	70.7	8.6
Gender	Male	72		
	Female	140		
Preoperative IOP (mmHg)		212	15.1	3.4
Postoperative IOP (mmHg)		212	12.8	2.8
Axial length (mm)		212	23.4	1.1
Anterior chamber depth (ACD) (mm)		212	2.98	0.58
K-reading (diopter)		212	44.2	3.9
Difference of Preoperative IOP and Postoperative IOP (mmHg)		212	2.95	2.52

* IOP = intraocular pressure

In this study, we found a significant ($p<0.05$) correlation in the difference between pre- and post-operative IOP >3 mmHg and axial length and pre-operative IOP, whereas, it was not significantly correlated with ACD and K-reading (Table 2).

Discussion

Cataract and glaucoma are the first and second leading causes of blindness worldwide. A decrease in IOP after cataract surgery has been reported in both glaucomatous and non-glaucomatous eyes[1-10]. Although the physiological reasons for decreased IOP after cataract surgery remain speculative, the facility of out-flow is known to increase after cataract surgery.

Many studies support the significant IOP reduction after uncomplicated phacoemulsification in glaucoma eyes. Several hypotheses have been proposed to explain this effect. These include a reduction in aqueous production followed by ciliary body stimulation and increased prostaglandin production during surgery, an increase in aqueous outflow attributable to widening of the anterior chamber angle, as well as an increase in prostaglandin production after surgery. As the eye ages the crystalline lens increases significantly in volume. This may initiate anatomical changes that lead to the increase in IOP observed with aging. However, there has been no confirmed explanation for the effect to date[7,11-12].

Our retrospective study also showed a significant relationship between pre-operative and post-operative IOP. The mean post-operative IOP values were lower than pre-operative IOP 2.95 ± 2.52 mmHg (group of preop IOP > 15 mmHg)[13]; our results show some similarities to Hayashi et al.[2], Shingleton et al.[14], Poley et al.[3,15]. They found average IOP reductions at 1 to 5 years follow-up[3-6,17].

When we consider the reduction of mean IOP with AL, ACD, K reading, the pre-operative axial length > 23.42mm was related to decreased post-operative IOP > 3 mmHg. ($p<0.05$). According to this study, we found that only AL is significant, with AL > 23.42 mm, which differs from the study by Cho[16], which showed a statistically significant post-operative IOP decrease in the axial length 21 - 25 mm

groups and a statistically significant IOP increase in the axial length 25 - 27 mm groups. Kashiwagi et al.[18] reported that increases of ACD and reductions of IOP were significant in patients having a shallow preoperative ACD and a small optic axis length. Bilak et al.[19] reported no significant correlation between IOP change and pre-operative axial length in their study, even though patients were not classified according to AL measurements, unlike the results of previous studies. The reason for a relationship between axial length and post-operative IOP may be due to multiple factors.

Several studies document a change in IOP and ACD after cataract extraction[4,13,17,18,20]. According to a study by Hyun Seung Yang et al.[11], in addition to pre-operative IOP and lens thickness[3], parameters such as changes in the anterior chamber area and angle opening distance were significantly and positively associated with reduced IOP after phacoemulsification. Huang et al.[21] found surgically induced angle opening distance widening was significantly correlated with anterior chamber biometric factors[22]. Preoperative lens vault appears to be a significant factor in angle widening and IOP reduction after phacoemulsification. As a result, we tried to find a value of ACD with an appropriate value that had a significant ($p<0.05$) correlation. If pre-operation has an ACD ≤ 2.72 mm, there will be a difference of pre-operative and post-operative IOP > 3 mmHg., which is statistically significant ($p<0.05$). Moreover, the value of K-reading does not have any statistical relation irrespective of any data (Table 3). The K-reading was not a factor for the change in IOP after phacoemulsification in this study.

Table 2:

Factors affecting Intraocular Pressure reduction after phacoemulsification in glaucoma with cataract patients

		Difference of Pre-postoperative IOP >3 mmHg	Difference of Pre-postoperative IOP ≤ 3 mmHg	p value
Age	≤ 70 years	31	69	0.650
	> 70 years	38	74	
Gender	Male	26	46	0.427
	Female	43	97	
Preoperative IOP (mmHg)	Preop. IOP ≤ 15	16	105	<0.001
	Preop. IOP > 15	53	38	
Axial length (AL) (mm)	AL ≤ 23.42	31	87	0.029
	AL > 23.42	38	56	
Anterior chamber depth (ACD) (mm)	ACD ≤ 2.97	38	73	0.583
	ACD > 2.97	31	70	
K-reading (diopter)	K-reading ≤ 44.16	28	60	0.849
	K-reading > 44.16	41	83	

* IOP = intraocular pressure

Table 3:

Characteristics of patients with differences of pre-postoperative IOP >3 mmHg and ≤3 mmHg

		Difference of pre-postoperative IOP >3 mmHg	Difference of pre-postoperative IOP ≤3 mmHg	p value
Age	≤ 70 years	31	69	0.650
	> 70 years	38	74	
Gender	Male	26	46	0.427
	Female	43	97	
Preoperative IOP (mmHg)	Preop IOP ≤ 15	16	105	<0.001
	Preop IOP > 15	53	38	
Axial length (AL) (mm)	AL ≤ 23.42	31	87	0.029
	AL > 23.42	38	56	
Anterior chamber depth (ACD) (mm)	ACD ≤ 2.72	30	40	0.024
	ACD > 2.72	39	103	
K-reading (diopter)	K-reading ≤ 44.16	28	60	0.849
	K-reading > 44.16	41	83	

An ultrasound biomicroscopic study found the small incision cataract surgery significantly deepened the anterior chamber and widened its angle because of backward movement of the iris diaphragm away from the inner surface[21]. Some studies suggest that in eyes with angle closure glaucoma, cataract extraction and IOL implantation permanently improve IOP control. In cases of open angle glaucoma, the wider angle and deeper chamber after cataract surgery seem to improve aqueous outflow facility to a degree, although the effect may be transient because the IOP rise in open angle glaucoma is the result of deteriorated aqueous outflow through the trabecular meshwork (Bilak et al.[19]).

Conclusion

In conclusion, in glaucomatous eyes, phacoemulsification induces a reduction in IOP. In addition to preoperative IOP > 15mmHg, AL > 23.42 mm and ACD ≤ 2.72 mm were also significantly associated positively with reduced IOP after cataract surgery, which leads to a decrease in the requirement of anti-glaucoma medicines for IOP control in glaucomatous eyes. Moreover, IOP was normalized in most cases of glaucoma. Cataract surgery is a safe procedure that rarely causes visual acuity impairment. Even if control of IOP is insufficient after cataract surgery, subsequent glaucoma surgery can be performed safely because of the deepened anterior chamber and intact conjunctiva. Based on these results, we suggest that the first surgical option for treating coexisting cataract and glaucoma is cataract surgery alone.

References

1. Shrivastava A, Singh K. The effect of cataract extraction on intraocular pressure. Curr Opin Ophthalmol. 2010;21(2):118-22
2. Hayashi K, Hayashi H, Nakao F, Hayashi F. Effect of cataract surgery on intraocular pressure control in glaucoma patients. J Cataract Refract Surg. 2001;27(11):1779-86.
3. 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.
4. Issa SA, Pacheco J, Mahmood U, Nolan J, Beatty S. A novel index for predicting intraocular pressure reduction following cataract surgery. Br J Ophthalmol. 2005;89(5):543-6.
5. Mathalone N, Htyams M, Neiman S, Buckman G, Hod Y, Geyer O. Long-term intraocular pressure control after clear corneal phacoemulsification in glaucoma patients. J Cataract Refract Surg. 2005;31(3):479-83.
6. Leelachaikul Y, Euswas A. Long-term intraocular pressure change after clear corneal phacoemulsification in Thai glaucoma patients. J Med Assoc Thai. 2005;88(Suppl 9): S21-5.
7. Mansberger SL, Gordon MO, Jampel H, Bhorade A, Brandt JD, Wilson B, Kass MA. Reduction in intraocular pressure after cataract extraction: the Ocular Hyertension Treatment Study. Ophthalmology. 2012;119:1826-31.
8. Pachimkul P, Intajak Y. Effect of lens extraction on primary angle closure in a Thai population. J Med Assoc Thai. 2008;91:303-8.
9. Jamil AZ, Iqbal K, Rahman FU, Mirza KA. Effect of Phacoemulsification on Intraocular Pressure. J Coll Physician Surg Pakistan. 2011;21(6):347-50.
10. Euswas A, Warrasak S. Intraocular pressure control following phacoemulsification in patients with chronic angle closure glaucoma. J Med Assoc Thai. 2005;88(Suppl):S121-5.
11. Yang HS, Lee J, Choi S. Ocular Biometric Parameters Associated With Intraocular Pressure Reduction After Cataract Surgery in Normal Eyes. Am J Ophthalmol. 2013;156:89-94.
12. Meyer MA, Savitt ML, Kopitas E. The effect of phacoemulsification on aqueous outflow facility. Ophthalmology. 1997; 104(8): 1221-7.
13. Guan H, Mick A, Porco T, Dolan BJ. Preoperative factors associated with IOP reduction after cataract surgery. Optom Vis Sci. 2013;90:179-84.
14. Shingleton BJ, Pasternack JJ, Hung JW, O'Donoghue MW. Three and five year changes in intraocular pressure after clear corneal phacoemulsification in open angle glaucoma patients, glaucoma suspects, and normal patients. J Glaucoma. 2006; 15(6): 494-8.
15. Poley BJ, Lindstrom RL, Samuelson TW, Schrlze R Jr. Intraocular pressure reduction after phacoemulsification with intraocular lens implantation in glaucomatous and nonglaucomatous eyes: evaluation of a causal relationship between the natural lens and open-angle glaucoma. J Cataract Refract Surg. 2009;35(11)1946-55.
16. Cho YK. Early intraocular pressure and anterior chamber depth changes after phacoemulsification and intraocular lens implantation in nonglaucomatous eyes Comparison of groups stratified by axial length. J Cataract Refract Surg. 2008;34:1104-9.
17. Slabaugh MA, Bofikian KD, Moore DB, Chen PP. The effect of phacoemulsification on intraocular pressure in medically controlled open-angle glaucoma patients. Am J Ophthalmol. 2014; 157:26-31.
18. Kashiwagi K, Kashiwage F, Tsukahara S. Effects of small-incision phacoemulsification and intraocular lens implantation on anterior chamber depth and intraocular pressure. J Glaucoma. 2006;15:103-9.

19. Bilak S, Simsek A, Capkin M, Guler M, Bilgin B. Biometric and Intraocular Pressure Change after Cataract Surgery. Optom Bis Sci. 2015;92:464-70.
20. Shin HC, Subrayan V, Tajunisah I. Changes in anterior chamber depth and intraocular pressure after phacoemulsification in eyes with occludable angles. J Cataract Refract Surg. 2010;36:1289-95.
21. Huang G, Gonzalez E, Lee R, Chen YC, He M, Lin SC. Association of biometric factors with anterior chamber angle widening and intraocular pressure reduction after uneventful phacoemulsification for cataract. J Cataract Refract Surg. 2012;38:108-16.
22. Kim M, Park KH, Kim TW, Kim DM. Changes in anterior chamber configuration after cataract surgery as measured by anterior segment optical coherence tomography. Korean J Ophthalmol. 2011;25:77-83.