

Effect of phacoemulsification surgery on intraocular pressure control in glaucoma patients

A.F.Elsawy, A.A.Elshayeb, M.G.Sharawy, and A.S.E.Rezk

Ophthalmology, Dept., Faculty of Medicine, Benha Univ., Benha, Egypt

E-Mail:

Abstract

Background and aim: The incidences of both cataract and elevated intraocular pressure (IOP) increase with age. Elevated intraocular pressure is considered as important risk factor for development and progression of glaucoma. Determination of the type of glaucoma is mandatory to define the most appropriate therapeutic approach that used to decrease IOP. this study aimed to study the effect of phacoemulsification surgery on intraocular pressure (IOP) control in eyes with angle-closure glaucoma (ACG) and eyes with open-angle glaucoma (OAG). Methods: Patients were divided into three group; Group I: 15 eyes (10 patients) with normal physiological, range IOP. Group II : 15 eyes (15 patients) with primary open angle glaucoma (POAG). Group III: 15 eyes (15 patients) with primary angle closure glaucoma(PACG). Results and conclusion: Phacoemulsification surgery had been shown to decrease IOP in eyes with or without glaucoma .Phacoemulsification had the potential to fulfill many features of an ideal approach to reduce intraocular pressure (IOP) compared with anti-glaucoma medications. As it lower the long term cost, and minimize systemic side effects also it result enhance visual acuity and contrast sensitivity after surgery and decrease time needed for post operative follow up . The magnitude of IOP reduction varies among patients. Postoperative IOPreduction was directly related with preoperative IOP values.so you might not expect IOP reduction postoperative when the preoperative IOP was not high.Patients with angle-closure glaucoma, phacoemulsification is well established as an effective procedure result in IOP reduction.

Keywords: phacoemulsification; intraocular pressure; glaucoma.

1. Introduction

Elevated intraocular pressure (IOP) is a major risk factor for development or progression of glaucoma. Among various therapeutic approaches, lowering IOP is the only proven one to prevent or slow down progression of glaucomatous optic neuropathy. Phacoemulsification surgery has been shown to decrease IOP in eyes with or without glaucoma [1].

Normal intraocular pressure, in non-glaucomatous eyes, varies in the population between 10 to 21 mm Hg .Although there is no absolute upper limit of IOP, pressure over 21 mm Hg is considered as suspicious. The elder population have a higher mean value of intraocular pressure with a normal range up to 24 mmHg .The intraocular pressure varies during the day because it depends on several factors such as heartbeat, blood pressure level and respiration. The variation in pressure during the day could shift as much as 5 mm Hg in normal eyes, and in glaucomatous eyes and ocular hypertensive eyes the range varies even more [2].

The incidences of both cataract and elevated intraocular pressure (IOP), with or without glaucoma, increase with age. IOP, still the only known modifiable risk factor in the management of glaucoma, is well recognized as a primary risk factor for glaucoma onset, development, and progression. Meanwhile, cataract surgery has been suggested to be of clinical benefit for both cataract and glaucoma. It has been found to reduce IOP in eyes with or without glaucoma, though with variable magnitude and affected by factors such as anterior-chamber anatomy and angle configuration [3].

Phacoemulsification has the potential to fulfill many features of an ideal approach to reduce intraocular pressure (IOP) compared with medications. It can lower the IOP to low teens, achieve long-term IOP reduction,

minimize IOP fluctuations, lower the long term cost, and minimize systemic side effects [4].

In eyes with angle-closure glaucoma, phacoemulsification is well established as an effective IOP-lowering procedure. Although not as much as in ACG eyes, phacoemulsification has also been shown to provide a decrease in IOP in eyes with open-angle glaucoma (OAG) [5].

In the present study, we aimed to study the effect of phacoemulsification surgery on intraocular pressure (IOP) control in eyes with angle-closure glaucoma (ACG) and eyes with open-angle glaucoma (OAG)

2. Patients and methods

This study is designed as a prospective selected comparative study.

Patients were divided into three group :

- **Group I:** 15 eyes (10 patients) with normal physiological range IOP.
- **Group II :** 15 eyes (15 patients) with primary open angle glaucoma (POAG).
- **Group III:** 15 eyes (15 patients) with primary angle closure glaucoma(PACG).

2.1. Inclusion criteria

- Adult patients (18 years or older).
- Preoperative diagnosis of POAG or PACG.
- Use of the same anti-glaucoma medication during the 3-month postoperative period.

2.2. Exclusion criteria

- History of trabeculectomy or other intraocular glaucoma surgeries.
- History of uveitis.
- History of ocular trauma .
- History of any change in medication regimen within 3 months before surgery.

- Patients not having at least 3 months of follow-up after surgery will be excluded .
- Intraoperative or postoperative complications related to the phacoemulsification surgery (e.g., posterior capsule rupture, vitreous loss) will be excluded .

2.3. Pre-operative evaluation including

- History: patient information (e.g. age ,occupation , residence and history of any chronic disease e.g.diabetes).
- Visual acuity : The unaided ,best corrected visual acuity was recorded by using snellen chart .
- Slit lamp examination for conea state ,anterior segment state.
- IOP measurement with goldman applanation tonometer performed one day before the surgery .

2.4. Operative technique

All surgeries were performed by single skilled surgeon, And the pupil should be fully dilated so pharmacological mydriasis is very important for uneventful phacoemulsification surgery .

1- pupil was dilated by using topical application of acombination of tropicamide 1%, phenylephrine hydrochloride 10% .

2- After sterilization and draping, the operative procedure began by application of aspeculum.

3- A clear corneal incision was done by a keratome 3.2 mm Fig. (1)

4-Then AC was filled with adispersive (Hydroxypropyle Methylene Cellulose 1.4%) or acohesive (Healon) OVD injected through side port incision to inflate AC to facilitate anterior capsulotomy. Fig(2).

5- Acontinuous curvilinear capsulorhexis was performed by using either a cystotome or forceps. The tear started at the center of the capsule to generate a flap with a peripheral edge then it was inverted and regrasped with the forceps or a cystotome till completion of the CCC. Fig. (3, 4 5).

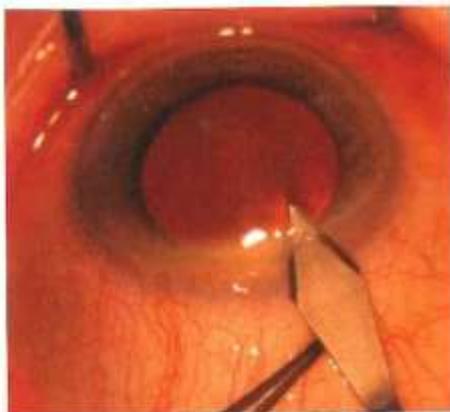


Fig. (1) clear corneal incision.

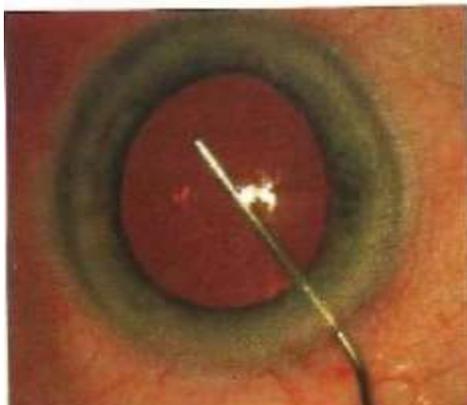


Fig. (2) AC filled with viscoelastic agent.

6-Then hydrodissection was done by placing acannula just beneath the anterior capsule then gentle and

continuous irrigation was performed till fluid wave passed circumferentially under the capsule Fig(6).

7-paracentesis made by using MVR at 2-3 o'clock near limbus then phaco probe was introduced through corneal

incision continued till removing all the nuclear fragment Fig(7).

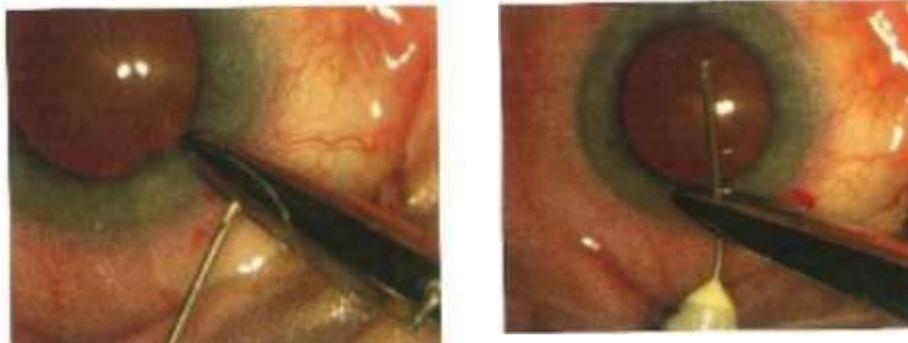


Fig. (3) Bent needle to form acystotome using a needle holder.



Fig. (4) Formation of a flap at the center of capsule.

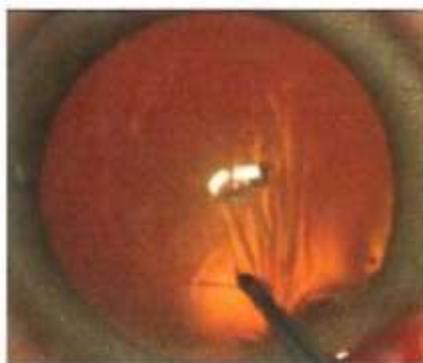


Fig. (5) completion of CCC.



Fig. (6) Hydrodissection.

9-Implantation of IOL Fig(9).

8-Then the remaining cortical material removed by using the I&A Handpiece Fig (8).

10-Removal of all the remaining viscoelastic material by I/A Handpiece.

11-Finally ,stromal hydration of wound Fig(10).g and assessing IOP.

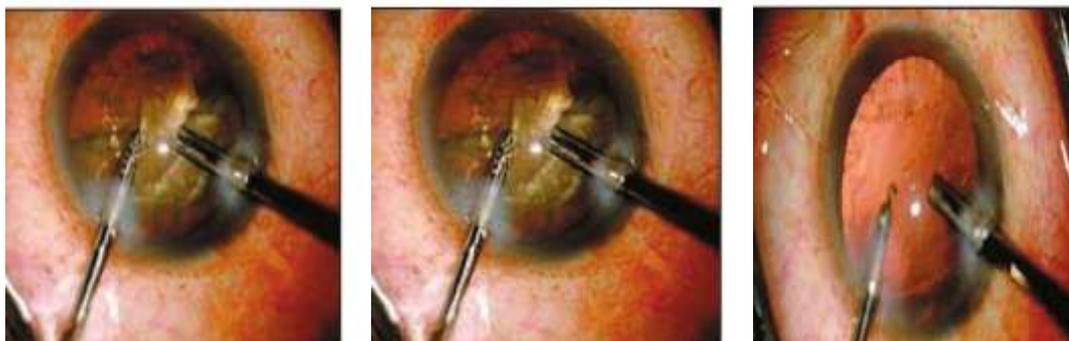


Fig. (7) Phacoemulsification of all lens matter.

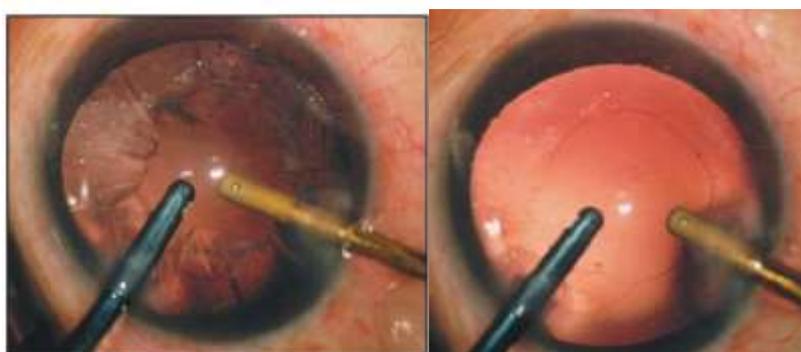


Fig. (8) irrigation /aspiration.



Fig. (9) Implantation of IOL.



Fig. (10) Hydration of wound.

All surgeries were successful and no complications occurred.

2.5. Post-operative treatment and follow up

- Broad spectrum antibiotic eye drops e.g. quinolone antibiotic eg : Moxifloxacin eye drops four times daily for two weeks .
- Non steroid antiinflammatory eye drops e.g.diclofenac sodium eye drops twice daily for two weeks .
- Eye ointment mixed antibiotic and steroid e.g.tobramycin /dexamethasone eye ointment once daily at bed time .
- Systemic antibiotic e.g. levofloxacin 500mg tablet once daily .
- Systemic analgesic e.g. acetaminophen tablet twice daily.

2.6. Post-operative evaluation included

Regular post-operative follow up 1st day postoperative then if every thing well it was conducted on 1st week ,2nd week ,3rd week ,2nd month and 3rd month with special attention to:

- IOP measurement by using Goldman applanation tonometer.
- Slit lamp evaluation of corneal clarity.
- Best corrected visual acuity.

2.7. Statistical Analysis

Descriptive statistics were performed to describe study population. All data were entered and analyzed by using the software SPSS version 23. The descriptive statistics were used to calculate the mean and standard deviation in the three groups, and then a comparison were made between groups pre- and post-operative by Mixed ANOVA test was used at significance level 0.05

to test the significance between three groups at different time intervals.

3. Results

In this study 45 eyes were included .All the patients had undergone uncomplicated phacoemulsification with intraocular lens implantation. IOP measured by usinggoldmanapplanation tonometer and was recorded preoperative and postoperative at 1st week ,2nd week ,3rd week ,2nd month and 3rd month. The study group was constituted of 45 eyes of 40 patients. Mean age ± SDwas 57.18 (± 7.2) years.

In control group(Group I) :The preoperative mean IOP was 12.8 ± 2.9 mmHg. the data collected postoperative at 1 week, mean iop become 11.1 ± 2.9 mmHg. At 3 week, the mean IOP had decreased again, to 11 ± 2.4 mmHg. And at 2nd month postoperative, the mean IOP become 11 ± 2.7 mmHg, and lastly at 3rd month mean iop 10.7±2.3 mmHg table (1).

There was no statistically significant difference in IOP between preoperative &1st week postoperative as P value ≥ 0.05, but there was a statistically significant difference between preoperative IOP , 2nd weeks, 3rd week , 2 month and 3 months postoperative Where P value < 0.05 . Fig. (11).

In open angle glaucoma group (Group II) : The preoperative mean IOP was 23.1 ± 6.4 mmHg. the data collected postoperative at 1 week, mean IOP become 26.1 ± .5 mmHg. And at 2 week post-operative it becomes 19.6 ±4.7. At 3 week, the mean IOP had decreased again, to 20.2 ± 4.6 mmHg. And at 2nd month and 3 month the mean IOP become 20.2 ± 4.5 mmHg, 20.3± 4.6 respectively table (2).

Table (1) descriptive analysis of the preoperative IOP and postoperative IOP in group I.

Group	Control group		Control group		P value
	Mean	SD	Min	Max	
Preoperative	12.8	2.9	8	18	
week1 st	11.1	2.9	8	16	1.000
2 nd week	11.1	2.5	7	15	.014
3 rd week	11	2.4	8	15	.023
2 nd months	11	2.7	8	14	.007
3 rd months	10.7	2.3	8	14	.002

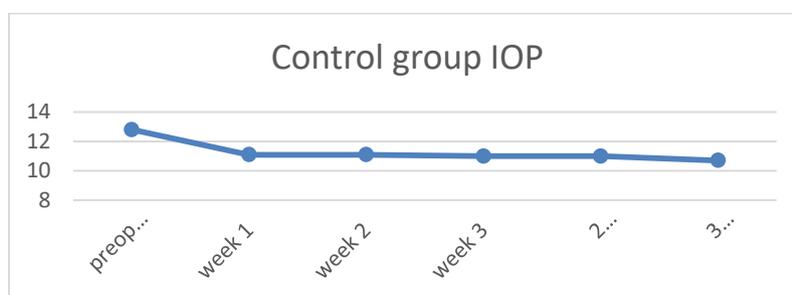


Fig. (11) comparison of IOP measurement in groupI.

There was no statistically significant difference in IOP between preoperative & 1 week postoperative as P

value ≥ 0.05, but there was a statistically significant difference between preoperative IOP & 2 weeks, 3

weeks, 2 month, & 3 months where P value < 0.05.Fig.(12).

While in closed angle glaucoma (Group III): The preoperative mean IOP was 28.5 ± 4.4 mmHg. the data collected postoperative at 1 week, mean iop become 22.5 ± 4 mmHg. at 2nd week mean iop become 23.6 ± 3.6 . At 3 week, the mean IOP become 23.1 ± 3.4 mmHg. at 2nd month postoperative, the mean IOP become $23.1 \pm$

3.7 mmHg, and lastly at 3rd month mean iop 23.1 ± 3.7 mmHg table (3)

There was a statistically significant difference between preoperative IOP and postoperative 1 week, 2 weeks, 3 weeks, 2 month, 3 months as the P value was < 0.05. Fig(13).

Comparison between three groups is shown in fig. (14).

Table (2) descriptive analysis of the preoperative and postoperative IOP in group II.

Group	open angle				P value
	Mean	SD	Min	Max	
Preoperative	23.1	6.4	12	32	
1 st Week	26.1	0.5	26	28	.068
2 nd week	19.6	4.7	12	26	.000
3 rd week	20.2	4.6	12	26	.000
2 nd months	20.2	4.5	12	26	.000
3 rd months	20.3	4.6	12	26	.000

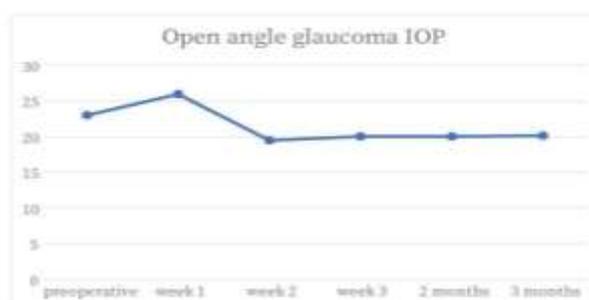


Fig. (12) comparison of IOP measurement in group II.

Table (3) descriptive analysis of the preoperative and postoperative IOP in group III.

Group	closed angle				P value
	Mean	SD	Min	Max	
Preoperative	28.5	4.4	20	36	
1 ST week	22.5	4.0	14	28	.000
2 nd week	23.6	3.9	16	30	.000
3 rd week	23.1	3.4	16	28	.000
2 nd months	23.1	3.7	16	28	.000
3 rd months	23.1	3.7	16	28	.000

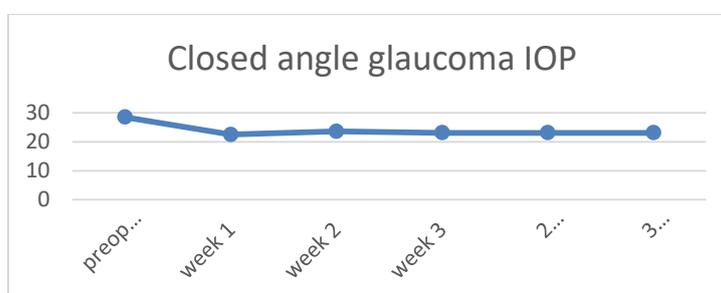


Fig. (13) comparison of IOP measurement in group III.

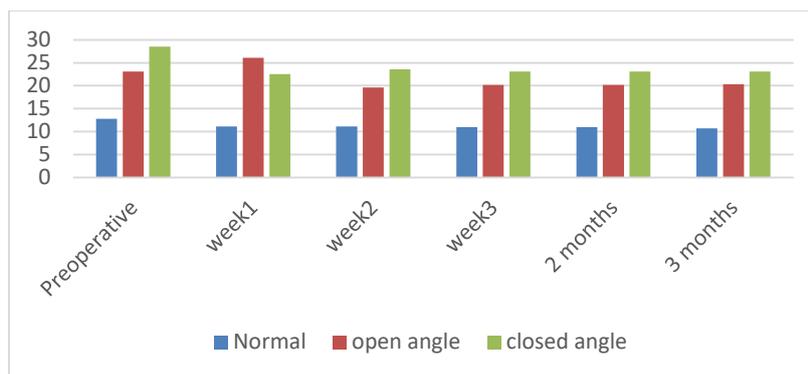


Fig. (14) Comparison between three groups in relation to the time IOP measured.

4. Discussion

In this study we evaluated the effect of phacoemulsification surgery on IOP control in three groups one group within physiological range IOP, other group include patients with POAG and the last group include patients with PACG.

We found that there is statistically significant decrease in IOP in patients with physiological range IOP, also in patients with POAG. And in patients with PACG the effect of phacoemulsification appear immediately post operative within 1st week and continue till 3 months post operative.

From our study, the persistent reduction of IOP after phacoemulsification with intraocular lens implantation had the benefit of decreasing antiglaucoma medication. Although antiglaucoma drugs are able to control eye pressure well, they have both local and systemic side effects especially if multiple drugs are used for along time. So this of great benefit toward patients.

In a meta-analysis for the American Academy of Ophthalmology, Chen et al. showed 13% average decrease in IOP in patients with POAG after phacoemulsification alone [5].

However, studies evaluating IOP after phacoemulsification in POAG eyes showed variability of results with IOP reduction ranging. Similarly, the number of glaucoma medications varied after cataract surgery. This may be explained by the variability of inclusion and exclusion criteria in these studies.

Several studies of PACG patients reported that anterior chamber depth before cataract surgery was associated with IOP changes after surgery, and a shallower anterior chamber was associated with a greater reduction in IOP after surgery [6]. Other studies revealed a significant association of axial length or lens thickness with postoperative IOP change in nonglaucomatous eyes [7]. While Coh et al. [8] did not find a significant relationship between axial length or lens thickness and IOP reduction after cataract surgery in glaucomatous eyes.

Also a recent survey of the American Glaucoma Society showed that, independently of IOP level or glaucoma stage, 44% of glaucoma surgeons performed a phacoemulsification alone in eyes with concomitant POAG and visually significant cataract, whereas 24% did a combined phacoemulsification with a

trabeculectomy procedure and 22% performed a microinvasive glaucoma surgery (MIGS) associated with cataract surgery [9]. The result of the study showed that in patients with POAG, cataract surgery by phacoemulsification can lead to decrease in IOP without significant change in the number of antiglaucoma medications. Moreover, although a slight decrease was observed at 1 year, individual variations showed that postoperative IOP was stable (defined as an IOP variation < 5 mmHg) in the vast majority of cases (87%). In spite of this unclear long-term effect of phacoemulsification on IOP in POAG patients, some patients will experience early postoperative IOP rises. Approximately 13% of patients at 1 day and 4% at 7 days showed IOP spikes > 30 mmHg after phacoemulsification.

Previous studies also showed IOP spikes in 3–27% of POAG patients in the first postoperative days after phacoemulsification [5]. It is well known that POAG patients have a higher risk of IOP spikes in the early postoperative period exposing them to additional optic nerve damage on their already compromised optic disc [10]. It has been reported that patients with severe glaucoma may lose fixation or develop visual field progression with IOP spikes following cataract surgery. Consequently, in mild to advanced glaucoma patients, IOP spikes should be avoided to protect the optic nerve from additional damage. Some patients may also undergo a long-term IOP increase.

Some studies also reported that 6–26% of glaucoma patients had long-term IOP increase [11] and 4–26% of them required a glaucoma medication increase 1–5 years after phacoemulsification [12]. Contrary to what it is often reported [13] these results confirm that most patients with POAG and a widely open angle may not had a reduction in IOP after phacoemulsification and that some patients may had even an immediate or a long-term IOP increase.

5. Conclusion

Cataract surgery without complication can lower the intraocular pressure and can improve the visual acuity with short period of follow up not like the traditional glaucoma surgery which need long follow up and special care more than phacoemulsification. But Cataract surgery in POAG patients although many

studies have shown that with modern phacoemulsification glaucoma patients can expect excellent visual outcome. Despite of this there is also studies showed that for patients with medically controlled mild or moderate POAG, cataract surgery by phacoemulsification resulted in a clinically nonsignificant decrease of IOP after 1 year of follow-up. In such patients cataract surgery alone should not be considered an efficient IOP-lowering method and other options should be considered for patients with more severe disease.

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