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Intraocular Pressure Changes Before and After (Within 1st Week and 1st Month) Cataract Surgery in Patients with and without Glaucoma in Benghazi Teaching Eye Hospital

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Abstract – Background: The concurrent existence of cataract and glaucoma is a common finding in the aging population and this trend is likely to increase worldwide as the population ages. Cataract surgery is the most commonly performed ophthalmic surgical procedure of any kind. Modern phacoemulsification techniques give us the ability to rehabilitate patients with vision loss secondary to cataract. Aim of the study: The objective of the study was to compare intraocular pressure changes before and After Cataract Surgery (within 1st week and 1st month) in patients with and without Glaucoma in Benghazi Teaching Eye Hospital, Lybia. Patients & Methods: This prospective randomized study was carried out on 100 eyes that underwent measuring IOP by air puff and applanation tonometer before phacoemulsification and IOL implantation and one week, one-month post-operative in Benghazi Teaching Eye Hospital, Lybia. Results: There were no differences in the baseline demographics between the two groups, except for better preoperative visual acuity in the glaucoma group ($P < 0.05$). there was a positive correlation between the preoperative value and postoperative 1 day ($P < 0.001$); but there was a negative correlation between preoperative value and postoperative 1 week and 1 month, ($P < 0.001$). Conclusion: Intraocular pressure significantly decreased after phacoemulsification cataract surgery. 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.

Keywords – Colour Vision Disorder, School Children, Prevalence.

I. INTRODUCTION

Cataract and glaucoma are the first and second leading causes of blindness worldwide. Although usually not severe enough to cause blindness, it is not surprising that these two diseases occur simultaneously in many patients. Many studies have demonstrated intraocular pressure reduction after cataract surgery. However, most data indicates that IOP reduction after cataract surgery is more significant and sustained than previously thought [(1)].

Cataract extraction has been shown to decrease intraocular pressure (IOP) in patients with narrow angles, as well as in patients with open angles and ocular hypertension. Among patients with narrow angles, the IOP-lowering effect of cataract surgery is at least in part thought to be related to widening of the angle due to removal of the crystalline lens. In patients with open angles, changes in anterior segment anatomy due to cataract surgery may also contribute to lower IOP· Also suggested that the IOP-lowering effect may be related to phacoemulsification energy and related effects on the trabecular meshwork.[(2)]

Large studies of IOP-lowering in patients with diverse preoperative diagnoses are generally limited to data collected from registries, such as the Swedish National Cataract Register, which has reported on follow-up data collected from a single postoperative visit, or an electronic health records registry in the UK, which was also limited to data from a single postoperative visit and did not distinguish between different glaucoma subtypes or include information on the use of glaucoma medications[3].

Randomized controlled trials have also provided evidence for IOP-lowering in patients with open angle glaucoma, or ocular hypertension, but these studies by design do not have patients with diverse preoperative diagnoses and are subject to strict trial protocols, medication washout regimes, and inclusion/exclusion criteria, which make it difficult to infer the effects of cataract surgery on IOP in the real-world setting. To better understand the effect of cataract surgery on IOP across a broad range of patients, more granular data are needed [4].

II. Aim of the Study

To compare intraocular pressure changes before and After Cataract Surgery (within 1st week and 1st month) in patients with and without Glaucoma in Benghazi Teaching Eye Hospital

III. Materials and Methods

This prospective randomized study was carried out on 100 eyes that underwent measuring IOP by air puff and applanation tonometer before phacoemulsification and IOL implantation and one week, one-month post-operative in Benghazi Teaching Eye Hospital durring the period from January 2024 to April 2024.

Written informed consent was obtained from all patients and the study was approved by the research ethical committee of Faculty of Medicine, Benghazi University (Institutional review board).

Study Design:

A prospective randomized study has been chosen as an appropriate design suiting for the aims and conditions of our study.

Inclusion criteria

1. Senile cataract.
2. Pre-operative clear cornea.
3. Uncomplicated phacoemulsification.

Exclusion criteria

1. Complicated and infantile cataract
2. Patients with previous intraocular surgeries.
3. Patients with corneal opacity.
4. Patients with intra operative complications.
5. Patients with ocular diseases affecting IOP
6. Patient with history of ocular trauma
7. patient with history of serious illness.

All patients were subjected to the following :

Personal history: as name, age, gender, and race.

Ocular history: as glaucoma, previous history of trauma, and ocular surgeries. measurement of spherical, refractive error, onset, course, and duration of visual loss, and if there is any other ocular complaint.

Medical history: of current and previous medications the patient had been taken.

Past history and family history of the similar conditions.

Examination done to patients included general examination to exclude medical conditions that increase the risk of intraoperative and postoperative complications.

Ocular examination: Detailed ocular examination to exclude any abnormality that may lead to intraoperative and postoperative complication; Also, IOP was measured as a part of a routine examination.

Pre-operative evaluation including

1. Slit lamp examination to detect any segment abnormality.
2. Visual acuity and best corrected visual acuity was recorded by using snellen chart.
3. IOP measuring using air puff and applanation tonometer.
4. Grading of cataract.

Operative technique:

All surgeries were performed by the same surgeon. Following ocular anesthesia, an incision was made 3.2 mm into clear cornea. The anterior chamber was injected with a viscoelastic agent. Approximately 5 to 5.5 mm diameter continuous curvilinear capsulorhexis was performed. After the lens nucleus were (hydrodiscted), phacoemulsification (divide and conquer technique) was performed in the capsular bag. The lens cortex was sucked clean using an automatic irrigation/aspiration system. Before and after capsule polishing, the viscoelastic agent was injected into the capsular bag and an artificial lens was implanted into it. The viscoelastic agents were then sucked clean to restore the anterior chamber. All surgeries were successful and no complications occurred.

Post-operative evaluation included

1. Slit lamp evaluation of corneal clarity
2. Best corrected visual acuity.
3. IOP measurement using air puff and applanation tonometer one day, one month and three months post-operative.

Data collection, and Statistical Analysis

Data were collected, revised, coded and entered to the statistical package for social science (SPSS) version 23. The quantitative data will be presented as mean, standard deviations and ranges. So, the p value was considered significant when $P > 0.05$.

IV. Results

Table (1): Baseline demographics and clinical features of healthy subjects and glaucoma patients

Characteristics	Non glucoma patients (n = 55)	Glaucoma patients (n = 45)	P value
Mean age, yr	63.15 ± 12.38	65.45 ± 11.36	0.106
Gender,:			
men	30	28	0.595
women	25	17	
Preoperative IOP, mmHg	14.1 ± 2.95	13.75 ± 3.35	0.184
Preoperative visual acuity (Snellen chart)	0.40 ± 0.29	0.47 ± 0.29	0.011*

IOP = intraocular pressure. * signficant

Table (1) showed that in a total of 100 eyes of 100 patients were enrolled in the study, there were 45 patients (45%) were included in glaucoma group with mean age 65.45 ± 11.36 and 55 patients (55%) patients were included in non glaucoma group with mean age 63.15 ± 12.38. There were no differences in the baseline demographics between the two groups, except for better preoperative visual acuity in the glaucoma group ($P < 0.05$).

Table (2). postoperative iop at different time for all patient

Characteristics	Preoperative IOP	Preoperative IOP	Difference
1 day	14.1 ± 2.95	16.2 ± 6.15	2.07
1 week	14.1 ± 2.95	12.15 ± 3.84	- 1.95
1 month	14.1 ± 2.95	12.75 ± 3.72	-1.35

Table (2) showed that the preoperative mean IOP was 14.41 ± 2.95 mmHg, which, by postoperative 1 day, had increased to 16.2 ± 6.15 mmHg. However, by postoperative 1 week, the IOP had decreased again, to 12.15 ± 3.84 mmHg. After postoperative 1 month week, the mean IOP again showed an increasing tendency it was 12.75 ± 3.72 mmHg.

Table (3): Serial changes of mean IOP for healthy subjects and glaucoma patients

Variables	IOP, mmHg		
	Non glucoma patients (n = 55)	**Glaucoma patients (n = 45)**	**P valuea**
Preoperative IOP	13.9 ± 5.65	13.75 ± 2.15	0.656
Postoperative 1 day	16.5 ± 5.8	16.2± 6.15	0.844
Postoperative 1 wk	12.7± 4.9	12.15± 3.54	0.752
Postoperative 1 mon	12.1± 2.5	12.75 ± 3.72	0.252

Table (3) showed that there was no significant difference inter-group. After phacoemulsification, both groups showed immediate IOP elevation at postoperative 1 day; however, the mean IOP was decreased. In fact, from postoperative 1 week to 1 month, the mean IOP of both groups remained lower than the preoperative value. The IOP-lowering effect of phacoemulsification over the course of 1 month of follow up did not statistically differ between the Non glucoma patients and glaucoma patients ($P > 0.05$, respectively).

Table (4): Analysis of preoperative IOP change at each follow-up point

Comparison of IOP change (preop. vs. each postop.)	Estimate (r)	Standard error	Corrected P value
Preoperative IOP			
vs. 1 day	**2.07**	**0.205**	**< 0.001**
vs. 1 wk	**- 1.95**	**0.125**	**< 0.001**
vs. 1 mon	**-1.35**	**0.121**	**< 0.001**

Table (4) showed that there was a positive correlation between the preoperative value and postoperative 1 day ($P < 0.001$); but there was a negative correlation between preoperative value and postoperative 1 week and 1 month, ($P < 0.001$).

V. Discussion

The IOP-lowering effect of cataract surgery has been known for a long time. It is probably the result of the thinness of the inserted intraocular lens (IOL) compared with that of the natural crystalline lens and that lens exchange deepens the anterior chamber. Changes in IOP after cataract surgery are proportional to IOL thickness [5].

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[6].

Cataract is identified as a leading cause of reversible vision loss worldwide. The prevalence of cataract is going high as the population aging phenomenon making it a global health problem. With the new advances of cataract surgery technology, phacoemulsification has been the gold standard technique providing the advantage of being small incision suture less surgery with good visual outcomes, minimal complications and rapid visual recovery. The advances of intraocular lenses technology, has made phacoemulsification a refractive surgery not only a lens opacity removal [7].

Cataract surgery is now considered as one of the most commonly performed surgical procedures worldwide with proved clinical benefit for both cataract and glaucoma treatment. Besides removing lens opacity and restoring vision, cataract surgery has been proved to reduce intraocular pressure (IOP) in patients either with or without glaucoma, with variable magnitude and affected by many factors, including anterior chamber angle configuration [8].

This prospective randomized study was carried out on 100 eyes that underwent measuring IOP by air puff and applanation tonometer before phacoemulsification and IOL implantation and one week, one-month post-operative in Benghazi Teaching Eye Hospital durring the period from January 2024 to April 2024 to compare intraocular pressure changes before and After Cataract Surgery (within 1st week and 1st month) in patients with and without Glaucoma

The current study showed that in a total of 100 eyes of 100 patients were enrolled in the study, there were 45 patients (45%) were included in glaucoma group with mean age 65.45 ± 11.36 and 55 patients (55%) patients were included in non glaucoma group with mean age 63.15 ± 12.38. There were no differences in the baseline demographics between the two groups, except for better preoperative visual acuity in the glaucoma group ($P < 0.05$). in the same line **Baek et al.,** [9] reported that there were no differences in the baseline demographics between the two groups, except for better preoperative visual acuity in the glaucoma group ($P = 0.011$).

The current study showed that the preoperative mean IOP was 14.41 ± 2.95 mmHg, which, by postoperative 1 day, had increased to 16.2 ± 6.15 mmHg. However, by postoperative 1 week, the IOP had decreased again, to 12.15 ± 3.84 mmHg. After postoperative 1 month week, the mean IOP again showed an increasing tendency it was 12.75 ± 3.72 mmHg. Simillary to the study of **Baek et al.,** [9] who reported that the preoperative mean IOP was 14.48 ± 3.37 mmHg, which, by postoperative 1 day, had increased to 17.17 ± 6.15 mmHg. However, by postoperative 1 week, the IOP had decreased again, to 12.59 ± 3.84 mmHg. After postoperative 1 month the mean IOP again was increasing to 12.94 ± 3.71 mmHg.

Previous studies have reported post-phacoemulsification IOP reductions from 1.1 mmHg to 3.5 mmHg in non-glaucomatous [10, 11] and 1.0 mmHg to 5.5 mmHg in glaucomatous eyes [12, 13]. There are possible explanations for this. The single most-common significant factor associated with greater IOP drop after phacoemulsification is higher IOP before phacoemulsification [14].

Also, **Abd El-All et al.,** [15] showed that there was a significant reduction in mean IOP after uneventful phacoemulsification cataract surgery 1 week, 1 month, and 3 months postoperatively after phacoemulsification cataract surgery. **Zamani et al.** [16], divided eyes into 3 groups, this study reported that there is a significant reduction in IOP in eyes after 1 week and 6 weeks after phacoemulsification and IOL implantation. IOP reduction was proportional to preoperative IOP, i.e. the higher the preoperative IOP, the greater is the reduction in postoperative IOP.

Perez et al., [17] reported that although the mean IOP reduction after cataract surgery was not different between eyes with or without glaucoma (p=0.375), the percent of eyes that increased IOP after surgery was higher in the group of eyes with glaucoma (13.2% vs 2.9%, p = 0.013). A possible theory to explain this finding is that glaucomatous eyes in which their trabecular meshwork is functioning at its limit, inflammation induced by the surgery could lead to a worsening in the drainage function, thus producing an increase in the postoperative IOP in a select amount of patients.

The principal mechanism that may explain a higher IOP reduction in eyes with narrower angles is the greater mechanical widening of the angle, leading to better aqueous outflow [18]**.** Another proposed theory of how phacoemulsification cataract surgery leads to IOP reduction includes the activation of an interleukin-1alpha pathway in the trabecular meshwork secondary to ultrasound energy during surgery [19]. However, a prospective randomized controlled trial comparing manual small-incision cataract surgery and phacoemulsification cataract surgery in normal eyes showed equivalent IOP reduction 6 months after surgery, suggesting the mechanism of IOP reduction is more likely due to the anatomic widening of the drainage angle rather than an ultrasound-related pathway [20]. A third mechanism could be the expansion of Schlemm's canal as described in eyes without glaucoma after phacoemulsification. The increase in the area and diameter of Schlemm's canal after cataract surgery was correlated with the amount of IOP reduction and the increase of the anterior vault after phacoemulsification [21].

The current study showed that there was no significant difference between groups regarding Serial changes of mean IOP at different times of follow up. After phacoemulsification, both groups showed immediate IOP elevation at postoperative 1 day; however, the mean IOP was decreased. In fact, from postoperative 1 week to 1 month, the mean IOP of both groups remained lower than the preoperative value. The IOP-lowering effect of phacoemulsification over the course of 1 month of follow up did not statistically differ between the healthy subjects and glaucoma patients ($P > 0.05$). Also, **Baek et al.,** [9] reported that There was no significant inter-group difference. After phacoemulsification, both groups showed immediate IOP elevation at postoperative 1 day; however, the mean IOP was decreased after 1 week and 1 month.

The current study showed that there was a positive correlation between the preoperative value and postoperative 1 day ($P < 0.001$); but there was a negative correlation between preoperative value and postoperative 1 week and 1 month, ($P < 0.001$). the same results were obtained by **Baek et al.,** [9] who reported that There was a positive tendency of change between the preoperative value and postoperative 1 day ($P < 0.001$); however, each subsequent follow-up point, from postoperative 1 week to 1 year, showed a negative coefficient value ($P < 0.001$).

Zetterström et al., [5] found a statistically significant correlation was between the preoperative IOP and the IOP reduction postoperatively. Eyes with a high preoperative IOP had a significantly greater reduction.

Although the short- and long-term effects of cataract extraction on IOP have been studied for many years, the mechanism of effects of cataract removal on IOP is not fully understood. Postulated mechanisms for the observed reduction in IOP after cataract surgery include a reduction in aqueous production, an increase in uveoscleral outflow, and an increase in conventional outflow mediated by the relief of latent and/or relative pupillary block in eyes with shallow anterior chambers [22, 23].

IOP lowering after cataract surgery in patients with open-angle glaucoma has been documented, but the extent of IOP lowering has been variable and sometimes considered insignificant. The mechanism for IOP reduction in open angle glaucoma is not fully elucidated, but it is hypothesized that cataract surgery may lower the IOP by affecting the trabecular meshwork, ciliary body, or anterior segment anatomy [1].

VI. Conclusion

Intraocular pressure significantly decreased after phacoemulsification cataract surgery. 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.

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