Changes of Anterior Chamber Biometry and Relationship to Intraocular Pressure Changes after Phacoemulsification Surgery in Non-Glaucomatous Eyes

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ABSTRACT:

BACKGROUND:

Fifty percent of blindness worldwide is attributed to cataract, and cataract surgery is the most common surgery performed by ophthalmologist.

OBJECTIVE:

The objective of this study was to investigate the changes in anterior segment parameters and its correlation to IOP changes after phacoemulsification.

PATIENTS AND METHODS:

It's a prospective cohort study that was done at Ibn Al-Haitham Teaching Eye Hospital for patients planned to have phacoemulsification, for 55 patients during 8 months, from the 1st.July.2018 to 28th.Feb.2019. The data included full preoperative and postoperative assessment, key parameters were: axial length measurement, intraocular lens, anterior chamber depth, anterior chamber volume, and anterior chamber angle for the four quadrants.

RESULTS:

There were statistically significant differences in preoperative compared to postoperative values of intraocular pressure (decreased by 4.55 mmHg), anterior chamber depth (increased by 0.74 mm), volume (increased by 32.75 µl), and mean angle (increased by11.78 degree) maximum inferiorly (12.31 degree) and minimum superiorly (8.29 degree). There was no statistically significant correlation between intraocular pressure changes with anterior chamber depth, volume, or angles, but there was a statistically significant correlation with preoperative intraocular pressure (correlation coefficient 0.513).

CONCLUSION:

A decrease in intraocular pressure does not correlate with anterior chamber depth, volume, and angle, so IOP seems not related to anatomical changes directly but to facility of drainage change after the surgery or uveoscleral outflow increase. The decrease in intraocular pressure was significantly higher in patients with higher preoperative values of intraocular pressure.

KEYWORDS: cataract surgery, phacoemulsification, anterior segment, intraocular pressure.

INTRODUCTION:

Cataract is an eye disease affecting vision. It is characterized by a degradation of the optical quality of the crystalline lens. In most cases, cataract is related to aging and it may occur in one or both eyes [(1)].

Cataract maintains to be the largest cause of blindness worldwide, and in Iraq [(2)]. Cataract may account for moderate vision impairment (less than 6/18 to 6/60), severe vision impairment, (less than 6/30 to 3/60) or blindness (less than 3/60). As people may have unilateral or bilateral cataract, it is more significant to contemplate the number of eyes requiring surgery rather than the number of people. The number of cataract operations performed in one year per million populations is known as cataract surgical rate. It is considered as a measure of the quantity of cataract services [(3)]. With the rate of 1178 operation/million between 2005 and 2009, Iraq occupies the 30th position among 50 nations in cataract surgical rates[(4)].

Cataract surgery is the most widely performed surgery worldwide. Phacoemulsification is the major procedure of modern cataract surgery. Cataract surgery aims at achieving the most optimum possible visual outcome rather than merely being a procedure to remove the opaque lens, putting into account minimum invasiveness and maximum safety. These objectives have established a tendency for smaller lacerations of 2.8 mm–2.2 mm incisions in phacoemulsification instead of a 10 mm incision used for

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extracapsular cataract extraction to. This breakthrough is accompanied by reduced surgically-induced astigmatism, improved fluidics, reduced inflammation and tissue damage, and faster recovery. On the other hand, ultrasonic energy used during phacoemulsification can bear the risk of endothelial cell loss and tissue damage, specifically in hard cataracts[5].

The IOP reductions after phacoemulsification indicating that the aging crystalline lens may be a major cause of ocular hypertension and glaucoma and that phacoemulsification with IOL implantation may help prevent and treat adult glaucoma[5].

METHODOLOGY:

Study design settings: cohort prospective study that was commenced at Ibn Al-Haitham Teaching Eye Hospital for patients planned to have phacoemulsification.

Data collection

The data was collected from 55 patients by the researcher for 8 months, from the 1st of July/2018 until the 28th of February/2019. The data included both preoperative and postoperative assessment:

1. Visual acuity (VA) testing, slit-lamp examination, routine fundus examination, indirect gonioscopy by goldman three-mirror lens, grade 2 angles and below according to Shaffer grading are excluded, and IOP measured by Goldmann applanation tonometer after application of topical anesthesia and fluorescein staining to patients' eyes. The fundus was examined by using (+90 diopter) non-contact lens, and if the fundus could not be seen, the posterior segment was assessed by B-scan ultrasonography.
2. Axial length measurement and the intraocular lens (IOL) power calculation was done using IOL MASTER (Zeiss, Jena, Germany)
3. Anterior segment imaged by a Pentacam (PTC, Oculus Inc., Wetzlar, Germany) for anterior chamber depth (ACD) from the corneal epithelium to the anterior lens capsule [6] (or anterior IOL surface postoperatively), anterior chamber volume (ACV), anterior chamber angle (ACA) for the four quadrants (Inferior, Superior, Nasal, and Temporal) and their mean value was calculated. It was done before the operations and after two months from the operation, in standard setting (dimly illuminated room) by experienced technician.

Inclusion Criteria:

Any adult patient older than 18 years of both genders having Non glaucomatous with Open angle.

Exclusion Criteria:

Any patient who refused to involve or having Glaucoma, Uveitis, Pseudoexfoliation syndrome, previous ocular surgeries and trauma, Systemic disorder and surgical and post-surgical complications.

Ethical considerations

Institutional Review Board (IRB) approval was acquired from the Ethics Committee at Ibn Al-Haitham Teaching Eye Hospital Baghdad, Iraq.

Statistical analysis

Statistical analysis of the collected data was conducted by IBM© SPSS© (Statistical Package for the Social Sciences) Statistics Version 23. T-test was applied for numerical and normally distributed data in independent samples. Pearson Correlation was applied to identify the possible linear correlation between the study variables. All analyses were performed with 95% confidence intervals (CI). Throughout this study, P-values < 0.05 were considered statistically significant.

RESULTS:

In the current study, the mean age of the study group was 56.96±9.99 years; the commonest age group was 60 – 70 years with 28 (50.9%) patients, very close gender distribution 30 (54.5%) males compared to 25 (45.5%) females, this applied also to laterality as there were 29 (52.7%) right eyes, compared to 26 (47.3%) left eyes. The mean axial length was 23.12±1.11 mm.

There were statistically significant differences in preoperative compared to postoperative values of IOP (decreased by 4.55 mmHg), ACD (increased by 0.74 mm), ACV (increased by 32.75 µl), and mean AC angle (11.78 degree) maximum inferiorly (12.31 degree) and minimum superiorly (8.29 degree).

No statistically significant correlation was detected between IOP changes and anterior chamber depth, volume, or angles. However, IOP changes showed a statistically significant correlation with preoperative IOP (correlation coefficient 0.513), as showed in Table (1) and Figure (1).

Table 1: Baseline characteristics of patients included in this study.

Variable	N (%)
Age in years	
30-40.9	12 (21.8 %)
50-59.9	15 (27.3%)
60-70	28 (50.9%)
Age (mean±SD)	56.96±9.99
Gender	
Male	30 (54.5%)
Female	25 (45.5%)
Laterality	
Right eye	29 (52.7%)
Left eye	26 (47.3%)
Axial length (mean±SD)	23.12±1.11 mm

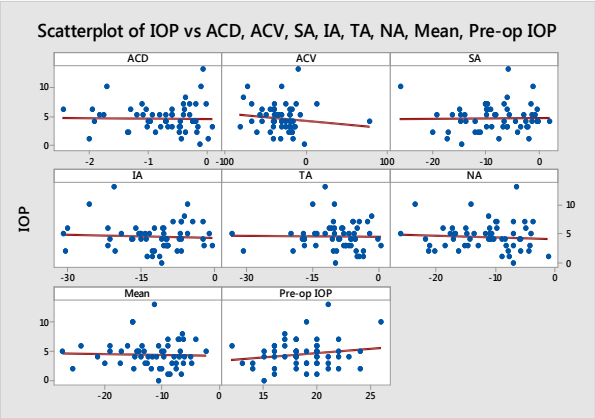

Figure 1: Scatterplot of IOP changes versus changes in ACD, ACV, SA, IA, TA, NA, mean chamber angle, and preoperative IOP.

Table 2: Comparison between preoperative and postoperative IOP and anterior chamber parameters.

Variables	Preoperative	Postoperative	Difference	P-value
IOP (mean±SD) (mmHg)	18.65± 2.84	14.11±2.61	4.55	<0.001
ACD (mean±SD) (mm)	2.62±0.43	3.36±0.71	0.74	<0.001
ACV (mean±SD) (µl)	139.84±37.20	172.58±35.97	32.75	<0.001
Anterior chamber angle				
Superior quadrant	32.09±7.06	40.38±6.54	8.29	<0.001
Inferior quadrant	31.71±6.60	44.02±5.84	12.31	<0.001
Temporal quadrant	34.95±7.58	44.72±6.29	9.77	<0.001
Nasal quadrant	34.04±6.19	45.93±4.87	11.89	<0.001
Mean angles	32.80±4.92	44.58±4.32	11.78	<0.001
Paired samples T-test				

Table 3: Correlation of IOP changes with axial length and changes of other parameters.

Changes	Correlation coefficient	P-value
AL	-0.174	0.204
ACD	-0.019	0.888
ACV	-0.133	0.332
Superior angle	0.030	0.830
Inferior angle	-0.058	0.675
Temporal angle	-0.012	0.933
Nasal angle	-0.073	0.597
Mean of angles	-0.035	0.798
Preoperative IOP	0.513	<0.001
Pearson correlation		

DISCUSSION:

The current study investigated the changes in anterior chamber biometry and how these changes are related to intraocular pressure changes after phacoemulsification surgery. The results showed a significant decrease in IOP post cataract surgery in non-glaucomatous eye with significant increase in ACD, ACV and ACA, although there is no relationship between IOP and, ACV, ACA, and ACD.

The results also showed a significant decrease in mean IOP preoperative and postoperative (18.68±2.84 mmHg, and 14.11±2.61 mmHg, respectively), with a statistically significant mean difference of 4.55 mmHg. This was comparable to the results reported by Sengupta et al (2016) in USA [7], who studied the AC and IOP changes in patients who underwent phaco in 500 cataract patients, and reported that the mean IOP in phaco group was 15.52±2.9 mmHg preoperatively, and decreased to 11.92±2.8 mmHg with a mean difference of 3.6±2.1 mmHg. Also Yang et al (2013) in South Korea [8], who studied 999 cases who underwent phacoemulsification, and reported significant IOP reduction postoperatively, as the preoperative IOP was 13.5 ± 6 2.9 mmHg which decreased to 11.9±6 2.8 mmHg after phaco. This could be explained by the different proposed mechanisms that reduce IOP after phaco, which could be an inflammatory response that may lead to increase in uveoscleral outflow, blood-aqueous barrier changes, effects on the ciliary body, in addition to anatomical alterations in the anterior segment which could be the pivotal factor explaining aqueous humor dynamics post cataract surgery.

In the current study, there was a statistically significant increment by 0.74 mm in ACD and by 32.75 mm^3 in ACV postoperatively. This was lower than the results of Huang et al (2011) [9] who studied 63 eyes and classified them according to irido-corneal angle status; 26 narrow and 37 open angle, and reported that in open angle group the ACD increased by 1.18 mm after one month. While our results were close to results of Simsek et al (2016) in Turkey [10], who studied one hundred and thirty-two phaco operations, and reported that ACD decreased by 0.64 mm and the ACV by 37.44 mm^3. These changes might reflect the latter is composed of two haptics and a central optic, which means that it would not fill the entire bag like the crystalline lens; which leads to posterior shift of the iris.

In the current study, the mean increase in anterior chamber angle (ACA) was 11.78 degrees, maximum inferiorly and minimum superiorly. This was comparable to results of Dooley et al (2010) [11] who studied 120 eyes without glaucoma, and reported that the ACA increased by 13.1 degrees, also Huang et al (2012) [12] who studied 73 eyes and reported increase in angle by 8.46 degrees. Adding to them, the results of Simsek et al (2016) [10] who reported an increment in ACA by 9.09 degrees. The crystalline lens continue to grow throughout life, and when doing so, it's pushing the iris anteriorly, shortening the AC and decreasing the angle opening, with lens removal and the smaller size of the implanted PC IOL, there won't be a structure that pushes the iris, which may be related to IOP decrement postoperatively, together with dysregulation of pre-inflammatory mediators after cataract extraction [13].

CONCLUSION:

Phacoemulsification in Iraqi patients was found to decrease the intraocular pressure, and increase anterior chamber depth, volume, and angle post cataract surgery. The decrease in intraocular pressure does not correlate with anterior chamber depth, volume, and angle.

So, IOP seems not related to anatomical changes directly but to facility of drainage change after the surgery or uveoscleral outflow increase. The decrease in intraocular pressure was significantly higher in patients with higher preoperative values of intraocular pressure.

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