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Original Research Article

An Observational Study Assessing Correlation between Phacoemulsification Effective Time and Anterior Chamber Depth in Uncomplicated Cataract Surgery

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Abstract

Aim: The aim of the present study was to correlate between phacoemulsification effective time and anterior chamber depth in uncomplicated cataract surgery.

Methods: This was a single-center prospective observational study conducted in cataract surgeries done for the period of one year in which patients were grouped according to preoperative anterior chamber depth. The outcome measures included total ultrasound time for phacoemulsification in cataract surgeries. 75 patients were in nuclear grade 3 cataract category.

Results: The difference in the means of anterior chamber depth was compared using the student t- test. There was a significant (<0.01) difference between pre and post- surgery anterior chamber depth values. Comparison of ACD and ACD difference shows a statistically significant negative correlation when compared in overall spherical refractive error and also when compared separately. A significant ($p<0.001$) negative association between overall postoperative spherical refractive error and difference in anterior chamber depth was reported in the present study with r value of -0.43. It was seen that there is statistically significant inverse correlation of anterior chamber depth to phacoemulsification ultrasound time. Similarly, the correlation of anterior chamber depth difference was studied with specific postoperative spherical refractive error. The results were inconsistent to that of the overall correlation for all spherical refractive error.

Conclusion: This study concluded that after cataract surgery, the anterior chamber deepens. Eyes with larger preoperative anterior chamber depth had a smaller amount of deepening of AC and resulted in more post op hyperopic spherical errors. Eyes with smaller preoperative anterior chamber depth had a larger amount of deepening of AC and resulted in more post op myopic spherical errors.

Keywords: phacoemulsification, anterior chamber depth, uncomplicated cataract surgery

Introduction

Phacomorphic glaucoma is a type of secondary acute angle closure characterized by rapid increase in intraocular pressure (IOP) with shallowing of anterior chamber caused by mature or hyper-mature cataract. Phacomorphic glaucoma was called so historically, but "glaucoma" implies an optic neuropathy. Since, majority of phacomorphic glaucoma patients do not have glaucomatous optic neuropathy at presentation, so the term "phacomorphic angle closure" (PMAC) was proposed, which seems to be more appropriate. [1] PMAC is less common in Western countries. In India, back in 1980s phacomorphic glaucoma was the cause of cataract extraction in 3.9 % of cases, more frequently among females. [2]

In PMAC, acute clinical presentation is typically preceded by gradual, painless decrease in vision. The initial management of PMAC is aimed at reducing corneal edema and IOP. The definitive treatment of PMAC is cataract extraction. [3] Cataract surgery in setting of PMAC might be challenging, due to shallow anterior chamber and raised IOP from swollen lens. Thus, shortening the duration of attack, effective control of IOP and uncomplicated cataract extraction are keys to improve visual outcomes in these eyes. With evolution of techniques of cataract extraction, the preference has shifted from sutured extracapsular cataract extraction (ECCE) toward manual small incision cataract surgery (MSICS), and

phacoemulsification in eyes with PMAC also. [2,4,5]

Currently, phacoemulsification (phaco) combined with intraocular lens (IOL) implantation is the gold standard for cataract treatment. [6] However, several factors affect the success of surgery, leading to intraoperative and postoperative complications. Among them, anterior chamber (AC) stability during phaco is a critical factor. [7] The balance between the inflow and outflow of irrigation fluid primarily influences AC stability. Modern phaco machines can maintain a relatively stable AC when the phaco tip and the irrigation/aspiration (I/A) tip are inserted into the eyes. [8] However, the AC immediately becomes shallow or even collapses once the surgical instruments are withdrawn from it.

The post-operative refractive outcome following cataract surgery is affected by a variety of factors. The assessment of ocular parameters such as keratometry, axial length and lens thickness, surgically induced astigmatism, intraoperative handling, the choice of IOL calculation formula, and the location of IOL implantation are among the most frequent factors. [9] Perhaps the most crucial and modifiable of these is IOL power. Most commonly used IOL power calculation formula SRK/T considers axial length, keratometry and lens constant. [10] In light of the well-established reliability of axial length and keratometry, the effective lens position (ELP) is considered an important factor affecting the predicted refractive error. [11]

The aim of the present study was to correlate between phacoemulsification effective time and anterior chamber depth in uncomplicated cataract surgery.

Materials and Methods

This was a single-center prospective observational study conducted in department of Ophthalmology , Sunaina Netralaya,Biharsharif ,Nalanda, Bihar, India ,cataract surgeries done for the period of one year in which patients were grouped according to preoperative anterior chamber depth. The outcome measures included total ultrasound time for phacoemulsification in cataract surgeries. 75 patients were in nuclear grade 3 cataract category.

Patients were recruited from the Ophthalmology OPD of our teaching hospital. All the patients possessed visually significant cataracts and had best corrected visual acuity of less than 6/18 in the affected eye.

Patients with age related cataract planning to undergo Phacoemulsification were included in the study. This was a prospective observational study. Patients were grouped according to preoperative anterior chamber depth. The grade of nuclear sclerosis and lens thickness, age, sex distribution were noted and consent for study was taken from patients. The exclusion criteria included ocular comorbidities such as previous penetrating surgery, complications related to the cataract surgery (such as posterior capsular rupture and vitreous loss, primary or secondary glaucoma, and peripheral anterior synechiae), glaucomatous optic neuropathy. Methodology included detailed preoperative history, written informed consent, measurement of Intra Ocular Pressure (IOP) using Goldmann applanation tonometer, measurement of Anterior chamber depth (ACD) by A-scan biometry making use of the single machine and slit lamp biomicroscopy after pupillary dilation.

Echorule 2: Biomedix A scan machine with Immersion non-contact mode biometry was done for measuring Central ACD. The mean of 10 readings with SD < 0.1 was taken. The other preoperative workup required for cataract surgery by phacoemulsification included measurement of Blood pressure, fasting and post prandial Blood sugar, Kreading, calculation of IOL power, pre-anesthetic checkup.

A standard Phacoemulsification surgery was performed by an experienced surgeon making use of the same kind of microscope and Phaco machine. Phacoemulsification ultrasound time US 1 US 2 and Total US time were noted during surgery. All the operations were performed by the same surgeon using conventional surgical procedures. In brief, eyes were prepared for surgery by instilling tropicamide, 0.5%, and phenylephrine hydrochloride, 10%, for pupil dilation, and lignocaine hydrochloride 2.0% 5ml for peribulbar anesthesia. All the surgical procedures were undertaken using a 2.8-mm superior clear corneal tunnel incision. After the incision, the continuous curvilinear capsulorrhexis measuring approximately 6 mm in diameter was performed using a cystitome. Hydrodissection, in-the-bag phacoemulsification using the stop and chop technique, cortical aspiration, and insertion of a foldable acrylic IOL in the capsular bag were performed step by step.

Observation tables were made and statistical analysis of results was done. All the data were reported as mean (SD) ACD and total ultrasound time. Differences between ultrasound time for phacoemulsification in the groups with different ACD were analyzed and compared using the paired t test. $P < .001$ was considered statistically significant. Data analysis was conducted using MS EXCEL 2016 software.

Results

Table 1: Comparison of pre and post anterior chamber depth

Anterior chamber depth(mm)	Pre		Post		P Value
	Mean	SD	Mean	SD	
N=75	3.4	0.4	4.6	0.2	<0.001

The difference in the means of anterior chamber depth was compared using the student t- test. There was a significant (<0.01) difference between pre and post- surgery anterior chamber depth values.

Table 2: Correlation of preoperative anterior chamber depth with ACD difference (ACD D)

Type of spherical refractive error	Pearson correlation	P value
Overall (n=75)	-0.48	<0.001
Myopic(n=30)	-0.32	<0.03
Hyperopic(n=45)	-0.55	<0.001

Comparison of ACD and ACD difference shows a statistically significant negative correlation when compared in overall spherical refractive error and also when compared separately.

Table 3: Correlation of anterior chamber depth difference and post-operative spherical refractive error: Overall spherical R.E

		AC Depth (mm)	p
Minimum	Maximum	Mean	
3.00	5.00	3.23	<0.001

A significant (p<0.001) negative association between overall postoperative spherical refractive error and difference in anterior chamber depth was reported in the present study with r value of -0.43.

Table 4: Correlation between anterior chamber and ultrasound time

Variables in pts	N	Mean	variance	P-Value
Ant chamber depth	75	2.88	0.22	<0.001
Ultrasound time	75	76.4	994.6	

It was seen that there is statistically significant inverse correlation of anterior chamber depth to phacoemulsification ultrasound time.

Table 5: Correlation between each post op spherical refractive error with Anterior chamber depth difference

Post-operative myopia (n=30)					
AC Depth (mm) Minimum	Maximum	Mean	Difference	r	p
2.76	3.7	3.27	1.27	0.17	0.32
Post-operative hyperopia (n=45)					
AC Depth (mm) Minimum	Maximum	Mean	Difference	r	p
2.07	3.87	3.17	1.26	0.18	0.16

Similarly, the correlation of anterior chamber depth difference was studied with specific postoperative spherical refractive error. The results were inconsistent to that of the overall correlation for all spherical refractive errors.

Discussion

Shallow anterior chamber depth is associated with difficulty in maneuvering phaco probe safely to reach the cataract during phacoemulsification while at the same time, the surgeon has to be cautious as to avoid damage to the endothelium by either the phaco probe or the second instrument viz chopper/dialler. [12,13] Phacoemulsification is fraught with many challenges, one of them being dealing with the peculiar anatomy of a small anterior chamber depth.

In accordance with previous reports we also found a significant difference between pre and post-surgery anterior chamber depth. [14] The difference in the means of anterior chamber depth was compared using the student t- test. There was a significant (<0.01) difference between pre and post- surgery anterior chamber depth values. Comparison of ACD and ACD difference shows a statistically significant negative correlation when compared in overall

spherical refractive error and also when compared separately. Studies done by Upasana et al [15] and many other studies have primarily focused on endothelial cell loss as outcome measure related to ACD in phacoemulsification as the postoperative complication and in most studies, we found correlation between ECL and shallowness of ACD.

A significant ($p<0.001$) negative association between overall postoperative spherical refractive error and difference in anterior chamber depth was reported in the present study with r value of -0.43. It was seen that there is statistically significant inverse correlation of anterior chamber depth to phacoemulsification ultrasound time. Similarly, the correlation of anterior chamber depth difference was studied with specific postoperative spherical refractive error. The results were inconsistent to that of the overall correlation for all spherical refractive error. Engren AL et al [16] studied the relationship between the IOL and the cornea and iris. They found that the average person's vision would be impacted by an ACD difference of 0.32 diopters. 8 Unlike the study done by Engren, this study could not derive the prediction of the magnitude of AC depth change post -surgery.

Measuring ACD provides a simple yet effective tool at the hands of the surgeon to gauge the extent of difficulty in cataract surgery. Such a study creates the groundwork for a larger study taking into consideration such and all other parameters to create an objective scoring system for grading of problems in cataract surgery. The results of this study show that phaco time is inversely related to ACD. Probably, a further implication of this study is that a regular assessment of ACD would be beneficial to note as an indicator of increased phaco time. As the amount of phaco time directly affects the endothelial cell loss adequate measures for endothelial protection can be thus taken in the light of this knowledge. Other benefits of measuring ACD are also worthwhile in cataract surgeries, such as reduction of IOP in narrow angle glaucoma after cataract operation wherein shallow ACD is also seen. Some studies [17,18] have suggested the breakdown of the blood-aqueous barrier (BAB), whose clinical features are flare and cells in the AC. Flare values and cell intensity peak on day 1 after phaco. Maintaining intraoperative AC stability decreases the disturbance of the iris and incidence of iris prolapse, thus reducing the damage to the BAB.

Conclusion

This study concluded that after cataract surgery, the anterior chamber deepens. Eyes with larger preoperative anterior chamber depth had a smaller amount of deepening of AC and resulted in more post op hyperopic spherical errors. Eyes with smaller preoperative anterior chamber depth had a larger amount of deepening of AC and resulted in more post op myopic spherical errors.

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