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ASSOCIATION BETWEEN ANTERIOR CHAMBER DEPTH AND ENDOTHELIAL CELL LOSS AFTER PHACOEMULSIFICATION

Ophthalmology

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ABSTRACT

Purpose: To assess the association between anterior chamber depth and endothelial cell loss after phacoemulsification

Material and Methods: Ninety patients were recruited for this comparative type of observational study who were further divided into 3 groups according to anterior chamber depth (ACD). All patients underwent phacoemulsification procedure and intraocular implantation. Postoperatively endothelial cell loss (ECL) was calculated by measuring percentage decrease in endothelial cell density of central cornea and regression coefficient between ACD and ECL was assessed in each group.

Results: Endothelial cell loss was significantly higher in shallow anterior chambers to other groups and the association between ACD and ECL was significant only in shallow anterior chamber depth group.

Conclusion: Eyes with shallow anterior chamber depth are at higher risk for endothelial cell damage and shows an association between ACD and ECL when compared to deep anterior chamber depth.

KEYWORDS

Corneal decompensation, Endothelial cell loss, Anterior chamber depth, Regression coefficient

INTRODUCTION

Phacoemulsification has become the treatment of age-related cataract due to small incision, which results in better control of postoperative astigmatism and more rapid recovery of visual acuity. Since the corneal endothelial cells damage is inevitable, the transparency of cornea plays a major role in postoperative visual recovery. Thus, the evaluation of risk factors for preoperative, intraoperative, and postoperative endothelial cell loss provides important information[1]. Some unfavourable preoperative factors and improper intraoperative procedures can lead to increased corneal decompensation after phacoemulsification surgery. Risk of endothelial cell damage increases with a high nucleus grade, advanced age, long phacoemulsification time (Phaco time), high ultrasound energy, increased corneal incisional tunnel length, small pupil diameter, large infusion volume, type of intraocular lens (IOL), and short axial length[2-7]. Thus, maintenance of corneal transparency is important for successful cataract surgery.

MATERIAL AND METHODS

This study was hospital based comparative type of observational study and was conducted under Department of Ophthalmology of a tertiary care centre. The tenets of the Declaration of Helsinki were followed throughout. Before commencing the study, each patient was acquainted with the investigative nature of the study, the advantages, and potential risks. The surgical technique, its visual prognosis was properly explained, and an informed consent was taken. The study was conducted on total of 90 patients who were divided in 3 groups (30 in each group) according to anterior chamber depth.

Patients with senile cataract and who gave written informed consent were included in the study. Based on Anterior Chamber depth, they were divided into 3 groups of 30 each (30 eyes)
Group A: ACD1: 1.5mm<ACD<2.5mm
Group B: ACD2: 2.5mm<ACD<3.5mm
Group C: ACD3: 3.5mm<ACD<4.5mm

Patients having history of previous ocular surgery, glaucoma, trauma, intraoperative complications such as posterior capsule rupture or nucleus drop and those who were not able to come for follow up were excluded from the study.

All patients underwent complete systemic, clinical, and ophthalmological evaluation and underwent Phacoemulsification. All surgeries were performed by the same surgeon.

Any case of intraoperative or postoperative complication led to patient's exclusion from the study.

Patient's data regarding anterior chamber depth (ACD) and endothelial cell count (ECC) were recorded and percentage endothelial cell loss (ECL) was assessed at 1st post-operative day, 1 week, 1 month and 3 months by comparing pre -operative and post-operative ECC values at each visit.

Statistical analysis was done by using paired t-test to compare preoperative and postoperative data and unpaired t-test to compare results between the three groups. ANOVA regression method was used to find the association between ACD and ECL at the end of follow up. P value of <0.05 was considered significant.

RESULTS

This study was conducted among 90 patients of 3 groups divided as follows: (30 in each group after excluding who did not meet the inclusion criteria)

Group A: 30 eyes of 30 patients who had anterior chamber depth between 1.5 mm to 2.5 mm
Group B: 30 eyes of 30 patients who had anterior chamber depth between 2.5 mm to 3.5 mm
Group C: 30 eyes of 30 patients who had anterior chamber depth between 3.5 mm to 4.5 mm

In our study, the mean age in group A was 63.7 ± 11.8 years, in group B was 61.9 ± 11.1 years and in group C was 59.8 ± 9.8 years. The difference was not statistically significant. (P value is 0.38 between the groups).

It was also found that in group A, out of 30 patients, 23 patients (76.7%) had grade 1-2 cataract and 7 patients (23.3%) had grade 3-4 cataract. In group B, out of 30 patients, 23 patients (76.7%) had grade 1-2 cataract and 7 patients (23.3%) had grade 3-4 cataract. In group C, out of 30 patients, 27 patients (90%) had grade 1-2 cataract and 3 patients (10%) had grade 3-4 cataract. There was no statistically significant difference found between the three groups. (P value is 0.31)
In our study, the mean ACD in group A was 2.3 ± 0.1 mm, in Group B was 3.1 ± 0.2 mm and in group C was 3.8 ± 0.2 mm. The difference was statistically significant between the groups. (P value < 0.05) (Table 1)

Table 1 showing Distribution of patients according to anterior chamber depth in all three groups

	GROUP A	GROUP B	GROUP C	P value
Mean ACD (mm)	2.3	3.1	3.8	0.001
S.D.	0.1	0.2	0.2	
Maximum ACD	2.49	3.47	4.28	
Minimum ACD	1.98	2.73	3.52	

The mean endothelial cell counts preoperatively in Group A, Group B and Group C were 2642.7 ± 294.6 cells/mm2, 2702.6 ± 304.9 cells/mm2 and 2706 ± 174.5 cells/mm2 respectively. Values were considered statistically insignificant between the groups. (P value is 0.58)

Mean endothelial cell loss in percentage was calculated at each follow up by comparing preoperative and post-operative endothelial cell counts at 1st day, 1 week, 1 month and 3 months. There was statistically significant difference found in %ECL in all the three groups at each follow up. (p-values on 1st day, 1st week, 1 month and 3 months was 0.0024) (Table 2)

Table 2 showing % endothelial cell loss in all three groups

	GROUP A		GROUP B		GROUP C	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Post_op_1day	12.14	1.12	8.19	0.43	5.96	0.26
Post_op_1wk	12.95	1.11	9.03	0.43	6.82	0.26
Post_op_1mth	13.23	1.10	9.33	0.43	7.12	0.26
Post_op_3mth	13.42	1.10	9.52	0.43	7.32	0.26

We also assessed the functional relationship between ACD and %ECL at 3 months for each group. Anterior chamber depth was considered as an independent variable on X axis while %ECL was considered as a dependent variable on Y axis and regression coefficient was calculated and was represented as R square. (Table 3)

The results were statistically significant only for Group A suggesting that change in anterior chamber depth reflects the change in endothelial cell loss only in patients having shallow anterior chamber.

Table 3 showing Regression Statistics for all three Group

Regression Statistics	Group A	Group B	Group C
Multiple R	0.424745	0.21270485	0.120539
R Square	0.180408	0.04524335	0.01453
Adjusted R Square	0.151137	0.0111449	-0.02067
Standard Error	0.010148	0.00426065	0.002611
Observations	30	30	30
Significance F	0.019305	0.25918	0.525766
P-value	0.019305	0.259108	0.525766

DISCUSSION

Phacoemulsification has become the first choice of surgery for age related cataract due to due to small incision, which results in better control of postoperative astigmatism and more rapid recovery of visual acuity. However, damage to the corneal endothelial cells during phacoemulsification is inevitable, the transparency of cornea becomes a major determinant of postoperative visual recovery.

90 eyes of 90 patients were evaluated in our study with the aim to assess Association of anterior chamber depth and endothelial cell loss after phacoemulsification, divided according to ACD.

In our study, postoperative status of the corneal endothelium in three different anterior chamber depth groups is reported and comparison between the three groups was done. It also shows the association between ACD and %ECL.

The mean ACD in group A, Group B and Group C was 2.3 ± 0.1 mm, 3.1 ± 0.2 mm and 3.8 ± 0.2 mm, respectively. The difference was statistically significant between the groups. (p value < 0.05)

The mean Endothelial Cell Count (ECC) in Group A, preoperatively was 2642.7±294.6 cells/mm2, in Group B was 2702.6±304.9 cells/mm2 and Group C was 2706±174.5 cells/mm2. There was no difference in ECC preoperatively in all the three groups. (p value 0.58)

ECC postoperatively at intervals of day 1, 1 week, 1 month and 3 months was assessed. Statistically significant difference was found postoperatively in all the three groups. (p-values postoperatively on 1st day, 1st week, 1 month and 3 months was 0.0024)

We calculated the percentage of endothelial cell loss at each follow up and found that in Group A, the mean endothelial cell loss postoperatively on day 1, 1st week, 1 month and 3 months was 12.14±1.12%, 12.95±1.11%, 13.23±1.10% and 13.42±1.10%. The mean endothelial cell loss was found to be increasing gradually on each follow up and was stabilised at 3 months. The mean endothelial cell loss was highest between the preoperative and 1st postoperative day and decreased gradually between 1st day to 1 week, 1 week to 1 month and 1 month to 3 months. The mean endothelial cell loss in Group B and Group C also followed the similar trend. The mean endothelial cell loss in Group B was 8.19±0.43%, 9.03±0.43%, 9.33±0.43% and 9.52±0.43% on day 1, 1st week, 1 month and 3 months, respectively. In Group C, the mean endothelial cell loss was 5.96±0.26%, 6.82±0.26%, 7.12±0.26% and 7.32±0.26% on day 1, 1st week, 1 month and 3 months, respectively.

It was observed that there was no significant difference in the endothelial cell counts preoperatively between the three groups, still the percentage of mean endothelial cell loss was significantly higher in Group A as compared to Group C at each follow up (p-value <0.01).

Similar results were seen by Hwang HB et. al[1]. The mean decreases in endothelial cell density at two months in the Group A (1.5 mm<ACD≤2.5 mm) was 12.94±3.16% and 9.61±2.96% in Group C (3.5 mm<ACD≤4.5 mm). The difference in cell density between these two groups was statistically significant (p<0.05).

Similar results were seen in a study conducted by Walkow T et. al[7]. Fifty consecutive patients scheduled for routine cataract surgery were selected prospectively for this clinical trial. After 12 months, the mean overall central endothelial cell loss in all eyes was 8.5%.

Although, the above-mentioned studies failed to demonstrate the relationship between ACD and endothelial cell loss count, we tried to find out the association between these two parameters in all three groups. A functional relationship was found statistically significant between ACD and ECL for Group A with p value of 0.019, indicating shorter eyes with short axial length have a significantly higher risk for greater endothelial cell loss. However, no association was observed for Group B and Group C. (p value 0.25 and 0.52 respectively)

Since phacoemulsification surgery is performed in a limited, confined space; thus, we hypothesized that a shallow ACD would make corneal endothelium cells more vulnerable to torsional ultrasound energy, heat energy, movement of lens fragments, and touch by surgical instruments. For this reason, eyes with shallow ACDs are thought to suffer more endothelial cell loss and ACD has a significant impact on ECL than eyes with deep ACDs. However, study could have been more informative with larger sample size and longer follow up period.

CONCLUSION

In conclusion, we can say that in eyes with shallow anterior chamber, as phacoemulsification is being performed closer to the endothelium, is therefore associated with an increased endothelial cell loss and these eyes also have a positive association between anterior chamber depth and endothelial cell loss compared to eyes with normal or deep anterior chamber depth.

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