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Comparison of Changes in Endothelial Corneal Cell Count of Vitrectomized Silicone Oil-Filled Eyes

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ABSTRACT

Objective: To determine the mean endothelial cell change in patients undergoing vitrectomy with silicon oil replacement and to compare the corneal endothelial cell loss frequency of phakic, pseudophakic, and aphakic Vitrectomized Silicone Oil-filled eyes.

Study Design: Cross-sectional Study.

Place and Duration of Study: Retina Department, Al-Shifa Trust Eye Hospital, Rawalpindi Pakistan, from Aug 2020 to Jan 2021.

Methodology: A total of one hundred patients of either gender, aged 50-80 years, who underwent vitrectomy with silicon oil replacement were enrolled in the study. Patients were assigned to one of the three groups based on their lens status, phakic, pseudophakic and aphakic. Mean endothelial count density before and three months after vitrectomy was estimated in all the patients.

Results: Cell loss was higher in the pseudophakic and aphakic groups than in the phakic groups. More than 5% cell loss at three months was observed in 11.8%, 21.2% and 33.3% in the phakic, pseudophakic, and aphakic groups, respectively (*p*-value 0.102).

Conclusions: Mean endothelial cell loss was higher in the pseudophakic and aphakic groups than in the phakic groups.

Keywords: Retinal detachment, Silicone oil, Vitrectomy.

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INTRODUCTION

Corneal endothelial cell (EC) loss can occur due to traumatic injury, ophthalmic surgery, systemic disease (such as diabetic patients) and UV radiation.[1,2] Other factors that can affect this are age, gender, race and genetic predisposition1. It is known that the ability of ECs to repair themselves is limited, and a lack of the ability to proliferate results in age-related reductions in endothelial cell density (ECD).[3] ECD can be clinically estimated using specular microscopy, fluorophotometry and pachymetry.[4]

The ECD analysis provides a measure of the general condition of the corneal endothelium, which is important before any intraocular surgery.[5] It has been observed that the surgery duration for cataract and VR surgery is also related to EC loss, tear film instability and goblet cell loss, causing ocular surface damage.[6,7]

Few studies have been conducted on the effects of posterior segment surgery on ECs.[8,9] Most studies are for posterior segment surgery with Silicone Oil (SO), which is known to be toxic for corneal endothelium.[10] This study will benefit surgeons in planning, with more efficiency, their patient selection criterion for vitrectomy surgeries. The right phakic status will become one of the factors in deciding to proceed with vitrectomy for the patients.

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METHODOLOGY

The cross-sectional study was carried out at the Retina Department of Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan from August 2020 to January 2021. The sample size was calculated using a population mean of 24388 and while population standard deviation as 327.68.[11] The sampling technique was Non-probability consecutive sampling.

Inclusion Criteria: Patients of either gender,aged 50-80 years, undergoing vitrectomy with silicon oil (5000 cs) replacement were included in the study.

Exclusion Criteria: Patients with previous ocular surgery for any reason and other pathologies that may contribute to corneal damage, e.g. Trauma, Infection, Glaucoma, systemic corticosteroids or immunosuppressive therapy were excluded from the study.

As per the protocol of the hospital, every patient had his complete ophthalmological examination done in the general OPD by an ophthalmologist. Every

patient underwent a standard ophthalmological examination, including refractive error, best-corrected visual acuity testing, slit-lamp biomicroscopy, Goldmann applanation tonometry, and funduscopy. Patients with corneal abnormalities, glaucoma, strabismus, and a previous history of ocular trauma and intraocular surgery (excluding cataract surgery) were excluded. After routine ophthalmic examinations, all volunteers underwent corneal EC evaluations using non-contact specular microscopy (SP 2000P; Topcon, Tokyo, Japan). Parameters recorded from the system include MCD(cells/mm^2), Patients were assigned to one of the three groups: Group-1 (phakic and SO tamponade), Group-S2 (pseudophakic and SO tamponade), and Group-3 (aphakic and SO tamponade). On follow-up after three months of surgery, specular microscopy was again advised, and endothelial cell count was recorded again. All the observations, along with demographic information of patients noted by the researcher on a pre-designed structured proforma.

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 18. Mean and standard deviation were calculated for quantitative variables, i.e. age and Endothelial Cell Change at pre-op and three-months intervals. Qualitative variables like gender, DM and HTN were calculated by frequency and percentage. ANOVA test was used to compare the endothelial cell loss after cataract surgery between three groups. Post-stratification independent sample t-test was applied. The *p*-value of ≤0.05 was considered significant.

RESULTS

A total of one hundred (n=100) patients fulfilling the inclusion criteria were enrolled in the study. Mean ECD before surgery, at three months after surgery, mean cell loss at three months and mean cell loss are represented in Table-I. The distribution of gender, DM, and HTN are represented in Table-II. More than five percent cell loss at three months was observed in 11.8% (n=4/34) in the Phakic Group, 21.2% (n=7/33) in the Pseudophakic Group and 33.3% (n=11/33) in the Aphakic Group. However, the difference was not statistically significant (*p*=0.102), shown in Table-III.

DISCUSSION

In the present study, we intended to estimate endothelial cell loss in post-vitrectomized patients based on their lens status. Surgeons must be aware of these as corneal abnormalities commonly cause visual loss following an otherwise successful surgery. A total of one hundred (n=100) patients of either gender, aged 50-80 years, who underwent vitrectomy with Silicon Oil replacement were enrolled in the study. Patients were assigned to one of the three groups based on their lens status, phakic, pseudophakic and aphakic.

Table-I: Mean Endothelial Cell Density Pre-Operative And At Three Months (n=100)

Groups		Phakic	Pseudophakic	Aphakic	*p*-value
Endothelial Cell Density PRE-OP (Cells/mm2)	Mean	2448.6 ±462.3	2167.4 ±419.9	2008.8 ±429.9	0.001
	SD				
Endothelial Cell Density 3 MONTHS (CELLS/mm2)	Mean	2361.7 ±456.9	2088.6 ±416.7	1935.7 ±429.6	0.001
	SD				
Endothelial Cell Density Mean Change (Cells/mm2)	Mean	93.4 ±21.3	101.2 ±50.4	114.1 ±58.3	0.073
	SD				

Table-II: Demographic Distribution of Study Sample (n=100)

Variables		Groups		
		Phakik	Pseudophakik	Aphakik
Gender	Males	21	20	21
		61.8%	60.6%	63.6%
	Females	13	13	12
		38.2%	39.4%	36.4%
Diabetes	Present	15	13	12
		44.1%	39.4%	36.4%
	Absent	19	20	21
		55.9%	60.6%	63.6%
Hypertension	Present	8	8	8
		23.5%	24.2%	24.2%
	Absent	26	25	25
		76.5%	75.8%	75.8%

Table-III: More Than Five Percent Cell Loss in All the Groups (n=100)

Groups	>5% Cell Loss		*p*-value
	Present	Absent	
Phakic	4	30	0.102
	11.8%	88.2%	
Pseudophakic	7	26	
	21.2%	78.8%	
Aphakic	11	22	
	33.3%	66.7%	
Total	22	78	
	22.0%	78.0%	

Mean endothelial count density before and three months after vitrectomy was estimated in all the patients. Our results showed that cell loss was higher

in the aphakic and pseudophakic groups than in the phakic groups. ANOVA test was employed to assess the significance of the difference, and the difference was not statistically significant (p>0.05). The only significant difference was observed among diabetic patients (p<0.05). Some basic studies reported the possible mechanisms of endothelial cell loss due to Silicone Oil.

It has been reported that SO is also cytotoxic to cultivated human endothelial cells, and contact with SO inhibited endothelial cell proliferation.[12,13] Higher viscosity SO suppressed cell cycling significantly more than lower viscosity SO.[13,14] Damage to endothelial cells reflects a reduction in cell density, which may lead to corneal decompensation and opacity.[15,16]

Our results are quite comparable with the already published studies on the subject. In a similar study, Goezinne *et al.*[17] evaluated the endothelial cell density changes in eyes with Silicone Oil tamponade after vitrectomy for complex rhegmatogenous retinal detachment. Endothelial cell density (in cells per square millimetre), coefficient of variance (standard deviation per mean cell area×100), percentage of hexagonal cells, and corneal thickness were documented preoperatively and compared with values obtained at 3,6, and 12 months postoperatively. Damage to the endothelium and reducing cell density increase mean cell size and disrupt the normal morphological pattern.[18] For the study analysis, all study eyes were divided into five groups according to their lens status during the follow-up. Their results showed that high endothelial cell density loss was found in Group-3 (eyes that underwent an additional phacoemulsification procedure) and Group-4 (eyes that underwent lens and/or intraocular lens removal during the follow-up) at 12 months with a mean cell loss of 19% and 39%, respectively (p<0.001). The highest loss in EC at postoperative 12 months was observed in aphakic eyes (39.2%), followed by pseudophakic eyes (19.2%) that underwent cataract surgery during the follow-up period. They concluded that an intact natural or artificial lens-iris diaphragm might provide a protective barrier against corneal endothelial cell damage from long-term Silicone Oil tamponade. Another trial reported a reduction of ECD at six months postoperatively in both aphakic eyes (13%) and eyes undergoing lensectomy combined with PPV (17%), compared with phakic eyes (0.4%).[14] In another prospective study on ECD after PPV without SO tamponade, Friberg *et al.*[19] reported a significant ECD reduction in aphakic eyes and eyes that underwent simultaneous lensectomy, with or without gas–fluid exchange, compared with patients undergoing scleral buckling alone. No EC loss was found in phakic eyes undergoing PPV without lens removal. These authors hypothesized that the intact lens might protect the corneal endothelium during PPV & fluid–gas exchange may harm aphakic eyes.

In summary, the theme derived from the current study and literature review on the same subject is that patients undergoing vitrectomies are at risk of corneal cell loss after surgery. It has been observed in the present study and reported in previous studies that mean endothelial cell loss was higher in pseudophakic and aphakic groups as compared to the phakic group post-vitrectomy with Silicone Oil replacement. An intact natural or artificial lens-iris diaphragm may provide a protective barrier against corneal endothelial cell damage from long-term Silicone Oil tamponade. We recommend further studies taking larger sample sizes and more prolonged follow-ups. There is a need for a more detailed histopathological analysis of corneal endothelium, which has been exposed to silicon oil in the posterior chamber or anterior chamber. One such review showed marked changes in all layers of the cornea and not only endothelium.[20] Such detailed data on the effect of silicon oil on the corneal layer will drive the need to develop new surgical techniques for safe, easy and early removal of silicon oil from the anterior chamber before it starts to cause corneal stress.

CONCLUSIONS

Mean endothelial cell loss was higher in pseudophakic and aphakic groups compared to the phakic group at three-months post vitrectomy with Silicone Oil replacement. However, the difference was not statistically significant.

Conflict of Interest: None.

Author's Contribution

Following authors have made substantial contributions to the manuscript as under:

AH & SZ: Data acquisition, critical review, approval of the final version to be published.

AJB & HM: Conception, study design, drafting the manuscript, approval of the final version to be published.

KH & AN: Data analysis, data interpretation, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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