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Comparitive Study of Post Operative Endothelial Cell Loss in Diabetic versus Non Diabetic Eyes after Small Incision Cataract Surgery versus Phacoemulsification with IOL Implantation

Dr. Phoolchand Dhaka[1], Dr. Varsha Varshney[2*]
[1]Senior Specialist, Department of Ophthalmology, Churu Medical College & Associated Group of Hospitals, Churu, Rajasthan, India
[2]Senior Resident, Department of Ophthalmology, Churu Medical College & Associated Group of Hospitals, Churu, Rajasthan, India

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***Corresponding author**
Dr. Varsha Varshney

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Abstract: The Aim of our study was to evaluate functional impairment in the corneal endothelium of eyes in patients with diabetes mellitus, after small-incision cataract surgery & after phacoemulsification as compared to non-diabetic patients in Indian population. We also compared endothelial cell morphology in diabetic and non-diabetic patients as a part of pre-operative evaluation of cataract patients undergoing cataract surgery either by SICS or phacoemulsification with IOL implantation as well as we compared postoperative endothelial cell loss between small incision and phacoemulsification cataract surgery. This study included 100 patients attending OPD from Jan 2013 to Dec 2013. Specular microscopy was done preoperatively and follow up done at 1 day, 5 days, and 1 month post operatively for the same parameters. Corneal edema was almost completely resolved in non diabetic patients while diabetic patients still showed increased CCT at 1 month. Rate of resolution was faster in non diabetic. Although Mean endothelial cell loss was statistically significant in diabetic patients but there was no significant difference in ECD loss when the 2 operative procedures were compared. (P value = 0.88). There was no significant difference in cell size variation between diabetics and non diabetics in both the procedures postoperatively. We concluded that cataract surgery is a big trauma for cornea, especially for its endothelium. The operation is mainly dangerous for patients suffering from diabetes. However, despite significant higher loss of endothelial cells and a significant slower process of cell repair in diabetic subjects, functional ocular status seemed unchanged.
Keywords: Diabetes, endothelial cell loss, cataract surgery.

INTRODUCTION

Cataract surgery is one of the most common causes of iatrogenic corneal edema. Reports of endothelial cell loss after cataract surgery using a variety of surgical approaches have demonstrated variable cell loss ranging from no detectable cell loss to as much as 40% cell loss. Endothelial cell loss following uncomplicated phacoemulsification and posterior chamber intraocular lens implantation using viscoelastic and modern, small-incision techniques is quite low, ranging from no detectable cell loss to 20% [1,2]. The morphologic changes that develop in the diabetic patient's corneal epithelial cells are well known. These include polymorphism, polymegathism, irregular cellular distribution, and stunting of surface cell microvilli [3]. In addition to these corneal epithelial problems, the corneal endothelium has an increased incidence of dysfunction in individuals with diabetes [4]. Thus corneal healing can be influenced in a big way in patients of diabetes mellitus. Hence it is very important to evaluate diabetic patients for corneal endothelial cell count and morphology preoperatively for a probable outcome of surgery.

MATERIALS AND METHODS

This study included 100 patients attending outdoor of ophthalmology department, Sardar Patel Medcal College and associated group of hospitals, bikaner with complaints of diminution of vision and on examination were diagnosed having cataract. Patients were admitted for either of the two surgical procedures namely small incision cataract surgery and phacoemulsification with intraocular lens implantation.

We studied 4 groups of 25 patients each as follows:

Group A: non diabetic patients undergoing SICS serving as a control group to group B patients. **Group**

B: diabetic patients undergoing SICS. **Group C:** non diabetic patients undergoing phacoemulsification serving as a control group to group D patients. **Group D:** diabetic patients undergoing phacoemulsification.

All the surgeries were performed by one of the experienced surgeons of the department following standard protocols. Specular microscopy was done with a non-contact type TOPCON SP 3000P specular microscope, Tokyo, Japan with automated analysis, preoperatively and follow up done at 1 day, 5 days, and 1 month post operatively for the same parameters. Each time 3 readings were taken and average of them was taken as the final parameter. The parameters under our study include: Central corneal thickness (CCT), Central endothelial cell density (ECD), which is the number of cells per square millimeter, Coefficient of variation (C.V), Percentage of Hexagonal cells.

RESULTS

Most of the cases (≈93%) were in the age group of 50 – 70. There was no statistical difference in age distribution between the 4 groups. There was male predominance in all 4 groups. Preoperative data showed no statistically significant difference in any of the 4 parameters studied between diabetic and non diabetic subjects, though clinically diabetic corneas tend to be more thicker, with more pleomorphism and polymegathism.

On post operative day 1, CCT measurements showed increase in corneal edema in all 4 groups which was more in diabetic patients. There was no statistical difference in CCT between SICS and phaco group.

On further follow up on day 5 and day 30, there was continuous drop in the corneal thickness. Rate of reduction in CCT was faster in non diabetic patients. Corneal edema was almost completely resolved in non diabetic patients while diabetic patients still showed increased CCT at 1 month.

Mean endothelial cell loss was statistically significant in diabetic patients with an average % loss of 7.2% as compared to 3.2% loss in non diabetic patients who underwent SICS. (P value = 0.03) Mean endothelial cell loss was also statistically significant in phaco group with an average cell loss of 152 cells/mm2 (6.9%) in diabetics as compared to loss of 42 cells/mm2 (2.9%) in non diabetics. (P value = 0.03).There was no significant difference in ECD loss when the 2 operative procedures were compared. (P value = 0.88).There was no significant difference in cell size variation between diabetics and non diabetics in both the procedures postoperatively.

One month postoperatively, the percentage of hexagonal cells in the diabetic group was still significantly decreased compared with the nondiabetic group in both the surgical procedures (SICS and phaco)(p value = 0.03, 0.03), which reveals that the endothelial cells have not yet returned to the preoperative status of steady state. There was no difference in postoperative CCT, ECD, C.V and hexagonal cell in patients operated either by SICS or phaco.

DISCUSSION

Cataract is a major cause of avoidable blindness worldwide, with the developing countries accounting for three quarters of it. Main aim of cataract surgery is to provide good vision to the patients affected by this blinding condition, and in order to do that modern cataract surgery has evolved with minimum complications and maximum visual output today. This evolution was possible only by understanding the causes responsible for low vision after cataract surgery. The main issues being the change in astigmatism and the Corneal/anterior chamber factors: corneal endothelial cell loss, postsurgical corneal swelling, and anterior chamber cell and flare and the systemic factors affecting the ocular health like diabetes mellitus. To address these issues, thorough preoperative examination is inevitable, and here lies the role of specular microscopy.

Our present study was aimed at the comparision of endothelial cell characteristics in normal and diabetic individuals and the effect of surgical trauma on corneal health in the 2 groups. Preoperative morphology data showed no statistically significant difference in any of the 4 parameters studied between diabetic and non-diabetic subjects, though clinically diabetic corneas tend to be more thicker, with more pleomorphism and polymegathism. Schultz *et al*. [5] investigated corneal endothelial changes in type 1 and type 2 diabetes. They found a significant higher coefficient of variance and a significant decrease in the percentage of hexagonal cells in the diabetic group. In both the studies, the level of glycemic control was not indicated.

In the present study, patients with diabetes were under good glycemic control (as based on criteria of the World Health Organisation with a lower cut off for fasting plasma glucose of 126 mg per dL [7 mmol per L]) and this might explain why no difference was observed preoperatively between patients with and without diabetes. This result is in accordance with other studies using modern noncontact specular microscope technique. This suggests that corneal changes should be evaluated and confirmed before intraocular surgery in chronic diabetic patients.

Post Operative Endothelial Morphology

On post operative day 1, CCT measurements showed increase in corneal edema in all 4 groups which was more in diabetic patients. There was no statistical difference in CCT between SICS and phaco group. On further follow up on day 5 and day 30, there was

continuous drop in the corneal thickness. Rate of reduction in CCT was faster in non diabetic patients. Patients of group A and C attained almost preoperative values while group B and D patients showed statiscally significant higher CCT at 1 month with P value of 0.03. However there was no statistically significant difference in CCT in patients operated by either SICS or phaco. P value = 0.5.

Mathew *et al*. [6] studied Endothelial Cell Loss and Central Corneal Thickness in Patients With and Without Diabetes after Manual Small Incision Cataract Surgery in 2011 and concluded that in both the groups, an initial increase in CCT till the second postoperative week was followed by a reduction of CCT in the subsequent follow-up. The change in CCT between the second and sixth weeks was significantly higher in the diabetic group (P = 0.045) thus The diabetic endothelium was found to be under greater metabolic stress and had less functional reserve after manual SICS than the normal corneal endothelium.

Changes in endothelial cell density (ECD)

Mean endothelial cell loss was statistically significant in diabetic patients with an average % loss of 7.2% as compared to 3.2% loss in non diabetic patients who underwent SICS. (P value = 0.03) Mean endothelial cell loss was also statistically significant in phaco group with an average cell loss of 152 cells/mm2 (6.9%) in diabetics as compared to loss of 42 cells/mm2(2.9%) in non diabetics. (P value = 0.03) There was no significant difference in ECD loss when the 2 operative procedures were compared. (P value = 0.88)Hugod M *et al*. [7] in 2010 studied Corneal endothelial cell changes associated with cataract surgery in 30 patients with type 2 diabetes mellitus and concluded that there is a significantly greater loss of corneal endothelial cells in a diabetic group under good glycemic control, compared with nondiabetic group 3 months after phacoemulsification. Mathew *et al*. [6] also showed that there was a significant endothelial cell loss in diabetics after cataract surgery. Based on these results, we speculated that the corneal endothelium in diabetic patients is under metabolic stress, and weaker against mechanical loads, such as cataract surgery, than that in nondiabetic subjects.

Changes in coefficient of variation

There was no significant difference in cell size variation between diabetics and non diabetics in both the procedures postoperatively. (P value = 0.33, 0.36) Similar studies were done by Hugod M, Nanako Furuse, and Soichi Morikubo [8]. All the studies showed no significant difference in C.V in both the groups.

Changes in hexagonality

Although endothelial cell density is a widely used parameter for the status of the cornea after cataract surgery, it does not reflect the dynamics of the endothelial healing process that occurs in response to surgical trauma. The decrease in cell density reflects the surgical trauma itself, whereas the change in morphology is more closely associated with the process of repair. In an immediate response to a loss of endothelial cells, the remaining cells enlarge and slide in an attempt to cover the posterior corneal surface fully, and this is reflected in a short term increase in the cell size and a decrease in the percentage of hexagonal cells. When the endothelium is stabilized after a period of rearrangement, the CV and the hexagonality shift toward the preoperative status. Theoretically, this process of repair might be delayed or diminished in diabetes. In the present study, there was no difference in endothelial cell size, percentage of hexagonal cells, or corneal thickness before cataract surgery. One month postoperatively, the percentage of hexagonal cells in the diabetic group was still significantly decreased compared with the nondiabetic group in both the surgical procedures (SICS and phaco)(p value = 0.03, 0.03), which reveals that the endothelial cells have not yet returned to the preoperative status of steady state.

Postoperative results of SICS and phaco with regards to endothelial cell structure

Our present study has shown no significant difference in any parameter (CCT, ECD, C.V, and hexagonality) in the group of patients operated by SICS or phaco with p value of 0.5, 0.88, 0.38, 0.42 respectively. Previous studies also concluded similar results. Wilczynski M *et al*. [9] studied Evaluation of early corneal endothelial cell loss in bimanual microincision cataract surgery (MICS) in comparison with standard phacoemulsification. Their study included 40 patients. There was no significant difference between BCVA in the two groups (Mann Whitney U two-tailed test: p>0.05). In both groups there was a significant decrease in postoperative endothelial cell densities (ECDs) when compared to preoperative values. Mean postoperative ECDs were 2235+/-418 cells/mm2 in the MICS group and 2079+/-399 cells/mm2 in the standard phacoemulsification group; the difference was not statistically significant (Mann-Whitney U test: p>0.05). Patients in the MICS group lost an average of 9.5% of cells, whereas patients after standard phacoemulsification lost about 7.6% of cells. This difference was statistically insignificant. They concluded that Microincision cataract surgery induced corneal endothelial cell loss similar to a standard phacoemulsification and allowed excellent visual results. Thus, with the above discussion we can say that small incision cataract surgery and phacoemulsification both are standard surgeries for cataract and give comparable results post operatively.

CONCLUSION

Thus, after the completion and analysis of the present study, we concluded that cataract surgery is a big trauma for cornea, especially for its endothelium. The operation is mainly dangerous for patients suffering from diabetes. The surgeon should be aware of the

above threat during cataract surgery in diabetic patients, and therefore should express high level of caution, irrespective of the technique of operation. Also that the corneal endothelium in diabetic patients is under metabolic stress, and weaker against mechanical loads, such as cataract surgery, and has a lower capability in the process of repair than that in nondiabetic subjects and the damage might be irreversible as evidenced by structural change in the endothelial cells. However, despite significant higher loss of endothelial cells and a significant slower process of cell repair in diabetic subjects, functional ocular status seemed unchanged.Thus, a sufficient reserve capacity to maintain normal corneal functional status in well-controlled patients with diabetes exists during the period of follow-up.

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