Original Research Article

Corneal endothelial cell changes in patients with diabetes after manual small incision cataract surgery

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Abstract

Introduction: Cataract surgery can lead to endothelial cell damage and cell loss. Loss or damage to corneal endothelial cells during surgery may lead to corneal decompensation, causing corneal edema and loss of corneal transparency, which disrupts vision. Specular microscopy provides a non-invasive view of morphology of corneal endothelium. This study was undertaken to evaluate the changes in endothelial cells in patients with diabetes mellitus after manual small incision cataract surgery**. Material and methods**: Prospective, longitudinal study was conducted in 50 diabetic patients and 50 non-diabetic patients who underwent manual small incision cataract surgery. Endothelial cell density, coefficient of variation, hexagonality and central corneal thickness was assessed using non contact specular microscope preoperatively and 1 week, one month and three months postoperatively. Statistical analysis was done using using t-test. A p-value <0.05 was considered as statistically significant. **Results**: The mean preoperative endothelial cell density was lower in diabetics as compared to non diabetics (p-value 0.11). There was a statistically significant decrease in endothelial cell density in diabetics post-operatively as compared to non-diabetics (p value: 0.008). There was also a significant increase in corneal thickness in diabetics as compared to non-diabetics (p value: 0.02). The change in coefficient of variation was also higher in diabetic patients (p value: 0.01). However there was no significant change in percentage of hexagonal cells (p-value: 0.74). **Conclusion**: Diabetic patients have lower endothelial cell density and lower capacity for endothelial repair which increases the risk of decompensation in these patients. Thus, specular microscopy should be performed in every diabetic patient before undergoing cataract surgery, wherever possible and precautions should be taken to protect the corneal endothelium preoperatively.

Keywords: Corneal endothelium, Cataract extraction, Diabetes Mellitus, Corneal pachymetry.

Introduction

Cataract is one the leading causes of blindness all over the world, accounting for 47.8% of total blindness and 17.7 million blind people[1]. Cataract surgery is on the most common surgical procedure in the world. Manual small incision cataract surgery and phacoemulsification are the two most common cataract surgeries performed. Manual small incision cataract surgery is more cost effective and has comparable results to phacoemusification[2].

Corneal endothelium is monolayer of cells, which lines the posterior corneal surface. The corneal endothelium has several important functions like maintenance of corneal transparency, dehyadration and thicknes[2]. The endothelial cell density at birth is approximately 3500 cells/mm2 and it continues to decline thereafter. A minimal cell density of 400-500 cells/mm2 is required for maintaining normal pumping activity of endothelium. Loss or damage to corneal endothelial cells may lead to corneal decompensation, causing corneal edema and loss of corneal transparency, which disrupts vision[3].

Changes in corneal endothelial cells are commonly seen in patients with diabetes mellitus. Corneal endothelial pleomorphism and polymegathism has been documented in patients with diabetes mellitus.

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They also have thicker corneas and a low endothelial reserve, making corneal endothelium more prone to injuries with ocular surgeries[4].

Cataract surgery can lead to endothelial cell damage and cell loss. Various studies have documented endothelial cell of around 15% after manual small incision cataract surgery[5,6]. Mechanical trauma at the time of surgery is the main cause of endothelial cell loss during the cataract surgery. Intraocular lens implantation also increases the risk of endothelial cell loss[7].

Specular microscopy provides a non-invasive view of morphology of corneal endothelium[8]. The effect of cataract surgery on the corneal endothelium can be effectively analyzed by the advent of specular microscopy. Hence, this study was undertaken to evaluate the changes in endothelial cells in patients with diabetes mellitus after manual small incision cataract surgery, in order to improve the refractive outcomes after cataract surgery more effectively.

Material and methods

This prospective, longitudinal study was conducted in the Ophthalmology department of a tertiary care teaching hospital in North India over a period of one year extending from October 2020 to September 2021, after getting clearance from the Institutional Ethics Committee.

This study included 100 patients undergoing cataract surgery with posterior chamber intraocular lens implantation (PCIOL). Written informed consent was obtained from each patient and patients who fulfilled the following criteria were included in the study after explaining the purpose of study.

Inclusion criteria

1. Patients above 40 years of age, of either sex, having senile cataract.
2. Patients having cortical cataract and nuclear sclerosis grade 1, 2, 3 cataract on Lens Opacities Classification System 3 (LOCS III)[9]

Exclusion criteria

1. Patients with corneal pathologies like dystrophy and opacities
2. Patients with uveitis
3. Patients with lens induced glaucoma
4. Patients with pseudoexfoliation syndrome, pigment dispersion syndrome
5. Patients with glaucoma
6. Patients with traumatic cataract
7. Patients having intraoperative or postoperative complications
8. Patients with any retinal pathology
9. Poorly controlled diabetes with HbA1c levels >7.0 %
10. Patients with nuclear sclerosis grade IV, V.
11. Preoperative endothelial cell count <1500 cells/mm2.

Patients were divided into two groups of 50 patients each: Group A and B. Group A comprised of type 2 diabetic patients, having good control of blood sugar levels and group B comprised of non diabetic patients. Glycemic control was assessed with HbA1c levels, fasting and post prandial blood sugar levels to disclose any undetected diabetes.

Detailed history regarding ocular and systemic diseases were noted from each patient and visual acuity was recorded. IOP was recorded with non-contact tonometer (SHIN NIPPON NCT-200) by single investigator at the same time of the day, in the morning. A detailed slit lamp examination and gonioscopy was done using three mirror Goldman goniolens. Cataract grading was done according to LOCS III. Fundus was examined with 90D non contact slit lamp biomicroscopy and indirect ophthalmoscopy. Keratometry and axial length were also recorded using Bausch and Lomb keratometer and Biomedix A-scan mode contact biometer.

Preoperative corneal endothelial cell parameters like endothelial cell density, coefficient of variation, hexagonality and central corneal thickness was assessed using non contact specular microscope (TOPCON SP-3000P).

All the patients underwent manual small incision cataract surgery by the same surgeon. Single drug formulation of 0.8% tropicamide and 5% phenylepherine eye drops was started 1 hour prior to surgery to dilate the pupil. Peribulbar anaesthesia was given with 50:50 mixture of 2% lignocaine and 0.5% bupivacaine with 150 units of hyaluronidase injection. Surgery was done through 6.5 mm scleral incision. Nucleus was prolapsed into the anterior chamber after performing capsulorrhexis and delivered using wire vectis. Single piece polymethylmethacrylate lens was implanted after cortical cleanup.

Postoperatively all the patients were started on topical antibiotic-steriod drops and topical mydriatic eye drops for a period of six weeks. Postoperatively endothelial cell parameters and central corneal thickness was analyzed at the end of first week, 1 month and three months after the cataract surgery.

Statistical analysis

Statistical analysis was done using OpenEpi online software version 3. Continuous variable were represented as mean±SD and categorical variables as number and percentages. Statistical significance was assessed using t-test. A p-value <0.05 was considered as statistically significant. All p-values used were two-tailed.

Results

The mean age and gender distribution in two groups is shown in table 1. There was no statistically significant difference between the two groups with respect to age and gender distribution.

Table 1: Demographic data of patients in different study groups

	Group A	Group B
Mean age (in years)	63.4± 8.5 years	65.2±9.2 years
Males	24	20
Females	26	30

Endothelial cell density: The pre-operative and post-operative endothelial cell count is shown in table 2. There was a statistically significant difference between the two groups at the end of 1st week, one month and three months after the cataract surgery. There was a rapid fall in endothelial cell density in both the groups in the first week after cataract surgery. In patients with diabetes mellitus there was 19.35% fall in endothelial cell count in three months whereas in non-diabetic group there was 17.11% decrease in endothelial cell density over the same time period.

Table 2: Comparison of preoperative and post operative endothelial cell density between two groups

	Group A	Group B	p-value
Pre-operative	2533.04± 206. 441	2634.50±258.553	0.11
Post-operative 1 week	2302.07±207.047	2454.38±354.636	0.0002*
Post operative 1 month	2099.06±225.321	2243.45±334.520	0.006*
Post operative 3 months	2042.74±210.780	2183.64±308.442	0.008*
*= p value: significant			

Central corneal thickness: There was a statistically significant difference in central corneal thickness between the two groups at 1st week, at the end of one month and three months after the cataract surgery as depicted in table 3.

Table 3: Comparison of preoperative and post operative central corneal thickness between two groups

	Group A	Group B	p-value
Pre-operative	516.43±16.76	507.67±20.42	0.17
Post-operative 1 week	540.07±21.54	532.45±30.39	0.01*
Post operative 1 month	530.50± 22.07	517.68± 29.58	0.04*
Post operative 3 months	522.89± 19.52	513.84± 30.45	0.02*
*= p value: significant			

Coeffecient of variation: There was a increase in the CV in both the groups at the end of three months postoperatively with a statistically significant difference between the two groups at the end of one month and three months postoperatively. (Table 3).

Table 4: Comparison of preoperative and post operative coefficient of variation between two groups

	Group A	Group B	p-value
Pre-operative	31.75± 4.20	30.68± 3.34	0.11
Post-operative 1 week	33.46± 3.79	32.51± 3.89	0.85
Post operative 1 month	35.21 ± 3.95	34.46± 3.08	0.08*
Post operative 3 months	38.64± 4.14	35.37± 2.90	0.01*
*= p value: significant			

Hexagonality of cells

There was no statistically significant difference between the two groups preoperatively as well as postoperatively at any of the follow up visits for three months postoperatively.

Table 5: Comparison of preoperative and post operative hexagonality of cells between two groups

	Group A	Group B	p-value
Pre-operative	52.45± 6.61	53.02± 5.57	0.23
Post-operative 1 week	50.09± 5.67	51.10± 5.79	0.88

Post operative 1 month	49.89± 5.25	50.88± 5.40	0.84
Post operative 3 months	48.44± 5.31	50.34± 5.56	0.74

Discussion

In the present study we compared the endothelial cell characteristics and central corneal thickness in diabetics and non diabetics undergoing manual small incision cataract surgery. The mean endothelial cell count was lower in diabetic patients as compared to non-diabetics, with no statistically significant difference between the two groups. This is in accordance with study conducted by Kudva AA et al, who reported no significant difference between the two groups preoperatively[10]. However in the study conducted by Dhasmana R et al. there was a statistically significant difference between the diabetic and non diabetic patients with endothelial cell count being higher in non diabetic patients[2].In present study, both the groups showed a decrease in the endothelial cell count in the postoperative period, with a statistically significant difference between the two groups at the end of 1st week, on month and three months after the MSICS. Mathew et al reported a decrease in endothelial count in diabetics at 3 months. Post-operatively the endothelial cell loss in control group versus diabetics was 16.58 + 12.9 per cent and 19.24 + 11.57 per cent in their study[11], similar to our study where there was 17.11 % and 19.35% decrease in endothelial cells in non-diabetic and diabetic group respectively. Similarly, other studies by Lee et al, Parekh et al and Dhasmana R et al. also reported that both the groups showed significant endothelial cell loss in the post operative period[12,13,2].The central corneal thickness was more in diabetics as compared to non-diabetics with no significant difference between the two groups in our study. These findings are similar to studies by Siribunkum J et al and Schultz RO et al[14,15]. Postoperatively, the central corneal thickness increased in both the groups, with a greater and statistically significant increase in diabetic as compared to non-diabetics. In diabetics, there is reduced functioning of Na+-K+ ATPase in the corneal endothelium, which causes morphological and functional changes in cornea[16]. Also, aldose reductase causes intracellular accumulation of polyol, an osmotic agent, which causes swelling of endothelial cells[17]. The central corneal thickness takes longer time to return to baseline levels as compared to non-diabetics. Similar findings have been reported by Kudva AA et al, Dhasmana R et al and Morikubo et al[2,10,18].

There was a statistically significant difference between the coefficient of variation between the two groups preoperatively. Postoperatively there was an increase in the coefficient of variation in both the groups. However, coefficient of variation was more in diabetics as compared to non-diabetics with a statistically significant difference between the two groups at one month and three months postoperatively. Studies by Kudva AA et al , Sahu P et al and Sudhir R et al have also reported an increase in the coefficient of variation in both the groups[10,19,20]. The percentage of hexagonal cells were lower in diabetics preoperatively with no statistically significant difference. There was a decrease in the percentage of hexagonal cells in both the groups postoperatively, which was more significant in diabetics as compared to non-diabetics. Studies by Kudva AA et al , Dhasmana R et al. and Hugod M et al. have reported that there was a significant decrease in percentage of hexagonal cells in both the groups[2,10,21]. The increase in coefficient of variation postoperatively is an indicator of the repair process of cornea. The coefficient of variation comes back to preoperative values when cornea stabilizes after a period of rearrangement.

Conclusion

It can be concluded that diabetics have more loss of endothelial cells post-operatively. This might cause mild risk of decompensation diabetic patients after intra-ocular surgery. Also, there is delay in endothelial repair in diabetic patients as indicated by increased corneal thickness postoperatively. Therefore, corneal endothelium of diabetics is more vulnerable to surgical stress and has lower capability for repair. Thus, specular microscopy should be performed in every diabetic patient before undergoing cataract surgery, wherever possible and precautions should be taken to protect the corneal endothelium preoperatively.

Limitations

Follow-up period was short for evaluation of long-term effects on endothelial cells in diabetic patients. The changes in corneal endothelial cells were not correlated with duration of diabetes, grade of retinopathy and grade of cataract.

Conflict of Interest: Nil Source of support: Nil

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