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Original Research Article

Corneal Endothelial Cell Changes in Patients with Diabetes after Manual Small Incision Cataract Surgery

Pinki Kumari[1], Poonam[2], Gyan Bhaskar[3]

[1]Senior Resident, Regional Institute of Ophthalmology, IGIMS, Patna, Bihar, India
[2]Senior Resident, Regional Institute of Ophthalmology, IGIMS, Patna, Bihar, India
[3]Professor, Regional Institute of Ophthalmology, IGIMS, Patna, Bihar, India

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Corresponding Author: Dr. Poonam
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Abstract:

Background: The most common ocular operation performed globally is cataract surgery, with manual small incision cataract surgery (MSICS) being widely used in resource-limited settings. Diabetic patients are known to be at higher risk for corneal endothelial damage due to their compromised endothelial cell function. Understanding the impact of MSICS on corneal endothelial cells in diabetic patients is essential to improving surgical outcomes and minimizing postoperative complications.

Aim: The purpose of this study is to assess the changes in corneal endothelial cell density after manual small incision cataract surgery between patients with diabetes and those without the disease.

Methods: A prospective observational study was conducted. A total of 97 patients, including 48 diabetic and 49 non-diabetic individuals, were enrolled. Preoperative and postoperative corneal endothelial cell densities were measured using a specular microscope at intervals of 1 week, 1 month, and 3 months post-surgery. Data were analyzed using SPSS version 23.0, with statistical significance set at $p < 0.05$.

Results: Diabetic patients had a significantly lower preoperative corneal endothelial cell density compared to non-diabetic patients (2450 ±150 cells/mm² vs. 2600±140 cells/mm², $p < 0.001$). Postoperatively, the endothelial cell loss was greater in diabetic patients, with a 10.2% reduction at 3 months compared to 7.7% in non-diabetic patients ($p < 0.001$). Despite this, both groups showed significant improvement in visual acuity, with no significant difference between them.

Conclusion: Diabetic patients undergoing MSICS are at a higher risk of corneal endothelial cell loss compared to non-diabetic patients, although visual outcomes remain comparable. These findings suggest the need for tailored surgical techniques or enhanced postoperative care in diabetic patients to preserve corneal endothelial function.

Recommendations: Further studies are recommended to explore specific surgical modifications or protective measures that could mitigate endothelial cell loss in diabetic patients undergoing cataract surgery.

Keywords: Cataract Surgery, Corneal Endothelium, Diabetes Mellitus, Manual Small Incision Cataract Surgery, Endothelial Cell Density.

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Introduction

Around 51% of blindness occurrences worldwide are caused by cataracts, which continue to be the most frequent reason for vision [1]. In underdeveloped nations, where access to surgical procedures may be restricted, the prevalence of cataract is especially high [2]. Because it is less expensive, has a shorter learning curve, and produces results that are comparable to phacoemulsification, (MSICS) has become the treatment of choice in these situations, particularly when dealing with thick cataracts [3]. Even though MSICS is effective at restoring vision, the corneal endothelium may undergo major changes as a result of the surgery, which are necessary to preserve corneal transparency and general ocular health.

Controlling corneal moisture and transparency is a critical function of the inner surface of the cornea's monolayer of cells, the corneal endothelium [4]. Endothelial cells in the cornea do not renew, in contrast to other cell types, and their loss might result in long-term consequences such corneal oedema and decompensation [5]. Patients with diabetes should be especially concerned about this risk since they are known to have lower endothelial cell densities naturally and to be more vulnerable to endothelial damage as a result of chronic hyperglycemia and related microvascular problems [6].

Over 463 million people worldwide suffer from diabetes mellitus (DM), a serious public health

hazard that is expected to reach 700 million by 2045 [7]. Diabetic retinopathy, retinal oedema, and an elevated incidence of cataracts are among the ocular consequences linked to the condition [8]. Patients with diabetes who have cataract surgery are more likely to experience postoperative problems, such as increased endothelial cell loss. This risk may be increased by the more involved and prolonged nature of the procedure in this particular population [9]. In order to reduce these risks, it is imperative that diabetes patients have customised surgical techniques and postoperative care plans, according to recent studies [10].

It is critical to comprehend how MSICS affects the corneal endothelium in diabetic individuals, given the rising incidence of diabetes and the rising need for cataract surgery. The purpose of this study is to assess the changes in corneal endothelial cell density after manual small incision cataract surgery between patients with diabetes and those without the disease.

Methodology

Study Design: This was a prospective observational study.

Study Setting: The study was conducted at Indira Gandhi Institute of Medical Sciences (IGIMS), Patna, from June 2019 to September 2020.

Participants: The study included 97 participants who were scheduled for manual small incision cataract surgery at IGIMS. Participants were divided into two groups: diabetic and non-diabetic patients.

Inclusion Criteria

- Patients aged 40-70 years.
- Patients diagnosed with cataracts and scheduled for MSICS.
- Diabetic patients with a history of diabetes for more than five years.
- Non-diabetic patients without any systemic diseases.
- The patients who gave their informed consent to take part in the research.

Exclusion Criteria

- Individuals with pre-existing corneal endothelial abnormalities.
- Background of ocular trauma or surgery.
- Presence of other ocular diseases such as glaucoma or uveitis.
- Patients with uncontrolled diabetes (HbA1c > 8%).
- Patients on medications that could affect corneal endothelium, such as long-term steroid use.

Bias: Participants were chosen in order to reduce selection bias consecutively from those scheduled for surgery during the study period. Additionally, observer bias was minimized by ensuring that the person evaluating the corneal endothelial cells was blinded to the patient's diabetic status.

Data Collection: Data were collected on patients' demographic details, diabetic status, and history, along with preoperative and postoperative (at 1 week, 1 month, and 3 months) corneal endothelial cell counts. The data were recorded using a standardized data collection form.

Procedure: Prior to surgery, each participant had a thorough ophthalmic examination, which included a specular microscope examination, intraocular pressure measurement, and corneal endothelial cell count. To maintain consistency, the MSICS procedure was carried out by a single skilled surgeon. Following surgery, the patients were checked on at one, one week, and three months to evaluate changes in the number of corneal endothelial cells.

Statistical Analysis: SPSS version 23.0 was used to analyse the data. The individuals' clinical and demographic features were compiled using descriptive statistics. Preoperative and postoperative endothelial cell counts within the same group were compared using the paired t-test. The independent t-test was utilised to compare the variations between the groups with and without diabetes. When the p-value was less than 0.05, statistical significance was reached.

Results

A total of 97 participants were included in the study, with 48 diabetic patients and 49 non-diabetic patients. The mean age of the participants was 62.3 ± 8.7 years.

Table 1: Demographic and Clinical Characteristics of Participants

Characteristic	Diabetic Patients (n=48)	Non-Diabetic Patients (n=49)	p-value
Age (years, mean ± SD)	63.1 ± 8.4	61.5 ± 9.0	0.32
Gender (Male/Female)	26/22	28/21	0.71
Duration of Diabetes (years)	10.4 ± 3.2	N/A	N/A
Preoperative Visual Acuity	0.35 ± 0.10	0.36 ± 0.12	0.78
HbA1c (%)	7.5 ± 0.6	N/A	N/A

Corneal Endothelial Cell Density (ECD): The mean preoperative (ECD) in diabetic patients was 2450 ± 150 cells/mm², and in non-diabetic patients, it was 2600 ± 140 cells/mm². Postoperatively, the ECD decreased in both groups, with a more significant reduction observed in diabetic patients.

Table 2: Corneal Endothelial Cell Density Changes

Time Point	Diabetic Patients (n=48) (cells/mm²)	Non-Diabetic Patients (n=49) (cells/mm²)	p-value
Preoperative	2450 ± 150	2600 ± 140	<0.001
1 Week Postoperative	2320 ± 160	2500 ± 130	<0.001
1 Month Postoperative	2250 ± 170	2450 ± 120	<0.001
3 Months Postoperative	2200 ± 180	2400 ± 110	<0.001

Endothelial Cell Loss: The overall endothelial cell loss at 3 months was 10.2% in diabetic patients and 7.7% in non-diabetic patients, indicating a statistically significant difference between the two groups.

Table 3: Percentage of Endothelial Cell Loss at 3 Months

Group	Preoperative ECD (cells/mm²)	3-Month ECD (cells/mm²)	Percentage Loss (%)	p-value
Diabetic Patients (n=48)	2450 ± 150	2200 ± 180	10.2 ± 1.5	<0.001
Non-Diabetic Patients (n=49)	2600 ± 140	2400 ± 110	7.7 ± 1.2	<0.001

Viscual Acuity (VA) Improvement: Postoperative (VA) improved in both groups, with no statistically significant distinction between people with diabetes and those without having patients. The mean postoperative (VA) at 3 months was 0.80 ± 0.15 in diabetic patients and 0.82 ± 0.14 in non-diabetic patients (p = 0.58).

Table 4: Postoperative VA at 3 Months

Group	Preoperative VA	Postoperative VA	p-value
Diabetic Patients (n=48)	0.35 ± 0.10	0.80 ± 0.15	<0.001
Non-Diabetic Patients (n=49)	0.36 ± 0.12	0.82 ± 0.14	<0.001

Discussion

The study revealed a significant reduction in (ECD) in both diabetic and non-diabetic patients after surgery. However, the extent of cell loss was notably higher in diabetic patients. Preoperatively, diabetic patients had a lower mean ECD compared to non-diabetic patients, indicating a baseline difference potentially attributable to the effects of long-term diabetes on the corneal endothelium. Postoperative follow-up at 1 week, 1 month, and 3 months showed a progressive decline in ECD across both groups, with diabetic patients consistently exhibiting a greater reduction. By the 3-month mark, the percentage of endothelial cell loss was 10.2% in diabetic patients, significantly higher than the 7.7% observed in non-diabetic patients. This difference underscores the heightened vulnerability of the corneal endothelium in diabetic individuals, likely due to the chronic metabolic changes associated with diabetes, which may impair cellular function and recovery post-surgery.

Despite the greater endothelial cell loss, both diabetic and non-diabetic patients experienced significant improvement in (VA) post-surgery. The mean postoperative (VA) at 3 months was comparable between the two groups, suggesting that while endothelial cell preservation is a concern, the visual outcomes of MSICS are similarly favorable for both diabetic and non-diabetic patients.

Studies conducted in the recent past have repeatedly demonstrated that during (MSICS), patients with diabetes suffer from a markedly higher loss of corneal endothelial cells than people without diabetes. According to one study, three months after surgery, the mean endothelial cell loss in diabetic patients was 27.5%, significantly more than the 18.3% loss in non-diabetic controls. Furthermore, at every follow-up point, the diabetic group showed a significant increase in central corneal thickness (CCT) and coefficient of variance (CV), suggesting that the diabetic corneal endothelium experiences increased metabolic stress and has a decreased functional reserve following surgery [11].

In a different study, after MSICS, the central corneal thickness and alterations in corneal endothelial cells were evaluated in patients with Type 2 diabetes mellitus in comparison to age-matched controls. According to this study, diabetic individuals had a statistically significant decrease in endothelial cell density following surgery; their endothelial cell loss was 14.19%, while non-diabetic patients had an endothelial cell loss of 8.05%. Additionally, the diabetic group showed a greater rate of alterations in hexagonal cells and a considerable rise in CCT [12].

Conclusion

The study found that diabetic patients experienced a significantly higher loss of corneal endothelial cells following manual small incision cataract

surgery compared to non-diabetic patients. However, both groups showed significant improvement in (VA) postoperatively. These findings suggest that while MSICS is effective in improving visual outcomes in diabetic patients, special attention should be paid to the preservation of corneal endothelial cells in this population.

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