Original Article

Comparison Of Endothelial Cell Count Before And After Phacoemulsification In Grade 2 Nuclear Sclerosis Cataract Versus Grade 4 Nuclear Sclerosis Cataract In Tertiary Care Hospital In Pakistan

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Abstract

Objective: During Phacoemulsification, hardness of the lens opacity has definitive impact on corneal endothelial cells. In our study we provided comparative data for endothelial cell count by comparing Phacoemulsification procedure in grade 2 versus grade 4 cataract.

Methods: Our study included 90 patients after taking approval from the Ethical Review Committee from 1st May 2024 to 31st October 2024. Technique of Non-Probability Purposive sampling was used. Patients were selected for the data collection process in the Eye Outpatient Department at the Institute of Ophthalmology, Allied Hospital, Faisalabad. Slit lamp examination was performed on all patients to diagnose cataract. Specular microscopy was done to examine the endothelial cell count before and after phacoemulsification in grade 2 versus grade 4 nuclear sclerosis cataract. Patients were divided into two groups based on the grade of nuclear sclerosis cataract: Group A (patients with grade 2 nuclear sclerosis cataract) and Group B (patients with grade 4 nuclear sclerosis cataract).

Results: The mean age of patients was 61.311±3.97 years in Group A and 62.400±3.58 years in Group B. The mean ± SD of baseline endothelial cell count in Group A was 2248.022 ± 132.05 $mm^{2,}$ while in Group B it was 1977.488 ± 180.90 mm^2 (p-value <0.05). The mean ± SD of postoperative endothelial cell count after 6 weeks in Group A was 1935.622 ± 165.57 mm^2 (mean cell loss), and Group B was 1535.955 ± 177.37 mm^2 (mean cell loss; p-value <0.05). Endothelial cell loss% increased from 13.89% in grade 2 nuclear sclerosis cataract to 22.32% in grade 4 nuclear sclerosis cataract.

Conclusion: Endothelial cell loss was higher with high grade of nuclear sclerosis cataract ranging from 13.89% in grade 2 to 22.32% in grade 4 cataract.

Keywords: Endothelial cells. Phacoemulsification, Cataract. Pachymetry, Specular microscopy, Corneal oedema.

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Introduction

It is well known that the corneal endothelium is a monolayer of polygonal cells with little capacity for regeneration. In a healthy adult cornea, the mean endothelial cell count is between 2000 and 3000 cells/mm^2, and it gradually decreases at a rate of 0.3-0.6% annually.[1-3] The degree of stromal hydration is regulated by endothelial ionic pumps.[4,5] Reduced vision, irreversible loss of corneal transparency and corneal oedema occur when the endothelial cell count falls below 450–800 cells/mm.[2] Some worries compared to phacoemulsification, manual small-incision cataract surgery may be more damaging to the endothelium.[6] The only options to compensate for the loss of corneal endothelial cells are through their migration, growth, and increasing heterogeneity because they are incapable of reproducing.[1,6]

The loss of corneal endothelial cells during phacoemulsification is influenced by the degree of nucleus sclerosis. Irrigation flow, fluid turbulence and movement, air bubbles, direct trauma from instruments or lens fragments, and the time and power required to complete nuclear emulsification are other factors that might result in endothelial cell injury during phacoemulsification. Since almost 5 million cataract surgeries are carried out annually in Pakistan, it is critical to identify the endothelium's safest surgical method. The impact of phacoemulsification on the corneal endothelium (both morphologically and functionally) is not well documented in Pakistan. The goal of this study is to examine the short-term alterations in endothelial morphology with postoperative endothelial cell loss following phacoemulsification. Some studies have found that ensuring adequate surgical space throughout the procedure may lower the risk of corneal endothelial cell death as a result of the phacoemulsification process, even if the surgery is performed in a small, confined space. To preserve endothelial cells during phacoemulsification surgery, specific anatomical and surgical aspects, such as proper anterior chamber depth (ACD), must be

maintained.[6,7] Ultrasound power and Ultrasonic time are recognised to be significant risk factors for the death of endothelial cells following phacoemulsification.[8] In our study, we compared the loss of corneal endothelial cells based on nucleus hardness grades 2 and 4 before and after phacoemulsification.

Materials And Methods

This is a cross-sectional prospective study conducted after taking approval from the Institutional Ethical Committee of the Department at the Institute of Ophthalmology, Allied Hospital, Faisalabad. The research comprised a total of 90 cataract patients who visited the Eye OPD at the Institute of Ophthalmology, from 1st May 2024 to 31st October 2024. Technique of Non-Probability Purposive sampling was used. Before enrollment, a complete medical history along with a comprehensive ophthalmic examination by confirming the presence of cataract on slit lamp biomicroscope (graded from 1 to 4 nuclear sclerosis cataract) was performed on each patient.

Patients with age group between 40 -80 years, of either gender undergoing phacoemulsification for grade 2 or grade 4 nuclear sclerosis cataract and having a endothelial cell count between 1500- 3000 cells/mm^2 were included in the study.

Patients with grade 1 or 3 nuclear sclerosis cataract, with subluxated, dislocated, nuclear, hard, mature cataract, having a history of previous intraocular surgery, including refractive surgery or ocular trauma, with corneal pachymetry > 630 mm, having a preoperative endothelial cell count <1500 cells/mm^{2}or a preoperative diagnosis of glaucoma (intraocular pressure > 21 mmHg), patients with pseudo-exfoliation or corneal endothelial dystrophy, with pupillary dilatation <6mm and anterior chamber depth < 2.5mmor having a posterior capsule rupture with vitreous loss, were excluded from the study.

Following selection, patients were then divided into two groups:

- Group A (Patients with nucleus sclerosis grade 2)
- Group B (Patients with nucleus sclerosis grade 4)

Phacoemulsification cataract surgery was performed by a single consultant eye surgeon. Standard Phacoemulsification surgical protocol was followed for every patient. The next day, postsurgical patients were examined by an ophthalmologist. Endothelial cell count was assessed on the first postoperative day, one week later, and six weeks later. The percentage of postoperative endothelial cell loss (EC Loss% %) was calculated as follows:

EC Loss (%) = ([ECC-pre – ECC-post]/ ECC-pre) × 100

Sample size (n=90) was calculated with the help of the OpenEpi sample size calculator, taking a confidence level of 95% and a power of 80%. SPSS was used for analyses. For quantitative variables such as age, endothelial cell count at baseline and after 6 weeks, the mean ± SD was calculated. Frequency was computed for qualitative variables such as gender, lateral side, duration of cataract and presence of associated comorbidities. An independent sample T test was applied to compare endothelial cell count and the change in cell count before and after phacoemulsification among the two groups of nuclear sclerosis cataract patients, with p- p-value <0.05 being considered statistically significant. To prevent variables and design prejudices, the exclusion criteria were adhered to strictly. Using a specular microscope, patients were monitored for corneal endothelial cell loss after 6 weeks following phacoemulsification.

Results

The mean age of patients was 61.311±3.97 years in Group A and 62.400±3.58 years in Group B. See Table 1.

Table 1: Clinic demographics of cataract patients n=90

Demographics	Group A (Nuclear sclerosis cataract grade 2) n=45	Group B (Nuclear sclerosis cataract grade 4) n=45	p-value
Age (years)	61.311±3.97	62.400±3.58	0.176
Gender (male: female)	29: 16	25:20	0.389
Lateral side (right: left)	26: 19	20:25	0.206
Comorbids (Diabetes/ Hypertension/ Multiple comorbidities/ none)	23/ 11/ 5/ 6	25/ 17/ 0/ 3	0.061

The mean ±SD of baseline endothelial cell count in Group A was 2248.022 ±132.05 mm2, while in Group B it was 1977.488 ±180.90 mm2 (p-value <0.001). The mean ±SD of postoperative endothelial cell count after 6 weeks in Group A was 1935.622 ±165.57 mm2 (mean cell loss 312.4 mm2), and Group B was 1535.955 ±177.37 mm2 (mean cell loss 441.5 mm2; p-value <0.001). The difference in baseline endothelial cell count between the two grades of nuclear sclerosis cataract was 270.53 mm2, which increased to 399.66 mm2 after 6 weeks following phacoemulsification (p-value <0.001). Endothelial cell loss% increased from 13.89% in grade 2 nuclear sclerosis cataract to 22.32% in grade 4 nuclear sclerosis cataract, with an average cell loss of around 8%. See Table 2. Duration of cataract was statistically significant, with higher grade of nuclear sclerosis cataract being associated with more than 8 years of duration (p-value<0.001). The differences in the baseline mean endothelial cell counts in

both groups are due to age differences between the two groups; with advancing age, nucleus sclerosis increases, and endothelial cell count decreases. (references 1,2,3)

Table 2: Comparison of intraocular characteristics according to the Independent sample t-test

Intraocular characteristics	Mean±SD Group A (Nuclear sclerosis grade 2) n=45	Mean±SD Group B (Nuclear sclerosis grade 4) n=45	p-value
Baseline endothelial cell count (mm2)	2248.022± 132.05	1977.488± 180.90	<0.001
Endothelial cell count after 6 weeks (mm2)	1935.622± 165.57	1535.955± 177.37	<0.001
Change in endothelial cell count (mm2)	312.400± 56.64	444.555± 25.14	<0.001
Endothelial cell loss%	13.89% 22.32%	22.32%	<0.001

Table 3: Duration of cataract in patients

Duration of cataract	Group A (Nuclear sclerosis cataract grade 2) n=45	Group B (Nuclear sclerosis cataract grade 4) n=45	p-value
Less than or equal to 6 years	12	0	
Between 6-7 years	21	0	<0.001
Between 7-8 years	12	5	<0.001
Beyond 8 years	0	40	<0.001

Discussion

The difference in baseline endothelial cell count between the two grades of nuclear sclerosis cataract was 270.53 $mm^{2,}$ which increased to 399.66 mm^2 after 6 weeks following phacoemulsification. Endothelial cell loss% increased from 13.89% in grade 2 nuclear sclerosis cataract to 22.32% in grade 4 nuclear sclerosis cataract, with an average cell loss of 8.43%. Independent sample T test revealed that decreased endothelial cell count was associated with a higher grade of nuclear sclerosis cataract, with p value <0.05. Surgical damage can interfere with the endothelial corneal pump function, which controls corneal transparency.[9] Because postoperative corneal decompensation is a prominent consequence of cataract surgery, endothelial cell loss is a significant worry. Reducing endothelial cell injury requires a high level of surgical expertise and precision in the operating procedure. Cell loss can be accelerated by a variety of conditions, including nuclear density, mechanical contact with nuclear fragments, and equipment.[10,11,19] Additionally, surgical complications like capsular rupture, vitreous loss, comorbidities like diabetes mellitus and advanced age are linked to an increased incidence of endothelial cell loss.[12-15]

The findings of our study are coherent with a clinical trial carried out in India in which 500 patients with age-related cataracts were studied by Mehra et al.[8] While all other parameters remained unchanged, the number of endothelial cells before and after surgery was measured and compared in various nucleus grades. Endothelial cell loss was shown to be highly statistically significant after surgery (correlation coefficient "r"=0.981). With a median range of 373.04 cells/mm^2, the mean post-operative endothelial cell loss% was 14.5%. With increasing nucleus hardness grades, the percentage of endothelial cell loss rises from 13% in grade 2 to 16.7% in grade 4 cataract. Endothelial cell loss was higher during the first week and the early postoperative period. Similar results are shown in studies conducted by Singh R et al. and He L et al, which are consistent with the results of our investigation, emphasising the fact that increased endothelial cell loss% is associated with a higher grade of nuclear hardness.[16,17] Singh R et al found a substantial correlation between the grade of nuclear opacity and the proportion of endothelial cell loss, along with longer effective phacoemulsification time and shallow anterior chamber depth. Ibiary HE et al and Perone JM et al found a 11.5% decrease in endothelial cell loss two months following phacoemulsification.[17,18] In future larger studies with a variety of cataract types are needed to see the full scale of endothelial cell changes/loss. Our study is indeed very helpful in predicting the endothelial cell loss in phacoemulsification in harder cataracts

Conclusions

Our study concluded that there is an increased rate of endothelial cell loss postoperatively, with an increase in nucleus hardness from 13.89% in grade 2 to 22.32% in grade 4 cataract, with an average cell loss of 8.43%. This study was conducted to improve our practice and knowledge regarding the outcome of cataract surgery and patients' visual disability, as patients in our local population routinely undergo the Phacoemulsification procedure at grade 4 cataract. Overall, the relationship between endothelial cell count loss between different grades of cataracts in patients with comorbid such as diabetes and hypertension are complex and further research should be carried out to investigate this association for further management and optimization of patients care.

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