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Changes in intraocular pressure (IOP) after uncomplicated phacoemulsification in diabetic vs non-diabetic patients.

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ABSTRACT… Objective: To assess the frequency of type 2 diabetes mellitus (T2DM) in patients undergoing phacoemulsification and compare mean changes in IOP postoperatively between diabetic and non-diabetic individuals. **Study Design:** Descriptive Case Series. **Setting:** LRBT Eye Hospital, Lahore. **Period:** May to November 2024. **Methods:** The study enrolled 100 cataract patients aged 40 to 65 years. Participants were categorized as diabetic (HbA1c >7%) or non-diabetic. Preoperative and postoperative IOP measurements were obtained via Goldmann applanation tonometry. Phacoemulsification was performed under topical anesthesia, and postoperative care followed a standardized protocol. Data analysis utilized SPSS version 25.0, with t-tests and chi-square tests determining statistical significance. **Results:** Among 100 patients, 55% had T2DM. Preoperative mean IOP was 18.00 ± 0.82 mmHg in diabetic and 18.00 ± 0.83 mmHg in non-diabetic patients (p=0.900). Postoperatively, mean IOP was 15.91 ± 0.87 mmHg in diabetic and 15.93 ± 0.84 mmHg in non-diabetic patients (p=0.451). The mean IOP reduction was 2.09 ± 0.29 mmHg in diabetics and 2.07 ± 0.25 mmHg in non-diabetics (p=0.786), indicating no significant difference between groups. **Conclusion:** Phacoemulsification significantly reduces IOP in both diabetic and non-diabetic patients, with no statistically significant differences between the groups. Diabetes, in the absence of advanced retinopathy, does not impair surgical outcomes. Routine postoperative IOP monitoring is recommended.

Key words: Cataract Surgery, Diabetes Mellitus, Intraocular Pressure, Phacoemulsification, Postoperative Outcomes.

INTRODUCTION

A cataract is an opacification or alteration in the homogeneity of the lens inside the eye, impacting the anterior epithelium, capsule, cortex, or nucleus.[1] Cataracts are the most common cause of blindness worldwide, and in Pakistan, they account for 53% of blindness.[2-6] Cataracts are more common in individuals with diabetes than in those without the condition. The global incidence of diabetes is rising, and the likelihood of cataract formation escalates with prolonged diabetes, exacerbated hyperglycemia, and advancing age. A process in the development of diabetic cataract is the buildup of advanced glycation end products (AGE) inside the lens.[7-8]

Phacoemulsification, which was developed by Charles David Kelman in 1967, is one of the most frequently employed surgical procedures worldwide.[9-12] Contemporary phacoemulsification is esteemed for its little incisions, expedited visual recovery, and diminished postoperative inflammation, attributable to breakthroughs in surgical methodologies.[13] Although the majority of cataract patients experience a satisfactory recovery, cataract surgery that involves phacoemulsification and lens implantation results in an increased loss of endothelial cells in diabetic corneas, thereby increasing the risk of suboptimal visual outcomes post-surgery.[14-16]

In order to maintain the integrity of the eye, intraocular fluids exert pressure on the ocular membranes. Intraocular Pressure (IOP) is the

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term used to describe the pressure that is administered to the eye. Standard intraocular pressure ranges from 10 to 21 mmHg.[17] Intraocular pressure may rise even after uncomplicated phacoemulsification which might need intervention.[18] The pathophysiology of intraocular pressure rise is multifaceted, including inflammation, haemorrhage, pigment dispersion, and the retention of viscoelastic substances, lens, or iris debris. If untreated, uncontrolled postoperative intraocular pressure spikes may lead to discomfort, corneal oedema, glaucomatous optic nerve injury, and, in rare cases, anterior ischaemic optic neuropathy. The pattern of intraocular pressure (IOP) alteration after uncomplicated phacoemulsification exhibits a steady increase in the first postoperative hours, reaching its peak between 4 to 6 hours post-surgery, subsequently followed by normalisation of pressure one day after the procedure.[19]

Beato and colleagues (2019) conducted a research to examine intraocular pressure variations after uncomplicated phacoemulsification in individuals with and without type 2 diabetes mellitus (DM). Forty-four diabetic eyes and forty-four non-diabetic eyes were involved in the research. The study indicated that the mean preoperative intraocular pressure (IOP) was 17.8±3.1 mmHg in the diabetes mellitus (DM) group and 16.9±2.9 mmHg in the non-DM group, with a p-value of 0.188. A significant drop in postoperative intraocular pressure (IOP) was seen 6 months post-surgery ($p<0.001$), averaging 2.9±2.9 mmHg (15.5%) in the diabetes mellitus (DM) group and 2.4±2.8 mmHg (13.0%) in the non-DM group ($p=0.410$).[20]

To investigate the changes in intraocular pressure (IOP) after cataract surgery in individuals with type 2 diabetes mellitus (T2DM), Bayat and associates (2021) performed a study. During the investigation, 57 eyes of cataract patients were examined. The patients were classified into two categories. The T2DM cohort comprised cataractous type 2 diabetic patients devoid of diabetic retinopathy (52.6%) (n=30), whereas the non-T2DM cohort included nondiabetic individuals with cataract (n=27). The research indicated that the average age of patients in the diabetic cohort was 66.56±6.20 (ranging from 57 to 72) years, whereas the control group exhibited a mean age of 65±6.48 (ranging from 55 to 70) years. In the T2DM cohort, the alteration in intraocular pressure (IOP) demonstrated a significant negative correlation with preoperative IOP (mean preoperative 14.83±1.70, mean postoperative 13.43±1.50, $p<0.001$). The non-T2DM cohort demonstrated similar correlations. The change in intraocular pressure (IOP) was significantly correlated with preoperative IOP (mean preoperative 14.44±1.84, postoperative 12.81±1.32, $p=0.004$). The study determined that cataract surgery led to a reduction in intraocular pressure (IOP) in both diabetic and nondiabetic patients, with no significant differences between the groups.[21]

Phacoemulsification has been recognized as a possible technique for reducing intraocular pressure (IOP). To far, few studies have assessed the change in intraocular pressure after phacoemulsification in both diabetes and non-diabetic eyes. To our knowledge, no similar comparison has been conducted within the Pakistani community.[22] Consequently, it is essential to do a research to evaluate the changes in intraocular pressure after straightforward phacoemulsification in diabetes compared to non-diabetic individuals.

METHODS

This descriptive case series was conducted at LRBT (Layton Rahmatulla Benevolent Trust) Eye Hospital in Lahore over six months, from May to November 2024. The study aimed to assess the frequency of type 2 diabetes mellitus (T2DM) in patients undergoing phacoemulsification and compare mean changes in intraocular pressure (IOP) postoperatively between diabetic and non-diabetic individuals. Patients aged 40 to 65 years with cataracts, regardless of gender, were included. Exclusion criteria comprised patients unwilling to participate, those with a history of anti-VEGF therapy, mature cataracts (brown or white), proliferative diabetic retinopathy, maculopathy, or prior eye surgery or trauma. Ethical approval was obtained, and informed written consent was

secured from all participants. (No. 2/Admn/Ex-Cer/LRBT-2022)

Intraocular pressure was measured using Goldmann applanation tonometry at baseline and three months postoperatively. A median value was recorded when discrepancies exceeded 2 mmHg. Cataracts were classified based on lenticular opacification, and a Consultant Ophthalmologist confirmed the diagnosis using a slit lamp. Patients with an HbA1c value of more than 7% were classified as diabetic. A dilated fundus exam was performed preoperatively to rule out diabetic retinopathy, and only those with non-proliferative diabetic retinopathy were included.

Preoperative evaluations included a thorough ophthalmologic examination encompassing visual acuity testing, refraction, slit-lamp examination, indirect ophthalmoscopy, and intraocular pressure measurement. Phacoemulsification was performed under topical anesthesia by experienced surgeons using Provisc® (sodium hyaluronate 10%). Postoperative treatment comprised flurbiprofen, moxifloxacin, and dexamethasone drops, administered five times daily for a week and tapered over three weeks. Follow-up assessments at one and six months postoperatively included IOP measurement using the same protocol as the baseline examination.

Collected data were analyzed using SPSS version 25.0. Mean and standard deviation were computed for quantitative variables like age and IOP, while frequencies and percentages were calculated for qualitative variables like gender and T2DM presence. Independent sample t-tests compared mean IOP changes between groups. Stratification by gender and age was performed, followed by post-stratification chi-square and t-tests. A p-value of <0.05 was considered statistically significant.

RESULTS

The gender distribution of the participants is visually represented in a pie chart, indicating the relative proportions of males and females in the study. The table data reveals that Males constitute a higher proportion of the study population, comprising 57.0% of the total participants, whereas females account for 43.0%, reflecting a slightly lower representation compared to males. These percentages suggest that the study had an almost balanced representation of genders but leaned slightly more toward male participants. The gender distribution highlights the diversity in participant recruitment, which helps ensure representativeness in analyzing the study outcomes.

The age distribution of the participants is illustrated using a bar chart. Participants are divided into two age categories: 40–60 years and >60 years. The study reports a mean age of 59.70 ± 1.80 years, suggesting the population is primarily middle-aged to elderly. Specific findings are:

The 40–60 years age group has the largest representation, as evident from the taller bar in the chart. This group reflects the majority of participants in the study whereas the >60 years age group constitutes a smaller proportion of the study population but remains essential for understanding outcomes in older individuals. The bar chart uses light green for the 40–60 years group and salmon for the >60 years group, making the visualization distinct and easy to interpret.

The study assessed the frequency of type 2 diabetes mellitus (T2DM) among patients undergoing phacoemulsification, a widely used surgical procedure for cataract removal. Out of a total of 100 participants, 55 patients (55%) were diagnosed with T2DM, while the remaining 45 patients (45%) were non-diabetic. These findings indicate that more than half of the patients undergoing phacoemulsification had diabetes, reflecting the high prevalence of diabetes in this population. This distribution highlights the importance of understanding whether diabetes might influence surgical outcomes, particularly postoperative changes in intraocular pressure (IOP).

The research further contrasted preoperative, postoperative, and variations in intraocular pressure (IOP) between diabetic and non-

diabetic individuals undergoing straightforward phacoemulsification. Prior to surgery, the average preoperative intraocular pressure (IOP) was comparable in both cohorts, recorded at 18 ± 0.82 mmHg for diabetes patients and 18 ± 0.83 mmHg for non-diabetic patients. The comparison produced a p-value of 0.900, indicating no statistically significant difference in preoperative IOP levels between the two groups.

Postoperatively, the mean IOP decreased in both groups, with diabetic patients having a mean postoperative IOP of 15.91 ± 0.87 mmHg compared to 15.93 ± 0.84 mmHg in non-diabetic patients. The difference between the groups was minimal, with a p-value of 0.451, showing no statistically significant variation in postoperative IOP.

The study further analyzed the mean change in IOP, which represents the reduction in pressure from preoperative to postoperative measurements. Diabetic patients experienced a mean reduction of 2.09 ± 0.29 mmHg, while non-diabetic patients had a similar reduction of 2.07 ± 0.25 mmHg. The p-value for this comparison was 0.786, confirming no significant difference in the magnitude of IOP reduction between the two groups.

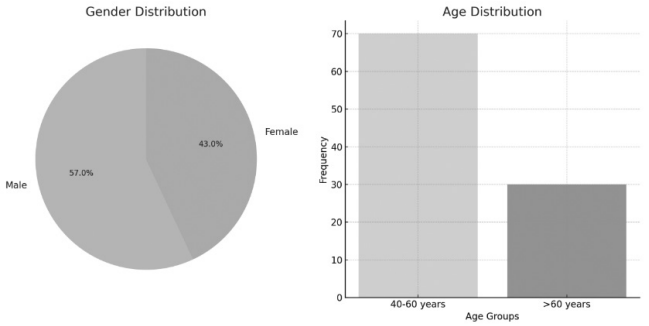

Figure-1. Frequency of T2DM in patients undergoing phacoemulcification (n=100)

Diabetes Mellitus	No. of Patients	%
Yes	55	55
No	45	45

Table-I: Frequency of patients with diabetes mellitus.

DISCUSSION

This study examined alterations in intraocular pressure (IOP) subsequent to uncomplicated phacoemulsification surgery in diabetic and non-diabetic individuals within the Pakistani demographic. The findings indicated no significant disparities in preoperative intraocular pressure (IOP), postoperative IOP, or mean IOP variations between the two cohorts. These results corroborate previous research, reinforcing the safety and effectiveness of phacoemulsification in diabetic and non-diabetic individuals alike.

Beato et al. (2019) reported no significant difference in preoperative IOP between diabetic (17.8 ± 3.1 mmHg) and non-diabetic patients (16.9 ± 2.9 mmHg; p = 0.188) and observed significant IOP reductions in both groups post-phacoemulsification (p < 0.001). Similarly, in our study, the preoperative IOP values for diabetic and non-diabetic patients showed no significant difference, and both groups experienced comparable IOP reductions postoperatively. This consistency underscores the generalizability of these findings to different populations, including ours. However, the mean IOP reductions in Beato et al.'s study (2.9 ± 2.9 mmHg in diabetics and 2.4 ± 2.8 mmHg in non-diabetics) were higher than those observed in our population, which could be attributed to differences in baseline characteristics, surgical techniques, or follow-up durations.[20]

Group		N	Mean	Std. Deviation	P-Value
Pre-Operative IOP	Diabetes Mellitus	55	18	0.82	0.900
	Non Diabetics	45	18	0.83	
Post-Operative IOP	Diabetes Mellitus	55	15.91	0.87	0.451
	Non Diabetics	45	15.93	0.84	
Change in IOP	Diabetes Mellitus	55	2.09	0.29	0.786
	Non Diabetics	45	2.07	0.25	

Table-II. Comparison of the mean changes in intraocular pressure after uncomplicated phacoemulsification in diabetic versus non-diabetic patients.

Bayat et al. (2021) found slightly higher preoperative IOP in diabetic patients (14.83 ± 1.70 mmHg) compared to non-diabetic patients (14.44 ± 1.84 mmHg), with significant postoperative reductions in both groups ($p < 0.001$ and $p = 0.004$, respectively) and no significant intergroup difference. This mirrors our findings of similar preoperative IOP levels between groups and comparable reductions post-surgery, reinforcing the conclusion that diabetes does not adversely impact phacoemulsification outcomes when retinopathy is absent.[21]

Our data also align with Vidhya et al. (2016), who reported higher preoperative IOP in diabetic patients (16.4 ± 1.32 mmHg) than in non-diabetic patients (12.9 ± 1.09 mmHg), followed by significant reductions in both groups. Although our study did not observe this preoperative disparity, likely due to population-specific differences, the significant IOP-lowering effect of phacoemulsification was consistent across both studies.[23]

Abdel-Ghany et al. (2024) demonstrated significant and comparable IOP reductions in diabetic and non-diabetic patients post-phacoemulsification, with diabetic patients showing higher endothelial cell loss. Our study corroborates these IOP findings, emphasizing that well-controlled diabetes does not impair surgical benefits. However, while we did not assess endothelial changes, their findings highlight the need for future research focusing on endothelial health in our population.[24]

Grzybowski et al. (2023) highlighted the potential risks of phacoemulsification in diabetic patients, including endothelial cell loss and IOP fluctuations, but emphasized that well-controlled diabetes does not compromise surgical outcomes. Our findings echo their conclusions, demonstrating that diabetic patients, in the absence of advanced retinopathy, achieve similar IOP reductions as non-diabetic patients, further supporting the safety of the procedure.[25]

In Pakistan, where diabetes mellitus is common and significantly contributes to cataract development, our results highlight the efficacy of phacoemulsification as a safe and efficient intraocular pressure-lowering therapy for diabetic patients without retinopathy. The analogous decreases in IOP across diabetic and non-diabetic individuals seen in our investigation confirm that diabetes alone does not impede surgical success. This underscores the need of early cataract surgery, particularly for diabetic individuals, to reduce the likelihood of sequelae such as glaucoma.

Although our study confirms the efficacy of phacoemulsification in lowering IOP, the potential for increased endothelial cell loss in diabetic patients noted by prior studies suggests a need for comprehensive preoperative and postoperative care. Regular monitoring of IOP and assessments of endothelial health are critical to minimizing complications and optimizing outcomes in diabetic patients undergoing cataract surgery.

While our sample size of 100 participants was adequate, its limited scope may restrict the generalizability of our findings. Additionally, the six-month follow-up period does not account for long-term IOP trends. The exclusion of patients with advanced diabetic retinopathy limits insights into this subgroup. Future studies should explore larger, more diverse populations with extended follow-up periods. Investigating correlations between HbA1c levels, early retinopathy, and IOP changes post-phacoemulsification could provide valuable insights. Further, analyzing endothelial cell health and its impact on surgical outcomes in diabetic patients would enhance our understanding of the procedure's risks and benefits.

CONCLUSION

This study concludes that uncomplicated phacoemulsification significantly reduces IOP in both diabetic and non-diabetic patients, with no significant differences between the groups. Diabetes, in the absence of advanced retinopathy, does not impede the benefits of IOP reduction. Phacoemulsification should be considered a viable option for managing IOP in cataract patients, regardless of diabetic status. Routine

postoperative IOP monitoring and focused attention on endothelial health in diabetic patients are recommended to prevent complications and ensure optimal outcomes.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Sardar Awais Tahir Khan:** Data collection, analysis, paper writing.
2	**Zaheer Uddin Aqil Qazi:** Data collection, paper writing.
3	**Muhammad Farhan Lodhi:** Discussion writing and review of manuscript.
4	**Ibtihaj Imran:** Data analysis, discussion writing.
5	**Talha Nafees:** Discussion writing, review of manuscript.
6	**Hafiz Rana Muhammad Mansoor:** Data analysis, manuscript writing.