Original Article

Pre-operative Risk Factors, Intraoperative Complications and Postoperative Visual Outcome in Diabetic Patients Undergoing Phacoemulsification

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ABSTRACT

Purpose: To evaluate the effect of diabetes on phacoemulsification surgery by analyzing risk factors, intraoperative complications and final visual outcome.

Study Design: Case control study.

Place and Duration of Study: Indore, India from November 2018 to January 2019.

Methods: This study analyzed 100 eyes of 100 patients who underwent phacoemulsification. Data included demographic details, history of diabetes, pupillary dilatation, anterior chamber depth, lens thickness, intraoperative complications and final visual outcome.

Results: The patients had similar age distribution with female predominance in diabetic group. Diabetics had a statistically significant ($p<0.05$) shallower anterior chamber depth (2.92 $\pm$ 0.52 mm) compared to non-diabetics (3.12 mm $\pm$ 0.44 mm). Lens thickness was greater in diabetics but was statistically not significant. Diabetic group had 6 (12%) eyes with poor pupillary dilatation (<6 mm). Intraoperative complications were more frequent in diabetics, which included escaping capsular hexisin 3 (6%) cases, floppy iris syndrome in one (2%) case. On the contrary, the non-diabetic group had no intraoperative complications. Out of total sample of 100, 86% patients with diabetes and 96% patients without diabetes had postoperative visual acuity between 6/6 and 6/9, ($p<0.05$).

Conclusion: Diabetes can affect pupillary dilatation, anterior chamber depth, and lens thickness in patients with senile cataract. Although diabetic patients have a higher risk of intraoperative complications, their visual outcomes are comparable to those of non-diabetic patients.

Keywords: Cataract, Diabetes mellitus, Anterior chamber depth, Lens thickness, Floppy iris Syndrome.

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INTRODUCTION

Diabetes mellitus, a metabolic disorder with raised blood glucose levels, has profound effect on various organ systems including eyes.[1]Among numerous complications associated with diabetes, its role in cataract development and its management is still debated.[2]Cataract can manifest earlier and progress more rapidly in individuals with diabetes.[3] This accelerated lens opacification is primarily driven by advanced glycation end products (AGEs), which accumulate rapidly in diabetic patients as compared to general aging process, thereby exacerbating the loss of lens transparency.[2] Evidence from large-scale studies suggest that patients with diabetes have a substantially higher risk, up to five times greater, of developing

cataracts compared to those without diabetes.[4]Another study highlights that within a decade of diagnosis, 8.3% of type 1 diabetics and 24.9% with type 2 diabetes will require cataract surgery.[5]

Cataract surgery remains a crucial intervention for improving visual function and quality of life. However, in diabetic patients, the surgical procedure can present challenges with a higher risk of intraoperative complications.[6]Diabetesinfluences several key parameters critical in cataract surgery, including anterior chamber depth, pupillary dilatation, and lens thickness.[7,8]The poorly dilating pupils in diabetic patients limit the access to the cataractous lens.[9] Further, diabetics often have shallow anterior chamber and increased lens thickness compared to non-diabetic individuals, which may propose surgical challenges and affect visual outcome.[7]

The visual outcomes following cataract surgery vary significantly between diabetic and non-diabetic patients.Cataract surgery has an excellent visual prognosis, but presence of diabetes makes it prone to intraoperative complications which can lead to less predictable improvement in vision after the surgery.[10]Therefore, this study aims to evaluate and analyze pre-operative risk factors, intraoperative complications and visual outcomes in diabetic and non-diabetic patients undergoing phacoemulsification.

METHODS

The study retrospectively evaluated 100 eyes of 100 patients who underwent phacoemulsification at a tertiary healthcare centre. The data was collected from the case records chronologically from November 2018 to January 2019. Hundred eyes (50 diabetic and 50 non-diabetic cataract patients) who fulfilled the inclusion criteria were enrolled in the study. After seeking approval from the **Institutional Ethical Committee(IEC No./SAIMS/RC/22),**the study was conducted according to the guidelines of Declaration of Helsinki.

The patients of senile cataract above the age of 50 years, of either gender, without diabetes mellitus or having diabetes mellitus with well-controlled blood glucose levels were included. Patients with fasting blood sugar >126 mg/dL or postprandial blood sugar >200 mg/dL or HBA1C >6.5% were categorized as diabetics.[11] The exclusion criteria were patients of < 50 years age and cases of congenital, traumatic cataract, and presenile cataract, individuals with diabetic retinopathy or ocular comorbidity and those who did not give consent.

Clinical data, including patient demographic details, presenting complaints, history of diabetes, anterior chamber depth, lens thickness, intraoperative complications, and pre- and post-operative best corrected visual acuity, were retrieved from the case records.

Preoperative evaluations included visual acuity, intraocular pressure measurement by applanation tonometer, and detailed anterior segment examination. Comprehensive slit-lamp examination for cataract grading was done using Lens Opacity Classification System III (LOCS III)[12]and to rule out other ocular comorbidities. Lens thickness (LT) and anterior chamber depth (ACD) were measured by ultrasound biomicroscopy (UBM). The fundus examination was done to rule out posterior segment pathology. In cases of dense cataract obscuring visualization of posterior segment, B-scan ultrasonography was performed. Just before the start of surgery, pupillary dilation was measured under operating microscope using Castroviejo calipers and diameter of less than 6 mm was classified as poor pupillary dilation.[9]

All the study patients and their relatives were explained about the surgical procedure and related complications. After the informed written consent, all surgeries were performed under peribulbar anesthesia by a single surgeon. Two side port incisions were made in the horizontal meridian of the cornea by MVR blade.The anterior capsule of the lens was stained with trypan blue dye. The anterior chamber was filled with ophthalmic viscosurgical device (OVD) using 1.4% sodium hyaluronate (ContacareOphthalmics and Diagnostics, Vadodara, Gujarat, India). A 26- gauge bent needle was used to complete the capsulorhexis. Phacoemulsification (direct chop technique) through a clear corneal incision was performed and a foldable hydrophilic acrylic intraocular lens (Intra Ocular Care Pvt Ltd., Vadodara, Gujarat, India) was implanted in the capsular bag.

All intraoperative complications were documented in the case sheets. The patients were examined postoperatively at weekly intervals and data at 1month post-surgery was collected. For uniformity in analysis, visual acuity measurements were converted to logMARunits. Data for comparison and analysis was entered into an excel sheet. The analysis was done by SPSS software. The data was further presented in the

frequency table. The data for statistical analysis was calculated to determine mean and standard deviation (SD) for quantitative variables. For comparative analysis and to calculate p-value, independent t test was used. P-value of < 0.05 was considered as significant.

RESULTS

Hundred eyes of 100 patients were analyzed in this study. The 2 groups (diabetic and non-diabetic) had similar age distribution. The participants in the diabetic group had a mean age of 59.2 ± 7.36 years, whileit was 60.02 ± 10.33 years in the non-diabetic group.

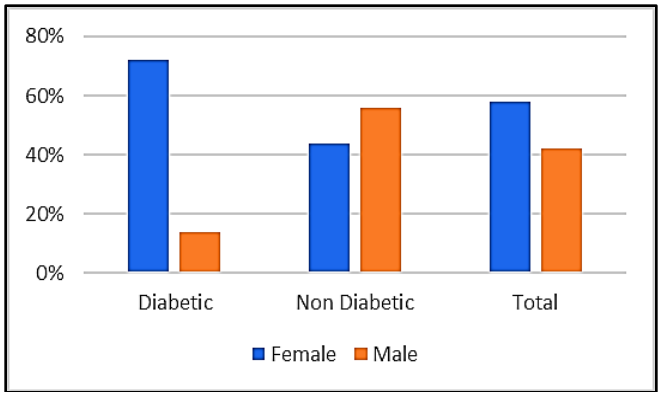

Figure 1: Showing gender distribution.

The diabetic group comprised of 72% females (36 out of 50), whereas the non-diabetic group consisted of 44% females (22 out of 50) as shown in Figure 1.

The non-diabetic group had a deeper AC with a mean of 3.12 mm ± 0.44 mm as compared to the diabetic group (2.92 ± 0.52 mm) as shown in Figure 2. The difference in ACD was statistically significant (p = 0.04). In contrast, the diabetic group showed a slightly more LT with a mean of 4.17± 0.73 mm as compared to the non-diabetic group (4.05 mm ±0.59 mm); however, this difference was not statistically significant (p = 0.353).

Four patients with diabetes encountered intraoperative complications, 3 cases developed Capsulorhexisrun out and one case had floppy iris syndrome (Table 1).

The mean preoperative best-corrected visual acuity (BCVA) was 0.96 ± 0.65 in diabetic patients and 1.09 ± 0.75 in non-diabetic patients. Postoperatively, the mean BCVA improved to 0.11 ± 0.11 in diabetic patients and 0.05 ± 0.08 in the non-diabetic patients. Forty three (86%) patients in diabetic group had visual improvement between 6/6 and 6/9 and seven (14%) patients had 6/12. In the non-diabetic group, 48 (96%) eyes showed Best corrected visual acuity (BCVA)of 6/6-6/9 and two (4%) eyes had 6/12. The preoperative and postoperative BCVA

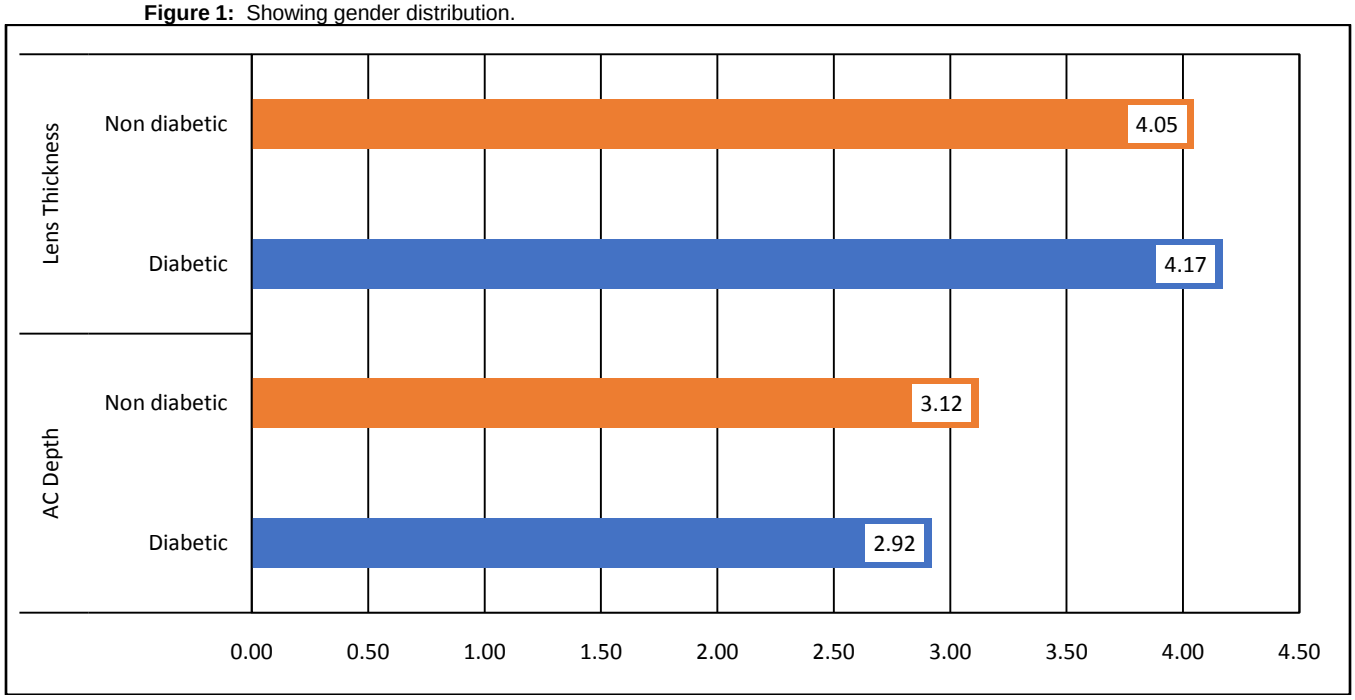

Figure 2: Comparing the depth of anterior chamber (AC) and thickness of lens in diabetic and non-diabetics.

Table 1: Comparing perioperative risk factors and intraoperative complications during phacoemulsification in diabetic and non-diabetic patients.

Parameter	Diabetic Patients *(n=50)*	Non-Diabetic Patients *(n=50)*
Mean anterior chamber depth	2.92 ± 0.52 mm	3.12 ± 0.44 mm
Mean lens thickness	4.17 ± 0.73 mm	4.05 ± 0.59 mm
Capsulorhexis run out	3 cases (6%)	Nil
Floppy iris syndrome	1 case (2%)	Nil

Table 2: *Comparison of Visual acuity between diabetic and non-diabetic groups.*

Visual Acuity (BCVA)	Diabetic Patients (Mean ±SD)	Non-diabetic Patients (Mean ±SD)	P-value
Preoperative	0.96 ± 0.65 LogMAR	1.09 ± 0.75 LogMAR	0.001
Postoperative	0.11 ±0.11 LogMAR	0.05 ± 0.08 LogMAR	0.001

were compared between the two groups which showed a significant improvement after phacoemulsification surgery (Table 2).

DISCUSSION

Diabetes mellitus (DM) is recognized as a serious health concern globally and the cases of DM are continuously rising at an alarming rate. World health organization reported 830 million cases of DM worldwide in 2022.[13]India has an estimate of 77 million cases of diabetics (2023) and an additional 25 million are prediabetics. It is expected that this reported number will rise to over 134 million diabetics by the year 2045.[13]

Diabetes impacts ocular health which can affect vision and quality of life. The major contributors being diabetic retinopathy and cataract.[10] Although cataract extraction improves vision, diabetic patients have an increased risk of developing complications which can affect the final visual outcome.[11]Literature has consistently highlighted a higher prevalence of cataract among diabetic patients.[14] The prevalence of cataract in general population ranges from 35-48%, however, in diabetics the prevalence is approximately 66%.[15]A cross-sectional study found high prevalence of cataract in diabetic population with nearly two out of three being affected.[14] Cataract develops approximately 20 years earlier in diabetics as compared to age related cataract.[16]

In DM, there is an increased level of sorbitol and advanced glycation end products (AGEs) in DM.[2] AGEs are normally produced as a part of aging, but their level is significantly higher in diabetic patients. They are responsible for high levels of free oxygen radical formation in the lens which has already compromised antioxidative enzymes due to DM. These alterations in the internal biochemical environment of the lens induce conformational changes in the lens fibers leading to loss of transparency and opacification of lens. Hence, the morphological and biochemical changes in the lens of a diabetic patient is the basis of diabetic cataract.[2]

Demographically, females have higher prevalence of cataract than males.[17] Similar demographic results are seen in cases of cataract in DM.[15] Zetterberg et al, reported an increased prevalence of cataracts in women with diabetes, suggesting antioxidative properties of estrogen which reduces after menopause.[17] The present study found a higher prevalence of cataract in females in diabetic group.

Diabetic patients may encounter more surgical challenges during cataract surgery. A well-planned surgery with a prior awareness of risk factors helps in minimizing intraoperative complications and achieving favorable postoperative results. Studies have shown that DM may lead to increased lens thickness and shallow anterior chamber depth.[7,8] Foster et al, suggested that diabetic patients have shallower anterior chambers than patients without diabetes, independent of age, gender, and socioeconomic factors.[18]A similar study by Kelkar et al, explained the mechanism underlying changes in ocular dimensions. They suggested that increased lens thickness results from the conversion of excess glucose into sorbitol by aldose reductase, leading to osmotic swelling of the lens.[3] It has been reported that these changes in ocular dimensions may restrict surgical maneuvers and increase the risk of intraoperative challenges, such as capsule tears and iris damage.[9]The lens thickness in the present study was higher in diabetics than non-diabetics although the difference was statistically not significant. Further, diabetics had statistically significant shallower ACD compared to non-diabetics.

Capsulorhexis in diabetic patients can be difficult and tricky. DM leads to calcification and thickening of lens capsules which makes it more susceptible for

rhexis related complications.[19]According to another study anterior capsule of the lens was found thicker in diabetic patients due to changes in the lens capsule caused by raised blood glucose.[20]Similarly, there was higher incidence of Capsulorhexis-related complications in diabetic patients.[3]Increased capsular fragility also makes it prone to tearing and running out during the procedure. In our study, the diabetic group experienced more rhexis related complications than non-diabetic patients. The Capsulorhexis extended in 3 cases of DM and was not round and regular. However, phacoemulsification was completed successfully in these patients.

Diabetic patients have poor pupillary dilatation which may pose a surgical challenge. Diabetics are weak responders to mydriatic agents.[9] Jain et al, linked diabetic neuropathy and microvascular complications to inadequate pupillary dilation in diabetics.[21]Whereas, Kızıltoprak found that early parasympathetic neuronal damage leads to poor dilatation of pupil.[22]Furthermore, diabetics may have predisposition for surgically induced miosis.[9]In the current study, 2% patients in diabetic group exhibited poorly dilating pupils (<6 mm).

Pupillary size has also been associated with intraoperative floppy iris syndrome (IFIS). According to literature, DM was associated with pupillary constriction and iris billowing leading to IFIS.[19]A strong association of IFIS with smaller pupil is also reported. In the present study, only one case had IFIS in the diabetic group that had poor pupillary dilatation, while the non-diabetic group had none. Chatziralli et al, noted no significant association between IFIS and diabetes, suggesting that other factors might contribute to this complication.[23]

The chances of posterior capsular rent (PCR) during phacoemulsification are increased in diabetic patients due to the surgical complexity like poor pupillary dilatation and dense cataract.[6] However, in the current study PCR and vitreous loss were not encountered in any case.

Posterior capsular opacification (PCO) is a commonly reported delayed postoperative complication seen after phacoemulsification. Primary PCO is defined as an opacity on the posterior lens capsule that is resistant to removal by vacuuming or polishing.[24] It may affect the postoperative visual outcome. In the present study, primary PCO was more in the diabetic group which can be a coincidental observation. A total of 9 cases had primary PCO out of which 7 cases were diabetics and 2 cases were non-diabetics.

Several studies indicate that non-diabetic patients typically experience superior visual outcomes compared to their diabetic counterparts after cataract surgery.[3,23]Zaczek et al, on the contrary, found that diabetics with no evidence of retinopathy have good visual prognosis like that in patients without diabetes.[25]

There are some limitations of the study. The sample size was small, and it can affect the generalizability of the findings. This is a single-center retrospective study that could lead to bias. Variations in diabetes management and a short duration postoperative follow-up are other limitations of the study. We recommend a multi-center large population-based study with a long duration of follow-up to authenticate our results.

CONCLUSION

Diabetes mellitus scan have an influence on pupillary dilatation, depth of anterior chamber and thickness of lens in cases of senile cataract that may enhance the risk of complications during phacoemulsification. However, the postoperative visual outcome in diabetics is comparable to that in patients without diabetes.

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Patient's Consent: Researchers followed the guidelines set forth in the Declaration of Helsinki.

Conflict of Interest: Authors declared no conflict of interest.

Ethical Approval: The study was approved by the Institutional review board/Ethical review board **(IEC No./SAIMS/RC/22).**

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