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Diabetes mellitus as a risk factor of corneal edema post cataract surgery

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Summary:
Patients with diabetes mellitus are reported to be up to five times more likely to develop cataract. Through phacoemulsification, most of the patients are able to achieve excellent visual outcome. A retrospective cohort was conducted at the Department of Ophthalmology, of 20 Aout 1953 Teaching Hospital, in Casablanca, Morocco to compare the incidence of post-operative corneal edema and the corneal thickness changes between diabetic and non-diabetic patients after phacoemulsification. Patients with corneal affections prior to surgery, with intraoperative or postoperative complications besides corneal edema were excluded. The follow up duration was 3 months. 376 eyes of 376 patients fulfilled the inclusion criteria and were enrolled in the study. The non-diabetic group had 293 eyes and the diabetics group had 83 eyes. Early post-operative corneal edema was more frequent in the diabetic group. The evolution was comparable between the two groups. At three months after surgery, the difference was still significant. The odds ratio (OR) for developing severe corneal edema in diabetics compared to non-diabetics was 3.54 (95% IC: 1.18–10.5, p = 0.023). The follow-up of diabetic patients should be customized and particular care should be given during the surgery to minimize the damage of the endothelial cells

Keywords*: endothelium, edema, phacoemulsification, diabetes mellitus.*

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I. Introduction:

The prevalence of diabetes mellitus has reached 13, 5 in general population. The disease is considered to be a major risk factor of cataract. Patients with diabetes mellitus are reported to be up to five times more likely to develop cataract. With all the recent advances in investigations and management of cataract through phacoemulsification, most of the patients are able to achieve excellent visual outcome.

Although the cornea may appear disease free in the diabetic, an awareness of the marked biochemical and ultrastructural abnormalities associated with diabetes mellitus enables us to prevent more overt complications

Purpose: To compare the incidence of post-operative corneal edema and the corneal thickness changes between diabetic and non-diabetic patients after phacoemulsification

Patients and methods:

A retrospective cohort was conducted at the Department of Ophthalmology, of 20 Aout 1953 Teaching Hospital, in Casablanca, Morocco. All patients included underwent cataract surgery by phacoemulsification

Patients with keratopthy or any corneal damage before to the surgery were ruled out. Any anterior situation undermining the surgery duration or intra-operative complications were considered exclusion criteria.

All diabetic patients included had controlled blood glucose for 3 months before the surgery. Preoperative assessment included a thorough slit-lamp and retinal examination. No premedication was required.

Uncomplicated phacoemulsification was performed in all cases using loco regional anesthesia, and the same technique for all patients. Dissipated Energy metric that was consumed during the phacoemulsification cataract operation was recorded as a parameter of interest.

The operated eye was examined on one day, one week, and one month and 3 months after the surgery. The postoperative pharmaceutical treatment included use of steroid drops every 4 hours for the first week and 6 times per day until the fifth week. Antibiotic drops were recommended for 6 times per day for the first3 weeks

Corneal edema was defined as an increase in central corneal thickness with or without descemet folds classified as: mild corneal edema (+), moderate corneal edema with descemet membrane folds of <10 (++), and severe corneal edema with descemet membrane folds of >10 (+++)
Clinical measurements included corneal thickness evaluation which was compared at each follow-up using the spectral domain optical coherence tomography between the diabetic and non-diabetic groups were studied.
Statistical analysis was performed using SPSS version 16.0 for Windows. P-values < 0.05 were considered statistically significant.

II. Results:

376 eyes of 376 patients fulfilled the inclusion criteria and were enrolled in the study. The non-diabetic group had 293 eyes and the diabetics group had 83 eyes. The two groups had similar percentages of female/male patients and were also age-matched (two-tailed P value=0.1949). Demographic data of all subjects and surgery parameters are summarized in table 1:

Table 1. Demographic data and surgery parameters of patients

	Diabetic group (n=83)	**Non diabetic group (n=293)**	**p-value**
Gender (male)	47.8 %	44.5 %	0.27
Age (SD) years	63.5 (5.4)	64.7 (6.6)	0.129
Surgery time (SD)min	19.2 (9.3)	17.7 (11.5)	0.276
Cumulative dissipated energy (SD) seconds	12.3 (6.1)	11.2 (5.9)	0.137

In the patients with diabetes, the preoperative mean central thickness was 535.76 µm (range 478–627 µm), and in the non-diabetic patients it was 532.19 µm (range 432–631 µm). Preoperatively, there was no significant difference between the two groups in terms of central thickess ($p > 0.05$)

Early post-operative corneal oedema was more frequent in the diabetic group as shown in table 2. The evolution was comparable between the two groups. At three months after surgery, the difference was still significant. Detailed results for both groups are summarized in Table 3.

Table2. Incidence of early and persistent corneal oedema in diabetic and non-diabetic patients

	Diabetic group % (n=83)	**Non diabetic group % (n=293)**	**P-value**
Early corneal edema	**43%** (n= 36)	27% (n= 79)	**0.0053**
Persistent corneal edema	**16%** (n= 13)	6% (n= 18)	**0.0034**

Table 3. Evolution of corneal edema in the diabetic and non-diabetic groups

	Diabetic group **(n=83)**			Non diabetic group**(n=293)**		
Corneal edema	+	++	+++	+	++	+++
Day 1	19.28%(n=16)	26.51%(n=22)	8.43%(n=7)	4.78%(n=14)	2.05%(n=9)	1.36%(n=4)
Week 1	16.88%(n=14)	7.23%(n=6)	4.82%(n=4)	3.07%(n=9)	1.36%(n=4)	0.34%(n=1)
Month 1	18.07%(n=15)	4.82%(n=4)	2.41%(n=2)	2.73%(n=8)	0.68%(n=2)	0.34%(n=1)
Month 3	13.25%(n=11)	3.61%(n=3)	2.41%(n=2)	1.36%(n=4)	0.34%(n=1)	0.4%(n=1)

In patients with diabetes, the mean change in central CT was 40.11 µm on the first postoperative day, 19.22 µm at 1 week and 8.21 µm at 1 month, postoperatively. In the non-diabetic control group, the mean change in central CT was 26.81 µm on the first postoperative day, 9.81 µm at 1 week and 1.22 µm at 1 month postoperatively (figure 1) . These changes in central CT were significantly different between the diabetic and non-diabetic patients at any time point during follow-up period ($p < 0.012$).

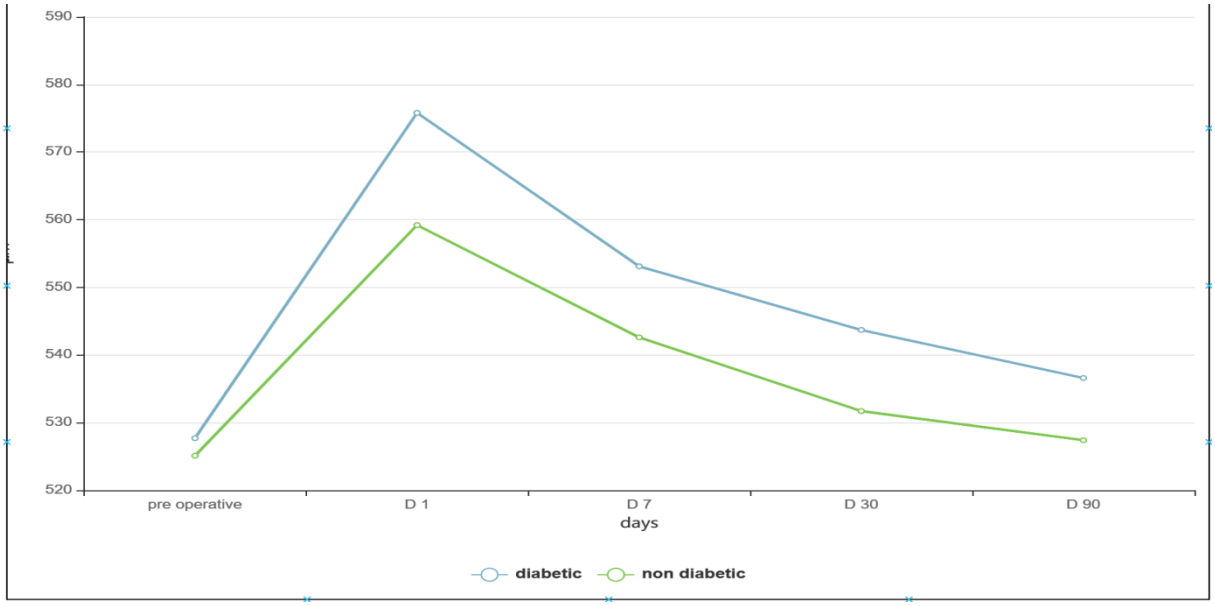

Figure 1. Evolution of corneal center thickness post operatively in diabetic and non-diabetic groups

The odds ratio (OR) for developing severe corneal edema in diabetics compared to non-diabetics was 3.54 (95% IC: 1.18–10.5, p = 0.023), meaning that patients with diabetes were 3.5 times more likely to develop severe corneal oedema after phacoemulsification compared to non-diabetics.

III. Discussion:

The prevalence of cataract is up to five times higher in patients with diabetes under the age of 65. In patients over 65, cataracts are twice as prevalent(1,2). The main risk factors are longer duration of diabetes and poor metabolic control(3).

During last decade, surgical techniques for cataract have undergone phenomenal revolution resulting in better visual outcome. Phacoemulsification involves ultrasonic fragmentation and aspiration of a cataractous lens through a self sealing small corneal or corneoscleral valve incision followed by intercapsular intra-ocular lens implantation(4).

Cataract extraction in diabetic patients as compared to non-diabetic patients is associated with higher risks of reported complications such as capsular contraction and opacification as well as post-surgical worsening of macular edema and diabetic retinopathy(5). Corneal complications in diabetic patients include delayed wound healing, risk of developing epithelial defects and corneal edema.

In our study diabetes was positively associated with both early and persistent corneal edema. The results of the study conducted by Tsaousis et al. confirmed that the behavior of corneal endothelium after cataract surgery is different in patients with diabetes mellitus inducing a higher risk of early post-operative corneal edema(6). In a study led in a Nepalese teaching hospital, the corneal edema after surgery was significantly higher in the diabetic group than in the non-diabetic group ($p < 0.000$)(7). Similarly, S Morikubo et al found that the corneal endothelial cell losses one day and one week after surgery were significantly higher in the diabetic group than in the non-diabetic group (after one day, P =.03; and after one week, P =.04), thereby delaying the post-operative recovery of corneal edema(8).

These results can be explained by the change of endothelial cell . The type of diabetes mellitus, severity, and duration of disease could differentially impact the corneal endothelium cells. Several studies have evaluated the morphology, number and function of corneal endothelium in diabetic patients. Endothelial cell morphology is reportedly changed in diabetics with increased pleomorphism and variability of cell area (9–11). Some data also show decreased in vivo endothelial cell counts in corneas of patients with diabetes mellitus.(9, 10)Concerning endothelial function: some studies found that it was decreased compared to non-diabetic corneas in terms of deswelling(12), but others failed to confirm this finding(13).. However, diabetes carries increased risk of endothelial complications following corneal surgery(14)

Other studies, couldn't conclude to the association between diabetes and post-surgery corneal edema. Sekelj et al conducted a prospective cohort study to assess corneal edema recovery and compare best corrected visual acuity after phacoemulsification in type 2 diabetic versus non-diabetic patients(15). Unlike our study, the prevalence and corneal edema was approximately the same in both studied groups on all check-up examinations. This was explained by the use of phaco-chop technique to have minimally invasive cataract operation. Al-Sharkawey et al. reached the conclusion that endothelial cell loss is 8% in all patients, regardless of diabetes

mellitus(16). Also, Budiman reported that there were no differences in endothelial cell density between diabetic and non-diabetic group (17).

The limitations of this study were lack of specular microscope or the assessment of endothelial cells density chart due to lack of resources. Another limitation was the exclusion of patients with intraoperative and postoperative complications other than corneal edema in both groups.

IV. Conclusion:

With the use of modern technology and with minimally invasive surgical techniques in cataract surgery, a better functional prognosis is to be expected. The follow-up of diabetic patients should be customized and particular care should be given during the surgery to minimize the damage of the endothelial cells. Preoperative and postoperative assessments should be adapted to the specific needs of diabetic patients.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

Contribution of the authors:

All the authors participated in the care of the patient and the writing of the manuscript. All authors have read and approved the final version of the manuscript.

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