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Comparative Evaluation of Corneal Endothelial Parameters in Diabetic and Non-Diabetic Individuals Using Specular Microscopy

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ABSTRACT

Background: Diabetes mellitus is a globally-expanding disease that alters the anatomy and physiology of all human tissues including the cornea. Corneal endothelium is believed to be negatively affected by the ongoing metabolic challenges in diabetic patients. Aims: To detect the differences in corneal endothelial morphology among diabetic and non-diabetic individuals. Methods: A cross sectional study operated on total 46 subjects, twenty-three subjects were well-controlled type II DM patients and the other were non-diabetics. All subjects undergone specular microscopy. Collected data (Endothelial cell density (ECD), Coefficient Value (CV), percentage of hexagonal cells and Central Corneal Thickness (CCT) was statistically analyzed and presented in suitable charts and tables. Results: The mean endothelial cell density (ECD) in diabetic group was 2687.65 ± 155.99 cell/mm2 and 2751.43 ± 152.65 cell/mm2 in non-diabetic group. The difference in ECD in both groups was rated to be non-statistically significant. The mean CV value was significantly higher in diabetic subjects (P value<0.001).Mean percentage of hexagonal cells was lower in diabetic group (P value=0.297) and the mean central corneal thickness was higher in diabetic subjects (P=0.932). The differences in mean percentage of hexagonal cells and the mean central corneal thickness between both groups were statistically non-significant. Conclusion: Despite good control of glycemic condition, corneal endothelium in diabetic patients shows a lower density and a higher variation in the size and shape of hexagonal cells when compared to corresponding non-diabetic subjects.

Keywords: Cornea, Endothelium, Diabetes, Specular Microscopy.

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INTRODUCTION

Cornea is responsible for transmitting and refracting light rays entering the eye. This function is allied to the continuous action of corneal endothelium that pumps fluid outside corneal stroma, thus maintaining it's deturgescence and clarity [1]. Diabetes mellitus is a world-wide chronic disorder of carbohydrate and lipid metabolism. Beside the countless negative impacts of diabetes on the eye, it is believed that diabetes could exert a metabolic burden over corneal endothelial cells [2]. In the current study, comparison of endothelial anatomy and function in diabetic and non-diabetic individuals was done in a trial to show the impact of diabetes on corneal endothelium.

MATERIALS AND METHODS

This is a cross-sectional study operated on 46 individuals 23 patients were diagnosed with type 2 diabetes mellitus. An equal number of non-diabetic subjects were included as controls. Absence of diabetes was confirmed by normal fasting blood glucose (<100 mg/dl) and low glycosylated hemoglobin (HbA1c) values (less than 5%). Involved diabetic patients had a disease duration ranging between 5 and 10 years and had their diagnosis of type 2 DM based on criteria of World Health Organization for diagnosis. All diabetic patients had their glycemic status in well controlled section (HbA1c<7%). Patients with history of intraocular surgeries, diagnosed with glaucoma, uveitis, pseudo exfoliation syndrome or endothelial dystrophies and patients with corneal opacities that hinders good imaging quality were excluded from the study. All patients undergone detailed ophthalmological examination fulfilling the items of best corrected visual acuity, papillary response and amount of dilation, detailed anterior segment and funds exam. All patients were imaged by specular microscope (CEM-530, Nidek co., Ltd, Gomgori, Japan) and ECD (Endothelial Cell Density), CV (Coefficient value), percentage of hexagonal cells and CCT (central corneal thickness) were recorded. All imaging results were automated. The minimum number of clearly defined 60 cells/frame was essential for imaging to be reliable. Informed consent was obtained from each individual in both groups for participation in the study. The study design was revised and approved by IRB (Institute Review Board) of Zagazig University. Data analysis was performed using the software SPSS (Statistical Package for the Social Sciences) version 20. Quantitative variables were described using their means and standard deviations. To compare means of two groups, Mann Whitney test (for non-normally distributed data) and independent sample t test (for normally distributed data) were used.

RESULTS

Analysis of demographic data revealed that most of diabetic group were female patients (16 female versus 7 males) while (12 females versus 11 males) in the non-diabetic group. The mean age was 58.56 ± 5 and 60.17 ± 3.13 years in diabetic and non-diabetic patients. Analysis of the HbA1c values between both groups revealed a higher percentage in diabetic patients, table (1).
Table (1) HbA1c values in both groups

Hemoglobin A1c(HbA1c)	Study groups		t	p
	Diabetic group	Non-diabetic group		
	N=23 (%)	N=23 (%)		
Mean ± SD Range	6.78 ± 0.12 6.5 – 7	4.96 ± 0.29 4.4 – 6	27.727	<0.001**

It was clearly-observed that there was a significant difference between the diabetics and other subjects regarding endothelial cell parameters. The endothelial cell density and percentage of hexagonal cells were less in diabetic patients than in the non-diabetic group (p>0.5%). Only coefficient values were statistically higher in diabetic patients (p<0.05), tables (2) and (3).

Table (2): Comparison between the studied groups regarding endothelial cell density

Endothelial cell density (ECD)	Diabetic group	Non-diabetic group	t/Z	p
	Mean ± SD	Mean ± SD		
Preoperative	2687.65 ± 155.99	2751.43 ± 152.65	-1.402	0.168

**p≤0.001is statistically highly significant Z Mann Whitney test t Independent sample t test

Table (3): endothelial parameters in both groups

Endothelial parameter	Diabetic group	Non-diabetic group	t	p
	Mean ± SD	Mean ± SD		
Coefficient value	33.17 ± 2.41	27.65 ± 1.94	8.561	<0.001**
Percentage of hexagonal cells (%)	66.3 ± 5.52	67.78 ± 3.81	-1.056	0.297
Central corneal thickness (µm)	534.65 ± 14.21	534.13 ± 25.4	0.086	0.932

**
p≤0.001is statistically highly significant t Independent sample t test

DISCUSSION

Metabolic changes accompanying DM is known to cause deterioration in the visual function of diabetic patients mainly by eliciting retinal changes that degrade the photoreceptor function. Meanwhile, it is believed that diabetes predispose patients to visual compromise by impairing the corneal endothelial normal architecture and physiology [2]. In this study, endothelial cell density was found to be higher in healthy subjects and the difference between both groups was not statistically significant (p value=0.168). In other studies, a non-statistically significant reduction in ECD of diabetic population was observed. This fact apply to the studies done by Storr-Paulsen et al,2013 and Beato et al, 2020 [3-4]. Other studies such as Modis et al 2010; El-Agamy and Alsubaie, 2017 had found a statistically significant reduction in ECD when comparing healthy subjects with age matched type I diabetics (the former) or type 2 diabetic patients (the latter) [5-6]. Concerning the variability in sizes of adjacent endothelial cells, a higher CV value was observed in diabetic population in comparison to control group. The difference between CV in both groups was statistically different. The relative increase in polymegathism in diabetic patients is allied to the continuous slow-rated cell loss and replacement. The high CV value in diabetics was also documented by Shenoy et al, 2009; El-Agamy and Alsubaie2017 [6-7]. However, the studies done by Sudhir et al, 2012 and Beato et al,2020 showed non-significant difference between diabetic and non-diabetic population regarding the difference in CV [4], [8]. There were no statistically significant differences among both groups on comparing the percentage of hexagonal cells and central corneal thickness. This result is similar to what (Beato et al, 2020) had found [4].

CONCLUSION

Although diabetic patients in this study had shown a good glycemic control, diabetic corneas possess some microscopic alterations that could make them more susceptible to injurious stimuli.

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