Changes in central corneal thickness and endothelial cells count in patients with type 2 diabetes

Hassanain H. Attar*

*FRCS.FICMS.MBChB,

College of Medicine, University of Al-Qadisiyah

ABSTRACT:

AIM: comparison between the central corneal thickness (CCT)and corneal endothelial structure in type II diabetics and non-diabetic control patients.

METHODS: this observational study was performed in Diwanyia teaching hospital in which 350 persons (190 type II diabetic patients and 160 control subjects) were included. Specular microscopy and pachymetry were used to measure endothelial cell density, hexagonality, size, coefficient of variation as well as corneal thickness. Independent tests were used to compare variables between diabetics and controls.

RESULTS: Endothelial cell density in the diabetic group (2459± 244 cells/mm2) was significantly lower than that in the control group (2720± 129 cells/mm2,). The central corneal thickness (CCT) was higher in diabetics (541 ±32.8 micrometer) in comparison to control group (524±44.2 micrometer).

CONCLUSION: Type II diabetes causes a significant alteration in the state of the cornea including reduction in endothelial cell density and increased central corneal thickness.

Keywords: type 2 diabetes, corneal endothelial cells, central corneal thickness, diabetes duration and control

Introduction:

Diabetes mellitus (DM) consider as a major health concern in the industrialized world and a rapidly progressive problem for developing countries, where urbanization is producing changes that increase the risk factors for the disease. By 2025, nearly 75% of all diabetic patients will be located in developing countries[1]. Patients with DM are prone to different micro and macrovascular complications e.g diabetic retinopathy as well as they often develop corneal abnormality (Diabetic keratopathy) which is a frequent disease that entails several alterations, especially in the comeal epithelium and endothelium, like punctate epithelial keratopathy, recurrent comeal erosions and persistent epithelial defects. Diabetic keratopathy result in alterations in all layers of cornea especially the endothelium like decrease in endothelial cell density and hexagonality, as well as increased polymegathism, pleomorphism and central comeal thickness . Reduced corneal endothelial cell density and swelling of the cornea are indicators of comeal dysfunction[3,4]. Alterations on the endothelium can cause a deficient pumping function, and possibly endothelial thickening and folds. From the clinical perspective, diabetic keratopathy is interesting due to its associated nuisances, since they may become more severe in

contact lens holders, and translates into a decreased comeal transparency and fluctuation of vision[5]. It was found that diabetic eye disease associated with longer disease duration and difficulty in controlling glucose levels[6].

The purpose of this study was to investigate the effect of type II diabetes mellitus on comeal endothelial density, morphology and central comeal thickness by comparing those patients with normal people at Diwanyia teaching hospital. Informed consent conforming to the tenets of the Declaration of Helsinki (1975), as revised in Edinburgh 2000, was obtained from all participants.

Statistical analysis:

For the analysis of data, we depend on SPSS 16. unpaired t-tests was used for the comparisons of age and mean central corneal thickness(CCT), endothelial cells density (ECD) between diabetic patients and cont. Table 1 demographics of study participants

Results:

The study was conducted in at ophthalmology unit in Diwanyia teaching hospital where 350 persons were randomly selected to participate in this study. they were divided into two groups, first group consist of 190 patients with diabetes and the second group,160 persons as control. The mean age of the participants was 58_+11.5 years. There was no statistically significant difference between the age of the two groups. The duration of diabetes in our participants was 15+_6.7 years.One hundred persons with diabetes for less than 10 years while ninety subjects had diabetes over ten years. Endothelial cell density was less (about 2495+_244)in patients with diabetes in comparsion to healthy control where the cell density was higher (about2720_+125).Between diabetec patients with duration of less than ten years and those with duration of more than ten years ,the difference in CCT was statistically not significant (about 13micrometer),however ,the mean ECD of diabetics with duration more than ten years was less by 182 cell/mm^2 when compared those with disease duration of less than 10 years.

Table 1 demographic of study participants

	Control	Diabetics
Patients (no)	160	190
Age	52±12	53±11
Gender (male/female)	82/78	118/72

Table 2 age distribution of study participants

Age group (years)	Diabetics No of patient	%	Control No of subject	%
30-40	32	16.85%	27	16.8%
40-50	40	21%	36	22.5%
50-60	52	27.4%	41	25.6%
60-70	40	21%	34	21.3%
>70	26	13.7%	22	13.8%

Table 3 A comparison of age-matched mean± standard deviation (SD) values between diabetic patients and age matched healthy control subjects

	Control group Mean± SD	Diabetic patients Mean ±SD	P value
CCT (micrometer)	524±44.2	541±32.8	0.01
ECD	2720±129	2495±244	0.0001

CCT central corneal thickness. ECD endothelial cell density

Discussion:

There are several anatomical and physiological factors responsible for the corneal transparency. One of the major participants in this feature is the corneal endothelium. The evaluation of the thickness and density of this layer is valuable in wide range of disorders e.g. dry eye disorders, contact lens related problems, glaucoma and diabetes.AS well as, the status of cornea affects the outcome of different ocular surgeries such as cataract surgery, corneal transplant, refractive surgery and vitrectomy.

The presence of polymegathism, pleomorphism and reduction in endothelial cell density in type 2 diabetic patients manifest that DM affect corneal endothelium.

It is proposed that the accumulation of sorbitol into the cells result in endothelial cells swelling. The Krebs cycle slow down with consequent reduction in ATP production which is necessary for endothelial pump. This eventually results in morphological and permeability changes in the cornea. Ocular changes in patients with DM are well reported in different studies . According to our results, CCT and ECD measurements obtained in type 2 diabetic subjects were different from control subject. In the present study, endothelial cell density was significantly lower and central corneal thickness higher in patients with type2 DM than in normal subjects. This is in accordance to the CCTs reported in the previous study on type 2 DM patients without retinopathy but inconsistent with reports by Inoue et al where noncontact devices were utilized in assessment of central corneal thickness[12.13]The changes in endothelial cell density found in our patients agree with those of other studies including the report on children with diabetes mellitus showing significantly reduced endothelial cell density[14].

Didenko et al reported that corneal abnormalities occur in 73.6% of adult patients with DM. These reports together with the age-matched control data in our study imply that changes in these parameters are not a result of aging but are largely due to diabetes. It was observed that duration of diabetes had significant impact on endothelial cells density which was absent on correction for the effects of age. we found in this study that endothelial cell density was less in those with duration of diabetes more than ten years in comparison to patients with less than ten years duration of diabetes. This supports Lee et al. report that ECD was lower and CCT was higher with longer duration of diabetes.

Conclusion:

This study reveal that an increase in central corneal thickness and decrease in endothelial cell density is present in early stages of diabetes.

Diabetic patients had a higher statistically significant average central corneal thickness and less ECD than non-diabetics. These changes increase with the longer duration of the disease. Further, it is recommended to study the correlation of

blood sugar level and HbA1c along with the above mentioned parameters.

References:

1. Chawla R. Complications of Diabetes. New Delhi, India: Jaypee Brothers Medical Publishers 2012.
2. Herse PR. A review of manifestations of diabetes mellitus in the anterior eye and cornea. *Am J Optom Physiol Optics*. 1988;65:224–230.
3. Thomas N, Jeyaraman K, Asha HS, Velevan J. *A Practical Guide to Diabetes Mellitus*. New Delhi, India: Jaypee Brothers Medical Publishers; 2012.
4. Sudhir R, Raman R, Sharma T. Changes in the corneal endothelial cell density and morphology in patients with type 2 diabetes mellitus: a population-based study, Sankara Nethralaya Diabetic Retinopathy and Molecular Genetics Study (SN-DREAMS, Report 23). *Cornea*. 2012;31(10):1119–1122.
5. Guthrie DW, Guthrie R. *Management of Diabetes Mellitus: A Guide to the Pattern Approach*. 6th ed. New York, NY: Springer Publishing Company; 2008.
6. World Health Organization. Definition, Diagnosis and Classification of Diabetes Mellitus and Its Complications. Report of a WHO Consultation. Geneva, Switzerland: World Health Organization; 1999.
7. Inoue K, Kato S, Inoue Y, Amano S, Oshika T. The corneal endothelium and thickness in type II diabetes mellitus. Jpn J Ophthalmol. 2002;46(1):65–69.
8. Lee JS, Oum BS, Choi HY, Lee JE, Cho BM. Differences in corneal thickness and corneal endothelium related to duration in diabetes. Eye. 2006;20(3):315–318
9. Chen Y, Huang S, Jonna G, Channa P. Corneal endothelial cell changes in diabetes mellitus. Invest Ophthalmol Vis Sci. 2014;55(5):2054.
10. Browning DJ. Diabetic Retinopathy: Evidence-Based Management. New York, NY: Springer; 2010.
11. Tripathy BB, Chandalia HB, Das AK, Rao PV. Textbook of Diabetes Mellitus. New Delhi, India: Jaypee Brothers Medical Publishers; 2012
12. Altay Y, Burcu A, Ornek F. The change in central corneal thickness after successful control of hyperglycemia in diabetic patients. Int Eye Sci
13. Choo M, Prakash K, Samsudin A, Soong T, Ramli N, Kadir A. Corneal changes in type II diabetes mellitus in Malaysia. Int J Ophthalmol. 2010;3(3):234–236
14. Siribunkum J, Kosrirukvongs P, Singalavanija A. Corneal abnormalities in diabetes. J Med Assoc Thai. 2001;84(8):1075–1083.
15. Shenoy R, Khandekar R, Bialasiewicz A, Al Muniri A. Corneal endothelium in patients with diabetes mellitus: a historical cohort study. Eur J Ophthalmol. 2009;19(3):369–375
16. Storr-Paulsen A, Singh A, Jespersen H, Norregaard J, Thulesen J. Corneal endothelial morphology and central thickness in patients with type II diabetes mellitus. Acta Ophthalmol. 2013;92(2):158–160.