How to Cite:
Dirawi, A. M. F. (2023). Correlation between type 2 diabetes mellitus and corneal dysfunction. *International Journal of Health Sciences*, *6*(S9), 4532–4537. Retrieved from https://sciencescholar.us/journal/index.php/ijhs/article/view/13821

Correlation between type 2 diabetes mellitus and corneal dysfunction

Aymen Majeed Fadil Dirawi
Department of Ophthalmology, Basrah Teaching Hospital, Basrah Health Directorate, Ministry of Health, Basrah, Iraq
Email: aymenashoor@gmail.com

***Abstract*---**Globally, diabetes has emerged as an important health concern because of various adverse events on the ocular tissue and other parts of human body. The present study was conducted to determine the correlation between type 2 DM and corneal thickness in Basrah province. One year at the Department of Ophthalmology, fifty individuals with type 2 DM on medical treatment and 25 healthy control non-diabetics subjects were enrolled. The central corneal thickness was measured using an anterior segment tomography. Male were 53% and female were 47%. Though male with DM were 56% and 48% were non-diabetic. While female DM were 44% and 52% were non-diabetic. There was no significant difference. About 24% aged below forty, whereas 76% were aged above forty, without significant. The DM patients have high mean CCT (549±23 μ) than non-diabetic subjects (501±18 μ), with a high statistical difference (P= 0.049). The central corneal thickness was found to be higher in patients with type 2 DM when compared to non-diabetics. Individuals with type 2 DM have thicker corneas as compared to non-diabetics. Taking into consideration while interpreting intraocular pressure and before any refractive surgeries in diabetic patients the thickness of corneas.

***Keywords*---**corneal dysfunction, diabetes mellitus type 2, anterior segment tomography, Pentocam.

Introduction

DM is a syndrome with inappropriate hyperglycemia and is chronically associated with micro-vascular and macro-vascular complications and poor prognosis. Patients develop diabetic retinopathy, corneal endothelial damage, kerato-epitheliopathy, superficial punctate keratitis, recurrent corneal erosion, and persistent epithelial defects [1, 2]. Commonly, the retinopathy, cataract and glaucoma are indicator of corneal dysfunction. The corneal changes associated with DM is called as diabetic keratopathy [3]. The manifestation including

decreased corneal sensitivity, epithelial disorders, superficial punctate keratitis, epithelial erosions, and thickened basement membrane [4, 5].

Physiologically speaking, increased serum levels of Hemoglobin A_{1c} lead to elevate the predisposition to impaired corneal epithelial barrier function. Glucose can act as a collagen cross-linking agent that resulted of advanced glycosylation end products. These products then accumulate in collagen proteins result in the formation of covalent cross-linking bonds and may lead to raised corneal thickening and lead to biochemical changes [6, 7]. They increase covalent bond in corneal stroma caused raised corneal thickness [8]. Authors suggested two theories, the first is that intracellular accumulation of sorbitol act as an osmotic agent cause corneal hydration, and the second is the reduction of Na+K+ ATPase activity inhibit the corneal endothelial pump and can also cause increased corneal thickness. The corneal endothelium in DM is considered as tissue under continuous metabolic stress and it has elevated coefficient of variation of endothelial cell area, declined percentage of hexagonality and raised corneal autofluorescence [9, 10].

This thickness is a sensitive indicator of the health of the cornea function and serves as an index for corneal hydration and metabolism. In addition, it is an important indicator of corneal patency endothelium pump. Thickness measured by optical pachymetry (OP), ultrasound pachymetry (UP), confocal microscopy (CM), biomicroscopy, optical ray path analysis (ORA, scanning slit corneal topography, optical coherence tomography (OCT) and anterior segment tomography [11, 12]. The present study was conducted to determine the correlationbetween type 2 DM and corneal dysfunction.

Methods

Study design and setting
A case-control study conducted for one-year at the Department of Ophthalmology on 50 diabetic cases and 25 non-diabetic control.

Ethical approval
Ethical approval was taken from the institutional ethical committee and written informed consent was taken from all the participants.

Inclusion criteria
1. Fifty patients with type 2 DM
2. Twenty-five age- matched controls who are non-diabetics

Exclusion criteria
1. Corneal dystrophies
2. Contact lens users
3. Ocular surface disorders
4. Previous ocular surgeries
5. Ocular medications
6. Loss of follow-up patients
7. Unwilling cases

Routine ophthalmic examination was done in all patients. The central corneal thickness was measured using an anterior segment tomography (OCULUS Pentacam®, Germany) [13]. Average of five consecutive readings with a SD less than 0.005 mm was taken as the final reading.

Statistical analysis

The recorded data was analyzed by Microsoft Excel 2007 and SPSS version 20 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics consist of numbers, and percentages were measured. Mean and SD for categorical data calculated. An association between variables assessed by chi-square test. T-test unparied was used to described the association between groups. A two-sided *P* value of less than 0.05 was considered statistically significant.

Results

Table 1 listed the gender distribution of sample. Male were 53% and female were 47%. Though male with DM were 56% and 48% were non-diabetic. While female DM were 44% and 52% were non-diabetic. There was no significant difference. Table 2 showed age distribution of sample. About 24% aged below forty, whereas 76% were aged above forty, without significant. The DM patients have high CCT (549±23 μ) than non-diabetic subjects (501±18 μ), with a high statistical difference (P= 0.049), as shown in Table 3.

Table 1: Gender distribution

Gender	Cases	Control	Total
	No. (%)		
Male	28 (56)	12 (48)	40 (53)
Female	22 (44)	13 (52)	35 (47)

(Chi-square 0.43; p-value 0.513)

Table 2: Age distribution

Age	Cases	Control	Total
	No. (%)		
<40	13 (26)	5 (20)	18 (24)
≥40	37 (74)	20 (80)	57 (76)

(Chi-square 0.33; p-value 0.566)

Table 3: Mean central corneal thickness (CCT) in cases and control

Subjects	No.	Mean CCT (μ)
Diabetics	50	549±23
Non-Diabetics	25	501±18

(T-test unpaired 8.12; p-value 0.049)

Discussion

Lifestyle changes have led to anelevate in the incidence of DM worldwide. Diabetic keratopathy implie a spectrum of changes happening in the cornea of DM. The corneal thickness of DM is thicker than that of normal persons because of morphological changes of the diabetic cornea [14,15]. Experimentally speaking, mammals experiments reported a decrease in the corneal endothelium density, a decline in hexagonality, and an raise in the coefficient of variation for cells size in the case of DM [16]. Lee and colleagues [17] showed that DM with ≥ chronic duration have more corneal morphological abnormalities compared with the normal subjects and the corneal thickness was significantly correlated with diabetic duration. Ates and his authors [18] concluded that diabetics frequently had abnormal corneal endothelium in contrast to normal persons, but there were no significant differences in terms of the function of the fluorescence permeability of the corneal thickness and endothelium.

In this study, patients with Type 2 DM have a greater average CCT than non-diabetics. Ozdamar Y, et al. showed that mean CCT in diabetics (564 ± 30μ) was higher compared with the control group (538±35μ) with significant difference (P=0.001) [2]. Claramonte and investigators conducted a study to proven the correlation between corneal dysfunction and DM, they found that CCT in diabetic patients was (570.48±21.72μ) and in non-diabetics was (543.49 ± 34.21μ) [14]. Bikbova et al., [19] and Pont et al., [20] reported that there was a positive correlation between HbA1c levels in type 2 diabetes. They observed a positive correlation between HbA1c level and CCT in Type 1 DM but reported thicker corneas in DM but found no direct correlation with HbA1c level in type 2 DM, which supported by Yasgan S et al., [21].

Conclusion

Patients with type 2 DM have thicker corneas as compared to non-diabetics. Taking into consideration while interpreting intraocular pressure and before any refractive surgeries in DM. I suggest to measuring CCT in DM in preoperative workup of refractive surgery, for donor tissue evaluation before keratoplasty, glaucoma suspects, and long term contact lens users. Further studies required to evaluated correlation between elevate CCT and diabetes, and duration of diabetes.

Conflict of interesting
None

Funding support
None

References

1. Su DH, Wong TY, Wong WL, Saw SM, Tan DT, Shen SY, et al. Diabetes, hyperglycemia, and central corneal thickness- the Singapore Malay Eye Study. Ophthalmology.2008;115(6)964-968.
2. Ozdamar Y, Cankaya B, Ozalp S, Acaroglu G, Karakaya J, Ozkan SS. Is there a correlation between diabetes mellitus and central corneal thickness? J

Glaucoma. 2010;19(9):613-6.
3. Gekka M, Miyata K, Nagai Y, Nemoto S, Sameshima T, Tanabe T, et al. Corneal epithelial barrier function in diabetic patients. Cornea. 2004 Jan;23(1)35-7.
4. Naumann GOH, Holbach L, Kruse FE. Apliedpathology for ophthalmic microsurgeons. Springer-verlag Berlin Heidelberg NewYork. 2008;Germany 351.
5. Sahin A, Bayer A, Ozge G, Mumcuoğlu T. Corneal biomechanical changes in diabetes mellitus and their influence on intraocular pressure measurements. Invest Ophthalmol Vis Sci. 2009;50(10)4597-604.
6. Priyadarsini S, Whelchel A, Nicholas S, Sharif R, Riaz K, Karamichos D. Diabetic keratopathy: Insights and challenges. Surv Ophthalmol. 2020 Sep-Oct;65(5):513-529.
7. Gekka M, Miyata K, Nagai Y, Nemoto S, Sameshima T, Tanabe T, et al. Corneal epithelial barrier function in diabetic patients. Cornea. 2004;23(1)35-7.
8. Mortazavi SA, Akhlaghi M, Dehghani A, Pourazizi M, Malekahmadi M, Fazel M, Tavakoli M, Noorshargh P. Diabetic retinopathy and corneal endothelial parameters: an analytical cross-sectional study. BMC Ophthalmol. 2022;22(1):427.
9. Jha A, Verma A, Alagorie AR. Association of severity of diabetic retinopathy with corneal endothelial and thickness changes in patients with diabetes mellitus. Eye (Lond). 2022;36(6):1202-1208.
10. Mayali H, Altinisik M, Diri I, Ilker S, Kurt E, Kayikcioglu O. Comparison of Central Corneal Thickness Measurements by Contact and Non-contact Pachymetry Devices. J Curr Glaucoma Pract. 2021;15(1):28-31.
11. Ho WC, Lam PT, Chiu TY, Yim MC, Lau FT. Comparison of central corneal thickness measurement by scanning slit topography, infrared, and ultrasound pachymetry in normal and post-LASIK eyes. Int Ophthalmol. 2020;40(11):2913-2921.
12. Williams R, Airey M, Baxter H, Forrester J, Kennedy-Martin T, Girach A. Epidemiology of diabetic retinopathy and macular oedema- a systematic review. Eye (Lond). 2004;18(10)963-83.
13. Beato JN, Esteves-Leandro J, Reis D, Matos R, Falcão M, Rosas V, Carneiro Â, Falcão-Reis F. Agreement between IOLMaster® 500 and Pentacam® HR for keratometry assessment in type 2 diabetic and non-diabetic patients. Int J Ophthalmol. 2020;13(6):920-926.
14. Claramonte PJ, Ruiz-Moreno JM, Sánchez-Pérez SI, León M, Griñó C, Cerviño VD, et al. Variation of central corneal thickness in diabetic patients as detected by ultrasonic pachymetry. Arch Soc Esp Oftalmol. 2006;81(9)523-6.
15. O'Donnell C, Efron N. Corneal endothelial cell morphometry and corneal thickness in diabetic contact lens wearers. Optom Vis Sci. 2004;81(11)858-62.
16. El-Agamy A, Alsubaie S. Corneal endothelium and central corneal thickness changes in type 2 diabetes mellitus. Clin Ophthalmol. 2017;11:481-486.
17. Lee JS, Oum BS, Choi HY, Lee JE, Cho BM. Differences in corneal thickness and corneal endothelium related to duration in diabetes. Eye(Lond). 2006;20(3)315-8.
18. Ates KM, Estes AJ, Liu Y. Potential underlying genetic associations between keratoconus and diabetes mellitus. Adv Ophthalmol Pract Res. 2021 Nov;1:100005.

19. Bikbova G, Oshitari T, Tawada A, Yamamoto S. Corneal changes in diabetes mellitus. Curr Diabetes Rev. 2012;8(4):294-302.
20. Pont C, Ascaso FJ, Grzybowski A, Huerva V. Corneal endothelial cell density during diabetes mellitus and ocular diabetes complications treatment. J Fr Ophtalmol. 2020;43(8):794-798.
21. Yazgan S, Celik U, Kaldırım H, Ayar O, Elbay A, Aykut V, et al. Evaluation of the relationship between corneal biomechanic and HbA1C levels in type 2 diabetes patients. Clin Ophthalmol.2014;8;1549-53.