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Assessment of Corneal Endothelial Morphology and Central Corneal Thickness in Patients with Type 2 Diabetes Mellitus

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Abstract

Background: To assess corneal endothelial morphology and central corneal thickness in patients with type 2 diabetes mellitus (T2DM). **Methods:** Ninety- four type II diabetes mellitus patients (Group I) and normal subjects without diabetes were selected as control (group II). Visual acuity, slit-lamp examination, intraocular pressure measurement, corneal endothelial structure and central corneal thickness (CCT) were recorded by noncontact specular microscopy. **Results:** Visual acuity was 0.56 dm in group I and 0.64 dm in group II, IOP was 18.2 mm Hg in group I and 15.8 mm Hg in group II, FBG was 124.8 mg/dl in group I and 90.2 mg/dl in group II and PPBG was 184.2 mg/dl in group I and 132.0 mg/dl in group II. CCT was 516.2 µm in group I and 512.6 µm in group II, CV was 32.4% in group I and 31.1% in group II, ECD was 2784.2 cells/mm2 in group I and 2790.4 cells/mm2 in group II and HEX was 56.2% in group Iand 56.9% in group II. **Conclusion:** Diabetes mellitus patients had higher intra- ocular pressure and corneal cell thickness as compared to healthy control.

Keywords:- Cornea, Diabetes, Intra- ocular pressure, Visual acuity.

INTRODUCTION

Diabetes mellitus (DM) is described as metabolic disorder of multiple aetiology characterised by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both.[1,2] The effects of diabetes mellitus include long term damage, dysfunction and failure of various organs.[3]

Corneal endothelial cells are critical to maintain the hydration and clarity of the cornea. These cells are known to decrease with age at a rate of 0.5% per year.[4] As patients with T2DM are usually more than 40 years of age, there may also be an additional effect of age-related corneal dysfunction. Corneal endothelial cell changes in diabetic patients have been explained by the assessment of polyol pathway in the diabetic cornea.[5] Earlier researches have documented that high glucose levels led to increased activity of the aldose reductase, causing sorbitol build up in the corneal epithelial and endothelial cells.[6] This sorbitol acts as an osmotic agent and leads to the swelling of endothelial cells. Diabetes mellitus (DM) diminishes Na+–K+ ATPase activity of the corneal endothelium. This results in the morphological and permeability changes in a diabetic cornea. Endothelial pump function was proven to be affected by decreased ATP production as a result of slowing down of the Krebs cycle in a diabetic cornea.[7]

The endothelial cell morphologic features are related to severity of Diabetes. The Diabetic corneas were thicker and more auto-

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fluorescent than the non–diabetic corneas. Diabetes mellitus affects the corneal hydration.[8] The endothelial morphology is influenced by many factors. The variants of endothelial morphology i.e., endothelial cell density (ECD), Co-efficient of variation (CV) and percentage of hexagonal cells are affected by age, race, and refractive errors.[9] Considering this, the present study aimed at assessing corneal endothelial morphology and central corneal thickness in patients with type 2 diabetes mellitus (T2DM).

MATERIALS & METHODS

Ninety- four type II diabetes mellitus patients of both genders were enrolled for the study who visited for ophthalmology examination (Group I). Normal subjects without diabetes were selected as control (group II). Written consent was obtained from each patient after explaining the purpose of the study to them. Institutional clearance from ethical committee was obtained beforehand.

Data pertaining to them was recorded. A comprehensive ocular examination such as visual acuity, slit-lamp examination, intraocular pressure measurement using Goldman applanation tonometer, dilated fundus examination with a direct ophthalmoscope and 90D lens was performed. Grading of retinopathy was performed based on early treatment diabetic retinopathy study (ETDRS) classification. Corneal endothelial structure and central corneal thickness (CCT) were recorded by noncontact specular microscopy using Topcon Specular Microscope (SP-1P model). The endothelial morphologic such as endothelial cell density (ECD), coefficient of variance (CV), percentage of hexagonal cells (HEX) were studied. Results of the present study after recording all relevant data were subjected for statistical inferences using chi-square test. The level of significance was significant if p value is below 0.05 and highly significant if it is less than 0.01.

RESULTS

Group I comprised of 54 males and 40 females and group II had 42 males and 52 females [Table 1].

Visual acuity was 0.56 dm in group I and 0.64 dm in group II, IOP was 18.2 mm Hg in group I and 15.8 mm Hg in group II, FBG was 124.8 mg/dl in group I and 90.2 mg/dl in group II and PPBG was 184.2 mg/dl in group I and 132.0 mg/dl in group II. A significant difference was observed (P< 0.05) [Table 2].

CCT was 516.2 µm in group I and 512.6 µm in group II, CV was 32.4% in group I and 31.1% in group II, ECD was 2784.2cells/mm2 in group I and 2790.4 cells/mm2 in group II and HEX was 56.2% in group Iand 56.9% in group II. A non-significant difference was observed (P> 0.05) [Table 3, Figure 1].

Table 1: Distribution of patients

Parameters	Group I	Group II
Status	Diabetes	Healthy
M:F	54:40	42:52

Table 2: Comparison of baseline characteristics

Characteristics	Group I	Group II	P value
Visual acuity (dm)	0.56	0.64	<0.05
IOP (mm Hg)	18.2	15.8	<0.05
FBG (mg/dl)	124.8	90.2	<0.05
PPBG (mg/dl)	184.2	132.0	<0.05

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Table 3: Corneal endothelial measures in both genders

Characteristics	Group I	Group II	P value
CCT (µm)	516.2	512.6	>0.05
CV (%)	32.4	31.1	>0.05
ECD (cells/mm²)	2784.2	2790.4	>0.05
HEX (%)	56.2	56.9	>0.05

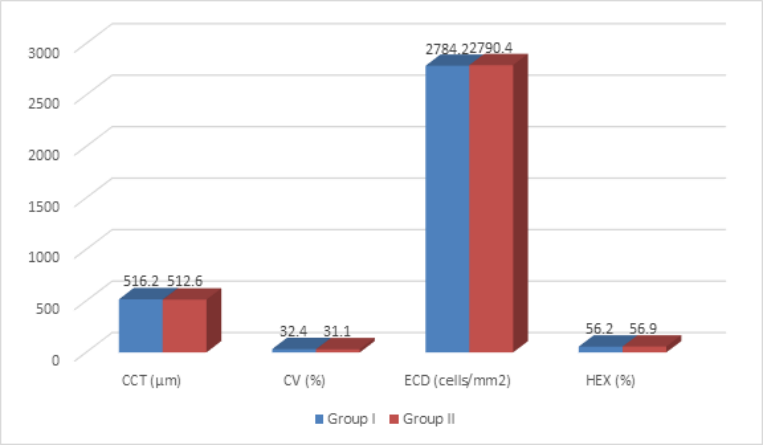

Figure 1: Corneal endothelial measures in both genders

DISCUSSION

Type-2 diabetes mellitus (T2DM) is a major public health problem worldwide and is fast gaining the status of a potential epidemic in India. Various studies have reported structural, functional, and biochemical alteration in endothelial cells due to diabetes mellitis (DM).[10] These changes are known to cause endothelial dysfunction which is well known in type-1 diabetes mellitus (T1DM), whereas studies on corneal dysfunction in T2DM have reported variable results.[11] Corneal endothelial cells are critical to maintain the hydration and clarity of the cornea. These cells are known to decrease with age at a rate of 0.5% per year.[12] As patients with T2DM are usually more than 40 years of age, there may also be an additional effect of age-related corneal dysfunction. Therefore, in interpreting the corneal endothelial dysfunctions in T2DM, age must be taken into consideration.[13] The present study aimed at assessing corneal endothelial morphology and central corneal thickness in patients with type 2 diabetes mellitus (T2DM).

We found that group I comprised of 54 males and 40 females and group II had 42 males and 52 females. Visual acuity was 0.56 dc in group I and 0.64 dm in group II, IOP was 18.2 mm Hg in group I and 15.8 mm Hg in group II, FBG was 124.8 mg/dl in group I and 90.2 mg/dl in group II and PPBG was 184.2 mg/dl in group I and 132.0 mg/dl in group II.Chowdhury et al,[14] had 262 patients in which 131 were T2DM as cases and 131 without diabetes as controls. Patients with T2DM showed poorer visual acuity and higher intraocular pressure. As compared to controls, patients with T2DM had thicker CCT, lesser ECD, decreased HEX, and higher CV but the differences were statistically nonsignificant. HbA1c levels showed a significant positive correlation with CCT and CV and a negative correlation with ECD. Macroalbuminuria and higher albumin creatinine ratio was associated with an increase in CV in patients with T2DM.

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It was observed that CCT was 516.2 µm in group I and 512.6 µm in group II, CV was 32.4% in group I and 31.1% in group II, ECD was 2784.2cells/mm2 in group I and 2790.4 cells/mm2 in group II and HEX was 56.2% in group I and 56.9% in group II.Nagaraj et al,[15] compared the endothelial cell density (ECD), central corneal thickness (CCT) and morphology in diabetic and non-diabetic patients. A total of 200 study subjects, 100 diabetics and 100 non-diabetic age matched controls were selected, and complete timed ophthalmic evaluation was performed. Specular microscopy was performed on all patients for endothelial cell count assessment and corneal thickness was measured by Pachymeter. The mean endothelial cell density in diabetic group was significantly lower (2438.73±250.23cells/mm2) compared to non-diabetic group (2599.88±168.16cells/mm2). The hexagonality percentage was significantly lower in diabetic group compared to the controls suggesting less pleomorphism in the diabetic group.

Lee JS et al,[16] studied the correlation of the endothelial morphology and the corneal thickness to the duration of the diabetic found that the endothelial morphological change in the diabetics and central corneal thickness increased in the diabetic compared to the non– diabetic population and correlated to the duration of diabetic.

Kadri et al,[17]conducted a study on 192 diabetics and 192 age- and sex-matched healthy controls. Corneal endothelial cell characteristics, CCT were measured using a specular microscope. The mean corneal endothelial cell density (CECD) in the diabetic group (2521.3 ± 300.7 cells/mm^2) was significantly lower compared to the nondiabetic group (2629.3 ± 221 cells/mm^2) ($P < 0.001$). The mean CCT in diabetic group was significantly higher (532.00 ± 24.88 µm) compared to control group (499.47 ± 24.76 µm) ($P < 0.001$). The co-efficient of variation though higher and hexagonality though lower in diabetics was not statistically significant. CCT showed a significant positive correlation with duration of DM ($r = 0.566$, $P<0.001$). A weak positive correlation was observed between CCT and HBA1C ($r = 0.271$, $P<0.001$) No correlation between CECD and CCT for diabetics with a duration of >10 years when compared with those with a duration of <10 years was observed.

CONCLUSION

Diabetes mellitus patients had higher intra-ocular pressure and corneal cell thickness as compared to healthy control.

REFERENCES

1. Hugod M, Storr-Paulsen A, Norregaard JC, Nicolini J, Larsen AB, Thulesen J. Corneal endothelial cell changes associated with cataract surgery in patients with type 2 diabetes mellitus. Cornea. 2011;30(7):749-53. doi: 10.1097/ICO.0b013e31820142d9.
2. Shimazaki J, Tsubota K, Yoshida A, Tornheim K, Laing RA. Changes of corneal redox state in diabetic animal models. Cornea. 1995;14(2):196-201. PMID: 7743804.
3. Anbar M, Ammar H, Mahmoud RA. Corneal Endothelial Morphology in Children with Type 1 Diabetes. J Diabetes Res. 2016;2016:7319047. doi: 10.1155/2016/7319047.
4. Roszkowska AM, Tringali CG, Colosi P, Squeri CA, Ferreri G. Corneal endothelium evaluation in type I and type II diabetes mellitus. Ophthalmologica. 1999;213(4):258-61. doi: 10.1159/000027431.
5. 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. doi: 10.1038/sj.eye.6701868.

6. Larsson LI, Bourne WM, Pach JM, Brubaker RF. Structure and function of the corneal endothelium in diabetes mellitus type I and type II. Arch Ophthalmol. 1996;114(1):9-14. doi: 10.1001/archopht.1996.01100130007001.
7. Módis L Jr, Szalai E, Kertész K, Kemény-Beke A, Kettesy B, Berta A. Evaluation of the corneal endothelium in patients with diabetes mellitus type I and II. HistolHistopathol. 2010;25(12):1531-7. doi: 10.14670/HH-25.1531.
8. Schultz RO, Matsuda M, Yee RW, Edelhauser HF, Schultz KJ. Corneal endothelial changes in type I and type II diabetes mellitus. Am J Ophthalmol. 1984;98(4):401-10. doi: 10.1016/0002-9394(84)90120-x.
9. Keoleian GM, Pach JM, Hodge DO, Trocme SD, Bourne WM. Structural and functional studies of the corneal endothelium in diabetes mellitus. Am J Ophthalmol. 1992;113(1):64-70. doi: 10.1016/s0002-9394(14)75755-1.
10. Dhananjayan R, Koundinya KS, Malati T, Kutala VK. Endothelial Dysfunction in Type 2 Diabetes Mellitus. Indian J ClinBiochem. 2016;31(4):372-379. doi:10.1007/s12291-015-0516-y
11. 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):65-9. doi: 10.1016/s0021-5155(01)00458-0.
12. Mc Namara NA, Brand RJ, Polse KA, Bourne WM. Corneal function during normal and high serum glucose levels in diabetes. Invest Ophthalmol Vis Sci. 1998;39(1):3-17. PMID: 9430539.
13. Weston BC, Bourne WM, Polse KA, Hodge DO. Corneal hydration control in diabetes mellitus. Invest Ophthalmol Vis Sci. 1995;36(3):586-95. PMID: 7890490.
14. Chowdhury B, Bhadra S, Mittal P, Shyam K. Corneal endothelial morphology and central corneal thickness in type 2 diabetes mellitus patients. Indian J Ophthalmol. 2021;69(7):1718-1724. doi: 10.4103/ijo.IJO_3120_20.
15. Nagaraj G, Desai AS, Jayaram N. Corneal thickness and endothelial cell density in diabetic and non- diabetic patients: a hospital based comparative study. Int J Adv Med. 2018;5(3):649-699.doi.10.18203/2349-3933.ijam20182125
16. 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. doi: 10.1038/sj.eye.6701868.
17. Kadri R, Sasalatti N, Hegde S, Kudva AA, Parameshwar D, Shetty A. Corneal endothelial cell characteristics and central corneal thickness in patients with type 2 diabetes mellitus. Kerala J Ophthalmol 2021;33:56-60.doi: 10.4103/kjo.kjo_91_20

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