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COMPARATIVE STUDY OF CORNEAL ENDOTHELIAL CELL DENSITY, MORPHOLOGICAL FEATURES AND CENTRAL CORNEAL THICKNESS AMONG DIABETIC AND NON-DIABETIC PATIENTS

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ABSTRACT

Introduction: Diabetes can cause a decrease in endothelial cell density and hexagonality, as well as increased polymegathism, pleomorphism and subsequently decrease in corneal endothelial function, corneal hydration and the increase in central corneal thickness.

The cell density of endothelium is around 3500 cells /mm2 in young adults. Corneas with cell count < 1000 cells /mm2 poorly tolerate intraocular surgery.

Coefficient Of Variation: The normal endothelium has a co-efficient of variance of 0.25. An increase in this value means that the cell size is variable and is known as polymegathism.

Aims And Objectives

1.To compare corneal endothelial cell changes namely, endothelial cell density, morphological features and central corneal thickness between diabetics and nondiabetic subjects

2.To compare corneal endothelial cell changes namely, endothelial cell density, morphological features and central corneal thickness among diabetics in relation to their HbA1c levels and their grades of retinopathy.

Materials And Methods: Analytical study in Ophthalmology OPD of Lokmanya Tilak Municipal Medical College, Mumbai Specular microscopy findings of diabetics and nondiabetics were compared.

Results And Conclusion: ECD of both eyes were reduced in cases as compared to the controls, CV and CCT were increased in both eyes of cases as compared to that of the controls, these values were correlated to their HbA1c levels and grade of diabetic retinopathy except CCT which was increased in NPDR group. Hence regular specular microscopy evaluation prior to any ocular surgeries and use of dispersive viscoelastics in ocular surgeries are essential pre requisites in patients with diabetes mellitus.

KEYWORDS : Diabetes, Endothelial Cell Density(ECD), Co-efficient of Variation(CV), Central Corneal Thickness(CCT)

INTRODUCTION

Just under half a billion people are living with diabetes worldwide and the number is projected to increase by 25% in 2030 and 51% in 2045[1]. Diabetes mellitus can affect any part of the eye, including the cornea. Diabetes can affect any structure of the cornea mostly epithelium and endothelium causing endothelial defects, punctate epithelial keratopathy, recurrent corneal erosions and persistent epithelial defects. Corneal endothelial cell damage can cause disturbances in the management of proliferative DR (Diabetic retinopathy) before and after surgeries because of endothelial decompensation showing bullous keratopathy. Patients with diabetic keratopathy have impairments of the epithelial basement membrane, epithelial wound healing, epithelial–stromal interactions, endothelial function, and corneal nerve function [2].

Abnormalities also include a decrease in endothelial cell density and hexagonality, as well as increased polymegathism, pleomorphism and subsequently decrease in corneal endothelial function, corneal hydration and the increase in central corneal thickness. Hyperglycemia reduces the activity of the Na+ –K+ adenosine triphosphatase (ATPase) of the corneal endothelial cells. This leads to morphological changes of the cells which leads to corneal decompensation. EM-3000 specular microscope is a non-contact specular microscope that avoids some disadvantages of the classic contact specular microscopes such as corneal ulceration and transmission of the infectious diseases [3].

Study conducted by Nurdan Gamze, Erel Icel,Yucel Karakut and others showed that the hexagonal cell ratio and Endothelial Cell Count were significantly lesser, while the average cell size, central corneal thickness and CV% were determined to be significantly higher in diabetic patients than in healthy controls. When correlation study was performed between the corneal morphological characteristics and laboratory data of diabetic patients, Endothelial Cell Density showed a noteworthy negative correlation with diabetes duration. Urinary albumin-creatinine ratio, HbA1c levels, average cell size and Coefficient of Variation showed a positive correlation [4].

Considering the huge diabetic population in India and paucity of literature, study was proposed to evaluate corneal endothelial changes among diabetics and non-diabetics using specular microscope.

AIMS AND OBJECTIVES OF THE STUDY

1. To compare corneal endothelial cell changes namely, endothelial cell density, morphological features and central corneal thickness between diabetic and nondiabetic subjects.
2. To compare corneal endothelial cell changes namely, endothelial cell density, morphological features and central corneal thickness among diabetics in relation to their HbA1c levels and their grades of retinopathy.

MATERIALS AND METHODOLOGY

Study Design

Analytical study

Duration of Study

18 months

Inclusion Criteria

Subjects diagnosed as having diabetes mellitus in Ophthalmology OPD during examination.

Exclusion Criteria

1. Patients of diabetes mellitus with duration of less than 5 years
2. Previous ocular surgery or trauma
3. Active or previous eye infection or inflammation
4. Glaucoma
5. Previous retinal photocoagulation
6. Contact lens wear
7. Corneal diseases or dystrophies
8. Regular usage of eye drops
9. Known tear interfering systemic drugs such as Hormone replacement and antihistamines, systemic illness such as rheumatoid arthritis and SLE that are known to impair tear function
10. Pregnancy, labour

Written informed consent was taken from the subjects.

Detailed history and clinical examination was noted in a designed case record form.

Specular microscopy findings of diabetics and nondiabetics were compared.

For data collection- Endothelial cell count, central corneal thickness and morphological features were studied using EM-3000 specular microscopy.

Proposed and expected outcome of the study was : Scope of early intervention and prevention of severe form of corneal diseases.

Data Analysis And Interpretation:

Data was entered into Microsoft Excel (Windows 7; Version 2007) and analyses were done using the Statistical Package for Social Sciences (SPSS) for Windows software (version 22.0; SPSS Inc, Chicago). Descriptive statistics such as mean and standard deviation (SD) for continuous variables, frequencies and percentages calculated for categorical variables were determined. Association between variables was analyzed by using Chi-Square test for categorical variables. Comparison of mean of quantitative variables were analyzed using unpaired t test. Bar charts and Pie charts were used for visual representation of the analyzed data. Level of significance was set at 0.05.

RESULTS:

Table 1: Comparison of Endothelial Cell Density between Cases and Controls (N=114)

ECD/mm^2	Cases (n=57) Mean ECD/mm^2 (SD) n (%)	Controls (n=57) Mean ECD/mm^2 (SD) n (%)	P Value
Right	2034.25 (136.33)	2524.58 (54.37)	<0.001*
Left	2004.93 (138.24)	2520.16 (56.20)	<0.001*
Unpaired t Test, P Value *Significant			

Table 2: Comparison of Coefficient of Variation between Cases and Controls (N=114)

CV	Cases (n=57) Mean CV %(SD) n (%)	Controls (n=57) Mean CV %(SD) n (%)	P Value
Right	44.82 (2.34)	31.65 (1.64)	<0.001*
Left	45.00 (3.36)	31.02 (2.41)	<0.001*
Unpaired t Test, P Value *Significant			

Table 3: Comparison of Central Corneal Thickness between Cases and Controls (N=114)

CCT microns	Cases(n=57) Mean CCT microns (SD) n (%)	Controls (n=57) Mean CCT microns (SD) n (%)	P Value
Right	567.79 (12.29)	539.56 (6.06)	<0.001*
Left	571.96 (12.98)	540.16 (6.93)	<0.001*
Unpaired t Test, P Value *Significant			

DISCUSSION

A total of 114 subjects participated in this study. Out of 114 subjects, 57 subjects were diabetics and they were labelled as cases and the rest 57 were non diabetics, and they were labelled as controls.

Endothelial cell density, co-efficient of variation and central corneal thickness were compared between the cases and controls and later the cases group was subdivided into NPDR and PDR groups for further evaluation. Changes in ECD, CV and CCT were co-related with the HbA1c levels of the subjects.

Patients in different age groups were analysed by dividing them into 4 sub-groups. The sub groups were as follows: less than or equal to 50 years, 51-60 years, 61-70 years, 71-80 years.

Sex distribution among the subjects were equal in both the groups.

While evaluating ECD in right eyes in the study participants, we noticed the mean ECD of 2034.25 with SD 136.33 in cases group and mean ECD of 2524.58 with SD 54.37 in control group which was statistically significant. In the same way, ECD in left eyes in the study participants, we noticed the mean ECD of 2004.93 with SD 138.24 in cases group and mean ECD of 2520.16 with SD 56.20 in control group which was statistically significant.

In the study conducted by Amira El-Agamy and Shams Alsubaie showed that mean ECD was lower in cases group as compared to that of the control group in both the eyes which was statistically significant [5].

While evaluating the CV in right eyes in the study participants, we noticed the mean CV of 44.82 with SD 2.34 in cases group and mean CV of 31.65 with SD 1.64 in control group which was statistically significant. In the same way, CV in left eyes in the study participants, we noticed the mean CV of 45.00 with SD 3.36 in cases group and mean CV of 31.02 with SD 2.41 in control group which was statistically significant.

In the study conducted by Amira El-Agamy and Shams Alsubaie, mean CV was higher in cases group as compared to the control group in both the eyes which was statistically significant.

While evaluating the CCT in right eyes in the study participants, we noticed the mean CCT of 567.79 with SD 12.29 in cases group and mean CCT of 539.56 with SD 6.06 in control group which was statistically significant. In the same way, CCT in left eyes in the study participants, we noticed the mean CCT of 571.96 with SD 12.98 in cases group and mean CCT of 540.16 with SD 6.93 in control group which was statistically significant.

In the study conducted by Nurdan Gamze, Erel Icel,Yucel Karakut CCT among cases group was higher than that of control group in both the eyes which was statistically significant.

On comparing the ECD in right eyes of case group with respect to HbA1c values, we noticed that mean ECD of 2133.94 with SD 168.63 in group with HbA1c levels <6.4 and mean ECD of 1988.23 with SD 88.24 in group with HbA1c levels >6.4 which was statistically significant.

On comparing the ECD in Left eyes of case group with respect to HbA1c values, we noticed that mean ECD of 2109.67 with SD 161.81 in group with HbA1c levels <6.4 and mean ECD of 1956.23 with SD 94.60 in group with HbA1c levels >6.4 which was statistically significant.

On comparing the CCT in right eyes of case group with respect to HbA1c values, we noticed that mean CCT of 559.0 with SD 13.46 in group with HbA1c levels <6.4 and mean CCT of 571.85 with SD 9.39 in group with HbA1c levels >6.4 which was statistically significant On comparing the CCT in left eyes of case group with respect to HbA1c values, we noticed that mean CCT of 562.33 with SD 13.30 in group with HbA1c levels <6.4 and mean CCT of 576.41 with SD 10.25 in group with HbA1c levels >6.4 which was statistically significant.

On comparing the CV in right eyes of case group with respect to HbA1c values, we noticed that mean CV of 43.39 with SD 2.45 in group with HbA1c levels <6.4 and mean CV of 45.49 with SD 1.99 in group with HbA1c levels >6.4 which was statistically significant On comparing the CV in left eyes of case group with respect to HbA1c values, we noticed that mean CV of 42.61 with SD 4.24 in group with HbA1c levels <6.4 and mean CV of 46.10 with SD 2.16 in group with HbA1c levels >6.4 which was statistically significant.

Evaluation of ECD in right eye among NPDR (Non proliferative diabetic retinopathy) and PDR (Proliferative diabetic retinopathy) groups showed that mean ECD of 2012.91 with SD 101.85 in NPDR groups and mean ECD of 1951.40 with SD 51.55 in PDR groups which was statistically significant.

Evaluation of ECD in left eye among NPDR and PDR groups showed that mean ECD of 1991.61 with SD 111.16 in NPDR groups and mean ECD of 1914.90 with SD 67.98 in PDR groups which was statistically significant.

Evaluation of CCT in right eye among NPDR and PDR groups showed that mean CCT of 571.79 with SD 8.85 in NPDR groups and mean CCT of 571.60 with SD 10.08 in PDR groups which is statistically significant. This is the different finding which we noticed in our study.

Evaluation of CCT in left eye among NPDR and PDR groups showed that mean CCT of 575.58 with SD 9.85 in NPDR groups and mean CCT of 576.50 with SD 11.69 in PDR groups which was statistically significant.

Evaluation of CV in right eye among NPDR and PDR groups showed that mean CV of 45.24 with SD 1.93 in NPDR groups and mean CV of 45.30 with SD 2.40 in PDR groups which was statistically significant.

Evaluation of CV in right eye among NPDR and PDR groups showed that mean CV of 45.82 with SD 2.02 in NPDR groups and mean CV of 46.70 with SD 2.49 in PDR groups which was statistically significant.

CONCLUSION

ECD of both eyes were reduced in cases as compared to the controls, CV and CCT were increased in both eyes of cases as compared to that of the controls, these values were correlated to their HbA1c levels and grade of diabetic retinopathy except CCT which was increased in NPDR group. Hence regular specular microscopy evaluation prior to any ocular surgeries and use of dispersive viscoelastics in ocular surgeries are essential pre requisites in patients with diabetes mellitus.

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