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Comparison of central corneal thickness and endothelial cell count among diabetic retinopathy and non-diabetic cases

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ABSTRACT

Objective: Diabetes is associated with alterations in the structure and functions of corneal endothelial cells. Current research has been carried out to compare the central corneal thickness and endothelial cell density in patients with diabetic retinopathy (DR) and non-diabetic (ND) individuals.

Materials and Methods: A Cross Sectional comparative research was carried out in a tertiary eye care hospital, over the period of two years from April 2021 to March 2023. Among 160 study participants, 80 cases with diabetic retinopathy (DR) and 80 non-diabetic (ND) cases as age matched control have been selected. Thorough Ophthalmic assessment was done. We have included only retinopathy cases as they have longer duration of diabetis and poorer metabolic control, for better comparison of the endothelium parameters with non-diabetics. Specular microscopy has been done in all cases for endothelial cell count evaluation and thickness of cornea has been estimated by Pachymeter. Statistical analysis was carried out by students't' test by comparing the variables between two groups.

Results: P-value was not significant for the mean age and sex distribution in the two groups. Mean endothelial cell density was lesser (2512.12±260.23cells/mm2) in DR than in ND group (2699.10±95.68cells/mm2). Mean central corneal thickness was greater (522.65±36.56μm) in DR than in ND group (486.50±18.67μm) (P<0.05). Also, the Co-efficient of variation percentage was more whereas the percentage of hexagonality was found to be statistically less in DR than ND group.

Conclusions: Among DR patients, endothelial cell density was significantly reduced and central corneal thickness considerably raised when compared with ND. Our results also suggest that poor metabolic control and advanced Diabetic Retinopathy are risk factors for developing keratopathy.

1. Introduction

Globally, Diabetes is emerging as a chief health concern attaining epidemic proportions.[1] The prevalence of diabetes mellitus has increased significantly in the past several decades and it is estimated that by the year of 2045, India will top the list.[1,2] Since diabetes mellitus is a metabolic disorder, it causes chronic dysfunction and failure of multiple organs including the eye.[3,4] Globally, the early visual loss due to retinopathy is mostly affecting the working and elderly population.[4] Retinopathy is most widely studied and researched ocular complication of diabetis mellitus.[4–6]Documentation of corneal impediment and ocular surface disorders in cases of diabetes mellitus seems to be lacking.[5] Keratopathy caused by alterations in epithelial basement membrane, epithelial stromal interfaces, endothelial permeability and corneal nerve conduction, impairs wound healing.[7] These difficulties in diabetics, particularly post cataract and / or vitreoretinal surgery are of chief concern because of

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possible corneal decompensation. Because of the crucial role of corneal endothelium in preserving corneal clarity, numerous investigations have been done to observe the possible modifications in such endothelia. An injured endothelium effects in corneal oedema and increased central corneal thickness. This correlation was recognized in subjects with diabetes mellitus in a huge research by Rosenberg.[8,9] Regarding endothelial cell density among diabetics, some researches have described it as reduced though others have stated that it is comparable to values in non-diabetic cases.[10,11] Therefore, the present report has been commenced to find the association of endothelial cell density, morphological variations and central corneal thickness in DR cases in comparison to ND cases.

2. Materials and Methods

A cross-sectional comparative research was done up to two years in the Ophthalmology department and RIO at SCB medical college and hospital Cuttack during the period from April 2021 to March 2023. 80 cases with diagnosis of diabetes having various grades of retinopathy according to ETDRS classification and on treatment for either Type 1 or 2 diabetes and 80 age matched healthy non diabetic cases were chosen randomly by multilevel stratification among the age group of forty to eighty yrs.

2.1. Exclusion criteria

Cases with history of prior ocular surgery or trauma, primary or secondary glaucoma, corneal infections, dry eye syndrome, other systemic diseases or medications affecting endothelium and diabetics without retinopathy were exempted. We have included only diabetic retinopathy cases as they have longer duration and poorer metabolic control of diabetes, for better comparison of endothelium parameters with non-diabetics.

80 cases (160 eyes) of diabetic retinopathy (DR) and 80 cases (160 eyes) of non-diabetes (ND) were included.We also investigated demographic factors, systemic factors, duration of diabetes, HbA1c, metabolic profile like nephropathy, neuropathy. All cases underwent ocular examinations for visual acuity by ETDRS 3 m chart, slit lamp examination, non-contact tonometry, indirect funduscopy, fundus fluorescence and ocular coherence tomography for grading Diabetic Retinopathy by ETDRS staging.

Estimation of Corneal thickness **-** Corneal thickness was assessed by ultrasonic pachymeter. Mean value of 3 successive values displayed on the digital screen was processed for statistical investigation. All observations were obtained by the same Ophthalmologist with Pachymeter probe vertical to the apex of cornea.[11]

Estimation of Endothelial cell count **-** by Non-contact specular microscopy was done for central endothelial density, variation in the size of the endothelial cells and percentage of hexagonal cells. Mean cell area and co-efficient of variation in the cell area were used as an index of the extent of the variation in cell area. Per cent of hexagonal cells in the area investigated was used as a manifestation of difference in the cell form.[12]

2.2. Statistical analysis

All the observations were investigated by SPSS software version 18. Variables were investigated; characterized using percentage, proportions.

This research has been permitted by the institutional ethics committee and informed consent has been collected from all cases after clarification of the procedure in adherence to declaration of Helsinki.

3. Results

80 cases (160eyes) of diabetic retinopathy (DR) cases and 80 cases (160 eyes) of non-diabetic cases were studied for observing the changes in variables.

Table 1 shows that in DR group 43 % were males and 35 % were females and the mean age was found to be 62.65±7.85 years. In ND group 45 % were males and 37 % were females and mean age was 60.22±7.56 yrs respectively. P-value was not significant for the mean age and sex distribution.

Table 1: Demographic profile of subjects

Demographics	DR Group (N=80)	ND Group (N=80)
Age (Mean±SD)	62.65±7.85	60.22±7.56
Gender		
Male	43	45
Female	35	37

Table 2 shows majority i.e., 43 % and 46 % cases were among 60 to 70 years among DR and ND cases.

Table 2: Age distributions

Age (yrs)	DR Group (n=80)	ND Group (n=80)
40-50	12 (15%)	10 (13%)
51 to 60	13 (16%)	28 (35%)
61 to 70	34 (43%)	37 (46%)
71 to 80	21 (26%)	05 (06%)
Total	80 (100)	80 (100)

Table 3 shows age wise distribution of Endothelial cell density & central corneal thickness among the DR & ND groups. Mean endothelial cell density seems to be lesser as 2512.12±260.20 cells/mm2 among DR group than ND group as 2699.10±95.68 cells/mm2 (P-value<0.05). Mean central corneal thickness seems to be greater as 522.65±36.56 μm in DR group than ND group as 486.50±18.67μm (P-value<0.05).

Table 3: Evaluation of endothelial cell density and central corneal thickness

Variables	Age (in yrs)	DR group (n=160)	ND group (n=160)	P value
Endothelial cell density (cells/mm^2)	40 to 50	2517.75±165.70	2409.10±91.27	<0.0001*
	51 to 60	2660.10±142.43	2689.90±138.63	
	61 to 70	2512.90±269.21	2481.87±173.62	
	70 to 80	2492.23±274.90	2539.60±101.85	
	Mean±SD	2512.12±260.23	2699.10±95.68	
Central corneal thickness (μm)	40 to 50	520.58±31.71	481.80±21.70	<0.0001*
	51 to 60	526.70±19.34	497.78±21.59	
	61 to 70	524.36±32.33	481.55±27.87	
	71 to 80	514.61±23.09	486.40±18.88	
	Mean±SD	522.65±36.56	486.50±18.67	

Table 4: Evaluation of Co-efficient of variation and hexagonality

Variables	Age	DR group (n=160)	ND group (n=160)	P-value
Co-efficient of variation (%)	40 to 50	37.16±5.06	35.80±4.96	<0.0001
	51 to 60	38.60 ± 3.76	37.89±4.28	
	61 to 70	39.47 ± 3.83	38.62±3.81	
	71 to 80	36.66±3.49	38.0±2.34	
	Mean±SD	37.22±3.86	37.98±2.40	
Hexagonality (%)	40 to 50	39.16±7.34	46.30±4.08	<0.0001*
	51 to 60	43.50±5.13	44.57±3.87	
	61 to70	39.25±5.13	44.51±4.26	
	71 to 80	40.47±3.70	43.20± 3.83	
	Mean±SD	41.25±40	44.56±4.67	

Table 4 shows age wise distribution of Endothelial cell morphology as co-efficient of variation and hexagonality percentage among DR and ND groups. There was minimal alteration in the co-efficient of variation. The mean co-efficient of variation were found as 37.22±3.86% among DR group and 37.98±2.40% among ND group. The hexagonality % were significantly less as 41.25±40% among DR group than ND group with 44.56±4.67% (P-value <0.05).

4. Discussion

Corneal endothelium is under chronic metabolic strain in diabetics and it's function gets affected by several morphological changes.[13] In the current observation, mean age was 62.65±7.85 years among DR group and 60.22±7.56 years among ND group and it was found to be similar to the study performed by Sahu et al with average age as 63.38±7.31 years among diabetic group & 64±8.32 years among non-diabetic groups respectively.[14]

Morphological changes of the corneal endothelium in diabetics is documented in numerous studies showing a reduction in endothelial cell density, pleomorphism together with polymegathism, augmented co-efficient of variation of cell size and increased central corneal thickness.[15,16] Choo et al while reporting corneal variations among type 2 diabetics in Malaysian patients revealed substantial modification of cornea comprising of decrease in the endothelial density & augmented polymorphism and polymegathism whereas corneal thickness was not much affected.[15] Sudhir et al described only cell density declined with no alterations in hexagonality, co-efficient of variation of the cell surface or cell dimensions.[16] Our study exhibited comparable observations with lessened endothelial density & increased central corneal thickness among DR group, co-efficient of variation per cent in DR group was higher in all age categories. Kukadia et al revealed reduced endothelial cell density & augmented corneal thickness in diabetics than among non-diabetic groups. Paulsen et al too reported lesser endothelial density & increased corneal thickness among diabetic patients.[17] Roszkowska et al documented the effect of corneal endothelium among type 1 & 2 diabetes mellitus patients and revealed significant dissimilarity among groups, with less mean cell density of 5% among type 1 and 11% among type 2 diabetes cases. The central corneal thickness was found to be statistically significant among diabetic cases.[9] Urban et al documented lesser corneal endothelial cell density & thicker cornea among youngsters & teenagers with type 1 diabetes.[18] Lee et al also estimated association of endothelial morphology & corneal thickness to duration of diabetes.[19]

5. Conclusion

Endothelial cell density is significantly reduced and central corneal thickness increased among DR group when compared to ND group. A change in endothelial morphology is also observed as pleomorphism, however co-

efficient of variation was not significantly altered between the groups in our study. As the altered parameters are related to the status of metabolic control (HbA1c) and stage of diabetic retinopathy, diabetic patients with poor metabolic control and advanced stage of retinopathy should be examined for endothelial changes. Proper preoperative evaluation and counseling should be done before any intra-ocular procedure or surgery and adequate precautions should be taken intra operatively to minimise endothelial decompensation leading to irreversible visual loss.

6. Limitations of Study

This was a hospital OPD based study and does not represent the population. Also, study duration and sample size were less and no follow up was conducted to compare long term outcomes in the two groups.

7. Source of Funding

None.

8. Conflicts of Interest

None.

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