

ORIGINAL ARTICLE

Relationship of Central Corneal Thickness with the Status of Diabetic Retinopathy and Level of HbA1C in Diabetic Patients

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ABSTRACT

Study Objectives: To determine the relationship of central corneal thickness with the status of diabetic retinopathy and level of HbA1c in diabetic patients.

Study Design and Settings: Department of Ophthalmology, Allied Hospital/DHQ Hospital, Faisalabad Pakistan from Jan 2021 to June 2021.

Patients and Methods: Out of the patients visiting OPD, 100 patients with clinically diagnosed type 2 DM which satisfied the range of selected standards and offered written informed agreement were involved in the research with the use of simple random sampling. Snellen's visual acuity chart for distance vision and Jaeger's chart for near vision were used to determine the best-corrected visual acuity. Wet Refraction and axial length was measured using A-scan. Goldmann applanation tonometry was used to measure the intraocular pressure.

Results of the Study: In this research sixty two percent of the patients were men and thirty eight percent patients were women. Total 84 patients had type 2 DM of duration 5-10 years, and the remaining 16 patients had diabetes for over 10 years. Total 35 patients had HbA1c between 4-5.6%, 31 patients had HbA1c between 5.7- 6.5% and 34 patients had HbA1c \geq 6.5%. From 100 patients with Diabetes Mellitus Type 2, 21 patients had no diabetic retinopathy, 28 patients had very minor and minor NPDR, 25 patients had average NPDR, 19 patients had critical and very acute NPDR and 7 patients had PDR. The mean HbA1c in patients with no diabetic retinopathy was 5.05%. The mean HbA1c in patients having minor and very little NPDR remained 5.64%. The mean HbA1c in patients with moderate NPDR was 6.36%. The mean HbA1c in patients with critical and very acute NPDR was 8.26%. The mean HbA1c in patients with severe PDR was 9.86%. This was a statistically significant survey (P-value = 0.01).

Conclusion: This study showed a strong correlation between the central corneal thickness to the severity of diabetic retinopathy and HbA1c levels emphasizes the importance of evaluation of corneal endothelial morphology in the early screening and diagnosis of microvascular complications of DM

Keywords: Central Corneal Thickness, Diabetic Retinopathy, HbA1c

INTRODUCTION

One of the most frequent chronic diseases in the world is diabetes mellitus (DM), and its prevalence and disease burden continue to rise (1). A common consequence of diabetes mellitus is Diabetic retinopathy (DR), which is the main cause of vision impairment in individuals all over the world (2). With Diabetic Retinopathy (DR) patients may undergo from damaged blood vessels of the light-sensitive tissue at the retina (back of the eye) and any diabetes types, type 1, type 2, or DR complications are possible in gestation. In DM patients, smoking, hyperlipidemia Hypertension, and certain races have been identified as risk factors for DR advancements (1, 2). In the early stages, DR is mostly asymptomatic, and regular eye screening is required with diabetic patients in order to ensure diagnosis to be done timely and ensure managing the state. (3, 4, 5).

Cornea is the outer most transparent layer of the eye. Along with protection, cornea also adds to the refractive power of the eye. The corneal thickness varies from periphery to the central region, being thinnest at the center.⁶ The famous landmark study Ocular Hypertension Treatment Study (OHTS) has reported that corneal thickness can be used as an important predictor for the primary open angle glaucoma. According to OHTS, people with a corneal thickness of less than 555 μ m have a three-fold greater risk of developing glaucoma within 5 years as compared to the people having central corneal thickness of 588 μ m.⁷ This clearly signifies the title role of core optical diameter in the normal eyes. IOP is created when aqueous humor exerts force on the structures of the anterior chamber of eye. It is most commonly measured by applying a contact tonometer to the middle portion of the cornea. Literature suggests that changes in intraocular pressure may result in change in corneal thickness.⁸

Our study aims to correlate the corneal endothelial changes and CCT with DR status and HbA1c levels in diabetes type 2. With such review results it will be possible to recommend routine assessment of CCT and corneal endothelium especially in conditions like glaucoma assessment and prior to keratorefractive procedures in type 2 DM to prevent visual disability by early detection and management. .

PATIENTS AND METHODS

This was a cross-sectional study which was conducted at Department of Ophthalmology, Allied Hospital/DHQ Hospital, Faisalabad Pakistan from Jan 2021 to June 2021. Out of the patients visiting OPD, 100 patients with clinically diagnosed type 2 DM which satisfied the range of selected standards and offered written informed agreement were involved in the research with the use of simple random sampling. Assuming an absolute precision of 8% required sample size has been calculated as 71 (alpha error 8%). Therefore, we are taking 100 patients. Diagnosed cases of diabetes mellitus Type 2 in people aged from 40 to 60, greater than 5 years' duration. Patients with Glaucoma, Previous ocular surgery or trauma, corneal diseases or dystrophies or degeneration, contact lens wearers, patients on topical medications were excluded from the study. Snellen's visual acuity chart for distance vision and Jaeger's chart for near vision were used to determine the best-corrected visual acuity. Wet Refraction and axial length was measured using A-scan. Goldmann applanation tonometry was used to measure the intraocular pressure. The section of anterior and posterior was examined by Slit lamp examination. Tropic amide eye drops dilated the pupils of both eyes. Quantitative analysis of cell count was done by corner method. The outcome variable will be relationship between CCT and grade of diabetic retinopathy will be established. The

association of HbA1c values with CCT will be also checked. The Statistical Package for Social Sciences (SPSS) version 20 was used to statistically analyze the data. To test the significance between qualitative parameters Chi square test was used. Pearson correlation was applied to examine the correlation among 2 quantitative parameters. P - value < 0.05 was set as significance level.

RESULTS

Table 1: Demographics of participants

Gender	Number of cases	Percentage
Female	38	38.0
Male	62	62.0
Age		
40 – 45	8	8.0
46 – 49	25	25.0
50 – 54	31	31.0
55 – 60	36	36.0
Duration of Diabetes		
> 5 – 10 y	84	84.0
> 10 y	16	16.0
HbA1c		
4 - 5.6	35	35
5.61 - 6.5	31	31
> 6.5	34	34

Table 2: Number of patients according to Severity of diabetic retinopathy

Severity of Diabetic retinopathy	Frequency	Percent
No DR	21	21.0
Very little and minor NPDR	28	28.0
Average NPDR	25	25.0
Acute and very critical NPDR	19	19.0
PDR	7	7.0
Total	100	100.0

Table 3: Association between HbA1c and Severity of diabetic retinopathy

Severity of (DR) Diabeticretinopathy	HbA1c (%)		95% CI		F value	p value
	Mean	SD	Lower Bound	Upper Bound		
No Diabetic retinopathy	5.05	.384	4.87	5.22	128.139	0.001
Very mild and mild NPDR	5.64	.488	5.45	5.83		
Moderate NPDR	6.36	.860	6.00	6.72		
Severe and very severe NPDR	8.26	.452	8.05	8.48		
PDR	9.86	1.069	8.87	10.85		
Total	6.49	1.560	6.18	6.80		

Table 4: Duration of Diabetes and Association between Severity of Diabetic Retinopathy

Severity of Diabetic retinopathy	Duration of diabetes (years)		95% CI		F value	p value
	Mean	SD	Lower Bound	Upper Bound		
No Diabetic retinopathy	6.52	.750	6.18	6.87	63.585	0.001
Very mild and mild NPDR	6.96	.922	6.61	7.32		
Moderate NPDR	8.76	1.165	8.28	9.24		
Severe and very severe NPDR	11.63	1.892	10.72	12.54		
PDR	12.14	2.193	10.11	14.17		
Total	8.57	2.438	8.09	9.05		

In this research sixty two percent of the patients were men and thirty eight percent patients were women. In our study, out of the 100 diabetic patients, 8 patients were between 40-45 years, 25 patients were between 46-49 years, 31 patients were between 50-54 years and 36 patients were between 55-60 years. Total 84 patients had type 2 DM of duration 5-10 years, and the remaining 16 patients had diabetes for over 10 years. Total 35 patients had HbA1c between 4-5.6%, 31 patients had HbA1c between 5.7-

6.5% and 34 patients had HbA1c ≥ 6.5%. From 100 patients with Diabetes Mellitus Type 2, 21 patients had no diabetic retinopathy, 28 patients had very minor and minor NPDR, 25 patients had average NPDR, 19 patients had critical and very acute NPDR and 7 patients had PDR. The mean HbA1c in patients with no diabetic retinopathy was 5.05%. The mean HbA1c in patients having minor and very little NPDR remained 5.64%. The mean HbA1c in patients with moderate NPDR was 6.36%. The mean HbA1c in patients with critical and very acute NPDR was 8.26%. The mean HbA1c in patients with severe PDR was 9.86%. This was a statistically significant survey (P-value = 0.01).

Table 5: Association between CCT and Severity of diabetic retinopathy

Severity of Diabetic retinopathy	CCT (µm)		95% CI		F value	p value
	Mean	SD	Lower Bound	Upper Bound		
No Diabetic retinopathy	526.62	8.084	522.94	530.30	175.444	0.001
Very mild and mild NPDR	542.07	8.713	538.69	545.45		
Moderate NPDR	562.16	8.255	558.75	565.57		
Severe and very severe NPDR	582.79	7.368	579.24	586.34		
PDR	610.43	18.256	593.54	627.31		
Total	556.37	25.983	551.21	561.53		

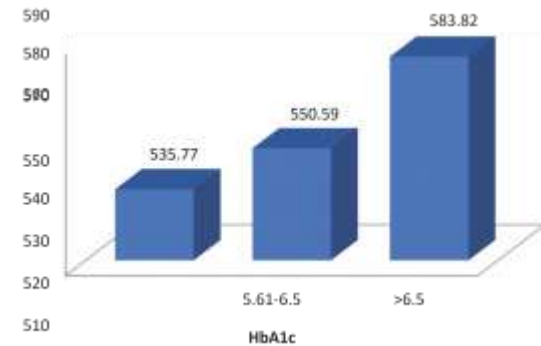


Figure 1: Association between CCT and HbA1c

DISCUSSION

The CCT in diabetics signifies overall functional and morphological position of the retina. It's been described as a sensitive sign for diabetic keratopathy in the early stages and a key parameter for refractive surgeries. Shukla et al. (2016) & Amira et al. (2017) discovered that HbA1c levels and Central Corneal Thickness have a positive connection in Type 1 diabetics and reported increased CCT in diabetic patients however, no direct connection was discovered with HbA1c levels in type 2 DM as in this research. A cross-sectional study was carried out by Rashmi Kumari et al⁽¹⁷⁾ in Max Eye Hospital, Patna, (from May 2015 to April 2016). They measured CCT in hundred patients from which fifty patients were discovered as diabetics and fifty were discovered as non-diabetics and according to the study, Diabetic patients had denser retina than non-diabetics. Prem pal Kaur et al⁽¹²⁾ performed a cross sectional study in Amritsar on two hundred and forty eyes, out of which one hundred and twenty eyes were of diabetic patients and one hundred twenty eyes were of non-diabetic patients were evaluated at GMC (Govt. Medical College), Amritsar, and discovered that the mean CCT and mean ECD (endothelial cell density) in diabetics differ significantly from non-diabetics. They also discovered that diabetics with a CCT of >10 years and a HbA1c of >7 had considerably thicker CCT.

On the other hand, a Japanese researcher Kenji Inoue et al (2006)⁽¹³⁾ associated the thickness of the cornea and endothelial structure and in diabetics and non-diabetics. CCT in diabetics and non-diabetics did not differ significantly. In type 2 diabetics, the structure of the corneal endothelial cells was impaired, although

CCT did not rise. However, Allan Storr-Paulsen et al. (2014)¹⁴ in his research established that Type 2 diabetics did not differ from the non-diabetics with regards to ECD, variation in CV or hexagonality, however revealed a substantial rise in Central Corneal Thickness. . Su et al.(2008)¹⁵ also discovered that among 3280 Malay individuals between the ages of 40 and 80, those with hyperglycemia and diabetes presented considerably denser CCT, which was independent of age and Intraocular Pressure levels. In Sudanese populations, Abdulghani et al (2013)¹⁶ and Busted et al (2009)¹⁷ found comparable results to the current study, showing that CCT in diabetics is higher than in non-diabetics. Another similar study showed that the HbA1c levels interrelated with prevalence of retinopathy status in diabetic patients on insulin therapy. HbA1c concentrations or blood glucose reductions through tight blood glucose control in diabetics reduce the rate of progression of DR and microvascular complications such as DR, neuropathy and nephropathy.

Our findings imply that lowering HbA1c levels or meeting ADA requirements can help avoid or delay the onset of microvascular problems such diabetic retinopathy. As diabetic retinopathy is a severe microvascular problem, regular DR screening and stricter glycemic control may reduce the number of people who develop vision-threatening retinopathy.

Similar study was published in 2018 by Sewak et al. shows a significant difference between HbA1c values of NPDR, PDR compared to control group. The elevated HbA1c was associated with severity of diabetic retinopathy. Also prevalence of retinopathy was higher in NPDR (43.75%) group than PDR (37.54%).^(18, 19, 20)

CONCLUSION

This study showed a strong correlation between the central corneal thickness to the severity of diabetic retinopathy and HbA1c levels emphasizes the importance of evaluation of corneal endothelial morphology in the early screening and diagnosis of microvascular complications of DM.

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