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Research Article

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Diabetic Retinopathy and Central Corneal Thickness

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Abstract

Background: *Diabetes mellitus (DM) is a metabolic disease that can lead to many ocular complications such as increased Central Corneal Thickness (CCT), cataracts, and diabetic retinopathy. The aim of this study was to compare the CCT between subjects with type I and type II diabetes.*

Method: *This was a retrospective study which included subjects with diabetes (with and without Diabetic Retinopathy (DR)) aged between 18 to 80 years old. The data collected were type and duration of diabetes mellitus, diabetes treatment, glycated hemoglobin level, visual acuity, CCT, and intra ocular pressure. Subjects were divided into subgroup (with and without DR). Statistical program (SPSS) was used to compare the central corneal thickness between the groups.*

Result: *A total of 205 subjects with type I (n=100) and type II (n=105) diabetes were included in this study. In type 1 DM, the mean CCT was 547.06±27.3 microns in patients with diabetic retinopathy (DR) and 533.85±26.8 microns in patients without DR. In type 2 DM, the mean CCT was 542.85±39.3 microns in patients with DR and 532.44±27.4 microns in patients without DR. The CCT in type 1 diabetic patients was higher in both groups (with and without DR) than the CCT in type 2 diabetic patients in both groups (with and without DR). However, this was not statistically significant.*

Conclusion: *The type of diabetes mellitus did not affect CCT. The presence of diabetic retinopathy in either type I or type II diabetes mellitus can affect the measurements of CCT.*

Keywords: Type I diabetes mellitus, Type II diabetes mellitus, Central Corneal Thickness, Diabetic Retinopathy.

Diabetes mellitus is a metabolic disease that results from an increased level of glucose in the blood, which can lead to microvascular and macrovascular complications [1]. Failure of pancreatic beta cells to secret adequate insulin can lead to hyperglycemia, which may have been affected by genetic and environmental factors [2]. The prevalence of the condition is different from a region to other. Many factors including aging, obesity and lack of physical activities can play a major role in the severity of the disease [3,4]. For example, the prevalence of diabetes in Saudi Arabia was 17.6%, which is considered the highest proportion in the Middle East and North Africa Region.

The condition can affect multiple structures of the eye such as the cornea, Diabetic retinopathy (DR) is one of the complications of diabetes mellitus, which can lead to blindness. It was found that about 34.6% of all diabetic patients worldwide were developed some forms of diabetic retinopathy that resulted from microvascular changes associated with hyperglycaemia [5,6]. Thus, controlling blood sugar and blood pressure can prevent and delay the progression of DR [7,8].

Many previous studies found that diabetes mellitus can affect the structure of corneal endothelial cells and its thickness [9,10]. It was found that patients with diabetes do experience many functional abnormalities in their corneas such as low corneal sensitivity, increased corneal thickness, reduced endothelial cells and changes in endothelial permeability to fluorescein after intraocular surgery [11,12].

The status of the corneal density and thickness is crucial in many systemic diseases which can affect the eye such as diabetes mellitus, as well as in ocular disorders such as, glaucoma and dry eyes [13]. The outcomes of some intraocular surgeries including cataract, keratoplasty, vitrectomy and refractive surgeries are also relied on the status of the cornea [14]. The effects of diabetes mellitus on corneal thickness in both types I and II diabetes mellitus was investigated in previous studies studies and found an increase of central corneal

thickness (CCT) in both types of diabetes mellitus [15,16]. Although the cause of increased CCT was obscure, it was postulated that endothelial pump function disturbance due to reduction of ionized sodium/ionized potassium (Na+/K+), ATP ase activity were resulted in an increase in stromalhydration [17-19]. Abdulghaniand Ali (2013) reported that CCT in diabetic patients was thickerthan that of controls due tomorphological changes of the diabetic cornea [15]. The comparison of CCT between patients with type I and type II diabetes mellitus needs more investigation. Thus, the purpose of the present study was to compare CCT between type I and type II diabetic patients in the Saudi population.

Methods

This was a retrospective study designed to compare the CCT between type I and type II diabetic patients. Medical records of diabetic patients at the university diabetes center at King Abdulaziz University Hospital, King Saud University, Saudi Arabia were reviewed. Subjects with diabetes mellitus (with and without diabetic retinopathy) aged between 18 to 80 years from both gender were included in this study. Subjects included in this study were divided into two groups: type I diabetes mellitus and type II diabetes mellitus. Any patient with glaucoma, intraocularsurgeries, keratoconus or history of contact lens wear were excluded from this study. Inaddition, gestational diabetic mothers were excluded from this study in order to avoid the impact of pregnancyon CCT [16,20,21]. Collected data included demographic information (e.g. age, gender), clinical examination (Type of diabetes, duration and type of medication), visualacuity, CCT, intraocular pressure and glycated hemoglobin (HBA1c) level. The tenets of the Declaration of Helsinki were followed and the study was approved by the Human Research Ethics Committee of Collage of Applied Medical Sciences, King Saud University and Institutional Review Board at the university diabetes center at King Abdulaziz University Hospital.

For statistical analysis, SPSS version, was used to compare demographic information and CCT between groups and subgroups [22]. In addition, independent t-test was used to compare CCT between type I and type II diabetes mellitus with and without DR. Correlation between CCT and factors such as duration of diabetes mellitus, intraocular pressure were investigated using Pearson Correlation test. The confidence level was 95% and significance P value was considered as < 0.05.

Results

A total of 205 medical records of diabetic patients were reviewed (n=100 Type I diabetes mellitus, n= 105type II diabetes mellitus). The meanage ± Standard Deviation (SD) was 23.6±7.2 years in type I diabetes mellitus group and 50.1±11. 6 years in type II diabetes mellitus group (Table 1). About more than half (65%) of subjects in type I group had the disease for more than 10 years and 29% of them had DR. In type II diabetes mellitus, about 50% of subjects had the disease for more than 10 years and 76% of them had DR.

Table1: The characteristics of subjects in type I and type II DM.

	TypeI diabetes			**TypeII diabetes N=105**		
	With DR	**Without DR N=67**	**Total type I**	**With DR N=33**	**Without DR N=72**	**Total Type2**
Age (mean±SD)	23.81±6.8	23.4±7.2	23.6±7.2	51.4±10.9	49.2±11.9	50.1±11.6
Gendermale (%)	13 (13%)	33 (33%)	46 (46%)	17 (16%)	37 (35%)	54 (51%)
Diabetes treatment(%) Insulin OHA OHA+insulin	 26 (26%) 0 7 (7%)	 56 (56%) 0 11 (11%)	 82 (82%) 0 18 (18%)	 0 14 (13%) 19 (18%)	 6 (6%) 48 (46%) 18 (17%)	 6 (6%) 62 (59%) 37 (35%)
Durationof diabetes <10 years >10 years	 4 (12%) 29 (88%)	 31 (46%) 36 (54%)	 35 (35%) 65 (65%)	 8 (24%) 25 (76%)	 44 (61%) 28 (39%)	 52 (50%) 53 (50%)
HBA1clevel (%) 6.5-9% 9.1-14% >15	 12 (12%) 19 (19%) 2 (2%)	 41 (41%) 26 (26%) 0	 53 (53%) 45 (45%) 2 (2%)	 17 (16%) 16 (15%) 0	 53 (50%) 19 (18%) 0	 70 (67%) 36 (33%) 0
AverageIOP(mmHg)	17.12±2.7	16.76±3.1	16.82±2.9	15.30±3.1	15.58±2.6	15.49±2.8
VAlogMAR(mean±SD)	0.2±0.2	0.2±0.3	0.2±0.3	0.1±0.1	0.1±0.2	0.1±0.1

***SD**=Standard Deviation. **OHA**=Oral Hypoglossal Agent. **HBA1c**=Glycated Hemoglobin. **IOP**=Intraocular Pressure

Most subjects (82%) in type I diabetes mellitus group used insulin only as a treatment for diabetes. In contrast, oral hypoglycemic agents (OHA) were used by more than half (59%) of subjects in type II diabetes mellitus (including both with and without DR), while 35% of subjects used both Insulin and OHA treatments for diabetes. A HbA1c level range of 6.5-9% was found in 12% of subjects in type I diabetes mellitus who had DR as opposed to 41% of subjects in type I diabetes mellitus with no DR. Similarly, A HbA1c level range of 6.5-9% was found in 16% of subjects in type II diabetes mellitus who had DR as opposed to 50% subjects in type II diabetes mellitus with no DR (Table1).

When the CCT between subjects in type I and type II diabetes mellitus was compared the mean ± SD of CCT for subjects in type I diabetes mellitus group was 547.06±27.3 microns in subjects with DR and 533.85±26.8 microns in subjects without DR. In Type II diabetes mellitus group with DR was 547.06±27.3 microns as opposed to 532.44 ± 27.4 microns in subject's without DR. Although the mean CCT in type I diabetic subjects was higher in both sub groups (with and without DR) than CCT in type II diabetic subjects

in both sub groups (with and without DR), no statistical significant difference (p> 0.05) was found in the CCT between type I and type II diabetes mellitus groups. In addition, mean ± SD of CCT was compared between type I and type II diabetes mellitus based on the presence or absence of DR. No statistical significant difference (P> 0.05) was found in the presence or absence of DR (Figure1).

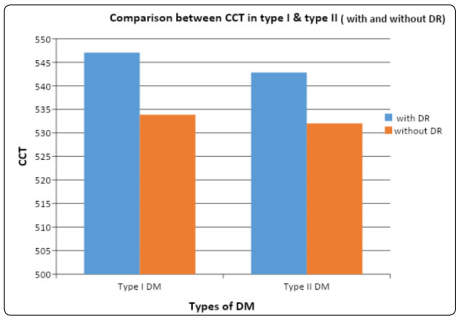

Figure 1: Comparison of CCT between subjects in type I and type II diabetes mellitus
Abbreviation: DR= Diabetes mellitus

The correlation between intraocular pressure, duration of diabetes mellitus were compared in each subgroup. It was found that CCT was positively correlated (P = 0.000, r =0.656) with intraocular pressure in type I diabetes mellitus, either with or without DR. In addition, the duration of diabetes mellitus was positively correlated with CCT (p=0.003 and p-0.035) in both type I and II diabetes mellitus subjects with DR (Figures 2 and 3).

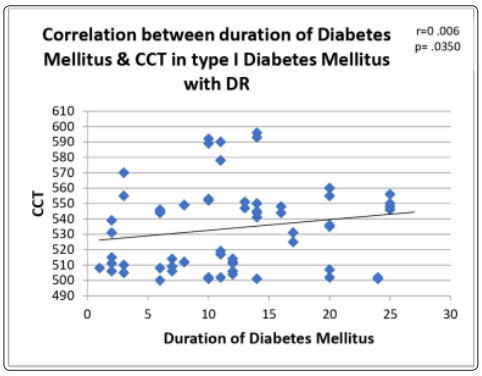

Figure 2: The Duration of diabetes mellitus was positively correlated with CCT in
Abbreviation: CCT= Central Corneal Thickness, DR=Diabetic Retinopathy

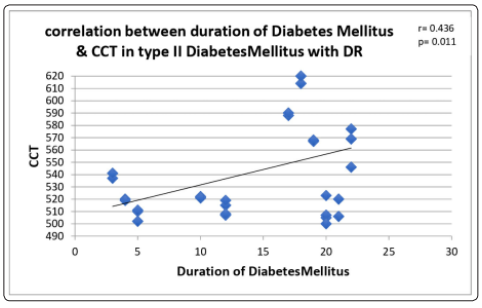

Figure 3: The Duration of diabetes mellitus was positively correlated with CCT in type II diabetes mellitus with DR
Abbreviation: CCT= Central Corneal Thickness, DR=Diabetic Retinopathy

Discussion

This study compared the Central Corneal Thickness (CCT) between subjects with type I and type II diabetes mellitus (with and without DR). The study found thicker CCT in type I diabetes mellitus subjects than that in type II diabetes mellitus subjects, although this difference was not statically significant. This finding was surprising, as it is known that CCT increases with age. The mean age of type I diabetic subjects in the current study was less than the mean age of type II diabetic subjects (Table 1). Parekhetal observed a significant correlation between CCT and aging in non-diabetic control populations, and stated possibility of morphological changes with aging, which could be responsible for the increase of the CCT in diabetic patients [13]. The present finding suggested that blood sugar in type I diabetic group maybe poorly controlled as 45% of subjects had a HbA1c level between 9.1 to 14, as opposed to 33% of type II diabetics, and this can lead to cornealedema and high CCT. Previous studies measured CCT in type I and type II diabetes mellitus (with and without DR) without comparing the values between the two groups [22-25]. While other studies measured the CCT in one type of diabetes mellitus only [13,21,26]. Zenginetal investigated the correlation between HbA1c values and CCT in type II diabetic patients and found that patients with high HbA1c levels had higher CCT than patients with low HbA1c levels [21]. In contrast, other studies did not find any correlation between HbA1c and CCT [27,28].

The duration of diabetes was significantly correlated with the measurement of CCT in both types of diabetes mellitus with the presence of DR (figures 2 and 3). Likewise, Parekhetal found a significant correlation between CCT and the duration of diabetes mellitus with the presence of DR. Similarly, Lee et al., found that CCT was significantly correlated with the duration of diabetes [13,24]. However, Busted et al., did not find any correlation between CCT and duration of diabetes, as no patients with DR were include in that study [17].

The present study showed that the presence of DR affect CCT measurement. Mathebula and Segoati found no statistically significant difference between CCT in patients with DR and those without DR [25]. Unlike, another study by Parekah et al which reported a thicker CCT in patients with DR compared to controls [13]. Zenginetal stated that only patients with mild to moderate non proliferative retinopathy had significantly higher CCT than patients without DR whereas Rosenberg et al., found no significant difference between diabetic CCT in the presence or absence of DR [21,29].

This study had a sufficient sample size that enabled us to compare the CCT between type I and type II diabetes mellitus, including subgroups with and without DR. This has provided more strength of statistical power. There were some limitations in this study. The CCT was measured by non-contact tonometer. The measurements of the CCT could have been different if it was measured by a different technique, such as pachymetery or Pentacam. However, as this study was designed to be retrospective, it was difficult to obtain the measurement of CCT from the same participants using a different device. In conclusion, the findings of the present study suggest that the type of diabetes mellitus did not affect central corneal thickness. However, the presence of diabetic retinopathy in either type I or type II diabetes mellitus can affect the measurements of the CCT but are not significant.

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