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A Comparative Study of Central Corneal Thickness and Intraocular Pressure in Diabetic and Non-Diabetic Patients Attended a Tertiary Health Care Centre

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Abstract: ***Background: Diabetes is a rapidly-growing global health problem with a significant effect on morbidity and mortality due to diabetes-related complications. Objective: The aim of this study is to determine the correlation between central corneal thickness (CCT), intraocular pressure (IOP) and diabetes in Indian patients. Patients and Methods: This prospective case-control study was performed at the ophthalmic department of sree Balaji medical college and hospital. 100 subjects from different age groups were included in the study. An ultrasound pachymeter was used to measure CCT and GAT to measure IOP. The sample was divided into two groups, 50 of them were non-diabetic subjects, and 50 were diabetic patients. Results: Diabetics with PDR showed significantly higher IOP and CCT values compared to the non-diabetic group. IOP was significantly compared with CCT and with the duration of diabetes. Conclusion: The sample group with diabetics with PDR showed a significantly high IOP and thicker corneas when compared to the sample group with non-diabetics. These data highlight the importance of considering CCT measurements in diabetics for proper interpretation of IOP.***

Keywords: intraocular pressure, type II diabetes, central corneal thickness

1. Introduction

Diabetes mellitus is a metabolic disease characterized by hyperglycemia and is associated with microvascular and macro vascular complications [1]. Patients with diabetes mellitus mostly develop diabetic retinopathy. Other effects of diabetes on eye include corneal endothelial damage and keratoepitheliopathy such as superficial punctate keratitis, recurrent corneal erosion, and persistent epithelial defects [1, 2].

Diabetes is a very common disease worldwide, having a reasonable impact on society, not only because of its high prevalence but also because of its chronic complications and high mortality rate [3, 4], affecting approximately 180 million people around the world [4]. Symptoms may or not appear from the onset, and thus go completely unnoticed [2, 3].Early diagnosis of diabetes allows prescribing an adequate treatment and avoiding potential complications, which is a key element in the development of this disease [1, 3, 4]. At the ocular level, main indicators of diabetes are diabetic retinopathy, cataracts and glaucoma [5]. Diabetic retinopathy being the most common cause of blindness for working age individuals and the second cause of blindness for the whole population after age-related macular degeneration [6].

Diabetic keratopathy is a frequent disease that causes many changes, mainly in the epithelium and endothelium of the cornea. Corneal epitheliopathy presents as punctate keratitis, decreased adherence to the basal membrane and also corneal hyposthesia[6.7]. Alterations on the endothelium result in a deficient pumping function, as well as cell alterations, and possibly endothelial thickening and folds[7]. From clinical point of view diabetic keratopathy is intriguing since they may become more severe in contact lens holders, and presents as decreased corneal transparency and diminution of vision [7, 8].

A population-based study showed that individuals with diabetes had thicker corneas.[6] In this aspect, central corneal thickness (CCT) has also been demonstrated to be associated with the onset and progression of glaucoma.[7] In addition, thicker or thinner central corneas may lead to either overestimation or underestimation of intraocular pressure (IOP), [8, 9] which is the most important and treatable risk factor for glaucoma. Previous studies indicated that CCT profile affects Goldmann applanation tonometry–measured IOP.[10, 11] This is especially so for eyes with CCT greater than 550 μm; every 25 μm increase in CCT was associated with 1 mm Hg change in IOP.[12]

In clinical practice, CCT is widely regarded as a static parameter and is often only measured once during a patient's long-term follow-up. However, several studies suggest that diabetic status and serum glucose concentrations may affect CCT measurement, thus potentially affecting IOP measurement.

The IOP can be altered by varioys systemic conditions like hypertension [17–19], atherosclerotic diseases [17], and diabetes [17, 20, 21]. For example, Lee and colleagues studying the relationship between IOP and systemic disorders found that increased mean blood pressure is correlated with risk of increased IOP.

Although diabetes is associated with higher IOP values in most population studies, the underlying mechanisms are still not understood [17, 20, 21]. Numerous studies indicate that changes in corneal biomechanics (increased corneal hysteresis) in eyes of patients with diabetes can lead to overestimated IOP measurements [22-24]. Although, it is unfamiliar whether changes in glucose levels could lead to IOP changes in diabetic and nondiabetic individuals. As diabetes and glaucoma can co-occur in many patients, a understanding about how glucose levels can affect IOP would give additional information to the IOP assessment.

Therefore, we seek to determine the correlation between glucose levels variation and IOP fluctuation in diabetic and nondiabetic patients.

The purpose of the present study is to determine whether there are any differences in the central corneal thickness and intraocular pressure of diabetic and non-diabetic patients in indian population.

2. Materials and Methods

A cross-sectional study was conducted in the ophthalmology clinic of Sree Balaji Medical College and Hospital . Hundred subjects, (50 healthy and 50 diabetic), were included in the study aged from 20 to 80 years. Diabetics – 20 type 1 and 80-type 2 participated in this study.

Patients were asked about the duration of diabetes. And accordingly patients were classified into 3 groups; group 1 (duration less than 5 years), group 2 (duration 5-10 years), and group 3 (more than 10 years).

Routine eye ocular examination for both eyes was done including visual acuity, refractive error, and fundus examination done.

Subjects included were those diabetics, with reliable visual fields and intra ocular pressure (IOP). Subjects excluded were those with history of glaucoma, ocular trauma, intraocular laser or surgery.

Intraocular pressure (IOP) was measured with Goldmann Applanation Tonometer (GAT) and the Central Corneal Thickness (CCT) measurements were recorded from a seated patient using a contact ultrasonic pachymeter probe gently placed in the mid-pupillary axis of the cornea in the undilated eye. All measurements were taken by expert technician.

3. Results

The mean central corneal thickness in diabetic patients was 543.61microns with a range between 515 and 588. The average central corneal thickness in non-diabetic patients was found to be 522.41 microns with range of 446 to 555 (see table 1). The increase in central corneal thickness found in diabetic patients when compared to non-diabetic patients was statistically significant (P<0.0005).

Table 1: Central corneal thickness of diabetic and non-diabetic patients

Patients	Number of patients	Mean CCT(**µm**)
Diabetics	50	543.61
Non- diabetics	50	522.41

Table 2: Central Corneal Thickness (CCT) of type 1 and type 2 diabetic patients:

Diabetes type	Number of patients	Mean CCT (**µm**)
Type1	20	542.88
Type 2	80	546.42

The mean central corneal thickness in type 1 diabetic patients was 542.88microns. The mean central corneal thickness in type 2 diabetic patients was 546.42 microns (see table 2).

The increase in central corneal thickness was found in type 2 diabetic patients compared to type 1 diabetic patients was not statistically significant (P=0.77).

Table 3: Central Corneal Thickness (CCT) in diabetic patients with different duration of the disease:

Duration of DM	Number of patients.	Mean CCT
< 5yrs	20	530.86
5-10 yrs	45	542.56
>10yrs	25	544.87

The mean central corneal thickness of diabetic patients for less than 5 years duration was 530.86, 542 for patients with duration 5-10 years, and 544.87 for more than 10 years duration (see table 3). Although there was increase in central corneal thickness with increase duration of diabetes, it was not statistically significant (P=.072).

The mean IOP in diabetic patients was found to be 16.5 ± 0.55 mmHg; $P< 0.001$ and in non diabetic patients 15.3 ± 0.72 mmHg; $P = 0.006$.(table 4).

IOP was found to be high in diabetic patients when compared to non diabetic patients.

Table 4: IOP of diabetic and non diabetic patients:

Patients	Number of patients	IOP (MEAN)
Diabetic	50	16.5 ± 0.55 mmHg
Non- diabetic	50	13.3 ± 0.72 mmHg

4. Discussion

The central coreal thickness of patients with diabetes is higher than that of normal persons because of the morphological changes seen in diabetic cornea[9, 10].There are some experimental studies that reported decrease in the corneal endothelial cell count and hexagonality, showed increase in coefficient of variation for cell size in diabetes[11]. Some studies [12] showed that diabetics with ≥ 10 years of duration have more corneal morphological abnormalities when compared to the normal subjects.

Various studies showed [13] that the corneal endothelium of diabetics has a structural disorder, but the functional disorder of the corneal tissues is not affected. Studies also

[15] showed that it took longer time for diabetic corneas to recover from damages when compared with normal persons.

Diabetics corneal endothelium has a structural disorder. Functional disorder of diabetic corneas is either caused by external factors like stress and trauma or from decreased supply of oxygen to the cornea. Studies showed that diabetes decreases the Na+-K+ ATPase function of the corneal endothelium, and this leads to the morphological and permeability changes in the corneas [16].

As per the results of the present study, diabetic patients showed significant increase of central corneal thickness when compared with normal persons. These results correlate with previous studies done worldwide. If diabetic patients have increased corneal thickness it should be taken into consideration while assessing the accurate intraocular pressure measurements.

The relationship between diabetes and IOP has been studied in previous publications. Their, results shows that there is a positive association between diabetes and IOP [21, 17-24]. Regarding the association between glucose levels and IOP, there are very little data in the literature. Traisman et al. [25] and associates, while assessing IOP in patients with blood glucose values under and above 200mg/dL, observed higher IOP values in those with glucose levels above 200mg/dL (mean difference of1.3mmHg).

Nevertheless, we believe that our data are in we found a mean IOP increase of 2.3 and 1.6mmHg in diabetic and nondiabetic patients, respectively.

Several theories have been made to explain the relation between high glucose levels and IOP. Some researchers believe that there are genetic factors associated in family history of diabetes [26] and some agree with the idea that a diabetic person could have an autonomic dysfunction which would lead to an IOP increase [27]. Nonetheless some authors believe that high blood glucose levels results in creation of an osmotic gradient which leads to shift of fuid into the intraocular space [21].

Diabtetic patients are seen on a daily basis in an ophthalmologist practice and most of these patients already have glaucoma (or ocular hypertension) or are glaucoma suspects. Attention is given to each 1mmHg variation in IOP; the glycemic control is rarely taken into account.

Based on the findings in our study, blood glucose levels variation may have an effect on IOP change and is therefore relevant for diagnosis and treatment management, especially in diabetic patients.

Therefore, we believe that ophthalmologists should consider the patient's glycemic status and glucose level variations concurrently with IOP assessment.

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