RESEARCH ARTICLE

Central Corneal Thickness (CCT) in Patients of Type2 Diabetes Mellitus and its Correlation with Primary Open Angle Glaucoma (POAG)

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Abstract

Background: Various studies have demonstrated the association of thin (CCT) with existing progression of existing glaucoma. The explanation for why CCT is a risk factor for glaucoma is not known. The simple explanation is that it is a surrogate for the known risk of IOP as the actual IOP is higher than the measured IOP in eyes with thin CCT. Diabetes mellitus affects corneal endothelium by altering sodium potassium ATPase activity. Few studies were done by some researchers to analyse corneal morphological changes including corneal thickness in diabetic patients. Our study will add to this research.

Objectives: To quantitatively analyze central corneal thickness in patients of type2 diabetes mellitus and its correlation with primary open angle (POAG)

Material and Methods: This study was conducted on diabetic patients for a period of 9 months at department of ophthalmology District Hospital Pulwama & G.M.C Doda, J & K. 100 known diabetic patients aged between 50 to 80 years and 100 age matched non-diabetic controls were selected as per inclusion and exclusion criteria. Detailed history was noted in all the patients and they underwent ophthalmic evaluation and Investigation

Results: The study group consisted of 100 diabetic patients (48 males & 52 females) in the age group of 50 to 80 years with mean age of 62.15 ± 6.48 years and 100 non diabetics (31 Males & 59 females) in the age group of 50 to 80 years with mean age of 63.15 ± 5.37. Among diabetics Mean CCT was 572.44 ± 10.65 µm in right eye and 572.11 ± 10.52 µm in left eye. Control group had mean CCT of 539.83 ± 10.85 in right eye and 538.83 ± 10.32 µm in left eye. POAG cases found were 7% in diabetic group and 3% in control group. Mean CCT among diabetics with POAG was 568.60 ± 5.648 µm as compared to 532.23 ± 5.848 µm in non-diabetics with POAG in Right eye & 565.09 ± 6.264 µm as compared to 536.12 ± 6.464 µm in left eye of non-diabetics with POAG. Mean CCT among non-glaucomatous diabetic patients was 576.29 ± 11.047 µm as compared to 547.43 ± 11.247 µm in non-diabetics without POAG in Right eye & 579.14 ± 10.80 µm as compared to 541.54 ± 10.600 µm of non-diabetics without POAG in left eye. Mean CD ratio of POAG & normal diabetics was respectively 0.680 & 0.400 ($p<0.05$). Mean IOP in right eye among POAG, and non-glaucomatous patients was 27.00 ± 2.55 mmhg and 15.15 ± 2.61 mmhg respectively. Mean IOP in left eye among POAG, and non-glaucomatous patients was 27.20 ± 2.77 mmhg and 15.52 ± 2.26 mmhg.

Thus, our study found statistically significant thicker central corneal thickness in diabetics than in non-diabetics both in glaucomatous and non-glaucomatous subjects.

Conclusion: Diabetics have thicker corneas than non-diabetics

Keywords: Diabetes mellitus, Central Corneal Thickness, Pachymetry, POAG.

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Introduction

Diabetes mellitus is a prevalent health problem worldwide. Several studies have found that diabetes is a risk factor for primary open-angle glaucoma.[1] Micro-angiopathy and compromise of micro-circulation of the optic disc is possible contributing mechanism in the pathogenesis of glaucoma. Data from a some population-based study showed that individuals with diabetes had thicker corneas.[2] Various studies have demonstrated the association of thin (CCT) with existing glaucoma, with progression to glaucoma from ocular hypertension, and progression of existing glaucoma.[3] Thicker or thinner central corneas may lead to either overestimation or underestimation of intraocular pressure (IOP),[4] which is important modifiable risk factor for glaucoma. Previous studies indicated that CCT profile affects measured IOP. This is especially so for eyes with CCT greater than 550 µm;

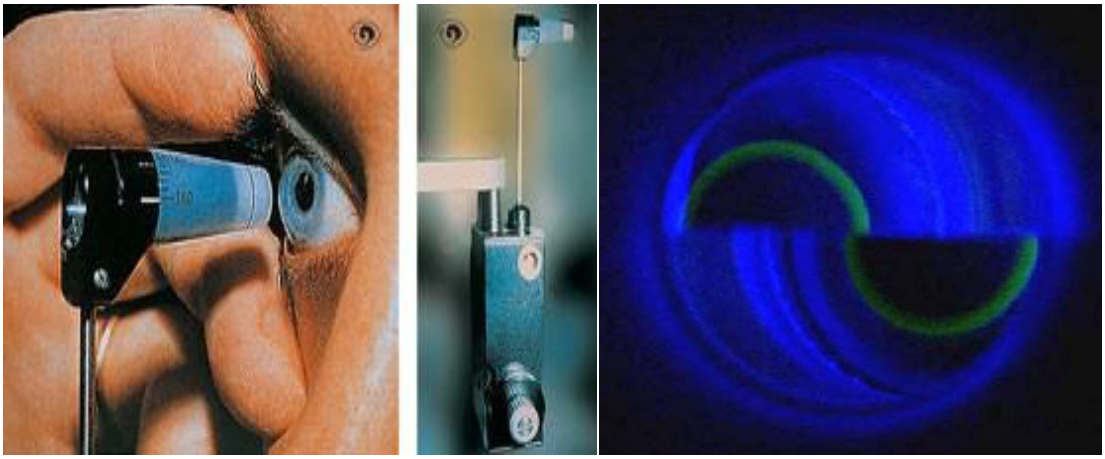

Figure 1: Perkins and Draeger are handheld versions of GAT. The applanation principle is also used by the Tono-Pen®.

every 25 µm increase in CCT was associated with 1 mm Hg change in IOP.[5] Therefore it is important to take CCT profile into account when interpreting IOP measurement. Accurate determination of CCT is important in the context of glaucoma diagnosis and management.

Primary open angle glaucoma (POAG) also known as chronic simple glaucoma of adult onset is commonest form of glaucoma. POAG is typically defined by following criteria:

- Slowly progressive raised IOP >21 mmHg recorded on at least few occasions
- An open, normal appearing anterior chamber angle
- Typical glaucomatous visual field and/or optic nerve head damage
- Absence of signs of secondary glaucoma or a non-glaucomatous cause for optic neuropathy

Applanation tonometry

The current gold standard for the measurement of intraocular pressure is the Goldmann applanation tonometer.

Applanation tonometry is based on the Imbert-Fick principle, which states that the pressure (p) inside an ideal dry, thin-walled sphere equals the force (F) necessary to flatten its surface divided by the area of the flattening (A).

$$P = F/A$$

In order to measure IOP with GAT, a drop of anaesthetic and fluorescein is instilled in the eye. Through an optical prism, the examiner sees two semicircles and adjusts the force until the inner edges of the semicircles connect. GAT is mounted on a biomicroscope and thus requires the patient to be in a sitting position.

Pachymetry

Central corneal thickness (CCT) can be measured by optical and ultrasound methods. CCT was assumed to be a constant variable when Goldmann designed his applanation tonometer. Using ultrasonic pachymetry values above or below 540 µm that are designated as thick or thin has an acknowledged effect on estimating a "true" IOP or rating relative risk of disease progression for ocular hypertensives or glaucoma patients.

Aims & Objectives

To quantitatively analyze central corneal thickness in patients of type2 diabetes mellitus and its association with primary open angle (POAG)

Methods and Materials

This study was conducted on 100 diabetic patients and 100 non diabetics (as controls) for a period of 9 months at Department of Ophthalmology District Hospital Pulwama & G.M.C Doda, J & K.

Inclusion criteria

- Known case of diabetes
- Age >50yrs
- Open angle on gonioscopy

Exclusion criteria

- Closed angle on gonioscopy
- Drug induced glaucoma (corticosteroids)
- Secondary glaucoma patients (eg:- Patients having uveitis, trauma, pigment dispersion syndrome, exfoliation syndrome, rubeosis).
- Patients with corneal decompensation , opacity, or any other corneal diseases.
- Those not willing to participate in study

Diabetic patients above 50 years were selected as per inclusion and exclusion criteria. Proper written consent was taken from each participant to participate in study. Detailed history was noted in all the patients and they underwent ophthalmic evaluation and Investigations including

- Vision
- Torch light examination of anterior segment
- Slit lamp examination(SLE)
- Fundus evaluation
- Tonometry with Goldmann applanation tonometer

Table 1: Age & Sex wise distribution of the Study group

Age group	Sex			Total
		Male	Female	
50-59	Cases	15	20	35
	Controls	12	21	33
60-69	Cases	26	24	50
	Controls	24	31	55
70-79	Cases	7	8	15
	Controls	5	7	12
Total		89	111	200

- Gonioscopy by Goldmann three mirror Goniolens
- Visual field testing using automated perimeter (SITA Standard)
- Optical coherence tomography (OCT)
- Ultrasound Pachymetry for central corneal thickness (CCT)

Statistical Analysis

Data collected was subjected to different statistical tests including Fisher Exact test, T-test using statistical package for social sciences (SPSS) version 20. P<0.05 was taken significant

Observations and Results

Scatter diagram demonstrating positive co relation between IOP & CCT.

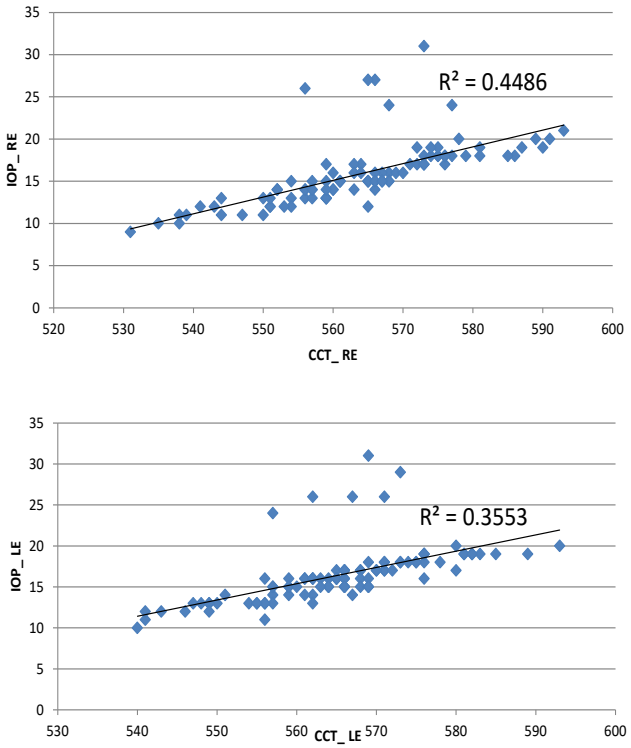

Figure 2: Corelation between IOP & CCT

Discussion

Various studies have demonstrated the association of thin (CCT) with existing glaucoma, with progression to glaucoma from ocular hypertension, and progression of existing glaucoma.[1] The explanation for why CCT is a risk factor for glaucoma is not known. The simple explanation is that it is a surrogate for the known risk of IOP as the actual IOP is higher than the measured IOP in eyes with thin CCT. Ocular changes

Table 2: Mean CCT among glaucomatous and non glaucomatous patients

Right Eye						*Left Eye*					
	Diagnosis	*Number*	*Mean CCT*	*Standard Deviation*	*p - value*		*Diagnosis*	*Number*	*CCT Mean*	*Standard Deviation*	*p - value*
POAG	Cases	7	568.60	5.648		POAG	Cases	7	565.09	6.264	
	Controls	3	532.23	5.848			Controls	3	536.12	6.464	
Normal	Cases	93	576.29	11.047		Normal	Cases	93	579.14	10.800	
	Controls	97	547.43	11.247			Controls	97	541.54	10.600	
Total	Cases	100	572.44	10.655		Total	Cases	100	572.11	10.527	
	Controls	100	539.83	10.855	<0.0000001		Controls	100	538.83	10.327	<0.0000001

Table 3: Co-relation between Mean CCT & IOP in diabetic patients

Mean CCT			*Mean IOP*		*Pearson Correlation*	*p-value*
	Value	*Std. Deviation*	*Value*	*Std. Deviation*		
RE	572.41	10.655	15.84	3.744	0.67	<0.001
LE	572.11	10.327	16.39	3.504	0.596	<0.001

in diabetic patients have been well reported. Prolonged abnormal glucose metabolism leads to alterations in the epithelium, stroma and endothelium of the cornea. CCT is also influenced by glycaemic status. In our present study, CCT measurements in the diabetic patients were found to be significantly higher than the normal subjects. Our study found mean CCT of 572.44 ± 10.65 µm in right eye and 572.11 ± 10.52 µm in left eye in diabetics. Non diabetics had mean CCT of 539.83 ± 10.85 in right eye and 538.83 ± 10.32 µm in left eye. Kumari.R et al. found similar results; mean CCT in diabetics (564.541 ± 24.56) more than mean CCT in non-diabetics (519.453 ± 25.98).[6] Busted N et al found that diabetic corneas were significantly thicker than the normal corneas. [7] Ozdamar Y et al in 2010 also reported that the CCTs of diabetic patients were thicker than that of normal subjects.[8] Sorokhaibam R et al in 2015 also reported an increase in CCT in diabetic population and also suggested complementing CCT findings with the condition of the endothelial cells [9]. N McNamara et al. stated that CCT changes were due to hyperglycaemic effects on the cornea which directly inhibits the corneal endothelial pump.[10] However our study also has a few limitations. We didn't take blood sugar level or HbA1c levels in to consideration while measuring CCT thus cannot ascertain the actual causal relationship between diabetes, blood glucose level, HbA_{1c}, and CCT. Confocal microscopy of corneal endothelium was not performed in our study, which would have provided potential insights on underlying corneal thickening changes among individuals with diabetes

Conclusion

Diabetics have thicker corneas than non-diabetics

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