Original Article

Relationship between Central Corneal Thickness and Intraocular Pressure in Selected Pakistani Population

Mazhar ul Hassan, Aziz ur Rehman, Munawar Abbas, Umar Fawad, Nasir Bhatti, Ashraf Daud

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See end of article for authors affiliations

Correspondence to:
Mazhar ul Hassan
Consultant Eye Surgeon
Al-Ibrahim Eye Hospital/
Isra Postgraduate Institute of Ophthalmology, Old Thana, Malir, Karachi

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Purpose: To explore the relationship between central corneal thickness (CCT) and intraocular pressure (IOP) in selected Pakistani population and to formulate recommendations for its application in clinical practice as well as future research.

Material and Methods: The study was conducted at Al-Ibrahim Eye Hospital Karachi for six months, on five hundred eyes of 250 adults attending the outpatient. After informed consent, all patients underwent a comprehensive assessment including medical and ophthalmic history and examination. Intraocular pressure (IOP) was measured with Goldmann Applanation Tonometer and CCT with ultrasonic pachymeter.

Results: Mean CCT in males was measured as 529.5 ± 33.6 (range 438-619 µm) and 524.1 ± 33.3 (range 443-623 µm) in females. Mean IOP in males was 12.75 ± 2.85 (range 8-20 mmHg) and in females 12.98 ± 2.39 (range 8-20 mmHg). There was a statistically significant association between CCT and IOP for normal subjects (Pearson correlation coefficient r=0.136, p=0.022). However, no statistically significant relationship was found between CCT and age (p=0.103).

Conclusion: CCT is a significant predictor of IOP. Thin corneas lead to an underestimation and thick corneas, to an overestimation of intraocular pressure. Pakistani population in our study has comparatively thinner corneas as compared to Caucasian and African-American population. However further studies with sufficiently large sample size are needed to validate and to demonstrate its original value.

The normal intraocular pressure varies from 10-20 mmHg. Goldmann applanation tonometer is considered to be the gold standard in measuring intraocular pressure[1]. It works according to Imbert-Fick principle, which states that for an ideal, dry, thin walled sphere, the pressure inside equals to the force necessary to flatten its surface divided by the area of flattening[2]. A pachymeter is a device that uses ultrasound to determine the thickness of the cornea in any given location. Normal CCT is 490-560 µm[2]. The clinical use of central corneal thickness measurements has become so important that it directly affects glaucoma management strategy in 15% of patients[3, 4]. Various studies have been performed worldwide to study the significance of CCT in measuring IOP and glaucoma management. We want to perform a similar study to find out the relationship between central corneal thickness and intraocular pressure in Pakistani individuals.

MATERIALS AND METHODS

We conducted this study at Al-Ibrahim Eye Hospital (AIEH), Karachi. It was a prospective, non intervenetional, comparative study which included 500 eyes of 250 adults who attended the outpatient department over a period of 6 months. We used non-purposive, convenience sampling. As this was a descriptive study, therefore no sample size calculation was made. The inclusion criterion was age between 40 and 60 yrs

regardless of the gender. We excluded patients with preexisting ocular pathologies, history of contact lens wear, history of intraocular surgery, laser or trauma, corneal astigmatism greater than 3 diopters, patients with systemic illness or taking any topical or systemic medications. The patients were selected from outpatient department of AIEH. After informed consent, all patients underwent a comprehensive ophthalmic assessment which consisted of history regarding refractive errors, glaucoma, use of topical steroids, use of contact lenses, history of refractive surgery or laser. Best corrected visual acuity was obtained followed by slit lamp examination to rule out anterior segment pathologies corneal pathologies and infections. After anesthetizing the eye with topical proparacaine 0.5% and using the fluorescein strips 2%, we measured IOP in both eyes using Goldmann applanation tonometer. We examined all the patients between 9:00am-12:00noon. We took three consecutive readings and the mean was noted. CCT was measured with ultrasonic pachymeter (Pac Scan 300p digital biometric ruler). The ultrasound pachymeter was calibrated at the beginning of each day according to the manufacturer's instructions. After anesthetising the cornea with topical proparacaine 0.5% and the patient looking in primary position of gaze, the pachymeter probe was placed on the centre of the cornea. Five measurements were taken from each eye and the average was used for analysis.

The data was entered in MS Excel and was cleaned and analyzed using SPSS v. 10.0. Mean ± SD was calculated for all quantitative variables. Frequencies and percentage was computed for sex. Pearson correlation test was applied to find the relationship between corneal thickness and intraocular pressure at $p \leq 0.05$ level of significance.

RESULTS

Out of 250 patients, 130 (52%) were males and 120 (48%) were females. Most of the patients 83(33.2%) belonged to the age group of 40-44 years. The mean CCT in males was 529.5 ± 33.6 (range 438-619µm) and 524.1 ± 33.3 (range 443-623µm) in females. The mean intraocular pressure in males was 12.75 ± 2.85 (range 8-20 mmHg) and 12.98 ± 2.39 (range 8-20 mmHg) in females. A significant association was found between central corneal thickness and intraocular pressure for normal subjects (Pearson correlation coefficient r=0.136, p=0.022). There was no statistically significant relationship between the central corneal thickness and age. (p =0.103).

Table 1. Mean intraocular pressure for both genders according to central corneal thickness n=250

CCT (µm)	Male		Female	
	n	IOP (mm Hg)	n	IOP(mm Hg)
< 525	61	12.67± 2.8	67	12.81± 2.25
525 – 575	58	12.75± 2.9	47	13.05± 2.35
> 575	11	13.5± 3.51	6	11± 4.2

CCT = Central Corneal Thickness

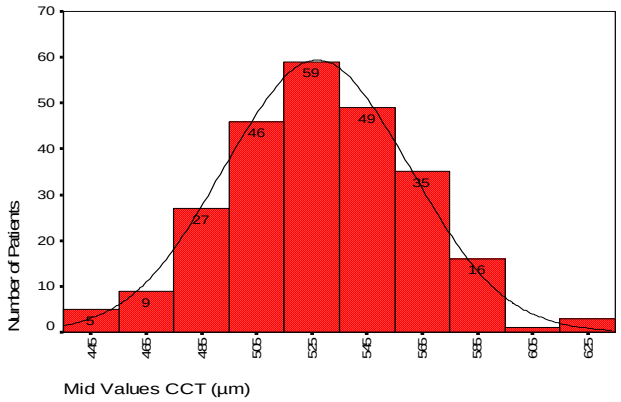

Fig. 1. Distribution of Central Corneal Thickness
Mean± SD = 527± 3.5 (Range = 438 - 623 (µm)

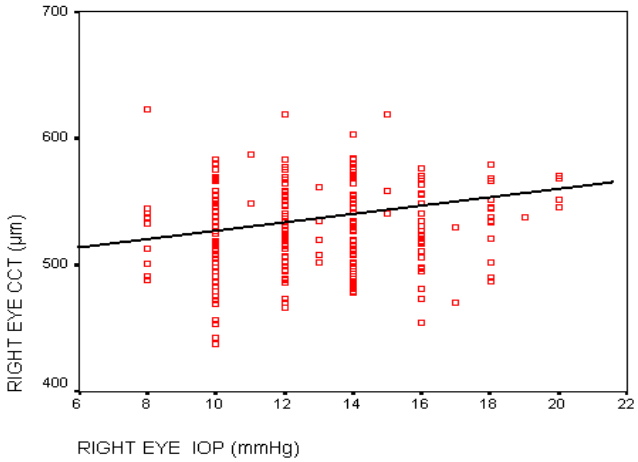

Fig. 2. Relationship between central corneal thickness and intraocular pressure
Pearson Correlation Coefficient (r) = 0.136, P= 0.022

DISCUSSION

Intraocular pressure is an important factor that has a significant influence in the diagnosis and follow-up of ocular hypertension and glaucoma patients. Know-

ledge of the central corneal thickness therefore, is important to know the validity of the intraocular pressure readings. To the best of our knowledge, this is the second hospital based study from Pakistan to determine the effect of CCT on IOP[5].

Dueker et al concluded that CCT measured by ultrasound pachymetry is a reliable indicator of risk for progression of ocular hypertension to glaucoma. Mixed evidence was found in terms of the association of CCT with the presence of glaucoma, therefore the value of CCT measurement as a screening tool for glaucoma appears to be negligible[6].

The Ocular Hypertension Treatment Study (OHTS) established corneal thickness as a risk factor for glaucoma. In the opinion of Kass, the OHTS demonstrated that moderate IOP reductions could be achieved and maintained during a median follow-up period of 72 months[7].

In a cross-sectional study arm of the OHTS, Brandt et al set out to determine if CCT is related to race. CCT was measured in 1301 patients with ocular hypertension[8]. Ultrasonic pachymeters of the same make and models were used in all sites. The mean CCT in Caucasians was 573 µm, while the mean CCT for African-American subjects was 555.7µm. The study demonstrated that African-American subjects have thinner corneas than white subjects. The effect of CCT may influence the accuracy of applanation tonometry in the diagnosis, screening and management of patients with glaucoma and ocular hypertension.

La Ros reported a comparative study of CCT of Caucasians and African-Americans in glaucomatous and non glaucomatous populations. A statistically significant difference was found between the central corneal thickness of African-Americans (n=56) and Caucasians (n=32) who had suspected or confirmed glaucoma from control populations of African-Americans (n=56) and Caucasian (n=51) subjects who had no evidence of glaucoma, elevated intraocular pressure (IOP) or optic nerve damage. It is proposed that the finding that African-Americans have thinner corneas than Caucasians may lead to lower applanation, intraocular pressure readings, and potentially result in an underestimation of the actual level of intraocular pressure[9].

The Ocular Hypertension Treatment Study is the first to establish corneal thickness as a risk factor for glaucoma. Based on the results of this study, the American Academy of Ophthalmology Preferred Practice Pattern on Evaluation of the Glaucoma Suspect recommends measurement of corneal thickness with electronic pachymetry in evaluating the glaucoma suspect[7,10].

Our study had 500 eyes of 250 subjects. The mean CCT in males was 529.5 ± 33.6 and 524.1 ± 33.3 in females. In contrast the earlier studies had mentioned that the mean CCT in Caucasians was 573 µm, and 555.7µm in African-American subjects. Figure 1 illustrates the normal Gaussian curve for distribution of CCT in our patients. It demonstrates that majority of patients had mean CCT in the range of 525µm, which is smaller when compared to the other ethnicities.

Our study has the following limitation. Firstly, the sample size is relatively small and may not be able to detect the exact relationship between IOP and CCT. Secondly, we used convenience sampling and all the samples were taken from the hospital. Therefore, our findings cannot be extrapolated to the general Pakistani population. Thirdly, our hospital is a charity hospital and majority of our patients belong to underprivileged group of society therefore our findings may be biased with factors such as socioeconomic status, occupation, exposure to sunlight etc.

In conclusion, thin corneas lead to an underestimation and thick corneas, to an overestimation of intraocular pressure. CCT is a significant predictor of IOP. Pakistani population has comparatively thinner corneas when compared to Caucasian and African-American population. However further studies with sufficiently large sample size are needed to validate this finding and to demonstrate its value in the management of glaucoma.

Author's affiliation

Dr. Mazhar ul Hassan
Al-Ibrahim Eye Hospital /
Isra Postgraduate Institute of Ophthalmology
Old Thana, Malir, Karachi

Dr. Aziz ur Rehman
Al-Ibrahim Eye Hospital /
Isra Postgraduate Institute of Ophthalmology
Old Thana, Malir, Karachi

Dr. Munawar Abbas
Al-Ibrahim Eye Hospital /
Isra Postgraduate Institute of Ophthalmology
Old Thana, Malir, Karachi

Dr. Umar Fawad
Al-Ibrahim Eye Hospital /
Isra Postgraduate Institute of Ophthalmology
Old Thana, Malir, Karachi

Dr. Nasir Bhatti
Al-Ibrahim Eye Hospital /
Isra Postgraduate Institute of Ophthalmology
Old Thana, Malir, Karachi.

Dr. Ashraf Daud
Al-Ibrahim Eye Hospital /
Isra Postgraduate Institute of Ophthalmology
Old Thana, Malir, Karachi

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