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CENTRAL CORNEAL THICKNESS IN PSEUDOEXFOLIATIVE GLAUCOMA WITH CATARACTS IN A TERTIARY CARE HOSPITAL

Ophthalmology

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ABSTRACT

To compare the central corneal thickness (CCT) in pseudoexfoliation glaucoma (PXG) patients undergoing cataract surgery with healthy adults. A total of 104 patients having PXG (Group A) and 104 controls having normal intraocular pressure (Group B) were included in the study. Intraocular pressure (IOP) in both groups was measured using gauged Goldmann applanation tonometer (GAT).Central corneal thickness (CCT) was measured in both groups. The comparison of Mean CCT in both Groups showed that Mean CCT was significantly lesser(p-value <0.05) in PXG Group (556.4 µm) as compared to control Group (572.5 µm). CCT in PXG patients group was found to be statistically significantly thinner as compared to healthy adults Group. CCT must be assessed in patients with pseudoexfoliation syndrome (PXF) in order to avoid the underestimation of IOP.

KEYWORDS

Central corneal thickness (CCT), Goldmann Applanation Tonometer (GAT), Intraocular pressure (IOP), Pseudoexfoliation glaucoma (PXG), Pseudoexfoliation syndrome (PXF).

INTRODUCTION

The cornea is the transparent front part of the eye that covers the iris, pupil, and anterior chamber. The cornea, with the anterior chamber and lens, refracts light, with the cornea accounting for approximately two-thirds of the eye's total optical power[1,2]. In humans, the refractive power of the cornea is approximately 43 dioptres[3]. While the cornea contributes most of the eye's focusing power, it's focus is fixed. The curvature of the lens, on the other hand, can be adjusted to "tune" the focus depending upon the object's distance.

The cornea has unmyelinated nerve endings sensitive to touch, temperature and chemicals; a touch of the cornea causes an involuntary reflex to close the eyelid. Because transparency is of prime importance the cornea does not have blood vessels; it receives nutrients via diffusion from the tear fluid through the outside surface and the aqueous humour through the inside surface, and also from neurotrophins supplied by nerve fibres that innervate it.As cornea has no blood supply it gets oxygen directly through air. Oxygen first dissolves in the tears and then diffuses through out the cornea to keep it healthy[4]Transparency,avascularity, the presence of immature resident immunecells,and immunologic privilege makes the cornea a very special tissue.

In humans, the cornea has a diameter of about 11.5 mm and a thickness of 0.5—0.6 mm in the center and 0.6—0.8 mm at the periphery. Central corneal thickness (CCT) has a very important value in glaucoma patients, if the central cornea is thinner then it suggests that the intraocular pressure is falsely low.[5]

Patients classified as glaucoma suspects have been reported to have a higher CCT than individuals with chronic open angle glaucoma or healthy individuals with 42% of glaucoma suspects having a CCT of greater than 585 µm[6,7,8]. There is no universally accepted formula, however, that can be applied to 'correct' the IOP measurement for any given CCT. Based on a review of various correction factor approaches, the range probably falls between 2.5 and 3.5 mmHg per 50µm of difference from normal[9]. Hence, if a patient's CCT measured 650um, then the "true" IOP would likely be several mm of mercury less than measured.In children the reported central corneal thickness ranges from roughly 540 µm at 6 to 23 months of age to approximately 550 to 560µm for older children, with thinner central corneal thickness reported in white compared with black children.[10]

Mathematical calculation for Goldmann applanation tonometry is based on a presumed average CCT of 520 µm. Deviations from the average central corneal thickness are a source of error with corneal edema underestimating the true IOP, whereas variations of CCT in normal corneas can lead to falsely higher pressure readings with thicker corneas and falsely lower ones with thinner corneas.[11]

Pseudoexfoliation syndrome is a generalized disorder of the extracellular matrix associated with excessive production and progressive accumulation of abnormal fibrillar material in intraocular and extraocular tissues[12]. In glaucoma patients, the prevalence of pseudoexfoliation is high, and elevated intraocular pressure occurs in 15%-50% of patients, about 6-10 times the rate in eyes without pseudoexfoliation[13,14]. The characteristics of pseudoexfoliation glaucoma are high intraocular pressure, fluctuation in diurnal curve of intraocular pressure, marked spiking and pressure peaks, pigment dispersion and trabecular pigmentation, and poor response to medical therapy. Smaller optic disc, and significant correlation between intraocular pressure level and the mean visual field defect suggest that intraocular pressure is the main factor for glaucomatous damage[15].

Pseudoexfoliation glaucoma accounts for approximately 25% of all open angle glaucomas worldwide[16]. The prevalence of pseudoexfoliation glaucoma as reported by population-based surveys from South India vary between 7.5 and 13%[17,18]. Pseudoexfoliation glaucoma has a more serious clinical course and a worse prognosis than primary open angle glucoma[19,20].

Flakes of exfoliative material and pigment accumulation may be seen on the corneal endothelium, scattered diffusely or in the form of a vertical spindle similar to the Krukenberg spindle in pigmentary glaucoma. Specular microscopy of the corneal endothelium has revealed a significantly lower than normal cell density in eyes with the exfoliation syndrome and changes in cell size and shape. These findings have also been observed in the unaffected eye of unilateral cases, leading the researchers to suggest that these corneal endothelial changes might serve as an early sign of the disorder.[21]

The exfoliation syndrome is associated with excessive pigment dispersion which leads to increased trabecular meshwork pigmentation. An accumulation of pigment may also be seen along the schwalbe line, which has been termed the Sampaolesi line[22].

In eyes with marked asymmetry of mesh work pigmentation, glaucoma is more common in the more pigmented eye[23]. Although the anterior chamber depth is normal in most eyes with the exfoliation syndrome the anterior chambler angle is occludable in a high percentage of cases.[24] Ultrastructural studies indicate that there is active exfoliation production in the trabecular meshwork, schlemm canal and collector channels as well as passive deposition of exfoliative material within intertrabecular spaces[25].

Most eyes with exfoliative glaucoma have an open angle mechanism, although acute angle closure glaucoma also occurs in a small number of cases [26,27,28,29]. Mechanism of IOP elevation in exfoliative glaucoma associated open angle may include local production of exfoliative material, endothelial cell damage of the trabecular meshwork and passive deposition of exfoliative material and pigment originating from elsewhere in the anterior segment[30,31,32]. A less common mechanism of glaucoma in patients with the exfoliation syndrome is acute or chronic angle closure glaucoma[23,26,27,28,29]. A number of mechanisms may create a tendency towards pupillary block and angle closure, including zonular weakness, causing anterior movement of the lens, lens thickening from cataract formation, increased adhesiveness of the iris to the lens due to exfoliative material, sphincter muscle degeneration and uveitis and iris rigidity from hypoxia.[33]

Aims And Objectives

To measure central corneal thickness in pseudoexfoliative glaucoma in patients undergoing cataract surgery

Materials And Methods

This hospital based prospective comparative observational study was conducted in the Postgraduate Department of Ophthalmology, Government Medical College, Srinagar from March 2014 to August 2018 in patients with pseudoexfoliation patients undergoing cataract surgery. After obtaining the ethical clearance from the Institutional Ethical Committee the following patients were included in the study. Those patients with no previous corneal surgeries or history of contact lens wearing, an untreated IOP≥21mm Hg with an open angle , typical pseudoexfoliation material within the angle and upon the lens and in the pupillary area, glaucomatous optic disc with glaucomatous visual field defects were included as subjects

Non cooperative patient, previous intra-ocular surgery, history of ocular trauma, uveitis, corneal scars, lens induced glaucoma and other ocular pathology that could have led to secondary glaucoma were excluded from the study

After obtaining informed consent from the patients, ocular examination in all patients was performed with slit lamp examination, gonioscopy with Goldmann two mirror indirect gonioscope and dilated fundus examination using +90D lens. The IOP was recorded with a Goldmann Applanation Tonometer.(Haag-Streit, Koniz, Switzerland) Visual Field Assessment (VFA) was performed using Humphrey Field Analyser II (Carl Zeiss, Meditec). Optical coherence tomography (OCT) for retinal nerve fibre layer (RNFL) was performed with ZEISS CIRRUS HD-OCT. (Carl Zeiss AG, Feldbach)

As controls, 104 patients were examined over the same time period. Diagnosis in these control patients was senile cataract or refractive error. The controls had normal IOP, normal fundus, no pseudoexfoliative material at the anterior lens capsule or pupillary margin, no previous intraocular surgery and no abnormalities of the cornea.

The patients were seated at the instrument with the chin on the chin rest and the forehead against the forehead band. When the endothelium was in proper focus the instrument automatically took a picture of the endothelium. All readings were taken in a very calm and comfortable environment. The central corneal thickness and tonometric values (IOP) were recorded on a proforma containing the patient's identity and all the necessary details required for the study. Measurement of IOP and CCT was done by the same person for all the cases to eliminate bias. Data had been analyzed in the SPSS. Descriptive statistics were used to describe the results. Independent sample t-test was applied to compare the Mean difference of CCT between the two groups, p-value of < 0.05 was taken as significant.

RESULTS

A total of 208 patients were examined with equal number of pseudoexfoliative glaucoma patients and controls.

The demographic characteristics of the participants are summarized in tables 1. The mean age with standard deviation in control group and PXG group were 73.6 (8.6) and 74.8 (9.8) years respectively. No significant differences were found in between age and sex among the patients of two groups.

Table 1:Age and Gender Distribution

		Control		PXG		p value
		No.	%age	No.	%age	
Age group (years)	60-69	36	34.6	34	32.7	0.41 NS
	70-79	35	33.7	37	35.6	
	≥80	33	31.7	33	31.7	
Gender	Male	53	50.9	55	52.8	0.75 NS
	Female	51	49.1	49	47.2	

The comparison of mean CCT in both groups showed that Mean CCT in PXG group (556.4 µm) was significantly lesser (p-value <0.05) compared to control group (572.5 µm) as given in table-2.

Table 2: Descriptive statistics of CCT in both groups along with comparison

CCT (µm)	N	Minimum	Maximum	Mean	SD	SE Mean	p value
PXG	104	503.6	590.2	556.4	24.95	3.22	0.001
Control	104	516.4	604.7	572.5	22.61	3.50	

SD: standard deviation
SE: Standard Error

DISCUSSION

Pseudoexfoliative glaucoma is a disease that has a greater prevalence in older population as reported by Schlotzer-Schrehardt U et al and Sood NN [34,35]. Patients enrolled in our study had mean age of 74.8year which is comparable to previously published reports Arvind et al, Krishnadas R et al and Ritch R et al.[17,18,36].

Five consecutive measurements were taken at the center of the cornea of eye and their mean was taken for analysis as proposed by Colin et al in their study to obtain the accurate central corneal thickness.[37] There is diurnal variation in corneal thickness. [38] Harper et al also observed that central corneal thickness varies during the day.[39] However it does not appear to vary significantly during working hours.[40] Similarly IOP also shows diurnal variation as discussed previously. To avoid the effects of diurnal variation, the measurements in our study were taken between 0900-1200 hrs

Several studies have pointed that cornea is thinner in PEX cases.[41] These alterations are probably secondary to changes in endothelial cells because corneal thickness is an indirect indicator of endothelial function. The mean central corneal thickness in PXG patients has been reported as 493±33 by Bechmann M et al, 507±25 by Ventura AC et al and 528±30 by Puska P et al.[42,43,44] These findings are comparable to our study group [556.4±28.95]. In our study there was a significant difference in the CCT in PXG patients compared to the normal group [572.5±19.91]. Our study, like some previous studies has shown that CCT in PXG patients is thinner compared to the control Group.[42,45,46]

The main sufferers are those patients who have thin corneas and their IOP measurements taken by GAT are in higher teens. These patients can be easily diagnosed as having PXG if the CCT corrective factor is incorporated into IOP measurements because this will take the IOP reading out of normal limits resulting in timely diagnosis of the disease at an earlier stage. People with undiagnosed PXG and thinner corneas disease tends to progress unchecked leading to extensive irreversible glaucomatous damage.

CONCLUSION

In our study CCT in PXG patients was statistically significantly thinner as compared to the CCT of control group. Assessment of CCT in patients with PXF is a must in order to avoid underestimation of IOP. Timely diagnosis of the disease at an initial stage will help in preventing considerable irreversible visual damage.

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