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Study of Role of Central Corneal Thickness in the Measurement of Intra Ocular Pressure in Patients with Primary Open Angle Glaucoma

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ABSTRACT
The present study of role of central corneal thickness in the measurement of intraocular pressure in primary Open angle glaucoma study was conducted in the Department of Ophthalmology. 100 patients were selected from those attending the Glaucoma clinic were evaluated for measurement of Central Corneal Thickness. They were subjected to central corneal thickness measurement by ULTRASOUND PACHYMETRY. Patients with OHT have a thick CCT than do patients with POAG or NTG. Underestimation of the IOP in patients with POAG who have thin corneas may lead to a mis diagnosis of NTG, while overestimation of the IOP in normal subjects who have thick corneas may lead to a mis diagnosis of OHT. Low CCT is a risk factor for primary open-angle glaucoma. Whether it is a confounding factor in IOP measurement or an independent risk factor for glaucomatous optic neuropathy, is yet to be established. Baseline central corneal thickness measurement in all glaucoma patients and suspects is recommended. This will not only improve clinical decision making regarding "ocular hypertension" and "normal tension glaucoma", but will also aid in adequate management of glaucomatous optic neuropathy by reducing error in the measurement of target IOP.

INTRODUCTION

Central corneal thickness plays an important role in understanding the risk of glaucoma[1,2]. Corneal thickness of <555µm provides false results of low intra ocular pressure, whereas, corneal thickness of >555µm provides a false result of raised intra ocular pressure when measured with Goldmann applanation tonometry[3]. Primary open angle glaucoma is defined as multi factorial progressive optic neuropathy that is chronic and progressive with characteristic acquired loss of optic nerve fibres. Such loss develops in presence of open anterior chamber angle, characteristic visual field defects and intraocular pressure that is too high for the continued health of the eye. It manifests by cupping and atrophy of the optic disc in the absence of other known causes. Glaucoma is one of the leading cause of irreversible blindness in the world and accounts for about 12% of all new cases of blindness each year. Primary open angle glaucoma (POAG) accounts for nearly half of the cases[4]. Intraocular pressure (IOP) is an important clinical outcome in glaucoma diagnosis. IOP should be recorded with an accurate technique for reliability. The Ocular Hypertension Treatment Study (OHTS) showed that central corneal thickness (CCT) was a significant predictor of which patients with ocular hypertension are at higher risk for converting to glaucoma[3,4]. IOP measurement is altered by corneal thickness. Patients with thinner cornea would have very high IOP reading and thicker cornea patients would have very low IOP recording. Central Corneal Thickness (CCT) plays a major role in IOP manipulation. IOP should be adjusted with CCT to target IOP in glaucoma management[5]. Most patients with early glaucoma are asymptomatic. Much peripheral vision can be lost before the patient notices visual impairment. Failure of early detection of the disease poses a management problem towards controlling glaucomatous blindness. Thin Central cornea has been suggested as one of the risk factors of POAG along with other risk factors such as positive family history, age, black race, myopia, diabetes mellitus, migraine and steroid usage. Measurement of intraocular pressure (IOP) is fundamental to the management of glaucoma since it remains the only modifiable risk factor[4-11]. Very few studies have been conducted on the impact of central corneal thickness on intra ocular pressure in South Indian population with primary open angle glaucoma. We carried this study to determine the effect of central corneal thickness on the measurement of intra ocular pressure as measured by Goldmann applanation tonometry.

Aims and Objectives:

- To determine the effect of central corneal thickness on the measurement of intra ocular pressure as measured by Goldmann applanation tonometry.
- The resultant reclassification of patients as having primary open angle glaucoma (POAG), normal tension glaucoma (NTG) or ocular hypertension (OHT).

MATERIALS AND METHODS

A prospective study was conducted in the Department of Ophthalmology. 100 patients were selected from those attending the Glaucoma clinic were evaluated for measurement of Central Corneal Thickness. They were subjected to measurement of central corneal thickness by Ultrasound pachymetry.

Inclusion Criteria:

- Newly diagnosed and old cases of Glaucoma were taken into account.
- Age >40 years was chosen keeping in mind that Glaucoma develops in middle age.

Exclusion Criteria:

- Any corneal pathology affecting curvature and thickness.
- Any previous ocular surgery.
- Contact lens wearers.
- Angle closure glaucoma.
- Secondary glaucoma.

All Patients Underwent Preliminary Investigations which Included:

- V/A.
- Slit lamp biomicroscopy.
- Refraction.
- IOP by Goldmann Applanation tonometer.
- Gonioscopy by Goldmann indirect gonioscope.
- 78D biomicroscope.
- Visual field assessment by Humphrey field analyzer.
- CCT measurement by ultrasound pachymetry.

Method of Pachymetry: CCT was performed by a single observer. Topical anaesthesia was achieved by 1 drop of 4% xylocaine in both eyes. Patient seated upright and made to fix at a point with the other eye. Hand held probe is aligned as Perpendicular as possible on the central cornea.3 readings are taken in each eye and average is noted.

RESULTS AND DISCUSSIONS

Urban population is predominant than rural population in the current sample. Maximum are in the age group of 50-59. The range is from 40 years to 79 years. Mean age of the sample was 55.4+.8.42 years. Mean IOP was 25 mm HG and Standard Deviation of 8. 72 eyes are found to be in the range of 20-24mmHg. Glaucoma is a heterogeneous group of eye diseases from the viewpoint of pathogenesis and clinical expression. Glaucoma is characterized by optic nerve damage,

Table 1: IOP Range in the Current Sample

S no	IOP Range	Number of Eyes	Percentage of Cases
1	10-14mm Hg	12	6%
2	15-19 mmHg	36	18%
3	20-24 mmHg	70	35%
4	25-29 mmHg	56	28%
5	30-34 mmHg	16	8%
6	35-39 mmHg	8	4%
7	40-44 mmHg	2	1%
8	**Total**	200	100%

Table 2: Reclassification of Patients in the Present Sample Taking CCT Adjusted IOP Into Account

SNO	Type of glaucoma	Number of cases	Percentage of Cases
1	**POAG**	74	74%
2	**OHT**	7	7%
3	**NTG**	16	16%
4	**TOTAL**	97	97%

Table 3: Mean Difference Between 2 Eyes

S. No	Type of Glaucoma	No. of Cases	Mean Difference Between 2 Eyes	Standard Deviation
1	**POAG**	67	10.58	6.43
2	**OHT**	10	7.2	6.87
3	**NTG**	23	13.52	6.62

Table 4: Correlation and Significance Between Mean CCT and Mean IOP

S.No	Type of Glaucoma	No. of Cases	Mean CCT	Mean IOP	Correlation factor (R)	P value
1	**POAG**	67	529.5	24.85	0.1414	0.2537
2	**OHT**	10	536.5	23.55	0.5187	0.1244
3	**NTG**	23	528.56	22.10	0.1081	0.6234

leading ultimately to irreversible blindness. Glaucoma is estimated to affect approximately 70 million people worldwide. In the years to come, this disease is expected to affect even greater populations, especially as the elderly population grows disproportionately. In the present study, 65 were males and 35 were females, with a ratio of 1.22: 1. Our findings are similar to few other studies in which males had a higher prevalence of POAG. Diagnostic findings include a symmetrical enlarged cup to disc ratio. Our patients with NTG had thinner CCT than the group with POAG while the group with OHT had notably thicker CCT than patients with POAG and NTG. The study have shown that underestimation of IOP may result in some patients with POAG receiving a misdiagnosis and being treated for NTG. Indeed, when corneal thickness was taken into account, 7 (7%) of our patients thought to have NTG actually met the criteria for a diagnosis of POAG. Similarly 3 patients diagnosed as having OHT in our study actually have normal IOP. In other words, 7 patients (7%) diagnosed as having NTG actually had POAG and 3 of the patients diagnosed as having OHT really had an IOP that was within normal limits. Through our study we found that there was an influence of central corneal thickness on intraocular pressure in patients with primary open angle glaucoma. There is a need for evaluation of central corneal thickness in patients who were presented with symptoms of glaucoma, but, with low intraocular pressure as it helps in providing effective intervention for controlling intraocular pressure and preventing optic nerve damage. We suggest that the measurement of intraocular pressure (IOP) is fundamental to the management of glaucoma since it remains the only modifiable risk factor. CCT is among the strongest, independent predictors for the development of primary open-angle glaucoma (POAG) in the Ocular Hypertension Treatment Study (OHTS)1 and the European Glaucoma. Prevention Study (EGPS). The risk of developing POAG doubled for every 40 µm decrease in CCT from the overall mean of 573.3 µm in the OHTS and EGPS pooled sample. Other independent predictive factors for the development of POAG in the OHTS and EGPS prediction models were baseline age, intraocular pressure (IOP), vertical cup-to-disc ratio (VCDR) and pattern standard deviation (PSD). Other studies have also reported similar associations between CCT and the incidence of POAG or the prevalence of POAG. By comparison, IOP reflects transient factors that may or may not be relevant to the risk of developing POAG. The test-retest agreement between multiple IOP's at a given OHTS visit is very high, but the test-retest agreement between 6 month visits is low to moderate. OHTS may not have captured information that is important to ascertaining the relationship of IOP to the risk of developing POAG. Tonometry are thus well worthwhile, the accurate measurement of central corneal thickness being important not only for individual patient care, in permitting more precise estimations of IOP, but also for clinical studies, in assuring a more reliable classification of subjects. Finally, CCT shows a strong parent-child heritability. Siblings and offspring of those with thin CCT are likely

to have similarly thin CCT and perhaps a more susceptible optic nerve head underlying the increased familial risk for glaucoma.

CONCLUSION

Low CCT is a risk factor for primary open-angle glaucoma. Whether it is a confounding factor in IOP measurement or an independent risk factor for glaucomatous optic neuropathy, is yet to be established. Baseline central corneal thickness measurement in all glaucoma patients and suspects is recommended. This will not only improve clinical decision making regarding “ocular hypertension” and “normal tension glaucoma”, but will also aid in adequate management of glaucomatous optic neuropathy by reducing error in the measurement fo target IOP.

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