

TYPE OF SUBMISSION-ORIGINAL ARTICLE
TITLE OF PAPER- TO CLINICALLY EVALUATE LINEAR
CORRELATION BETWEEN INTRAOCULAR PRESSURE
AND CENTRAL CORNEAL THICKNESS IN VARIOUS
TYPES OF GLAUCOMA AND GLAUCOMA SUSPECT

AUTHORS-

1) DR. BAHUBALI JAIN (M.B.B.S ,M.S)

Associate Professor, Department Of Ophthalmology- NSCBMCH

Email: drbahu@gmail.com

Address- 5/14,CBI office road, Vijaynagar-Jabalpur(M.P.), PIN-482002

Phone no-9425384573

2) DR. SABA FIRDOS KHAN (M.B.B.S ,M.S)

Assistant Professor, Department Of Ophthalmology- NSCBMCH

Email: sabafirdosk@gmail.com

Address- C-603, koushalya my homes-Jabalpur (M.P.) ,PIN-482003

Phone no-9340765178

3) DR.SHUBHAM NAMDEO (M.B.B.S ,M.S)

Eye Specialist, Indira Eye Hospital, DH Sagar (M.P)

Email: shubh91.nam@gmail.com

Address- C/O mr G.P. shandilya, manorama colony, Sagar (M.P.) PIN-470001

Phone no-7987077696

SUBJECT- OPHTHALMOLOGY

WORD COUNT- 2017

Abstract

Background- Glaucoma is a progressive optic neuropathy. Elevated intraocular pressure is a well-known major risk factor for glaucoma. Thus, any factor that alters the value of the IOP can affect in the management of the patient. Several studies in the past has proven that central corneal thickness affects the accuracy of applanation tonometry. Thus Central Corneal Thickness (CCT) should be considered in the clinical evaluation of the glaucoma patient and glaucoma suspect. The aim of present study is to detect linear correlation between intraocular pressure and corneal thickness using Goldmann applanation tonometer and pachymeter and to compare the Central corneal thickness value in various type of glaucoma patients.

Methods: The present Cross Sectional Clinical study was conducted in 100 patients attending the out patient department for the academic year 2021-2023. Patients of age more than 40 years who are diagnosed cases of glaucoma or are glaucoma suspects were included. IOP was measured using Goldmann's Applanation Tonometer and CCT was measured using the ultrasound pachymeter. All the patients were classified as primary open angle glaucoma (POAG), primary angle closure glaucoma(PACG), ocular hypertensive (OHT) and glaucoma

suspect(GS). Analysis of Variance and Pearson's Correlation Test was used to determine any significant difference in CCT and the corrected IOP between the these groups.

Results: The mean CCT of OHT was much higher ($567.12 \pm 25.49 \mu\text{m}$) than the other groups. In case of thin cornea, corrected IOP is slightly greater than mean IOP while in case of normal and thick cornea as in cases of OHT corrected IOP is lower than mean IOP.

Conclusion: Increased corneal thickness in ocular hypertension may lead to an overestimation of IOP. Measurement of central corneal thickness is advisable in evaluation of all the cases of glaucoma and glaucoma suspects.

Keywords: CCT, Glaucoma, GAT, IOP, Ocular hypertension.

INTRODUCTION

Glaucoma is one of the leading causes of irreversible blindness in the adult population worldwide. It is a chronic, bilateral and often asymmetrical progressive disease of adults with acquired loss of optic nerve fibres and abnormality in the visual field. Intraocular pressure is detrimental to the structural and functional integrity of optic nerve head.⁽¹⁾ The prevalence of POAG is highest in Africa and the prevalence of PACG is highest in Asia. As per the data from World Health Organization, India has 1% prevalence of blindness. The Vellore Eye Survey (VES) reported a prevalence of 0.41% for POAG in the 30 to 60-year age group whereas the Andhra Pradesh Eye Diseases Study (APEDS) estimated the prevalence of POAG in the urban population to be 2.56% in those aged 40 years and older. The prevalence of POAG in the Aravind Comprehensive Eye Survey (ACES) was 1.2%.^(2,3,4,5) Elevated intraocular pressure is a well-known major risk factor for POAG.⁽⁶⁾ Recent studies have especially stressed on influence of central corneal thickness (CCT) on IOP measurement by applanation tonometry. Actual IOP may be underestimated in patients with thinner CCT and overestimated in patients with thicker CCT.

AIMS AND OBJECTIVES

To detect linear correlation between intraocular pressure and corneal thickness using Goldmann applanation tonometer and pachymeter and to compare the Central corneal thickness value in various type of glaucoma patients.

MATERIAL AND METHODS –

The present Cross Sectional Clinical study was conducted in 100 patients attending the out patient department for the academic year 2021-2023. Patients of age more than 40 years who are diagnosed cases of glaucoma or are glaucoma suspects with either elevated IOP or optic nerve head appearance, visual field suggestive of glaucoma are included in this study. Patients of age less than 40 year and patients with any kind of secondary glaucoma were excluded.

All the patients were subjected to a brief history taking regarding any ocular trauma or surgery, followed by slit lamp evaluation to rule out any pathologies of conjunctiva, cornea, sclera, iris, anterior chamber, pupil and lens. Intraocular pressure recorded with

Goldmann applanation tonometer. Posterior segment examination was done using 90D lens. Gonioscopy was done by 4 mirror contact gonioscopy. Central corneal thickness measured with Quantel compact pachymetry. All the patients were classified as primary open angle glaucoma (POAG), primary angle closure glaucoma (PACG), ocular hypertensive (OHT) and glaucoma suspect (GS) based on their intraocular pressure, optic nerve head appearance, gonioscopy findings and visual field defects.

Correction of IOP based on CCT- Shih CY, Graff Zivin JS et al.⁽⁷⁾ in their study used a linear correction formula based on extensive literature review and 2.5 mmHg is added or subtracted for every 50 μm deviation in CCT from the reference value. In our study we used the same linear correction scale. (Reference value of CCT - 545 μm)

Corrected IOP = Measured IOP – (CCT – Reference CCT) \times 2.5

OBSERVATION AND RESULTS

A total of 100 patients with 57 male and 43 females were included in our study which were categorized in 4 study groups - 52 POAG (primary open angle glaucoma), 13 PACG (primary angle closure glaucoma), 25 OHT (ocular hypertension) and 10 GS (glaucoma suspect). Maximum patients were in 40-50-year age group (51%).

The mean IOP of POAG group was 25.44 ± 4.20 mmHg, 23.08 ± 3.84 mmHg in PACG, 25.52 ± 5.03 mmHg in OHT group and 20.80 ± 2.62 mmHg in GS group. The difference observed in mean IOP values among the groups was statistically significant ($p < 0.05$).

The mean CCT of POAG was 547.75 ± 21.23 μm , 559.38 ± 19.91 μm in PACG while in OHT it was 567.12 ± 25.49 μm and 556.80 ± 14.63 μm in GS. The difference observed in mean CCT among the groups was statistically significant ($p < 0.05$). The mean CCT of OHT was much higher (567.12 ± 25.49 μm) than the other groups. Table -1 shows comparison of IOP and CCT in various study groups.

Table 2 compares mean CCT after correcting the mean IOP. The corrected IOP shows a decrease in case of PACG, GS and OHT while there is increase in corrected IOP of POAG patients in comparison to mean IOP. The difference observed in various study groups was statistically significant ($p < 0.0001$).

CCT values are stratified in three groups: thin cornea (CCT < 540 μm), normal cornea (CCT = $540-580$ μm) and thick cornea (CCT > 580 μm). There was statistically significant difference in IOP values among different CCT groups ($p < 0.0001$). Table-3 shows the relationship between different CCT and corrected IOP. In case of thin cornea, corrected IOP is slightly greater than mean IOP while in case of normal and thick cornea corrected IOP is lower than mean IOP. Thus in cases of thick cornea there is overestimation of IOP, as is the case with ocular hypertension.

DISCUSSION

This study was designed to compare the CCT of OHT with GS, POAG and PACG patients. The study also evaluates the effect of CCT on the diagnosis and management of glaucoma patients.

The average age of the patients was 52.45 ± 8.71 years. Majority of the patients in our study were of the age group of 40-60 years. Fifty seven percent patients were male and forty three percent patients were female. The most common type of glaucoma was found to be POAG.

The mean intraocular pressure of the POAG, PACG, GS and OHT to be 25.44 ± 4.20 , 23.08 ± 3.84 , 20.8 ± 2.62 mmHg and 25.52 ± 5.03 mmHg respectively, which is comparable to study done by Rene-Pierre Copt et al.⁽⁸⁾

In our study, the mean CCT in OHT was 567.12 ± 25.49 μm , 547.75 ± 21.23 μm in POAG, 559.38 ± 19.91 μm in PACG and 556.80 ± 14.63 μm in GS. The mean CCT in patients with OHT was higher as compared to patients with other types of glaucoma with statistical significance. Similar results were also found in studies done by RP Copt et al.⁽⁸⁾, Ling Ling Wu et al.⁽⁹⁾, Emarah et al.⁽¹⁰⁾, RP Singh et al.⁽¹¹⁾

This is a proven fact that central corneal thickness affects the accuracy of applanation tonometry. In our study, linear regression formula was applied and 2.5mmHg is added or subtracted for every 50 μ deviation from reference value of 545 μm . Corrected IOP values for all subjects were calculated. Central corneal thickness values are stratified in three groups: thin cornea (CCT < 540 μm), normal cornea (CCT = 540-580 μm) and thick cornea (CCT > 580 μm). There was statistically significant difference in corrected IOP values among different CCT groups ($p < 0.0001$). In POAG patients, in case of thin (< 540 μm) and normal cornea (540-580 μm) corrected IOP is slightly greater than mean IOP while in case of thick cornea (CCT > 580 μm) corrected IOP is lower than mean IOP. This shows the false interpretation of IOP in cases with thick central cornea. Similar results were also found in study by Wen Wei et al.⁽¹²⁾

SUMMARY AND CONCLUSION

Measurement of intraocular pressure (IOP) is fundamental in management of glaucoma. The central corneal thickness (CCT) affects the accuracy of IOP measurement by applanation tonometry. Ocular hypertensives have a significantly greater CCT thus their corrected IOP is lower than mean IOP. Similarly the glaucoma patients with thin central corneal thickness are more likely to be found at an advanced stage of the disease. Thus CCT should be considered in clinical evaluation of all the cases of glaucoma, and glaucoma suspects especially ocular hypertensives.

CONFLICT OF INTEREST- NONE**REFERENCES-**

1. Yanof M, Duker JS. "Ophthalmology", 2nd ed. Printed in United Kingdom; copyright Mosby International Ltd: 2004. P 1482-1486.
2. Jacob, A., Thomas, R., Koshi, S. P., Braganza, A., & Muliyl, J. (1998). Prevalence of primary glaucoma in an urban south Indian population. *Indian journal of ophthalmology*, 46(2), 81-86.
3. Vijaya, L., George, R., Paul, P. G., Baskaran, M., Arvind, H., Raju, P., ... & McCarty, C. (2005). Prevalence of open-angle glaucoma in a rural south Indian population. *Investigative ophthalmology & visual science*, 46(12), 4461-4467.
4. Dandona, L., Dandona, R., Srinivas, M., Mandal, P., John, R. K., McCarty, C. A., & Rao, G. N. (2000). Open-angle glaucoma in an urban population in southern India: the Andhra Pradesh eye disease study. *Ophthalmology*, 107(9), 1702-1709.
5. Ramakrishnan, R., Nirmalan, P. K., Krishnadas, R., Thulasiraj, R. D., Tielsch, J. M., Katz, J., ... & Robin, A. L. (2003). Glaucoma in a rural population of southern India: the Aravind comprehensive eye survey. *Ophthalmology*, 110(8), 1484-1490.
6. McMonnies, C. W. (2008). Intraocular pressure spikes in keratectasia, axial myopia, and glaucoma. *Optometry and Vision Science*, 85(10), 1018-1026.
7. Shih, C. Y., Zivin, J. S. G., Trokel, S. L., & Tsai, J. C. (2004). Clinical significance of central corneal thickness in the management of glaucoma. *Archives of ophthalmology*, 122(9), 1270-1275.
8. Copt, R. P., Thomas, R., & Mermoud, A. (1999). Corneal thickness in ocular hypertension, primary open-angle glaucoma, and normal tension glaucoma. *Archives of ophthalmology*, 117(1), 14-16.
9. Wu, L. L., Suzuki, Y., Ideta, R., & Araie, M. (2000). Central corneal thickness of normal tension glaucoma patients in Japan. *Japanese journal of ophthalmology*, 44(6), 643-647.
10. Emara, B. Y., Tingey, D. P., Probst, L. E., & Motolko, M. A. (1999). Central corneal thickness in low-tension glaucoma. *Canadian journal of ophthalmology. Journal canadien d'ophtalmologie*, 34(6), 319-324.
11. Gazzard, G., Foster, P. J., Devereux, J. G., Oen, F., Chew, P., Khaw, P. T., & Seah, S. (2003). Intraocular pressure and visual field loss in primary angle closure and primary open angle glaucomas. *British journal of ophthalmology*, 87(6), 720-725

12. Wei, W., Fan, Z., Wang, L., Li, Z., Jiao, W., & Li, Y. (2014). Correlation analysis between central corneal thickness and intraocular pressure in juveniles in Northern China: the Jinan city eye study. PLoS One, 9(8), e104842.

TABLES

Table 1: Comparison of CCT and IOP in various study group

Group	N	IOP (mmHg)		CCT (μm)		T test	P value
		Mean	SD	Mean	SD		
POAG	52	25.44	4.20	547.75	21.23	17.0	<0.0001
PACG	13	23.08	3.84	559.38	19.91	10.0	<0.0001
OHT	25	25.52	5.03	567.12	25.49	11.0	<0.0001
GS	10	20.80	2.62	556.80	14.63	12.0	<0.0001

Table 2- Comparison of CCT and Corrected IOP in various study groups

Group	N	Corrected IOP (mmHg)		CCT (μm)		T test	P value
		Mean	SD	Mean	SD		
POAG	52	25.62	4.47	547.75	21.23	16.0	<0.0001
PACG	13	22.43	3.66	559.38	19.91	96.52	<0.0001
OHT	25	25.48	5.11	567.12	25.49	10.0	<0.0001
GS	10	20.78	2.66	556.80	14.63	11.0	<0.0001

Table 3- Relationship between different CCT and corrected IOP

CCT Group	N	Corrected IOP (mmHg)			
		Mean	SD	Min	Max
<540	22	28.27	5.73	17.07	37.32
540-580	62	23.45	3.74	16.17	32.72
>580	16	24.57	3.93	16.77	31.22