MAK HILL Publications International Journal of Tropical Medicine

Research Article
doi: 10.59218/makijtm.2024.1.185.189

Pressure-to-Cornea Index in Primary Open Angle Glaucoma, Normal Tension Glaucoma, Ocular Hypertensive Patients and Patients Without Glaucoma: A Comparitive Case Control Study

[1]Ram Krishna Saxena, [2]Shaurabh Gupta, [3]Ruchi Gupta and [4]Monu Yadav

[1]Department of Opthalmology, Sarawati Medical College, Unnao, India
[2]Department of Opthalmology, Government medical college, Jalaun, India
[3]Department of opthalmolgy, MKN Netrjyoti Hospital Jalaun, India
[4]Department of Dentistry, Sarawati Medical College, Unnao, India

OPEN ACCESS

Key Words
Pressure corneal index, true intra-ocular pressure, central corneal thickness, glucoma

Corresponding Author
Monu Yadav,
Department of Dentistry, Sarawati Medical College, Unnao, India

Author Designation
[1,2,4]Associate professor
[3]Senior consultant

Received: 7 January 2024
Accepted: 18 February 2024
Published: 4 March 2024

Citation: Ram Krishna Saxena, Shaurabh Gupta, Ruchi Gupta and Monu Yadav 2024. Pressure-to-Cornea Index in Primary Open Angle Glaucoma, Normal Tension Glaucoma, Ocular Hypertensive Patients and Patients Without Glaucoma: A Comparitive Case Control Study Int. J. Trop. Med., 19: 185-189, doi: 10.59218/ makijtm.2024.1.185.189

Abstract
The purpose of this study was to correlate and compare the PCI with a structural and two functional measures of glaucoma on the basis of mean intra ocular pressure (MIOP), central corneal thickness (CCT), True Intra-ocular pressure (TIOP) and pressure to corneal index. This case control cross sectional study was done in our institute, in which to integrate intraocular pressure measured by goldmann applanation tonometry and central corneal thickness measured by ultrasonic pachymetry as a single risk factor in the form of pressure-to-cornea index for various intra-ocular pressure levels in primary open angle glaucoma, normal tension glaucoma, ocular hypertensive patients and patients without glaucoma as an aim. Total 100 subjects (200 eyes) were taken for the study and divided into 4 groups, 25 patients with PRIMARY OPEN ANGLE GLAUCOMA (POAG), 25 patients with NORMAL TENSION GLAUCOMA (NTG), 25 patients with OCULAR HYPERTENSION (OCULAR HTN) and 25 as a control group who were attending our department as outpatient as well as inpatient in the wards of our Saraswati Medical college, Unnao. Obtained data were tabulated and perform statistical analysis done then we found out of 100 patients, 25 patients (25%) were between 40-50 years of age., 41 patients (41%) were between 51-60 yrs and 34 patients (34%) were between 61-70 year. The sex distribution among the four groups, wherein 55% (55 patients) were males and 45% (45 patients) were females, mean value of MIOP (mean intraocular pressure) in normal, POG, NTG, OHTN groups were 16.12, 18.92, 16.08 and 27.6 mmHG respectively and this was statistically highly significant among the groups. The mean CCT value in the four groups viz., Normal, POG, NTG and OHTN, as shown in table 5 were 0.538, 0.508, 0.53 and 0.53 respectively with $p<0.00001$ showing a statistically highly significant difference among the four groups. The mean value of TIOP (True intraocular pressure) in Normal, POG, NTG, OHTN groups were respectively 16.95, 19.65, 17.54 and 24.48 mmHG respectively and there was statistically significant difference among the groups. The mean value of PCI (pressure to cornea index) in Normal, POG, NTG, OHTN groups were respectively 105.59, 152.58, 110.58 and 142.69 respectively and there was statistically significant difference among the groups. After completion of the study we concluded, In addition to serve as a single risk factor, PCI can be used to stage glaucoma severity as well.

INTRODUCTION

The measured intraocular pressure becomes falsely high or falsely low when measured on thicker corneas or thinner corneas respectively. So, IOP has to be adjusted according to the central corneal thickness by a correction factor[1]. Whereas the relationship between IOP and CCT is not linear, so even if the correction factor is applied, the correction of IOP over the extreme values of CCT becomes inaccurate and not reliable. Also, none of the correction factors, so far proposed, has been universally accepted as a standard formula[2,3]. So, to overcome this error in correction of IOP by various non-standardized formulae, and also to integrate IOP and CCT as a single risk factor for glaucoma, a new index called as Pressure-To-Cornea Index (PCI) was introduced. "PCI is the ratio between the highest recordable pretreatment IOP in mm Hg to the cubic power of Central Corneal Thickness (CCT) expressed in mm."

Glaucoma is defined as a multi-factorial chronic progressive optic neuropathy caused by a group of ocular conditions, causing damage to retinal ganglion cells at levels beyond normal baseline ager related loss resulting in optic disc changes and corresponding visual field defects with raised intraocular pressure being the only modifiable risk fact "Intraocular pressure (IOP) is defined as the pressure exerted by the intraocular contents on the coats of the eyeball"[4,5]. It is the most important and only modifiable risk factor for glaucoma. However, glaucoma can occur even with normal IOP. Normal IOP is the IOP which does not lead to any glaucomatous damage to the optic nerve head and is in the range of 10-21 mm Hg. Normal diurnal variation in IOP is 3-6 mm Hg. IOP >21 mm Hg or diurnal variation more than 8 mm Hg even with normal IOP becomes a risk factor and raise the suspicion of glaucoma[6,7,8].

Aims and Objectives: To integrate intraocular pressure (IOP) measured by goldmann applanation tonometry (GAT) and central corneal thickness(CCT) measured by ultrasonic pachymetry as a single risk factor in the form of pressure-to-cornea index (PCI) for various IOP levels in primary open angle glaucoma, normal tension glaucoma, ocular hypertensive patients and patients without glaucoma.

MATERIALS AND METHODS

The non-randomized comparative cross sectional study was conducted among 200 eyes of 100 patients above 40 years of age or age group 40-70 years both genders included, in which 25 patients are normal subjects with no evidence of glaucoma, 25 patients with PRIMARY OPEN ANGLE GLAUCOMA (POAG), 25 patients with NORMAL TENSION GLAUCOMA (NTG), 25 patients with OCULAR HYPERTENSION (OCULAR HTN) attending our department as outpatient as well as inpatient in the wards of our Saraswati Medical college, Unnao, were included in this study. Subjects were evaluated for entry into the study if they are 40 years of age or older. Subjects believed to fulfill eligibility criteria and none of the exclusion criteria, invited to participate in the study. Total study of period was 1 year (Jan 2023-Dec 2023). 100 samples divided

- Into four groups
- GROUP I -NORMAL SUBJECTS
- GROUP II-PRIMARY OPEN ANGLE GLAUCOMA PATIENTS
- GROUP III-NORMAL TENSION GLAUCOMA PATIENTS AND
- GROUP IV-OCULAR HYPERTENSION PATIENTS

200 eyes of 100 patients 40-70 years of age, 25 normal subjects with no evidence of glaucoma, 25 patients with primary open angle glaucoma, 25 patients with ocular hypertension and 25 normal patients, were evaluated for PCI(pressure to corneal index). All the patients were subjected to detailed clinical evaluation before being taken for the study. The evaluation was done by history, examination or detailed glaucoma examination in which considered, best corrected visual acuity, slit lamp examination, intra ocular pressure by Goldmann Applanation Tonometry, central corneal thickness by ultrasonic pachymetry and angle by gonioscopy. To integrate Intraocular Pressure(IOP) measured by Goldmann Applanation Tonometry (GAT) and Central Corneal Thickness(CCT) measured by ultrasonic pachymetry as a single risk factor in the form of Pressure-to-Cornea Index (PCI) for various IOP levels(ie, for POAG, NTG AND OCULAR HTN EYES)

Observation and Analysis Statistical Method: The information collected regarding all the cases were recorded in a Master Chart. Data analysis was done.

RESULTS AND DISCUSSIONS

In our study, 200 eyes of 100 patients were included, 25 normal controls, 25 with POAG, 25 with NTG, 25 with OHT were included. The demographic characteristics are given in (Table 1 and 2).

(Table 1) shows age distribution among the patients in our study .The patients included in the study were between 40-70 years of age. Out of 100 patients, 25 patients (25%) were between 40-50 years of age, 41 patients (41%) were between 51-60 yrs and 34 patients (34%) were between 61-70 year.

(Table 2) shows the sex distribution among the four groups, wherein 55% (55 patients) were males and 45% (45 patients) were females. There was minor variable sex distribution among four groups as showing in (Table 2). As showing in (Table 4), the mean value of MIOP (mean intraocular pressure) in normal, POG,

Table 1: Distribution based on age among four groups

Age in years	Normal	POAG	NTG	Ocular HTN	Total
40-50	11	2	7	5	25
51-60	11	8	13	9	41
61-70	3	15	5	11	34
Total	25	25	25	25	100

Table 2: Distribution based on sex among four groups

Sex	Normal	POAG	NTG	Ocular HTN	Total
Male	10	16	16	13	55
Female	15	9	9	12	45
Total	25	25	25	25	100

Table 3: Distribution based on (best corrected visual activity) bcva among four groups

BCVA	Ocular HTN	POAG	NTG	Normal
6/60	5	7	5	0
6 36	4	0	0	0
6/24	7	10	3	0
6/18	10	5	4	7
6/12	9	20	6	1
6/9	1	0	6	8
6/6	14	6	26	34
PL+	0	2	0	0
Total	50	50	50	50

Table 4: Distribution based on miop among four groups

MIOP	Normal (G1)	POG (G2)	NTG (G3)	OHTN (G4)	Total
N	25	25	25	25	100
Mean	16.12	18.92	16.08	27.6	19.68
Std. Dev.	1.4236	7.8471	1.6563	4.2426	6.5503
P-value	<.00001				

Table 5: Distribution based on central corneal thickness among four groups

CCT	Normal (G1)	POG (G2)	NTG (G3)	OHTN (G4)	Total
N	25	25	25	25	100
Mean	0.5383	0.5082	0.53	0.5744	0.538
Std. Dev.	0.0265	0.0369	0.0368	0.0458	0.0437
p-value	<.00001				

Table 6: Distribution based on true iop (tiop) among four groups

TIOP	Normal (G1)	POG (G2)	NTG (G3)	OHTN (G4)	Total
N	25	25	25	25	100
Mean	16.952	19.656	17.54	24.48	19.657
Std. Dev.	2.9078	5.5027	1.4098	5.7636	5.1748
P-value	<.00001				

Table 7: Distribution based on pci among four groups

PCI	Normal (G1)	POG (G2)	NTG (G3)	OHTN (G4)	Total
n	25	25	25	25	100
Mean	105.5944	152.5812	110.5808	142.6964	127.863
Std. Dev.	22.6297	72.6244	22.7274	45.4211	49.3825
P-value	.000487 (<.05)				

NTG, OHTN groups were 16.12, 18.92, 16.08 and 27.6 mmHG respectively and this was statistically highly significant among the groups.

The mean CCT value in the four groups viz., Normal, POG, NTG and OHTN, as shown in table 5 were 0.538, 0.508, 0.53 and 0.53 respectively with p<0.00001 showing a statistically highly significant difference among the four groups.

From the (Table 6), the mean value of TIOP (True intraocular pressure) in Normal, POG, NTG, OHTN groups were 16.95, 19.65, 17.54 and 24.48 mmHG respectively and there was statistically significant difference among the groups.

From the above (Table 7), the mean value of PCI (pressure to cornea index) in Normal, POG, NTG, OHTN groups were 105.59, 152.58, 110.58 and 142.69 respectively and there was statistically significant difference among the groups. In our study, 200 eyes were considered with 50 eyes in each of the four groups-Ocular hypertension, Primary open angle glaucoma, Normal tension glaucoma and normal group. The demographic characteristics of the study group were as follows: age group from 40-70 years with maximum persons in 51-60 years of age (41%) with maximum mean age of 61.00 years in POAG group and minimum of 52.4 years in the normal group. There were 55% of males and 45% of females totally. There were no statistically significant differences based on age and sex distribution among the four groups similar study has to be done Ilive ME *et al*[1]. Based on BCVA, 29 eyes of OHT group and 38 eyes of POAG group had impaired vision. The mean value of MIOP (mean intraocular pressure) was highest in OHTN group (27.6 mmHG) followed by POG group with the mean value of 18.92 mmHG. The mean values for the NTG and normal groups were 16.08 and 16.12 mmHG respectively. The mean CCT value was highest in OHT group (0.5744 mm) and lowest in POAG group (0.5082

mm) with 0.53 mm in NTG and 0.5383 in normal groups and there was a highly significant statistical difference among the four groups similar study has to be done by Cursiefen *et al*.[4] This finding was similar to previous studies showing a thicker CCT in OHT and thinner CCT in POAG group (Brandit *et al*.)[5]. On comparing the mean of the CCT value among four groups showed a statistically significant difference among the groups. The TIOP was calculated as there is no linear correlation between MIOP and CCT. In our study, the highest mean value for TIOP was seen in OHT group which was similar to the previous studies. The POAG group had second highest mean TIOP of 19,656 mmHG followed by NTG (17.54) and Normal control group (16.952). There was a statistically significant difference between MIOP and TIOP among all four groups which was similar to the findings of the study done by Ileiv et al, In this study, a new parameter , the pressure to cornea index was studied which is calculated based on pretreatment IOP and CCT. This PCI is novel parameter investigated by Iliev *et al.* as a more precise glaucoma risk than either parameter alone. The mean PCI in 25 (50 eyes) normal subjects was 105.5944 whereas in the study by Iliev *et al,* most of the normal subjects had mean PCI of 80-100. The highest mean PCI was for POAG group with the value of 152.5812 and SD was 72.6244, which was similar to the study done by Iliev *et al*, who investigated 89 eyes with POAG showing a mean value of 173.6. In our study, the mean PCI was 142.6964 (SD of 45.4211) for OHTN group , which was slightly higher than the mean value of PCI according to Iliev *et al*, who studied 76 eyes of OHT (134.0). The NTG group in our study had a mean PCI value of 110.5808 (SD of 22.7274) which was slightly lower than the NTG group studied by Iliev *et al.* (129.1) On analyzing the mean PCI value among the four groups statistically, there was a significant difference observed as similar to Me Cafferty *et al*[12]. In our study, correlation between PCI with MIOP , CCT and TIOP were studied independently for each of the four groups which revealed the following findings: OCULAR HYPERTENSION GROUP-PCI was significantly correlated with CCT and TIOP indicating positive correlation with TIOP and negative correlation with CCT. i.e, as the PCI increases, TIOP increases and CCT decreases. However no significant correlation was observed with MIOP. PRIMARY OPEN ANGLE GLAUCOMA GROUP-There was a significant correlation between all three parameters with PCI, with positive correlation for TIOP and MIOP and a negative correlation with CCT similar study to be done by Brandit *et al*.[11]. NORMAL TENSION GROUP-PCI was significantly correlated with CCT and TIOP indicating positive correlation with TIOP and negative correlation with CCT. i.e, as the PCI increases, TIOP increases and CCT decreases. However, very low correlation was observed with MIOP. NORMAL GROUP-showed positive correlation with TIOP and negative correlation with CCT similar study has to be done by Kass *et al*., Tham *et al*[9,10].

CONCLUSION

Integrating TIOP and CCT into single risk factor in the form of pressure to cornea index (PCI) for four groups is better parameter than the independent parameters (TIOP and CCT) which is highly variable. The relationship of PCI was significantly correlated among the four groups making it a more reliable parameter for various IOP levels. Hence PCI may be taken as a independent glaucoma risk factor , as it can reflect changes in various levels of IOP and CCT.

REFERENCES

1. Iliev, M.E., A. Meyenberg, E. Buerki, G. Shafranov and M.B. Shields, 2007. Novel pressure-to-cornea index in glaucoma. Br. J. Ophthalmol., 91: 1364-1368.
2. Eballe, A., 2010. Central corneal thickness and intraocular pressure in the Cameroonian nonglaucomatous population. Clin. Ophthalmol., 4: 717-724.
3. Leung, D.Y.L., M.E. Iliev, P. Chan, N. Baig, S.C.C. Chi, C.C.Y. Tham and D.S.C. Lam, 2010. Pressure-cornea-vascular index (PCVI) for predicting disease progression in normal tension glaucoma. Br. J. Ophthalmol., 95: 1106-1110.
4. Cursiefen, C., M. Wisse, S. Cursiefen, A. Jünemann, P. Martus and M. Korth, 2000. Migraine and tension headache in high-pressure and normal-pressure glaucoma. Am. J. Ophthalmol., 129: 102-104.
5. Suzuki, Y., A. Iwase, M. Araie, T. Yamamoto and H. Abe *et al.,* 2006. Risk factors for open-angle glaucoma in a Japanese populationthe tajimi study. Ophthalmology, 113: 1613-1617.
6. Shih, C.Y., J.S.G. Zivin, S.L. Trokel anfd J.C. Tsai, 2004. Clinical significance of central corneal thickness in the managementof glaucoma. Arch. Ophthalmol., 122: 1270-1275.
7. Francis, B.A., R. Varma, V. Chopra, M.Y. Lai, C. Shtir and S.P. Azen, 2008. Intraocular pressure, central corneal thickness, and prevalence of open-angle glaucoma: The los angeles latino eye study. Am. J. Ophthalmol., 146: 741-746.
8. Wong, T.T., T.Y. Wong, P.J. Foster, J.G. Crowston, C.W. Fong and T. Aung, 2009. The relationship of intraocular pressure with age, systolic blood pressure, and central corneal thickness in an asian population. Invest. Opthalmol. Visual Sci., 50: 4097-4102.
9. Kass, M.A., 2002. The ocular hypertension treatment study. Arch. Ophthalmol., 120: 701-713.

10. Tham, Y.C., X. Li, T.Y. Wong, H.A. Quigley, T. Aung and C.Y. Cheng, 2014. Global prevalence of glaucoma and projections of glaucoma burden through 2040. Ophthalmology, 121: 2081-2090.
11. Brandt, J.D., M.O. Gordon, F. Gao, J.A. Beiser, J.P. Miller and M.A. Kass, 2012. Adjusting intraocular pressure for central corneal thickness does not improve prediction models for primary open-angle glaucoma. Ophthalmology, 119: 437-442.
12. McCafferty, S., K. Tetrault, A. McColgin, W. Chue, J. Levine and M. Muller, 2018. Intraocular pressure measurement accuracy and repeatability of a modified goldmann prism: Multicenter randomized clinical trial. Am. J. Ophthalmol., 196: 145-153.