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RESEARCH ARTICLE

Correlation between intraocular pressure and blood pressure in North Indian subjects

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Abstract

Aim: To find out the correlation between Intraocular pressure and systemic blood pressure in adult North Indian subjects.

Material and method: The study included 300 healthy individuals above 40 years of age. On the basis of BP the subjects were divided into three groups i.e. non hypertensive, pre-hypertensive and hypertensive. After careful history taking and general examination BP and IOP recording was done on all the subjects. The observations were subjected to statistical comparison

Result: The mean IOP of non-hypertensive group was 14.17 ±2.14 mm of Hg. The mean IOP of pre-hypertensive group was 15.45±2.07 mm of Hg and that of hypertensive group was 17.93 ± 2.22 mm of Hg. The mean IOP was found to increase with increase in systemic blood pressure. The difference was statistically significant ($p< 0.001$).

Conclusion: Our observation reveals that there exists a positive correlation between IOP and BP. Evaluating our observations in light of available literature we concluded that high blood pressure is a risk factor for development of raised IOP which can lead to glaucoma. Periodic checking of IOP in hypertensive subjects and vice-versa is the key to the prevention of irreversible blindness due to glaucoma. Thus population based screening would reduce the burden of blindness due to glaucoma.

INTRODUCTION

Intraocular pressure is dependent upon various systemic and local factors. It has been postulated that IOP increases proportionately with increase in systolic blood pressure. The probable physiological basis for correlation between IOP and systemic blood pressure may be an increased production of aqueous humor by ultrafiltration due to elevated ciliary artery pressure or increase in episcleral venous pressure. [1] Elevated IOP is one of the major risk factor for developing glaucoma or glaucomatous optic neuropathy and its progression. Glaucoma is a

common ophthalmic disease worldwide and is a significant cause of visual impairment and blindness. It is the second leading cause of blindness responsible for 23% of all cases. Population based studies have revealed prevalence of glaucoma in India to be 11.9 million and 60.5 million in the world by the year 2010 out of which roughly half are still undiagnosed. [2, 3] The diagnosis of glaucoma is more frequently made in subjects with hypertension than in subjects with normal blood pressure. [4] Although raised IOP may not be the only risk factor for glaucomatous optic nerve damage but it is the only risk factor that can be modified by contemporary medical and surgical intervention. Ocular hypertension or glaucoma if detected early and treated appropriately, its progression and blindness can be prevented. The detailed literature on variation of IOP with systemic parameters like BP is still not available especially with respect to North Indian population. The aim of the study is to find the relationship of IOP with blood pressure and to emphasize on the necessity to check IOP periodically in hypertensive patients to prevent blindness due to irreversible damage to optic nerve fibers.

AIMS AND OBJECTIVES:

To find out the relationship of Intra ocular pressure with systemic blood pressure in adult North Indian subjects.

MATERIAL AND METHOD:

The study was conducted in the department of Physiology in association with Ophthalmology department of Maharishi Markandeshwar Institute of Medical Sciences & Research, (Mullana). The study included 300 adult subjects (> 40 years) randomly selected from the patients visiting Ophthalmology OPD. Subjects with chronic morbid illness and on any systemic or ocular medication were excluded from the study. Hypertensive subjects on medication were also excluded. On the basis of BP the subjects were divided into three groups i.e. non hypertensive, pre-hypertensive and hypertensive according to the definition of hypertension in 7th joint National Committee report by World health organization (WHO).[5] The mean IOP difference

was compared amongst the three categories. The systolic and diastolic blood pressure in the three categories was as follows:

1. Non-hypertensive subjects: systolic blood pressure <120mm of Hg and diastolic blood pressure <80mm of Hg.
2. Pre-hypertensive subjects: systolic blood pressure 120-139 mm of Hg and diastolic blood pressure between 80-89mm of Hg.
3. Hypertensive subjects: systolic blood pressure >140 mm of Hg and diastolic blood pressure >90mm of Hg.

A detailed personal history including name, age, sex, occupation and habits was taken from the patient. History of any past illness and chronic medication was obtained. Family history of diabetes, hypertension and glaucoma was recorded. The blood pressure was recorded using mercury sphygmomanometer in right arm in sitting position. The ocular examination included uncorrected and best corrected visual acuity. Anterior segment of the eye was examined under slit lamp. Optic disc was examined using direct ophthalmoscope. The intraocular pressure recording was done using Slit lamp mounted Goldmann Applanation tonometer. To avoid the effect of diurnal variation the readings were taken during 10 am to 11 am

OBSERVATION AND RESULT:

The total number of subjects in non-hypertensive group was 81with 32 males and 49 females. The total number of subjects in Pre-hypertensive group was 85 with 41 males and 44 females and in hypertensive group was 134 having 69 males and 65 females. (Table 1, Figure 1) The mean IOP of non-hypertensive group was 14.17 ±2.14 mm of Hg. The mean IOP of pre-hypertensive group was 15.45±2.07 mm of Hg. The mean IOP of hypertensive group was 17.93 ± 2.22 mm of Hg. (Table 2, Figure 2) The mean IOP was found to increase with increase in systemic blood pressure. The difference was statistically significant ($p< 0.001$). The IOP was compared among the three groups applying ANOVA and the change in IOP was found to be highly significant. ($p<0.001$)(Table 3) Multiple comparisons were made applying POST HOC test among the groups on dependent variable IOP. On Post hoc test the difference of IOP between non-hypertensive group and pre-hypertensive group and also between non- hypertensive and

hypertensive group was highly significant ($p<0.001$).On comparison of IOP in pre-hypertensive and hypertensive group the difference was also highly significant ($p<0.001$).(Table 4)

Table 1 BP wise distribution of subjects

BP Group	Male (no.)	Female (no.)	Total (no.)
Non hypertensive	32	49	81
Pre hypertensive	41	44	85
Hypertensive	69	65	134

Table 2 Relationship of IOP with BP

Group	Mean IOP±SD (mm of Hg)	Minimum	Maximum
Nonhypertensive	14.17±2.14	10.0	19.5
Prehypertensive	15.45±2.07	11.0	23.0
Hypertensive	17.93±2.22	11.0	22.0

Table 3 Statistical comparison of IOP with blood pressure (ANOVA test)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	783.682	2	391.841	84.234	<.001
Within Groups	1381.588	297	4.652		
Total	2165.270	299			

Table 4 Statistical comparison of IOP in the three groups according to BP(POST HOC TEST)

(I) BP groups	(J) BP groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Nonhypertensive	Prehypertensive	-1.28039	.33490	<.001	-2.0867	-.4741
	Hypertensive	-3.76244	.30355	<.001	-4.4933	-3.0316
Prehypertensive	Nonhypertensive	1.28039	.33490	<.001	.4741	2.0867
	Hypertensive	-2.48205	.29907	<.001	-3.2021	-1.7620
Hypertensive	Nonhypertensive	3.76244	.30355	<.001	3.0316	4.4933
	Prehypertensive	2.48205	.29907	<.001	1.7620	3.2021

Figure 1: BP wise distribution of subjects

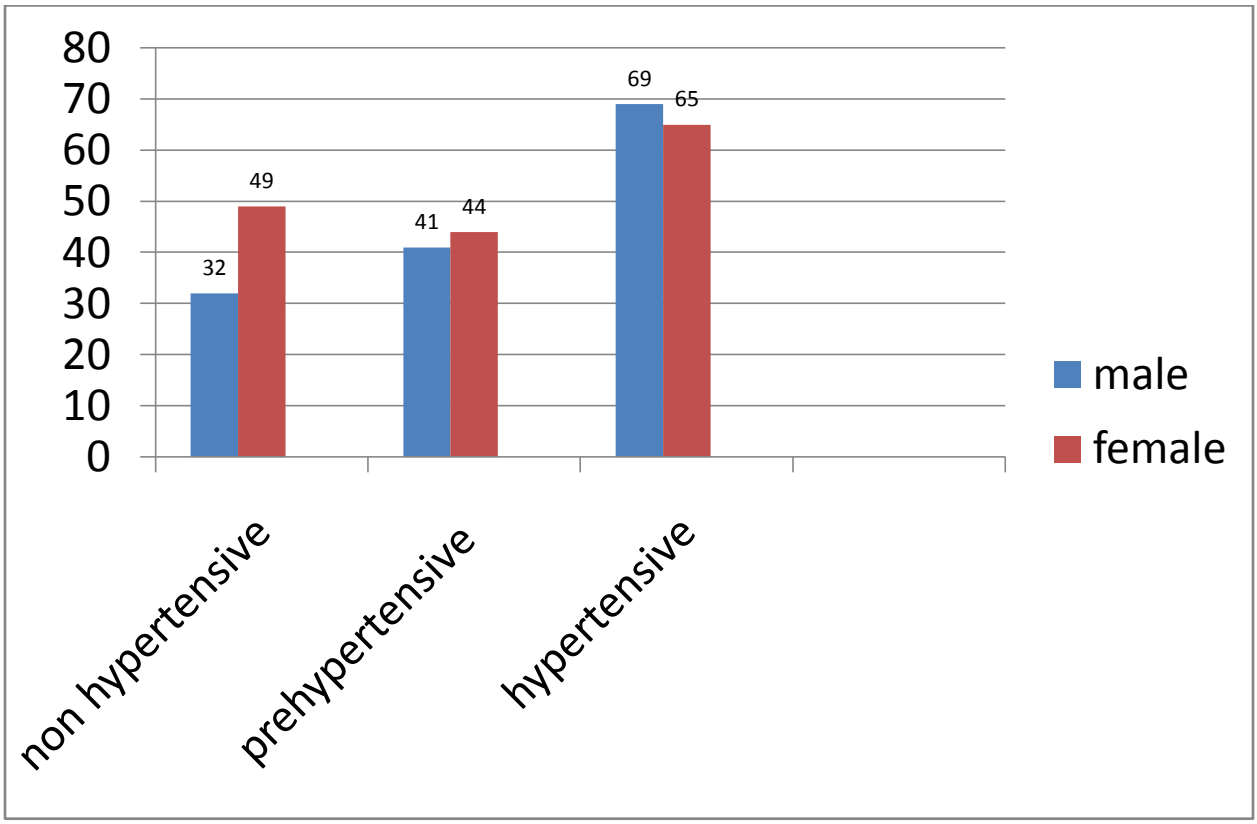
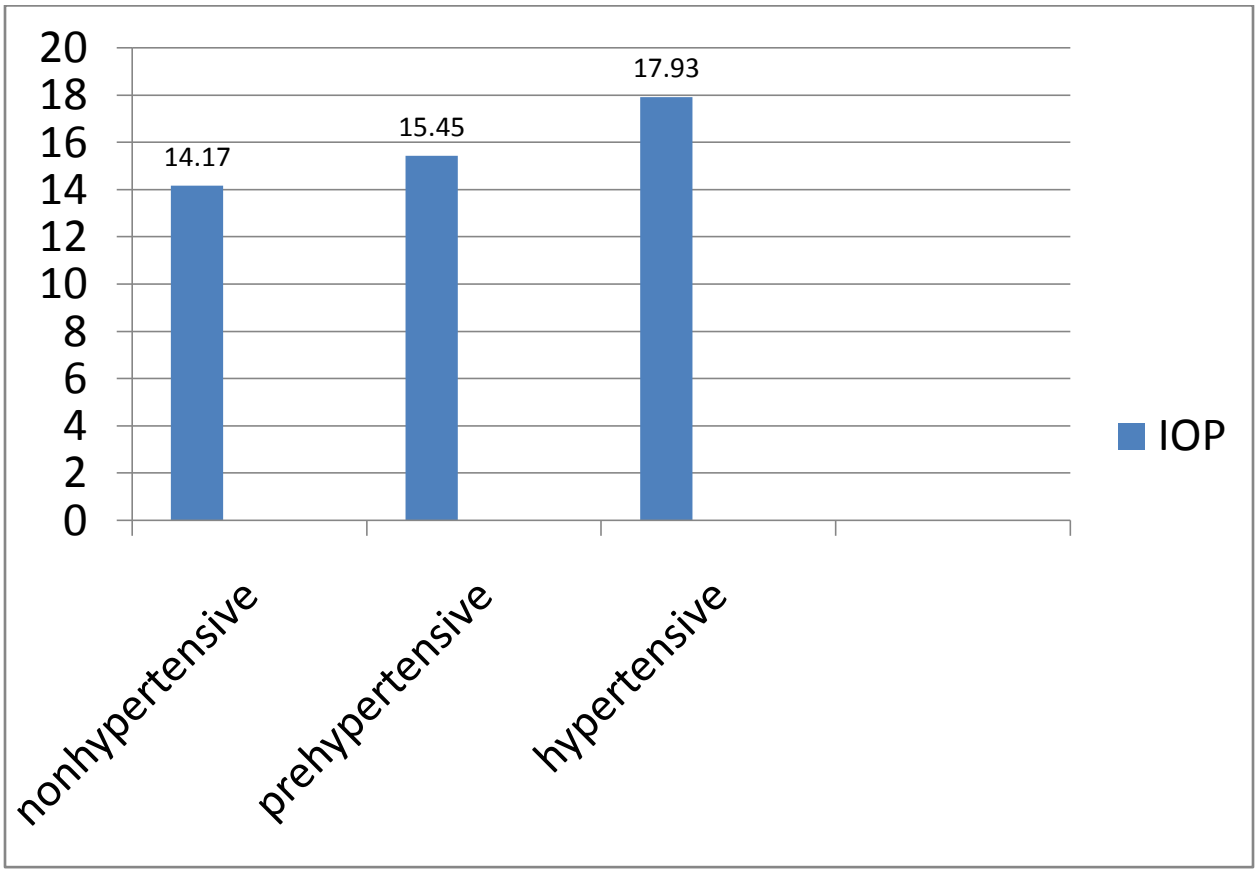


Figure 2 : Relationship of IOP with BP



DISCUSSION:

The IOP is determined by the dynamic equilibrium between the rate of aqueous formation (F), rate of outflow (C) and episcleral venous pressure (Pv). The three factors are related to each other by Goldmann equation i.e. IOP = F/C + Pv. IOP increases with increase in aqueous formation and episcleral venous pressure and decreases with increase in rate of outflow [1]

In our current study the mean IOP of non-hypertensive group was 14.17 ±2.14 mm of Hg, pre-hypertensive group was 15.45±2.07 mm of Hg and of hypertensive group was 17.93 ± 2.22 mm of Hg. The mean IOP was found to increase with increase in systemic blood pressure. The statistical analysis of our observation showed that both systolic and diastolic blood pressure are independently and positively correlated with IOP ($p<0.001$).

The results of Baever dam eye study showed that an increase of sBP by >10mm of Hg from baseline leads to 0.44 mm of Hg rise in IOP whereas a decrease of sBP by <10mm of Hg from baseline leads to 0.59 mm of Hg decrease in IOP over a five year interval. [6] SD Mcloed et al in their study on middle aged men concluded that subjects with IOP >20 mm of Hg had significantly higher systolic blood pressure than age matched controls. [7] Nangia V et al in their study on population of Central India found that systemic blood pressure is positively correlated with IOP. [8] Seddam JM et al in their case control study on ocular hypertension concluded that ocular hypertensive have history of hypertension more frequently as compared to ocular normotensives. [9]Foster PJ et al in their study found a significant positive relationship between IOP and systolic blood pressure. [10]The findings of our study are supported by the results of the previous investigators in showing a positive trend of IOP with systemic blood pressure.

The higher incidence of glaucoma among hypertensive individuals led to a suspicion of common pathogenic mechanism between the two diseases. The recent data suggests existence of common pathogenic mechanisms related to altered epithelial sodium transport by ENaC (Epithelial sodium channels in distal nephron of kidneys and cilliary epithelium of eye. Langman MJS et al attributed this common pathogenic mechanism to explain the coincidence of glaucoma and hypertension.[2]The initial rise in IOP with increase in BP is a protective autoregulating mechanism. The failure of autoregulation in hypertensive individuals lead to damage of small blood vessels on optic disc and hence glaucomatous optic neuropathy. [10] Lin C et al observed a positive correlation between IOP and BP and also identified that elevated intraocular pressure is associated with a number of metabolic variables, All components of metabolic syndrome has an impact on intraocular pressure. [11]

The mechanism of increased IOP with rise in systemic blood pressure have been explained in various studies as follows: could be due to an increased ultrafiltration at the ciliary epithelium due to increased ciliary artery pressure leading to increased aqueous production. Increased aqueous production by altered sodium transport due to defect in ENaC. [2] Obstruction of the aqueous outflow by raised episcleral venous pressure that controls the aqueous humor exit across

the trabecular meshwork. Exaggerated dynamic cortisol response influence IOP by decreasing outflow facility. [12, 13]

CONCLUSION:

Glaucoma is a chronic progressive optic neuropathy multi factorial in origin. Raised IOP is a major risk factor for development of glaucoma and its progression. Early diagnosis and treatment is the key in preventing vision loss due to glaucoma. Currently IOP is the only risk factor of glaucoma that can be modified with medical and surgical intervention. IOP increases with increase in both systolic and diastolic blood pressure. Evaluating our observations in light of available literature we concluded that high blood pressure is a risk factor for development of raised IOP which can lead to glaucoma. Periodic checking of IOP in hypertensive subjects and vice-versa is the key to the prevention of irreversible blindness due to glaucoma. Thus population based screening would reduce the burden of blindness due to glaucoma.

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