

**Effect of Systemic Blood Pressure on Intraocular Pressure-A Comparative study.**

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**Abstract**

**Background:** Vascular insufficiency at the optic nerve and retrolaminar portion of optic nerve occurs when normal balance between IOP and BP in choroidal vessels supplying the optic nerve head and the retrolaminar portion of optic nerve is disrupted resulting in a disease called glaucoma. One of the modifiable risk factor in the genesis of glaucoma is BP & its role has been identified recently. Hence, screening of IOP is of utmost importance in patients with hypertension.

**Objectives:** The objective of the study was to find out the relationship between BP and IOP.

**Materials & Methods:** The present comparative study involved 420 patient presenting with refractive error (age-sex matched 210 normotensive “Normal BP varies between 100-140 mmHg systolic and 60-90 mmHg diastolic” & 210 hypertensive with BP  $\geq$  140/90) was conducted in the out-patient department of ophthalmology at tertiary care hospital of North India. After meeting inclusion & exclusion criteria the patients underwent detailed clinical history, general

examination, dilated fundus examination, BP & IOP of every participant was recorded.

**Results:** Maximum number of studied subjects in hypertensives i.e.54% were seen in age group of  $\geq$ 51yrs followed by 24% in 41-50yrs. Males i.e. 56% outnumbered females in present study. The mean, minimum and maximum IOP values in normotensive patients was 14.8 $\pm$ 3.4, 6.5 , 26 whereas mean, minimum and maximum IOP values in hypertensive patients was 17.4 $\pm$ 4.5, 10, 38. Mean difference between IOP values in normotensive & hypertensive patients was 2.6 which was significant (p value <0.001).

**Conclusion:** From present study we may conclude that there is a strong relationship between increase in BP and IOP. Authors recommend that screening of IOP is of utmost importance in patients with hypertension as it helps to prevent glaucoma, which is the second most common cause of blindness and visual impairment worldwide. Hence, every physician should target toward maintaining adequate systemic BP levels in every hypertension patients & also IOP of every hypertensive should checked.

**Keywords:** Blood Pressure (BP), Intraocular Pressure (IOP), Relationship.

### Introduction

About 16-37% of the population worldwide is affected by hypertension which is a condition characterized by elevated blood pressure (BP) in the arteries. When BP is above 140/90 mmHg in the resting state, it is called high BP (Normal BP varies between 100-140 mmHg systolic and 60-90 mmHg diastolic). Effect of high BP on the retinal arterioles lead to blindness.<sup>1</sup> Intraocular pressure which is defined as the pressure exerted by the intraocular fluids on the coats of eyeball is found to be associated with systemic BP levels.<sup>1,2</sup> Many new risk factors have been discovered for rise in IOP which include thin central corneas, blood pressure and diabetes mellitus.<sup>3,4</sup> Relationship of IOP and BP is complex and is effected by many factors as effect of BP on IOP, use of antihypertensive, anti glaucoma drugs and hypertension duration.<sup>5</sup> Recently, the role of BP in the genesis of glaucoma has been identified as one of the modifiable risk factors. Hence, screening of IOP is of utmost importance in patients with hypertension as it helps prevent glaucoma, which is the second most common cause of blindness and visual impairment worldwide. Thus, a population based screening for raised IOP can reduce the prevalence of glaucoma, which has been recognized as a major cause of blindness worldwide.<sup>6</sup>

### Material and method

The present comparative study was conducted over a period of 1 year in the out-patient department of ophthalmology at tertiary care hospital of North India. The informed consent from all the participants were undertaken before inclusion in the current study. The data was recorded by independent observer.

### Inclusion criteria

**Cases/Group 2:** Both sexes, Patients presenting with refractive error with systolic BP of  $\geq 140$  mmHg and/or diastolic BP of  $\geq 90$  mmHg were included in the hypertensive group.

**Controls/Group 1:** Age & sex matches normotensive, healthy patients presenting with refractive error.

### Exclusion criteria

Those who didn't gave consent, Patients having other systemic/ocular diseases which could contribute to eye problems.

After meeting inclusion & exclusion criteria the patients were divided into two groups:

- Group 1 comprise 210 normotensive individuals
- Group 2 comprise 210 hypertensive individuals

All patients underwent detailed clinical history, general examination was done and vitals recorded. BP of all patients were recorded in the supine position after 30 min rest. IOP of every participant was recorded using Non coherence tonography. Both direct & indirect ophthalmoscopy of dilated fundus of every participant was done.

### Statistical analysis

The data was analysed using statistical software MS Excel / SPSS version 17.0 for windows. Data presented as number/ percentage (%) as discussed appropriate for quantitative & qualitative variables.

### Observation & Results

Table no.1 shows out of total 420 patients maximum number i.e.54% were seen in age group of  $\geq 51$  yrs followed by 24% in 41-50 yrs. Males i.e. 56% outnumbered females in present study.

Table no.2 shows mean, minimum and maximum IOP values in normotensive patients was  $14.8 \pm 3.4$ , 6.5, 26 whereas mean, minimum and maximum IOP values in hypertensive patients was  $17.4 \pm 4.5$ , 10, 38. Mean difference between IOP values in normotensive &

hypertensive patients was 2.6 which was significant (p value <0.001).

Table no.3 shows that only 15 patients in normotensive group have IOP>20 whereas in hypertensive group 41 patients have IOP>20.

### Discussion

In the present study it has been found that maximum number of participants were in the age group  $\geq 50$  years i.e. 54%. Wong TT et al., in a study found that IOP increases with age upto the sixth decade & with the further increase in age a decrease in IOP was seen.<sup>7</sup>

In the present study maximum number of patients were males i.e. (56%) while female were 44%.

In the present study the mean IOP value in group-1 i.e. normotensives was  $14.8 \pm 3.4$  & in group-2 i.e. hypertensives was  $17.4 \pm 4.5$ . The mean difference was 2.6 which was highly significant. Various explanation for the direct relationship between intraocular & systemic pressure were given as: increased perfusion pressure in the ciliary arteries results in increased filtration of aqueous fluid in the ciliary body thus rises IOP, high BP increases ciliary artery pressure which enhance the ultrafiltration of aqueous & thus increases ocular pressure, there may be some structural changes in the trabecular meshwork as the age advances which may increase resistance in the episcleral & anterior ciliary veins which results decrease in the facility of aqueous outflow, thereby elevating the IOP.<sup>6</sup> Devadas BS et al in a study found that mean IOP value in group-1 i.e. normotensives was  $14.64 \pm 4.00$  & in group-2 i.e. hypertensives was  $18.04 \pm 6.02$ , a significant correlation between changes in systemic BP and intraocular pressure (IOP) was seen. A significant rise in IOP with an increase in systemic BP was shown by Independent *t*-test.<sup>1</sup> Abraham ML et al in a study found that IOP was increasing with increase in BP and both

SBP & DBP were positively & significantly correlated with IOP. Therefore, compared to normotensives both prehypertensives and hypertensive were at increased risk for the developing glaucoma.<sup>6</sup> According to various studies, a positive correlation was noted between intraocular pressure and BP.<sup>8</sup> Beaver Dam study showed that an increase of systolic BP  $\geq 10$  mmHg from baseline leads to 0.44 mmHg rise in IOP and a decrease of systolic BP  $\leq 10$  mmHg from baseline leads to 0.59 mmHg decrease in IOP over a 5-year interval.<sup>1</sup> Similarly, diastolic BP was associated with 0.19 mmHg in IOP over a 9-year follow-up.<sup>9</sup> Based on sympathetic tone of hypertensive individuals, hypertension has an indirect effect on IOP<sup>10</sup> which influence IOP by affecting the episcleral venous pressure which helps in regulation of aqueous outflow across the trabecular meshwork into the Schlemm's canal.<sup>11</sup> The increase in IOP can lead to optic neuropathy further leading to deterioration of vision which is irreversible.<sup>12</sup> Fasih U et al in study found that the patients with systolic blood pressure of more than 140mm Hg have significant rise in IOP with p value of less than 0.005. Intraocular pressure in patients with primary open angle glaucoma rises as there is a rise in systolic as well as diastolic blood pressure. So it is important to have a good control of blood pressure in patients of POAG to halt or slow down the progression of glaucomatous optic nerve damage.<sup>5</sup> Hence, hypertension being a modifiable risk factor for increase in IOP should be controlled and maintained at optimal level to prevent its effect on vision.<sup>1</sup>

### Limitations

Follow up of these hypertensive patients for the development and progression of glaucoma were not done. Therefore, further studies should be conducted to assess the independent contribution of BP for the

development of glaucoma, even in the presence of other potential risk factors.

### Conclusion

From present study we may conclude that there is a strong relationship between increase in BP and IOP.

### Recommendations

Authors recommend that screening of IOP is of utmost importance in patients with hypertension as it helps to prevent glaucoma, which is the second most common cause of blindness and visual impairment worldwide. Hence, every physician should target toward maintaining adequate systemic BP levels in every hypertension patients & also IOP of every hypertensive should checked.

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**Legends Tables**

Table no. 1 Demographic characteristics of studied (group 1+2) subjects:

Characteristics	Percentage of studied subjects(gp-1+2)
Age (in years)	
≤40	22
41-50	24
≥51	54
Sex	
Males	56
Females	44

Table no. 2 Minimum & maximum IOP values of group 1 and group 1 including mean ±SD.

Group	Minimum IOP	Maximum IOP	Mean ±SD	Mean difference	t-value	p-value
Normotensive(gp 1)	6.5	26	14.8±3.4	2.6	6.8	<0.001
Hypertensive(gp-2)	10	38	17.4±4.5			

IOP: Intraocular Pressure, SD:Standard Deviation

Table no. 3 Distribution of IOP in normotensive & hypertensive subjects.

IOP	Normotensive (n)	Hypertensive (n)
≤10	17	1
>10-20	178	168
>20-30	15	37
≥30	0	4
Total	210	210

n=number of patients