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A Study of Mean Intraocular Pressure in Male and Female Hypertensive Patients

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Abstract: The blood pressure changes are sometimes reflected by changes in Intra-ocular pressure. We in the present study tried to evaluate the changes in IOP with the change in blood pressures in borderline hypertensive to known hypertensive patients graded according to recent ACC/AHA guidelines of hypertension in male and female patients visiting Rajiv Gandhi Institute of Medical Sciences [RIMS], Adilabad. The study was carried in the Department of General Medicine and Department of Ophthalmology. A total of (n=222) patients were involved in the study. Subjects with the history of glaucoma, ocular hypertension, corneal abnormalities or those who underwent ophthalmic surgeries were excluded from the study. Systolic blood pressure was determined at the point at which the Korotkoff's sounds become audible (first phase) whereas the diastolic BP was measured at the point at which the sounds suddenly become faint (fourth phase of Korotkoff's sounds). Blood pressure measurements were determined by taking the mean value of three readings at 30 minutes interval. The IOP was measured in the Department of Ophthalmology, of both eyes with help of Goldmann applanation tonometer using 2% fluorescein eye drops by the same examiner to avoid any difference. In this study, we included a total number of (n=222) patients out of which males were (n=120) 54.54% and female were (n=102). The mean age of the individuals involved in the study was 52.25 ± 12.5 years. The overall mean IOP in males was 18.85 ±6.65 [95% CI 17.7 ± 20.0] similarly the overall mean IOP in females was 17.54 ± 5.83 [95% CI 16.4 -18.7]. The differences between the IOP of male and female were statistically insignificant. The Pearson's correlation coefficient was measured for each subgroup of hypertension among the male the all the subgroups showed the positive correlation of IOP with blood pressure and a strong correlation was shown by Hypertension stage II. In females, the correlations were also positive in all subgroups however in hypertension stage II showed weak to the moderate correlation coefficient. There is a strong positive correlation between the blood pressure and IOP, especially in males. Considering IOP as one of the screening means of glaucoma detection we would recommend that every hypertensive patient undergo IOP check regularly to prevent glaucoma.

Keywords: Intraocular Pressure, Hypertension.

INTRODUCTION

Hypertension has profound effects on structure and functions of the eye. First the retinal, choroidal and optic nerve circulations undergo a series of pathophysiological change in response to increased blood pressure leading to a range of clinical signs referred to as hypertensive retinopathy, hypertensive choridopathy, and hypertensive optic neuropathy [1]. Intraocular pressure is the pressure exerted by the ocular components against the fibrous tunics of the eye. Intraocular pressure is determined by the volume of aqueous humor, central corneal thickness, choroidal blood volume, rigidity, sclera compliance, the tone of extraocular muscles and external pressure [2]. Systemic Hypertension may contribute to increased IOP via overproduction or impaired outflow of aqueous humor [3, 4]. Elevation of intraocular pressure is the principal modifiable risk factor for the development and progression of glaucoma [5]. Several population based studies have found statistically significant positive associations of systolic blood pressure and diastolic blood pressure with IOP [6-11]. Some clinical trials have shown a relationship between IOP and glaucoma development and progression [12-14]. Besides the mechanical effect of raised IOP on the optic nerve head, several vascular factors have been identified as risk factors [15]. Among the vascular factors systemic hypertension is known to contribute to increased IOP via over production or impaired aqueous humour flow [16]. A direct and clear relationship between glaucomatous damage and BP level has not been established [17]. In blue mountains eye study [9] the mean IOPs of the two eye increased from 14.3 mmHg for systolic BP levels, 110 mmHg to 17.7 mmHg for

systolic BP levels >200 mmHg. The mean IOP of the two eyes increased from 15.2 mm Hg for diastolic BP levels, 70 mm Hg to18.6 mm Hg for diastolic BP levels of >120 mm Hg. The mean IOP in right eyes increased by 0.28 mm Hg for each 10 mm Hg increase in systolic BP, or by 0.52 mm Hg for each 10 mm Hg increase in diastolic BP. Hennis *et al.*, [18] examined the longitudinal relationship between systemic hypertension and a 4-year IOP change in residents of Barbados aged >40 years. Overall, the mean IOP increased by 2.5 (SD 3.9) mm Hg in black participants during the 4-year period of follow up. With this background we in the present study tried to evaluate the IOP measurements with Blood pressure as determining IOP distribution in this group and factors associated with it can be useful in understanding the difference in glaucoma prevalence and its associated factors in this group of the population.

MATERIALS AND METHODS

This prospective study was conducted in Department of General Medicine and Ophthalmology Rajiv Gandhi Institute of Medical Sciences [RIMS] Adilabad. Institutional Ethical committee permission was obtained for the study. Written consent was obtained from the patients involved in the study. The study involved cases having elevated BP (120 – 129/ < 80) and known hypertensive patients on medical treatment. The age range was from 40 -60 years. A total of (n=222) patients were involved in the study. Subjects with a history of glaucoma, ocular hypertension, corneal abnormalities or those who underwent ophthalmic surgeries were excluded from the study. Blood pressure was recorded in a seated position with back support from right upper arm kept at the level of the heart, by mercury sphygmomanometer after giving 5 minute rest to the subjects between 9:00 AM to 11: AM. The subjects were advised not to take tea, coffee within half an hour before the measurement of blood pressure. Systolic blood pressure was determined at the point at which the Korotkoff's sounds become audible (first phase) whereas the diastolic BP was measured at the point at which the sounds suddenly become faint (fourth phase of Korotkoff's sounds). Blood pressure measurements were determined by taking the mean value of three readings at 30 minutes interval. The subjects were grouped into various subgroups based on the recent 2017 ACC/AHA Hypertension Guidelines [19]. At the same time the IOP was measured in the Department of Ophthalmology, of both eyes with help of Goldmann applanation tonometer using 2% fluorescein eye drops by the same examiner to avoid any difference. The data obtained were put in MS Excel format and analyzed.

RESULTS

In this study, we included a total number of (n=222) patients out of which males were (n=120) 54.54% and female were (n=102). The mean age of the individuals involved in the study was 52.25 ± 12.5 years [95% CI 50.6 – 53.9]. More numbers of male and female patients were from stage I hypertension n=75 (33.78%) followed by elevated BP group (n=65) 29.28% and followed by stage II hypertension having (n=57) 25.68% and (n=25) 11.26% given in Table-1.

Blood pressure range in [mmHg]	Male	Female	Total	Percentage
120 – 129/ < 80 [Elevated BP]	35	30	65	29.28
130 – 139 /80 – 89 [Stage I Hypertension]	40	35	75	33.78
140 – 149/ 90 – 99 [Stage II Hypertension]	30	27	57	25.68
> 160 / > 100 [Stage II Hypertension]	15	10	25	11.26
Total	120	102	222	100

The overall mean IOP in males was 18.85 ±6.65 (95% CI 17.7 ± 20.0) similarly the overall mean IOP in females was 17.54 ± 5.83 [95% CI 16.4 -18.7]. The differences between the IOP of male and female were statistically insignificant. The Pearson's correlation coefficient was measured for each subgroup of hypertension among the male the all the subgroups showed the positive correlation of IOP with blood pressure and a strong correlation was shown by Hypertension stage II. In females, the correlations were also positive in all subgroups however in hypertension stage II showed weak to moderate correlation coefficient given in Table-2.

Blood pressure range in [mmHg]	Mean IOP Male in mmHg	Pearson Correlation 'r' values	Mean IOP Female in mmHg	Pearson Correlation 'r' values
120 – 129/ < 80 [Elevated BP]	13.85 ± 2.25	+ 0.3	13.05 ± 3.25	+ 0.28
130 – 139 /80 – 89 [Stage I Hypertension]	15.59 ± 3.35	+0.35	15.58 ± 2.5	+0.3
140 – 149/ 90 – 99 [Stage II Hypertension]	18.79 ± 3.09	+ 0.5	17.90 ± 3.25	+0.33
> 160 / > 100 [Stage II Hypertension]	20.75 ± 3.25	+0.6	19.05 ± 2.5	+0.42

DISCUSSION

There appears to be a close relationship between the mean IOP and hypertension. The literature shows a higher prevalence of this problem in the western population. The data is sparse in the Asian population. Ethnicity appears to play an important role in the association of IOP and glaucoma prevalence [20]. Therefore we in the present study tried to evaluate the mean IOP with hypertension in this group of the population. In this study, we found the mean IOP in males was 18.85 ±6.65 (95% CI 17.7 ± 20.0) and mean IOP of female patients was 17.54 ± 5.83 [95% CI 16.4 - 18.7]. There was a strong positive correlation of IOP with blood pressure in males. A Bill [21] demonstrated that variations in systolic BP resulted in small changes in aqueous humour formation possibly related to increase capillary pressure in the ciliary body. In animal experiments when monkeys were rapidly bled, through femoral arterial BP of about 60 mmHg, the rate of aqueous formation is reduced to 20%. The possible cause could be the role of the autonomic nervous system which could control IOP by changing the balance between aqueous humour formation and outflow [22]. The Beijing eye study [23-25] found significant associations between IOP and both systolic and diastolic BP. Kelvin *et al*., [26] investigated the association between change in systemic BP and change in IOP in the Beaver Dam. In cross-sectional analyses at baseline and follow-up, it was found that a 10 mm Hg increase in systolic BP was associated with a 0.3 mm Hg increase in IOP, whereas a 10 mm Hg increase in diastolic BP was associated with a 0.6 mm Hg increase in IOP Over the 5-year interval [26]. Shiose *et al*., [27] reported mean IOP to be 13.3 mmHg for normal people aged over 40 years while in a Korean study despite enrolling younger people (over 20 years). H Hashemi *et al*., [28] in Iran studying the distribution of intraocular pressure in healthy Iranian individuals found Mean (SD) IOP was 14.5 (2.6) mmHg in the total population, 14.4 (2.7) in men, and 14.5 (2.5) in women. Mean (SD) IOP in people ⩾40 years was 15.1 (2.9) mmHg. IOP increased significantly with age and cup: disc ratio except for a fall in old age. Hoehn R *et al.*, [29] showed Intraocular pressure distribution in this cohort yielded a lower mean IOP than in similar white study populations. Increasing age in women correlated with lower IOP. Association analyses with several systemic characteristics revealed that cardiovascular risk factors correlated with higher IOP. Suh W *et al.*, [30] in the South Korean population-based study measuring IOP found; Mean IOP of the urban areas was found to significantly higher than the corresponding value of the rural area. From the above we can conclude that there is a definite relation between the IOP and Blood pressure, however, it is subjected to ethnic variations as related to BP and geographic variations. Therefore these factors must be kept in mind before generalizing and interpreting results of such studies.

CONCLUSION

There is a strong positive correlation between the blood pressure and IOP especially in males in this group of the population. Considering IOP as one of the screening means of glaucoma detection we would recommend that every hypertensive patient undergo IOP check regularly to prevent glaucoma.

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