MEAN INTRAOCULAR PRESSURE IN HYPERTENSIVE ADULTS

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ABSTRACT

Objective: To determine the mean Intraocular Pressure (IOP) in already diagnosed adult hypertensive patients with different grades of hypertension.

Study Design: Cross-sectional descriptive study.

Place and Duration of Study: Combined Military Hospital, Lahore, from March 2012 to Aug 2012.

Patients and Methods: A total of 178 already diagnosed hypertensive patients were selected. A detailed history of ocular or systemic diseases was taken. Intraocular pressure was measured with help of Goldmann applanation tonometer. Three consecutive readings of IOP of each eye were taken at 30 minutes interval and mean calculated. Blood pressure was recorded in seated position from right upper arm, by mercury sphygmomanometer. Blood pressure measurements were determined by taking the mean value of three systolic and diastolic readings.

Results: The results of intraocular pressure (IOP) between various grades of hypertension were determined. There was an increase in mean IOP with rise in blood pressure. The subjects with grade I hypertension showed a mean IOP of 13.95 ± 3.74 mmHg, while grade II and grade III hypertensive subjects had mean IOPs as 18.10 ± 3.32 and 20.21 ± 2.52 mmHg respectively.

Conclusion: A higher value of mean IOP was found with increase in systolic and diastolic blood pressures.

Keywords: Intraocular pressure, Systolic and diastolic blood pressure.

INTRODUCTION

Intraocular pressure is defined as 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, scleral compliance, tone of extra ocular muscles and external pressure. Elevation of intraocular pressure is the principal modifiable risk factor for the development and progression of glaucoma[1].

Elevated intraocular pressure is strongly associated with the development of glaucomatous optic neuropathy[2]. This implies that those at risk of higher IOP also have a higher risk of glaucoma. Several studies over the years have shown that, as IOP rises above 21 mmHg, the percentage of patients developing visual field loss increases rapidly, most notably at pressures higher than 26-30 mmHg. A patient with an IOP of 28 mmHg is about 15 times more likely to develop field loss than with a pressure of 22 mmHg[3].

Diagnostically, glaucoma is a disease suited to a preventive approach. Keeping in view the prevalence of glaucoma as a cause of visual morbidity, it is important to identify factors that may be associated with elevation of intraocular pressure[4]. Intraocular pressure is a dynamic function and is found to be positively associated with central corneal thickness, systolic blood pressure, age and female gender[5,6,7]. Determining the IOP distribution in our population and factors associated with it can also be helpful in understanding the difference in glaucoma prevalence and its associated factors in our part of the world. Therefore this study was carried out to determine the mean intraocular pressure in various grades of hypertension.

PATIENTS AND METHODS

This cross sectional descriptive study was carried out at the Department of Ophthalmology, Combined Military Hospital Lahore from March 2012 to August 2012. A total of 178 already diagnosed hypertensive patients for more than a year were selected through non probable

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Received: 13 Aug 2013; Accepted: 07 Feb 2014

consuctive sampling, with or without medication, between ages 40 to 60 years, from medical outpatient department. Subjects with personal or family history of glaucoma, ocular hypertension, and corneal abnormalities secondary to trauma, drugs, laser, or anterior segment surgery were excluded. Systemic diseases were also ruled out other than hypertension. Permission was taken from hospital ethical committee. Written informed consent was taken. Both IOP and blood pressure readings were taken on the same day with calibrated instruments. Intraocular pressure of both eyes was measured with help of Goldmann applanation tonometer using 2% fluorescein eye drops by the first author to avoid inter examiner and inter tonometer variation, between 9 to 11 AM to minimize the effect of diurnal variation. Three readings of each eye were taken at 30 minutes interval and mean was calculated. Blood pressure was recorded in seated position from right upper arm, by mercury sphygmomanometer by one of two nurses trained for the subject 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. Blood pressure of 140-159/90-99 mmHg was labeled as Grade I hypertension (mild), 160-179/100-109 mmHg as Grade II hypertension (moderate) and more than 180/110 mmHg was labeled as Grade III hypertension (severe).

Data analysis was performed through SPSS version 10. All continuous variables including age, intraocular pressure and systolic and diastolic blood pressure were presented by mean ± standard deviation. Frequency and percentages were presented for different grades of hypertension. One way ANOVA and post hoc tukey was carried out to compare the mean IOP in three grades of hypertension.

RESULTS

In our study 88 (49.6%) patients were male and 90 (50.6%) were female. The mean age among our data set was 50.08 ± 5.87 years (range 40-60 years). The overall mean intraocular pressure in hypertensive adults was 17.10 ± 4.12 mmHg.

The differences of intraocular pressure (IOP) among male and female subjects was not found to be significant [{Males (n = 88): 16.98 ± 4.02} {Female (n = 90): 17.22 ± 4.23}, (p = 0.706)}].

There was a statistically significant difference between groups as determined by one way ANOVA ($p < 0.001$). Tukey post hoc tests of multiple comparisons revealed significant differences between grade I and grade II ($p < 0.001$), grade I and grade III ($p < 0.001$), and grade II and grade III ($p = 0.004$).

DISCUSSION

Mean intraocular pressure rises with development of hypertension. Literature reviews do show a higher relevance of this problem among western populations; only limited data is available from South East Asian population. The results show a clear association of IOP and glaucoma prevalence with ethnicity[8]. Therefore it seems advisable to employ a geographical approach to interpretation. Furthermore, there is substantial discrepancy between different studies even when these studies were performed on populations within similar geographic locations or racial groups. For example, in a Japanese survey, Shiose et al[9] 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), Lee et al reported mean IOP to be 15.5 mmHg. The two studies also present considerable variations in their results in terms of IOP determining factors.

The normal IOP is 12 - 21 mmHg. In our study, the mean value of intraocular pressure was 17.106 ± 4.120. In the Beaver Dam study[3], the median IOP was 15.34 ± 2.07 mmHg. In an Australian study, the geometric mean was 14.2 mmHg for those participants without glaucoma and 17.9 mmHg for those with glaucoma. This

difference in mean IOP in different populations is owing to geographic and ethnic variations and indicates that it is not appropriate to set a universal IOP cut-off (such as greater than 21 mmHg) to indicate the presence of Open Angle Glaucoma in different populations.

This is where a need for a local study on intraocular pressure and its determinants in a Pakistani population was felt. Owing to the geographic, racial and ethnic variations found, international data cannot be generalized on a Pakistani community. Local data available on the subject is scarce[10]. An extensive search could find only one study each on linking of intraocular pressure with age and gender and none on that with other systemic parameters.

Some studies have shown mean IOP to be slightly higher in men[11]. Most studies, however that have used a multivariable model to evaluate simultaneous relations of risk factors and confounder adjustment, have reported an insignificant connection between gender and IOP or categorized gender with variables of little importance.

All the major studies, including the Blue mountains Eye Study, Beaver Dam Eye Study[3], the Tanjong Pagar study[12], the Barbados Eye Study[13] and the Rotterdam Study have shown positive involvement of systolic and diastolic blood pressure with intraocular pressure. An explanation given for these findings was that variations in systolic BP resulted in small changes in aqueous humour formation, possibly related to increase capillary pressure in the ciliary body[14]. This could result in increased IOP. Blood pressure may affect episcleral venous pressure, which is important in regulating the flow of aqueous across the trabecular meshwork into Schlemm's canal[15].

Leske et al[16] and Tielsch JM et al[17] found systemic and ocular hypertension to be interlinked. However, they could not find an independent effect of blood pressure on open angle glaucoma. There is also longitudinal data from developed countries which suggests that baseline systolic BP is directly connected with mean IOP measured at follow up of 4 years and 8 years[18].

Overall this data is in congruence with the major findings of most international studies. Although the diagnosis of glaucoma is made independently of IOP, a reduction in IOP would reduce the number of people at greatest risk of glaucoma as IOP is strongly linked to the risk of glaucoma. However it is a justifiable concern that reduction of blood pressure may reduce perfusion pressure, and increase risk of glaucoma, although this effect should be negligible in those with normal auto-regulatory function.

Table-1: Frequency and percentage of hypertension grades.

Hypertension Grades	Frequency	Percentage
Grade I (140-149 / 90-99 mmHg)	62	34.7%
Grade II (160-179 / 100-109 mmHg)	78	43.8%
Grade III (>180 / 110 mmHg)	38	21.3%
Total	178	100.0%

Table-2: Mean intraocular pressure (IOP) levels among subjects with different grades of hypertension.

	Grades of Hypertension		
	Grade I n = 62	Grade II n = 78	Grade III n = 38
Mean IOP (mmHg)	13.95 ± 3.74	18.10 ± 3.32	20.21 ± 2.52

Limitations of this study were small sample size, randomization was not possible and sampling was non-probability convenience so results cannot be generalized. But this data has an edge: being personally collected by a single examiner after applying specific inclusion and exclusion criteria, using the same method and set of instruments for each subject in order to avoid inter examiner and inter instrument variation. This is in contrast to the retrospective use of computer-filed data in certain international studies like that done by Shiose[8] on a large sample of about 187,000 eyes of 94,000 Japanese subjects data already filed in computer for undergoing multiphasic tests. Moreover keeping in view the geographic and ethnic variations in IOP distribution, the deviation of these results from international studies is logical and understandable.

CONCLUSION

In our study we determined high readings of mean IOP with increasing grades of hypertension which confirms the same internationally emphasized hypertensive implications in our part of the world as well.

Considering IOP as a traditional still in-use, one of the screening means of glaucoma detection, it would be necessary to implement further studies to determine the normal range and distribution of IOP in our population. There is also a need to educate doctors and all hypertensive patients about regular monitoring of IOP so that all cases of subclinical glaucoma and ocular hypertension can be picked up earlier.

Conflict of Interest: This study has no conflict of interest to declare by any author.

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