A comparative study of intraocular pressure changes in postmenopausal normotensive and hypertensive women

Nirmala N¹*, Adhilakshmi A¹, Harshila Jain², Karthika Priyadarshini U¹

INTRODUCTION

Glaucoma commonly known as the ‘thief of sight’ is the second leading cause of blindness worldwide markedly affecting women and Asians.¹² It is estimated that there are more than 60 million cases of glaucoma worldwide and is expected to increase to 80 million by 2020.

India has 12 million cases and accounts for 1/5th of the global burden of glaucoma.³ According to world population projection for 2010 and 2020; India would become second in having the maximum number of glaucoma cases.

The prevalence of primary open angle glaucoma in rural South Indians aged 40 and above was 1.7% (AECS study)⁴ and 3.5% in urban South India (CGS).⁵

Advancing age, increased body mass index, genetic and increased Intraocular Pressure (IOP) are the factors associated with increased risk of glaucoma.

IOP-induced ganglion cell injury is explained by mechanical (axonal) and ischemic (vascular) mechanisms.  

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Chronic IOP elevation causes deformation of the lamina cribrosa, which gives rise to mechanical compression of ganglion cell axons at the optic nerve head, leading to impaired axoplasmic transport. Lamina cribrosa distortion induced by IOP elevation causes compression of blood vessels at the optic nerve head which in turn reduces the ocular perfusion pressure, thus producing regional hypoxia and ischemia which is the basis of vascular mechanism.6

Changes in IOP are directly and significantly associated with changes in systemic blood pressure with age especially so after menopause. Menopause is defined as irreversible cessation of female reproductive cycle and menstruation. Menopause related increase in blood pressure has been attributed to oestrogen withdrawal, weight gain and age hence increased IOP is more common in postmenopausal women.

Not many studies have been done in South India among postmenopausal women relating systemic blood pressure with IOP. ‘Vision 2020 right to sight’ India program has considered glaucoma as one of the priorities among avoidable blindness and hence this study was chosen.

METHODS

The study was a descriptive comparative study carried out after obtaining institutional ethical committee clearance. A total of 70 females in the age group of 45 to 55 years, 35 normotensive (BP 100/60 to 118/78 mmHg) and 35 known hypertensive (≥140/90 mmHg) postmenopausal women who gave history of amenorrhea of more than one year (WHO) were included in the study based on JNC 7 criteria.7

Postmenopausal women who gave h/o glaucoma, family h/o glaucoma, ocular trauma, ocular surgeries, refractive errors, migraine, medical or surgical illness and who were on medications such as Beta blockers, diuretics and hormone replacement therapy were excluded from the study.

Written informed consent was obtained from all the subjects. All of them were examined by the ophthalmologist in the department of ophthalmology.

Anthropometric measurements

Height was measured to the nearest 0.1 cm without footwear using a wall mounted measuring tape and weight was measured in kg using a digital weighing scale. BMI was calculated from these values. Blood pressure was recorded using a mercury sphygmomanometer with subjects in a comfortable sitting position after 5 minutes rest. IOP was measured using Goldman applanation tonometer between 9AM to 11AM to avoid diurnal variations.

Subject was informed about the test. Aseptic precautions were taken to disinfect the applanation prism and wiped dry. Tonometer calibrated each time. The subject was made to sit comfortably before the slit lamp at the right height with her chin on the chinrest and forehead against the headband. Magnification of the slit lamp was set at x10. A drop of topical anaesthetic agent Proparacaine Hydrochloride ophthalmic solution 0.5% (Paracaine) was instilled into the right eye. Fluorescein strips were used to stain the eyes. The tonometer was moved forward slowly until the prism rested gently on the centre of the patient’s cornea. With the other hand the calibrated dial on the tonometer was turned clockwise until the inner lines of the two fluorescein semicircles (mires) coincided. The reading on the dial was noted. The prism was withdrawn from the corneal surface and the tip wiped dry. The procedure was repeated for the other eye.

Statistical analysis

Analysis was done using SPSS version 17.0. The results were presented as Mean ± SD. After checking for normality of data distribution unpaired student’s ‘t’ test was used to find the significance of study parameters between the two groups. Correlation analysis was performed to assess relationship between different variables. P value of 0.05 or less was considered statistically significant.

RESULTS

Table 1: Mean baseline parameters in postmenopausal normotensive women and postmenopausal hypertensive women.

<table>
<thead>
<tr>
<th></th>
<th>Normotensive</th>
<th>Hypertensive</th>
<th>t value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>50.20 ± 2.91</td>
<td>50.26 ± 3.37</td>
<td>-0.076</td>
<td>0.940</td>
</tr>
<tr>
<td>Height</td>
<td>153.51 ± 4.86</td>
<td>159.37 ± 7.94</td>
<td>-3.718</td>
<td>0.000</td>
</tr>
<tr>
<td>Weight</td>
<td>57.43 ± 8.49</td>
<td>58.20 ± 9.69</td>
<td>-3.54</td>
<td>0.724</td>
</tr>
<tr>
<td>BMI</td>
<td>24.35 ± 3.38</td>
<td>22.95 ± 3.54</td>
<td>1.699</td>
<td>0.094</td>
</tr>
<tr>
<td>SBP</td>
<td>108.1 ± 6.1</td>
<td>152.7 ± 12.0</td>
<td>-19.607</td>
<td>0.000</td>
</tr>
<tr>
<td>DBP</td>
<td>69.4 ± 5.5</td>
<td>96.0 ± 7.6</td>
<td>-16.722</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Figure 1: Mean IOP in postmenopausal normotensive women was 13.01 ± 2.61 mmHg and 15.15 ± 2.16 mmHg in postmenopausal hypertensive women (P <0.05).

Table 2: Correlation analysis a statistically significant correlation of mean IOP with systolic BP in postmenopausal hypertensive women (P <0.05) and a positive correlation with diastolic BP in postmenopausal hypertensive women.

Figure 2: Scatter diagram relating mean IOP with systolic and diastolic BP.
DISCUSSION

The intraocular pressure is the pressure within the eye which is maintained as a result of balance between constant formation and drainage of aqueous humour. Normal range of IOP is 10-21 mmHg. Even though studies have concluded that IOP increased proportionally with degree of obesity our study did not show a positive correlation between BMI and IOP.

A change in blood pressure is directly associated with a change in IOP and an elevated IOP is one of the major risk factors for glaucoma or glaucomatous neuropathy.

A study taken up by I. A. Qureshi in Pakistan showed that menopause significantly increases intraocular pressure. He concluded that mean IOP of postmenopausal hypertensive women was significantly higher than that of postmenopausal normotensive women. Mean IOP of postmenopausal hypertensive women was significantly higher than that of postmenopausal normotensive women in our study which is consistent with other studies.

Studies have shown that there is a positive correlation between IOP and BP. In the Beaver dam eye study conducted by Klein et al. there was significant correlation between IOP and both systolic and diastolic BP. Ravikisan et al. in their study have concluded that systolic, diastolic and mean arterial pressure were positively correlated to IOP and it was statistically significant.

Table 2: Correlation analysis in postmenopausal hypertensive women.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group</th>
<th>Correlation coefficient</th>
<th>Spearman’s rho value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Normotensive</td>
<td>0.163</td>
<td>0.350</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hypertensive</td>
<td>0.128</td>
<td>0.464</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>Normotensive</td>
<td>0.242</td>
<td>0.161</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hypertensive</td>
<td>0.211</td>
<td>0.223</td>
<td></td>
</tr>
<tr>
<td>Systolic BP</td>
<td>Normotensive</td>
<td>0.027</td>
<td>0.876</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hypertensive</td>
<td>0.342</td>
<td>0.044*</td>
<td></td>
</tr>
<tr>
<td>Diastolic BP</td>
<td>Normotensive</td>
<td>0.108</td>
<td>0.536</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hypertensive</td>
<td>0.312</td>
<td>0.068</td>
<td></td>
</tr>
</tbody>
</table>
Some cross-sectional and longitudinal studies have shown positive association between systolic BP and raised IOP.\textsuperscript{14-17} We obtained a statistically significant correlation between IOP and systolic BP and a positive correlation with diastolic blood pressure which is similar to other studies.\textsuperscript{18,19}

The role of systemic hypertension in the development and progression of glaucoma and the physiological basis of the relationship between blood pressure and IOP remains unclear. Hypothesis state that both elevated IOP and blood pressure might be driven by a common extrinsic factor such as an age-related increase in sympathetic tone. An increase in blood pressure tends to elevate ciliary artery pressure, thus increasing the ultrafiltration component of aqueous production, resulting in IOP elevation.\textsuperscript{20,21} Increased arterial pressure can produce a small increase in venous pressure leading to reduced aqueous clearance which may also contribute.

Ocular Perfusion Pressure (OPP), which regulates blood flow to the optic nerve, depends on blood pressure and IOP. When OPP varies secondary to blood flow changes, the ability of the eye to buffer against changes in perfusion pressure (autoregulation) increases the risk of impaired metabolic supply (reduced oxygen and nutrients)\textsuperscript{22} thus causing neuronal dysfunction.

Longstanding hypertension might also reflect a compromised peripheral vascular capacity and autoregulation to a higher IOP. Studies have also indicated that chronically elevated BP results in arteriosclerotic changes in the size of precapillary arterioles and capillary dropout leading to increased resistance to blood flow and thus reduced perfusion.\textsuperscript{23}

CONCLUSION

Menopausal women are at an increased risk of developing hypertension due to age, hormonal changes and obesity which may lead to increased IOP. IOP is also directly and significantly related to systemic blood pressure hence postmenopausal women with systemic hypertension need periodic ophthalmologic examination. Detecting early IOP changes will help them in identifying the risk groups and formulating strategies for screening glaucoma.

Early diagnosis and management will help in reducing the incidence of blindness due to glaucoma. ‘Vision 2020 right to sight’ India program has considered glaucoma as one of the priorities among avoidable blindness.\textsuperscript{24} Hence periodic ophthalmological examination in postmenopausal women will reduce the incidence of blindness in India.

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Ethical approval: The study was approved by the institutional ethics committee

REFERENCES