A correlation of blood pressure and intraocular pressure in hypertensive patients above 40 years

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Introduction

Intraocular pressure is an essential entity in maintaining the structural and functional integrity of the eyeball. Any abnormality in the intraocular pressure of a given eye can result in the dysfunction of the eye. The most important factor which regulates the intraocular pressure within physiological limits is the aqueous humour. The intraocular pressure is maintained by the equilibrium between aqueous production from ciliary body and its drainage via trabecular complex. The aqueous humor helps in maintaining the nutrition of the avascular structure of the globe and act as a refractive medium in the eye. An increase in intraocular pressure leads to a clinical complex known as glaucoma. Among the various possible causes, high blood pressure is one of the possible cause of ocular hypertension.

Material & Methods

200 subjects aged above 40 years were examined to find out the relationship between blood pressure and intraocular pressure. They were further divided into four groups (a), (b), (c) and (d) according to their blood pressure and each group consisted of 50 subjects. The group (a) constituted subjects having systolic BP <120 mmHg and diastolic Bp <80 mmHg, group (b) constituted subjects having systolic BP between 120-139 mmHg and diastolic BP between 80-8g mmHg, group (c) constituted subjects having systolic BP between 140-160 mmHg and diastolic 80-100 mmHg, group (d) constituted subjects having systolic Bp >160 mmHg and diastolic >100 mmHg. Bp was recorded in the supine position and intraocular pressure was recorded by using Schiotz's tonometer. This work was undertaken to study the relationship between blood pressure and IOP in hypertensive patients above 40 years, so the prediction of ocular hypertension and its consequences can be forecasted by using more common systemic parameters that is BP. The patients were recruited after taking their informed consent. Inclusion criteria were subjects above 40 years and subjects who were newly diagnosed hypertensive and not on antihypertensive medication. Exclusion criteria were subjects below 40 years, subjects who were previously diagnosed as hypertensive and on medications, subjects with any ocular disease, subjects who were blind, subjects who had undergone ocular surgery.

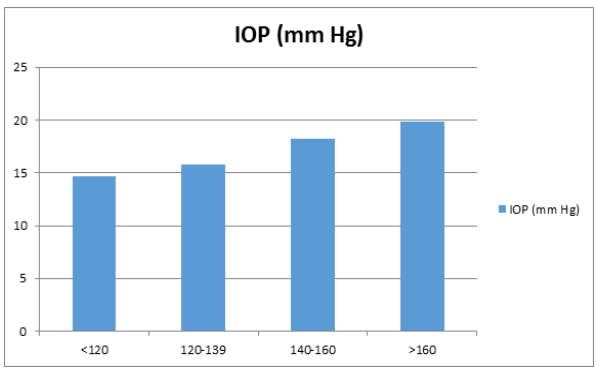
Procedure of recording the IOP

The IOP was recorded by using Schiotz indentation tonometer. The patient was laid in the supine position and asked to look straight upward on an over head target or a mark on the ceiling with fixed gaze, They were told to relax and breath normally and keeping eyes wide open without blinking during the procedure. Cornea was anesthetized with 2-3 drops of 4o/o topical lignocaine. The tonometer tip and footplate were wiped carefully with an alcohol swab and allowed to air dry. Subject's eye lids were retracted gently with left hand without placing tension on the globe. The footplate of the tonometer was placed directly over the cornea by holding the handle of the tonometer with right hand. The IOP measurement was repeated until three consecutive readings agreed within 0.5 scale units. The average scale reading and the plunger weight were then converted into IOP in mmHg by using a conversion chart, Friedenwald Nomogram. After each use the tonometer plunger and footplate were rinsed with water followed by alcohol, and then wiped dry with lint-free material. After the procedure, a prophylactic antibiotic, ciprofloxacin eye drops were instilled in both the eyes to prevent infections.

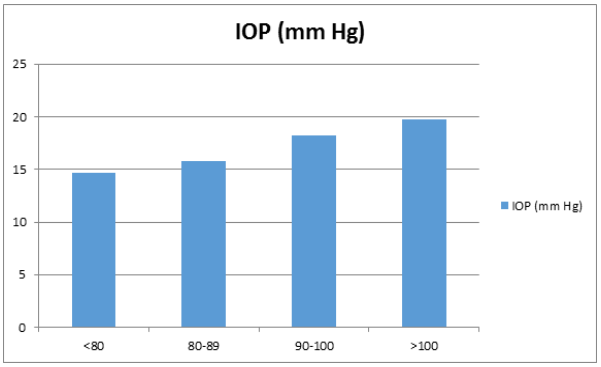
Procedure to rule out other causes of raised IOP: Other cause of raised IOP like angle closure glaucoma was ruled out by doing flash light test.

Observations and Results

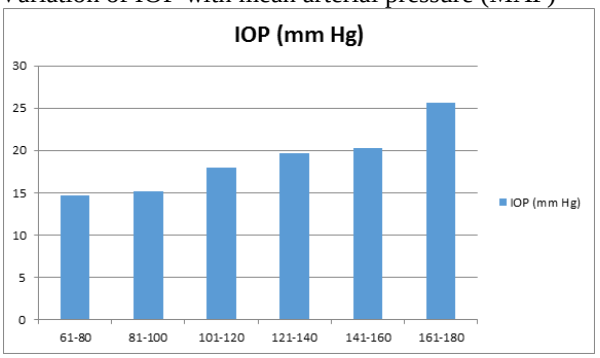
Variation of IOP with systolic blood pressure (SBP)



Variation of IOP with diastolic blood pressure (DBP)



Variation of IOP with mean arterial pressure (MAP)



Discussion

Hypertension is an important public health challenge in both economically developing and developed countries. We have found that change in IOP is directly and significantly associated with changes in systemic blood pressure. This would suggest that treatment of blood pressure might have an effect on the risk of developing glaucoma, as IOP is probably the most important risk factor for glaucoma in general populations. Bill demonstrated that variations in systolic blood pressure resulted in (small) changes in aqueous humour formation, possibly related to increased capillary pressure in the ciliary body. 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.

Lack of knowledge about hypertension makes the general population prone to various complication. Most patients seldom realized that they were hypertensives until complication occurred. Our study showed that systolic and diastolic blood pressure is positively related to IOP regardless of gender. It is thought that physiological basis for this IOP blood pressure relationship may be an increased production of aqueous humor by ultrafiltration through the elevated ciliary artery pressure. Systemic hypertension can lead to increased IOP through this relationship, but other physiological factors such as sympathetic tone, sclerotic changes or serum corticosteroids should be considered.

By 2020 it is projected that India will become second in terms of the number of glaucoma patients surpassing Europe. From 2010 to 2020 maximum increase in number of glaucoma patients will be seen in India. As the proportion of those above 40 years of age increases, the proportional increase in glaucoma will challenge our resources and ingenuity. Glaucoma or glaucomatous optic neuropathy is characterized by a chronic, slowly progressive loss of retinal ganglion cells and their neurons. The disease is associated with remoulding of the optic nerve head and retina leading to the major clinical signs: characteristic optic nerve head cupping and visual field defects. Elevated IOP is one of the major risk factors for developing glaucomatous optic neuropathy. By far the most common reason for an increased IOP is the reduced outflow capacity of aqueous humor usually at the anterior chamber angle and trabecular meshwork level. When the chamber angle is normally developed and not blocked by the iris and there is no other apparent ocular cause for an increased IOP, then the term primary open angle glaucoma is used. Open angle glaucoma is a leading cause of visual impairment and blindness. Ocular hypertension is a predisposing factor for open angle glaucoma or glaucomatous optic neuropathy. IOP is widely regarded as the most important modifiable risk factor associated with the development of glaucomatous optic neuropathy. Therefore factors that influence IOP and its measurement are of great relevance in understanding the pathogenesis of the disease and in reducing the burden of blindness.

IOP is an inherited physiologic characteristic of importance in maintaining structure and function of the eye. Correlates of this measurement include other physiologic parameters that may need to be considered in investigating determinants of IOP. As IOP is the ocular parameter that is associated most commonly with graucoma, it may be important to evaluate these physiologic correlate of IOP; they may confound relationships between IOP and glaucoma.

Relationship between brood pressure and intraocular pressure: Findings from this study indicate systolic BP and diastolic BP, were positively independently correlated to IOP and were statistically significant. Studies have found that change in IOP was directly and significantly associated with change in BP. Positive association between systolic BP and raised IOP has constantly been shown in both cross sectional and longitudinal studies. Some studies have shown that diatolic BP was positively associated with raised IOP.

The IOP may have been increased by four mechanisms in patients with increased BP:

1. Increased retinal blood volume after a rise in central retinal vein pressure because of increased pressure in the adjacent central retinal artery.
2. Increased blood volume in the ciliary body and decreased facility of aqueous outflow owing to an increase in resistance in the episcleral and anterior ciliary veins.

3. Increased ultrafiltration of aqueous fluid in the ciliary body owing to the increased perfusion pressure in the ciliary arteries and this theory appear to be most likely explanation of direct relationship between IOP and systemic pressure.
4. Obstruction to the aqueous drainage at the anterior chamber angle by increasing episcleral venous pressure, which is important in regulating the flow of aqueous across the trabecular meshwork into Schlemm's canal.

The IOP rises and falls by 1 mmHg with every heart beat. During systole the central retinal artery compress the accompanying vein to increase the vascular resistance in this vessel. It was hypothesized that increased BP in early course of systemic hypertension, prior to the onset of small vessel damage might result in increased blood flow or greater hydrostatic resistance to closure of small vessels and therefore protect the ganglion cells and their axons from damage. In another explanation, elevated IOP may be thought of as a physiological equilibrium state in response to high BP, a relationship that does not exists in glaucoma and may involve a compromised vascular auto regulation mechanism resulting as a damage to the small vessels of the optic disc and mechanical strain on the optic nerve as it passes through the lamina cribrosa.

Conclusion

Elevated IOP is the major risk factor for developing glaucoma or glaucomatous optic neuropathy. Glaucoma is the second commonest cause of irreversible blindness and visual impairment. Glaucoma is a chronic disease with insidious onset. If it is diagnosed early and treated appropriately, its progression can be arrested. IOP which is a major risk factor for glaucoma is influenced by other systemic parameters.

From this study it is evident that,

- IOP increases as systemic blood pressure increases.
- Advancing age is associated with elevated intraocular pressure.
- Females are at higher risk for developing elevated intraocular pressure.

It can be concluded that, persons with hypertension and advancing age need to be monitored for high intraocular pressure and periodic BP monitoring may be indicated. Hence a population based screening for elevated IOP and its control could reduce the number of people at greatest risk of glaucoma, which is the second commonest cause for blindness and visual impairment in India and worldwide.

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