



A comparative analysis of the association among perfusion pressure, glaucoma and systemic hypertension in Indian adults

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(Received: 25 January 2024

Revised: 10 February 2024

Accepted: 02 March 2024)

KEYWORDS

Open-angle glaucoma, systemic hypertension, mean ocular perfusion pressure

Abstract

Background: Glaucoma is a progressive disorder and can be treated only if it is diagnosed before it progresses to the irreversible state. This is possible if healthcare practitioners know the comorbidity that leads to glaucoma and takes appropriate measures to prevent the development of glaucoma.

Aim: This study aims to determine the association of systemic hypertension and the mean ocular perfusion pressure with the occurrence of glaucoma. Also, the correlation of the risk factor (antihypertensive drug) associated with the occurrence of glaucoma is determined.

Method: This was a comparative study carried out at Dr. D.Y. Patil Medical College in Pune, Maharashtra, India over a period of a year. Participants were divided into two groups. Group A had hypertensive patients, and the Group B participants had normotensive volunteers which was control. Their intraocular pressure and parameters related to glaucoma, such as field defects and retinal film, were determined. Parameters related to hypertension were determined. The correlation of the parameters was determined statistically.

Results: The average intraocular pressure in groups A and B was 15.39 mm of Hg and 13.43 mm of Hg respectively. It was found that the patient had 1.5 times more chances of becoming a suspect of glaucoma and twice the chances of having primary open-angle glaucoma if they were on antihypertensive medication. It was found that 0.55 units of increase in intraocular pressure and similarly, 0.96 units of increase in intraocular pressure with each 10-unit rise in the systolic and diastolic pressure respectively.

Conclusion: From the study, it can be demonstrated that the use of antihypertensive drugs can increase the risk of developing glaucoma, which can be due to a nocturnal drop in blood pressure after taking anti-hypertensive drugs. A reduced MOPP also indicated the occurrence of glaucoma.

Introduction

Glaucoma is a neuropathy in the ocular region. It occurs chronically, with initial loss of peripheral vision; later the central vision is lost. The damage done to the nerves in the ocular area cannot be reversed. Hence, understanding the progression of this disease can aid in

optimum treatment and prevent further damage to the neurons [1].

The most accepted hypothesis of OAG is the increase in IOP, which puts pressure on the head of the optic nerve. Pressure in the ocular region rises due to the myriad of complex mechanisms of vascular blood pressure. Apart from blood pressure, other cardiovascular diseases may



also increase the risk of open-angle glaucoma. Such as atherosclerosis and vasospasm either directly or indirectly, alter the intraocular pressure [2].

Systemic hypertension is a common disorder among the middle-aged population in India [3]. The increase in blood pressure increases the intraocular pressure which can cause nerve damage. Also, low blood pressure can lead to a decreased supply of oxygen and nutrients to the ocular area, which might cause nerve damage [3]. There are various studies carried out in this domain, but the correlation of hypertension with OAG is not clear yet [4, 5].

Glaucoma is a progressive disorder and can be treated only if progress is made. This is possible if the risk factors associated with glaucoma are well understood and the appropriate measures are taken to prevent the development of glaucoma [6]. This study aims to determine the correlation between systemic hypertension and mean perfusion pressure the ocular region with open-angle glaucoma. The intra-ocular pressure and mean ocular perfusion pressure are studied in hypertensive patients and normotensive controls. The other aim of this study is to determine the risk factors associated with the occurrence of open angle glaucoma such as antihypertensive drugs, age, gender, and diabetes.

Methods

Study design: This was a cross-sectional comparative study carried out at Dr. D.Y. Patil Medical College in Pune, Maharashtra, India over a year.

Participants: The patients visiting the outpatient department of the Dr. D.Y. Patil Medical College were considered for the study. There were two groups group A had patients with hypertension, and group B had normotensives. There were 50 participants in each group. The patients included in the hypertension group had a systolic pressure of more than 130 mm of Hg and a diastolic pressure of more than 90 mm of Hg. Patients who had hypertension due to endocrine disorder were excluded from the study. The gender and age of both groups were comparable. The age of the patients above 40 years was considered for the study.

Methodology: Intraocular pressure was determined for participants in both groups. Participants who had intraocular pressure of more than 21 mm of Hg were tested for the presence of glaucoma. Retina film was diagnosed, and gonioscopy, optical coherence tomography, ultrasound pachymetry, and optical disc photography were performed.

If the patient had defects in the field, reduced retinal nerve fiber and open angles in the gonioscopy, they were confirmed to have open-angle glaucoma, whether or not they had increased intraocular pressure. If the fields had suspicious defects but the intraocular pressure was normal, then the patient was considered a suspect of glaucoma. If the patient had ocular pressure more than 21 mm of Hg but the other characteristics were normal, then the patient was considered to have ocular hypertension.

Statistical analysis: The data such as age, gender, and hypertension medications were subjected to statistical analysis to find their correlation with intraocular pressure. Mean perfusion pressure in the ocular region was also correlated with the glaucoma status. The chi-square test was used to determine the P-value, if it was less than 0.05 then the correlation was considered to be significant.

Results

There were a total of 100 participants in the study. 50 of them belonged to group A which is the hypertensive group and the other 50 belonged to group B which was the normotensive control group. The intraocular pressure in the group A ranged from 10 to 25 mm of Hg. Whereas group B had intraocular pressure in the range of 9 to 24 mm of Hg. The average intraocular pressure in groups A and B was 15.39 mm of Hg and 13.43 mm of Hg respectively. The variation in the average IOP among the groups was statistically significant.

The MOPP was comparatively greater in Group A than the Group B. According to optical coherence tomography, 7 patients in the hypertensive group and 4 patients in the normotensives group were suspected of developing glaucoma. Ocular hypertension was not reported in either of the groups. 4 hypertensive patients and 1 normotensive patient were confirmed to have primary open-angle glaucoma. Numerically as well as statistically, the difference in glaucoma status between groups A and B was not significant.

The treatment received by the patients of Group A for hypertension was recorded. Around 50% of the patients were taking CCBs which is amlodipine. 20% of the patients were taking an ACE inhibitor that is enalapril, 20% of the patients were on salt restriction, and the remaining 10% were either on beta-blocker propranolol or multiple medications. Using regression analysis, It was found that 0.55 units of increase in intraocular pressure and similarly, 0.96 units of increase in intraocular pressure with each 10-unit rise in the systolic



and diastolic pressure respectively. Intraocular pressure increased with the increase in mean arterial pressure but the increase was not statistically significant. However, the increase in mean ocular perfusion pressure indicated chances of developing glaucoma but again the correlation was not statistically significant.

Using regression analysis, multiple factors, such as the usage of antihypertensive drugs, age, gender, and occurrence of diabetes, were correlated with intraocular pressure, status of glaucoma, and mean ocular perfusion

pressure. It was found that the patient had 1.5 times more chances of becoming a suspect of glaucoma and twice the chances of having primary open-angle glaucoma if they were on antihypertensive medication. Similarly, the intraocular pressure and mean ocular perfusion pressure increased significantly if they were on antihypertensive medication. Table no. 1 summarizes the findings in group A and Group B it illustrates the significance of the difference between the values found in both the groups.

Table no. 1: Summary of the parameters related to hypertension and glaucoma in group A and group B

Parameters	Group A	Group B	Significance
Sex	33 M 17 F	23 M 27 F	Not significant
Age	55.3	55.7	Not significant
Duration of hypertension	3 years	-	-
Duration n of T2DM	2 years	4 years	Not significant
Systolic BP	141.6 mm of Hg	125.6 mm of Hg	Significant
Diastolic BP	87 mm of Hg	77.7 mm of Hg	Significant
MAP	105 mm of Hg	94 mm of Hg	Significant
Intra ocular pressure (left eye)	15.3 mm of Hg	13 mm of Hg	Significant
Intra ocular pressure (right eye)	15.7 mm of Hg	13 mm of Hg	Significant
Mean ocular perfusion pressure	54 mm of Hg	49 mm of Hg	Significant
Primary open angle glaucoma	4	1	Not significant
Suspect of glaucoma	7	4	Not significant
No glaucoma	39	45	Not significant

Discussion

Hypertension is correlated with the occurrence of glaucoma in our study. It was found that the occurrence of glaucoma does not only depend on the hypertension there were multiple factors associated. A study conducted showed that the occurrence of glaucoma is strongly related to hypertension when it is poorly managed [7]. Yet another study showed that hypertension has no association with the occurrence of glaucoma [8]. Contradictory findings are reported in multiple studies [7-9]. However, in our study, the association of antihypertensive drugs and the occurrence of glaucoma was reported. This could be explained; the hypertension medication is usually taken at night leading to a nocturnal drop in blood pressure, this nocturnal drop in the pressure can reduce the blood supply in the optic nerve head leading to glaucoma. A study reported that extreme nocturnal drop increases the chances of glaucoma [10].

Average intraocular pressure was much greater in the patients with hypertension than in the normotensives. In

our study, the regression results showed that 0.96 unit rise in intraocular pressure with each 10 unit rise in diastolic blood pressure. Whereas another study reported only a 0.25-0.35 units rise in intraocular pressure with each 10 unit rise in DBP [11]. This could be due to bias in the clinical setting of the tertiary care centre. The patients taken for this study were suffering from systemic hypertension for a long duration.

MOPP is inversely related to the occurrence of glaucoma in our study. This was consistent with the other studies conducted in this domain [12, 13]. As the MOPP decreases there is decrease in the supply of the blood to the eyes. It can cause ischemia of the optical nerve head which can create defects in the film and retina. However, intraocular pressure varies continuously due to changes in the blood pressure. Thus continuous monitoring is required to determine its effect on glaucoma [14].



Conclusion

In this study, it is found that the use of antihypertensive drugs can increase the risk of developing glaucoma which can be due to nocturnal drop in blood pressure. A decrease in the MOPP also increases the occurrence of glaucoma.

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