



## A COMPARATIVE STUDY OF MEAN ARTERIAL PRESSURE AND OCULAR PERFUSION PRESSURE IN NORMOTENSIVE AND PREHYPERTENSIVE INDIVIDUALS

**Dr. Kavitha K V**

Department of physiology, Coimbatore medical college, Tamilnadu, India.

**Dr. Selvam. D\***

Asso. Prof., Coimbatore Medial College, Coimbatore, Tamilnadu, India.  
\*Corresponding Author

**ABSTRACT** According to the WHO, glaucoma is the second leading cause of blindness in the world. Alterations in Ocular perfusion pressure (OPP) play a significant role in pathogenesis of glaucoma. Hence this study was conducted to assess the effects of prehypertension on IOP (Intra ocular and OPP). 102 participants in the age group of 30–50 years, divided into study group and normal control group were recruited for this study. Basal IOP and BP were recorded using rebound tonometer and sphygmomanometer, respectively. There was significant increase in the IOP and OPP in study group. Elevated IOP in prehypertensives are deleterious to optic disc. The early detection and measures to reduce the BP in prehypertensives have to be done to prevent the development of glaucoma.

**KEYWORDS :** Mean blood Pressure; intraocular Pressure; Ocular Perfusion Pressure; Prehypertension

### INTRODUCTION:

Pre-hypertension is also known as high normal blood pressure. A person's blood pressure is elevated above normal, but not to the level considered hypertension (high blood pressure).

According to the Joint National Committee (JNC 7 Pre-hypertension - systolic pressure from 120 to 139 mm Hg or a Diastolic pressure less than 80 mm Hg.

Hypertension- greater than or equal to 140/90 mm Hg<sup>1</sup>. Pre-hypertension is often asymptomatic at the time of diagnosis. Thus, blood pressures above normal can go undiagnosed for a long period of time. Elevated blood pressure develops gradually over many years usually without a specific identifiable cause. However, possible medical causes, such as medications, kidney disease, adrenal problems or thyroid problems, must be excluded. High blood pressure that develops over time without a specific cause is considered benign or essential hypertension. Blood pressure also tends to increase as age advances. According to the WHO, glaucoma is the second leading cause of blindness in the world<sup>2</sup>. Mean arterial pressure (MAP) is better indicator of perfusion to vital organs, normal MAP 70-100mmHg. Ocular perfusion pressure (OPP), an important determinant of ocular blood flow, represents the balance between the opposing forces of blood pressure (BP) and intraocular pressure (IOP). Alterations in OPP play a significant role in pathogenesis of glaucoma. There is a paucity of literature regarding the vascular effects of prehypertension on optic disc<sup>3</sup>. This study assesses the effects of prehypertension on IOP and OPP.

### MATERIALS & METHODS:

The cross sectional study was carried out in Coimbatore medical college hospital, Coimbatore. Institutional ethical committee clearance obtained. A total of 102 participants were recruited from NCD OPD, in the age group of 30–50 years. They were categorized into two groups based on their blood pressure. The study group comprised of subjects with pre-hypertension (SBP of 120–139 mmHg or DBP of 80–89 mmHg) and control group comprised of age and sex matched normotensives with BP <120/80 mmHg.

### Exclusion criteria:

Subjects with conjunctivitis, glaucoma, contact lens users, smokers, alcoholics, hypertensives and individuals with a history of diabetes mellitus and chronic kidney diseases were excluded from the study. Informed written consent obtained and the details of the procedure explained to the individuals. Basal IOP and BP will be recorded in sitting position using rebound tonometer and sphygmomanometer respectively and all the recordings were done between 9 am and 12 pm. Mean arterial pressure (MAP) and mean ocular perfusion pressure (MOPP) were calculated using the following formulas: MAP=Diastolic BP+1/3(SBP-DBP), MOPP=(2/3) MAP-IOP. The results were compared and correlated between normotensives and prehypertensive by unpaired *t*-test and Pearson's correlation and interpreted as statistically significant at  $P < 0.05$ .

### RESULTS:

**Table 1: Comparison of study variables between prehypertensives and normotensives**

Parameters (mmHg)	Prehypertensives (n=51) mean±SD	Normotensives (n=51) mean±SD	P value
SBP	128.39±6.8	112.906±6.1	0.001
DBP	80.88±3.8	74.58±3.2	
MAP	96.68±2.8	86.19±4.2	
R-IOP	18.67±0.8	14.10±1.4	
L-IOP	18.38±1.2	13.1±1.2	
R-OPP	45.88±2.3	43.61±2.6	
L-OPP	45.95±2.4	43.74±2.8	

SBP: Systolic blood pressure, DBP: Diastolic blood pressure, MAP: Mean arterial pressure, R-IOP: Right intraocular pressure, L-IOP: Left intraocular pressure, R-OPP: Right ocular perfusion pressure, L-OPP: Left ocular perfusion pressure, SD: Standard deviation.

**Table 2: Pearson's correlation between IOP and BP parameters**

BP parameters	Right IOP		Left IOP	
	r value	P value	r value	P value
SBP	0.786	0.001	0.766	0.001
DBP	0.658		0.632	
MAP	0.786		0.758	

**Table 3: Pearson's correlation between OPP and BP Parameters**

BP Parameters	Right OPP		Left OPP	
	r value	P value	r value	P value
SBP	0.726	0.001	0.688	0.001
DBP	0.842		0.822	
MAP	0.838		0.826	

In the present study, the MAP in pre-hypertensive's was 10.49 mmHg higher than controls. The mean right IOP and left IOP values showed a statistically significant increase of 4.57mmHg and 5.28 mmHg respectively, in pre-hypertensive's when compared with normotensives individuals. The mean OPP values in the right and left eyes also showed a marginal increase of 2.27 mmHg and 2.21 mmHg, respectively, in pre-hypertensive cases (Table-1) The IOP values of right and left eyes were positively correlated with the BP parameters (Table-2) A positive correlation was also observed between OPP and BP values (Table-3).

### DISCUSSION:

IOP and OPP are the important risk factors for glaucoma development. To determine this relationship, one must understand the complex interplay between BP, IOP, and OPP. It was observed in this study that the IOP was significantly higher in pre-hypertensives when compared with normotensives ( $P < 0.001$ ). Positive correlation was also observed between MAP and IOP in prehypertensives<sup>1</sup>. The glaucoma suspects and ocular hypertension were significantly higher in non HT group where the MOPP was lower<sup>2</sup>. In hypertensive individuals,

suggests that there is a close relationship between OPP values and POAG, providing further evidence of the vascular mechanism in the pathogenesis of glaucoma<sup>3</sup>. High blood pressure is a risk factor for development of raised IOP which can lead to glaucoma<sup>4</sup>. The Blue Mountains eye study, a significant association was seen between HT and OAG and associate<sup>5</sup>. In addition circadian fluctuation of ocular perfusion pressure (OPP) is a contributory factor in the pathogenesis of glaucomatous optic neuropathy<sup>6</sup>. On was strongest in those with uncontrolled HTN Few studies have shown significant associations between high BP and glaucoma<sup>7</sup>. Elevated levels of IOP in prehypertensives could probably be due to an increase in sympathetic tone in blood vessels which have been proved by some of the studies conducted on hypertensive patients<sup>8</sup>. Another study also states that in a non-autoregulated vascular bed, small changes in perfusion pressure may lead to changes in ocular blood flow<sup>9</sup>. Obstruction of the aqueous outflow by raised episcleral venous pressure that controls the aqueous humor exit across the trabecular meshwork. Exaggerated dynamic cortisol response influence IOP by decreasing outflow facility<sup>10</sup>. LALES study shows that on hypertensive individuals also showed a positive correlation between MAP and IOP<sup>11</sup>. Hence, increased IOP is more risk factor for glaucoma development and further studies have to be done to know the vascular changes in the optical nerve head by using Doppler optical coherence tomography. Since we observed that raised IOP in prehypertension itself, which is a high-risk group for developing hypertension, so regular monitoring of IOP and OPP is essential to prevent the occurrence and progression of glaucoma.

### CONCLUSION:

In our study, IOP and OPP were significantly higher in prehypertensive individuals when compared with normotensive individuals. So when assessing prehypertension and glaucoma, the complex relationship between BP, IOP, and OPP should be considered. Hence, early detection of prehypertension and lifestyle modifications to reduce BP are recommended. So progression to systemic hypertension and risk of developing glaucoma can be prevented.

### REFERENCES:

1. Sreenivas, SB., Vinitha, KR., Kulkarni P. A comparative study of intraocular pressure and ocular perfusion pressure changes in pre-hypertensive individuals. *Natl J Physiol Pharm Pharmacol*. 2018; 8(10): 1396-1399.
2. Shikha Baisakhiya, Surjit Singh, Prafulla Manjhi Raised. Correlation between intraocular pressure and blood pressure in North Indian subjects. *International Journal of Advanced Research*. 2015; 3(7): 1545-1554.
3. Erika Cantor, Fabián Méndez, Carlos, Rivera, Andrés, Castillo, Alexander Martínez-Blanco. Blood pressure, ocular perfusion pressure and open-angle glaucoma in patients with systemic hypertension. *Clinical Ophthalmology*. 2018; 12: 1511–1517.
4. Bindu Thampi, Antony J., Mahadevan, K., Rekha, R.S., Simi, F., Relationship between Intraocular Pressure and Mean Ocular Perfusion Pressure in Hypertensive and Non Hypertensive Adult Population. *Scholars Journal of Applied Medical Sciences*. Aug 2017; 5(8E): 3313-3317.
5. Mitchell, P., Lee, A.J., Rochtchina, E., Wang, J.J. Open angle glaucoma and systemic hypertension. The blue mountains eye study. *J Glaucoma*. 2004; 13: 319-26.
6. Quaranta, L., Katsanos, A., Russo, A., Riva I 24-hour intraocular pressure and ocular perfusion pressure in glaucoma. *Surv Ophthalmol* 2013; 58: 26-4.
7. Deb, A.K., Kaliaperumal, S., Rao, V.A., Sengupta, S. Relationship between systemic hypertension, perfusion pressure and glaucoma. A comparative study in an adult Indian population. *Indian J Ophthalmol*. 2014; 62: 917-22.
8. Vingrys, A.J., Armitage, J.A., Nguyen, C.T., Bui, B.V. Chronic hypertension increases susceptibility to acute IOP challenge in rats. *Invest Ophthalmol Vis Sci* 2014; 55: 7888-95.
9. Swati, J., Veena, H.C., Taklikar, R.H., Taklikart, A. Intra ocular pressure in normotensive and hypertensive subjects of same age group. *Int J Bioassays* 2015; 4: 4219-22.
10. Schmidl, D., Garhofer, G., Schmetterer, L. The complex interaction between ocular perfusion pressure and ocular blood flow-relevance for glaucoma. *Exp Eye Res* 2011; 93: 141-55.
11. Bulpitt, C.J., Hodes, C., Everitt, M.G. Intraocular pressure and systemic blood pressure in the elderly. *Br J Ophthalmol*. 1975; 59(12): 717-20.
12. Memarzadeh, F., Ying-Lai, M., Azen, S.P., Varma, R. Los Angeles Latino Eye Study Group. Associations with intraocular pressure in Latinos: The Los Angeles Latino eye study. *Am J Ophthalmol* 2008; 146: 69-76.