Original Research Article

CORRELATION BETWEEN INTRAOCULAR PRESSURE AND BLOOD PRESSURE AT PRIMASATYA HUSADA CITRA HOSPITAL SURABAYA

ABSTRACT

Background and Objective: Intraocular pressure (IOP) depends on a variety of local and systemic factors, including systemic blood pressure. This study conducted to analyze the correlation between IOP and blood pressure (BP).

Methods: This was a cross-sectional study conducted in Ophthalmology Clinic Primasatya Husada Citra Hospital Surabaya from September 2021 until October 2021 with consecutive sampling. The statistic analyzed using Kruskal-Wallis test and Pearson correlation test in SPSS program version 24.0.

Results: A total 115 patients were included, 69 (60%) females and 46 (40.0%) males. Mean age 35.78 ± 11.64 years old. This study revealed a significant difference in intraocular pressure in both eyes between subjects in four category of BP (p=0.000). Positive correlation was found between IOP and BP of the right eyes (R = 0.393, P = 0.000) and left eyes (R = 0.363, P = 0.000).

Conclusion: There was a statistically significant correlation between IOP and BP, which the higher BP, the higher IOP in both eyes.

Keywords: Intraocular pressure, blood pressure, glaucoma

1. INTRODUCTION

Intraocular pressure (IOP) depends on a variety of local and systemic factors. Elevation of IOP is hypothesized to proportionally increase in systemic blood pressure. The

physiologic basis for the correlation of IOP and systemic blood pressure may be the increased production of aqueous humor by ultrafiltration due to increased ciliary arterial pressure or increased in episcleral venous pressure.[1]

Glaucoma is a group of progressive optic neuropathy caused by damage to the lamina cribrosa, which the main site of structural injury that can cause optic disc excavation or "cupping", and loss of ganglion cells and retinal axons. Elevated intraocular pressure (IOP) is a major risk factor for optic nerve damage in glaucoma, but that is the only modifiable risk factor.[2-5]

An estimated 60 million people worldwide suffer from optic neuropathy due to glaucoma and it is estimated that by 2040 will increase to 111.8 million.[6] As the leading cause of irreversible blindness in the world, glaucoma poses a significant public health problem.[3]

Ocular hypertension and glaucoma can be prevented from blindness if detected early and treated appropriately. Detailed literature on changes in IOP due to systemic parameters such as BP is not yet available, especially in Indonesian population. Knowing that high blood pressure can elevate the IOP highlight the importance to maintain blood pressure within normal limit. Thus, the purpose of this study is to find the correlation between IOP and BP.

2. METHODS

This study was cross-sectional study conducted in Ophthalmology Clinic Primasatya Husada Citra Hospital Surabaya from September 2021 until October 2021. Based on Lemeshow formula, we included 115 subjects with consecutive sampling. The inclusion criteria were patients visiting ophthalmology clinic on period of study, aged 20-60 year old. The exclusion criteria were patients who has (1) history of glaucoma or under medication of

glaucoma, (2) history of hypertension and under medication of hypertension, (3) body mass index (BMI) above 30 kg/m2, (4) under steroid treatment (topical, systemic, periocular, inhalation), (5) undergone eye surgery, (6) smoker (>100 cigarettes in his/her life and is still smoking) (7) Alcoholic (> 1 time/month), (8) history of chronic kidney disease (CKD), (9) severe myopia (>6 diopters).

Systemic blood pressure (BP) was measured using GEA mercurial sphygmomanometer in right arm in sitting position. On the basis of BP, subjects were divided into 3 groups: normal, high-normal, and hypertensive. According to *American Heart Association* (AHA) 2020, systolic (SBP) and diastolic blood pressure (DBP) categorize as follows: (1) normal: SBP <130 and DBP <85 mmHg, (2) high-normal: SBP 130-139 and/or DBP 85-89 mmHg, (3) hypertensive grade 1: SBP 140-159 and/or DBP 90-99 mmHg, (4) hypertensive grade 2: SBP ≥ 160 and/or ≥100 mmHg.

Intraocular pressure (IOP) was measured using *non-Contact Tonometers* Canon TX – 20P. To avoid the effect of diurnal variation, the readings were taken during 9-11 am.

Primary data included patient's age, sex, BP and IOP were taken. Normal distribution of variables was examined using Shapiro-Wilk test. Since the data was not distributed normally, we used the Kruskal-Wallis test to determine the differences between two group. The correlation analyzed using Pearson correlation. The statistical analyses were done using SPSS program version 24.0 with p value of 0.05 or less was regarded statistically significant.

This study was approved by the Health Research Ethics Commission of Medical Faculty Widya Mandala Catholic University based on WHO-CIOMS International Ethical Guidelines for Health-related Research Involving Humans.

3. RESULTS

A total 115 patients were included, consisting 69 (60%) females and 46 (40.0%) males. Mean age 35.78 ± 11.64 years old. Mean SBP was 126.96 ± 18.073 mmHg and mean DBP was 80.96 ± 11.315 mmHg. A total 58 subjects (50.4%) in normal tension, 26 (22.6%) in high-normal group, 18 (15.7%) in hypertension grade 1, and 13 (11.3%) in hypertension grade 2. (Table 1)

The intraocular pressure of this study showed a significant difference in both eyes between four groups of blood pressure (Kruskal-Wallis, P = 0.000). The mean intra-ocular pressure in the right and left eyes in each group and the statistical analysis are shown in Table 2.

We found a positive correlation between intra-ocular pressure and blood pressure of the right eyes (Pearson Correlation Coefficient, R = 0.393, P = 0.000) and left eyes (Pearson Correlation Coefficient, R = 0.363, P = 0.000) (Table 3).

Table 1. Characteristic of subjects

	N	**Percentage (%)**
Sex		
Female	69	60.0
Male	46	40.0
Blood pressure		
Normal	58	50.4
High-normal	26	22.6
Hypertension grade 1	18	15.7
Hypertension grade 2	13	11.3

Table 2 . Statistical comparison of IOP to BP using Kruskal-Wallis test

	Status BP	IOP OD	IOP OS
Normal	N	58	58
	Mean	15.8	15.6
	95% CI	14.9-16.6	14.8-16.4
	Std. deviation	3.26	3.05
High normal	N	26	26
	Mean	17.1	16.7
	95% CI	15.8-18.3	15.4-18.0
	Std. deviation	3.1	3.1
Hypertension grade 1	N	18	18
	Mean	18.7	20.5
	95% CI	17.3-20.2	16.2-24.8
	Std. deviation	3.0	8.5
Hypertension grade 2	N	13	13
	Mean	19.3	19.4
	95% CI	17.6-20.9	17.9-20.8
	Std. deviation	2.8	2.4
P value		.000	.000

*****BP: Blood Pressure, IOP: Intraocular Pressure

Table 3. Correlation between IOP and BP using Pearson correlation coefficient

Ocular pressure	Blood Pressure	
	r-value	P-value
Right IOP	0.393	0.000
Left IOP	0.363	0.000

4. DISCUSSION

This study aimed to analyze the relationship between IOP and BP. We found that the mean IOP of the normal BP was lower than high-normal, hypertension grade 1 and 2 group, in both eyes (p=0.000, Table 2.). The analysis of the relationship between IOP and BP with Pearson's correlation coefficient showed a positive and statistically significant relationship in both eyes (p=0.000, Table 3). It suggests that a higher BP is correlated with a higher IOP. Some studies also reported similar results to ours.

Baisakhiya et al reported that average IOP in non-hypertensive patients (<120/80 mmHg) 14.17 ± 2.14, in pre-hypertensive patients (systolic 120 – 139 mmHg, diastolic 80 – 89 mmHg) 15.45 ± 2.07, and hypertensive patients (systolic 140 mmHg, diastolic 90 mmHg) 17.93 ± 2.22 (Anova test, $P < 0.001$)[7]

Christopher J et al also reported that there were more patients with high IOP in the hypertension group (>140/90 mmHg) than in the non-hypertensive group ($p= 0.044$)[8]

Deb et al also reported that 108 of 208 patients with hypertension, the average value of intraocular pressure was 15.37 mmHg ± 2.01 mmHg, while other 100 patients in the control/non-hypertensive group showed an average result of 13.41 mmHg ± 2.82 mmHg.[9]

The mechanism for the increase in IOP at high blood pressure can be due to ultrafiltration of the ciliary epithelium caused by increased ciliary artery pressure and causes increased aqueous production.[7] Another mechanism may be due to antihypertensive drugs before bedtime, which can cause a decrease in blood pressure during sleep and decrease perfusion to the optic nerve head.[9] Langman et al and Topouzis et al reported hypotension, especially a decrease in blood pressure at night is an important risk factor for the development of open angle glaucoma.[10,11]

Another possible association between the use of antihypertensives and the occurrence of open angle glaucoma is that patients tend to have more severe disease and in greater risk to have optic nerve head disorders. Chronically elevated blood pressure can lead to arteriosclerosis, changes in the size of the precapillary arterioles, and capillary ejection leading to increased resistance to blood flow and thus reduced perfusion.[9]

This study has limitation that it was conducted with cross-sectional design with 1-month period. Longer period and larger sample size are recommended for further study. Besides, in this study, IOP was measured using *non-Contact Tonometers*. We highly recommend the use of Goldmann applanation as the gold standard for measuring IOP.

5. CONCLUSION

This study showed that there was correlation between blood pressure and IOP, which the higher BP, the higher IOP in both eyes. We found it statistically significant (r=0.393 (RE), r= 363 (LE), p=0.000).

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