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Correlation Between Blood Pressure at Emergency Room and Mortality in Acute Non-Hemorrhagic Stroke

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Abstract: According to data from the World Stroke Organization (WSO), the annual incidence of stroke is around 13.7 million new cases, with an estimated 5.5 million deaths among those impacted. Stroke caused by complications of hypertension instigates 51% of the 9.4 million deaths worldwide. The neurological severity of stroke patients is associated with a decrease in systolic blood pressure of 10 mmHg for every value below 150 mmHg. The purpose of this study is, therefore, to examine the correlation between blood pressure levels and mortality in patients with acute non-hemorrhagic stroke. This study employed cross-sectional research methods to conduct observational research. The study included a total of 60 patients with acute non-hemorrhagic strokes who were admitted to PKU Muhammadiyah Gamping Hospital. The patients were all over the age of 50 and met the specified inclusion and exclusion criteria. Data analysis used univariate tests and Spearman's bivariate tests. The results exhibited no significant correlation between blood pressure at hospital admission and mortality in patients with acute non-hemorrhagic stroke, as evidenced by a p-value of 0.5. In conclusion, there is no meaningful correlation between blood pressure on admission to the hospital and mortality in patients with acute non-hemorrhagic strokes.

Keywords: Stroke; Blood Pressure; Mortality

INTRODUCTION

According to data from the World Stroke Organization (WSO), the annual incidence of stroke is around 13.7 million new cases, with an estimated 5.5 million deaths among those impacted. Stroke is the primary factor leading to death across all age groups, accounting for 15.4% of all deaths.[1] A non-hemorrhagic stroke, also known as an ischemic stroke, refers to the necrosis of brain tissue resulting from the interruption of blood supply to the brain. This interruption can be caused by the blockage of cerebral or cervical arteries or, less commonly, by the blockage of cerebral veins.[2] Thrombosis, embolism, and reduced perfusion pressure are the three main causes of ischemic stroke. Thrombosis is the condition when blood flow is decreased or completely stopped because of the obstruction of blood vessels in a specific area. The vascular disorders that contribute to thrombosis are arteritis, atherosclerosis, vascular dissection, bleeding throughout atherosclerotic plaque, and fibromuscular dysplasia. Atherosclerosis is a major vascular condition.[3]

On the other hand, blood pressure is acquired through the mechanism of the heart pumping blood. Systolic blood pressure is the result of the contraction of the ventricles, forcing blood into the arteries. Diastolic blood pressure refers to the pressure exerted on the arterial walls when the ventricles of the heart are in a relaxed state and are being filled with blood from the atria. The average blood pressure of healthy young individuals is 120/80 mmHg.[4] Hypertension, often known as high blood pressure, is the primary risk factor associated with stroke.[5] Hypertension can disrupt blood circulation in the brain due to the thickening and remodeling of blood vessels, which will result in a reduction in the diameter of blood vessels and trigger atherosclerosis.[6] Orthostatic hypotension can cause reduced venous return, so cardiac output will also

decrease. Decreased cardiac output can result in blood pooling in the lower body and reducing blood flow to the brain.[7]

Stroke patients with elevated blood pressure are more likely to exhibit severe neurological deficits in comparison to stroke patients with lower blood pressure.[8] Neurological severity and clinical consequences, including earlier death, are connected with a reduction in systolic blood pressure of 10 mmHg below 150 mmHg.[9] Therefore, the purpose of this study is to examine the correlation between blood pressure levels and mortality in patients with acute non-hemorrhagic stroke.

MATERIALS AND METHOD

This study used cross-sectional research methods to conduct observational research. The independent variable employed in the study was the blood pressure recorded at the beginning of hospital admission, while the dependent variable was the mortality incidence among patients with acute non-hemorrhagic stroke. The study protocol was approved by the Research Ethics Commission of PKU Muhammadiyah Gamping Hospital. Blood pressure is divided into five categories: low (<90/0 mmHg), normal (<120/80 mmHg), elevated (120-129/80 mmHg), hypertension stage I (130-139/80-89 mmHg), and hypertension stage II (>140/90 mmHg).[10] The research subjects obtained in this study were 60 medical records of patients who were admitted to the emergency room at PKU Muhammadiyah Gamping Hospital. The subjects involved were selected based on inclusion criteria, including patients with non-hemorrhagic stroke aged >50 years, and the exclusion criteria were a history of previous strokes. Data analysis utilized SPSS with univariate tests and Spearman's bivariate tests. This research was conducted at PKU Muhammadiyah Gamping Hospital from August 2023 to September 2023. This research has received approval from the ethics committee of PKU Muhammadiyah Gamping Hospital with number 137/KEP-PKU/VII/2023.

RESULTS

The data is categorized based on characteristics using the SPSS bivariate descriptive test to determine frequencies and percentages, as detailed in Table 1.

Table 1. Subject Characteristics

Characteristics	Percentage			
	Passed away		Live	
	n	%	n	%
Gender				
Male	3	5	27	45
Female	7	11.7	23	38.3
Age (years old)				
51-60	2	3.3	15	25
61-70	2	3.3	16	26.7
71-80	1	1.7	11	18.3
81-90	3	5	6	10
≥ 91	2	3.3	2	3.3
Blood pressure				
Low	0	0	2	3.3
Normal	1	1.7	1	1.7
Elevated	0	0	1	1.7
Hypertension stage I	2	3.3	6	10
Hypertension stage II	7	11.7	40	66.7

The study included a total of 60 subjects who had non-hemorrhagic strokes. The participants had an equal distribution according to gender, with a 50% representation of males and a 50% representation of females. The majority of the participants, representing 30% of the total, were in the age range of 61 to 70 years old. Most of the subjects came under the classification of hypertension stage II (78.3%).

The correlation between blood pressure and mortality

The correlation between blood pressure and mortality was analyzed through Spearman's rank correlation test on SPSS. This test was used to determine the correlation between different blood pressure categories, as presented in Table 2.

Table 2. The correlation between blood pressure and mortality

Blood pressure	Percentage				Total	*p*	*r*
	Passed away		Live				
	n	%	n	%			
Low	0	0	2	3.3	2 (3.3%)		
Normal	1	1.7	1	1.7	2 (3.3%)		
Elevated	0	0	1	1.7	1 (1.7%)	0.521	0.084
Hypertension stage I	2	3.3	6	10	8 (13.3%)		
Hypertension stage II	7	11.7	40	66.7	47 (78.3%)		
Total	10	16.7	50	83.3	60 (100%)		

The results of the correlation test between blood pressure and mortality using the Spearman test obtained an r-value of 0.084 with a p-value of 0.521. Since the p-value is > 0.05, no correlation exists between blood pressure at hospital admission and mortality in patients with acute non-hemorrhagic stroke, and the relationship is very weak.

DISCUSSION

The characteristic distribution results of this study indicate that women possessed a higher incidence of mortality among patients with non-hemorrhagic stroke. This is consistent with previous studies that revealed higher mortality rates in women with ischemic strokes. On average, female stroke patients have a higher risk of death than men.[11] The subjects of this study were over 50 years of age and, therefore, belong to the elderly category. The incidence of stroke in women increased in correlation with increasing age and aligned with the beginning of menopause and a decrease in levels of female sex hormones. Estrogen helps prevent atherosclerotic plaques from forming in the blood vessels of the brain. Estrogen production decreases before and during menopause.[12]

Mortality in patients with ischemic stroke ranged from 51 years old to over 91 years old. This corroborates with previous research showing that people aged ≥55 years are 3.23 times more likely to have a stroke. The risk of stroke tends to increase with age, and the likelihood of having the disease doubles after age 55.[13] The age of a patient is a significant determinant of the outcome or prognosis of an ischemic stroke. The process of aging results in the progressive aging of blood vessels, which can cause the endothelium to thicken as a result of atherosclerosis.[6] Decline in vascular function occurs in older people. Vascular elasticity is reduced, especially in the intima, where endothelial thickening occurs, narrowing the vessel lumen and reducing cerebral blood flow.[12] Additional research has also shown a correlation between the age of stroke patients and their quality of life. Older age groups often have a lower quality of life.[14]

This study uncovered that the majority of subjects, 50 out of 60, had hypertension, with 47 classified as stage II hypertension and eight as stage I hypertension. These results agree with previous studies in which respondents' mean blood pressure levels were placed in the hypertensive category. High blood pressure can seriously affect blood flow throughout the body, including the brain.[15] Other studies have unveiled that patients with hypertension have a 5.69-time increased risk of having a stroke compared to those without hypertension. The occurrence of non-hemorrhagic stroke associated with hypertension is correlated with cell damage in the lining of arteries, leading to the accumulation of circulating fat. This can reduce the elasticity of artery walls and impede blood circulation throughout the body, including the brain.[13] The thickening of blood vessels and elevated blood pressure can lead to the accumulation of cholesterol and other fatty substances, resulting in the damage of arterial walls and the obstruction of cerebral arteries. Smoking and consuming foods that are rich in fat and salt worsen this condition by promoting the formation of atherosclerotic plaques. The progressive growth of atherosclerotic plaques can result in the occurrence of a stroke.[16] The effects of plaque in blood vessels include narrowing of the lumen or diameter of the blood vessel. Vulnerable plaques can rupture and slough off, increasing the risk of blocking blood vessels in the brain and causing a stroke.[17]

Additionally, the correlation analysis exhibited no indication of a significant correlation between blood pressure at the emergency room and mortality in patients with acute non-hemorrhagic stroke. The study results demonstrated that blood pressure ($p = 0.451$) had a significance value > 0.05. This may be attributed to other factors influencing the mortality in patients with acute non-hemorrhagic stroke. For example, the patients in this study may have received appropriate treatment to prevent a fatal outcome. Choosing a simple random sample for sample selection may also contribute to these results, as the precision and reliability of the representation are low.[18] The findings of a 5-year retrospective analysis revealed that a lower Glasgow Coma Scale (GCS), decreased arterial oxygen saturation, elevated respiration rates, and increased pulse rates at admission were correlated with the higher mortality rate of patients with acute non-hemorrhagic stroke receiving treatment in hospitals. A low GCS at admission is associated with an elevated risk of mortality during the hospital period.[19] The decrease in blood pressure within the initial 24 hours on admission might be used as an indicator of the probability of death in patients with acute stroke. The neurological decline and prognosis may be associated with elevated or reduced blood pressure within 24 hours following a stroke. Attentional observation of blood pressure within the initial 24-hour period is of the utmost importance.[20] Previous studies have shown that the degree of stroke severity, as measured by the National Institute of Health Stroke Scale (NIHSS), correlates to a higher risk of death in individuals who have had a stroke.[21] However, the results are conflicting, as other studies exposed no significant correlation between initial blood pressure and final NIHSS in patients with acute thrombotic stroke.[7]

CONCLUSION

There is no significant correlation between blood pressure and mortality in patients with acute non-hemorrhagic stroke, and the correlation is very weak. Since there is no meaningful correlation between initial blood pressure and mortality in patients with acute non-hemorrhagic stroke, it is crucial to carefully monitor blood pressure over the initial 24-hour period. This is because both high blood pressure and low blood pressure may have an impact on neurological decline and potential outcomes after a stroke within the first 24 hours.

CONFLICT OF INTEREST

No conflict of interest.

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