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Defining The Correlation between Blood Pressure and Improvement of Clinical Severity Using the National Institutes of Health Stroke Scale (NIHSS) in Acute Ischemic Stroke Patients of Dr. Soetomo Hospital Surabaya

Correlation between Blood Pressure and Improvement of Clinical Severity in Acute Ischemic Stroke

Prita Aulia Nastaghfiruka[1,*], Mohammad Saiful Ardhi[2] and Sita Setyowatie[3]
[1]*Department of Neurology, Faculty of Medicine Universitas Airlangga, Dr. Soetomo Public Hospital, Surabaya Indonesia*
[2, 3]*Division of Neuro-vascular, Department of Neurology, Faculty of Medicine Universitas Airlangga, Dr. Soetomo Public Hospital, Surabaya Indonesia*

** Correspondence:*
Prita Aulia Nastaghfiruka
Faculty of Medicine, Universitas Airlangga,
Surabaya, Indonesia,
Campus A, Jl. Mayjen Prof. Dr. Moestopo 47,
Surabaya, Indonesia (Zip Code: 60131),

Abstract:- Aims: To determine the correlation between blood pressure and clinical improvement status of patients with an acute ischemic stroke which measures using the National Institutes of Health Stroke Scale (NIHSS). Methods: A cross-sectional was used in this research. Participants of the study were patients with acute ischemic stroke in Seruni room, Dr. Soetomo Hospital Surabaya, Indonesia. Blood pressure measurements are classified according to JNC7, while improvement in clinical severity is defined using NIHSS. Data were analysed using SPSS version V.23 with significances of p<0.05. Results: There were 60 participants with 51 hypertension patients (85%). From all participants, we found that about 36 patients (60%) showed NIHSS improvement. The Chi-Square correlation test analysis indicates a significant correlation between hypertension and improvement in the degree of clinical severity (p=0.045, RR at 6.571) 95% CI (0.765-56.469). Conclusion: There is a correlation between blood pressure and clinical severity improvement as measured using the NIHSS.

Keywords:- *Acute Ischemic Stroke; Hypertension; Indonesia; Measurement of Severity Level: National Institutes of Health Stroke Scale.*

I. INTRODUCTION

Stroke is defined as a functional brain disorder that occurs suddenly with clinical signs and symptoms both local and global that lasts more than 24 hours or can cause death, caused by circulatory disorders of the brain(WHO and World Health Organisation 2014). Stroke has become the highest cause of death in 2012 according to the WHO country risk profile (21%). These cases have not changed significantly since 2000 (Kementerian Kesehatan RI 2019). Based on the Global Burden Disease report, all age groups of ischemic stroke and heart disease are the main causes of death, with ischemic stroke sufferers who died were 7.2 million people (12.2%), and heart disease were 5.7 million people (9.7%). The incidence of ischemic stroke for the first attack is around 9 million people(Gorelick 2019). According to researchers from the Centers for Disease Control and Prevention (CDC), strokes are common among adolescents and young adults, with the number of patients aged 15-44 years increased by more than a third between 1995 and 2008. In Indonesia, around 500,000 people were diagnosed with a stroke, of which around 125,000 people died (2.5%) (Centers for Disease Control and Prevention 2018).

Several factors influence stroke, namely modifiable and unmodifiable risk factors. Modifiable factors include smoking, diabetes mellitus, hypertension, hyperlipidemia, obesity, hyperuricemia, psychosocial factors: stress-behavioural patterns of using progestin's, corticosteroids, cyclosporine, and lack of movement. While the unmodifiable factors consist of gender, age (women>55 years, men>45 years), family history or genetic factors, environmental influences (climate, pollution, air, metal exposure in drinking water) (Kementerian Kesehatan RI 2019).

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High blood pressure is a significant risk factor that often occurs in stroke. High intraluminal pressure will cause changes in endothelial and smooth muscle function in the intracerebral arteries. Damage to the endothelium and changes in the interaction between blood cells and endothelium can cause thrombus (Johansson 1999). High blood pressure increases the risk of stroke by six times. High blood pressure, according to JNC 7, is grouped into stage 1b hypertension with the systolic blood pressure of 140 to 159mmHg or diastolic blood pressure of 90 to 99mmHg. Meanwhile, stage 2 has systolic blood pressure above 160 or diastolic blood pressure greater than 100 (Kirshner 2009). The higher the patient's blood pressure, the greater the chance of a stroke; this is due to damage to the blood vessel walls resulting in blockage or even rupture of brain blood vessels (Budhi Rianawati, Aurora, and Nugrahanitya 2015).

A temporary increase in blood pressure often occurs in acute ischemic stroke patients. The pathophysiology of this response is still being debated and the clinical outcome is controversial. This study suggests that increased blood pressure may be a protective response to ischemic tissue perfusion. It is very beneficial in some acute ischemic stroke patients with hypertension (Bager et al. 2018; Kvistad et al. 2013).

To measure the severity of stroke patients, researchers used the NIHSS (National Institutes of Health Stroke Scale) assessment. The NIHSS is a systematic assessment tool that quantitatively measures stroke associated with neurologic deficits. NIHSS is not only used to assess the degree of neurological deficits but also to facilitate communication between patients and medical personnel, evaluate, determine appropriate treatment, and predict treatment outcomes of stroke patients, determine the initial prognosis and complications, and necessary interventions. Currently, the NIHSS is widely used routinely to assess stroke severity in stroke care centres (Lyden 2017; Sackner-Bernstein 2003).

STUDY OBJECTIVE

This study aimed to determine the effect of high blood pressure on the degree of severity in acute ischemic stroke patients based on clinical severity assessment using NIHSS.

II. MATERIALS AND METHODS

This study was a mini research with an analytical observational study design and a cross-sectional approach to the stroke registry data for acute ischemic stroke patients who were in the neurological inpatient room (Seruni A room) RSUD Dr. Soetomo Surabaya, Indonesia. The data collected covers a period of 3 months from January to March 2019. The primary data used in this study include: (1). age, (2). Gender, (3). hypertension or not classified according to JNC 7, (4). National Institutes of Health Stroke Scale (NIHSS). The inclusion criteria in this study were patients with acute ischemic stroke hospitalized in the Seruni A room of Dr. Soetomo for three months from January to March 2019, and a stroke-registry form was created.

The clinical severity of the studied acute ischemic stroke patients was assessed using the National Institute of Health in Stroke Scale (NIHSS) worksheet. The NIHSS assessment is divided into (a) Score <5: mild neurological deficit, (b) Score 6-14: moderate neurological deficit, (c) Score 15-24: severe neurological deficit, (d) Score ≥ 25: the very severe neurological deficit (Lyden 2017; Sackner-Bernstein 2003). From the score obtained, the researcher then observed whether there was an improvement when the patient was admitted to the hospital and compared when the patient was discharged.

Data on patients with elevated blood pressure were stratified according to JNC 7 where hypertension was stage 1 with the systolic blood pressure of 140 to 159mmHg or diastolic blood pressure of 90 to 99mmHg. While stage 2 is a condition where the systolic blood pressure is above 160 or the diastolic blood pressure is greater than equal to 100 (Budhi Rianawati et al. 2015).

The collected data was analyzed using the Statistical Package for the Social Sciences (SPSS) v22 for Windows (IBM Inc., Chicago, IL). Chi-square test with the calculation of relative risk (RR) and 95 percent confidence interval was used to determine correlation with considered statistically significant when the value was $p<0.05$.

III. RESULTS

This study involved 60 participants, most of whom were 58 years old. The total number of male patients was 38 (63.3%) and female patients were 22 (36.7%). About 51 (85%) of patients with hypertension were found in this study. While 9 (12%) of patients who were not affected by hypertension were classified according to the JNC 7 classification. The degree of severity calculated showed improvement in as much as 36 (60%) patients, while there were no improvements in 24 (40%) patients (Table 1).

Table 1. Distribution data of participants

Age	***Total (%)***	***Mean***	***Std. Deviation***
<41 th 41-50 th 51-60 th 61-70 th >70 th	4 (7.3) 13 (23.6) 25 (25.5) 15 (27.3) 9 (16.4)	58.45	12.613
Gender Men Women	 38 (63.3) 22 (36.7)		
Hypertency No Yes	 9 (15) 51 (85)		
Sistol Pressure	Min: 110 Max: 220	152.15	22.619
Diastol Pressure	Min: l 80 Max: 130	91	9.334
Improvement rate of NIHSS Yes	36 (60) 24 (40) Min: 1	8.58	5.613

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No Pre NIHSS	Max: 30		
Post-NIHSS	Min: 0 Max: 30	7.15	5.845

There were 28 patients with hypertension with improved NIHSS and 23 patients who did not show improvement. From the analysis of the chi-square correlation test, it was found that there was a significant relationship between the increases in blood pressure. The improvement in the degree of clinical severity recorded p= 0.045, RR of 6.571, 95 percent of CI (0.765-56.469). So H0 is rejected, which means there is a significant relationship between blood pressure and improvement in clinical severity as measured by the National Institutes of Health Stroke Scale (NIHSS). (Table 2)

Table 2. The chi-square analysis test between increased blood pressure and NIHSS

Hypertension	***The Improvement of NIHSS Score***		***p-value***	***95% Confidence Interval***
	Yes	**No**		
No Yes	8 28	1 23	0.045	(RR 6.571) 95% CI (0.765-56.469).
Total	36	24		

IV. DISCUSSION

In this study, researchers found a significant relationship between blood pressure and improvement in clinical severity in acute ischemic stroke patients, which is the standard measurement using the National Institutes of Health Stroke Scale (NIHSS). The result of the p-value is 0.045 (<0.005) which is significant. Then the results obtained a relative risk (RR) of 6,571 with a confidence interval of 95 percent, this indicates that compared with patients who do not suffer from hypertension, acute ischemic stroke patients with hypertension have a risk of 6 times greater to experience improvement in clinical severity. This is related to a study that states that an increase in blood pressure in the acute phase of ischemic stroke greatly affects stroke severity later in life. This happens because there is an autoregulation mechanism of cerebral blood flow (CBF) to prevent the penumbra formation (Bager et al. 2018; Baron 2001; Kvistad et al. 2013; Strbian et al. 2010).

Cerebral blood flow (CBF) in patients with chronic hypertension indicate cerebrovascular or cerebral artery autoregulation changes. Cerebral artery autoregulation is the ability of brain blood vessels to adjust their lumen so that CBF remains stable even though perfusion pressure changes. If the intraluminal pressure drops there will be vasodilation and vice versa. At mean arterial blood pressure (MABP) of up to 60-70mmHg and an increase of up to 150-160 mmHg can still be overcome by autoregulation. A low MABP can decrease CBF (Hingot et al. 2020; Markus 2004). Total human CBF at rest is about 800 ml/min, 15-20 precents of total cardiac output (CO). The flow of cerebral perfusion is very high, whereas the ratio of diastolic to systolic flow is much higher for cerebral circulation. Anatomical characteristics and functional responses, including cerebral autoregulation, serve as protection for preventing expansion of ischemia (Kety 1950). A similar finding in another study stated that a temporary increase in blood pressure in patients with acute ischemic stroke indicates a protective response to maintain perfusion in ischemic brain tissue. Patients with hypertension significantly improved the degree of clinical severity obtained from the NIHSS score with a p-value = 0.001 (Bager et al. 2018; Kvistad et al. 2013; Shin et al. 2008; Whitworth 2003).

The findings indicate that blood pressure has correlation with the improvement of NIHSS score. This means there is a quite significant correlation between blood pressure and the severity of ischemic stroke. The literature disclosed by Qureshi (2008) explains that increased blood pressure is a natural response or a natural protective effect to maintain perfusion and collateral blood flow in the penumbra to remain good. This condition will prevent continuous ischemia, which will affect the patient's clinical outcome (Qureshi 2008). The Heart Association/American Stroke Association (AHA/ASA) guidelines reveal that the benefit of lowering blood pressure in patients with systole/diastole of ≥220/120 in acute ischemic stroke patients within the first 48-72 hours is doubtful. It will be better if the medication declines the patient's blood pressure for 24 hours after the onset of the attack. Moreover, the blood pressure can be lowered by 15 percent from the previous condition. Clinicians must be careful that reducing blood pressure in the early phase of acute ischemic stroke will interfere with collateral blood flow and pose a risk for expansion of ischemic or recurrent strokes. This is an essential aspect of preventing brain hypoperfusion due to disruption of acute cerebral artery autoregulation (Zaidi et al. 2013).

The clinical severity of this study was determined by the NIHSS, which has been described as a well-validated and commonly used stroke scoring scale for assessing neurological deficits. The NIHSS can be used and has been validated (Williams, Yilmaz, and Lopez-Yunez 2000). The NIHSS score can be a reference for assessing the severity of neurological deficits to determine the success of therapy in clinical practice and research (Lyden 2017). Various previous studies can support this study where there is a physiological mechanism of increasing blood pressure at the onset of ischemic stroke as prevention for deterioration of the patient's clinical condition, which was measured using NIHSS.

V. CONCLUSION

The variable affecting the degree of clinical improvement in patients was increased blood pressure during acute ischemic stroke. Patients with hypertension have high probability to experience improvement in clinical

severity, while those who have no hypertension diagnosis are less likely to be in severe condition.

RECOMMENDATION

As the explained findings in this paper, we recommend that patients and clinicians should be more careful in lowering blood pressure when facing an early phase of ischemic stroke

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