Correlation between Fibrinogen Level with Middle Cerebral Artery Pulsatility Index in Acute Ischemic Stroke

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Abstract

Background: High levels of fibrinogen will increase the blood viscosity. Pulsatility index parameter in transcranial doppler can measure blood vessel resistance which influence by cerebral blood flow velocity and blood viscosity. This study has aim to find correlation between fibrinogen with PI in acute thrombotic stroke patient.

Method: A cross sectional design was used in this study. The samples were patient with acute ischemic stroke in neurological ward Dr. Soetomo Hospital Surabaya from January 2019 to December 2020. Fibrinogen level was measured using *clauss* method. PI was calculated by peak systolic velocity, end diastolic velocity and mean vessel velocity, which were measured in middle cerebral artery.

Result: This study involved 32 samples consisted 22 males and 10 females. Mean age of subjects was 55.37 ± 10.55. The mean fibrinogen level is 356.95 ± 139.57. Mean MCA PI is 1.03 ±0.34. There is positive correlation with weak correlation strength between fibrinogen level with MCA PI in acute thrombotic stroke patients and statistically significant (p=0.024, r=0.398).

Conclusion: There is a positive correlation between fibrinogen level with PI MCA in acute thrombotic stroke.

Keywords: *acute ischemic stroke, fibrinogen, MCA PI*

Introduction

Stroke is the second leading cause of death (11.8% of all deaths) worldwide after ischemic heart disease and the leading cause of Disability Adjusted Life Years (DALYs).[1] Globally, there were 6.5 million deaths due to stroke in 2013. Around 87% of every stroke incident were ischemic stroke. [2] Stroke affects all the quality of life and become a serious problem in Asia, which has more than 60% of the world population with the majority of countries are lower middle income countries.[3,4]

Ischemic stroke occurs due to impaired cellular perfusion and metabolism which is closely related to the condition of blood flow, blood vessels and blood viscosity. High blood viscosity increases the risk of cerebrovascular disease.[5]

Fibrinogen plays an important role for the interaction of erythrocytes and platelets in acute local inflammation condition, so that if fibrinogen levels increase, there will be an increase in erythrocyte aggregation and platelet aggregation which causes often occurs in acute stroke.[6,7] Aside from that, fibrinogen in itself has a large molecular weight compared to its plasma proteins counterparts. These characteristics causes high levels of fibrinogen will increase blood viscosity.[8]

One of the Transcranial Doppler (TCD) parameters is the Pulsatility Index (PI) which evaluates the peripheral resistance of blood vessels.[9] The most important factors

influencing the PI are cerebral blood flow velocity and blood viscosity.[10]

The purpose of this study is to determine whether fibrinogen level is correlated with the PI as both are positively correlated with the blood viscosity level concurrently.

Method

This study is an observational analytic study with a cross sectional design. Inclusion criteria were acute thrombotic stroke patient in acute phase, ages over than 18 years, National Institutes of Health Stroke Scale (NIHSS)<15, and has complete medical record data. The exclusion criteria were: patients who suffers from sepsis, brain tumor, acute myocardial infarction, dysfunction of coagulation factor. Based on the formula for calculating the sample size of correlation study, the sample amount is 32.

All subjects underwent the same laboratory and clinical examinations. The fibrinogen level were measured using *clauss* method with Sysmex CS2500 when patient were admitted in neurological ward. TCD examination was performed by one neurologist certified in neurosonology with SONARA TCD system (Natus, Neurology USA). Doppler signals from the MCA were obtained at depths of 45-65 mm. PI was calculated as the difference between the peak systolic and end diastolic velocities divided by the mean flow velocity. Data were analyzed using Statistical Package for the Social Sciences (SPSS) software version 25.0. The normality of the data distribution was checked by the Kolmogorov Smirnov test. The Spearman statistical test was used to determine the correlation between the two variables with an abnormal distribution.

The research committee at the Dr. Soetomo Hospital Surabaya, approved this study ethical approval number 0180/KEPK/IV/2021.

Result

This study involved a total sample of 32 subjects. The total number of male patients were 22 (68.8%) and female patients were 10 (31.3%). The mean age was 55.37±10.55. There were no differences between with clinical manifestation among patients. Of these, right hemiparesis occurred in 17 (53.1%) and left hemiparesis in 15 (46.9%) patients. General characteristics are shown in table 1

Table 1: General Characteristics

Variable	n (%)	Mean ± SD
Sex Male Female	 22 (68.8%) 10 (31.3%)	
Age		55.37 ± 10.55
Hemiparesis Right hemiparesis Left hemiparesis	 17 (53.1%) 15 (46.9%)	

The mean level fibrinogen in this study was 356.96±139.58mg/dl with minimum level was 99.50 mg/dl and maximum level 723.40mg/dl. This data can be seen in table 2

Table 2 Mean value of fibrinogen level

Variable	Minimum	Maximum	Mean ± SD
Fibrinogen	99.50	723.40	356.96 ± 139.58

The result of MCA PI examination showed the mean PI value was 1.03 ± 0.34. with minimum PI value was 0.56 and maximum PI value 2.17. This data can be seen in table 3

Table 3 Mean value of MCA PI

Variable	Minimum	Maximum	Mean ± SD
Pulsatility index	0.56	2.17	1.03 ± 0.34

CORRELATION BETWEEN FIBRINOGEN LEVEL WITH MCA PI

There was a positive correlation with weak correlation strength between fibrinogen level with MCA PI and statistically significant with $p<0.05$. The correlation coefficient is 0.398. as seen in Table 4.

Table 4 Correlation between Fibrinogen Level with MCA PI

Variable	Correlation coefficient	p-value
Fibrinogen with PI MCA	0.398	0.024

Discussion

Since January 2019 until December 2020, we found 32 patients met the research criteria. Of these subject, 22 (68.8%) were males and 10 (31.3%) were females. This study shows that male suffered more acute thrombotic stroke than female. This is in accordance with several studies which state that male is more affected by stroke than woman. Unmodifiable characteristics of sex as a risk factor is making this demographic knowledge becomes an important feature. Other risk factor that also unmodifiable are age and race.[11]

The mean age of patients was 55.37±10.55. This is consistent with data from other study that risk of stroke doubles every decade above 55 age.[12] While in developing countries most stroke cases occur in people less than 60 years and low awareness about the treatment approaches.[13–15]

The baseline data that has been collected are test for normality with Kolmogorov -Smirnov test (KS test). This test aims to determine the distribution of normal or abnormal data. Analysis using the KS test found that the distribution data was abnormal. Therefore, the analysis to determine the correlation between fibrinogen level with MCA PI in acute ischemic stroke was performed using Spearman's correlation analysis.

In this study, researchers found a significant relationship between fibrinogen level with MCA PI in acute ischemic stroke patients. The result of the p value is 0.024 (<0.05) which is significant. This means that the higher fibrinogen level, the greater PI MCA value.

The results of this study are supported by other research which states that increased blood viscosity associated with acute ischemic stroke.[16] In addition, there are other studies that state fibrinogen is a factor that

independently affects blood viscosity in a population of acute ischemic stroke patient.[8] Other studies state that the higher the blood viscosity, the greater vascular resistance, resulting in an increase PI value.[17]

Conclusions and Suggestions

There was positive correlation with correlation coefficient (r=0.398) between fibrinogen level with MCA PI in acute ischemic stroke which was statistically significant ($p<0.05$). Further research need to be done, especially research that analyze confounding variables in blood viscosity and cerebral blood vessel imaging.

Ethical Clearance: This study received an ethical approval number.

Source of Funding: This research was carried out through individual funding.

Conflict of Interest: There was no conflict of interest from this study.

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