The Relationship Between Mean Platelet Volume (MPV) and Cardiac Troponin I (cTnI) Levels and Mortality in Patients With Ischemic Stroke

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Abstract

Introduction: Acute ischemic stroke is one of the important causes of mortality and morbidity. It is responsible for approximately 5% of in-hospital mortality. Early recognition of risk factors for mortality in acute ischemic stroke cases is important in terms of disease management and appropriate family information. In this study, we aimed to investigate the relationship between Cardiac Troponin I (cTnI) and Mean Platelet Volume (MPV) and mortality in patients with acute ischemic stroke.

Methods: Patients who applied to the Emergency Medicine Clinic between 01.01.2016 and 01.01.2018, whose diagnosis code was entered as cerebrovascular disease (CVD) and whose magnetic resonance diffusion imaging tests were reported as acute infarct by the radiology clinic were screened, and the patients' age, gender, current comorbid diseases, mean platelet volume (MPV) and troponin values were recorded. Mortality status of the patients were screened through the Turkish Republic Ministry of Health Death Notification System, and their first and third month mortality were recorded. Patients with elevated troponin and suspected acute coronary syndrome by a cardiology or emergency medicine specialist were excluded.

Results: A total of 357 patients were included in our study. The median age of the patients was 72 (IQR: 62-81). While 43 (12%) of 357 patients died within the first month, 66 (18.5%) of them died within the first three months. When the relationship between the first month and third month mortality of the patients and their comorbid diseases was examined, it was found that only the presence of dementia had a significant relationship with the third month mortality (Chi-square, p=0.021). When the relationship between MPV and troponin values of the patients and their first and third month mortality was examined, a significant relationship was found between first month mortality and troponin (Mann-Whitney U, p<0.001) and third month mortality and troponin (Mann-Whitney U, p<0.001).

Discussion and Conclusion: It was concluded that troponin elevation in patients with acute ischemic stroke is a parameter that may be useful in estimating the risk of mortality.

Keywords: Acute stroke; troponin; mortality.

Acute ischemic stroke is a condition that progresses with permanent brain damage as a result of impaired cerebral blood flow[1]. It is the second most common cause of death and leading cause of disability worldwide[2]. However, there are still problems in making decisions regarding the clinical course and prognosis of the disease for ischemic stroke patients[3]. Due to the resulting burden of disability and mortality, clinical biomarkers are needed that will play an important role in the estimation of mortality and treatment regimens of patients[4]. Cardiac troponins are completely myocardium-specific, unique regulatory proteins and are ideal biomarkers since their amounts of free forms in the bloodstream are very low in normal individuals[5]. The elevation of cardiac troponins in the blood is also detected in many non-ischemic clinical conditions apart from myocardial infarction[6]. Although the underlying mechanism is not fully known, hyperadrenergic state is blamed. In some patients, myocardial ischemia and infarction can indeed be seen[7]. Mean platelet volume (MPV) is an indicator of platelet function and is an important indicator of platelet activities such as thromboglobulin secretion and platelet aggregation[8]. Since platelet activation is one of the main components of atherosclerosis, it affects the clinical situation in conditions such as atherosclerosis-related myocardial infarction and ischemic stroke[9]. There are studies showing the relationship between MPV and some stroke subtypes. There are also studies related to stroke recurrence and MPV[10,11].

In our study, we aimed to investigate the relationship between cardiac troponin and mean platelet volume in predicting mortality in patients with ischemic stroke.

Materials and Methods

Study Design

This retrospective, cross-sectional study was performed with patients who applied to the Emergency Department of Ümraniye Training and Research Hospital within 2 years (between 01.01.2016 and 01.01.2018), diagnosed as cerebrovascular disease (CVD) with G46, I67, I68 codes in the ICD diagnostic coding and whose magnetic resonance imaging tests were reported as acute infarct by the radiology clinic.

Exclusion Criteria

Of the 405 patients included in the study at the beginning, patients with incomplete or incorrect (hemolysis/clot, etc.) examination results (12 patients), patients whose tests were requested at least one hour after the patient's admission (5 patients), patients with MRI diffusion results not reported as acute infarct by radiology clinic or patients with a diagnosis of hemorrhagic stroke (20 patients), and patients with elevated troponin levels who were considered to have Acute Coronary Syndrome (ACS) by the Cardiology or Emergency Medicine Specialist (11 patients), were excluded.

Data Collection

The files of the patients were scanned and demographic information such as age, gender, comorbid diseases in the history, Mean Platelet Volume (MPV) and cardiac troponin I (cTnI) results were recorded. The death dates of the patients were scanned from the Turkish Republic Ministry of Health Death Notification System, by entering ID numbers. Patients were grouped as patients who died in the first month after admission, died within the first three months, and those who were still alive at the end of three months, according to their admission and death dates.

Laboratory Protocol

After the venous blood samples are collected in our hospital, the complete blood count and thus the MPV level is measured with the Cell- Dynn 3700 (Abott, IL, USA) hematological analysis machine. Cardiac troponin measurements are made using the indirect ion-selective electrode dilution method with the ARCHITECH ci400 (ARCHITECH, IL, USA) clinical biochemistry analysis machine. Both laboratories are located in the central laboratory of the hospital and all samples are sent to the hospital laboratory by the pneumatic system half an hourafter they are collected.

The Primary Aim of the Study

To determine the existence of a relationship between mean platelet volume and cardiac troponin levels and mortality in ischemic stroke patients.

Statistical Measurements

Conformity of continuous data to normal distribution was examined by Kolmogorov-Smirnov test. Normally distributed data were expressed as mean and standard deviation, non-normally distributed data were indicated by median and quartiles, and categorical data were expressed as percentages. The Student's t-test was used to compare non-normally distributed continuous data between two groups, while the comparison of non-normally distributed continuous data and nominal data between two groups was made using the Mann Whitney-U test. Chi-square test and, where appropriate, Fisher's exact test were used to

compare the frequency data between the two groups. A level of p<0.05 was considered statistically significant. Analyzes were performed with SPSS 25.0 (SPSS, Inc., Chicago, IL, USA) program.

Results

A total of 357 patients were included in the study. Of the patients, 176 (49.3%) were male and 181 (50.7%) were female. Comorbidity distribution by gender and age information of the patients are given in Table 1.

While 43 (12%) of 357 patients died within the first month, 66 (18.5%) of them died within the first three months. When the relationship between the first month and third month mortality of the patients and their comorbid diseases was examined, it was found that only the presence of dementia had a significant relationship with the third month mortality (p=0.021). Table 2 shows the relationship between other comorbidities and mortality.

When the relationship between age, MPV and cardiac troponin I (cTnI) values of the patients and their first and third month mortality was examined, a significant correlation was found between first month mortality and age and cTnI (p=0.013 and p<0.001, respectively) and between third month mortality and age and cTnI (p=0.005 and p<0.001, respectively). There was no statistically significant relationship between MPV and mortality of the patients (Table 3).

Discussion

The reason for the high troponin values in ischemic stroke is not fully understood[12]. Although undetected myocardial infarction is seen as one of the causes of this condition, a correlation was found between cardiac troponin values and mortality in studies that excluded myocardial infarction and heart failure[13]. Elevated cardiac troponin is associated with high mortality in all ischemic stroke subtypes[14]. In a retrospective study of 1145 patients by

Table 1. Comorbidities according to the gender of the patients

	Male (n=176)	Female (n=181)	Total (n=357)
Age	68.5 (IQR: 58.25-79)	74 (IQR: 65-82)	72 (IQR: 62-81)
Comorbidity, n (%)			
Hypertension	67 (38.1)	95 (52.5)	162 (45.4)
Diabetes	35 (19.9)	50 (27.6)	85 (23.8)
Previous CVD	36 (20.5)	43 (23.8)	79 (22.1)
Heart Failure	9 (5.1)	13 (7.2)	22 (6.2)
Coronary Artery Disease	29 (16.5)	21 (11.6)	50 (14)
Chronic Renal Failure	14 (8)	4 (2.2)	18 (5)
COPD	9 (5.1)	4 (2.2)	13 (3.6)
Rhythm Disorder	3 (1.7)	11 (6.1)	14 (3.9)
Dementia	5 (2.8)	18 (9.9)	23 (6.4)

IQR: Interquartile Range; CVD: Cerebrovascular Disease; COPD: Chronic Obstructive Pulmonary Disease.

Table 2. Relationship between comorbidities and mortality of patients

	1st Month Mortality, n (%)	p	3rd Month Mortality, n (%)	p
Hypertension	18 (11.1)	0.621	27 (16.7)	0.419
Diabetes	13 (15.3)	0.292	21 (24.7)	0.091
Previous CVD	10 (12.7)	0.849	15 (19)	0.897
Heart Failure	3 (13.6)	0.738	7 (31.8)	0.150
Coronary Artery Disease	2 (4)	0.059	5 (10)	0.095
Chronic Renal Failure	5 (27.8)	0.052	5 (27.8)	0.297
COPD	4 (30.8)	0.058	4 (30.8)	0.271
Rhythm Disorder	2 (14.3)	0.680	2 (14.3)	1.000
Dementia	5 (21.7)	0.175	9 (39.1)	0.021

*Mann-Whitney U; CVD: Cerebrovascular Disease; COPD: Chronic Obstructive Pulmonary Disease.

Table 3. Relationship between age, mean platelet volume and troponin values and mortality of patients

	Age	MPV (fL)	cTnI (ng/mL)
1st Month Mortality			
Alive	71 (IQR: 61–80)	7.32 (IQR: 6.60–8.20)	0.007 (IQR: 0.003–0.016)
Dead	76 (IQR: 68–84)	7.42 (IQR: 6.69–9.03)	0.021 (IQR: 0.006–0.048)
p	0.013	0.293	<0.001
3rd Month Mortality			
Alive	70 (IQR: 61–79)	7.29 (IQR: 6.60–8.20)	0.006 (IQR: 0.003–0.014)
Dead	77 (IQR: 67–84,25)	7.46 (IQR: 6.63–8.88)	0.020 (IQR: 0.008–0.051)
p	<0.001	0.340	<0.001

*Mann-Whitney U; MPV: Mean platelet volume; cTnI: Cardiac troponin I.

Peddada et al.[3], in-hospital mortality rates were found to be three times higher in patients with elevated cardiac troponin compared to those without high cardiac troponin levels. When the causes of death were examined, it was determined that the mortality rates of patients with high cardiac troponin value were higher in each of the deaths due to neurological causes, deaths due to cardiac causes, and deaths due to other causes. In another study by Scheitz et al.[15], it was found that troponin elevation occurs in one of every seven patients and is also associated with in-hospital mortality. In another study on long-term mortality, it was found that 5-year mortality was twice as high in patients with high troponin[16]. In our study, similar to the literature, the 1st and 3rd month mortality of the patients were found to be statistically significantly higher in patients with high cardiac troponin values.

Mean platelet volume is an indicator of increased platelet activation and is associated with hemostasis[8]. Therefore, there are studies showing that increased MPV values in cerebrovascular diseases are a risk factor and associated with mortality in the general population[17,18]. In a retrospective study by Arıkanoğlu et al.[19] with 32 patients with a control group, high MPV values were found to be associated with mortality. There are also studies that associate high MPV rates with both mortality and infarct size[20]. In another study by Arvelo-Lorido et al.[21], a total of 379 patients were followed prospectively and the patients were divided into three groups according to their MPV values. Although cardiac mortality was higher in the group with high MPV values, there was no difference in mortality rates or re-admissions for any reason in all three groups. Similarly, studies have shown that MPV values were not associated with poor outcome in stroke[22,23]. In our study, similar to these studies, it was determined that MPV values were not related to the mortality of the patients.

Limitations

Because the study design is retrospective, observational and single-center, the findings may be misleading. Again, since the causes of mortality of the patients are not divided into different subtypes retrospectively, it cannot be understood whether the patients died due to cardiac, ischemic or other causes.

Conclusion

High cardiac troponin values detected in ischemic stroke patients are associated with mortality. MPV value was not found to be associated with mortality.

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