ORIGINAL RESEARCH

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The Role of MPV-to-Lymphocyte Ratio and MPV-to-Platelet Ratio in Predicting Mortality in Patients with Acute Myocardial Infarction

Akut Miyokard Enfarktüslü Hastalarda Mortaliteyi Öngörmede MPV-Lenfosit Oranı ve MPV-Trombosit Oranının Rolü

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Abstract

Objective: In this study, we aimed to evaluate the relationship between the laboratory parameters of mean platelet volume/lymphocyte ratio (MPVLR) and mean platelet volume/platelet ratio (MPVPR) with prognosis and mortality in patients with hospitalized glomerular filtration rate (GFR) <60 and a diagnosis of acute myocardial infarction (AMI).

Method: This study was designed as a retrospective cohort study. Two hundred myocardial infarction (MI) patients over the age of 18 years and with GFR <60, who were hospitalized in our hospital between January 01, 2018 and January 01, 2021, were included in the study. The patients were divided into 2 groups, as the survivor and mortality groups. The two groups were compared in terms of demographic characteristics and clinical data (symptoms, comorbidities, laboratory findings, GFR, coronary angiography, drugs used and complications). MPVLR was found by dividing the mean platelet volume to lymphocyte count. MPVPR was found by dividing the mean platelet volume to platelet count.

Results: The mean age of the survivor group was 64.3±10.4. In the mortality group, the mean age was 70.02±9.3. MPVLR levels were statistically significantly higher in the mortality group (8.39±5.9) compared to the survivor group (6.58±5.4) (p=0.011). However, MPVPR levels were statistically significantly lower in the mortality group (0.041±0.01) compared to the survivor group (0.044±0.01) (p=0.048). According to the results of ROC analysis in patients with mortality, sensitivity was 50.0% and specificity was 68.6% for MPVLR (p=0.010); sensitivity was 41.0% and specificity was 47.9% for MPVPR. The risk factors found to be significantly associated with mortality in the regression analysis included

Öz

Amaç: Bu çalışmada, hastanede yatan glomerüler filtrasyon hızı (GFR) <60 olan akut miyokard enfarktüsü (AMI) tanısı alan hastalarda ortalama trombosit hacmi/lenfosit oranı (MPVLR) ve ortalama trombosit hacmi/trombosit oranı (MPVPR) laboratuvar parametrelerinin prognoz ve mortalite ile ilişkisini değerlendirmeyi amaçladık.

Yöntem: Bu çalışma retrospektif bir kohort çalışması olarak tasarlanmıştır. 01 Ocak 2018-01 Ocak 2021 tarihleri arasında hastanemizde yatan 18 yaş üstü ve GFR <60 olan 200 miyokard enfarktüsü (MI) hastası çalışmaya dahil edildi. Hastalar sağkalım ve mortalite olarak 2 gruba ayrıldı. İki grup demografik özellikler, klinik veriler (semptomlar, komorbiditeler, laboratuvar bulguları, GFR, koroner anjiyografi, kullanılan ilaçlar ve hastalardaki komplikasyonlar) açısından karşılaştırıldı. MPVLR, ortalama trombosit hacminin kan basıncına bölünmesiyle bulundu. MPVPR ortalama trombosit hacminin trombosit sayısına bölünmesi ile bulundu.

Bulgular: Hayatta kalanların yaş ortalaması 64,3±10,4 idi. Mortalite grubunda ortalama yaş 70,02±9,3 idi. MPVLR düzeyleri mortalite grubunda (8,39±5,9), sağ kalan gruba (6,58±5,4) göre istatistiksel olarak anlamlı derecede yüksekti (p=0,011). Ancak MPVPR düzeyleri mortalite grubunda (0,041±0,01), hayatta kalan gruba (0,044±0,01) (0,01-0,16) göre istatistiksel olarak anlamlı derecede düşüktü (p=0,048). Mortalite grubundaki hastalarda ROC analizi sonuçlarına göre, MPVLR için duyarlılık %50,0 ve özgüllük %68,6 (p=0,010); MPVPR için duyarlılık %41,0 ve özgüllük %47,9 idi. Regresyon analizinde mortalite ile anlamlı olarak ilişkili bulunan risk faktörleri arasında MPVPR (β: 0,045, olasılık oranı (%95 güven aralığı): 0,945 (0,899-1,001), p=0,032] yer aldı.

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MPVPR [β: 0.045, odds ratio (95% confidence interval): 0.945 (0.899-1.001), p=0.032].

Conclusion: As inexpensive and easily available new inflammatory markers, MPVLR and MPVPR were significantly higher in patients with GFR <60 and in those who died from AMI. In addition, MPVLR and MPVPR could predict mortality from MI.

Keywords: Acute myocardial infarction, mortality, MPV-to-lymphocyte ratio, MPV-to-platelet ratio

Sonuç: Ucuz ve kolay bulunabilen yeni enflamatuvar belirteçler olarak MPVLR ve MPVPR, GFR <60 olan ve AMI'dan ölen hastalarda anlamlı olarak daha yüksekti. Ek olarak, MPVLR ve MPVPR, MI'dan ölüm oranını tahmin edebildi.

Anahtar kelimeler: Akut miyokard enfarktüsü, mortalite, MPV-lenfosit oranı, MPV-trombosit oranı

Introduction

Heart failure (HF) is a major public health problem, affecting more than 23 million individuals worldwide, and its incidence increases with age. After the diagnosis of HF, the average life expectancy is 50% in 5 years and 10% in 10 years. Despite advanced modern treatment approaches, mortality rates are still high. Moreover, HF patients need long-term care, as it is a chronic disease that can be exacerbated by acute exacerbations (1). It is known that inflammation has an important role in the pathogenesis of atherosclerosis and thus cardiovascular diseases (CVDs) (2). The role of inflammation in HF has been demonstrated in many previous studies. HF syndrome is largely due to the imbalance between inflammatory and anti-inflammatory forces (3).

Mean platelet volume (MPV) blood test measures the average size of your platelets. The test can help diagnose bleeding disorders and diseases of the bone marrow. In recent years, MPV-to-lymphocyte ratio (MPVLR) and MPV-platelet ratio (MPVPR) have been shown to be important indicators of systemic inflammation (1,4-6). Recently, the MPV-to-lymphocyte ratio (MPVLR) has arisen as a prognostic marker in patients with CVDs (4). However, it was reported that elevated MPVPR values at admission are independently associated with the development of no-reflow phenomenon after primary percutaneous coronary intervention (PCI) in patients with ST-segment elevation myocardial infarction (STEMI) (4,7). However, there is no study investigating the association of MPVLR and MPVPR with the severity and complexity of acute myocardial infarction (AMI). In addition, MPV-platelet ratio (MPVPR) has also been shown to vary in various diseases and are associated with prognosis (8-11).

In this study, we aimed to evaluate the relationship between the laboratory parameters of MPVLR and MPVPR with prognosis and mortality in patients with hospitalized glomerular filtration rate (GFR) <60 mL/min and a diagnosis of AMI.

Materials and Methods

This study was designed as a retrospective cohort study. Before the study started, the study protocol was approved by Local Ethics Committee of İstanbul Medipol University (approval no: E-10840098-772.02-3976). This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Two hundred myocardial infarction (MI) patients over the age of 18 years and with GFR <60 mL/min, who were hospitalized in our hospital between January 01, 2018 and January 01, 2021, were included in the study. The demographic characteristics of the patients and clinical data (symptoms, comorbidities, laboratory findings, GFR, coronary angiography, medications and complications that developed in the patients) were scanned.

The patients were divided into 2 groups, as the survivor and mortality groups. The two groups were compared in terms of demographic characteristics and clinical data. Fasting morning blood samples of the patients and control healthy subjects were collected through vein puncture. The MPVLR was found by dividing MPV to lymphocyte count. The MPVPR was found by dividing MPV to platelet count.

Statistical Analysis

The data obtained in this study were analyzed using SPSS v.25 (SPSS, Chicago, USA) statistical program. Descriptive statistics such as frequency distribution, mean and standard deviation were used to evaluate the data. The differences between the means of two independent groups were compared with the student's t-test, and the differences between more than two groups were compared with the analysis of variance with the parametric test. The Mann-Whitney U and Kruskal-Wallis tests, which are non-parametric alternatives of these tests, were used in cases where parametric test assumptions were not met. Categorical data were analyzed using the chi-square or Fisher's Exact test. Variables with a p-value ≤0.05 were entered in the regression model. Values of $p<0.05$ were considered statistically significant at 95% confidence interval (CI).

Results

Comparison of laboratory and socio-demographic findings between the mortality and survivor groups was shown in Table 1. The mean age of the survivor group was 64.3±10.4 years. In the mortality group, the mean age was 70.02±9.3 years. MPVLR levels were statistically significantly higher in the mortality group (8.39±5.9) compared to the survivor group (6.58±5.4) (p=0.011). However, MPVPR levels were statistically significantly lower in the mortality group (0.041±0.01) compared to the survivor group (0.044±0.01) (p=0.048).There was not any statistical significance between the groups in terms of gender, length of hospitalization, coronary artery disease, HF, STEMI, non-STEMI, hypertension, hyperlipidemia, diabetes mellitus, cigarette, nephropathy, acetyl salicylic acid, beta blocker, statins, angiotensin converting enzyme (ACE) inhibitors, GFR, hemoglobin (g/dL), creatinine (mg/dL), lymphocytes (10^9/L), and platelet (10^9/L) (Table 1).

ROC analysis results in patients with mortality are shown in Table 2. According to the results of ROC analysis in patients with mortality, sensitivity was 50.0% and specificity was 68.6% for MPVLR (p=0.010); and sensitivity was 41.0% and specificity was 47.9% for MPVPR (p=0.048) (Table 2, Figure 1).

Multiple logistic regression analysis of factors used for mortality was shown in Table 3. The risk factors found to be significantly associated with mortality in the regression analysis included MPVLR [β: 0.067, odds ratio (OR) 95% confidence interval (CI): 1.069 (1.016-1.125), p=0.010] and MPVPR [β: 0.045, OR (95% CI): 0.945 (0.899-1.001), p=0.032] (Table 3).

Discussion

In this study, the effects of retrospective clinical and laboratory data on mortality were evaluated in 200 MI

Table 1. The comparison of patients' socio-demographic, clinical and laboratory parameters

Parameters	Mortality (N=55, 27.5%) Mean ± SD (min-max), n (%)	Survive (N=145, 72.5%) Mean ± SD (min-max), n (%)	p
Age (year)	70.02±9.3 (43-103)	64.3±10.4 (30-97)	0.14
Gender			
Male	35 (63.6%)	89 (61.3%)	0.41
Female	20 (36.4)	56 (48.7%)	
Length of hospitalization	3.44±2.2 (1.0-12.0)	2.87±1.2 (1.0-13.0)	0.53
Coronary artery disease	18 (32.7%)	47 (32.4%)	0.92
Heart failure	7 (12.7%)	19 (13.1%)	0.90
STEMI	27 (49.0%)	85 (58.6%)	0.15
Non-STEMI	26 (47.2%)	63 (43.4%)	0.32
Hypertension	40 (72.7%)	118 (81.3%)	0.16
Hyperlipidemia	9 (16.3%)	26 (17.9%)	0.93*
Diabetes mellitus	21 (38.1%)	51 (35.1%)	0.71
Cigarette	9 (16.3%)	28 (19.3%)	0.62
Nephropathy	14 (25.4%)	45 (31.0%)	0.26*
Acetyl salicylic acid	55 (100.0%)	140 (96.5%)	0.88
Beta blocker	41 (74.5%)	110 (75.8%)	0.92*
Statins	48 (87.2%)	118 (81.3%)	0.17*
ACE inhibitors	19 (34.5%)	68 (46.8%)	0.09*
GFR	44.30±13.7 (4.0-55.0)	45.04±10.7 (4.0-55.0)	0.62
Hemoglobin (g/dL)	11.21±1.8 (5.7-15.8)	12.40±1.9 (1.2-17.1)	0.18
Creatinine (mg/dL)	1.64±1.4 (0.9-10.7)	1.51±1.4 (0.7-11.0)	0.29
MPV (10^9/L)	10.88±1.0 (8.1-13.9)	10.68±1.5 (7.1-19.1)	0.600
Lymphocytes (10^9/L)	1.91±3.9 (0.3-14.0)	2.49±2.6 (0.2-30.1)	0.146
Platelet (10^9/L)	261.13±69.5 (133.0-370.0)	247.10±71.8 (68.0-614.0)	0.181*
MPVLR	8.39±5.9 (0.8±28.4)	6.58±5.4 (0.3±52.7)	**0.011***
MPVPR	0.041±0.01 (0.01-0.09)	0.044±0.01 (0.01-0.16)	**0.048***

*Mann-Whitney U test used. STEMI: ST elevation myocardial infarction, ACE: Angiotensin converting enzyme, GFR: Glomerular filtration rate, MPVLR: Mean platelet volume/lymphocyte ratio, MPVPR: Mean platelet volume/platelet ratio, SD: Standard deviation, MPV: Mean platelet volume

Table 2. ROC analysis results in patients with mortality

	Cut-off	Sensitivity	Specificity	AUC (95% CI)	p
MPVLR	>6.88	50.0%	68.6%	0.607 (0.525-0.689)	**0.010**
MPVPR	<0.043	41.0%	47.9%	0.435 (0.353-0.516)	**0.048**

AUC: Area under the curve, MPVLR: Mean platelet volume/lymphocyte ratio, MPVPR: Mean platelet volume/platelet ratio, CI: Confidence interval

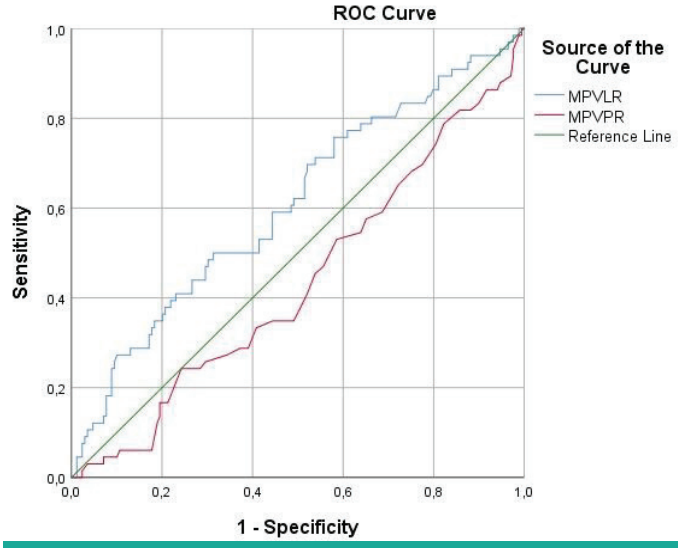

Figure 1. ROC analysis of MPVLR and MPVPR

MPVLR: Mean platelet volume/lymphocyte, MPVPR: Mean platelet volume/platelet ratio

Table 3. Multiple logistic regression analysis of factors used for mortality

	β	OR (95% CI)	p
MPVLR	0.067	1.069 (1.016-1.125)	**0.010**
MPVPR	0.045	0.945 (0.899-1.001)	**0.032**

MPVLR: Mean platelet volume/lymphocyte ratio; MPVPR: Mean platelet volume/platelet ratio, OR: Odds ratio, CI: Confidence interval

patients over 18 years of age and with GFR <60, who were hospitalized in coronary intensive care unit. There was a significant relationship between the laboratory markers obtained, especially MPVLR and MPVPR, and those who died from MI. MI is a disease with significant morbidity and mortality. While 145 (72.5%) patients survived in our study, 55 (27.5%) patients died in the hospital. MPVLR levels were statistically significantly higher in the mortality group compared to the survivor group. However, MPVPR levels were statistically significantly lower in the mortality group compared to the survivor group. The risk factors found to be significantly associated with mortality in the regression analysis included only MPVPR.

Increased inflammatory marker levels in the blood are associated with poor outcome in HF as in many chronic diseases. An increased inflammatory stimulus causes the secretion of many inflammatory cytokines. These inflammatory cytokines show detrimental effects on the myocardium, leading to decreased left ventricular function and thus HF (1,2,12-14). In one study, high neutrophil-lymphocyte ratio (NLR) values were associated with high mortality rates in individuals with acute decompensated HF, and the value of NLR in predicting death was superior to that of neutrophil count, total white blood cell count, and partially low lymphocyte count (15). Therefore, NLR has an important prognostic value in HF. On the other hand, previous studies have shown that high platelet and low lymphocyte counts are associated with poor cardiovascular outcomes (16-18). The value recently found and shown as one of the complete blood count parameters is the MPVLR. It was first reported by Hudzik et al. (5) in 2016 as a potential prognostic marker in patients with diabetes and MI. Życzkowski et al. (19) reported that prognostic relationship between high pre-operative MPVLR and higher long-term mortality of patients with clear cell renal cell carcinoma. In the study of Sut et al. (20) in 78 patients with breast cancer, they reported that MPVLR, NLR, and PLR levels were significantly higher in breast cancer patients compared to controls. In addition, a significant association was found between NLR and PLR but not MPVLR and low dietary polyphenol intake in breast cancer patients (20). In our study, MPVLR levels were statistically significantly higher in the mortality group compared to the survivor group. According to the results of ROC analysis in patients with mortality, sensitivity was 50.0% and specificity was 68.6% for MPVLR. However, in the regression analysis, risk factors were not found to be associated with mortality and MPVLR.

In the literature, studies examining the relationship of diseases with MPVPR are limited (7,8). Tezcan et al. (8) reported a prognostic relationship between MPVPR and Behçet's disease (BD), which determines the diagnosis and severity of BD. Bernardi et al. (7) reported a prognostic relationship between MPVPR and predictive markers of CVD. In a study conducted by Karakurt et al. (21) in complexity of coronary artery disease (CCAD) in patients with acute coronary syndrome (ACS), MPVPR and MPVLR were not independent predictors of CCAD in patients with ACS. In our study, MPVPR levels were statistically

significantly lower in the mortality group compared to the survivor group. According to the results of ROC analysis in patients with mortality, sensitivity was 41.0% and specificity was 47.9% for MPVPR. However, the risk factors found to be significantly associated with mortality in the regression analysis included MPVPR [β: 0.043, OR (95% CI): 0.435 (0.353-0.516), p=0.048].

Study Limitations

There were some limitations in our study. First, our study is a single-center and retrospective study. The small sample size of patients was the second limitation. Moreover, multi-center and prospective studies should be planned to support these pre-liminary results. However, the strengths of our study included that our sample was larger and our results were supported by logistic regression analysis.

Conclusion

As inexpensive and easily available new inflammatory markers, higher MPVLR and lower MPVPR were significantly in patients with GFR <60 and in those who died from MI. However, MPVLR levels may predict hemodynamically severe coronary obstruction better than MPVPR. The utility of this new marker warrants to be investigated in various cardiac situations. Large-scale, prospective, and multicenter studies will be necessary to clarify the relationship between MPVLR, MPVPR and MI.

Ethics

Ethics Committee Approval: The study protocol was approved by Local Ethics Committee of İstanbul Medipol University (approval no: E-10840098-772.02-3976).

Informed Consent: Informed consent was obtained.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Concept: S.K., E.O., M.R.Y., Design: S.K., E.O., M.R.Y., Data Acquisition: S.K., F.K., S.V., O.İ., Data Collection or Processing: S.K., İ.Ş., Analysis or Interpretation: S.K., İ.Ş., Drafting Manuscript: S.K., E.O., M.R.Y., Critical Revision of Manuscript: S.K., F.K., S.V., O.İ., İ.Ş., Final Approval and Accountability: S.K., F.K., S.V., O.İ., İ.Ş., E.O., M.R.Y.

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