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Journal of Cardiovascular Emergencies 2019;5(2):50-58
DOI: 10.2478/jce-2019-0008

ORIGINAL RESEARCH

Mean Platelet Volume Predicts Short-term Prognosis in Young Patients with St-segment Elevation Myocardial Infarction

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ABSTRACT

Background: Acute ST-elevation myocardial infarction (STEMI) is an uncommon diagnosis in patients less than 40 years of age. Over the last two decades, there is an increase in the frequency of cardiovascular events among young adults. However, at present there is only limited clinical data on the clinical characteristics and outcomes of STEMI in young patients who were treated with primary percutaneous coronary intervention (pPCI). Plaque erosion is the underlying pathological mechanism leading to STEMI in the vast majority of young adults. Thrombi that complicate superficial erosion seem more platelet-rich than the fibrinous clots precipitated by plaque rupture. Mean platelet volume (MPV) is recognized as a marker of the platelet activation process and may be a better indicator of short-term prognosis than the inflammatory markers in young patients with STEMI. Therefore, we aimed to investigate clinical and angiographic characteristics, risk factors and the independent value of MPV on predicting short-term major adverse cardiovascular events (MACEs) in young adults with STEMI. **Methods:** A total of 349 patients aged 40 years or younger who underwent pPCI at our center between 2010–2015 with the diagnosis of STEMI were retrospectively analyzed. **Results:** The mean age of the patients was 36.4 ± 3.6 years and 90% of them were men. Smoking was by far the most frequent cardiovascular risk factor. MACEs were observed in 23 patients (6.6%), and according to the multivariate regression analysis, Killip III-IV (OR 7.52, 95% CI 1.25–45.24, p = 0.03), lower admission SBP (OR 0.94, 95% CI 0.90–0.98, p <0.01) and increased MPV (OR 1.67, 95% CI 1.05–2.67, p = 0.03) were found to be independently correlated with MACE in the study population. **Conclusion:** Our results indicate that MPV is an independent predictor of MACEs at the short-term follow-up in young patients with STEMI undergoing pPCI. Accordingly, we suggested that MPV, a marker of platelet activation, could play a significant role in predicting clinical evolution in young patients with STEMI.

Keywords: acute myocardial infarction, primary percutaneous coronary intervention, young adult

ARTICLE HISTORY

Received: May 4, 2019
Accepted: May 27, 2019

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INTRODUCTION

In recent years, there has been growing interest and concern in respect to the early occurrence of cardiovascular (CV) diseases. Many investigators have observed a decline in CV mortality rates in the general population throughout the industrialized world.[1,2] On the contrary, CV events have increased in young adults, especially in low- and middle-income regions over the past 20 years.[3] Although young adults have lower prevalence rates of traditional CV risk factors, a few considerations can be postulated to explain why heart diseases are on the rise among young individuals. Previous studies comparing young adults with their seniors with established coronary heart disease (CHD) have found that obesity, dyslipidemia, tobacco use, and illicit substance abuse were more prevalent among young adult patients.[4–9] Also, it must be emphasized that one of the most important components in determining health-related behavior is the accurate perception of an individual's risk by both patients and health care providers. Physicians may underestimate the absolute CV risk of young patients, and the patients may show optimistic bias when considering their own risk and complaints. Moreover, the current risk scores unfortunately fail to identify the young individuals at risk for their first myocardial infarction (MI); as a consequence, these young adults rarely receive recommended preventive medications and lifestyle modification counseling, that could reduce the incidence of heart diseases.

There are few reports which provide information in respect to the predictors of short-term major adverse cardiovascular events (MACE) among young patients with ST-segment elevation myocardial infarction (STEMI) undergoing primary percutaneous coronary intervention (pPCI). Many studies have used ≤45 years of age as the cutoff value to describe young adults and included the entire spectrum of acute coronary syndrome (ACS) ranging from myocardial infarction to unstable angina.[10–12] Unlike previous studies, in this study we aimed to evaluate only young patients with STEMI below 40 years of age who underwent pPCI.

Mean platelet volume (MPV) represents an index of platelet size, which has been demonstrated to correlate with platelet activation. A number of studies have shown that elevated MPV concentration is significantly associated with cardiovascular conditions.[13–15] The association between elevated MPV and poor clinical outcomes in patients (without age restriction) with ACS is well documented, but less is known about MPV as a potential predictor of outcomes after STEMI in young patients.[16,17]

The purpose of this study was to examine the risk factors, clinical and angiographic characteristics of young patients with STEMI. Also, we sought to determine the role of MPV in predicting short-term outcomes of young patients with STEMI who underwent pPCI.

METHODS

STUDY POPULATION

The database of our tertiary referral center was searched for patients ≤40 years of age who underwent PCI between the years of 2010 and 2015, and a total of 697 patients were identified. Initially, 213 (30.5%) patients with the diagnosis of non-STEMI and 135 (19.3%) patients with stable CHD were excluded. We performed a retrospective analysis of 349 (50.1%) young adult patients ≤40 years with STEMI who underwent pPCI at our institution. Patients were enrolled in the study if they fulfilled the following criteria: (1) presented to the hospital within 12 hours of the onset of a typical chest pain lasting for >30 minutes, and (2) surface ECG showed ST segment elevation of ≥1 mm in at least two contiguous leads or ≥2 mm in leads V1 through V3, or new left bundle branch block. Coronary angiographies of the patients that fulfilled the aforementioned inclusion criteria were reviewed by two experienced interventionists using an Axiom (Siemens Medical Solution, Erlangen, Germany) workstation to confirm the existence of an identifiable culprit lesion which was intervened upon with at least plain old balloon angioplasty. No patient was excluded from the analysis. As a result, 349 young patients with STEMI admitted within 12 hours from symptom onset who underwent pPCI were included into the study. The study was carried out according to the declaration of Helsinki, and approval from a local ethics committee was obtained. All patients gave informed consent for the study.

DEFINITIONS OF DEMOGRAPHIC AND CLINICAL VARIABLES

Demographic and clinical data of the study population, including age, gender, diabetes mellitus (DM), hypertension (HT), hypercholesterolemia, cigarette smoking status, family history of CHD, history of PCI or coronary artery bypass graft surgery, history of MI, presence of renal disease, and Killip class on admission were extracted from medical records.

HT was defined as systolic blood pressure greater than or equal to 140 mmHg and/or diastolic blood pressure greater than or equal to 90 mmHg, or use of antihyper-

tensive drugs. A diagnosis of DM was established on the basis of fasting blood glucose ≥126 mg/dL, blood glucose >200 mg/dL at any time, or a history of DM. The diagnosis of hypercholesterolemia was defined as total cholesterol ≥200 mg/dL and/or low-density lipoprotein cholesterol ≥140 mg/dL, or use of cholesterol-lowering agents. Family history was considered significant for the current study if a first-degree relative, younger than 55 years (men) or 65 years (women), had coronary artery disease. Renal failure was defined as a glomerular filtration rate less than 60 mL/min/1.73 m^2, which was estimated by eGFR using the CKD-EPI formula.[18] The Killip class of each patient was established on the basis of the severity of heart failure signs at the time of hospital admission.[19]

DEFINITIONS OF ANGIOGRAPHIC AND PROCEDURAL VARIABLES

Symptom onset-to-balloon time was defined as the time from the onset of symptoms to the opening of the culprit vessel. Door-to-balloon time was defined as the time from the diagnosis of STEMI to the time of the first balloon inflation during pPCI. Multivessel coronary artery disease was defined as the presence of a luminal diameter stenosis ≥50%, involving at least two major epicardial coronary arteries. A successful procedure was defined as <20% residual stenosis in the infarct-related artery (IRA) associated with a Thrombolysis in Myocardial Infarction (TIMI) grade 3 flow. A TIMI thrombus score ≥4 was defined as high thrombus burden, which was assessed according to the TIMI thrombus grading scale.[20] The presence of a no-reflow phenomenon was considered if blood flow in the IRA was ≤ TIMI 2 flow despite successful dilatation and in the absence of mechanical complications.[21] If TIMI 3 flow was restored after standard therapy of no-reflow phenomenon with intravenous adenosine or nitroprusside, these procedures were assumed as successful.

LABORATORY ANALYSIS AND ECHOCARDIOGRAPHY

Venous blood samples were obtained from all patients on admission. Blood counts were determined within 30 minutes after venous blood sampling, using an autoanalyzer (Cell-dyn 3700; Abbott, Wiesbaden, Germany). Troponin I was measured on the Elecsys 2010 (Roche Diagnostics), and the test was considered positive at a cutoff value >0.03 ng/mL. C-reactive protein (CRP) measurements were conducted on a Cobas Integra analyzer (Roche Diagnostics, Istanbul, Turkey) using the turbidimetric method. Left ventricular systolic function was assessed by 2-dimensional echocardiography using the modified biplane Simpson method (Vivid 3 system; General Electric Company, Milwaukee, WI, USA).[22]

INTERVENTIONAL PROCEDURE

Patients were transferred to the cardiac catheterization laboratory and underwent emergency coronary angiography (CAG) to perform pPCI. CAG was performed using the Judkins technique through the femoral artery. Intraprocedural decisions, including device selection and adjunctive pharmacotherapy, such as glycoprotein IIb/IIIa inhibitors, were made on-site by the operator. At admission, all patients received clopidogrel in a loading dose of 600 mg, associated with 300 mg acetylsalicylic acid, and followed by a 100 U/kg bolus injection of unfractionated heparin after coronary angiography. pPCI was achieved with standard techniques according to established guidelines. Unless contraindicated, β-blocker, angiotensin-converting enzyme inhibitor, and statin therapy were administered to all patients during hospitalization. Also, a 75 mg clopidogrel and 100 mg acetyl salicylic acid dose were given in combination once daily.

ENDPOINTS

MACEs were defined as cardiovascular death and nonfatal reinfarction within 30 days after hospital admission. Reinfarction was diagnosed by the presence of electrocardiographic changes and new elevations of cardiac biomarkers with the recurrence of symptoms.

STATISTICAL ANALYSIS

All data were presented as mean ± SD for parametric variables and as percentages for categorical variables. Continuous variables were checked for the normal distribution assumption using Kolmogorov-Smirnov statistics. Correlation between MPV and platelet levels was demonstrated with Pearson correlation analysis. Univariate and multivariate logistic regression analysis was performed to investigate the predictors of MACE in the study population. Forward stepwise multivariate regression models using parameters with $p < 0.10$ were created to identify the independent predictors of mortality. Receiver operating curves were generated to define the cutoff values for MPV. P-values were two-sided, and values <0.05 were considered statistically significant. All statistical studies were carried out using Statistical Package for Social Sciences software (SPSS 16.0 for Windows, SPSS Inc., Chicago, IL, USA).

RESULTS

Our study population consisted of 349 patients ≤40 years of age (mean age 36.4 ± 3.6 years) who underwent pPCI with an admission diagnosis of acute STEMI. The majority of the study population (90%) was male, and the frequency of conventional cardiovascular risk factors was relatively low except smoking. The frequency of active smokers was 81.7% in our study population. Clinical, demographic, angiographic and procedural characteristics, laboratory results and MACE details of the patients are summarized in Table 1. Seventy-one percent of the subjects had single-vessel disease. The culprit lesions were mostly located in the left anterior descending artery (60.2%), and anterior wall infarction (57.9%) was the most frequent type of MI. Drug-eluting stents were used in 58.7% of the patients. Procedural success was achieved in 331 (94.8%) patients.

MACEs were observed in 23 patients (6.6%) in the study population. A total of 16 (4.5%) reinfarctions and 7 (2%) deaths occurred in 349 patients over 30 days. In 12 (3.4%) out of 16 patients, stent thrombosis (acute or sub-acute) was the cause of reinfarctions. All of the cardiovascular deaths occurred during the initial hospitalization. All of the deceased patients had presented with acute hemodynamic compromise.

In univariate correlation analysis, platelet counts were negatively correlated with MPV ($r = -0.30$, $p < 0.01$). In univariate regression analysis, angina onset to balloon time, heart rate, admission cardiopulmonary resuscitation, left ventricular ejection fraction, Killip class III-IV, platelet count, MPV, no-reflow phenomenon, procedural success, anterior MI, and admission systolic blood pressure (SBP) were found to be correlated with MACEs in the study population. These parameters were subjected to multivariate logistic regression analysis, according to which Killip III-IV (OR 7.52, 95% CI 1.25–45.24, $p = 0.03$), lower admission SBP (OR 0.94, 95% CI 0.90–0.98, $p < 0.01$), and increased MPV (OR 1.67, 95% CI 1.05–2.67, $p = 0.03$) were found to be independently correlated with MACEs in the study population (Table 2).

In ROC analysis, an MPV level >9.8 fL predicted MACEs with a sensitivity of 48% and a specificity of 92% (AUC 0.753, $p < 0.01$). This cutoff point had 96% negative predictive value and 30% positive predictive value (Figure 1).

DISCUSSION

The main findings of this study were as follows: 1) in multiple logistic regression analysis admission SBP, Killip class III-IV and MPV were independent predictors of short-term MACEs in young adults with acute STEMI; 2) a low MPV value has an excellent negative predictive value for short-term outcomes; 3) MPV values were inversely correlated with the platelet counts, and 4) female gender was not found as an independent predictor of in-hospital and 30-day MACEs in young patients.

The incidence of coronary heart disease at young age has increased over the last decades, and this condition is predicted to represent an increasingly important cause of morbidity and mortality in the next few years. The underlying pathology of premature atherosclerosis is in need of further explanation in order to define the patients at risk and to provide accurate preventive care to the high risk patients. Clarifying the mechanisms that lead to acute coronary events in young patients with CHD may give us a new perspective for the development of novel population-based approaches to its prevention and therapy.

There are two distinct pathways of plaque injury underlying the thrombotic coronary occlusions responsible for MI. Plaque rupture is the most prevalent form of plaque injury and is defined as the rupture of a thin fibrous cap that leads to exposure of blood to highly thrombogenic plaque components. Inflammation plays a crucial role in precipitating the rupture of the thin fibrous cap and the formation of occlusive thrombi. Macrophages and T lymphocytes are the major determinants of inflammation located in the ruptured plaques and secrete proteolytic enzymes, cytokines, and inhibitors of collagen synthesis. On the other hand, plaque erosion is the second pathway responsible for the development of MI. Plaque erosion is defined as an abrasion of the endothelium overlying a plaque without rupture. It has been demonstrated that the eroded plaques are rich in proteoglycans and smooth muscle cells, containing fewer macrophages and T lymphocytes than the ruptured ones. Plaques with superficial erosions do not cause critical obstruction by themselves.[23] Therefore, plaque erosion-related MI may present with sudden death without warning symptoms before the index event. In these circumstances, coronary occlusions are driven predominantly by a thrombus that develops on the eroded atherosclerotic plaque. Plaque erosion, rather than plaque rupture, is generally more prevalent in younger men and women (<40 and <50 years of age, respectively).[24] In a previous study, patients with plaque erosion were found to be more frequently smokers, but had fewer conventional coronary risk factors (dyslipidemia, HT, chronic kidney disease, and DM) than those with plaque rupture.[25]

Many inflammatory markers, such as CRP, neutrophil-lymphocyte ratio, platelet-to-lymphocyte ra-

TABLE 1. Clinical, angiographic and procedural data of the study patients according to MPV cutoff value 9.8. Data are presented as mean ± SD or n (%)

Characteristic	Total (n = 349)	MPV >9.8 (n = 38)	MPV <9.8 (n = 311)	p value
Demographics and past clinical history				
Age, years	36.4 ± 3.6	35.1 ± 4.6	36.6 ± 3.4	0.01
Men, n (%)	314 (90.0)	32 (84.2)	282 (90.7)	0.21
Obesity (BMI ≥27 kg/m^2)	106 (30.3)	14 (36.8)	92 (29.6)	0.35
Hypertension, n (%)	49 (14.0)	5 (13.2)	44 (14.1)	0.86
Diabetes mellitus, n (%)	46 (13.2)	1 (2.6)	45 (14.5)	0.05
Dyslipidemia, n (%)	43 (12.3)	4 (10.5)	39 (12.5)	0.72
Smoker, n (%)	285 (81.7)	28 (73.7)	257 (82.6)	0.17
Illicit drug use	2 (0.57)	0 (0)	2 (0.6)	0.62
Family history of CHD, n (%)	49 (14.0)	6 (15.8)	43 (13.8)	0.74
Previous coronary disease, n (%)	14 (4.0)	2 (5.3)	12 (3.9)	0.67
Anterior wall infarction, n (%)	202 (57.9)	30 (78.9)	172 (55.3)	<0.01
Killip class ≥3, n (%)	15 (4.29)	5 (13.2)	10 (3.2)	<0.01
Laboratory markers				
Total cholesterol (mg/dL)	184.4 ± 51.8	181.6 ± 44.6	184.8 ± 52.7	0.72
LDL cholesterol (mg/dL)	114.9 ± 42.8	111.3 ± 37.7	115.4 ± 43.4	0.58
HDL cholesterol (mg/dL)	34.5 ± 8.5	38.4 ± 9.6	34.0 ± 8.3	<0.01
Triglyceride (mg/dL)	141 [106.0]	146.5 [95]	139 [106]	0.97
Glucose (mg/dL)	128.8 ± 60.4	120.2 ± 26.1	129.8 ± 63.2	0.35
Creatinine (mg/dL)	0.83 ± 0.29	0.86 ± 0.45	0.83 ± 0.27	0.59
eGFR (mL/min/1.73 m^2)	110.5 ± 16.9	111.2 ± 23.4	110.5 ± 15.9	0.81
MPV admission (fL)	8.0 ± 1.2			
Platelet count (× 1,000/µL)	244.3 ± 65.1	203.3 ± 42.6	249.3 ± 65.6	<0.01
White blood cell count (× 1,000/µL)	12.0 ± 3.7	11.7 ± 3.0	12.1 ± 3.8	0.53
MPV/platelet count (mean ± SD)	0.035 ± 0.012	0.03 ± 0.01	0.05 ± 0.01	<0.01
Peak CK-MB (IU/L)	83 [144.2]	79 [134.2]	83 [146]	0.59
Peak TnI (ng/mL)	22.3 [28.0]	27.6 [26.8]	22 [27.7]	0.41
Previous medication, n (%)				
ACE inhibitor/ARB	21 (6.0)	2 (5.3)	19 (6.1)	0.83
Beta blocker	18 (5.1)	3 (7.9)	15 (4.8)	0.41
Statin	36 (10.3)	5 (13.2)	31 (10.0)	0.54
Aspirin	14 (4.0)	2 (5.3)	12 (3.9)	0.67
Procedural characteristics				
Multivessel coronary disease, n (%)	102 (29.2)	4 (10.5)	98 (31.5)	<0.01
Infarct-related artery, n (%)				
Left anterior descending	210 (60.2)	29 (76.3)	181 (58.2)	0.03
Left circumflex	40 (11.5)	3 (7.9)	37 (11.9)	0.46
Right coronary artery	85 (24.4)	5 (13.2)	80 (25.7)	0.08
Intermediate/diagonal	4 (1.1)	0 (0)	4 (1.3)	0.48
Baseline TIMI flow, n (%)				
0	251 (71.9)	28 (73.7)	223 (71.7)	0.79
1	22 (6.3)	4 (10.5)	18 (5.8)	0.25
2	42 (12.0)	4 (10.5)	38 (12.2)	0.76
3	34 (9.7)	2 (5.3)	32 (10.3)	0.32
Postprocedural TIMI, n (%)				
0	5 (1.4)	3 (7.9)	2 (0.6)	<0.01
1	4 (1.14)	1 (2.6)	3 (1)	0.36
2	14 (4.0)	2 (5.3)	12 (3.9)	0.67
3	326 (93.4)	32 (84.2)	294 (94.5)	0.01

TABLE 1. (continued)

Characteristic	Total (n = 349)	MPV >9.8 (n = 38)	MPV <9.8 (n = 311)	p value
Angiographic no-reflow, n (%)	23 (6.6)	6 (15.8)	17 (5.5)	0.01
Procedural success, n (%)	324 (92.8)	32 (84.2)	292 (93.9)	0.02
Chronic kidney disease, n (%)	9 (2.5)	2 (5.3)	7 (2.3)	0.26
Pain-to-balloon time (h)	180.9 ± 54.0	187.8 ± 54.4	180.1 ± 53.9	0.40
GpIIb/IIIa inhibitor, n (%)	156 (44.7)	18 (47.4)	138 (44.4)	0.72
TIMI thrombus grade IV-V, n (%)	261 (74.7)	32 (84.2)	229 (73.6)	0.15
Thrombus aspiration, n (%)	20 (5.7)	2 (5.3)	18 (5.8)	0.89
Use of stents, n (%)	349 (100)			
Stent length (mm)	23.1 ± 7.0	22.6 ± 7.2	23.1 ± 6.9	0.67
Stent diameter (mm)	3.1 ± 0.4	3.07 ± 0.35	3.1 ± 0.42	0.54
Pain-to-balloon time >4 h, n (%)	51 (14.6)	8 (21.1)	43 (13.8)	0.23
Hospitalization (day)	5.5 ± 3.0	6.1 ± 3.2	5.4 ± 3.0	0.16
Admission heart rate (bpm)	78.1 ± 15.6	86.0 ± 23.8	77.1 ± 14.1	<0.01
Admission anemia, n (%)	44 (12.6)	7 (18.4)	37 (11.9)	0.25
Admission CPR, n (%)	17 (4.9)	4 (10.5)	13 (4.2)	0.08
Admission SBP (mmHg)	127.6 ± 17.7	122.5 ± 26.1	128.2 ± 16.4	0.06
Postprocedural LVEF (%)	47.4 ± 9.9	45.5 ± 13.0	47.7 ± 9.5	0.20
Adverse events (total), n (%)	23 (6.6)	12 (31.6)	11 (3.5)	<0.01
In-hospital prognosis, n (%)				
Re-infarction	8 (2.2)	4 (10.5)	4 (1.3)	<0.01
Mortality	7 (2.0)	4 (10.5)	3 (1.0)	<0.01
Prognosis within 30 days after discharge, n (%)				
Reinfarction	8 (2.2)	5 (13.2)	3 (1)	<0.01
Mortality	0 (0)	0 (0)	0 (0)	

CHD – coronary heart disease; CPR – cardiopulmonary resuscitation; eGFR – estimated glomerular filtration rate; IABP – intra-aortic balloon pump; LVEF – left ventricular ejection fraction; MI – myocardial infarction; PCI – percutaneous coronary intervention; SBP – systolic blood pressure

tio, and monocyte/high-density lipoprotein ratio, have been demonstrated to represent independent predictors of both short-term and long-term outcomes in STEMI patients, without any age restriction.[26–32] In contrast to these previous studies, we have not found any significant association between the mentioned inflammatory markers and short-term prognosis of our patients. Attenuation of the predictive role of systemic inflammatory markers in young STEMI patients may be elucidated based on a detailed analysis by Libby *et al.* who have suggested that plaque erosion induces significantly lower inflammatory response compared with plaque rupture.[33] A previous autopsy study has found that there were fewer macrophages and T lymphocytes within the vessel wall of the patients with plaque erosion.[34] Although it has not yet been revealed in contemporary studies, we suppose that there may be a direct causal relationship between plaque morphology and blood biomarkers. Several studies were conducted to investigate the existence of any association between plaque complication type and the blood biomarkers of inflammation. In a previous optical coherence tomography (OCT)-guided study, Niccoli *et al.* have found that serum matrix metalloproteinase-9 and CRP levels were independently associated with plaque rupture in patients with non-STEMI.[35] Nonetheless, another OCT-guided study conducted by Ferrante *et al.* found no significant differences between CRP levels of ACS patients, who were divided into two groups according to the type of plaque complication – rupture or erosion.[36] Similarly, there were no significant differences between the morphology of the culprit plaque and analyzed blood biomarkers of inflammation and platelet activation in a recent study.[37] A very recent review has suggested that the widespread deployment of distinct strategies for the management of ACS (because of erosion versus rupture) could benefit enormously from the development and validation of biomarkers that indicate the underlying pathophysiology of ACS.[33]

In the present study, increased MPV was identified as an independent predictor of short-term outcome. Plate-

TABLE 2. Multivariate analysis showing independent predictors of MACEs

Variables	Adjusted OR (95% CI)	p value
Angina onset-to-balloon time	1.003 (0.99–1.01)	0.59
Heart rate	1.025 (0.98–1.07)	0.28
Admission CPR	1.43 (0.11–1.76)	0.77
LVEF	1.01 (0.95–1.08)	0.67
Killip class III-IV	7.52 (1.25–45.24)	0.03
Platelet count	0.99 (0.97–1.00)	0.11
MPV	1.67 (1.05–2.67)	0.03
Procedural success	1.51 (0.06–3.94)	0.88
No-reflow phenomenon	2.47 (0.09–6.51)	0.75
Anterior MI	1.49 (0.36–6.12)	0.43
Admission SBP	0.94 (0.90–0.98)	< 0.01

CI – confidence interval; CPR – cardiopulmonary resuscitation; IABP – intra-aortic balloon pump; LVEF – left ventricular ejection fraction; MI – myocardial infarction; MPV – mean platelet volume; OR – odds ratio; SBP – systolic blood pressure

lets are involved in all stages of atherosclerosis and have a profound influence on the pathogenesis of plaque-related complications. In particular, platelets are one of the most important components of the blood coagulation cascade which is initiated by plaque injury. Following plaque injury, exposure of the thrombogenic plaque components to the cellular elements of the blood stream results in platelet activation and thrombus formation. Excessive thrombus burden is an important determinant of prognosis in STEMI.[38] Platelet size is a well-known determinant of platelet function and activation.[39] MPV, a measure of platelet size, is an inexpensive and simple biological marker of platelet function. Studies investigating antiplatelet activity have found increased platelet turnover in the acute phase of STEMI in patients undergoing PCI.[40,41] Platelet size is determined at the level of progenitor cells as a consequence of cytokine activity, such as interleukin-3 and interleukin-6, which may lead to the production of larger and more reactive platelets via a complex mechanism that influences megakaryocyte ploidy.[42,43] The newly generated larger platelets, namely the reticulated platelets, are generally more active than the mature ones. Hence, platelet hyperreactivity may contribute to the increased risk of atherothrombotic complications. Several studies have accordingly suggested that MPV may be used as a prognostic biomarker of short- and long-term adverse events in patients with STEMI.[44,45] To our knowledge, no study has yet focused on MPV in young adult patients with STEMI as a predictor of poor short-term outcome. After identifying MPV as a strong predictor of short-term MACEs in our young population, we speculate that the predominance of thrombotic milieu, characteristic of plaque erosion, may indicate the importance of platelet hyperreactivity-associated markers such as MPV in young patients with coronary occlusion. The presence of highly hyperreactive platelets may lead to an increased risk of atherothrombotic complications during the short-term follow-up of young patients with STEMI.

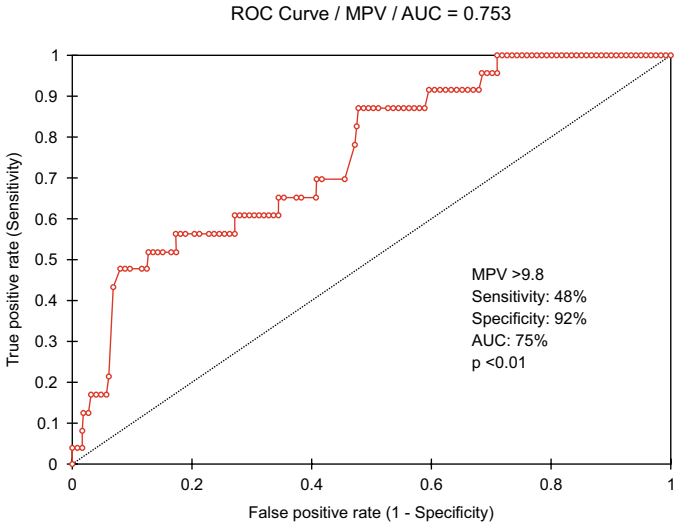

FIGURE 1. The receiver-operating characteristics (ROC) curve analysis representing the cutoff value for mean platelet volume to predict short-term major adverse cardiovascular events in the study population

STUDY LIMITATIONS

This was a retrospective study from one center with a limited number of patients and carries the well-known limitation of the retrospective design. Especially, low MACE rates related to the limited number of study participants was the most important limitation of our study. Moreover, it should be highlighted that the statistical multivariate models used in this study might have been affected by the low number of events encountered among young adults. Also, the lack of intravascular imaging modalities such as OCT limited our knowledge in respect to the plaque characteristics. Thus, our discussion, which was based on the presumption of "more frequent plaque erosion in young adult patients" is unable to go beyond an assumption. Moreover, the shortage of data regarding inflammatory markers, such as matrix metalloproteinases, myeloperoxidase, and interleukins, can be added as another limitation of our study. Due to these limitations, the present study may serve as a hypothesis-generating research and these findings should be confirmed in a larger and adequately powered prospective cohort study.

CONCLUSION

Despite increasing knowledge about the pathology of the atherosclerotic process and the importance of preventive measures, premature cardiovascular events appear to be increased especially in low- and middle-income regions over the last years. Although predictors of short-term outcome in the general population with STEMI were clearly defined in several previous studies, there is a gap in the existing literature in respect to the predictors of short-term MACEs in young individuals who presented with STEMI. In the present study, Killip class III-IV, admission SBP, and MPV were strongly related to subsequent cardiac mortality and reinfarction in 30 days. Although inflammatory markers are well-known predictors of short-term prognosis in unrestricted populations, only MPV, which is a marker of more thrombogenic and active platelets, was identified as a predictor of short-term outcome in our study population.

CONFLICT OF INTEREST

Nothing to declare.

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