

Role of platelet parameters and haematological indices in myocardial infarction and unstable angina

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Abstract

Objective: To explore the significance of platelet parameters, including mean platelet volume, platelet count and other haematological indices, in patients of acute coronary syndrome.

Methods: In this one-year retrospective cross-sectional study in 2010, a total of 631 patients were enrolled at the Cardiovascular Research Institute, Tabriz University of Medical Sciences, Iran, and classified into three groups: myocardial infarction, unstable angina, and Control. Cardiovascular risk factors such as smoking, diabetes mellitus, hyperlipidaemia and hypertension status were compared. Blood samples were collected for the measurement of platelet count, mean platelet volume and other haematological indices, including prothrombin time, partial thromboplastin time, blood group and Rh, haematocrit, haemoglobin, and erythrocyte sedimentation rate. SPSS 18 was used for statistical analysis.

Results: Of the total, there were 210 (33.3%; 163 men, 47 women) with myocardial infarction whose mean age was 62.7 ± 14.2 years; 211 (33.3%; 110 men, 101 women) had unstable angina with a mean age of 63.5 ± 13.1 years and 210 (33.3%; 117 men, 90 women) health controls with a mean age of 60.6 ± 12.8 years. The mean platelet volume values of patients in the first two groups were significantly higher than the control group (10.14 ± 1.05 fL, 9.82 ± 0.93 fL and 9.34 ± 1.14 fL, respectively; $p < 0.001$). The platelet count was detected to be significantly lower in the patients than the controls ($207.92 \pm 58.40 \times 10^9/L$, $220.18 \pm 65.81 \times 10^9/L$, $238 \pm 56.10 \times 10^9/L$, respectively, $p < 0.001$). While blood cell count was significantly higher in those with myocardial infarction compared to the unstable angina patients and control group ($P < 0.001$). Differences in mean values of mean platelet volume between the two patient groups was not significant, but mean values of platelet count was statistically significant between these two groups ($p < 0.04$).

Conclusion: Mean platelet volume and platelet count may be considered prognostic markers for acute coronary syndrome.

Keywords: Platelet count, Mean platelet volume, Acute coronary syndromes, Hematological indices. (JPMA 63: 1133; 2013)

Introduction

Platelets play role in the pathogenesis of cardiovascular disorders, including atherosclerosis and its complications, such as unstable angina (UA) and myocardial infarction (MI). Thrombus is major cause of acute coronary syndromes (ACS) and platelets play an important role in developing intravascular thrombus. Because it was well proved that platelets play a central role in both initiation and propagation of ACS, prevention and treatment of platelets is important; the use of aspirin started several years ago. More recently, researchers have achieved useful results by blockade of the final common pathway in platelet aggregation.¹

Patients with ACS need a therapy with an effective anti-platelets.² Platelet activation can be detected by changes

of plasma concentration in platelet counts (PC). At the same time, myocardial ischaemia and local destruction of cardiomyocyte lead to the increase troponin I concentration.³

Markers of platelet activation and haematological indices have been demonstrated to play a role in the pathophysiology of atherosclerosis and cardiovascular events. It has been shown that the mean platelet volume (MPV) is the most accurate measurement of the size of platelets, associated with platelet count, inversely. There is evidence that demonstrate MPV is an important biological variable and larger platelets have higher thrombotic potential. Platelet size has been shown to reflect platelet activity.⁴ Large platelets are metabolically and enzymatically more active than small platelets and platelet activation is measured via MPV.⁵

Risk factors such as smoking, diabetes mellitus, hypertension, hyperlipidaemia, mental stress, and obesity, acting either individually or in combination

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significantly play role in increasing the chances of coronary atherosclerosis. The PC and MPV were determined by automated cell counters that are routinely available in most clinical laboratories.

Studies have shown MPV, as an indicator of platelet activation, suggesting enhanced values in patients with ACS and MI.⁶ Finding in a study in Iran confirmed that not only could on-admission MPV predict impaired reperfusion and in-hospital cardiac events in acute ST segment elevation myocardial infarction (STEMI) patients treated with percutaneous coronary intervention (PCI), but also it could be considered a practical way to determine higher-risk patients.⁷

The MPV and mean platelet component in cardiovascular disease (CAD) have been subjects of numerous researches, because it is controversial, and the review of recent literature shows this parameter to be an independent predictive factor for the progression of CAD. Recent reports did not confirm a correlation between the MPV and platelet hyper-aggregability nor a mean platelet component as a marker of an enhanced platelet activation.

The aim of this study was to assess the role of MPV, PC, white blood cell (WBC) and other haematological indices like haemoglobin (Hb), haematocrit (Hct) and erythrocyte sedimentation rate (ESR) in hospitalised patients with ACS and MI and to find out a correlation.

Patients and Methods

The retrospective cross-sectional hospital-based study was carried out on 631 patients over a period of one year in 2010 at the Cardiovascular Research Centre, Tabriz University of Medical Sciences, Iran. Institutional ethical committee clearance was obtained and so was informed consent.

Samples were selected from hospitalised patients with diagnosis of ACS who were hospitalised within the first 24 hours of their chest pain into coronary care. Diagnosis of ACS was made by assessing unstable chest pain, typical electrocardiographic (ECG) changes and/or elevation of cardiac enzymes.

The data of 631 consecutive patients from their medical records with the diagnosis of non-ST elevation (NSTE) ACS who were hospitalised within the first 24 hours of their chest pain into coronary care were collected. Patients were classified into three groups. Group A: patients with MI; Group B: patients with UA; and Group C: healthy controls with no history of heart disease and a normal electrocardiogram.

Patients were considered in sub-groups depending on

smoking status and if they had or did not have diabetes mellitus (DM), hyperlipidaemia and hypertension. Hypertension was diagnosed as blood pressure above 140/90mmHg or being on anti-hypertensive therapy. DM was diagnosed as fasting blood glucose above 125mg/dl or being on anti-diabetic drugs. Patients who were smoking before hospitalisation were accepted as smokers. Patients with severe hepatic or renal impairment were excluded. Patients with more than 24h of unstable chest pain and patients who were received anti-coagulant, anti-platelet or anti-inflammatory drugs, that might interfere with the interpretation of results, at least 5 days before blood sampling were excluded. Patients were followed up in the coronary care unit (CCU) and treated by doctors who were blinded to the study. Before the administration of anti-platelet or anti-coagulant drugs, except aspirin, blood samples were collected for prothrombin time (PT), partial thromboplastin time (PTT), blood group and Rh, Hct, Hb, ESR, PC and MPV determination through the brachial vein during hospitalisation into tubes with ethylenediaminetetraacetic acid (EDTA). Samples were studied within 20 min with an automated cell counter (Sysmex Kx-212N, Japan).

Values were expressed as mean±standard deviation. The means of continuous variables were compared with independent samples t-test (between two groups MI and UA) and the one way analysis of variance (ANOVA) test (among the three study groups). Chi-square tests were used to compare categorical variables, such as status of smoking, diabetes, gender, hyperlipidaemia and hypertension. All of the tests were two-tailed; $p \leq 0.05$ was considered statistically significant. SPSS 18.0 was used for data analysis.

Results

Of the total, there were 210 (33.3%; 163 men, 47 women) with myocardial infarction whose mean age was 62.7 ± 14.2 years; 211 (33.3%; 110 men, 101 women) had unstable angina with a mean age of 63.5 ± 13.1 years and 210 (33.3%; 117 men, 90 women) health controls with a mean age of 60.6 ± 12.8 years.

Risk factors in patients with MI and UA were compared (Table-1). There were a significant relationship between gender, DM, number of diseased vessels, hypertension, smoking and hyperlipidaemia and type of diseases of MI and UA. There was no association between blood group, Rh and type of disease.

The mean WBC, PT and PTT was significantly raised in the groups A and B compared with controls (Table-2). There were significant difference in mean of ESR (1 and 2 hours)

Table-1 Comparison of clinical and cardiovascular risk factors between MI and UA groups.

Groups	MI Group (n =210)	UA Group (n =210)	P
Sex(female/male)	47/163	101/110	0.001
Diabetes mellitus	31 (14.8%)	62(28.4%)	0.001
Current smokers	64(30.5%)	39(18.5%)	0.004
Hyperlipidaemia	31(14.8%)	54(25.6%)	0.006
Hypertension	89(42.4%)	118(55.9%)	0.005
No. of diseased vessels:*			
1V	17	0	0.014
2V	28	4	
3V	28	6	
4V	25	13	
Blood group*:			
O	63	74	0.423
A	78	68	
B	39	39	
AB	22	15	
Rh(Positive/Negative)	179/22	174/21	0.955

MI: Myocardial infarction, UA: Unstable angina.

*Total number of patients in these two parameters were less than 210 or 211.

and PT and PTT between groups A and B ($p < 0.001$). ESR (1 and 2 hours) was raised in group B compared to the control group.

WBC was significantly raised in the MI group compared to the UA and control groups ($p < 0.001$). There was no relationship between WBC and age and smoking status. The means of Hb ($p < 0.001$) [but not Hct ($p < 0.053$)] decreased significantly in groups A and B compared to the control group.

The mean of MPV was significantly raised in groups A and B compared to the control group (10.14 ± 1.05 , $9.82 \text{ fL} \pm 0.93 \text{ fL}$, $9.2 \pm 0.96 \text{ fL}$, respectively; $p < 0.001$). There was no

significant difference in mean MPV between groups A and B ($p < 0.151$). A significant difference was seen when the mean PC was compared between the groups A and B with the control group ($207.92 \pm 58.40 \times 10^9/\text{L}$, $220.18 \pm 65.81 \times 10^9/\text{L}$, $238 \pm 56.10 \times 10^9/\text{L}$, respectively; $p < 0.001$) and significant difference was seen in mean PC between groups A and B ($p < 0.048$). Mean PC in UA patients was higher than in MI patients. There was no relationship between mean MPV and gender and no correlation was seen between the MPV and hb and Hct values.

Discussion

In ACS, rupture of unstable atherosclerotic plaque triggers a thrombogenic cascade leading to clinical events. However, platelet reactivity is critically important in the formation and propagation of intracoronary thrombus.⁸ MPV, one of the markers indicating the function of platelets, is a simple and easy measurement.⁵

This study recruited 631 patients with a mean age of 63.08 ± 13.65 years, which was 8 years more than the mean age of the patients in the Vakili H study in Iran in 2009,⁷ but in accordance with Huczek study.⁹ Besides 64.84% of our patients were men, and this percentage was almost similar to that in other studies on the correlation between MPV and ACS (70-80%). Distribution of risk factors was similar to that in another study carried out specifically on the relation between the risk factors of ACS and MPV.⁶

In some studies results failed to demonstrate a difference in mean PC between patients with CAD and those with normal coronary arteries.⁹ This study found that MPV was raised in patients who had suffered an acute coronary event compared with controls. This is in agreement with the results of similar studies.^{7,8,11-14}

Chu H et al in 2011 showed MPV is significantly associated with ACS in patients with acute chest pain and is an early

Table-2: Comparison of haematological parameters between MI and UA and in three study groups, separately.

Groups	MI Group (n =210)	UA Group (n =210)	p value (Between MI & UA)	Control (n=210)	p value (Among 3 groups)
Hb (gr/dL)	13.66±2.10	12.96±2.04	0.001	14.24±8.68	0.053
Hct (%)	41.23±5.61	39.28±5.41	<0.001	41.55±5.73	<0.001
WBC ($\times 10^9/\text{L}$)	10.47±3.75	8.54±3.24	<0.001	6.49±1.81	<0.001
ESR (1 hours)	8.42±7.17	27.83±26.84	0.001	6.10±4.94	<0.001
ESR (2 hours)	14.37±13.53	40.07±37.04	0.001	11.38±9.17	<0.001
PT (sec)	17.82±9.74	14.30±9.33	<0.001	11.30±0.27	<0.001
PTT (sec)	42.18±22.27	47.04±33.72	0.083	35.97±4.89	0.009
PC ($\times 10^9/\text{L}$)	207.92±58.40	220.18±65.81	0.048	238.3±56.1	<0.001
MPV (fL)	10.14±1.05	9.82±0.93	0.151	9.34±1.14	<0.001

MI: Myocardial infarction, UA: Unstable angina, PT: Prothrombin time, PTT: Partial thromoplastin time, Hct: Haematocrit, Hb: Haemoglobin, WBC: White blood cell, ESR: Erythrocyte sedimentation rate, MPV: Mean platelet volume, and PC: Platelet count.

and independent predictor.¹⁵ Chu SG et al. review demonstrated that elevated MPV is associated with acute MI, mortality following MI, and restenosis following coronary artery intervention.¹⁶

Some studies have shown higher MPV values in patients with UA than those with MI,¹⁷ but our study found no such difference which compares well with a study by Senaran et al.¹⁸ PC was significantly lower in our MI and UI patients compared with the controls which was in agreement with other studies.^{3,19,20}

In our study PC was higher in UA patients than MI patients, whereas Mathur et al. in 2001 showed MPV was higher in UA patients than in those diagnosed with MI and PC was lower in UA than in MI.¹⁶ Avramakis et al's study in 2007 showed that MPV was significantly raised in all MI and UI patient groups except in DM; non-smokers with UA or MI.²⁰

In this research UA and MI patients had significantly higher WBC counts compared to the controls and is similar to most other studies such as Avramakis et al's study.²⁰ Besides, in our study, in MI patients group significantly higher WBC were observed than in UA group and controls. We suggest the association of an immunologic process in coronary disease that is similar to other studies.²¹ Libby et al. reported that higher baseline WBC counts were associated with greater extent of CAD.²²

There is some evidence to suggest that inflammation and the WBC itself may directly contribute to coronary thrombosis, impaired perfusion, and reperfusion injury.²³ Enhanced MPV has been reported in subjects with cardiovascular risk factors, such smoking,⁶ hypertension,²⁴ DM,²⁵ obesity,²⁶ and hypercholesterolaemia,²⁷ suggesting a common mechanism by which these factors may increase the risk of cardiovascular disease. Our study is in agreement with literature.

Our study showed significant difference in mean Hb and Hct between MI and UA patients, also controls unlike the Yilmaz⁴ and Khandekar⁶ studies. Also, significant difference were seen in means of ESR1 and ESR2, PT between MI and UA patients as well as compared to control group, but difference of PTT was not significant.

Yilmaz et al. study⁴ demonstrated MPV was not associated with the number of diseased vessels which was in contrast with the Yang et al study.²⁹ In Cooke et al's study there was no relation between mean PC and severity of CAD.¹⁰

In our study, MPV increased significantly in MI patients compared to the controls, and PC in MI patients was

significantly lower than in UA patients and controls, alike.^{6,12,19}

Most studies suggest MPV to be associated adversely with PC. One study showed that an increase in MPV was inversely correlated with platelet count.¹¹

Our study showed that difference in MPV between MI patients and UA patients was not significant, like Khandekar et al. in India, but contrary to Yilmaz et al.⁴ In our study, difference of mean PC between MI and UA patients was significant, and in agreement with Yilmaz et al.⁴ In the Khandekar et al. study,⁶ it was not significant. PC between MI patients and controls is significant like the Khandekar study, while MPV was significantly higher in ACS group compared to the controls.

Our data demonstrated that the increased MPV contributes to the prethrombotic state in acute ischaemic syndromes. Whether the relationship is causal, and whether MPV should influence practice or guide therapy, remains unknown. Various drugs, including losartan and lipid-lowering therapies may reduce MPV, but no study to date has shown that lowering MPV reduces cardiovascular risk.²⁹

Further studies are needed to evaluate whether MPV provides added value in identifying patients at enhanced clinical risk and whether therapeutic modification of this marker may lead to improved cardiovascular care.

Conclusion

High MPV could be a risk factor for ACS and MI. Since MPV measurement is a simple, feasible, economic and practical method, it should be considered along with other conventional risk factors in ACS.

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