# Evaluation of Platelet Parameters in Patients With Coronary Artery Disease

**Mahdieh Mehrpouri[1], Afshin Ahmad Pour[2], Esmail Shahabi Satlsar[3]**

[1] *Department of Laboratory Sciences, School of Allied Medical Sciences, Alborz University of Medical Sciences, Karaj, Iran*

[2] *Department of Cardiology, School of Medicine, Taleghani General Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran*

[3] *Department of Laboratory Sciences, School of Allied Medical Sciences, Guilan University of Medical Sciences, Langroud, Iran*

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**Abstract-** Coronary artery disease (CAD) is one of the leading causes of death worldwide; therefore, identifying new risk factors to predict the severity of the disease is thought to be associated with mortality reduction. In an effort to investigate whether platelet parameters are related to the extent of CAD and can be considered as risk factors, we designed experiments to evaluate platelet parameters in these patients. In a cross-sectional study, sixty-nine patients with CAD (including fifty-two patients with acute coronary syndrome and seventeen patients with stable angina) and sixty-four healthy volunteers were evaluated for platelet count, mean platelet volume (MPV), and platelet distribution width (PDW). Echocardiography, electrocardiogram (ECG), and coronary angiography were conducted as well. Results showed significantly higher values for MPV and PDW in patients with acute coronary syndrome as compared to patients with stable angina and healthy volunteers ($P$<0.001 and $P$=0.009, respectively). There was no significant difference in platelet count between patients and healthy volunteers ($P$=0.379). Our results also revealed a significant difference in the ejection fraction (EF) percentage between the three groups ($P$=0.008). Investigating the correlation between platelet parameters and EF percentage, ECG changes, and the results of coronary angiography did not show any significant association. The present study showed that the elevated levels of MPV and PDW in patients with CAD are not related to the extent of coronary artery disease, which was estimated by echocardiography, ECG changes, and coronary angiography. Thus, these parameters cannot be considered as risk factors for coronary artery disease.



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**Keywords:** Platelet count; Mean platelet volume (MPV); Platelet distribution width (PDW); Coronary artery disease (CAD); Acute coronary syndrome; Stable angina

## Introduction

Coronary artery disease (CAD) is one of the leading causes of death (1) and accounts for 1 in 7 deaths in the United States (2). Several risk factors are associated with the incidence of CAD, including age, gender, having diabetes mellitus, hypertension, dyslipidemia and family history of CAD (metabolic syndrome), smoking, increased blood fibrinogen level, elevated white blood cell count, insufficient exercise, suffering from stress and being obese (3). Defining new risk factors that predict the degree and severity of CAD is thought to be associated with a reduction in morbidity and mortality of the disease (4). Circulating platelets play a central role in the pathogenesis of coronary artery disease (5), as platelet activation and aggregation at sites of disrupted vascular endothelial caused by atherosclerosis are crucial events leading to arterial thrombosis (6). Therefore antiplatelet therapy has a fundamental role in the management of patients with CAD (7). Platelet count, mean platelet volume (MPV), and platelet distribution width (PDW) are a group of platelet parameters that are easily obtained as a part of automatic complete blood count (8). MPV and PDW measure platelet volume and variability in platelet size, respectively, and are accurate indicators of platelet activation (5,9). Previous studies suggest that besides well-known risk factors, platelet indices may represent additional risk factors for myocardial infarction (10). Although several studies have compared platelet count, MPV, and PDW between patients with CAD and control groups, this assumption is still controversial. In an effort to investigate whether platelet parameters are related to the extent of CAD and can be considered as risk factors, we designed experiments to evaluate platelet count,

**Corresponding Author:** M. Mehrpouri
Department of Laboratory Sciences, School of Allied Medical Sciences, Alborz University of Medical Sciences, Karaj, Iran
Tel: +98 2634349802, Fax: +98 2634349802, E-mail address: mahdiyemehrpoori@gmail.com

MPV, and PDW in these patients.

## Materials and Methods

The present study was designed as a prospective cross-sectional study, which included sixty-nine patients with CAD who were admitted to Ayatollah Taleghani hospital, Tehran, Iran, from November 2018 to February 2019. Before any analysis, patients were classified into acute coronary syndrome (ACS; n=52) and stable angina (SA; n=17). As defined by Alvitigala *et al*., ACS includes unstable angina pectoris (UA), non-ST-segment elevated myocardial infarction (NSTEMI), and ST-segment elevated myocardial infarction (STEMI). Accordingly, the inclusion criteria of this study were based on the American College of Cardiology and the European Society of Cardiology guidelines, including chest pain and new or presumably new electrocardiogram (ECG) alterations (11). This study was conducted following the ethics committee approval of Shahid Beheshti University of Medical Sciences (IR. SBMU. RETECH.REC. 1397.742), and informed consent forms were obtained from all patients in accordance with the Helsinki deceleration. The exclusion criteria include diseases that affect platelet number and platelet indices, including malignancy, prior blood transfusion, idiopathic thrombocytopenic purpura (ITP), aplastic anemia, and other diseases that have evidence of inflammation, infection, or autoimmune disorder. Sixty-four age-and-sex-matched healthy volunteers with no history of coronary artery disease were also involved as normal controls.

Blood samples (2 ml) were collected from each patient and control individuals and poured into a vacutainer tube containing K2EDTA (Becton Dickinson). Platelet count, MPV, and PDW indices were analyzed immediately after blood collection using an automated cell counter (Sysmex KX21-N; Sysmex Corporation, Kobe, Japan) at the laboratory of Ayatollah Taleghani hospital. Correlation analysis between platelet count and platelet indices was also evaluated.

Ejection fraction (EF) percentage, which is an indicator of systolic left ventricular function, was determined by echocardiography in the cardiology department of Ayatollah Taleghani hospital. The correlation between EF percentage and platelet parameters (platelet count, MPV, and PDW) was also evaluated. We also investigated the association between the initial ECG obtained on admission and platelet count as well as platelet indices in all patients. To evaluate the extent of coronary occlusion, we applied coronary angiography in the cardiology department of Ayatollah Taleghani hospital. At least one coronary stenosis, more than 50%, was essential for the diagnosis of coronary artery disease (CAD).

Statistical analysis was performed using SPSS software (version 21). The results were presented as mean value±the standard deviation. The normal distribution of the variables was assessed by the Kolmogorov-Smirnov test. One way ANOVA was used for comparing the three groups, including control, ACS, and SA. Pearson's correlation test was used to determine the correlation between two continuous variables. $P< .05$ was considered statistically significant.

## Results

Demographic characteristics of patients with ACS, patients with SA, and healthy volunteers are shown in Table 1. The mean age of patients with ACS and SA was 58.06±10.3 years and 58.82±13.7 years, respectively, while the mean age of healthy volunteers was 57.53±16.4 years ($P$=0.1). Platelet count, MPV, and PDW are shown in Table 2. As shown in Figure 1, our results showed significantly higher values for MPV and PDW in patients with ACS compared with SA patients and healthy volunteers ($P$<0.001 and 0.009, respectively). It was also shown that there was no significant difference in platelet count value between patients with ACS, SA, and healthy volunteers ($P$=0.379). Investigating the correlation between platelet count and platelet indices in CAD patients showed a significant negative correlation between platelet count and MPV (r=-0.550; $P$<0.001) and also between platelet count and PDW (r=-0.450; $P$<0.001). A significant positive correlation was also observed between MPV and PDW (r=0.744; $P$<0.001). Echocardiography revealed a significant difference in EF percentage between the three groups ($P$=0.008) by which the ACS group had the lowest EF percentage (48±12.5) compared with the stable angina group (53.5±4.7) and healthy volunteers (58.4±2.4). Exploring the correlation between EF percentage and platelet parameters showed no significant association (data not shown), indicating that EF percentage does not affect platelet indices. Moreover, patients were sub-classified into following categories based on ECG records: normal (No ST-T change) (n=20), ST elevation (n=16), ST depression (n=28), and inversion (n=5). We did not find any significant difference in platelet parameters between these four groups ($P$>0.05, data not shown).

Following coronary angiography, patients were divided into five groups according to the extent of

coronary artery occlusion, including patients with 0 vessel CAD (n=10), 1 vessel CAD (n=18), 2 vessel CAD (n=13), 3 vessel CAD (n=23), and patients with coronary arterial ectasia (n=5). The resulting data found no significant difference in platelet count, MPV, and PDW between patients with or without coronary artery occlusion as well as patients with various degrees of coronary artery occlusion (data not shown), and similar values of platelet parameters were observed in these groups.

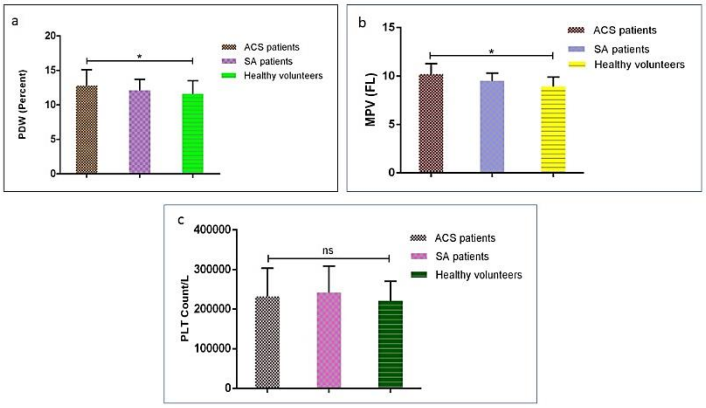


**Figure 1.** Mean of platelet parameters in patients with CAD. Mean of MPV (a), and PDW (b) showed significantly higher values in ACS patients (*$P$ < 0.01); (c) There was no significant difference in mean of platelet count in ACS patients, SA patients, and healthy volunteers (ns $P$>0.05)

**Table 1. Demographic characteristics in three groups**

| | ACS patients (n=52) | SA patients (n=17) | Healthy volunteers (n=64) |
|---|---|---|---|
| **Age (mean±SD)** | 58.06±10.3 | 58.82±13.7 | 57.53±16.4 |
| **Gender (male/female)** | 40/12 | 11/6 | 39/25 |
| **Hyperlipidemia (yes/ no)** | 10/42 | 4/13 | 6/58 |
| **Hypertension (yes/ no)** | 23/29 | 6/11 | 2/62 |
| **History of CAD in Family (yes/ no)** | 7/45 | 2/15 | 4/60 |
| **Smoking (yes/ no)** | 14/38 | 2/15 | 5/59 |

**Table 2. Comparison of platelet count and indices in three groups**

| | ACS patients (n=52) | SA patients (n=17) | Healthy volunteers (n=64) | *P* |
|---|---|---|---|---|
| **Platelet count (mean±SD)** | 231980±71071 | 241940±66666 | 221060±48986 | 0.379 |
| **MPV (mean±SD)** | 10.2±1.1 | 9.5±0.8 | 8.9±1 | <0.001 |
| **PDW (mean±SD)** | 12.8±2.3 | 12.1±1.6 | 11.6±1.9 | 0.009 |

## Discussion

Coronary artery disease is a major cause of mortality and morbidity worldwide (12). Since traditional risk factors are not always responsible for all cases of CAD, therefore identifying new risk factors may help in predicting CAD. Platelets play a fundamental role in every spectrum of CAD (13). Platelet count, MPV, and PDW are routine low-cost tests that are measured as part of the complete blood counts and are simple methods to evaluate platelet function (14). The present study was conducted to investigate the relationship between platelet parameters and coronary artery disease in order to evaluate them as CAD risk factors. It has been shown that platelets with higher MPV are metabolically and enzymatically more active than small platelets (9). Interestingly, the present study showed that patients with ACS have significantly higher MPV values when compared to patients with SA and healthy volunteers. In accordance with our data, SC Costa *et al.*, and Lippi *et al*., observed significantly higher MPV values in the ACS group in comparison to the control group (15,16). Rodrigues *et al*., also observed that all patients with coronary artery disease had an elevated MPV compared

with normal controls. It is supposed to be due to higher platelet consumption in coronary arterial diseases that stimulates the production of larger platelets with increased MPV (17).

Platelet distribution width (PDW) evaluates the variability in platelet size (18). We found higher PDW value in patients with ACS as compared to stable angina and healthy volunteers. This observation has been confirmed previously by other studies in which elevated PDW was found in patients with ACS compared with control group (15). In this regard, study of Biswajit Majumder *et al*., indicated that PDW was significantly higher in patients with ACS than patients with SA and control subjects (19). Furthermore, our results demonstrated a positive correlation between MPV and PDW values in CAD patients. Our findings are consistent with other studies, such as those by Alvitigala et al. and Aydogan *et al.*, (12,20).

We did not observe any significant difference in platelet count among ACS, SA and control groups. This finding is similar to prior studies demonstrating that platelet count exhibits no difference in CAD patients (21). Controversially, in the study of Ranjith *et al*., they showed that platelet count was significantly lower in patients with acute coronary syndrome as compared to those with stable angina and normal population (22).

Investigating the correlation between platelet count, MPV, PDW and EF percentage, ECG changes and coronary angiography didn't show any significant association. Supporting our data, De Luca *et al*., indicated that MPV and PDW were not associated with the extent of coronary artery disease (18,23). Several proposed explanations for these findings have been put forward. Previous studies have shown that platelet indices are increased in patients with diabetes mellitus (24) and obesity (25); therefore, it seems that they are associated with other prognostic factors rather than direct effects of CAD. Moreover, Senaran *et al*., showed that thrombopoietin (key thrombopoietic hormone) is increased in patients with CAD and possesses a positive correlation with MPV (26). Consequently, increased size of platelets in CAD patients may not imply platelet hyperactivity.

The present study showed that though MPV and PDW were higher among patients with ACS but elevated levels of these parameters are not related to the extent of coronary artery disease which was estimated by echocardiography, ECG changes and coronary angiography. Thus, these parameters cannot be considered as risk factors for coronary artery disease in patients with CAD.

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