

Mean Platelet Volume in Patients of Acute Coronary Syndrome

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Abstract

Objective: The purpose of our study was to assess the accuracy of elevated mean platelet volume (MPV) as an independent diagnostic marker for acute coronary syndrome (ACS).

Methodology: This descriptive cross-sectional study was conducted in the Department of Hematology in collaboration with the Department of Cardiology (CCU) at Fauji Foundation Hospital Rawalpindi, from December 2017 to June 2018. The Coronary Care Unit (CCU) records of 100 ACS patients admitted to FFH Rawalpindi were reviewed. All collected data were entered into SPSS version 17. Mean and standard deviation were calculated for quantitative variables, such as MPV and age. An independent sample t-test was used to compare effect modifiers like age and gender, with statistical significance set at $p < 0.05$.

Results: A total of 100 patients were enrolled, with a mean age of 57.06 ± 9.95 years for males and 56.0 ± 9.48 years for females. There were 17 (17%) male and 83 (83%) female patients. The mean platelet volume was found to be higher among ACS patients (10.736 ± 0.89 fl). The mean MPV in patients aged ≤ 55 years was 10.63 ± 0.97 , while in patients aged > 55 years it was 10.82 ± 0.81 . The mean MPV for male patients was 10.44 ± 0.72 , and for female patients, it was 10.80 ± 0.91 . No significant difference was observed in mean MPV between genders or age groups ($p > 0.05$).

Conclusion: The study concluded that MPV significantly increases in patients with acute coronary syndrome and may serve as a potential diagnostic marker in such patients.

Keywords: MPV, ACS, cardiovascular disease (CVD)

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Introduction

Despite recent advances in its diagnosis and treatment, acute coronary syndromes (ACS) remain a leading cause of morbidity and mortality throughout the world.¹ Cardiac diseases have been recognized as the leading cause of death since the early 20th century. Atherosclerosis, primarily driven by platelet activity, is the main cause of ACS. Therefore, mean platelet volume (MPV) might serve as a novel biomarker for predicting or diagnosing the condition.^{1,2} MPV is a measurement of platelet size and is positively related to platelet thrombotic tendency.³ It is a routinely calculated parameter as a part of complete blood count by most of the automated hematology analyzers. Normal range is given as 7.2-11.5 femtolitres(fl).⁴ There are increasing data supporting association of MPV with Acute Coronary Syndrome.⁵ ACS is the constellation of

signs and symptoms due to dislodging of coronary arterial platelet-rich thrombus causing myocardial ischemia.³ Despite remarkable advancements in diagnostic modalities, diagnosis of acute coronary syndrome is still challenging. Higher MPV indicates larger and more thrombogenic platelets which are associated with myocardial damage in ACS and is bad prognostic marker in survivors of acute myocardial infarction.⁶ During the acute coronary event, there is increased rate of consumption of platelets at atherosclerotic plaque site resulting in release of large sized platelets from bone marrow. This process leads to activation of signaling pathway resulting in change in shape and size of the platelets. These activated platelets secrete more thromboxane A₂ into the circulation. The larger platelets have more adhesive properties than the smaller ones.^{7,8}

MPV is a simple and cost-effective laboratory measurement that can be used together with other laboratory tests for early detection of ACS. MPV can also help in reduction of hospitalization of patients with chest pain of non-cardiac origin, preventing misdiagnosis and

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Results

stratifying cardiovascular risk.⁹ Understanding the accuracy of elevated MPV as an independent diagnostic marker for ACS may provide various benefits. It may offer a low-cost and easily accessible tool for early identification, perhaps improving patient outcomes through timely care. Furthermore, incorporating MPV measures into standard clinical practice may improve risk classification and lead to more tailored treatment methods. Therefore, this study intends to examine the accuracy of high MPV in detecting ACS independently, with the goal of determining its potential as a viable biomarker for improving the accuracy of diagnosis and treatment for patients in ACS.

Methodology

This descriptive cross-sectional study was conducted in the department of Hematology in collaboration with the department of Cardiology (CCU) at Fauji Foundation Hospital Rawalpindi, from December 2017 to June 2018 after approval from hospital ethical committee. All patients, of age ranging between 40 to 70 years, diagnosed to have acute coronary syndrome on basis of ischemic chest pain, characteristic ECG changes and positive cardiac biomarkers were included in the study. Any patient who had undergone any interventional procedure like cardiac angiography was excluded from the study. Sample size was calculated by using WHO sample calculator, using Confidence level=95%, population mean=9.92¹, population standard deviation=2.37¹, population variance=5.6169 which led to sample size of 100 patients. After taking written informed consent and explanation of the purpose of study the venous blood 2.5 ml was collected from each participant in CP bottle containing Ethylene Diamine Tetra Acetic acid (EDTA) as an anticoagulant. It was analyzed on automated Hematology analyzer Sysmex "XT 2000i" system. MPV values were recorded and categorized as elevated or normal based on established reference ranges. All collected data was entered into SPSS version 17. Mean and standard deviation was calculated for quantitative variable i.e. mean platelet volume and age. Effect modifiers like age and gender were controlled by stratification. Post stratification independent sample 't' test was applied. Frequency and percentage were calculated for gender. A p-value of <0.05 was taken as statistically significant.

This study enrolled 100 patients, 17 males and 83 females with mean age of 57.06±9.95 and 56.0±9.48 years respectively. The age distribution is depicted in table I.

Table I: Descriptive Statistics of Age of patients

Variables	Male	Female	Total
Gender	17(17.0%)	83(83.0%)	100 (100.0%)
Mean Age	57.06 years	56.0 years	56.18 years
SD	9.95 years	9.48 years	9.52 years

The mean MPV was 10.74±0.89fl. Minimum MPV was 8.8fl and maximum was 12.3 fl. The descriptive statistics are shown in Table II.

Table II: Descriptive Statistics of MPV (in femtolitres) of patients (n=100)

Mean	10.74
SD	0.89
Minimum	8.8
Maximum	12.3

In our study, we stratified our data into two groups depending upon the ages i.e. Age>55years and age <55 years. The mean MPV of patients age ≤55 years was 10.63±0.97fl while the mean MPV of patients' age>55 years was 10.82±0.81fl. There was insignificant difference observed between both age groups as p value was found to be 0.280 (p>0.05). The comparison between two groups is shown in Table III.

Table III: Comparison of MPV in different age groups.

MPV (fl)	Age Group		t-value	p-value
	≤55	>55		
N	21	79		
Mean	10.63	10.82	-1.087	>0.05
SD	0.97	0.81		

The mean MPV of male patients was 10.44±0.72fl while the mean MPV of female patients was 10.80±0.91fl. There was insignificant difference observed between both genders for mean MPV level as p-value was found to be 0.126 (p>0.05) as indicated in Table IV

Table IV: Comparison of MPV in both genders.

MPV (fl)	Gender		t-value	p-value
	Male	Female		
N	17	83		
Mean	10.44	10.80	1.545	>0.05
SD	0.72	0.91		

Discussion

Myocardial Infarction is a main cause of morbidity & mortality in urbanized countries.¹⁰ The etiology of acute coronary syndrome is multifactorial where many exogenous and endogenous risk factors lead to formation of atherosclerotic plaque. It is presumed that transformation of atherosclerotic cardiovascular disease into its major hostile clinical events such as myocardial infarction is mainly attributed to the activation of platelets. Such platelets are larger in size and have higher thrombotic tendency.¹¹ Although measuring platelet activity by various methods has been reported to identify individuals at risk for cardiovascular events, most of these methods are expensive, time-consuming, and require specialized equipment.¹² Mean platelet volume (MPV) is routinely measured entity in complete blood count and established laboratory marker for large platelet, however it remains a research tool that is yet to be included in routine clinical decision-making.¹³ MPV has not been previously studied in Pakistani population presenting with chest pain. Males are generally affected by ischemic heart diseases. Up to 70yrs of age, male predominance is observed, after that there is equal incidence of diseases in both genders.¹⁴ The present study showed increased female to male ratio, 5:1. This finding is in contrast to other studies conducted by Huang HL et al⁹ and Majidi M et al¹⁵ where males were the dominant population developing ACS. The female preponderance in our study is due to the female entitlement of families of ex-servicemen.

In the present study, the mean age was found to be 56.18±9.52 years. The age factor in our study is very much comparable with other published studies. The study by Mirzaie et al. demonstrated mean age of 68.59± 27.92¹⁰ while Ahmed MS et al showed mean age of 56.59 ± 13.6³. The survey conducted by Majidi M et al displayed mean age of 60.¹⁵ Above mentioned studies demonstrate that mean age of patients presenting with ACS is mostly at the end of fifth decade and above. This increasing incidence of ACS in elderly population has implications on global health care resources which warrant early and prompt diagnosis of the disease and better management. Ours is an under resourced region where there is dearth of most of the proven diagnostic modalities for ACS, therefore, the need for a simple inexpensive diagnostic tool is the need of the day.

The mean MPV value evaluated in our study was 10.73 ± 0.89fl. We found that MPV was raised in patients who have suffered an acute coronary event. This is in agreement with the results of similar studies by other workers. Mirzaie et al studied 851 patients with acute chest pain stratified as Trop-T positive (n=169) and Trop T negative (n=682). Their result displayed a clear-cut increase in the value of MPV in Trop T positive individuals as compared with Trop T negative with mean of 9.92±0.37 vs. 9.5±0.3.¹⁰

In addition, MPV value reported by Lordan R et al⁷ was stratified according to severity of acute coronary syndrome. The results showed a linear upward trend with the severity of the disease. The MPV being highest for non-ST segment elevation myocardial infarction (NSTEMI) 10.4±0.6 as compared to unstable angina (UA) for which MPV was 10±0.7. The study took patients of uncomplicated coronary heart disease as a control group which showed MPV of 8.9±0.7. The results of the aforementioned study are comparable to the results of our study in terms of general tendency of increase in MPV after thrombotic coronary event has ensued, however we did not stratify our data according to the severity of acute coronary syndrome. There is a narrow absolute difference in mean value of MPV in our study as compared to above cited references, (our study showed the highest MPV), which could be because of the fact that platelet indices have been shown to be sensitive to the differences in blood sample anticoagulation, storage temperature and delay in processing. There is time dependent swelling of platelets in samples anticoagulated by EDTA which can result in spurious increase of MPV and misinterpretation of results.¹²

However, in our study, time elapsed in drawing blood sample and measurement of MPV was not controlled which could be a reason for this difference. Attia, S. et al¹⁶, in a study conducted in 2021, demonstrated values of MPV in 107 patients who presented in emergency department with acute chest pain. Of their sample population, 71 patients were diagnosed as having ACS. Their results showed significantly higher MPV values in ACS group as compared to non-ACS group (9.33±1.29 fl vs. 7.51±1.52 fl). These results are comparable to our study; however, we had not taken any control group. Chu et al¹² who conducted a meta-analysis drawn from 24 studies of over 6000 subjects showed mean difference of

MPV between acute myocardial infarction (AMI) patients and non-AMI controls as 9.24 ± 0.84 vs. 8.48 ± 0.7 .

This result is in conformity with our study; however, the above cited study has further elaborated upon the prognostic significance of MPV. They demonstrated that 3184 patients of AMI with elevated MPV had significantly higher risk of death than those with a normal MPV. Pooled results from five cohort studies involving 430 patients who underwent coronary angioplasty revealed that MPV was significantly higher in patients who developed restenosis than in those who did not develop restenosis. This supports the hypothesis that raised MPV is an independent poor prognostic marker following MI and coronary angioplasty. Cetin et al¹⁷ investigated 260 patients and a relationship between platelet indices and stable coronary artery disease (CAD) vs. acute STEMI was noted. Moreover, relationship between platelet indices on admission and thrombolysis outcomes in patients with STEMI was also studied. Mean MPV was significantly higher in the thrombolysis failure group than in the thrombolysis success group (9.9 ± 1.8 vs. 9.2 ± 1.5 fl). The results of above cited study are relatable to our results though not exactly congruent in the way that they used platelet distribution width as a platelet parameter for the severity of acute coronary syndrome while MPV was studied as a predictor of intervention failure. In our study, we assessed levels of raised MPV which has similar trend as PDW in acute coronary syndrome.¹⁸

Conclusion

The revealed that the mean platelet volume (MPV) is significantly elevated in patients with acute coronary syndrome (ACS) and can serve as an independent diagnostic marker for the early detection of the disease.

References

- Dabhi A, Jhala A, Raval DM, Khan S, Mallik S. Association of Mean Platelet Volume with Acute Coronary Syndrome: A Case-Control Study. *APIK Journal of Internal Medicine*. 2023;11(4):p 233-36. https://doi.org/10.4103/ajim.ajim_49_22
- Vogiatzis I, Samaras A, Grigoriadis S, Sdogkos E, Koutsampasopoulos K, Bostanitis I. The Mean Platelet Volume in the Prognosis of Coronary Artery Disease Severity and Risk Stratification of Acute Coronary Syndromes. *Med Arch*. 2019 Apr;73(2):76-80. doi: 10.5455/medarh.2019.73.76-80. PMID: 31391691; PMCID: PMC6643353.
- Ahmed MS, Uddin MJ, Popy UZ, Ali MM, Saha BP, Afroz F, Haque MM, Khan ZI, Islam MS, Tohin MH, Alam N. Association of Platelet Count and Mean Platelet Volume in Acute ST-Elevated Myocardial Infarction. *Bangladesh Heart Journal*. 2023 Dec 12;38(2):120-6. <https://doi.org/10.3329/bhj.v38i2.70277>
- Pogorzelska K, Krętońska A, Krawczuk-Rybak M, Sawicka-Żukowska M. Characteristics of platelet indices and their prognostic significance in selected medical condition—a systematic review. *Advances in Medical Sciences*. 2020 Sep 1;65(2):310-5. <https://doi.org/10.1016/j.advms.2020.05.002>
- Galimzhanov A, Tenekecioglu E, Rustamova F, Tun HN, Mamas MA. The Prognostic Utility of Mean Platelet Volume in Patients With Acute Coronary Syndrome: A Systematic Review With Meta-Analyses. *Angiology*. 2022;73(8):734-743. doi:10.1177/000331972111070908
- Emam KA, El Shafey SM, El Saeed TM. Association between platelet volume indices and ST segment elevation myocardial infarction (STEMI). *Fayoum University Medical Journal*. 2022 Oct 1;10(4):48-58.
- Lordan R, Tsoupras A, Zabetakis I. Platelet activation and prothrombotic mediators at the nexus of inflammation and atherosclerosis: Potential role of antiplatelet agents. *Blood Rev*. 2021 Jan;45:100694. doi: 10.1016/j.blre.2020.100694. Epub 2020 Apr 21. PMID: 32340775.
- Braune S, Küpper J-H, Jung F. Effect of Prostanoids on Human Platelet Function: An Overview. *International Journal of Molecular Sciences*. 2020; 21(23):9020. <https://doi.org/10.3390/ijms21239020>
- Huang HL, Chen CH, Kung CT, Li YC, Sung PH, You HL, Lin YH, Huang WT. Clinical utility of mean platelet volume and immature platelet fraction in acute coronary syndrome. *biomedical journal*. 2019 Apr 1;42(2):107-15. <https://doi.org/10.1016/j.bj.2018.12.005>
- Mirzaie AZ, Abolhasani M, Ahmadinejad B, Panahi M. Platelet count and MPV, routinely measured but ignored parameters used in conjunction with the diagnosis of acute coronary syndrome: single study center in Iranian population, 2010. *Med J Islam Repub Iran*. 2012;26(1):17
- Hałucha K, Rak-Pasikowska A, Bil-Lula I. Protective Role of Platelets in Myocardial Infarction and Ischemia/Reperfusion Injury. *Cardiol Res Pract*. 2021 May 24;2021:5545416. doi: 10.1155/2021/5545416. PMID: 34123416; PMCID: PMC8169247.
- Chu S, Becker R, Berger P, Bhatt D, Eikelboom J, Konkle B, et al. Mean platelet volume as a predictor of cardiovascular risk: a systematic review and meta-analysis. *J Thromb Haemost*. 2010;8(1):148-5 <https://doi.org/10.1111/j.15387836.2009.03584.x>
- Korniluk A, Koper-Lenkiewicz OM, Kamińska J, Kemonia H, Dymicka-Piekarska V. Mean Platelet Volume (MPV): New Perspectives for an Old Marker in the Course and Prognosis of Inflammatory Conditions. *Mediators Inflamm*. 2019 Apr 17;2019:9213074. doi: 10.1155/2019/9213074.
- Cader FA, Banerjee S, Gulati M. Sex Differences in Acute Coronary Syndromes: A Global Perspective. *J Cardiovasc Dev Dis*. 2022 Jul 27;9(8):239. doi: 10.3390/jcdd9080239.

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15. Majidi M, Eslami V, Ghorbani P, Foroughi M. Are women more susceptible to ischemic heart disease compared to men? A literature overview. *J Geriatr Cardiol*. 2021 Apr 28;18(4):289-296. doi: [10.11909/j.issn.1671-5411.2021.04.004](https://doi.org/10.11909/j.issn.1671-5411.2021.04.004).
16. Attia, S., Soliman, A., Ahmed, M., Lasheen, A. Diagnostic Value of Mean Platelet Volume in Prediction of Acute Myocardial Infarction. *The Egyptian Journal of Hospital Medicine*, 2021; 84(1): 1893-1900. doi: [10.21608/ejhm.2021.178598](https://doi.org/10.21608/ejhm.2021.178598)
17. Cetin M, Bakirci EM, Baysal E, Tasolar H, Balli M, Cakici M et al. Increased platelet distribution width is associated with ST-segment elevation myocardial infarction and thrombolysis failure. *Angiology* 2014;0003319713520068 <https://doi.org/10.1177/0003319713520068>
18. Varasteh-Ravan H, Ali-Hassan- Sayegh S, Shokraneh S, Mozayan MR, Karimi-bondarabadi AA. Relationship of admission mean platelet volume, platelet distribution width and white blood cells with ST resolution in patients with acute ST segment elevation myocardial infarction treated with streptokinase without history of previous cardiovascular surgery. *Perspect Clin Res*. 2013;4(2):125-9 <https://doi.org/10.4103/2229-3485.111792>