


Original Research Article

A study on platelet volume indices in acute coronary syndrome

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Abstract

Background: Coronary artery disease is mainly caused by atherosclerosis and its complications. Platelets and their activity have an important role in initiation of atherosclerotic lesions and coronary thrombus formation. Larger platelets are enzymatically and metabolically more active and have a higher potential thrombotic ability as compared with smaller platelets.

Aim: To compare platelet volume indices in acute myocardial infarction, unstable angina, stable angina pectoris and healthy controls and to investigate the importance and role of platelet volume indices in acute coronary syndrome.

Materials and methods: This was cross-sectional study of 100 patients includes 25 patients with acute myocardial infarction, 25 patients with unstable angina, 25 patients with stable angina and 25 healthy controls. Venous samples would be drawn at the time of admission before initiation of treatment. Platelet volume indices were assayed within 30 minutes of blood collection, using auto analyser.

Results: Platelet volume indices were found to be higher among ACS (acute myocardial infarction and unstable angina) patients as compared to non ACS (stable angina and healthy control). For example mean platelet volume was significantly higher in patients with AMI (9.8 ± 0.86) and unstable angina (9.5 ± 0.84) as compared to stable angina (8.4 ± 0.58) and healthy control (8.2 ± 0.56).

Conclusion: Measurement of platelet volume indices may be of benefit in detecting those patients at higher risk for acute coronary syndrome in future.

Key words

Acute coronary syndrome, Coronary artery disease, Platelet volume indices.

Introduction

Acute coronary syndrome is one of the leading cause of death and disability even though the development of recent advances in its medical science. Coronary heart disease may present as silent myocardial infarction, stable angina (AP), unstable angina (UA), myocardial infarction (STEMI and NSTEMI), sometimes heart failure and rarely sudden cardiac death. Followed by the ruptured plaque, platelets play a vital role in the development of thrombus and further progression to myocardial infarction. Hence, by using cyclooxygenase II inhibitor and glycoprotein IIb/IIIa inhibitor (ticlopidine), inhibition of platelet action is used in the management of ACS. By altering one of the parameters i.e., density, size or activity, this leads to triggering of acute coronary syndrome and its spread. Smaller platelets are less adhesive, less active and tend to aggregate less easily than larger ones [1]. The prothrombotic tendency of atherosclerotic plaque in acute coronary syndrome is found to be increased in those who have increase in platelet volume and this leads to increased incidence of thrombus formation in such patients. Our aim was to investigate significance of platelet volume indices in acute coronary syndrome in this study. Formation of thrombus occurs in two settings: release of content of an atherosclerotic plaque once its surface gets disrupted, and local or systemic conditions which favor thrombogenesis exist. In the presence of above conditions, mural thrombus is formed at this site of plaque rupture, and finally results in occlusion of coronary artery. Production of potent vasoconstrictor Thromboxane A₂ and activated platelet cause change in conformational in glycoprotein IIb/IIIa receptor and then it is converted to its functional state, which has high affinity for soluble adhesive proteins-fibrinogen. Multivalent nature of fibrinogen helps in simultaneously binding with two different platelets at the same time, promoting aggregation of platelets and their cross-linking [1]. At the site of the plaque rupture, damaged endothelial cells release tissue factor. On exposure of tissue factor, the coagulation cascade is activated. Activation of extrinsic

pathway of coagulation cascade leads to release of Factors VII and X, finally leading to the conversion of prothrombin to thrombin, which eventually results in formation of fibrinogen to fibrin. The formed thrombus occludes the involved coronary artery. Platelets are formed from precursors megakaryocytes in the bone marrow. They are disc-shaped, enucleate cell fragments, which are released from the bone marrow into the blood circulation. Following a vascular injury, platelet help in the formation of hemostatic plug that initially seals vascular defect. They also provide a surface for recruiting and concentrating coagulation factors which further enhances the coagulation cascade. Thus platelets play a critical role in normal haemostasis [2].

Platelets

Platelets are heterogeneous regarding their size, density, and functional activity. Alterations of these parameters results in pulling the trigger of acute coronary syndrome and its spread. In ACS, thrombogenic phenomenon begins with the rupture of atherosclerotic plaque. The functions of circulating platelets are necessary for the thrombogenic phenomenon in ACS. Test like in vitro aggregometry, has found significant difference in the function of large and small platelets [3]. Compared to smaller platelets large platelets are more adhesive and aggregative. Large platelets contain higher levels of P-selectin and glycoprotein IIIa which are procoagulatory surface proteins. Thus in ACS, prothrombotic tendency of atherosclerotic plaque increases proportionality with increase in mean platelet volume and is also associated with increased risk of intracoronary thrombus formation in acute myocardial infarction cases [4]. Platelet volume has a major role in platelet function and activation. More secretory granules and mitochondria are present in larger platelets compared to small platelets thus large ones are more active. Larger platelets are hyperactive leading to the formation and embolisation of intracoronary thrombus and thus large platelet promotes the emergence of acute coronary syndrome.

Thus Increased platelet volume measured after MI, has been suggested to be a risk factor for further ACS episodes [4]. Along with the other cardiac biomarkers, usefulness of MPV is such that it can be used as a routine test for the risk stratification of ACS in patients admitted to the ICCU. Major advantage of PVI is that it is a simple and inexpensive laboratory measurement. Due to alterations in the autonomic nervous system MPV has great diurnal and nocturnal variation as found out by studies [5]. A study also showed that there is a correlation between sympathetic nervous activity and the MPV in AMI patients as the adrenergic system exerts its effect on thrombopoiesis in bone marrow and peripheral platelet activation. The effects of the adrenergic system on platelet activation take place in two ways in the peripheral circulation. Alpha₂ adrenoceptor activation results in change of the shape of platelets and hence increases MPV. Following exercise or following administration of adrenaline, larger, activated platelets which are sequestered in the spleen are released into the circulation leading to the increase in MPV. It has been shown that during admission in AMI patients high MPV can be used as an independent risk factor for risk stratification regarding impaired perfusion and associated death [6].

Mean platelet volume

The mean platelet volume result was calculated by an automated analyser. MCV is a calculation of the mean size of individual red blood cells whereas MPV is a calculation of the mean size of platelets. Normal Range is 7.5-11.5 femtolitre. MPV is found to be elevated in patients with acute coronary syndrome at the time of admission in coronary care unit, and it is being hypothesised that changes in the entire megakaryocytic-platelet-hemostatic axis precedes acute coronary events. It is postulated that MPV increases before MI for three reasons. a) The life span of platelets is eight days approximately, and the increase in MPV is noted within the first 12 hour of admission b) The increase in MPV persists beyond six weeks after discharge during which time the infarct would be largely healed. c) Log

normality of platelet volume is preserved [7, 8].

Materials and methods

This study was conducted in Cardiology Department and Department of Medicine, Government Royapettah Hospital in collaboration with Department of Pathology and Biochemistry. Ethical approval was obtained. This study was conducted over a period of 7 months. On the basis of history, physical examination and investigations patients were divided into four groups - those with STEMI, Unstable Angina/NSTEMI, Non Cardiac Chest Pain and chronic Stable Angina. The platelet indices of the four groups were compared. Patients are allotted by convenience sampling in each group.

Inclusion criteria

Patients presenting with chest pain were evaluated and divided according to clinical manifestations, ECG and echo into four groups.

- a) Non cardiac chest pain (controls).
- b) chronic stable angina
- c) UA/NSTEMI.
- d) STEMI.

Exclusion criteria

Patients with history of bleeding disorders, blood dyscrasias, preeclampsia, sepsis, blood transfusion recently (within 6 weeks), major operations, trauma recently (within 6 weeks) Usage of drugs causing thrombocytopenia, infections causing thrombocytopenia.

Sample size

The study included a total of **100** patients.

- **25** patients with **non cardiac chest pain**
- **25** patients with **UA/NSTEMI**
- **25** patients with **STEMI**
- **25** patients with **chronic stable angina**

Statistical analysis

The tests used are **ANOVA, Chi-square test** and **t test** Data were collected and statistical significance was analysed (**Table – 1**).

Table – 1: Platelet Volume Indices within Groups.

Platelet volume indices	Sig p value
MPV between groups	<0.001 (Highly significant)
PDW between groups	<0.001 (Highly significant)
P-LCR between groups	<0.001 (Highly significant)

Results

Mean platelet volume in comparison was as per **Graph – 1**. Comparison of Mean Platelet Volume (MPV), Platelet Distribution Width (PDW) Platelet-Large Cell Ratio (P-LCR) Between Cases and Controls was as per **Table – 2**. Comparison of groups by MPV was as per **Table – 3**. Comparison of groups by PDW was as per **Table – 4**. Comparison of groups by P-LCR was as per **Table – 5**.

Graph – 1: Mean platelet volume in comparison.

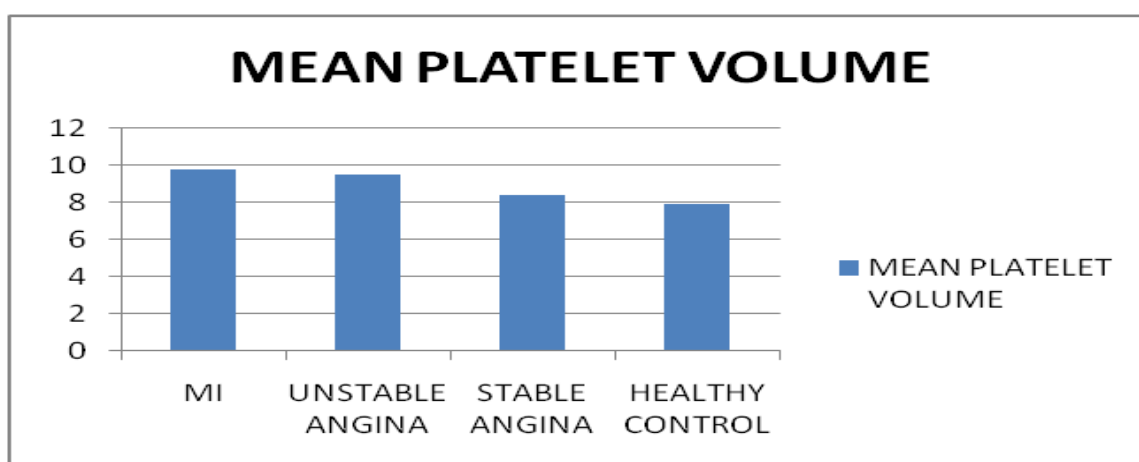


Table – 2: Comparison of Mean Platelet Volume (MPV), Platelet Distribution Width (PDW) Platelet-Large Cell Ratio (P-LCR) Between Cases and Controls.

	Mean value		
	MPV(fl)	PDW%	P-LCR
Cases (MI group and unstable angina group)	9.6	14.5	28.6
Control (Stable angina and healthy group)	8.3	12.9	24.5

Table - 3: Comparison of groups by MPV.

			P value	Significant/ Not significant
MPV	MI group (9.8 ± 0.9)	Unstable group (9.5 ± 0.8)	0.284	Not significant
	Unstable group (9.5 ± 0.8)	Stable group (8.4 ± 0.6)	<0.001	Highly significant
	Stable group (8.4 ± 0.6)	Healthy group (8.2± 0.6)	0.817	Not significant
	Healthy group (8.2± 0.6)	MI group (9.8 ± 0.9)	<0.001	Highly significant
	Unstable group (9.5 ± 0.8)	Healthy group (8.2± 0.6)	<0.001	Highly significant
	MI group (9.8 ± 0.9)	Stable group (8.4 ± 0.6)	<0.001	Highly significant

Table - 4: Comparison of groups by PDW.

			P value	Significant/ Not significant
PDW	MI group (14.3 ± 0.2)	Unstable group (14.8 ± 0.7)	0.752	Not significant
	Unstable group (14.8 ± 0.7)	Stable group (12.7 ± 0.2)	0.001	Significant
	Stable group (12.7 ± 0.2)	Healthy group (13.1 ± 0.2)	0.877	Not significant
	Healthy group (13.1 ± 0.2)	MI group (14.3 ± 0.2)	0.133	Not significant
	Unstable group (14.8 ± 0.7)	Healthy group (13.1 ± 0.2)	0.010	Highly significant
	MI group (14.3 ± 0.2)	Stable group (12.7 ± 0.2)	0.021	Significant

Table – 5: Comparison of groups by P-LCR.

			P value	Significant/ Not significant
P-LCR	MI group (29.4 ± 1.0)	Unstable group (27.8 ± 0.6)	0.258	Not significant
	Unstable group (27.8 ± 0.6)	Stable group (24.6 ± 0.6)	0.002	Significant
	Stable group (24.6 ± 0.6)	Healthy group (23.4± 0.3)	0.992	Not significant
	Healthy group (23.4± 0.3)	MI group (29.4 ± 1.0)	<0.001	Highly significant
	Unstable group (27.8 ± 0.6)	Healthy group (23.4± 0.3)	0.001	Highly significant
	MI group (27.8 ± 0.6)	Stable group (24.6 ± 0.6)	<0.001	Highly significant

Discussion

In our study, the significance of platelet volume indices in cases (acute coronary syndrome) is the prime concern and they were compared with controls (stable angina pectoris and healthy controls).

Mean Platelet Volume

Our study showed that mean platelet volume (hectolitres) in MI group was 9.8, Unstable angina group was 9.5, Stable AP group was 8.4 and Healthy controls was 8.2. Mean platelet volume were comparable between four groups with high statistically difference of 0.000 (<0.5). Mean platelet volume were comparable between Cases (acute coronary syndrome) includes MI group and unstable angina and Controls includes stable angina pectoris and healthy controls with high statistically difference of 0.000 (<0.5) [10]. In a similar study which compared AMI and unstable AP, MPV in unstable AP was 9.0 ± 1.0 fl and 8.9 ± 0.8 fl in acute myocardial infarction. No statistical significance was detected in MPV between these (difference p=0.999) two groups. In control group was 7.2 ± 0.6 fl and in stable AP

patients, MPV was 7.5 ± 0.6 fl, respectively. No statistical significance was detected in MPV between these two groups (difference p=0.126). When stable angina pectoris and control groups were compared to each of AMI cases and unstable angina, it was found that MPV was increased in AMI cases and unstable angina. Here in our study too, there is statistically significant difference between cases (MI group and Unstable angina) and other two groups which is similar to the above cited study [3]. In the study by Ender, et al. [4], it is concluded that MPV was found to be increased who those with AMI patients on comparison with stable AP patients and this result was consistent with our study too. In the study comparing AMI patients to control groups and stable angina pectoris conducted by Kishk, et al. [9, 10] revealed that lower platelet count and higher MPV to be associated with AMI group than the stable angina pectoris and control groups. In our study, mean platelet volume was higher in AMI group and platelet count was also reduced than others. In another study conducted by Puzzili, et al. [10], concluded that MPV was higher side in unstable angina pectoris patients,

compared to control groups and stable angina which is consistent with our study [10].

Mean Platelet Volume in ACS

In our study mean platelet volume in AAMI was 9.6, ASMI was 9.6, IWMI was 9.7, IW+PWMI was 10.0, IW+PW+RVMI was 9.8 and UA was 9.5. No statistical significance was detected in MPV between the various types of ACS (p value is 889 i.e. >.05).

Platelet Count and ACS

In our study, platelet counts in four groups were analysed. Mean value in AMI group was 2,10,840 cells/dl, UA group was 2,21,760 STABLE AP was 2,26,720 cells/dl and Healthy controls was 2,27,040 cells/dl. While comparing between the groups there was no statistical difference between any groups. But in our study we compared mean platelet count in AMI Patients to stable AP and control groups and we detected that the AMI group had lower platelet count comparing with stable AP and control group. Hence in our study the results were convincing while comparing to the Kishk, et al. [9] in terms of platelet count.

Platelet Distribution Width and ACS

In our study mean value of in cases (AMI group and Unstable angina group) was 14.5% and controls (Stable angina and Healthy group) were 12.9%. Statistically high significance was detected in PDW between cases and control (p value - <0.001).

Platelet-Large Cell Ratio and ACS

In our study mean value of P-LCR in cases (AMI group and Unstable angina group) was 28.6 and controls (Stable angina and Healthy group) were 24.5. Statistically high significance was detected between cases and control (p value - <0.001) [11].

Outcome and MPV in ACS

In our study, 5(10%) patients expired and 45(90%) survived out of 50 in the ACS group. No Statistical significance was detected in MPV between the outcomes in relation to ACS (p value is .606 i.e. < .05) [12].

Conclusion

Mean platelet volume was found to be increased in ACS group When compared to Stable angina pectoris and Healthy controls Platelet volume indices is found to be increased in patients with ACS (AMI group and Unstable angina group). Statistically significant difference in platelet volume indices was found to exist between cases (AMI group and Unstable angina group) and controls (Stable angina pectoris and Healthy controls). PVI is a feasible and easy reliable test, thus it can be used for the initial evaluation of patients admitted with ACS along with other cardiac biomarkers.

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