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Original Article

Community Medicine Section

Significance of Platelet Volume Indices in STEMI Patients: A Case-Control Study

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ABSTRACT

Introduction: Platelets have been well known contributors in the pathogenesis of cardiovascular disorders such as atherosclerosis and its complications such as acute Myocardial Infarction (MI).

Aim: To study the changes in platelet volume indices and platelet count in ST-Elevated Myocardial Infarction (STEMI) and assess their usefulness in predicting coronary events.

Materials and Methods: A case-control observational study was carried out on 173 cases diagnosed with STEMI and 191 controls from January 2015 to December 2015, considering the inclusion and exclusion criteria. In total, 364 patients were included, 173 patients with STEMI, from those patients admitted to the intensive care unit and the emergency ward. In addition, 191 healthy non diabetic non hypertensive age-matched controls were enrolled.

Results: The mean age of cases was 59.4±11.9 years and of controls were 55.25±8.5 years. Males (74.6%) had higher incidence of STEMI then females (25.4%). The Mean Platelet Volume (MPV) was significantly higher in patients with STEMI (10.2±2.8) as compared to controls (8.5±6.9). The Platelet Distribution Width (PDW) was also significantly higher in cases compared to controls ($p<0.05$). According to Pearson correlation analysis, the positive relationship determined between MPV and Gensini score was statistically significant ($p < 0.001$, $r = 0.132$).

Conclusion: High MPV and PDW seem to be an independent risk factor for STEMI and correlated with the severity of the STEMI. They can be used as a simple, reliable, and economical method for predicting an impending acute coronary event.

Keywords: Gensini score, Mean platelet volume, Myocardial infarction, Prognostic aid

INTRODUCTION

Coronary Artery Disease (CAD) is a well-known leading cause of mortality worldwide [1] and by the year 2020, will be first in the leading causes of disability [2]. While the death rates have been declining for the past three decades in the West, these rates are rising in India. In the last three decades, the prevalence of CAD has increased from 1.1% to about 7.5% in the urban population and from 2.1% to 3.7% in the rural population [3]. Regardless of improvement in primary prevention and treatment Acute Coronary Syndrome (ACS) remains the primary cause of death in the United States and most developed countries [4]. Almost 50% of all victims of MI die before they reach the hospital [5].

ACS results from rupturing of an unstable atherosclerotic plaque, followed by a cascade of platelet reactions resulting into thrombus formation. Platelets are heterogeneous blood elements with various sizes and densities. Chronic atherosclerotic plaque gets converted to an occluding thrombus, majorly with the help of platelets. Large platelets are denser, aggregation rate is more faster with subendothelial collagen, higher production of thromboxane A2 and greater expression of glycoprotein Ib and glycoprotein IIb/IIIA receptors [6]. All these features, increases thrombosis, and possibility of ACS. Large platelets have also been reported in patients with vascular risk factors and been related with myocardial damage in ACS, with a negative outcome of acute MI observed in survivors [7].

Hence, the present study was undertaken to investigate the association of platelet indices on STEMI patients admitted to the Tertiary Care Hospital in Southern region of India.

MATERIALS AND METHODS

A case-control study was carried out at the Kasturba Medical College, Manipal (Department of Cardiology) from January 2015 to December 2015. Ethical clearance for study was obtained from Institutional Ethics Committee of Kasturba Hospital, Manipal, Karnataka, India.

Sample size was calculated based on standard error obtained in pilot study. Sample size was calculated to allow detection of a 30% difference in MPV between different groups and with alpha (α) of 0.05 and power of 0.80. In total, 364 patients were included, 173 patients with STEMI, from those patients admitted to the intensive care unit and the emergency ward. In addition, 191 healthy non diabetic and non hypertensive age-matched controls were enrolled.

Primary objective was to find the association between platelet volume indices in STEMI patients and also to correlate with severity of CAD. Severity of CAD was assessed by Gensini Score (GS), from the angiographic evaluations [8].

Study Population

People were eligible to be included as cases for the study if they met the following criteria: those admitted to cardiology unit of Kasturba Hospital with STEMI and diagnosis of STEMI was based on third universal definition of MI [9]. Following patients were excluded from the study: Subjects with severe renal or hepatic impairment, with sepsis or any chronic inflammatory disorders and with myeloproliferative neoplasm or other malignancies. Pregnant women, patients with thyroid dysfunction or on oral anticoagulant therapy were also excluded.

Controls included patients who were admitted to KMC hospital for general health check-up, and who were healthy non-Hypertensive, Non-Diabetics and Non-smokers.

All demographical details and clinical variables of the patients were recorded (age, sex, body mass index, diabetes mellitus, hypertension and smoking status). Routine laboratory parameters were also recorded which consisted of total platelet count, MPV, PDW, WBC, Leukocyte count, troponin levels (for cases only).

STATISTICAL ANALYSIS

Data were transformed into a computerized database structure. An expert statistical advice was sought for Statistical analyses and computer assisted using SPSS version 20.0 (Statistical Package for Social Sciences). Continuous variables were presented as mean±standard deviation, and categorical variables as percentages. The normal distribution of the variables was analyzed using the Kolmogorov-Smirnov test. An independent sample t-test was used to compare continuous variables between the two groups. Nonparametric values were compared with the Mann-Whitney U test. The Pearson Corelation test was used to determine the relationship between two categorical data. A p-value of < 0.05 (5%) was considered to be statistically significant.

RESULTS

The study participants comprised of 364, who were divided into two groups: 191 controls and 173 with STEMI. The baseline clinical characteristics are depicted in [Table/Fig-1]. Mean age of 173 cases was 59.4±11.9 years and of 191 controls was 55.25±8.5 years. Male constituted 67.5% of healthy control, 74.6% of STEMI. Female constituted 32.5% of healthy control, 25.4% of STEMI. No important differences were observed between two study groups. All cardiovascular risk factors were also statistically significant among groups [Table/Fig-1].

Parameter	STEMI (n=173)	Control (n=191)	p-value
Age (years) mean±SD	59.4±11.9	55.25±8.5	0.125 (non-significant)
Male (%)	129 (74.6)	129 (67.5)	0.141
Female (%)	44 (25.4)	62 (32.5)	
BMI (Kg/m^2) mean±SD	29.3±3.8	26.3±3.8	<0.001
Family history of CAD (%)	56 (32.4)	12 (6.3)	<0.001
Hypertension (%)	89 (51.4)	0 (0)	
Diabetics (%)	63 (36.1)	0 (0)	
Smoking, current (%)	121 (69.9)	0 (0)	

[Table/Fig-1]: Baseline characteristics of patients with STEMI and control subjects.

Platelet Parameters

Mean platelet count and platelet indices are presented in [Table/Fig-2]. Comparative results showed a higher platelet count in STEMI group than control and it was significant (273.7±73.2 vs 257.1± 58.4, respectively, p=0.017). The MPV was significantly larger in STEMI cases compared to controls (10.2±2.8 FL vs. 8.5±6.9 FL, respectively, p < 0.005). The PDW was also significantly higher in cases compared to controls (17.8±2.2 vs 16.3±0.7, respectively, p < 0.001) [Table/Fig-2].

According to Pearson correlation analysis, the positive relationship

Platelet Parameter	STEMI mean±SD	Control mean±SD	p-value
Platelet count (x10^3 L)	273.7±73.2	257.1±58.4	0.017
Mean platelet volume (FL)	10.2±2.8	8.5±6.9	< 0.005
Platelet distribution width (FL)	17.8±2.2	16.3±0.7	< 0.001

[Table/Fig-2]: Comparison of platelet parameters values in patients with STEMI and Controls *.
All the above tests are conducted using the Independent sample t-test.

determined between MPV and Gensini score was statistically significant (p < 0.001, r = 0.132.). Change of MPV, were positively correlated with Gensini score, which can reflect the severity of coronary artery lesions.

MPV of value>9.0 Fl, was defined as high and the patients were divided into 2 Groups—Group 1 (low MPV) and group 2 (high MPV). The comparisons of clinical, laboratory properties and Gensini scoring of patients in the two groups are shown in [Table/Fig-3].

Gensini score was higher in Group 2 than in group 1 (58.2±30.3 vs 52.5±30.7; p=0.237). There was no statistically significant relationship between severity of CAD and the two MPV groups (p =0.237), by independent sample t-test.

MPV	Gensini Score	p-value
Group 1 (n= 86)	52.5 ± 30.7	0.237
Group 2 (n = 78)	58.2 ± 30.3	

[Table/Fig-3]: Association of MPV and Gensini scoring.

Subgroup Analysis

Since the males were more than females in groups, we compared the platelet indices in groups divided by gender. Accordingly, there were significant differences in terms of platelet count between both sexes; platelet count was higher in female than male, p < 0.001. Significant differences in MPV was also seen between male and female group in the STEMI Cases (p <0.034). PDW was higher in males than females in the STEMI cases (18.0±2.4 FL vs 16.9±1.1 FL, respectively, p<0.001) [Table/Fig-4].

Parameters	Total (n= 364)	STEMI (n= 173)	Control (n=191)
Platelet count (x10^3 L)			
Male	255.7±66.9	262.3±73.3	249.2±59.7
Female	287.5±58.9	307.6±62.5	273.6±52.5
p-value	<0.001	<0.001	0.007
Mean platelet volume (FL)			
Male	9.2±6.3	9.9±2.7	8.7±0.4
Female	9.3±2.5	10.9±3.0	8.1±0.9
p-value	0.975	0.034	0.632
Platelet distribution width (FL)			
Male	17.1±1.9	18.0±2.4	16.2±0.7
Female	16.5±0.93	16.9±1.1	16.3±0.8
p-value	< 0.001	<0.001	0.671

[Table/Fig-4]: Platelet indices of the patients with STEMI and control based on gender.

Pearson correlation analysis was used to determine the correlations between platelet count and platelet volume indices among all patients. Accordingly, there were moderate and negative correlations between platelet count and MPV (r = 0.031, p < 0.001), PDW (r= 0.108, p < 0.001).

Trop T and MPV

The present study showed that there is a positive corelation between MPV and Cardiac Troponin T by Pearson correlation test (r=0.063, p=0.425). Furthermore positive corelation between MPV and Gensini scoring was observed by Pearson correlation test (r= 0.132, p=0.091).

DISCUSSION

STEMI is the leading cause of death globally. For the development of atherothrombosis, platelets have a huge part to play. After atherosclerotic plaque rupture, platelets get activated. Platelets which are bigger in size have a greater mass and are also metabolically and enzymatically more active than smaller platelets [10]. These platelets which are haemostatically reactive and larger have more granules and adhesion receptors and net effect is reduced bleeding time indicating increased activation [11]. They have a greater prothrombotic potential, with higher levels of intracellular thromboxane A2 and beta thromboglobulin levels, as well as increased levels of procoagulant surface proteins [12].

The platelet activity and function can be best assessed by platelet volume indicators like MPV and PDW rather than Platelet Count (PC) as they increase during platelet activation. PDW directly measures the variability in platelet size, and its high values could suggest larger production of larger reticulated platelets. Several studies have demonstrated that an elevated MPV has been associated with increased vascular ischemic events and also have been found to be associated with increased mortality and morbidity and recurrent MI [10]. Hence, platelet volume parameters are simple and reliable biomarker to predict coronary events.

The current study examined the relationship between platelet parameters mainly PC, MPV and PDW and the occurrence of STEMI in patients from the Southern region of India. We found that patients with STEMI tend to have significantly larger MPV and PDW (which both reflect the platelet volume) than the control group. While no statistically significant difference was detected regarding the PC between the two groups. Lippi G et al. have demonstrated in a large scale study that MPV at admission is higher in STEMI compared to those with chest pain of non cardiac origin [7]. Likewise, similar observations were made by other investigators, where MPV was found to be higher in patients with STEMI compared to healthy controls [13,14]. The results of the present study are comparable with studies by Martin JF et al., and by Senaran H et al., from India which showed MPV was significantly higher in those patients who has MI, compared with healthy group [15,16].

In the present study, we demonstrated that there is no statistical difference for Gensini scoring between patients with low and high MPV values. However, correlation analysis showed positive associations between MPV with Gensini scoring.

In accordance with present study, several studies have reported that there is no relationship between MPV or PDW and the extent of CAD [17-20]. MPV has been shown to associate with both megakaryocyte ploidy and with the percentage of circulating reticulated platelets [21]. Additionally, a positive correlation between thrombopoietin levels and MPV values has been demonstrated in CAD [16]. Thus, larger platelet volume may not imply higher platelet reactivity shown to be related to the extent and complexity of CAD [16]. Furthermore, it may even be associated with reduced aggregation, since larger platelets may be precursors of mature platelets. In another large scale study conducted in 2009, De Luca G et al., and colleagues [17] found that there were no correlations between MPV and platelet activity and the extension of CAD according to coronary angiography and carotid intima media thickness.

The study definitely has several limitations, such as the follow up of the patients was not possible to examine the prognostic value of our findings and to examine correlation between the high MPV and mortality rate. Further studies could be carried out to investigate other known risk factors for STEMI (smoking, Hypertension, Diabetics etc.,) in controls, which can act as confounding factors.

However, platelet indices remains as good prognostic marker not requiring any expensive technology and can be easily adapted in clinical setup as routine testing.

CONCLUSION

High MPV and PDW seem to be an independent risk factor for STEMI and correlated with the severity of the coronary atherosclerosis. This is a simple, reliable, and economical method that indicates platelet activation and predicts the risk of STEMI.

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