Original Research Article

Association between mean platelet volume with risk factors of myocardial infarction

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Abstract

Background: MPV correlates with platelet function and activation and has recently emerged as a potential marker of cardiovascular diseases. MPV has been shown to be increased in patients with acute myocardial infarction (AMI) compared to stable angina patients. **Aim:** To study the association between mean platelet volume with risk factors of myocardial infarction. **Material and Methods:** Total consecutive 94 cases of Acute Myocardial Infarction were enrolled and were compared with an equal number of age and gender-matched comparison group. Blood Sample was collected within 6 hours on arrival at ICU into EDTA tubes who were subsequently diagnosed having AMI. For measurement of platelet count (PLC), mean platelet volume (MPV), platelet distribution width (PDW) and plateletcrit (PCT), complete blood count was done on Automatic Analyzer. **Results:** MPV of >11fl was seen maximum in 7 (41.18%) hypertensive cases in STEMI followed by 1 (7.69%) case in NSTEMI. MPV of >11fl was seen maximum in 4 (33.33%) smoking cases in STEMI followed 1 (12.5%) case in NSTEMI. There were no smoking cases in comparison group with MPV values >11fl. MPV of >11fl was seen maximum in 3(30%) alcoholic cases in STEMI followed by 1(16.67%) case in NSTEMI. MPV of >11fl was seen maximum in 3(33.33%) diabetic cases in STEMI followed 1(16.67%) case in NSTEMI. MPV values between 9-11fl were seen in 5 (55.56%) diabetes mellitus cases with STEMI. **Conclusion:** There was significant association between high mean platelet values and risk of myocardial infarction. STEMI patients have high MPV as compare to NSTEMI and comparative group. MPV is a very low-cost investigation available easily in most healthcare settings. In smoking and hypertension patients, MPV values can be used an early marker for CAD.

Key Words: Mean platelet volume, myocardial infarction, hypertension, smoking, alcohol, diabetes

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Received Date: 29/11/2019 Revised Date: 13/01/2020 Accepted Date: 07/02/2020
DOI: https://doi.org/10.26611/10211428

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	Accessed Date: 19 May 2020

INTRODUCTION

Some of the risk factors of coronary heart disease are uncontrollable but many of them can be modified like hypertension, hyperlipidemia, diabetes mellitus and cigarette smoking which are commutable risk factors of coronary artery disease. Mean platelet volume (MPV) is an accurate measurement of the size of platelets.[1] Larger platelets are metabolically and enzymatically more active and have higher homeostasis property than smaller platelets.[2] MPV correlates with platelet function and activation and has recently emerged as a potential marker of cardiovascular diseases. MPV received very little attention in the past. MPV has gained substantial attention in the past few years. MPV has been shown to be increased in patients with acute myocardial infarction (AMI) compared to stable angina patients.[3] MPV in stable angina patients is also larger than control subjects.[4-6] Larger MPV has been shown to be associated with poorer outcome in AMI patients10. MPV is simple and inexpensive to obtain, easy to interpret, and routinely measured in automated cell counters. As compared with other markers of platelet activity, MPV is a practical and prognostically important biomarker of cardiovascular disease. Very few Indian studies have been done to establish the role of high MPV values in causing myocardial infarction. The present study was done to study the association between mean platelet volume with risk factors of myocardial infarction.

How to cite this article: Ranjith K, Ganesh Jadhao. Association between mean platelet volume with risk factors of myocardial infarction. *MedPulse International Journal of Medicine.* May 2020; 14(2): 59-64. https://www.medpulse.in/Medicine/

MATERIAL AND METHODS

This cross-sectional study was initiated after obtaining Institutional Ethics Committee approval of the protocol. Total consecutive 94 cases of Acute Myocardial Infarction admitted to the tertiary care centre were enrolled during study period and were compared with an equal number of age and gender-matched comparison group. The diagnosis of AMI was as per criteria laid down by Joint European Society of Cardiology/American College of Cardiology Committee for the redefinition of myocardial infarction.

Study subjects

1. Cases: Patients admitted for acute myocardial infarction to tertiary care centre
2. Comparison group: Age and gender matched subjects from hospital other than AMI cases.

Sample size

Sample size was estimated using Open Epi software version 3.0 to find the mean difference in MPV between the groups (STEMI, NSTEMI and control group). The formula used was in the software was - N= [2 x (Z(1-α/2)+Zβ) x (S.D)2] / d2

- Where, S.D is Standard deviation and d is the minimal effect of interest.
- The maximum sample size to be covered was obtained when MPV was compared between STEMI and NSTEMI patient group.
- With the expected difference in mean platelet volume between STEMI and NSTEMI patients as 0.75 [mean (SD) MPV among STEMI patients – 10.48(1.42) and mean(SD) MPV among NSTEMI patients – 9.73(1.15)], the sample size is estimated as 94 (47 in each of 2 groups) with 95% confidence level (α) and 80% power (β).
- Hence, the total number of cases included in the study were 94.
- The comparison group also included equal number of subjects, i.e. 94.

Sampling technique

- Systematic random sampling was used to select patients.
- Department of medicine receives about 5 patients with myocardial infarction per day, mounting to about 150 patients per month.
- Hence, to cover a sample of 94 patients with MI (both STEMI and NSTEMI) in a year, at least 8 patients must be covered per month, assuming the proportion of STEMI and NSTEMI among patients with MI as 50% each.
- Sampling interval = 150/8 = 18.75. That is, the researcher chose every 18th patient with MI getting admitted in the department of medicine as per the inclusion and exclusion criteria till the desired sample size was reached.

Selection of controls

Controls were chosen from the first degree relatives of the patients as per the inclusion and exclusion criteria given below. If more than one eligible control is present, the control for study was chosen by lot method. If no eligible control was available, then the particular patient with MI was not chosen as case and the patient with MI admitted subsequently was approached for the study.

Cases were divided into 2 groups- on the basis of ECG findings -

a. ST segment elevation Myocardial infarction (STEMI)
b. Non- ST segment elevation (NSTEMI)

Inclusion criteria

- Patients aged above 12 years.
- Patients with ECG showing STEMI and Cardiac Markers
- CPK MB/TROP I for NSTEMI.

Exclusion criteria

- Those diagnosed with platelet disorders.
- Those diagnosed with bone marrow disorders/diseases.
- Bleeding disorder, blood dyscrasias
- Preeclampsia, liver disorder
- H/o recent surgery [<6 weeks], h/o blood transfusion [<6 weeks], K/C/O old CVE ,IHD on antiplatelet therapy
- Drugs causing thrombocytopenia like penicillin, sulfonamides, quinidine, Gold, Heparin etc.

Comparison group

Inclusion criteria for comparison group

- Age and sex matched apparently healthy controls accompanying the patients aged above 12 years without history of Coronary Artery Disease (CAD)

Exclusion criteria for comparison group

- Diagnosed to have Myocardial Infarction at any time in the past.
- Failure to obtain consent.

All study subjects underwent general examination and systemic examination.

A non-hemolysed venous blood sample Procedure of investigations

was withdrawn in the EMW prior to the administration of anti-platelet drugs for estimation. Blood Sample was collected within 6 hours on arrival at ICU into tubes containing EDTA who were subsequently diagnosed having AMI. Blood Sample was collected within 6 hours on arrival at ICU into tubes containing EDTA who were subsequently diagnosed having AMI. For measurement of

platelet count (PLC), mean platelet volume (MPV), platelet distribution width (PDW) and plateletcrit (PCT), complete blood count was done on Automatic Analyzer based on Impedance Technology (Coulter Principle). Normal MPV ranges 7.0-11.0 fl.(58)

Statistical analysis

The data was entered in Microsoft Excel sheet and analysed using Epi Info software. SPSS version 25 and EPI Info version 7.3 was used for analysis. Comparison of Categorical variables was done by using counts and percentages and Chi-square test for significance. Mean and standard variations for continuous variables was compared using Student 't' test or Fischer's exact test for significance. P value < 0.05 was considered to be significant.

RESULTS

The cases and comparison group were age matched hence, majority 29 (30.85%) cases and comparison group were in age group of 61-70 years followed by 24 (25.53%) in age group of 51-60 years. Mean age in both cases and comparison group was 57.87±11.91 years ranging from 28 to 80 years. There were equal number of males and females in both the groups. i.e. 56 (59.57%) males and 38 (40.43%) females. Out of total 188 subjects, 112 were males and 76 were females.

Table 1: Distribution of cases according to type of Myocardial infarction

Type of MI	Cases n (%)
Lateral wall MI	02 (2.13%)
Anterior wall MI	07 (7.45%)
Inferior wall MI	14 (14.89%)
Inferior+ posterior wall MI	02 (2.13%)
Anterior+ lateral wall MI	13 (13.83%)
Posterior wall MI	02 (2.13%)
Extensive Anterior wall MI	03 (3.19%)
Inferior+ lateral WMI	04 (4.26%)
NSTEMI	47 (50%)
Total	**94 (100)**

Out of total 94cases, there were equal number 47(50%) of cases of STEMI and NSTEMI. Out of 47 STEMI cases, 14 (14.89%) were Inferior wall MI followed by 13 (13.83%) cases of Anterior+ lateral wall MI. There were 7 (7.45%) cases of Anterior wall MI. 03(3.19%) had extensive Anterior wall MI.

Table 2: Distribution of MPV values in study subjects

MPV(fl)	Cases		Comparison group n (%)	P value
	STEMI n (%)	NSTEMI n (%)		
<9	01 (2.13)	01 (2.13)	62 (65.96)	
9-11	29 (61.70)	43 (91.49)	32 (34.04)	<0.000001*
>11	17 (36.17)	03 (6.38)	00 (00)	
Mean± S.D	10.85±0.84	10.02±0.62	8.62±0.98	
Total	**47 (100)**	**47 (100)**	**94 (100)**	

MPV values were <9 in 62 (65.96%) subjects of comparison group. Majority 43 (91.49%) NSTEMI cases were having MPV values between 9-11 fl. Majority 29 (61.70%) STEMI cases also MPV values between 9-11 fl. MPV values >11 fl was observed in 17 (36.17%) STEMI cases. It was inferred that STEMI cases had high MPV values as compared to other groups and this was found to be highly statistically significant. (p value=0.00001).

Table 3: Distribution of MPV values and hypertension in study groups

MPV	Hypertension (N=30)		Hypertension (N=12)	P value
	STEMI n=17	NSTEMI n =13	Comparison group n=12	
<9	00(00)	00(00)	10(83.33)	
9-11	10(58.82)	12(92.30)	02(16.67)	0.000001*
>11	07(41.18)	01(7.69)	00(00)	

When MPV values were compared in hypertensive subjects of 3 groups, MPV of > 11 fl was seen maximum in 07(41.18%) cases in STEMI followed by 01(7.69%) case in NSTEMI. There were no hypertensive cases in comparison group with MPV values >11 fl. Hence, hypertension with high MPV values can cause STEMI and this was found to be highly statistically significant. (p value=0.000001).

Table 4: Distribution of MPV values and Smoking in study groups

MPV	Smoking (N=20)		Smoking (N=11)	P value
	STEMI n=12	NSTEMI n =08	Comparison group n=11	
<9	00(00)	00(00)	09(81.81)	
9-11	08(66.67)	07(87.50)	02(18.18)	0.00001*
>11	04(33.33)	01(12.50)	00(00)	

When MPV values were compared in smoking subjects of 3 groups, MPV of > 11 fl was seen maximum in 04(33.33%) cases in STEMI followed 01(12.50%) case in NSTEMI. There were no smoking cases in comparison group with MPV values >11 fl. Hence smoking with high MPV values can cause STEMI and this was found to be highly statistically significant. (p value=0.00001).

Table 5: Distribution of MPV values and alcohol consumption in study groups

MPV	Alcohol consumption (N=16)		Alcohol consumption	P value
	STEMI n=10	NSTEMI n =06	Comparison group n=08	
<9	00(00)	00(00)	01(12.50)	
9-11	07(70.00)	05(83.33)	07(87.50)	0.33
>11	03(30.00)	01(16.67)	00(00)	

When MPV values were compared in alcohol consumption subjects of 3 groups, MPV of > 11 fl was seen maximum in 03(30%) cases in STEMI followed 01(16.67%) case in NSTEMI. There were no alcohol consumption cases in comparison group with MPV values >11 fl. Hence alcohol consumption with high MPV values can cause STEMI and this was not found to be highly statistically significant. (p value=0.33).

Table 6: Distribution of MPV values and diabetes mellitus in study groups

MPV	Diabetes mellitus (N=15)		Diabetes mellitus (N=08)	P value
	STEMI n=09	NSTEMI n =06	Comparison group n=08	
<9	01 (11.11)	00(00)	06(75.00)	
9-11	05 (55.56)	05(83.33)	02(25.00)	0.01*
>11	03 (33.33)	01(16.67)	00(00)	

When MPV values were compared in diabetes mellitus subjects of 3 groups, MPV of > 11 fl was seen maximum in 03(33.33%) cases in STEMI followed 01(16.67%) case in NSTEMI. MPV values between 9-11 fl were seen in 05(55.56%) diabetes mellitus cases with STEMI. There were no diabetes mellitus cases in comparison group with MPV values >11 fl. Hence diabetes mellitus with high MPV values can cause STEMI and this was not found to be statistically significant. (p value=0.01).

Table 7: Univariate analysis of MPV values with risk factors of MI among study subjects

Risk factor			Observation	Mean±SD MPV	P value
Hypertension	Cases	Present	30(31.91)	10.44±0.89	0.0001*
		Absent	64(68.09)	10.44±0.83	
	Comparison group	Present	12(12.77)	8.3±0.62	
		Absent	82(87.23)	8.66±1.22	
Diabetes mellitus	Cases	Present	15(15.96)	10.51±0.85	0.48
		Absent	79(84.04)	10.42±0.85	
	Comparison group	Present	08(8.51)	8.58±0.82	
		Absent	86(91.49)	8.62±1.00	
Smoking	Cases	Present	20(21.28)	10.54±0.88	0.03*
		Absent	74(78.72)	10.41±0.84	
	Comparison group	Present	11(11.70)	8.54±0.49	
		Absent	83(88.30)	8.63±1.03	
Alcohol consumption	Cases	Present	16(17.02)	10.47±0.94	0.06
		Absent	78(82.98)	10.43±0.83	
	Comparison group	Present	08(8.51)	8.6±0.48	

Dyslipidemia	Cases	Absent	86(91.49)	8.62±1.02	0.64
		Present	09(9.57)	10.44±0.85	
	Comparison group	Absent	85(90.43)	10.43±0.84	
		Present	02(2.13)	8.91±1.03	
		Absent	92(97.87)	8.62±0.97	

*statistically significant

DISCUSSION

The present study showed MPV as 10.43±0.84 fl in cases and 8.62±0.98 fl in comparison group. This was found to be statistically significant after applying t-test (p value=0.0001). Mean MPV in STEMI group was 10.85±0.84 fl and 10.02±0.62 fl in NSTEMI. Studies like Bharihoke *et al.*,[7] Khandekar *et al.*,[8] Manchanda *et al.*,[9] found significant differences in mean MPV values between cases and comparison groups. It implies that high mean MPV values are seen in cases of acute myocardial infarction and acute coronary syndrome when compared with healthy controls. Whereas, studies like Rai *et al.*[10] and Singhal *et al.*[11] did not find significant difference in both groups. Chu *et al.*[12] in their systematic review and meta-analysis investigating the association between MPV and AMI, all-cause mortality following myocardial infarction, and restenosis following coronary angioplasty 16 cross-sectional studies involving 2809 patients investigating the association of MPV and AMI indicated that MPV was significantly higher in those with AMI than those without AMI 95% confidence interval (p value < 0.001). These findings are consistent with present study findings. Murat *et al.*[13] in their study on 520 consecutive patients with ACS undergoing coronary angiography found that high MPV levels were independent predictors of multivessel CAD (p value<0 .001). Varol *et al.*[14] in their study on cases admitted with AMI having absolutely normal coronary arteries with coronary angiography found that MPV is significantly higher in such patients when compared with a control group. We did not find a single such case in present study with normal coronary arteries and AMI. Amraotkar *et al.*[15] in their study on platelet count and mean platelet volume at the time of and after acute myocardial infarction observed that MPV is significantly increased in subjects with acute MI as compared to subjects with stable CAD during acute phase of an MI and this difference is not observed during the quiescent phase (3 months post- MI). Also, MPV does not differ significantly between thrombotic and non-thrombotic MI patients and is therefore not useful as an independent biomarker in distinguishing between these types of MI. Slavka *et al.*[16] observed that increased MPV acted as a stand-alone risk factor and was associated with a high risk in patients experiencing an acute ischemic cardiovascular event. Patients within the highest quintile of MPV had a 1.5-fold higher hazard ratio for overall vascular mortality and an up to 1.8-fold higher risk in association with ischemic heart disease compared with patients within the lowest quintile. These findings were consistent with present study. In present study, when mean values of MPV were compared using ANOVA test in hypertensive and non-hypertensive subjects in cases and comparison group, it was found to be statistically significant. (p value=0.0001), also when mean values of MPV were compared using ANOVA test in smokers and non-smoker subjects in cases and comparison group, it was found to be statistically significant. (p value=0.03). Other risk factors like alcohol consumption and dyslipidemia was not statistically significant when compared in cases and comparison group along with mean MPV. The present study also observed that high MPV values along with history of hypertension, diabetes mellitus and smoking increases the risk of STEMI as compared to NSTEMI and comparison group. Similar studies like Agarwal *et al.*[17] found that MPV in those with diabetes was significantly greater than that in patients without diabetes (p=0.023) The correlation was not observed in control subjects with and without diabetes (p=0.664). Subgroup analysis of smokers vs nonsmokers and hypertensives vs non-hypertensive also did not reach statistical significance in neither cases nor controls. These findings were similar for diabetes but not for other risk factors with present study. Astuti *et al.*[18] in their study when correlated MPV with risk factor, diabetes was significantly associated with high MPV in cases while hypertension, DM and alcohol intake were significantly associated with high MPV in controls. These findings were consistent with present study. Rechcinski *et al.*[19] however in their study found previous MI and high HDL cholesterol along with high MPV values >11 fl were found to be significant.

CONCLUSION

There was significant association between high mean platelet values and risk of myocardial infarction. STEMI patients have high MPV as compare to NSTEMI and comparative group. MPV is a very low-cost investigation available easily in most healthcare settings. In smoking and hypertension patients, MPV values can be used an early marker for CAD.

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Source of Support: None Declared
Conflict of Interest: None Declared