IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 18, Issue 1 Ver. 2 (January. 2019), PP 26-30
www.iosrjournals.org

Study of Mean Platelet Volume in patients of Acute Myocardial Infarction

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Abstract: *Acute myocardial infarction is a common disease with serious consequences in mortality, morbidity, and cost to the society. Coronary atherosclerosis plays a pivotal part as the underlying substrate in many patients. Mean platelet volume (MPV)is a measure of platelet size, generated by full blood count analyzers as part of the routine complete blood count test cycle. An increased MPV, as an indicator of larger, more reactive platelets resulting from an increased platelet turnover, may therefore represent a risk factor for overall vascular mortality, including myocardial infarction. The objective of this study is find out Mean platelet volume (MPV) in AMI cases and compare them with age- and gender-matched controls, and to see correlation of MPV with established (Traditional) risk factors for AMI.*
Conclusion of study is that MPV is a very low cost investigation and can be obtained easily in most health care settings. This study corroborates others observations that MPV is higher in patients with AMI. It is not yet clear whether increase in MPV is the cause or effect of coronary artery occlusion. However we propose that it may be useful as a marker of myocardial infarction in an appropriate clinical situation.
Keywords*: Acute myocardial infarction, Coronary atherosclerosis, Mean platelet volume*

Date of Submission: 18-12-2018 Date of acceptance: 03-01-2019

I. Introduction

Acute coronary syndrome (ACS) is a unifying term representing a common end result, acute myocardial ischemia. Acute ischemia is usually, but not always, caused by atherosclerotic plaque rupture, fissuring, erosion, or a combination with superimposed intracoronary thrombosis and is associated with an increased risk of cardiac death and myonecrosis[1].It encompasses acute MI (resulting in ST-segment elevation or non–ST-segment elevation) and unstable angina. Cardiovascular disease is a global public health problem contributing to 30% of global mortality and 10% of the global disease burden.[2,3] Among the CVD, coronary heart disease events including acute myocardial infarction (AMI) and coronary death tend to strike at an earlier age in comparison to that in the Western countries.India has seen a rapid transition in its disease burden (number of cases/lakh) over the past couple of decades. The load of communicable and non-communicable diseases (NCDs) is projected to get reversed in 2020 from its distribution in 1990[4]. Prevalence of Coronary Heart Diseases (CHDs) is between 7-3 per cent in urban and 2-7 per cent in rural India.[5] A conservative estimate indicates that there could be 30 million CHD patients in India of which 14 million are in urban and 16 million in rural areas.[6] If the current trend continues by the year 2020, the burden of atherothrombotic CVD in India will surpass other regions of the world.

Mean platelet volume (MPV) is a machine-calculated measurement of the average size of **platelets** found in blood and is typically included in blood tests as part of the CBC.Mean platelet volume (MPV) is 6.8 to 10.5 fL (WinTrobe's DICI clinical Hematolog, 2014)[7]. An increased mean platelet volume (MPV), as an indicator of larger, more reactive platelets resulting from an increased platelet turnover, may represent a risk factor for overall vascular mortality, including myocardial infarction. Increase of platelet volume may contribute to increased prothrombotic tendency of atherosclerotic plaque in acute coronary syndrome and increased risk of intracoronary thrombus formation in AMI cases. High mean platelet volume (MPV) has been shown to be associated with AMI, acute ischemic stroke, preeclampsia, acute mesenteric ischemia.

Aspirin, an antiplatelet agent is essential in most of the situations whether it is thrombolytic approach or PCI or pharmacoinvasive (thrombolysis followed by PCI) approach. It is well known that platelet rich thrombus is central to the pathology of MI and acute coronary syndrome.

Therefore, the current study was carried out to compare MPV between MI patients and control group among patients admitted to Pt. JNM medical college and Dr. BRAM Hospital Raipur.

II. Materials & Methods:

Study Design: Hospital based case control study (age group within range of +_ 5yrs).

The study was initiated after obtaining Institutional Ethics Committee (IEC) approval of the protocol.―"*Study of Mean Platelet Volume in patients of Acute Myocardial Infarction*" was conducted in Department of General Medicine, Dr. B.R.A.M. Hospital, Raipur(C.G.) from 2014 to 2017. Thepatients admitted to the coronary care unit of Dr. Bhrimrao Ambedkar Memorial Hospital Raipur, Chhattisgarh were included for study.114 consecutive cases of AMI and equal number of age and sex matched controls (114) from the same population who did not have a past history of stroke or MI were enrolled for this study. Only newly diagnosed cases were included in the study. Informed and written consent was obtained from each participant. The diagnosis of AMI was as per criteria laid down in consensus document of the Joint European Society of Cardiology/American College of Cardiology Committee for the redefinition of myocardial infarction.The exclusion criteria included inflammatory diseases (like rheumatoid arthritis, systemic lupus erythematosus, inflammatory bowel disease etc.) severe liver disease, renal disease, myeloproliferative disorder, thrombotic thrombocytopenic purpura (TTP) and idiopathic thrombocytopenic purpura. Patients taking oral anticoagulation medicine. Thyroid disorders. Pregnant women. Sepsis.Recent history of Blood Transfusion.All the subjects wereassessed by clinical examination. ECG, serum CK-MB. Height & weight was recorded. Body mass index (BMI) was calculated by formula, weight in Kg divided by square of height in meters. BMI >25 will be considered as a risk factor for myocardial infarction. Blood pressure was recorded. Cases & controls were investigated for conventional risk factors(BMI, blood sugar, lipid profile).History of smoking & alcohol consumption were noted in detail.

Mean Platelet volume was estimated in all the subjects. Blood Sample was collected within 6 hours on arrival at ICU into tubes containing ethylene diamine tetra acetate (EDTA) was subsequently diagnosed having AMI and processed within 30 minutes of venesection.Platelet size tends to increase at room temperature on storage in first two hours and subsequently remain relatively stable for upto eight hours[8]. Dastjerdi et al., assured that MPV measurement could be accurate if sample is analyzed within one hour of collection[9]. The resident physician involved in the study was assigned to adhere to the time frame to minimize *in vitro* increase in platelet volume. All patients were managed according to the standard treatment guidelines under the physician in charge of the case. For measurement of platelet count (PLC), mean platelet volume (MPV), platelet distribution width (PDW) and plateletcrit (PCT), samples was analyzed by automated flow meter (By Erma INC PCE210). Controls coming for routine check-up and their blood samples will be collected in the outpatient department.For Statistical analysis, students 't' test was used. All were two tailed &P values <0.05 was considered statistically significant.

III. Results

This study entitled ―"*Study of Mean Platelet Volume in patients of Acute Myocardial Infarction*" was conducted in Department of General Medicine, Dr. B.R.A.M. Hospital,Raipur(C.G.) from 2014 to 2017. Total 114 cases of acute myocardial infarction and equal number of controls were enrolled for this study.In our study, Out Of 114 Cases Studied, 43(37.7%) were Females while 71(62.3%) were Males. Male female ratio is 1.65:1. Thus this study shows male predominance. In our study, a detailed clinical examination revealed that 40.4% (46) cases out of 114 were hypertensive, which is one of the major risk factors. Diabetes mellitus constitutes 37.7% (43) of all cases accounting for second most common risk factors. Dyslipidemia was present in 31.6% (36) of cases, 27.1% (31) cases had BMI of more than 25, 11.4% (13) were smokers whereas 21.5% (24) were chronic alcoholic. 87 of the patients had ST-segment elevation MI (STEMI) and 27 had Non-STEMI. The mean MPV in case group was 10.66 ±1.66 fl and in control group 8.45 ± 0.94 fl. Mean platelet volume was found to be significantly higher in cases compared to controls ($p<0.0001$).

Limitation of the Study: The results of the study cannot be generalized due to the potential bias resulting from the sampling technique and sample size.

IV. Discussion

In our study, mean age of cases was found to be 53.9 years with cases of age group ranging between 51 to 60 years were maximum followed by 41 to 50 years age groups. Least age groups affected were cases of less than 35 years and more than 70 years. It is acknowledged from this study that in our community, like any other communities, males are more at risk for AMI than females. Whereas in our study the predominant age group for MI is of 51 years and above. In a hospital based case control study for risk factors of acute myocardial infarction done by **Deshpande J. D. et al**[10]conducted in the 2001 comprising of 272 cases and equal amount of controls, concluded that age group of 51 years and above are at high risk of developing an acute myocardial infarction, which is in accordance with our study. Similarly a study containing 40 patients was conducted by **G. Channamma** in Karnataka in the year 2016 which showed that Out of 40 patients with acute myocardial infarction, 15% belong to 30 - 39 years, 17.5% belong to 40 - 49 years, 22.5% belong to 50 - 59 years, and

maximum patients (45%) were in age 60 years and above.[11]In a study conducted by **Christina Chrysohoou, Christos Pitsavoset al**1000 ACS patients who were consecutively enrolled during 2007–2008, maximum cases was found to be of age group more than 51 years.[12]

In our study, 62.3% were males while 37.7% of cases where females clearly showing male predominance with Male female ratio is 1.65:1.It is assumed that exposure to endogenous estrogens during the fertile period of life delays the manifestation of atherosclerotic disease in women. In the **Women's Ischemia Syndrome Evaluation (WISE)** study it was shown that young women with endogenous oestrogen deficiency have a more than sevenfold increase in coronary artery risk.[13] In a prospective study done by **Rohit Kumar Srivastava, Sunita Tiwari et al,** on 305 patients of acute myocardial infarction , 89.8% were found to be males, clearly showing male preponderance.[14]

From our study it is evident that, females of 51 to 60 years of age group are at higher risk of developing Acute Myocadial infarction than other age groups.it is in accordance with Recent data from the **National Health and Nutrition Examination Surveys (NHANES)** which shows that over the past two decades the prevalence of myocardial infarctions has increased in midlife (35 to 54 years) women, while declining in similarly aged men.**[15]**In this study MPV was significantly higher in patients with AMI in comparison to the control subjects. There was no significant difference in MPV values between ST elevation and non-ST elevation myocardial infarction. This finding was in accordance with the observation by **Yekelaret al[16]**. AMI occurs due to coronary atherosclerosis and thrombus formation. Platelets play a significant role in atherosclerosis as well as thrombosis[17,18]. When atherosclerotic plaque ruptures or erodes platelets are recruited to the exposed subendothelial region and partially occluded vessel becomes completely occluded with the newly formed thrombus. Larger platelets have greater prothrombotic potential and are biologically more potent. Increased platelet volume have been shown to be more reactive with greater production of thromboxane A2, and serotonin. There are other mechanisms by which platelets contribute to development of myocardial infarction via platelet mediated vasoconstriction and inflammation. **Chu et al.,** opined high MPV as a cardiovascular risk factor in a meta-analysis[19]. In a case control study done by **Bimal K. Agrawalet al** on 50 cases of acute myocardial infarction and equal controls concluded that Mean Platelet volume is significantly higher in cases than in controls.[20]

In our study, a detailed clinical examination revealed that 40.4% (46) cases out of 114 wear hypertensive, which is one of the major risk factors. Diabetes mellitus constitutes 37.7% (43) of all cases accounting for second most common risk factors. Dyslipidemia was present in 31.6% (36) of cases. 27.1% (31) cases and BMI of more than 25, 11.4% (13) were smokers whereas 21.5% (24) were chronic alcoholic.

There are various studies where higher MPV has been correlated with age, sex diabetes mellitus, hypertension, and dyslipidemia[21-24] but contradictory studiesalso exist[25]. In this present study, no association was found between mean platelet volume and age and gender. Risk factors like smoking, alcohol consumption and hypertension did not show correlation with MPV in either cases or controls.

Platelets have been implicated in the micro and macrovascular complications of diabetes mellitus[26].Subgroup analysis of patients with AMI in present study revealed that MPV was significantly higher in patients with diabetes than those without diabetes. **Hendra et al.,** in their study found that MPV was higher in patients with diabetes and AMI when compared to those with diabetes but without AMI[27]. Similarly **Tuzcu et al.,** had reported MPV to be higher in patients with diabetes complicated with retinopathy than those without retinopathy[28]. Diabetes, due to Insulin deficiency and/or insulin resistance, is considered a prothrombotic state. There are various ways by which diabetes can increase platelet activity.[29] Prolonged hyperglycemia leads to nonenzymatic glycation of platelet suface proteins. Moreover glycoprotein IIb/IIIa is reported to be overexpressed in diabetic individuals[30].

Subsequently In our study, Comparison of MPV in between Dyslipidemia and Non-Dyslipidemic cases was performed using Student's t test which show significantly higher levels of MPV were detected in Dyslipidemic subjects.

Mean Platelet volume was found significantly higher in patients who are obese with a BMI of > 25. Same finding was found when a case control study on 100 obese and 100 non obese subjects were carried out by Coban E et al[31] which concluded that The MPV was significantly higher in obese group than in non-obese control group.

Martin et al., had meticulously evaluated volume and density of platelets in myocardial infarction and suggested that platelet changes were secondary to megakaryocyte abnormalities and these changes preceded myocardial infarction[32]. They also seemed to have increased expression of procoagulant surface adhesion molecules like P-selectin and GPIIb/IIIa. In fact Huczek et al., observed that abciximab (GPIIb/IIIa antagonist) reduced mortality significantly only in patients of myocardial infarction who had high MPV[33]. They further observed that high MPV also carried worse prognosis in terms of poor angiographic reperfusion and higher six months mortality following primary percutaneous coronary intervention (PCI). Martin et al., also found that greater MPV correlated with subsequent mortality and nonfatal myocardial reinfarction[34]. Pereg et al., revealed that thrombolysis (in STEMI) failure rate was significantly higher in patients with high MPV[35]. Slavka et al., in

their study concluded that increased MPV may carry increased risk of mortality due to ischemic heart disease which was as much as that due to smoking or obesity.[36] Though in our study no significant association was found between raised MPV and mortality as also same was concluded by a study conducted by Senaran et al.[37]Adescriptive-analytical study with sample consisted of 200 patients were carried out in 2015 by Alireza Rai et al stating no association of mean platelet volume on cardiovascular mortality of acute myocardial infarction.[38]

V. Conclusion

In our present study, Mean Platelet Volume was found to be significantly higher in cases of acute myocardial infarction than in controls.MPV is a very low cost investigation and can be obtained easily in most health care with AMI. It is not yet clear whether increase in MPV is the cause or effect of coronary artery occlusion. However we propose that it may be useful as a marker of myocardial infarction in an appropriate clinical situation. Further study may be tested in a larger cohort of patients with AMI to confirm its use as an adjunct to diagnosis. In our study, Patients who were Diabetics, Dyslipidemic and patients having a BMI > 25 had significantly raised Mean Platelet Volume. In our present study, No significant difference was found when age and gender was compared with Mean Platelet Volume of cases and control. No significant difference of mean platelet volume was found between Patients who were alcoholic and smokers. In our study it was found that mean platelet volume has no association with overall mortality of patients of acute myocardial infarction.

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Tables & Charts

Table 1. Mean platelet volume in cases in association with risk factors.

Risk factors		n	%	MPV in cases (Mean ± SD)	P value
Sex	Male	71	62.3	9.28 ± 1.56	0.292
	Female	43	36.7	9.51 ± 1.74	
Hypertension	Yes	46	40.4	10.63 ± 1.66	0.069
	No	68	59.6	10.05 ± 1.64	
DM II	Yes	43	37.7	11.47 ± 1.20	<0.0001
	No	71	62.3	9.66 ± 1.50	
Smoking	Yes	13	11.4	10.32 ± 1.63	0.002
	No	101	88.6	10.03 ± 1.95	
Alcohol	Yes	24	21.1	9.99 ± 1.74	0.331
	No	90	78.9	10.37 ± 1.64	
MI	NSTEMI	27	23.7	10.11 ± 1.51	0.540
	STEMI	87	76.3	10.34 ± 1.71	
Dyslipidemia	Yes	36	31.6	10.99 ± 1.65	0.002
	No	78	68.4	9.96 ± 1.58	
Outcome	Discharge	98	86.0	10.31 ± 1.68	0.753
	Death	16	14.0	10.15 ± 1.59	

Table 2: Comparison of Mean platelet volume between cases and controls

	Cases (Mean ± SD)	Controls (Mean ± SD)	t	P value
MPV (fl)	10.29 ± 1.67	8.45±.95	10.242	<0.0001

Table 3. Comparison of various factors between cases and controls

FACTORS	Cases (Mean ± SD)	Controls (Mean ± SD)	t	P value
SBP	135.67 ±36.44	116.54±12.00	5.321	0.000
DBP	84.263±15.80	77.98±8.25	3.762	0.000
BMI	22.71±2.35	20.9921±1.39	6.718	0.000
Cholesterol (mg/dl)	235.36±81.14	169.26±21.49	8.408	0.000
CKMB (IU/L)	18.51±7.67	3.01±1.47	21.180	0.0001
Platelet count (/cumm)	169500±54797.98	185430±57065.55	-2.150	0.033

Table 4: Correlation of Various parameters with MPV

	Parameter	r	P value
MPV	Age	0.021	0.753
	BMI	0.433	<0.0001
	Cholesterol	0.490	<0.0001

Correlation of Various parameters with MPV was performed using Pearson's correlation analysis. Very weak uphill (r=0.021) correlation was found to exist between MPV and Age. This correlation was further found to be non-significant (p=0.753)

A moderate uphill correlation was found to exist between BMI (r=0.433) and Cholesterol (r=0.490) and these correlation were found to be significant (p<0.0001).