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Original Research Article

Increased mean platelet volume is associated with acute myocardial infarction in patients with diabetes mellitus type 2

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ABSTRACT

Background: The correlation between diabetes mellitus and acute myocardial infarction is greater every day. The mean platelet volume (MPV), which is the determinant of platelet function, is an independent risk factor for the cardiovascular disease. The aim of the study was to investigate the effect of each disease (hypothyroidism, hypertension, myocardial infarction) individually and combined on MPV in diabetic patients.
Methods: The cross-sectional study included 102 patients who suffer from diabetes mellitus type 2 (DMT2), of both sexes (46 females, 56 males), with the average age of 58.91 (SD=12.93). All the patients were treated at the Primary Health Centre in Zenica from May to July 2017. All patients had diabetes mellitus and the disease had lasted for 10 years in both sexes.
Results: Mean platelet volume was significantly higher in patients with myocardial infarction than in those without myocardial infarction. Age, sex, HbA1c, BMI, lipids and platelet count did not show any significance in either group of patients. Regression analysis showed that the prevalence of myocardial infarction had the highest predictive significance for MPV values, (predictor importance 0.49; coefficient 1.275, $p<0.001$).
Conclusions: Mean platelet volume was significantly higher in patients with diabetes mellitus and myocardial infarction than in DM patients without myocardial infarction. Regression analysis showed correlation with acute myocardial infarction in patients with DMT2, but not with other chronic illnesses. The highest platelet volume indices were observed in patients with myocardial infarction. MPV can be used as a specific indicator in diabetic patients with myocardial infarction.

Keywords: Diabetes mellitus, Mean platelet volume, Myocardial infarction, Thyroid disease

INTRODUCTION

Morbidity of more chronic illnesses at the same time is an increasingly common health problem in the general population. Many biomarkers of inflammation have been considered for the implementation in clinical practice.[1] Analyses of most parameters of platelet activity are time-consuming and expensive.[2] On the other hand, mean platelet volume (MPV) is a simple, quick and easy-to-measure parameter of platelet size. It can be determined by conducting a routine blood analysis at a relatively low

cost.[3] It has been found that MPV is significantly higher in DMT2 patients having micro- and macro-vascular complications than in patients without them.[4,5]

The correlation between diabetes mellitus and acute myocardial infarction is increasing every day. Numerous platelet markers have been investigated in connection with inflammation.[6] The mean platelet volume (MPV), which is the determinant of platelet function, is an independent risk factor for cardiovascular disease. Established cardiovascular risk factors, such as smoking, hypertension and dyslipidaemia, can influence MPV, depending on confounding factor.[6] Elevated MPV is associated with other markers of inflammation and platelet activity, including increased platelet aggregation, increased thromboxane synthesis and β-thromboglobulin release, and increased expression of adhesion molecules.[7] Available research data shows that increased MPV is linked to the presence of risk factors for cardiovascular disease, including diabetes mellitus, hyperlipidaemias, metabolic syndrome, hypothyroidism and other autoimmune diseases.[8] The relation between values of the MPV and thyroid gland diseases has not been comprehensively studied. Moreover, the available published literature is far from conclusive. For example, several studies revealed increased MPV in hypothyroidism, but other studies did not indicate such phenomenon.[8-12] There are some studies which showed that MPV level, as an indirect indicator of platelet activation, was significantly higher in hypertensive patients as compared to normotensives.[13] It is very important to know which of these diseases most commonly occurs with DMT2 and has most effect on MPV level.

The primary aim of this study was to investigate the influence of Acute myocardial infarction (AIM) on platelet activation through MPV values. An additional aim was to investigate the effect of multiple comorbidities on MPV in diabetic patients with diagnosis of AIM.

METHODS

This was a retrospective cross-sectional study which was conducted at the department of family medicine in Primary Health Care Centre in Zenica, Zenica, Bosnia and Herzegowina during the period from May 2017 to August 2017. In this study the total number of 102 patients with Diabetes mellitus type 2 (DMT2 patients) were analysed. All examinees had diabetes mellitus; the disease lasted for 10 years in both sexes. Patients were classified in three groups: I group was composed of patients with DM II who had AIM with or without other comorbidities. In the II group were patients with DM II without MI, but with other comorbidities. In III group were patients who had only DM II without other comorbidities.

Inclusion criteria

Patients with Diabetes melittus type 2, the disease lasted for 10 years in both sexes. Age group of study subjects was 53±16 years.

Exclusion criteria

In order to reduce the impact of the confounding factors, haematological disorders, pregnancy and malignancy were factors for exclusion from the study.

Ethical approval

The study approval was obtained from the Ethics Committee of Primary Health Care Centre Zenica, Zenica, Bosnia and Herzegowina.

Sample selection

Demographic, clinical and laboratory data was collected retrospectively. We have analysed the following variables: age, gender, duration of the disease, body mass index (BMI), physical activity, habit of smoking cigarettes, systolic and diastolic blood pressure, complete blood cell count including MPV, fasting blood glucose (FBG), HbA1c and lipid profile.

When blood count and HbA1c were measured, blood samples were taken in tubes with EDTA anticoagulant. The tubes without anticoagulant were used for collecting blood for glucose and lipid parameter measurement. Complete blood cell count, glucose and lipid measurements were performed at the Primary Health Care Centre in Zenica using XT 1800i haematology auto-analyser (Sysmex Corporation, Kobe, Japan) and chemistry analyser Olympus AU 480 (Beckman Coulter, USA), respectively.

Statistical analysis

Statistical analysis was conducted with IBM Statistical package social sciences (SPSS) Statistics software, version 25, and MedCalc version 18. Distribution was tested by Kolmogorov-Smirnov test. Statistically significant was SET level of $p<0.05$. All results are presented in numbers or percentages. Average value is presented as a mean value with standard deviation. Differences between groups were tested with Students t-test or chi square test. MPV values were tested by ROC to set cut off in determining differences in values between patients with myocardial infraction and those without it. Linear regression was used in examining the influence of disease on MPV value.

RESULTS

In total 102 patients with DM II were included in this study. From that number 54.9% were males, and 45,1% were females. Demographical characteristic and risk factors analysis are presented on table 1.

Table 1: The frequency of risk factors.

Variable	Description	MI with or without comorbidity		Comorbidity without MI		Only DM II		P
		N	%	N	%	N	%	
Sex	Male	13	52.0%	27	61.4%	16	48.5%	0.503
	Female	12	48.0%	17	38.6%	17	51.5%	
Age		67±10		60±13		53±16		0.001
Cigarettes	Yes	14	56.0%	17	38.6%	19	57.6%	0.153
	No	11	44.0%	27	61.4%	13	39.4%	
Alcohol	Yes	1	4.0%	5	11.4%	3	9.1%	0.584
	No	24	96.0%	39	88.6%	29	87.9%	
Physical activity	Yes	5	20.0%	9	20.5%	19	57.6%	0.001
	No	20	80.0%	35	79.5%	14	42.4%	
BMI		27.6±4.1		26.2±5.4		23.6±4.0		0.003

Results represents frequency and percentages. Average age is shown in mean with standard deviation, p – probability, statistically sig. set at p<0.05

Table 2: Distribution of patients and values of examined variables.

	MI with or without comorbidity			Comorbidity without MI			Only DM II			P
Variable	**Med.**	**95% CL Median**	**Per. range**	**Med.**	**95% CL Median**	**Per. range**	**Med**	**95% CL Median**	**Per. range**	
MPV	11.5	11.4-12.2	11-11.9	9.9	9.1-10.8	8.9-11	9	8.0-9.0	7.9-9.5	<0.001
Glucose	11	9-12.30	8.5-12.4	9.35	7.8-9.9	7.3-11.10	7.9	7.70-8.90	7.55-8.9	0.007
HbA1c	7.3	6.9-8.6	6.9-8.6	7.2	6.9-7.5	6.7-7.9	6.9	6.8-7.2	6.7-7.8	0.306

MPV, Glucose and HbA1c values are represented with median and interquartile range, MPV- mean platelet volume, Glucose – Blood sugar level; HbA1c- Glycolzsed haemoglobin; p-probability

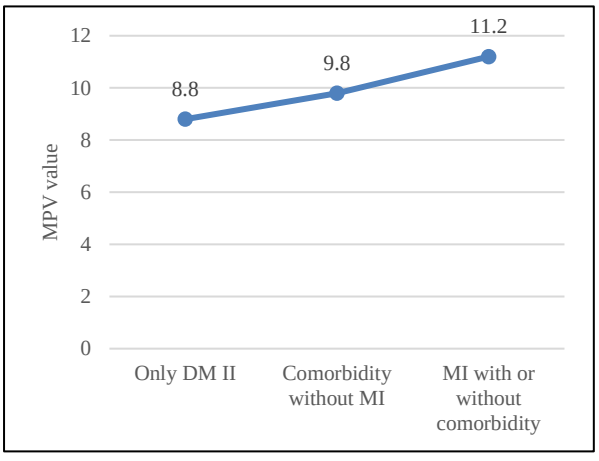

Figure 1: MPV value chart in comparison to comorbidity and myocardial infarction.

Groups were with similar gender distribution (p=0.503), There was significant difference in the patients age between examined groups. Patients with only DM II were significantly younger in comparison with patients who had comorbidity or MI (p=0.001). There wasn't any significant difference between groups in cigarettes consummation (p=0.153) or in alcohol consummation p=0.584). In the group with only DM II, 57,6% patients were physically active in comparison to 20,5% patients in the group with comorbidity or 20% in the group with MI. There was significant difference at the level of p=0.001. Also, patients who had DM II had significantly lower values than patients in other examined groups (p=0.003). Values of basic examined variables are shown on table 2.

Median value of MPV in group that had only DM II was 9, with the presence of other diseases MPV values were elevated (9.9). In the group that had MI median value of MPV was 11.5. Significantly, elevated values of MPV were determined in the group with MI presence. There wasn't significant difference between groups who had DM with other comorbidities but without MI, and the group with only DM II.

Table 3: Roc analysis.

Area under the ROC curve (AUC)		Youden index	
AUC	0.817	Youden index J	0.5758
Standard Error a	0.045	Associated criterion	>10.9
95% Con. lnter. b	0.728 to 0.887	Sensitivity	76
Z statistics	7.05	Specificity	81.58
Significance level P	<0.001	PPV	57.6
		NPV	91.2

Also, there is significant difference in glucose values between three groups, with largest values presented in the group with MI (p=0.007). HbA1c had similar results in all three groups, without significant difference (p=0.306). MPV value and impact of comorbidity and MI on MPV value were tested with Spearman's correlation factor. It is proven that there is positive moderate correlation between MPV values and comorbidity, with MI increases MPV values the most (Spearman's r=0.528, p<0.001).

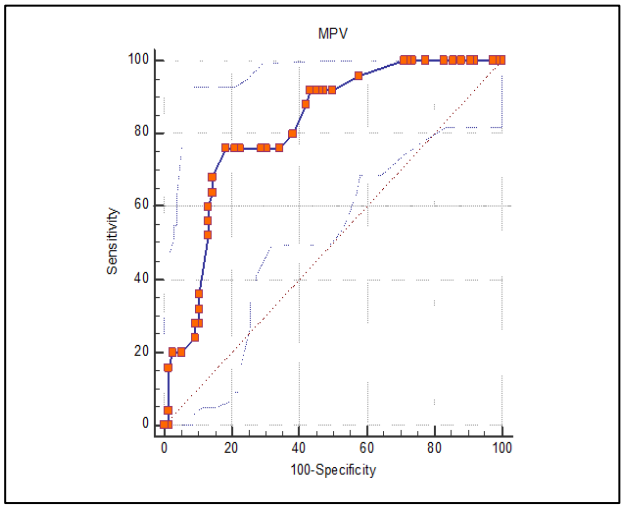

Figure 2: MPV as a test for myocardial infarction; ROC; AUC.

Using ROC curve analyses, MPV was analysed for usage as the test for myocardial infarction. Patients without any comorbidity but also those with comorbidities, but without MI were included in one group, to compare them with the group that had myocardial infarction. In our study, values of MPV >10.9 FL were pointing on myocardial infarction. Area under the curve was 0.817, p<0.001.

DISCUSSION

Multiple diseases such as hyperglycaemia, hypertriglyceridemia, hypertension or myocardial infarction have oxidative stress and inflammation in the background, affecting increased platelet reactivity and consequently increased MPV.[14-17] The mechanisms for an increased platelet volume are not understood. There are several theories that may explain the increase in MPV in myocardial infarction (MI), but they are all still being researched. One explanation for this is the consumption of platelets and release of more immature platelets from bone marrow in the circulation.[18,19] Another hypothesis is that in some patients, platelets are metabolically more active and therefore predisposing them for MI. Several studies have found that high MPV levels were associated with acute myocardial infarction.[20,21] Also body mass index (BMI) was statistically significantly increased in group with MI when compared to the group without MI. Active smoking, alcohol consumption and physical inactivity did not show any influence on MPV values. Therefore, MPV has been suggested as a simple marker of functional status of platelets and may represent a risk factor for vascular adverse events. All our patients had DMT2 and the aim was to investigate the effect of multiple comorbidities on MPV in diabetic patients with diagnosis of AIM. Hypothyroidism had a small predictive importance 0.223, with statistically sig. of p<0.025. Our results agree with Ren X result.[22] There wasn't any significant increase of MPV in hypertensive patients. Mean platelet volume was significantly higher in patients with diabetes mellitus and myocardial infarction than in DM patients without myocardial infarction, same as results of Varol et al.[23] The highest MPV value was in DMT2 patients with comorbidity of AIM, hypothyroidism and hypertension arterials, from which it follows that multi comorbidity had more significance on MPV values. We propose that MPV might be an important predictive factor for cardiac damage. Regression analysis showed only association with myocardial infarction in patients with DMT2 and somewhat with hypothyroidism. MPV values increased with the increase of comorbid conditions where the highest platelet volume increase was observed in patients with myocardial infarction.

Limitations

A limitation of our study was a relatively small number of patients. Further analysis on a larger number of subjects is recommended.

CONCLUSION

MPV can be used as a specific indicator in diabetic patients with MI. That could have important impact on clinical practice in treatment of DMT2 patients with AIM.

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