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Mean Platelet Volume (MPV) as an inflammatory marker in type 2 diabetes mellitus and obesity

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ABSTRACT

Background: Type 2 diabetes mellitus and obesity are two important disorders which are associated with the enormous amount of morbidity and mortality. Inflammation plays a crucial role in development and complications of these diseases.

Aim: We aimed to compare mean platelet volume (MPV) as an inflammatory marker in well and poorly controlled type 2 diabetic subjects and to observe its association with obesity indices, body mass index (BMI) and waist circumference.

Method: Data of type 2 diabetic patients obtained from institutional database retrospectively analyzed. Patients were divided into two groups according to the HbA1c level as follows: HbA1c lower than 7% were classified as well-controlled, and HbA1c equal to or greater than 7% were classified as poorly controlled diabetics.

Result: Both MPV, body mass index (BMI) and waist circumference were significantly higher in poorly controlled diabetics compared to patients with well-controlled type 2 DM.

Conclusion: MPV could be considered as a marker of inflammatory burden in type 2 DM and obesity. Due to its cost-effective and easy to assess nature, MPV may be screened periodically in these patients, along with HbA1c and other measures to keep both physicians and patients aware of the inflammatory load of these diseases.

Keywords: Type 2 diabetes mellitus, body mass index, obesity, mean platelet volume, inflammation

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INTRODUCTION

Type 2 diabetes mellitus (DM) is one of the most important cause of morbidity and mortality around the world. The uncontrolled disease is associated with increased morbidity and mortality. Obesity is another serious condition which has a close relation to mortal and debilitating diseases, such as, cardiovascular diseases, type 2 DM, cerebrovascular diseases and hypertension. Both type 2 diabetes mellitus and obesity increase the inflammatory burden and cause a continuous low-grade inflammation. Authors suggest that inflammatory microenvironment in obese and diabetic patients is responsible for many of the complications of these disorders.[1]

While inflammation plays a crucial role in the development of many diseases and their complications, hemogram parameters, such as mean platelet volume (MPV) is considered as a novel inflammatory marker. Mean platelet volume has been reported to be associated with mortality in critical care.[2] Beside overt inflammation, such as inflammatory bowel disease,[3] and rheumatoid arthritis,[4] it has also been found to be associated with low-grade inflammatory conditions.[5] Previously, we showed the association between MPV and type 2 DM.[6]

In present retrospective study, we aimed to compare MPV values of the well and poorly controlled type 2 diabetic subjects and to observe its association with obesity indices, body mass index (BMI) and waist circumference.

RESEARCH DESIGN AND METHODS

We retrospectively screened the computerized database and patient files of our institution and collected the data from subjects with type 2 diabetes mellitus. Patients with infection or any other inflammatory diseases were excluded. We also did not include pregnant subjects in the study. General characteristics, such as age, gender, antidiabetic medications used, and findings in physical examination, such as height, weight, waist circumference, blood pressure (systolic and diastolic) and heart rate were recorded. We calculated body mass index by the division of weight by the square of height.

We obtained and recorded the laboratory parameters from database and patient files. Those include glycated hemoglobin (HbA1c), fasting plasma glucose (FPG), blood urea, creatinine, aspartate aminotransferase (AST), alanine aminotransferase (ALT), white blood cell count (WBC), hemoglobin (Hb), hematocrit (Htc), platelet count (PLT) and MPV. Patients were divided into two groups according to the HbA1c level. Subjects

Table 1 General characteristics of the study groups

Characteristics		Well-controlled	Poorly controlled	p
		Median (Min-Max)		
Age (years)		64 (35-77)	58 (25-81)	0.02
Waist circumference (cm)		88 (74-121)	96 (79-110)	0.001
Systolic BP (mmHg)		122 (110-142)	128 (110-141)	0.19
Diastolic BP (mmHg)		80 (68-90)	80 (68-89)	0.96
		Mean ± SD		
Heart rate (beat per minute)		79 ± 4	78 ± 5	0.45
BMI (kg/m^2)		27.3 ± 4.7	29.1 ± 4.3	0.03
		Chi-Square test		
Gender	Men (n)	24	26	0.84
	Women (n)	30	35	
Metformin usage	Yes	33	25	0.03
	No	21	36	

Table 2 Laboratory parameters of the study groups

Laboratory parameters	Well-controlled	Poorly controlled	p
	Mean ± SD		
WBC (u/mm^3)	7.3 ± 1.6	7.8 ± 1.7	0.13
Hb (g/dl)	14 ± 1.3	14 ± 1.5	0.92
Htc (%)	42 ± 3.5	42 ± 4	0.98
PLT (u/mm^3)	252 ± 77	273 ± 74	0.13
MPV (fL)	7.9 ± 1.3	9.6 ± 1.1	**< 0.001**
	Median (Min-Max)		
HbA1c (%)	6.5 (5.5-6.9)	9.3 (7.1-12.5)	**< 0.001**
Urea (mg/dl)	33 (17-51)	28 (15-68)	0.24
Creatinine (mg/dl)	0.81 (0.6-1.5)	0.80 (0.50-1.81)	0.97
AST (IU/L)	19 (10-91)	18 (10-71)	0.55
ALT (IU/L)	20 (8-28)	24 (9-66)	0.21
FPG (mg/dl)	124 (92-134)	190 (104-315)	**< 0.001**

with an HbA1c lower than 7% were classified as well-controlled, and equal to or greater than 7% were classified as poorly controlled diabetics.

Statistical analyses were conducted by SPSS software (SPSS 15.0; SPSS Inc., IBM, Chicago, IL, USA). Homogenous variables were compared between groups by t-test and expressed as mean ± SD. Nonhomogenous variables were compared between groups by Mann-Whitney U test and expressed as median (min.-max.). Nonparametric variables were analyzed by chi-square test. Statistically, significance was set on the level of a p-value lower than 0.05. We conducted correlation analyses using Pearson's correlation. The significance of correlation was set on a p-value lower than 0.01. The study was approved by the institutional directorate.

RESULTS

A total of 115 subjects enrolled in the study, 54 in well-controlled and 61 in poorly controlled type 2 diabetes mellitus group. Age of the well-controlled diabetics (64 [35-77] years) was significantly advanced than that of the poorly controlled subjects (58 [25-81] years) (p = 0.02).

While 24 of 54 subjects in well-controlled diabetes group were men and 30 were women, 26 were men, and 35 were women in poorly controlled diabetes group. Gender was not statistically different between study groups (p=0.84). Systolic and diastolic blood pressures, heart rate, blood Hb, Htc, WBC, PLT, urea, creatinine, AST and ALT levels were not statistically different between well-controlled and poorly controlled subjects

($p > 0.05$ for all). Waist circumference and BMI were significantly higher in poorly controlled subjects compared to well-controlled diabetics ($p = 0.001$ for waist circumference and $p = 0.03$ for BMI). Table 1 shows the general characteristics of the study groups, and table 2 shows the summary of laboratory data.

Pearson correlation analysis revealed that MPV was positively and strongly correlated with both HbA1c ($p < 0.001$, $r = 0.55$), fasting plasma glucose ($p < 0.001$, $r=0.39$), waist circumference ($p < 0.001$, $r = 0.53$), and BMI ($p < 0.001$, $r = 0.42$). On the other hand, neither HbA1c ($p = 0.13$, $r = 0.14$) nor fasting plasma glucose ($p = 0.49$, $r = 0.06$) were correlated with BMI.

DISCUSSION

The main finding of the present retrospective analysis is that MPV could be considered as a marker of the inflammatory burden of glycemic control and obesity in patients with type 2 diabetes mellitus.

Association between obesity and inflammation is well established. Authors found that adiposity caused elevated C-reactive protein levels in bloodstream.[7] Obesity-related chronic low-grade inflammation is now considered as both an underlying trigger of the metabolic syndrome and its complications.[8] Reduction in the serum levels of inflammatory indices and improvement in insulin sensitivity could be achieved by weight loss of the obese subjects.[9-11] Inflammation is a response of the body to the noxious stimulants, however, if the immune cells fail to remove the harmful stimuli chronic inflammation persists. Recent studies suggested that perpetual activation of innate immune cells were responsible for chronic inflammation in extremely obese subjects.[12] Because inflammation in obesity is unsurpassed and activation range of the immune cells are not widespread as seen in infection or autoimmunity, the chronic inflammation in obesity and metabolic syndrome is called a low-grade inflammatory condition,[13] or as meta-inflammation,[14] or para-inflammation.[15] Many studies in literature pointed out an association between obesity and inflammatory indices.[16,17] Similar to the literature data, a positive correlation was demonstrated between MPV and BMI in the present study.

Association between type 2 DM and activation of the inflammatory system is also well established since the beginning of the 2000s.[18,19] Moreover, serum c-reactive protein of pregnant women in the first trimester who develop gestational DM subsequently was significantly increased compared to pregnant women that remain normoglycemic during pregnancy.[20] Beside the role of inflammation in the pathogenesis and development of the disease, inflammatory markers may also reflect the control level of type 2 DM. A study showed that aspirin treatment resulted in a reduction in fasting plasma glucose, and in c-reactive protein levels in subjects with DM.[21] Consistently with the literature, MPV elevation, as an inflammatory marker, was associated with worse control of the type 2 DM in the present study.

In literature, the correlation between diabetic control level and MPV is controversial. Researchers studied MPV in 265 type 2 diabetic subjects and compared to those in 151 nondiabetic controls, and found a significantly higher MPV in diabetic subjects than controls. However, they could not show a correlation between MPV and HbA1c level.[22] On the other hand, in another study in literature, authors found a strong correlation between MPV and HbA1c level.[23] Similarly, we also found the correlation between MPV and HbA1c in our report.

Although MPV tends to increase with age, well-controlled diabetics with lower MPV were significantly older than poorly controlled diabetics. This finding suggests MPV's strength to state inflammation in type 2 diabetes mellitus.

Lack of correlation between HbA1c and BMI may be explained by small study population of the present report and a higher percentage of metformin use in well-controlled diabetic subjects.

There are two main limitations of this study. First, relatively small cohort and second, retrospective design. However, a strong correlation between MPV and diabetic regulation and obesity indices that reported in our study adequately make our results to be interpreted with the clinical practice.

CONCLUSION

In conclusion, MPV could be considered as a marker of inflammatory burden in type 2 DM and obesity. Due to its cost-effective and easy to assess nature, MPV may be screened periodically in these patients, along with HbA1c and other measures, to keep both physicians and patients aware of the inflammatory load of these diseases.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest with the contents of this article. This study has not been funded by any organizations.

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