Role of Mean Platelet Volume in the Development of Peripheral Artery Disease

Dilek Mersin Özcanoğlu[1], Bedih Balkan[1], Ünal Aydın[2]

[1] University of Health Sciences, Istanbul Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Training and Research Hospital, Department of Anesthesiology and Reanimation, Istanbul, Turkey
[2] University of Health Sciences, Istanbul Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Training and Research Hospital, Department of Cardiovascular Surgery, Istanbul, Turkey

ABSTRACT

Introduction: The mean platelet volume (MPV) is one of several indicators of platelet activity. Recent studies have shown that MPV is increased in myocardial infarction, unstable angina, and stroke. Peripheral artery disease (PAD) manifests with the narrowing or obstruction of the abdominal aorta and arteries distal to the aortic bifurcation due to progressive atherosclerosis. The objective of this study is to investigate the MPV and platelet count in patients with PAD.

Patients and Methods: This study included 67 patients aged 40-80 years who underwent elective surgery for PAD in our hospital between January 2018 and June 2019, along with a control group comprising 67 patients without PAD. The MPV and platelet count values were obtained from a preoperatively performed hemogram analysis. Importantly, the groups were statistically compared in our study.

Results: As compared to the control group, the patients with PAD had a significantly higher mean age ($p= 0.02$), prevalence of diabetes mellitus ($p< 0.01$), as well as frequency of antiaggregant use ($p< 0.01$) and smoking ($p< 0.01$). There were no statistically significant differences in the other clinical features between the groups ($p> 0.05$). The mean platelet count and MPV were also significantly higher in patients with PAD as compared to patients without PAD ($p< 0.01$).

Conclusion: The use of inexpensive and widely used tests such as platelet count and MPV can facilitate an early diagnosis of the diseases with high morbidity and mortality, such as PAD.

Key Words: Peripheral artery disease; mean platelet volume; platelet count

Ortalama Trombosit Hacminin Periferik Arter Hastalığı Gelişimindeki Rolü

ÖZET

Giriş: Ortalama trombosit hacmi (OTH) trombosit aktivitesini gösteren parametrelerden biridir. OTH düzeyinin miyokart enfarktüsünde, unstabil anjinada ve inme durumunda arttığı son yıllarda yapılan çalışmalarda gösterilmiştir. Periferik arter hastalığı (PAH) da ilerleyici aterosklerozun sonucu olarak, abdominal aort ve aortun bifurkasyon seviyesinin distalindeki arterlerde daralma veya tıkanıklık ile kendini gösteren bir hastalıktır. Bu çalışmada PAH'ın tespitinde ve takibinde OTH'nin ve trombosit değerinin rolünün araştırılması amaçlanmıştır.

Hastalar ve Yöntem: Çalışmaya Ocak 2018-Haziran 2019 tarihleri arasında hastanemizde PAH nedeniyle elektif olarak opere olan 40-80 yaş arasında 67 hasta dahil edildi. Aynı tarihlerde PAH ve koroner arter hastalığı dışında kardiyak cerrahi geçiren 67 hasta ise kontrol grubu olarak seçildi. Operasyon öncesinde yapılan hemogram tetkiklerindeki OTH değerleri ve trombosit sayıları kaydedilerek istatistiksel olarak incelendi.

Bulgular: PAH pozitif hastalarda yaş ortalaması, diabetes mellitus pozitifliği, antiagregan ve sigara kullanım sıklığı, PAH negatif hastalara göre anlamlı düzeyde daha yüksekti. Çalışmada gruplar arasında diğer klinik özellikler açısından istatistiksel olarak anlamlı bir fark saptanmamıştır ($p> 0.05$). PAH pozitif hastalarda ortalama trombosit sayısı ve OTH düzeyleri, PAH negatif hastalara göre istatistiksel olarak anlamlı düzeyde daha yüksek tespit edilmiştir ($p< 0.01$).

Sonuç: PAH gibi morbidite ve mortalitesi yüksek olan hastalıklarda, trombosit sayısı ve OTH gibi ucuz ve yaygın olarak kullanılan tetkiklerin kullanımı PAH gelişiminde erken tanıda yardımcı olabilir.

Anahtar Kelimeler: Periferik arter hastalığı; ortalama trombosit hacmi; trombosit sayısı

Cite this article as: *Mersin Özcanoğlu D, Balkan B, Aydın Ü. Role of mean platelet volume in the development of peripheral artery disease. Koşuyolu Heart J 2020;23(2):91-4.*

Correspondence

Dilek Mersin Özcanoğlu

E-mail: dilekmersin@hotmail.com
Submitted: 07.04.2020
Accepted: 12.05.2020
Available Online Date: 25.08.2020

INTRODUCTION

Mean platelet volume (MPV) is a biomarker related to the function and activity of thrombocytes[1]. Recent studies have shown that MPV increases in myocardial infarction, unstable angina, and stroke[2-4]. Peripheral artery disease (PAD) is a condition that manifests with the narrowing and obstruction of the abdominal aorta and arteries distal to the aortic bifurcation due to progressive atherosclerosis[5]. MPV has also been analyzed in patients with PAD, but the few studies conducted to date have yielded conflicting results. Recent studies have investigated the relationship between MPV and the presence or absence of disease as well as disease severity[6,7]. The objective of this study is to investigate the potential utility of MPV and platelet count in the detection and follow-up of PAD by comparing these parameters in patients who were clinically and angiographically diagnosed with PAD and underwent surgery for the same disease with the control subjects having no atherosclerotic heart disease.

PATIENTS and METHODS

This study was conducted in accordance with the Declaration of Helsinki after obtaining approval from the ethics committee of University of Health Sciences, Istanbul Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Training and Research Hospital (date: July 30, 2019; no: 2019-46). The study group included 67 patients aged 40–80 years who were clinically and angiographically diagnosed with PAD and underwent elective surgery for the same disease in our hospital between January 2018 and June 2019. Additionally, the control group included 67 patients who underwent heart surgery for reasons other than PAD or coronary artery disease (CAD) during the same period. Patients who underwent emergency surgery were younger than 40 or older than 80 years of age, had liver or renal failure requiring hemodialysis, and patients whose data could not be obtained retrospectively were excluded from the study.

For MPV and platelet count measurements, values from the hemogram results obtained from the blood samples collected after 12 hours of fasting within the last week before surgery were used. The blood samples were collected into tubes containing tripotassium ethylenediaminetetraacetic acid (EDTA), and MPV and other hemogram parameters were analyzed in a SYSMEX XN-1000 hematology analyzer (Sysmex Corporation, Kobe, Japan).

The PAD group comprised the patients aged 40-80 years who were clinically and angiographically diagnosed with PAD and underwent elective surgery for the same disease. Additionally, the control group comprised the patients aged 40–80 years with no signs of CAD on angiography and underwent atrial septal defect or heart valve repair in our hospital.

The patient records were obtained retrospectively from the medical files and the hospital database. The data were entered into a Microsoft Excel spreadsheet, and statistical calculations of the data were then performed.

Statistical Analysis

Data distributions were evaluated and statistical analyses were performed using Statistical Package for the Social Sciences for Windows version 17 program. Student's t test was used to compare the mean values between the groups, whereas chi-square and Fisher's exact tests were used to compare the frequencies. $p< 0.05$ was considered as the statistically significant value for this study.

RESULTS

Table 1 shows the comparisons of sex, age, and selected clinical characteristics between the groups. Age, prevalence of diabetes mellitus, as well as frequency of antiaggregant use and smoking were significantly higher in the PAD group as compared to the control group ($p< 0.05$). Other clinical characteristics showed no statistically significant difference between the groups ($p> 0.05$).

Table 2 shows the comparison of platelet counts and MPV values between the groups. The mean platelet count and MPV values were significantly higher in the patients with PAD as compared to the patients without PAD ($p< 0.01$).

DISCUSSION

In this study, we found that preoperative MPV values and platelet counts were significantly higher among patients clinically and angiographically diagnosed with PAD as compared to the patients in control group. The use of inexpensive and widely used tests such as platelet count and MPV may facilitate an early diagnosis of diseases with high morbidity and mortality, such as PAD.

Previous studies on this subject are both limited in number and offer conflicting results. In addition to MPV and platelet count, Zeiger et al. also aimed to demonstrate platelet activation by analyzing the levels of P-selectin, which acts as an adhesion molecule on the surfaces of activated endothelial cells lining the blood vessels and activated platelets[8]. Their study included 42 patients with PAD and 30 healthy controls. Unlike our study, they detected no statistically significant difference between the patient and control groups, but the P-selectin levels were higher in the patient group as compared to the control group. The levels of platelet-derived microparticles and PAg, which enables platelet aggregation, were found to be markedly elevated in the PAD group.

In contrast, Rief et al. reported lower MPV levels in the patients with PAD, especially those with critical leg ischemia[9].

Table 1. Comparison of sex, age, and selected clinical characteristics between the patient groups

	Groups		
	PAD group (n= 67)	Control group (n= 67)	
Variable	n (%)	n (%)	p
Male sex	60 (89.6)	59 (88.1)	0.78
Age (years)	60 ± 9	56 ± 11	**0.02**
BMI	26.3 ± 3.8	27.8 ± 5.6	0.07
COPD (+)	19 (28.4)	23 (34.3)	0.46
HT (+)	32 (47.8)	30 (44.8)	0.73
DM (+)	29 (43.3)	12 (17.9)	**< 0.01**
CKD (+)	8 (11.9)	5 (7.5)	0.38
Antiaggregant use (+)	57 (85.1)	24 (35.8)	**< 0.01**
Smoking (+)	54 (80.6)	38 (56.7)	**< 0.01**
Alcohol use (+)	2 (3.0)	– (–)	0.50

Values are provided as number and percentage or mean ± standard deviation.
PAD: Peripheral artery disease, BMI: Body mass index, COPD: Chronic obstructive pulmonary disease, HT: Hypertension, DM: Diabetes mellitus, CKD: Chronic kidney disease.

Table 2. Comparison of platelet count and mean platelet volume between the study groups

	Groups					
	PAD group (n= 67)		Control group (n= 67)			
Variable	Mean	SD	Mean	SD	t*	p*
Platelet count (x10^9/μL)	309	116	256	66	**3.3**	**< 0.01**
Mean platelet volume (fL)	10.5	0.9	9.8	0.5	**6.0**	**< 0.01**

* Student's t test.
PAD: Peripheral artery disease, SD: Standard deviation.

These patients were found to be in the group with no myocardial infarction and stroke. The researchers acknowledged that performing a single blood test and having a retrospective study design may have affected the results.

Unlike other studies in the literature, a prospective study of 82 patients by Demirtaş et al. showed that MPV and red cell distribution width were correlated with a poor prognosis in patients with PAD[5]. They reached this conclusion by comparing a group of recently diagnosed patients to individuals with advanced disease according to Fontaine classification.

Slavka et al. investigated all the vascular mortality and deaths associated with ischemic heart disease in a large-scale study comprising 206.554 patients over 7 years and stated that MPV can be regarded as a predictive marker[3]. They also stated that MPV can be considered as a risk factor comparable to smoking and obesity.

Similar to our study, Özlük et al. compared 56 patients clinically and angiographically diagnosed with PAD and a group of 28 controls[10]. They detected no statistically significant difference between the groups. They further noted that MPV can be affected by numerous factors, and different measurement techniques may yield different results.

Our study is unique because it included patients who received a definitive diagnosis before undergoing surgery. However, the retrospective design and a small sample size are important limitations of this study.

In conclusion, high MPV and platelet count were associated in patients clinically and angiographically diagnosed with PAD. The MPV and platelet count are the parameters that provide a rough estimate of platelet function. Prospectively designed studies including more costly and complicated platelet function parameter measurements will be more elucidating in this subject.

Ethics Committee Approval: This study was conducted in accordance with the Declaration of Helsinki after obtaining approval from the ethics committee of University of Health Sciences, Istanbul Mehmet Akif Ersoy Thoracic and Cardiovascular Surgery Training and Research Hospital (date: July 30, 2019; no: 2019-46).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept/Design - DÖ, BB; Analysis/Interpretation - DÖ, BB; Data Collection - DÖ, BB; Writing - DÖ, BB, ÜA; Critical Revision -DÖ, BB, ÜA; Final Approval - DÖ, BB, ÜA; Statistical Analysis - DÖ, BB, ÜA; Obtained Funding - DÖ; Overall Responsibility - DÖ, BB, ÜA.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declared that this study has received no financial support.

REFERENCES

1. Bath PMW, Butterworth RJ. Platelet size: measurement, physiology and vasculer disease. Blood Coag Fibrinolysis 1996;7:157-61.
2. Kalkan GY, Gür M, Baykan AO, Uçar H, Elbasan Z, Şahin DY, et al. Mean platelet volume is associated with aortic intima-media thickness in patients without clinical manifestation of atherosclerotic cardiovascular disease. Anatol J Cardiol 2015;15:753-8.
3. Slavka G, Perkmann T, Haslacher H, Greisenegger S, Marsik C, Wagner OF, et al. Mean platelet volume may represent a predictive parameter for overall vascular mortality and ischemic heart disease. Arterioscler Thromb Vasc Biol 2011;31:1215-8.
4. D' Erasmo E, Aliberti G, Celi FS. Platelet count, mean platelet volume and their relation to prognosis in cerebral infarction. J Intern Med 1990;227:11-4.
5. Demirtaş S, Karahan O, Yazıcı S, Güçlü O, Çalışkan A, Yavuz C, et al. The relationship between complete blood count parameters and Fontaine's Stages in patients with peripheral arterial disease. Vascular 2014;22:427-31.
6. Madjid M, Fatemi O. Companents of the complete blood count as risk predictors for coronary heart disease: in-depth rewiew and update. Tex Heart Inst J 2013;40:17-29.
7. Kaya H, Ertaş F, İslamoğlu Y, Kaya Z, Arıtürk Atılgan Z, Çil H, et al. Association between neutrophil to lymphocyte ratio and severity of coronary artery disease. Clin Appl Thromb Hemost 2014;20:50-4.
8. Zeiger F, Stephan S, Hoheisel G, Pfeiffer D, Ruehlmann C, Koksch M. P-selection expression, platelet aggregates, and platelet-derived microparticle formation are increased in peripheral arterial disease. Blood Coagul Fibrinolysis 2000;11:723-8.
9. Rief P, Raggam BR, Avian A, Hafner F, Sareban M, Wehrschuetz M, et al. Low mean platelet volume is associated with critical limb ischemia in peripheral arterial occlusive disease. Sci Rep 2018;8:6718.
10. Özlük AÖ, Ber İ, Peker T, Yılmaz M, Tenekecioğlu E, Karaağaç K, Vatansever F. Mean platelet volume levels in the presence of angiographically documented peripheral artery disease. Int J Clin Exp Med 2015;8:2899-904.