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The Role of Mean Platelet Volume in Preeclampsia

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Abstract

Objective: Preeclampsia is a pregnancy-specific, multisystem disorder characterized by the development of hypertension and proteinuria 20 weeks after gestation. We investigated the role of mean platelet volume in preeclampsia according to the emergence of the disease, as being early or late, and its severity.

Material and Methods: Forty-six preeclamptic women and 49 healthy pregnant women as the control group were included in this retrospective study. Preeclamptic patients were divided into groups. Age, hemoglobin count, hematocrit, platelet count, mean platelet volume, platelet distribution width, and pregnancy weeks of the groups were compared with each other.

Results: The mean age of the groups was similar (preeclampsia=30±6.9 and control=28.4±5.3, p=0.125). There was no statistically significant difference between the two groups in terms of gestational weeks (P=0.2). The mean platelet count (x10^3/μL) was 207±83 in the preeclamptic group and 205±51 in the control group and there was no statistically significant difference between the groups (P=0.78). It was found that the mean platelet volume was notably higher in the preeclamptic group (10.8±1.3 and 9.8±1.3, respectively) (P=0.03). The platelet distribution width values of the preeclamptic group and the control group were 15.3±2.8 and 14.8±2.5, respectively, and there was no statistically significant difference between the groups (P=0.34).

Conclusion: Mean platelet volume was higher in the preeclamptic group than the control group. However, as far as mean platelet volume is concerned, there were no differences between the emergence of preeclampsia as early or late, or the severity of preeclampsia.

Key Words: Preeclampsia; Mean platelet volume; Severity of preeclampsia; Subclassification of preeclampsia.

Ortalama Platelet Hacminin Preeklampside Rolü

Özet

Amaç: Preeklampsi gebeliğin 20. haftasından sonra hipertansiyon ve proteinüri gelişimi ile karakterize gebeliğe özgü, multisistemik bir hastalıktır. Bu çalışmada, ortalama trombosit hacminin hastalığın ciddiyetine ve hastalığın erken ya da geç ortaya çıkmasına göre ilişkisini ortaya koymayı amaçladık.

Gereç ve Yöntemler: Bu retrospektif çalışmaya, preeklampsi tanısı almış 46 hasta ve kontrol grubu olarak 49 sağlıklı gebe kadın dahil edildi. Preeklampsi grubundaki hastalar erken veya geç ve hafif veya ağır hastalık olarak gruplara ayrıldı. Gruplar yaş, hemoglobin, hematokrit, trombosit sayısı, ortalama trombosit hacmi, trombosit dağılım aralığı ve gebelik haftaları açısından karşılaştırıldı. İki grup arasındaki parametrelerin karşılaştırılması için bağımsız örneklem t-testi kullanıldı.

Bulgular: Gruplar arası yaş ortalaması benzerdi (preeklampsi=30±6.9 ve kontrol=28.4±5.3, p=0.125). Her iki grup arasında gebelik haftaları yönünden anlamlı fark yoktu (p=0.2). Preeklampsi grubunda ortalama trombosit sayısı (x10^3/μL) 207±83 ve kontrol grubunda 205±51 bulundu ve gruplar arasında anlamlı fark yoktu (P=0.78). Preeklampsi grubunda ortalama trombosit hacmi kontrol grubundan anlamlı olarak daha yüksek bulundu (sırasıyla; 10.8±1.3 ve 9.8±1,3) (P=0.03). Ortalama trombosit dağılım aralığı preeklampsi ve kontrol grubunda sırasıyla, 15.3±2.8 ve 14.8±2.5 bulundu ve iki grup arasında fark yoktu (P=0.34).

Sonuç: Ortalama trombosit hacmi, preeklampsi grubunda kontrol grubundan daha yüksek bulundu. Ancak, preeklampsinin erken veya geç olmasında ve preeklampsinin ağırlığı açısından ortalama trombosit hacminde bir farklılık bulunmadı.

Anahtar Sözcükler: Preeklampsi; Ortalama trombosit hacmi; Preeklampsi şiddeti; Preeklampsi alt sınıflaması.

INTRODUCTION

Specific to pregnancy, preeclampsia is a multisystem disease characterized by the development of hypertension and proteinuria after the 20th week of pregnancy. This disorder is seen in 5% to 7% of all pregnancies (1). Although the pathogenesis of the disease is not yet fully understood, the main cause is thought to involve the placenta. The decrease in placental perfusion during preeclampsia leads to inflammation and oxidative stress (2,3). Redman et al. (4) suggested that preeclampsia develops as an increased intravascular inflammatory response to maternity. In recent years, the theory that regards preeclampsia as an increased inflammatory response to pregnancy has been supported by some studies (5,6).

Complete blood count is a routine, inexpensive, and practical procedure. Mean platelet volume (MPV) is a component of complete blood count. It is the geometric mean of the transformed log normal platelet volume data in impedance-based technologies. In some optical systems, MPV is the form of the measured mean platelet volume (7-9). Under normal conditions, there is an inverse relationship between platelet volume and

platelet number. In some inflammatory conditions, MPV has been found to have increased (10). As far as inflammation is concerned, elevated MPV values have been detected in conditions such as malignancies associated with endothelial dysfunction, deep vein thrombosis, ulcerative colitis, and Behçet's disease (11).

In this context, there have been numerous publications investigating the relationship between MPV and preeclampsia. Several of these studies (12,13) show increased levels of MPV in comparison to control groups in preeclampsia, while such an increase of MPV was not observed in other studies (14,15). In this study, we aimed to investigate the relationship between MPV and the severity of preeclampsia, as well as the time of emergence of the disease, whether early or late.

MATERIAL AND METHODS

The data for this study was retrospectively obtained from the computer databases of our hospital by screening the demographic data of patients who were treated at the Department of Obstetrics and Gynaecology between January 2010 and November 2013 and the hematological laboratory results of these patients. Our study was approved by the local ethical committee of our hospital (Ethics Committee No: 2013/6-96).

The following criteria were accepted for the diagnosis of preeclampsia: if arterial blood pressure was 140/90 or higher (indicated by two separate measurements within 6 hours) and if there was proteinuria (indicated by 100 mg/dl of proteinuria or greater in two different spot urine samples or 300 mg of proteinuria in urine within 24 hours) (16).

The criteria for severe preeclampsia were as follows: if arterial blood pressure was 160/110 mmHg or higher; if there was proteinuria (≥5g/24 hours); and, additionally, if there were oliguria (≤500ml/24 hours), cerebral or visual symptoms, pulmonary oedema or cyanosis, epigastric or right upper quadrant pain, elevated liver function tests (2 times more than normal), thrombocytopenia (<100000/mm3), or fetal growth retardation (16). If these findings emerged before the 34th week of pregnancy, it was termed as early preeclampsia, while late preeclampsia indicates the emergence of these signs after the 34th of pregnancy (17).

To evaluate the differences in MPV, we selected 46 preeclampsia patients from among 132 preeclampsia patients (14 with severe preeclampsia and 32 with mild preeclampsia; 16 with early preeclampsia and 30 with late preeclampsia). For our control group, we selected 49 healthy women with similar gestational weeks from 891 pregnant women using a random sampling method.

Patients were excluded from the study if they had antepartum vaginal bleeding, thrombocytopenia and elevated liver enzyme levels before pregnancy, abruptio placenta, intrauterine ex fetus, diabetes mellitus (DM), gestational diabetes mellitus (GDM), thyroid dysfunction, asthma, or if they were on aspirin or anticoagulant drugs. In addition to these exclusions, we also removed multiple pregnancies from the scope of the study.In our department, as a rule, blood samples that are taken in K-EDTA tubes for hematologic tests are sent to the laboratory within 1 hour. All full blood counts are done in the hematology laboratory of our hospital using a Sysmex XT 2000i (Kobe, Japan) device. In addition, our hematology laboratory employs an impedance counting method for measuring platelet count and MPV.

Data assessment was performed using the SPSS 15 (Chicago, IL) software. Data distribution was carried out with the Kolmogorov-Smirnov test and we found that the test results complied with a normal distribution of data. The data from our study was assessed as mean ± standard deviation (SD). To compare the groups, we made use of the independent samples t-test. A P value below 0.05 was regarded as statistically significant.

RESULTS

Between the preeclampsia and control groups there were no differences in terms of gestational weeks (33.7±3.8 and 34.1±4.2, respectively) and age (30±6.9 and 28.4±5.3, respectively) (p>0.05). However, we observed significant differences between the preeclampsia and control groups in terms of white blood cells (WBC) in complete blood counts (11.4±3.2 vs 10.1±3.1, respectively) (p=0.04).

All other blood parameters are summarised in Table 1. We noted statistically significant differences between the preeclampsia and control groups in terms of blood parameters in MPV (Table 1). In grouping the preeclampsia patients as early and late, we evaluated the MPV values, however the values did not reach any conclusive statistical significance (early preeclampsia MPV: 10.9±0.9; late preeclampsia MPV 10.7±1.5) (p=0.7).

Table 1. Characteristics and hematological parameters of the preeclampsia and control groups.

	Preeclampsia	Control	p*
Age, years	30±6.9	28.4±5.3	0.125
Hemoglobin, gr/dL	12.4±1.5	12.2±1.2	0.4
Hematocrit, %	37.4±4	36.9±3.4	0.21
Mean platelet volume, fL	10.8±1.3	9.8±1.3	**0.03**
Platelet distribution, %	15.3±2.8	14.8±2.5	0.34
Platelet count, x10^3/ µL	207±83	205±51	0.78
White blood cells	11.4±3.2	10.1±3.1	**0.04**
Gestational week, weeks	33.7±3.8	34.1±4.2	0.2

Independent sampling t-test was applied. All the data are presented as mean and standard-deviation (sd).
*Statistically significant value: p<0.05.

When we grouped the preeclampsia group as mild and severe and evaluated the two groups in terms of MPV, we did not find a statistically notable difference (mild preeclampsia MPV:10.6±1.3; severe preeclampsia MPV:10.8±1.3) (p=0.6).

Comparing the two subgroups (mild and severe) of the preeclampsia group with the control group in terms of MPV values, though there was no statistically significant difference between the mild preeclampsia and the control group (10.6±1.3 vs. 9.8±1.3) (p=0.08), the difference between the severe preeclampsia and the control group was found to be statistically significant (10.8±1.3 vs. 9.8±1.3) (p=0.004).

The differences between the two subgroups (early and late) of the preeclampsia group and the control group were statistically significant: MPV values of the early preeclampsia group and the control group being 9.10±0.98 vs 9.8±1.3 (p=0.01), and the MPV values of the late preeclampsia group and the control group being 10.7±1.5 vs. 9.8±1.3 (p=0.01). The power analysis showed the power of the study to be 96%.

DISCUSSION

We have observed higher MPV values in the preeclampsia group compared to the control group, although it was clear that whether preeclampsia was in its early or late stages or whether it was mild or severe did not cause any significant differences.

During pregnancy, there can be an increased loss or reduction in the life of platelets (18). Young platelets are larger than older ones. The mean platelet count decreases during pregnancy while the MPV increases, especially around the 28th-31st weeks. The reduced platelet count and increased MPV values continue throughout pregnancy (18-20).

It has been reported that preeclamptic women experience a decrease in platelet count (18,19,21). In normal pregnancies, there can be a slight increase in platelet aggregation due to the increased levels of MPV (19,22,23). There are also publications reporting increases in platelet volume in preeclampsia (19).

In numerous studies, the high MPV levels in preeclamptic women have been reported to be greater than those in healthy pregnant women without any blood pressure issues (24,25).

Several studies on platelet and MPV counts in preeclampsia have produced different results. Jaremo et al. (24), for instance, have associated high MPV with severe preeclampsia. They hypothesize that the severity of the disease could be determined by MPV levels. Dündar et al. (13), on the other hand, claim that MPV gradually increases during pregnancy, ending in preeclampsia, and that this increase starts in the 24th week of gestation.

In another study covering 56 preeclamptic and 43 normotensive pregnant women, however, no difference was observed in MPV levels or platelet count (23). Also in this study, researchers did not find any differences concerning these two parameters either between severe preeclampsia and mild preeclampsia cases, or normotensive pregnancies. For them, especially as far as MPV is concerned, the different results in the literature can be justified by different blood count methods. Piazza et al.'s study (22) showed that platelet count and MPV share relationships with preeclampsia. In their study, they reported decreased platelet count and MPV levels in preeclampsia and pregnancy-induced hypertension cases compared to normotensive pregnancies.

Parallel to the studies in the literature that pinpoint preeclampsia as a response to increased inflammatory conditions (4-6), our study has also shown statistically significant changes in WBC counts in the preeclampsia group compared to the control group.

Several studies on the changes in MPV in normal and preeclampsia pregnancies present MPV as a crucial predictor of preeclampsia (13,24,26).

Boriboonhirunsarn et al. showed that an increase in MPV takes place earlier than an increase in the number of platelets (26). Also, it was noted that there was certainly an increase in MPV during pregnancy, though this increase was more pronounced in cases of preeclampsia (13,27).

Howarth et al. claim that decreased platelet count and increased MPV may foretell the development of preeclampsia, with a sensitivity rate of 83.3% and a specificity rate of 90% (28).

During the course of our study, we could not find any significant differences between early preeclampsia and late preeclampsia as far as MPV is concerned. These results are not found in the literatüre, and therefore we believe that our work will contribute to the field.

Findings in the literature with regard to MPV's adequacy for determining the severity of disease are contradictory. Despite Jaremo et al.'s (24) claim that MPV can be used to determine the seriousness of the disease, Altınbaş et al. (14) argue just the opposite and state that MPV has no relation to the severity of preeclampsia. Throughout our study, we could not observe this relationship either.

The center where we conducted our research is one of the noteworthy hospitals in the region, serving a larger number of severe preeclampsia patients than those in the literature (29).

This is also the reason why we have a higher rate of severe preeclampsia cases in our results.

The retrospective nature of our research is a downside of the study. For instance, although all blood samples collected in K-EDTA tubes are sent to the laboratory for

haematological examinations within an hour, we could not confirm whether this was applied to all samples without any exception. In such cases, to ensure the reliability of the research at hand, extra attention should be paid to the following: standardizing haematological measurements (especially that of MPV), collecting the samples in the same kind of tubes (either a Na-EDTA, K-EDTA, or citrate tube) (30), examining the collected blood samples in similar periods of time (ideally within the first 1 hour) (31), and applying one of four different modes of counting for MPV measurements and platelet count (one of: manual counting with phase-contrast microscope, impedance counting, counting with optical light distribution, or immunological flow cytometry) (32).

In line with the literature, we found that MPV values increase in preeclampsia in contrast to normal pregnancies, though increased MPV levels are not helpful in determining the severity of preeclampsia. In addition, we also observed that there was no statistically significant relationship between MPV values and whether preeclampsia was in its early or late stage, a finding not previously reported in the literature.

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