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The effect of gestational hypertension on the maternal mean platelet volume

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Abstract

To evaluate the effect of gestational hypertension on the maternal mean platelet volume (MPV). The study group comprised pregnant women with gestational hypertension who gave birth to single, term, healthy fetuses and control group was pregnant women without any complications. MPVs were calculated within 24 hours in the intrapartum period. The mean MPV of 68 hypertensive and randomly selected 135 normotensive pregnant women were compared. The MPV of gestational hypertensive group was significantly higher (9.5 ± 0.98 vs 9.2 ± 0.9 fL; $p=0.015$). Using ROC analysis, the optimal MPV cut off value was found 9.25 fL with the sensitivity of 60.0% and the specificity of 61.0% (AUC=0.622, 95% CI=0.538-0.707, $p=0.004$) for the prediction of gestational hypertension. This study demonstrated that maternal MPV cannot be used to predict gestational hypertension in clinical practice due to its low sensitivity and specificity. However, further studies are needed to examine the predictive value of MPV in the progression of the hypertensive diseases of pregnancy.

Keywords: Pregnancy, gestational hypertension, mean platelet volume

Introduction

Gestational hypertension was defined as new-onset hypertension (systolic BP ≥ 140 mmHg and/or diastolic BP (phase 4) ≥ 90 mmHg) without proteinuria after 20 weeks' gestation which returned to normal within 12 weeks of delivery [1]. Hypertensive disorders complicate healthy nulliparous and multiparous pregnancies at a rate of 6–17% and 2–4%, respectively [2,3]. In 10–50% of cases, gestational hypertension progresses to preeclampsia between one and five weeks after diagnosis [4]. The recurrence rates of gestational hypertension and preeclampsia in further pregnancies are 22% and 7%, respectively [5].

Despite the unknown pathogenesis of preeclampsia, endothelial cell damage and dysfunction [6] and platelets play essential roles in its progression [7]. Thrombocytopenia is used as a defining criterion for the diagnosis of severe preeclampsia [8].

An enhanced mean platelet volume is associated with both incremental platelet activation [9] and newly produced platelet from bone marrow [10].

There is sufficient discussion in the literature about the relationship between preeclampsia and MPV [10-13], whereas there is a paucity of information about the effects of gestational hypertension. The early prediction of the progression to preeclampsia, eclampsia and HELLP syndrome can be important in reducing maternal and fetal mortality and morbidity. The aim of this study is to evaluate the presence or absence of the effects of gestational hypertension on MPV.

Materials and Methods

A retrospective case-control study was performed between January 2011 and December 2012 in our hospital. The study group was defined as women whose pregnancies were complicated with only gestational hypertension. The control group consisted of uncomplicated pregnant women. All data were obtained from the files of pregnant women and computerized registration documents. This study was approved by the local ethical committee (13.12.2017/25).

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The study group consisted of 68 patients with gestational hypertension and the control group consisted of 135 healthy pregnant women without hypertension. The criteria for inclusion in both the study and the control group were: healthy individuals aged between 18 and 35 years, singleton pregnancy and delivered after 37 gestational weeks. The exclusion criteria were: chronic hypertension, other pregnancy-induced hypertension disorders, hematologic disorders, all systemic disorders, gestational diabetes, intrauterine growth retardation, abnormal umbilical artery blood flow Doppler findings, fetal anomalies, antihypertensive drugs, magnesium or other drugs (with the exception of iron or vitamin supplements such as calcium, etc.) smoking or substance abuse. The level of maternal MPV and another hemogram parameters were measured within 24 hours of intrapartum and used for statistical analysis. The calculation of body mass index was performed by dividing maternal weight with the square of maternal height (kg/m^2).

Statistical analysis was performed using SPSS (version 20, SPSS, Chicago, IL). The data were expressed as mean $\pm$ SD and in percentile. The distribution of the variable data was determined using visual (histograms, probability plots) and analytical methods (Kolmogorov-Smirnov / Shapiro-Wilk's test). The normal distributions of the groups' variables were compared using the Student's t-test. The chi-square test was used to compare the proportional properties of both groups. The ROC (receiver operating characteristics) curve analysis was used to predict the capacity of maternal MPV. Sensitivity and specificity were presented to observe the cut-off level value. A p-value less than 0.05 was accepted as statistically significant.

Results

A total of 139 women were found to have their pregnancies complicated with gestational hypertension. However, only 68 of these women fulfilled the criteria for our study. Of the women excluded, 19 were aged 38 or more, two were adolescents, 16 pregnancies were also complicated with intrauterine growth retardation, 12 pregnancies were concomitant with thyroid disorders, one pregnant woman had existing deep venous thrombosis, one had rheumatoid arthritis and one suffered from concurrent asthma. Of the remaining 19 excluded pregnant women: six had coexisting abnormal umbilical blood flow (Doppler evaluated), seven were taking antihypertensive drugs, five women smoked and one woman was taking low molecular weight heparin (see Flowchart). The control group comprised randomly selected healthy pregnant women who delivered during the same time period.

Demographic characteristics of the patients are shown in Table 1. The mean age of the patients in the study group was 26.9 ± 5.3 years and the control group was 25.8 ± 4.2 years, and there was no significant difference between the groups ($p=0.090$). Examining the body mass index of the patients was no a statistically difference between groups. The mean birth weight was 3194 ± 393 in the study group and 3234 ± 402 in the control group, and there was no significant difference between the groups ($p=0.494$). In our study, there was a statistically higher mean maternal MPV in the study group than in the control group (9.5 ± 0.98 vs 9.2 ± 0.9 fL; $p=0.015$).

However, the mean maternal hemoglobin, thrombocyte count and serum creatinine levels were not significantly different between the two groups ($p=0.505$, $p=0.911$, $p=0.678$, respectively) (Table 2). Using ROC analysis, the optimal MPV cut off value was found 9.25 fL with the sensitivity of 60.0% and the specificity of 61.0% ($\text{AUC}=0.622$, 95% $\text{CI}=0.538-0.707$, $p=0.004$) for the prediction of gestational hypertension (Table 3 and Figure 1).

Table 1. Demographic characteristics

	GHT group n = 68	Control group n = 135	p
Maternal age (year)	26.9 $\pm$ 5.3	25.8 $\pm$ 4.2	0.090 ^a
Maternal body mass index (kg/m^2)	29.4 $\pm$ 2.8	28.5 $\pm$ 3.8	0.070 ^a
Nullipar	% 52.9 (36/68)	%50.4 (68/135)	0.729 ^b
Gestational birth week (LMP)	39.1 $\pm$ 1.2	39.3 $\pm$ 1.2	0.118 ^a
Neonatal birth weight (g)	3194 $\pm$ 393	3234 $\pm$ 402	0.494 ^a

a: t-student's test b: Chi-square test. $p < 0.05$ was statistically significant. LMP: last menstrual period. GHT: Gestational Hypertension

Table 2. Laboratory findings

	GHT group n = 68	Control group n = 135	p
Hemoglobin (g /dL)	11.6 $\pm$ 1.4	11.6 $\pm$ 1.2	0.505 ^a
Platelet count (mm3)	234.0 $\pm$ 68.5	232.7 $\pm$ 77.9	0.911 ^a
Mean platelet volume (fL)	9.5 $\pm$ 0.98	9.1 $\pm$ 1.19	0.014 ^a
Serum creatinin level (mg / dl)	0.6 $\pm$ 0.06	0.6 $\pm$ 0.05	0.678 ^a

a: t-student test. $p < 0.05$ was statistically significant. GHT: Gestational Hypertension

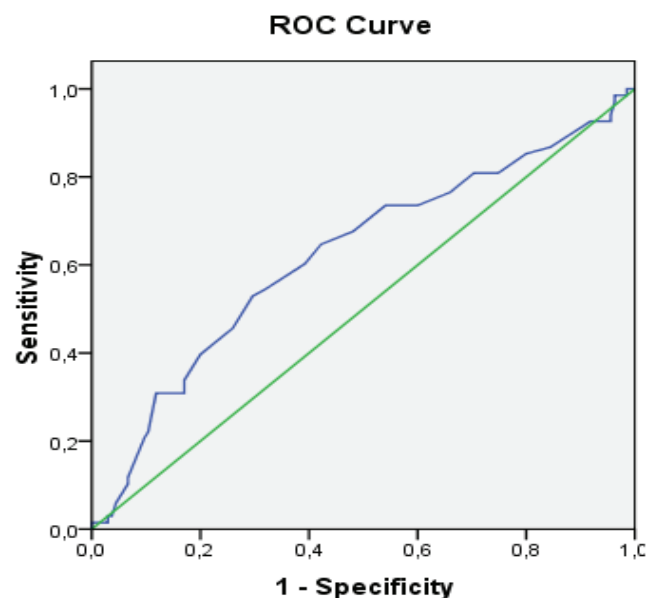


Figure 1. ROC curves for MPV value in predicting gestational hypertension

Table 3. Sensitivity and specificity for MPV value in predicting gestational hypertension

	MPV cut- off (fL)	Sensitivity	Specifity	AUC	CI (95%)		p
					Lower	Upper	
GHT	9.25	60	61	0.622	0.538	0.707	0.040

p: <0.05 was statistically significant. GHT: Gestational Hypertension

Discussion

We noted that the maternal MPV is statistically significantly increased in pregnancies complicated with gestational hypertension. In preeclampsia, endothelial injury leads to increased intravascular coagulation by platelet activation [14]. Furthermore, the volume of the newly produced (young) platelets is higher than that of the old platelets [15]. In our opinion, intravascular pressure can be higher by occurrence of vasoconstriction in gestational hypertension. This mechanism may lead to changing platelet surface and activating platelets function. Consequently the increment in volume of it can be seen without developing endothelial cell damage in gestational hypertension. MPV level was found to be significantly higher in hypertensive patients [16]. This finding can support our hypothesis.

The study found that there was no difference between the mean platelet counts of both groups; the balance between thrombocyte consumption and the production of bone marrow are adequate for gestational hypertension. Thrombocyte consumption is greater than production in severe preeclampsia and this has been seen to lead to thrombocytopenia [10]. Compared with preeclampsia, the lower microparticle concentration in gestational hypertension [17] can be explained by the lower degree of intravascular microthrombus formation and the reduced degree of endothelial injury.

There are studies in the literature that report different results concerning MPV. Although some studies have shown an increase in MPV in preeclampsia [10,13,14], others have reported no change [7,18,19]. However, the studies that report no change in MPV have some important limitations. First, the pregnancies were not grouped as preterm or term, so the effect of gestational age on MPV was neglected [7, 18, 19]. Second, the low sample size of the preeclampsia groups and the failure to specify factors that affect MPV values, such as diabetes, are important limitations of the studies that reported no change in MPV. Third, the classification of preeclampsia was not definitively described as mild or severe.

One study in the literature reports that maternal weight gain and Grade III preterm placental calcification are the most important risk factors for the progression of gestational hypertension to preeclampsia [1]. However, in that study, gestational hypertension and preeclampsia were not divided into as two different groups [1], which would have been more appropriate given their different properties. The gestational age at birth was preterm in hypertensive pregnancies, whereas normotensive pregnancies produced term births [1]. Therefore, this introduced bias into the study's research results. In another study reported in the literature, severe preeclampsia and normotensive pregnant women were divided into three subgroups early, late preterm and term birth deliveries in order to rule out the effect of the gestational week on MPV [10]. Further, the mean birth weight of all the subgroups of severe

preeclampsia women was significantly lower than those of the normotensive subgroups [10]. In our study, we observed that there was no difference in the groups according to birth weight. This is because all pregnancies came to term and there was no difference in the gestational ages between two groups. Furthermore, the cases with intrauterine growth restriction and abnormal umbilical artery Doppler parameters were excluded. Consequently, gestational hypertension without antihypertensive drug treatment may not have an adverse effect on increasing birth weight.

There are studies in the literature that have reported increased MPV in preeclampsia, thus the use in clinical practice should be discussed extensively [4,13,14]. There are no studies in the literature that address the clinical usefulness of MPV. In our findings, the sensitivity of MPV is 60% and specificity is 61% for the cut-off value of 9.25 fL. In our opinion, this suggests a limited use in clinical practice. Although the MPV values were significantly different in gestational hypertensive patients compared to the control group, there was no difference in the platelet number.

Our study has some limitations. This is a retrospective study and we did not take preterm pregnancies as another group. The small sample size meant that we were unable to compare the multiparous and nulliparous cases. The paucity of our data with regard to the sonographic measurement of the amniotic fluid index, newborn Apgar scores and complications in the neonatal period was a further limitation, as was our inability to provide any information about how many cases of gestational hypertension might have progressed to preeclampsia, eclampsia or HELLP syndrome. Due to lack of effect of progressive pregnancy induced hypertensive disorders on changing MPV, have not observed. However, the term pregnancies were included and the exclusion criteria were well defined, thus ensuring that this was a homogenous group. These are the main advantages of our study.

In our study, maternal MPV cannot be used clinically to predict gestational hypertension due to its low sensitivity and specificity. However, further studies are needed about the predictive value of MPV in the progression of the hypertensive diseases of pregnancy and of thrombocytopenia as an early marker in this progression. This study may be a pioneer for further research.

Competing interests

The authors declare that they have no competing interest.

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Ethical approval

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