CEOG Clinical and Experimental Obstetrics & Gynecology

Association of intrapartum maternal mean platelet volume with neonatal birth weight

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Summary

Purpose: To investigate the relationship between neonatal birth weight (NBW) and intrapartum maternal mean platelet volume (MPV). *Materials and Methods:* A total of 650 women who had a live birth at the Etlik Zubeyde Hanım Women's Health Education and Research Hospital in Ankara were divided into three groups according to the babies' birth weight adjusted for gestational week: 145 delivered small for gestational age (SGA) (< 10th percentile), 363 delivered appropriate for gestational age (AGA) (10−90th percentile), and 142 delivered large for gestational age (LGA) babies (> 90th percentile). Maternal MPV value of the women were taken into account together with demographic values, body mass index (BMI), and gestational age at delivery and birth weight. *Results:* MPV was found to be significantly higher in the mothers of LGA babies (9.69 ± 1.11) in comparison to SGA (9.38 ± 1.03) and AGA (9.36 ± 1.09) babies in the statistical analysis ($p = 0.009$). More than 9.65 fL value of intrapartum maternal MPV was associated with LGA. *Conclusion:* MPV was increased in the intrapartum period in women who delivered LGA babies.

Key words: Mean platelet volume; Neonatal birth weight; Small for gestational age (SGA).

Introduction

Neonatal birth weight (NBW) is generally evaluated in respect of the delivered gestational week. Large for gestational age (LGA) is described as a newborn birth weight greater than the 90th percentile for gestational age [1]. Overall neonatal morbidity is much more in LGA infants when compared to full-term appropriate for gestational age (AGA) infants [2]. Maternal complications contain an increased rate of severe hemorrhage, cesarean sections, and extensive perineal lacerations. Neonatal complications include shoulder dystocia, hypoglycemia, respiratory distress and even death [3, 4]. Small for gestational age (SGA) locution refers to a neonatal birth weight below the 10th percentile for gestational age [5]. SGA infants may be more vulnerable to cerebral palsy or more susceptible to infection in the short term; they may encounter physiological immaturity and shorter stature in the long term [6, 7].

Mean platelet volume (MPV) is a marker of platelet function and activation [8]. An increased value of mean platelet volume (MPV) and platelet distribution width (PDW) is generally found in the third trimester [9]. MPV is augmented in specific conditions with risk factors of the vascular system such as hypercholesterolemia and diabetes mellitus, as well as acute myocardial infarction, acute cerebrovascular stroke, pre-eclampsia, and renal artery stenosis. As a prominent note, an increased MPV following the development of preeclampsia predicts a poor outcome [8].

SGA and LGA infants are at major risk in the neonatal period. To the best of the present authors' knowledge, there are no articles in the hitherto literature in English that have studied intrapartum maternal MPV count with LGA newborns. The aim of this study was to assess the association between MPV and NBW for clinical use.

Materials and Methods

In this study, a total of 650 women who had a live birth between June 1, 2013 and November 31, 2013 were recruited. The research was performed at Etlik Zubeyde Hanım Women's Health Education and Research Hospital in Ankara, Turkey, in a retrospective case-control design. The study was approved by the hospital ethics committee and all the participants gave their informed consent before participation. The live neonates were born between the 37th and 42nd weeks of gestation. Data on the pregnant women were collected from recorded files and computer databases.

All participants reported a regular menstrual history before their last pregnancy. Gestational ages were calculated according to the first day of the last menstrual period. All pregnant women underwent a first trimester ultrasonography where the crown-rump lengths (CRL) of fetuses were measured and recorded. In the case of discrepancy between CRL and gestational age, calculated using the previously described methods, the case was excluded from the study group.

Inclusion criteria were that the women were healthy and had a singleton pregnancy. The exclusion criteria were the presence of diabetes mellitus, gestational diabetes, after antenatal screening with oral glucose tolerance test (OGTT) – this is the major known risk factor for LGA babies. Women with the known risk factors of delivering SGA and LGA babies were excluded. Multiple pregnancies,

Revised manuscript accepted for publication March 24, 2016

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Table 1. — *Characteristic features of the groups.*

Variables	SGA n= 145	AGA n= 363	LGA n= 142	*p*
Maternal age (year)	26.00± 5.364	26.68± 5.684	27.86± 5.841	0.018
Body mass index (kg/m^2)	26.89± 4.33	29.82± 4.51	32.2613± 4.98600	<0.001
Gestational period (weeks)	38.29± 1.178	39.40± 1.162	38.89± 1.004	<0.001
Duration of gestation (days)	270.03± 8.119	276.30± 8.550	274.48± 7.215	<0.001
Birth weight (grams)	2402.21± 238.084	3591.29± 442.400	4254.15± 307.696	<0.001

SGA – small for gestational age; AGA – appropriate for gestational age; LGA – large for gestational age.
[a] All values are shown in terms of mean ± standard deviation unless otherwise stated. [b] *p*-value was supplied by a Chi-square test for percentages and an ANOVA test for continuous variables; *p*-values for particular categories designate discrepancies present between the categories.

Table 2. — *Laboratory findings of the groups.*

Variables	SGA n= 145	AGA n= 363	LGA n= 142	*p*
Hemoglobin (gr/dl)	11.77± 1.16	11.76± 1.32	11.53± 1.244	0.170
Platelets (x10^9/L)	256.48± 73.09	240.92± 75.76	237.78± 76.52	0.063
Mean platelet volume (fL)	9.38± 1.03	9.36± 1.09	9.69± 1.11	0.009

SGA – small for gestational age; AGA – appropriate for gestational age; LGA – large for gestational age.
[a] All values are shown in terms of mean±standard deviation unless otherwise stated. [b] *p*-value is supplied by a Chi-square test for percentages and an ANOVA test for continuous variables; *p*-values for particular categories designate discrepancies present between the categories.

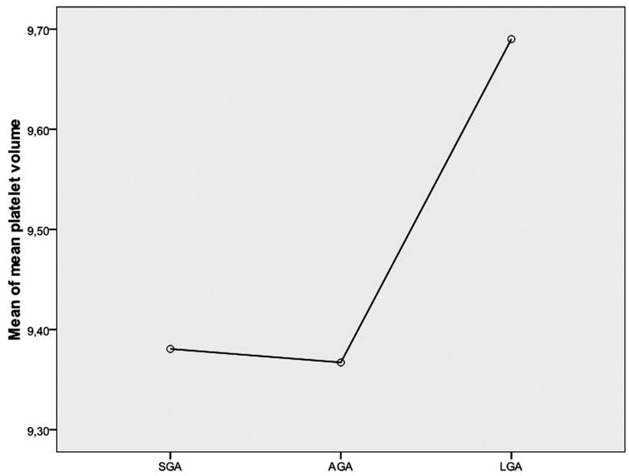

Figure 1. — Mean platelet volume of the groups.

fetuses with congenital or chromosomal anomalies, history of preterm deliveries, pregnancy-induced hypertensive disorders, presence of abnormal Doppler ultrasonography findings, history of maternal systemic disorders and history of anemia, drug abuse, smoking, and alcohol consumption were also the exclusion criteria. All pregnant women were prescribed oral ferrous and vitamin supplementation routinely in our hospital. Maternal MPV, hemoglobin level, thrombocyte count, and demographic values, were collected, as well as body mass index (BMI), gestational age at delivery, and fetal birth weight at the time of hospitalization. BMI categories were specified according to World Health Organisation (WHO) international classification. Authors confirmed in writing that they have complied with the World Medical Association Declaration of Helsinki regarding ethical conduct of research involving human subjects.

Statistical analysis

Statistical analyses were performed using the SPSS software version 22.0. Descriptive analyses were defined as means standard deviation. The variables were investigated using visual (histograms, probability plots) and analytical methods (Kolmogorov-Smirnov and Shapiro-Wilk's test) to determine whether or not they were normally distributed. A multiple linear regression model was used to identify independent predictors of maternal mean platelet volume (MMPV). For the multivariate analysis, the possible factors identified with univariate analysis were further entered into the multiple linear regression analysis to determine independent predictors of MMPV. Model fit was assessed using appropriate residual and goodness-of-fit statistics. A 5% type-I error level was used to infer statistical significance. A high statistical significance was considered as $p < 0.01$. Statistical power (1-b) was accepted as a minimum threshold of 80%.

Results

The demographic data of the 650 pregnant women enrolled in the study are summarized in Table 1. The patients were divided into three groups: 145 had SGA (< 10th percentile), 363 had AGA (10–90th percentile), and 142 delivered LGA babies (> 90th percentile). The maternal mean ages of SGA, AGA, and LGA neonates were 26.00 ± 5.36, 26.68 ± 5.68, and 27.86 ± 5.84 years, respectively. There was a statistically significant difference for all groups according to the mean maternal age ($p < 0.018$). The mean birth weight of SGA, AGA, and LGA neonates was 2,402.21 ± 238.08, 3,591.29 ± 442.40, and 4,254.15 ± 307.69 grams, respectively. All groups showed statistically significant difference compared to each other according to birth weight ($p < 0.001$). The gestational delivery week of the SGA, AGA, and LGA neonates were 38.29 ± 1.17, 39.40 ± 1.162, and 38.89 ± 1.00 weeks, respectively ($p < 0.001$). The maternal BMIs of SGA, AGA, and LGA neonates were 26.89 ± 4.34, 29.82 ± 4.51, and 32.26 ± 4.98, respectively. BMI was also found to be higher in LGA babies in comparison to the other two groups ($p < 0.001$). The maternal MPV values of SGA, AGA, and LGA neonates were 9.38 ± 1.03 fL, 9.36 ± 1.09 fL, and 9.69 ± 1.11 fL, respectively. MPV was found to be statistically significantly higher in the mothers of LGA babies in comparison to those of SGA and AGA babies ($p = 0.009$). The maternal mean

Table. 3 — *Multiple lineer regression analysis of covariates of maternal mean platelet volume.*

Model	Unstandardized coefficients B	Std. Error	Standardized coefficients Beta	95 % Confidence interval for B Lower bound	Upper bound	*p*
Age	0.018	0.008	0.091	0.002	0.033	0.024
BMI	-0.015	0.010	-0.069	-0.034	0.004	0.119
Gestational weeks	0.033	0.041	0.037	-0.047	0.113	0.417
Neonatal birth weight	0.000	0.000	0.115	0.000	0.000	0.019

platelet counts of the SGA, AGA, and LGA neonates were 256.48 ± 73.09, 240.92 ± 75.76, and 237.78 ± 7.52, respectively ($p = 0.063$) (Table 2). The levels of hemogram of all groups were aldo not significantly different from each other ($p = 0.170$) (Table 2). In order to evaluate the interaction and confounder variables between MPV and LGA, binary logistic regression analysis was performed with a cut-off level of 9.65 fL in terms of MPV is shown in Figure 1. As maternal age, BMI, gestational week, and neonatal birth weight parameters were all found statistically different between SGA, AGA, and LGA groups, these variables were all added into the present model. The maternal age and neonatal birth weight were statistically significant with maternal MPV, respectively ($p < 0.024$ and $p < 0.019$) is illustrated in Table 3.

Discussion

To the present authors' knowledge, prior studies have never analyzed the association between intrapartum maternal MPV and NBW. In this study, patients were divided into three groups according to neonatal birth weight; SGA, AGA, and LGA. The maternal MPV and maternal BMI in the LGA group were both significantly higher than the AGA and SGA groups.

According to the present results, in the authors' opinion, the intrapartum maternal MPV might be augmented in women who deliver LGA babies in order to decrease the uterine atony risk or postpartum bleeding. This preventive mechanism can be clarified that atony risk increases in women who deliver LGA babies [10]. Function and activation of platelets are related to MPV [8, 11] and large platelets are more active than small platelets metabolically, causing an increased thrombotic potential [12]. However, there is no data presented in this study as well as in the literature regarding uterine atony cases. The relationship between uterine atony and maternal MPV level should be further investigated.

In the present study, the authors found that maternal age was significantly associated with an increased size of platelet in LGA group. Advanced age participant had larger platelet volume than that of the younger ones [13]. In the present authors' opinion, atherosclerosis may progress with advanced aged, and it may induce thrombosis formation of platelets when their size is modified towards larger volume. This mechanism can be explained by vascular disorders [8]. Also, another idea, BMI was higher in LGA group. BMI is positively correlated to insulin-like growth factor (IGF) [14], which may stimulate bone marrow to produce hematopoietic products as a result enhanced synthesis of younger platelets that are larger in size. An increased BMI may indirectly cause enhanced maternal MPV. This suggestion can be supported by MPV that was significantly higher in the obese group than in the non-obese control group [15].

The main limitation of this study is that the changed range of maternal MPV levels in the first and second trimester was not evaluated. For this reason, the maternal MPV levels in these trimesters should further be investigated to employ them as predictive marker for neonatal birth weight according to the delivered gestational week. Additionally, association of uterine atony and higher maternal MPV level should be further assessed. Also IGF-I levels were not measured in the present study in order to explore the biologic causative relationship between IGF-I and maternal MPV level.

In conclusion, MPV was increased in the intrapartum period in women who delivered LGA babies; however, the increased maternal MPV level may not be used for clinical examination to predict LGA neonates.

References

[1] Xu H., Simonet F., Luo Z.C.: "Optimal birth weight percentile cut-offs in defining small- or large-for-gestational-age". *Acta Paediatr.*, 2010, *99*, 550.

[2] Linder N., Lahat Y., Kogan A., Fridman E., Kouadio F., Melamed N., *et al.*: "Macrosomic newborns of non-diabetic mothers: anthropometric measurements and neonatal complications". *Arch. Dis. Child Fetal Neonatal Ed.*, 2014, *99*, F353.

[3] Boulet S.L., Salihu H.M., Alexander G.R.: "Mode of delivery and birth outcomes of macrosomic infants". *J. Obstet. Gynaecol.*, 2004, *24*, 622.

[4] Henriksen T.: "The macrosomic fetus: a challenge in current obstetrics". *Acta Obstet Gynecol Scand.*, 2008, *87*, 134.

[5] Battaglia F.C., Lubchenco L.O.: "A practical classification of newborn infants by weight and gestational age". *J. Pediatr.*, 1967, *71*, 159.

[6] Kramer M.S.: "Determinants of low birth weight: methodological assessment and meta-analysis. *Bull. World Health Organ.*, 1987, *65*, 663.

[7] United Nations Children's Fund and World Health Organization: "Low birthweight: country, regional and global estimates", 2004. Available at: http://apps.who.int/iris/bitstream/10665/43184/1/9280638327.pdf

[8] Bath P.M., Butterworth R.J.: "Platelet size: measurement, physiology and vascular disease". *Blood Coagul. Fibrinolysis*, 1996, 7, 157.

[9] Mondestin M.A., Ananth C.V., Smulian J.C., Vintzileos A.M.: "Birth weight and fetal death in the United States: the effect of maternal diabetes during pregnancy". *Am. J. Obstet. Gynecol.*, 2002, *187*, 922.

[10] Joschko K.: "Obstetric problems of newborn infants with a birth weight over 4,500 g". *Zentralblatt fur Gynakologie*, 1988, *111*, 1176.

[11] Ataseven A., Ugur Bilgin A.: "Effects of isotretinoin on the platelet counts and the mean platelet volume in patients with acne vulgaris". *ScientificWorldJournal*, 2014, *2014*, 4.

[12] Kocer A., Yaman A., Niftaliyev E., Dürüyenyen H., Eryılmaz M., Kocer E.: "Assessment of Platelet Indices in Patients with Neurodegenerative Diseases: Mean Platelet Volume Was Increased in Patients with Parkinson's Disease". *Curr. Gerontol. Geriatr. Res.*, 2013, *2013*, 5.

[13] Budak Y.U., Huysal K., Demirci H.: "Correlation between mean platelet volume and B-type natriuretic peptide concentration in emergency patients with heart failure". *Biochem. Med. (Zagreb)*, 2015, *25*, 97.

[14] Simons C.C., Schouten L.J., Godschalk R., van Engeland M., van den Brandt P.A., van Schooten F.J., Weijenberg M.P.: "Body size, physical activity, genetic variants in the insulin-like growth factor pathway, and colorectal cancer risk". *Carcinogenesis*, 2015, *36*, 971.

[15] Coban E., Ozdogan M., Yazicioglu G., Akcit F.: "The mean platelet volume in patients with obesity". *Int. J. Clin. Pract.*, 2005, *59*, 981.

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