The impact of plateletcrit on the diagnosis and management of gestational diabetes mellitus

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Abstract

Aim: Gestational diabetes mellitus (GDM) is a condition that can cause serious maternal and fetal complications. Platelets are one of the cells that play an important role in inflammation in our body. In this study, we aimed to investigate whether there is a relationship between platelet values obtained by a simple blood count and GDM.

Materials and Methods: Two groups consisting of 60 individuals with GDM and 250 healthy populations were created. Demographic characteristics, the sugar loading test results performed between 24th-28th weeks and simple complete blood count results including platelets, plateletcrit (PCT), platelet distribution width (PDW), and mean platelet volume (MPV)) were analyzed with SPSS.

Results: When comparing the ages, BMI, average blood pressure, heights, and gestational weeks of both groups, there was no any significant differences (p>0.05). In terms of the hemoglobin, platelet, and white blood cell counts, there wasn't any significant differences between the two groups (p>0.05). MPV, PDW and PCT values were significantly increased in patients with GDM compared to healthy pregnant women (p<0.02, p<0.009, and p<0.001, respectively). Specifically, there was a significant positive correlation was found between PCT and the 1st hour glucose level (r: 0.585, p=0.001).

Conclusion: We predict that a simple blood count (especially MPV, PDW and PCT values) performed during the first routine visit of pregnant women may be useful in predicting the risk of GDM.

Introduction

Gestational diabetes mellitus (GDM) is a medical condition that frequently occurs during pregnancy and can cause serious complications for both the mother and the fetus [1]. The prevalence of gestational diabetes is seen between 1% and 15% of pregnancies worldwide. Studies conducted in our country show that the prevalence of GDM varies between 3.0% and 28.0% [2]. Over the past few decades, the frequency of GDM has increased in the same trend as obesity and type 2 diabetes mellitus. The increase in GDM prevalence is likely to continue as obesity is on the rise globally in women [3].

Gestational DM causes short- and long-term complications for both mother and fetus. The most significant of these include preeclampsia, miscarriage, macrosomia, and consequently birth trauma, among others [4-6].

It has been reported that hormones such as growth hormone, progesterone, lactogen, and cortisol, which are secreted from the placenta during pregnancy, increase insulin resistance and, along with underlying genetic predisposition, lead to GDM [7, 8]. Placental lactogen hormone, which increases especially during pregnancy, increases free fatty acids by increasing lipolysis. With these increased free fatty acids, insulin resistance also increases. High levels of insulin resistance also further accelerate the severity of inflammation. It is thought that the increased release of pro-inflammatory cytokines, including TNF-α, IL-6, and interleukin-1 (IL-1), in subchronic inflammation may contribute to the development of GDM [9-11].

Subchronic inflammation can lead to vascular damage and dysfunction over time, thereby impairing platelet functions. Since platelets are the first cells to respond to vascular damage, they are among the first to experience functional loss. As a first reaction, platelet functions may be impaired as a result of damage and loss of function in the vessels as a result of the progression of subclinical inflammation [12].

The best indicators representing platelet functions in complete blood count are plateletcrit (PCT), mean platelet volume (MPV), and platelet distribution width (PDW) parameters [11,12]. Studies in the literature have shown

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that these parameters increase in diabetes, cardiovascular diseases, preeclampsia-eclampsia and fatty liver disease [13-15].

In this study, the relationship between MPV, PDW, and PCT levels and GDM in patients diagnosed with GDM was evaluated.

Materials and Methods

Patient population

In this retrospectively designed study, laboratory values of pregnant women diagnosed with GDM and healthy pregnant women who attended outpatient clinic appointments at Hatay Private Reyhanlı MMT American Hospital Gynecology and Obstetrics Clinic between January 2022 and February 2024 were examined. According to the criteria of the International Association of Diabetes and Pregnancy Study Group (IADPSG), fasting blood glucose (FBG) is first measured on an empty stomach in the morning, followed by blood glucose levels at the 1st and 2nd hours after administering a 75 g glucose solution.

Accordingly, a diagnosis of GDM is made if two or three of the following values are elevated: FBG $\geq$92 mg/dl, 1st hour $\geq$180 mg/dl, 2nd hour $\geq$153 mg/dl. This test was performed to the all patients at 24-28 weeks of pregnancy. Also, complete blood count was taken at the 24-28 weeks of pregnancy.

Parameters within the complete blood count, including platelets, MPV (Mean Platelet Volume), PDW (Platelet Distribution Width), and PCT (Plateletcrit), were automatically counted using the Coulter LH 780 Hematology Analyzer device.

The study was divided into two groups. The first group included 250 healthy pregnant women, while the second group comprised 60 patients diagnosed with GDM. The inclusion criteria of the study were as follows having a pregnancy of 24-28 weeks according to the last menstrual period, Body Mass Index (BMI) of 18.5–29.9 before pregnancy, not using cigarettes, alcohol or drugs, not having a threat of miscarriage during pregnancy. The exclusion criteria for the study included a prior diagnosis of diabetes mellitus, the presence of preeclampsia, chronic inflammatory conditions, hemoglobinopathy, and autoimmune diseases.

Data on the ages, average blood pressure, height and weight, 75 g OGTT (Oral Glucose Tolerance Test) results, complete blood count, and BMI of all the pregnant women examined in the study were extracted from the hospital's archive system.

Our study was approved by the Ethics Committee of Adana City Education and Research Hospital (30.05.2024-1/2).

Statistical analysis

Kolmogorov Smirnov test was used to check the suitability of continuous variables for normal distribution. Student's t test was used to compare variables with normal distribution between 2 independent groups, and Mann Whitney U Test was used for variables with non-normal distribution. The results are presented as mean ± standard deviation (SD). Pearson chi-square / Fisher Exact Test were used in the analysis of nominal variables. Correlations were assessed using Spearman test. For statistical analyses, SPSS software (version 25.0, IBM, NY, USA) was performed. For p<0.05, the results were considered statistically significant.

Results

When comparing the ages, BMI, average blood pressure, heights, and gestational weeks of both groups, there were no any significant differences (Table 1).

In terms of the hemoglobin, platelet, and white blood cell counts, there weren't any significant differences between the two groups (Table 2).

MPV, PDW and PCT values were significantly increased in patients with GDM compared to healthy pregnant

Table 1. Comparing baseline characteristics of the healthy pregnant women (group 1) with diagnosed gestational diabetes mellitus pregnant women (group 2).

Variables	Group 1 (n=250) (mean±SD)	Group 2 (n=60) (mean±SD)	p value
Maternal age (year)	27.3 ± 3.42	28.5 ± 6.3	NS
Weight (kg)	70.7±7.4	73.2±5.1	NS
Height (cm)	161.3±4.3	163.4±3.2	NS
Body Mass Index (BMI)	25.9± 5.1	27.1± 2.5	NS
Systolic Blood Pressure (mmHg)	113±11	118±9	NS
Diastolik Blood Pressure (mmHg)	81±5	79±10	NS
Gestastional week (w/d)	26.3±3	27.1±2	NS

NS; non-significant (p>0.05).

**Table 2.** Comparison of hemoglobin, platelet, and white blood cell counts in groups.

Variables	Group 1 (n=250) (mean±SD)	Group 2 (n=60) (mean±SD)	p value
White Blood Cell (x10^3µL mm3)	11.3±0.1	10.7±2.2	NS
Hemoglobin (mg/dl)	10.5±1.3	10.9±1.6	NS
Platelet (10^3 / mm^3)	210±25	223±32	NS

NS; non-significant (p>0.05).

Table 3. Comparing the healthy pregnant women (group 1) with diagnosed gestational diabetes mellitus pregnant women (group 2).

Variables	Group 1 (n=250) (mean±SD)	Group 2 (n=60) (mean±SD)	p value
MPV (fl)	9.1±0.9	9.8±03	<0.02
PDW (%)	16.8± 1.9	18.5 ± 1.8	<0.009
PCT (%)	0.19±0.3	0.21±0.3	<0.001

MPV: Mean Platelet Volume, PDW: Platelet Distribution Width, PCT: Plateletcrit.
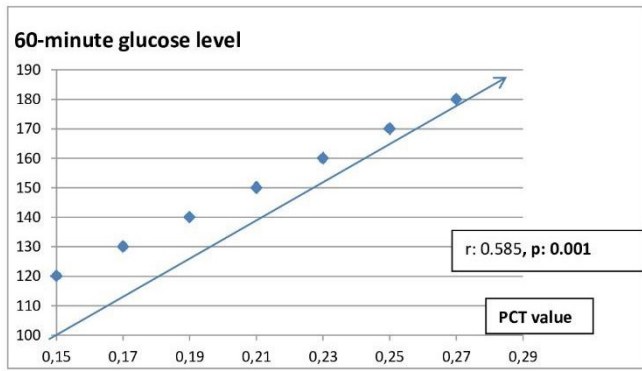
Figure 1. Correlation analysis between 60-minute glucose level and PCT value.
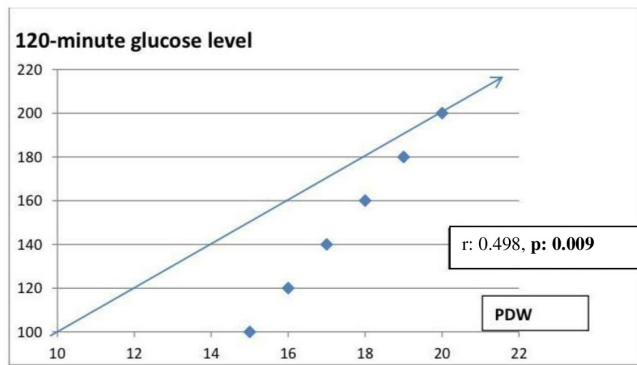
Figure 2. Correlation analysis between 120-minute glucose level and PDW value.

women (p<0.02, p<0.009, and p<0.001, respectively) (Table 3).

Specifically, there was a significant positive correlation was found between PCT and the 60-minute glucose level (r: 0.585, p=0.001) (Figure 1). In addition, we found poor positive correlation between 120-minute glucose level and PDW (r:0.498, p: 0.009) (Figure 2).

Discussion

In our study, it was determined that MPV, PDW, and PCT showed significant increases in patients diagnosed with GDM in the second trimester compared to the normal population. There were not any previous studies have reported a positive correlation between PCT and the 1-hour glucose level. In our study, we found a significant positive correlation between PCT and the 1-hour glucose level and we think that this connection could be a significant indicator in GDM.

It has been reported that the inflammatory process is as influential as hormones secreted from the placenta in the emergence of GDM [16, 17] Particularly during pregnancy, increased cytokines such as TNF-α, IL-6, and C-reactive protein (CRP) are the main causes of subchronic inflammation, leading to vascular damage [18, 19]. When this vascular damage begins to develop, one of the first responding cells is platelets.

Several studies have shown that values such as MPV, PDW, and PCT, which indicate platelet function, increase especially during inflammation [20, 21]. It is now well known that MPV increases in systemic conditions such as cardiovascular disease and preeclampsia [22, 23].

Similarly, there are publications suggesting that MPV increases in patients with GDM. In their studies, Liu et al. and Wei et al. demonstrated a significant increase in MPV in patients with GDM compared to other healthy populations [24, 25]. Our study also found that MPV significantly increased in patients with GDM.

Moreover, PDW indicates morphological changes in platelets. If there is an increase in platelet activation, morphological changes begin, resulting in increased PDW values. This increase usually occurs due to inflammation. Xiang et al. reported a significant increase in PDW in their study of 96 GDM patients and 95 healthy individuals [26]. In our study, there was a significant increase in PDW in patients with GDM.

PCT, obtained by dividing the platelet volume by the platelet count, is considered an analog of hematocrit for platelets. It is known that the value of PCT in inflammation is much more significant and informative than platelet count, MPV, and PDW [27]. Şahbaz et al. revealed a more significant increase in PCT in GDM patients compared to other platelet markers [28]. In our study, there was a significant increase in PCT in patients with GDM.

Limitations
Our study has some limitations. The most important limitation of this article is its retrospective nature. Additionally, the small number of GDM patients and the single-center study are significant limitations. However, the strengths of our study there was not any previous studies have reported a positive correlation between PCT and the 1-hour glucose level. In our study, we found a significant positive correlation between PCT and the 1-hour glucose level and we think that this connection could be a significant indicator in GDM.

Conclusion
The results of this study indicate that platelet markers play an important role in the diagnosis of GDM. However, more comprehensive studies are needed to obtain more definitive data. Furthermore, increased MPV, PDW, and PCT values in a simple blood count during the initial visit of pregnant women should prompt consideration of potential GDM. In such cases, a thorough anamnesis should be taken from the patients, and risk factors should be carefully questioned.

Informed consent
Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Conflicts of interest
None declared.

Financial disclosure
None.

Ethical approval

Consent was obtained by all participants in this study. The study was initiated after the approval of Adana City Training and Research Hospital Ethics Committee (Approval date and No: 30/05/2024 / 1/2).

Author contributions

A.K., R.K.: Conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; drafting the work or revising it critically for important intellectual content; final approval of the version to be published. Agreement to be accountable for all aspects of the work in ensuring that question related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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