Relation of platelet distribution width (PDW) and platelet crit (PCT) to preeclampsia

Związek wskaźnika anizocytozy płytek (PDW) oraz wskaźnika PCT ze stanem przedrzucawkowym

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Abstract

Objective: *While the relationship between platelet crit (PCT), platelet distribution width (PDW) and hypertension has been well-documented, data on the association between PCT, PDW and preeclampsia are scant at best. In our study, we aimed to investigate the possible correlation of PCT and PDW with preeclampsia and disease severity.*

Material and methods: *A total of 110 preeclamptic and 100 healthy pregnant women were included in the study. Baseline PCT and PDW were measured using an automatic blood counterin the entire study population.*

Results: *While there were no significant differences between the preeclampsia group and the control group in terms of hemoglobin and platelet counts, the PDW, mean platelet volume (MPV), systolic and diastolic blood pressure, proteinuria, WBC and Hs-CRP levels were significantly higher in the preeclampsia group. In addition, PCT level was significantly lower in the preeclampsia group as compared to controls. Moreover, subgroup analysis revealed that PDW and MPV levels were significantly increased in severely preeclamptic patients when compared to mildly preeclamptic patients.*

Conclusions: *Our study results revealed that PCT and PDW levels were associated with both, the presence and severity of preeclampsia.*

Key words: **platelet crit** / **platelet distribution width** / **preeclampsia** /

Streszczenie

Cel pracy: *Związek pomiędzy wskaźnikiem PCT, wskaźnikiem anizocytozy płytek krwi (PDW) a nadciśnieniem tętniczym jest dobrze udokumentowany, podczas gdy dane na temat zależności pomiędzy PCT i PDW a stanem przedrzucawkowym są skąpe. W naszym badaniu celem było zbadanie możliwych korelacji pomiędzy PCT i PDW a stanem przedrzucawkowym oraz ciężkością choroby.*

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Materiał i metoda: *Do badania włączono 110 kobiet ze stanem przedrzucawkowym i 100 zdrowych ciężarnych. Wyjściowe wartości PCT i PDW zmierzono przy pomocy automatycznego pomiaru krwi w całej badanej populacji.*

Wyniki: *Nie znaleziono istotnych różnic pomiędzy grupą pacjentek ze stanem przedrzucawkowym a grupą kontrolną w odniesieniu do hemoglobiny i liczby płytek krwi, podczas gdy PDW, średnia objętość płytek (MPV), ciśnienie skurczowe i rozkurczowe, obecność białka w moczu, WBC i poziom Hs-CRP były istotnie wyższe w grupie ze stanem przedrzucawkowym. Dodatkowo, poziom PCT był istotnie niższy w grupie ze stanem przedrzucawkowym w porównaniu do grupy kontrolnej. Co więcej, analiza podgrup wykazała, że poziom PDW i PCT wzrastał istotnie wraz z ciężkością stanu przedrzucawkowego.*

Wnioski: *Nasze badania wykazały, że poziom PCT i PDW jest związany zarówno z obecnością jak i ciężkością stanu przedrzucawkowego.*

Słowa kluczowe: **PCT** / **PDW** / **wskaźnik anizocytozy płytek krwi** / / **stan przedrzucawkowy** /

Introduction

Preeclampsia, a common disease characterized by proteinuria, high blood pressure and edema, increases morbidity and mortality of both,the mother and the fetus.There are numerous theories related to the etiopathology of preeclampsia, chief among them being deficient trophoblast invasion, failure of spiral artery remodeling, or inflammation [1].The exact mechanism of how preeclampsia worsens maternal and fetal outcome remains to be elucidated [2]. Uncontrolled inflammation, typical of preeclampsia, might be related to the development of intrauterine pathologies [3].

Platelet count (PC), platelet crit (PCT), and platelet distribution width (PDW) with mean platelet volume (MPV)are considered to be the markers of platelet activation [4]. These indices are easily available hematologic parameters that show the variation of platelet volume (thrombocytopenia) [5,6]. While it is not clear how preeclampsia influences the platelets, it is known that platelets have larger diameter due to hypertension [7]. Platelet parameters have been shown to be associated with cardiovascular diseases and hypertension [8,9]. Besides, they are known to have a prognostic value in cases of acute-chronic cardiac events and inflammatory bowel diseases [10,11]. Although it is not fully understood how these indices increase during the above mentioned events, elevated PCT, PDW and MPV levels are believed to be related tothe ongoing inflammation.

While the correlation between PC, PCT, PDW, MPV and hypertension has been demonstrated, there are no conclusive data on the relationship between PC, PCT, PDW, MPV and preeclampsia. In our study, we aimed to investigate the association between preeclampsia and platelet parameters.

Material and methods

The study population consisted of 110 preeclamptic patients and 100 heathy control subjects. Of the preeclamptic patients, 47 were mildly and 63 were severely preeclamptic. The diagnosis was based on the 2002 criteria of the American College of Obstetricians and Gynecologists [12], defining preeclampsia as the presence of: systolic blood pressure of ≥140 mm Hg or a diastolic blood pressure of ≥90 mm Hg, occurring after 20 weeks of gestation in a woman with previously normal blood pressure, and detectable protein in the urine(0.3g/24hour and more or >1+ by dipstick). Severe preeclampsia was defined as follows: blood pressure ≥160mmHg/110mmHg, with >5g of proteinuria in 24hours or urine dipstick test showing 3+ or 4+ readings in random urine sample. Other signs of severe preeclampsia were as follows: eclampsia, oliguria (<500mL/24hours) or anuria, increased serum creatinine, symptoms suggestive of significant end-organ involvement (headache, visual disturbance), pulmonary edema, intrauterine growth restriction, oligohydramnios and decolman placenta. Mild preeclampsia was diagnosed in cases when subjects met the criteria of preeclampsia but not severe preeclampsia.Exclusion criteria were as follows: chronic hypertension, diabetes mellitus, multiple gestation, polyhydramnios, active labor, premature rupture of membranes, kidney diseases, inflammatory diseases, as well as other know medical complications.The control group had no evidence of hypertension or proteinuria, no signs of any gestational complication,and delivered healthy neonates with appropriate for gestational age size.The study was approved by the Local Ethics Committee.

Platelets, PCT, PDW, MPV, white blood cell count and other hematological indices were measured as part of the automated Complete Blood Count (CBC) using a Coulter LH 780 Hematology Analyzer (Beckman Coulter Ireland Inc., Mervue, Galway, Ireland). All pregnant participants received daily supplementation of folic acid (0.4 mg) in the first trimester and daily supplementation of ferrous sulphate (90 mg of elemental iron) starting with the second trimester.

Statistics

Mean and standard deviation were used to describe numerical variables. The Kolmogorov-Smirnov test was used to evaluate the distribution pattern of the data. The Mann–Whitney U test was used to perform statistical comparisons between the groups. Statistical significance was defined as p-value of <0.05. Data analysis was performed with SPSS for Windows 15.0 (Statistical Package for Social Sciences; SPSS Inc., Chicago, IL).

Results

A total of 210 patients (mean age 28±1,) were included in the study. The baseline characteristics of patients with and without preeclampsia are shown in Table 1. There were no significant differences between the groups in terms of age, parity, labor and PC. However, PCT, PDW, MPV, systolic and diastolic BP, proteinuria, white blood cell and Hs-CRP values were significantly

higher in preeclamptic patients as compared to controls. Hs-CRP levels were found to be elevated (>3mg/dl) in 44.3 % of mildly preeclamptic and 82.5% of severely preeclamptic subjects. Of all the women with preeclampsia, 57.27% had severe preeclampsia. In addition, while PCT level was significantly higher in patients with mild preeclampsia, PDW and MPV levels were significantly higher in patients with severe preeclampsia (Table 2).

Discussion

Elevated levels of PDW and MPV and decreased levels of PC and PCT were detected in preeclamptic patients in our study. These parameters were also associated with disease severity. While PDW and MPV levels were higher, PC and PCT levels were lower in the severely preeclamptic group as compared to mildly preeclamptic subjects.

MPV shows that platelet size is related to platelet reactivity [13]. MPV, an indicator of platelet activation, is associated with numerous diseases [14]. Large platelets, which represent platelet reactivity, are seen in cardiovascular diseases and prothrombic states. Small platelets are associated with chronic diseases like rheumatoid arthritis, systemic lupus erythematosus, etc. Nowadays, MPV has become an important parameter of routine

Table I. Baseline characteristics of pregnant women with and without preeclampsia.

Variables	Preeclampsia (n:110)	Controls (n:100)	P value
Maternal age (years)	28±8	27±2	0.345
GA at delivery (weeks)	37.2±0.9	37.5±1	0.456
Systolic BP(mmHg)	149±25	128±13	**<0.001**
Diastolic BP(mmHg)	84±16	71±23	**<0.001**
Proteinuria (gr/dl)	1340±652	62±32	**0.004**
Gravidity (median)	2±1.3	2±1.1	0.540
Parity (median)	2±1.2	2±1.1	0.462
Abortus (median)	0±0.4	0±0.1	0.651
WBC (x10^3 µL)	11±2.4	6.5±1.9	**0.023**
Hemoglobin (md/dl)	10.3±1.7	10.1±1.5	0.395
PC (x10^3 µL)	216.7± 45.6	252.3± 41.9	0.08
PCT (%)	0.19±0.08	0.23±0.04	**<0.001**
PDW (%)	18.2±3.5	16.3±2.1	**0.004**
MPV µm^3	9.5±2.9	9.14±0.8	**0.02**
Hs-CRP mg/dl	3.7±3.7	2.8±2.8	**0.001**

BP: Blood pressure, GA: Gestational age, WBC: White blood cell, Hs-CRP: High sensitivity C-reactive protein

Table II. Baseline characteristics of pregnant women with mild and severe preeclampsia.

Variables	Mild preeclampsia(n:47)	Severe preeclampsia(n:63)	P value
Maternal age (years)	28±2	29±1	0.406
GA at delivery (weeks)	37.5±0.89	36.9±1	0.425
Systolic BP(mmHg)	139±13	157±12	**<0.001**
Diastolic BP(mmHg)	76±11	91±11	**<0.001**
Proteinuria (gr/dl)	967±654	1690±1320	**0.003**
Gravidity (median)	2±1.1	2±1.4	0.550
Parity (median)	2±1.4	2±1.1	0.356
Abortus (median)	0±0.3	0±0.4	0.480
WBC (x10^3 µL)	10.6±2.7	11.4±2	0.678
Hemoglobin (md/dl)	10.5±1.4	10.2±1.5	0.285
PC (x10^3 µL)	230±62	203±52	0.178
PCT (%)	0.21±2.3	0.17±0.9	**<0.001**
PDW (%)	17.6±2.5	18.7±0.8	**0.085**
MPV µm^3	9.2±1.8	9.7±0.7	**<0.001**
Hs-CRP mg/dl	3.3±1.7	3.9±2.76	**0.019**

BP: Blood pressure, GA: Gestational age, WBC: White blood cell, Hs-CRP: High sensitivity C-reactive protein

complete blood count. Increased MPV levels were reported in preeclampsia by some authors [15, 16]. Dundar et al., revealed that MPV increase proceeded the diagnosis of preeclampsia by approximately 4.6 weeks. Jaremo et al., stated that it is possible to estimate disease severity on the basis of MPV measurement. Similarly, our results showed that MPV was elevated in preeclamptic patients and severely preeclamptic women had greater MPV values than mildly preeclamptic subjects.The elevated MPV levels found in our study may have been due to increased platelet turnover. Altinbas et al., observed an increased MPV concentration in preeclamptic subjects but claimed it to be of no predictive value in terms of disease severity [17]. However, their study population(n=74) was smaller than our sample. In addition, methods used for complete blood count may differ between studies[18].

PDW indicate morphological shape changes and platelet reactivity. Activation of platelets causes morphologic changes, including spherical transformation and formation of pseudopodia. These changes are responsible for different platelet size, which means increased PDW [19]. In our study, we found increased levels of PDW in the preeclamptic groups as compared to controls.

Platelet crit, which corresponds to the volume that platelets have in 100 mL of total blood, is the product of platelet count and MPV [20]. It can be mentioned as analogous to the hematocrit. In our study, PCT levels were found to be lower in preeclamptic patients ascompared to the control group and severely preeclamptic patients had lower levels of PCT. Freitas et al., found that PCT levels were lower in severely preeclamptic subjects as compared to non-pregnant controls. Their study included only women with severe preeclampsia. However, we evaluated mild preeclampsia and severe preeclampsia together. Low levels of PCT in our study reflect platelet effect rather than MPV.

The major limitation of our study was its retrospective design. The study population, especially the group with mild preeclampsia, was relatively small. Moreover, MPV measurement should ideally be done soon after taking blood samples. Since our study was retrospective in nature, we could not know the exact duration of the process.

Conclusions

Platelet parameters that are associated with inflammation seem to be useful inpredicting the diagnosis and severity of preeclampsia. In our study, increased levels of PDW and MPV and decreased levels of PC and PCT were detected in preeclamptic patients. These results changed as disease severity increased. Platelet indices can be used more extensively for prediction of preeclampsia since they are a simple, effortless, and cost effective tool. More studies are needed to establish the role of platelet parameters in predicting preeclampsia and its severity.

Authors' contribution:

1. Atilla Karateke –concept, analysis and interpretation of data, article draft, corresponding author.
2. Raziye Keskin Kurt – revised article critically, acquisition of data.
3. Ali Baloğlu – assumptions, study design, revised article critically.

Authors' statement

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