

Predictive value of plateletcrit in the diagnosis of lower extremity deep vein thrombosis

Alt ekstremitte derin ven trombozu tanısında plateletcritin prediktif değeri

Mustafa Abanoz¹

¹ University of Health Sciences, Mehmet Akif Inan Training and Research Hospital, Department of Cardiovascular Surgery, Sanliurfa, Turkey

ORCID ID of the author(s)

MA: 0000-0003-1821-1706

Abstract

Aim: Deep vein thrombosis (DVT) is a prevalent cause of mortality and morbidity mostly seen in the lower extremities. Early diagnosis is important in terms of the usability of mechanical thrombolysis methods. In this study, we aimed to investigate the diagnostic value of Plateletcrit (PCT) values in patients with suspected DVT.

Methods: Patients who were admitted to our clinic with suspected DVT between January 10, 2017-January 10, 2020 were included in this retrospective cohort study. As a result of their examination with a preliminary diagnosis of DVT, patients who were not diagnosed with DVT were recorded as Group 1, and those with DVT were recorded as Group 2. Univariate and multivariate logistic regression analyses were performed to reveal parameters supporting the diagnosis of DVT.

Results: A total of 139 patients were included in the study. The mean ages of patients in Group 1 (n=33) and Group 2 (n=106) were 45.7 (11.3) years and 53.9 (12.8) years, respectively. Age, body mass index (BMI) and trauma history rates were significantly higher in Group 2 (P values: $P=0.019$, $P=0.038$, $P=0.015$, respectively). The mean platelet volume (MPV), C-reactive protein (CRP), D-Dimer and PCT values were significantly higher in group 2 (P values; $P=0.001$, $P=0.018$, $P<0.001$, $P<0.001$, respectively). In the ROC analysis, the cut-off value for PCT was 0.1989 (AUC=0.732, $P<0.001$, 70.8% sensitivity, 66.7% specificity)

Conclusion: In this study, we found that PCT value, which can be obtained easily and cheaply from routine blood parameters, may be a predictor in patients with suspected DVT.

Keywords: Venous thrombosis, Platelets, Blood cells, Blood vessels

Öz

Amaç: Derin ven trombozu (DVT), çoğunlukla alt ekstremitelerde görülen önemli bir mortalite ve morbidite nedenidir. Günümüzde kullanılan mekanik tromboliz yöntemlerinin kullanılabilirliği açısından erken tanı önemlidir. Bu çalışmada derin ven trombozu (DVT) şüphesi olan hastalarda plateletcrit (PCT)'in tanılma değerini araştırmayı amaçladık.

Yöntemler: Çalışmaya 10 Ocak 2017- 10 Ocak 2020 tarihleri arasında kliniğimize şüpheli DVT kliniği ile başvuran hastalar bu retrospektif kohort çalışmasına dahil edildi. Kliniğimize DVT ön tanısıyla başvurup yapılan tetkikleri sonucunda DVT saptanmayan hastalar Grup 1, DVT saptanan hastalar ise Grup 2 olarak kaydedildi. DVT tanısını destekleyen parametreleri ortaya çıkarmak için tek değişkenli analizler ve çok değişkenli lojistik regresyon analizi yapıldı.

Bulgular: Çalışmaya 139 hasta dahil edildi. Grup 1'de 33 hasta olup ortalama yaşları 45,7 (11,3)'di, Grup 2 de ise 106 hasta olup ortalama yaşları 53,9 (12,8)'di. Yaş, beden kitle indeksi (BMI) ve travma hikayesi oranları Grup 2'de anlamlı olarak yüksekti (Sırasıyla P değerleri; $P=0,019$, $P=0,038$, $P=0,015$). Grup 2'de ortalama trombosit hacmi (MPV), C- reaktif protein (CRP), d-dimer ve PCT değerleri anlamlı olarak yüksek bulundu (Sırasıyla P değerleri; $P=0,001$, $P=0,018$, $P<0,001$, $P<0,001$). Yapılan ROC analizinde, PCT için kesme değeri 0,198 (AUC= 0,732, $P<0,001$, %70,8 sensitivite, %66,7 spesifite) olarak tespit edildi.

Sonuç: Bu güncel çalışmada rutin kan parametrelerinden kolay ve ucuz olarak elde edilebilen PCT değerinin şüpheli DVT kliniği olan hastalarda prediktör olabileceğini tespit ettik.

Anahtar kelimeler: Venöz tromboz, Trombositler, Kan hücreleri, Kan damarları

Corresponding author/Sorumlu yazar:
Mustafa Abanoz

Address/Adres: Sağlık Bilimleri Üniversitesi, Mehmet Akif İnan Eğitim ve Araştırma Hastanesi, Kalp Damar Cerrahisi Kliniği, Şanlıurfa, Türkiye
e-Mail: mustafaabanozdr@hotmail.com

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Introduction

Deep vein thrombosis (DVT) is a prevalent cause of mortality and morbidity mostly seen in the lower extremities. Although this condition is sometimes asymptomatic, it usually presents with sudden onset of swelling and pain in the extremity. Although its global annual incidence is 50-124/100,000, its frequency is gradually increasing [1]. DVT may result in mortality due to a possible sudden pulmonary embolism but may also cause post-thrombotic syndrome in patients [2]. Although Doppler ultrasonography is the gold standard diagnostic method in its diagnosis, various blood parameters (D-dimer) can also provide diagnostic support. Early diagnosis is important in terms of the usability of mechanical thrombolysis methods that are used today.

Platelets play a significant role in the pathogenesis of thromboembolism. Larger size platelets are more active metabolically and enzymatically than small ones. In other words, increase in mean platelet volume (MPV) increases the risk of thrombosis. Numerous studies have investigated the roles of platelet and MPV in the pathogenesis and progression of vascular diseases [3-5]. Plateletcrit (PCT) is a parameter obtained by multiplying MPV with platelet count. In a recent study, PCT value was reportedly higher in patients with retinal vein thrombosis compared to the control group [6].

In this study, we aimed to investigate the diagnostic value of PCT in patients with DVT.

Materials and methods

Patients who were admitted to our clinic with a suspected DVT clinic between January 10, 2017-January 10, 2020 were included in the study retrospectively. The study was ethically approved by the local ethics committee by the decision numbered 17.01.2010/774035. All procedures were performed in accordance with the ethical standards of the institutional and/or national research committee and the 1964 Helsinki declaration. The data of patients were accessed from the hospital registry and patient registration files. Demographic data (age, gender, etc.), doppler ultrasonography (DUSG) results and routine hemogram and biochemistry parameters were recorded. Those with known systemic inflammatory disease, hematological disease, cancer patients, those receiving antiplatelet therapy, patients with previous DVT, and bed-dependent patients due to chronic diseases were excluded from the study. After exclusion criteria, 139 patients were included in the study. Patients with a preliminary diagnosis of DVT who were not diagnosed with DVT after examination were included in Group 1 (33 patients), and patients with a definite diagnosis of DVT were included in Group 2 (106 patients).

Hemogram and biochemical parameters were measured with automatic analyzers. Plateletcrit calculation was made according to the formula:

$$\text{PCT} = \text{Platelet count (} 10^3/\mu\text{L)} \times (\text{MPV}/10,000)$$

Statistical analysis

Statistical analysis was performed by using the SPSS 21.0 (IBM Statistical Package for the Social Sciences Statistic Inc. version 21.0, Chicago, IL, USA) program. Student's t-test was used for numerical values with normal distribution, and

Mann-Whitney U test was used for non-normally distributed numerical data. Numerical values were expressed as mean \pm standard deviation. Chi-square test was used to compare categorical variables. $P < 0.05$ was considered statistically significant. Multivariate logistic regression analysis was performed to evaluate significant parameters in the univariate analysis for predicting DVT. Receiver Operating Characteristic (ROC) analysis was performed to evaluate the predictive value of PCT for DVT and the area under the curve was calculated.

Results

A total of 139 patients were included in the study. The mean ages of patients in Group 1 (n=33) and Group 2 (n=106) were 45.7 (11.3) years and 53.9 (12.8) years, respectively. There was no statistically significant difference between the groups in terms of gender, smoking, hypertension, hyperlipidemia, diabetes mellitus or history of cerebrovascular events ($P=0.712$, $P=0.695$, $P=0.747$, $P=0.661$, $P=0.618$, $P=0.269$, respectively). Age, body mass index (BMI) and trauma history rates were significantly higher in Group 2 ($P=0.019$, $P=0.038$, $P=0.015$, respectively) (Table 1).

Laboratory parameter data of the patients are presented in Table 2. There was no difference between the groups in terms of hematocrit, white blood cells, lymphocyte, platelet and albumin values. The mean platelet volume (MPV), C-reactive protein (CRP), D-dimer and PCT values were significantly higher in Group 2 ($P=0.001$, $P=0.018$, $P<0.001$, $P<0.001$, respectively).

Table 1: Demographic features of the patients

| Characteristics | Group 1 N=33 | Group 2 N=106 | P-value |
|-------------------------------------|-----------------|------------------|---------|
| Age(years), mean (SD) | 45.7 (11.3) | 53.9 (12.8) | 0.019 |
| Female gender, n (%) | 20 (60.6) | 68 (66) | 0.712 |
| Smoking, n (%) | 10 (30.3) | 36 (33.9) | 0.695 |
| BMI (kg/m ²), mean (SD) | 25.4 (4.2) | 29.7 (7.8) | 0.038 |
| Hypertension, n (%) | 9 (27.2) | 32 (30.1) | 0.747 |
| Hyperlipidemia, n (%) | 6 (18.1) | 23 (21.6) | 0.661 |
| Diabetes mellitus, n (%) | 3 (9) | 13 (12.2) | 0.618 |
| History of stroke, n (%) | 3 (9) | 18 (16.9) | 0.269 |
| History of trauma, n (%) | 6(18.1) | 43 (40.5) | 0.015 |

BMI: Body mass index

Table 2: Laboratory variables of the patients

| Variables | Group 1 N=33 mean (SD) | Group 2 N=106 mean (SD) | P-value |
|---------------------------------|------------------------------|-------------------------------|---------|
| Hematocrit (%) | 42.9 (5.3) | 45.2 (6.1) | 0.297 |
| WBC ($10^3/\mu\text{L}$) | 7.9 (2.7) | 8.4 (3.1) | 0.272 |
| Platelet ($10^3/\mu\text{L}$) | 252.8 (69.2) | 269.5 (76.7) | 0.156 |
| MPV (fL) | 7.9 (1.3) | 8.6 (1.4) | 0.001 |
| CRP (mg/dL) | 4.8 (7.9) | 9.7 (11.3) | 0.018 |
| Albumin (g /dL) | 3.9 (0.8) | 3.6 (0.7) | 0.427 |
| D-dimer ($\mu\text{g/mL}$) | 1.98 (2.87) | 7.28 (11.96) | <0.001 |
| PCT | 0.176 (0.43) | 0.219 (0.57) | <0.001 |

WBC: White blood Cell, MPV: Mean platelet volume, CRP: C Reactive protein, PCT: Plateletcrit

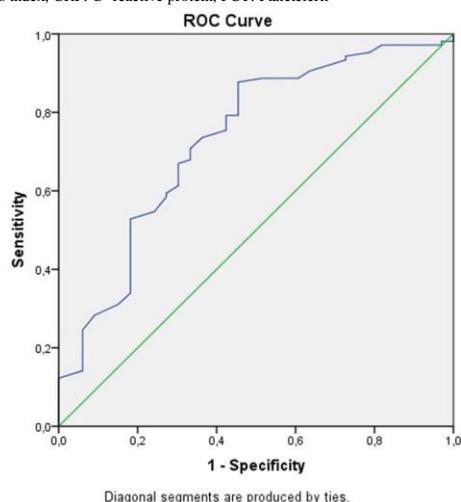
Multivariate logistic regression analysis was performed to reveal parameters supporting the diagnosis of deep vein thrombosis (Table 3). In the evaluation, high D-dimer values (OR: 3.645, CI 95%: 2.384-5.776, $P<0.001$), presence of trauma history (OR: 0.774, CI 95%: 0.594-0.996, $P=0.033$) and PCT (OR: 1.116, CI 95%: 1.090-1.227, $P=0.005$) were determined as independent predictors for showing deep vein thrombosis.

ROC analysis revealed that the cut-off value for PCT was 0.198 (AUC=0.732, $P<0.001$, 70.8% sensitivity, 66.7% specificity) (Figure 1).

Table 3: Multivariate logistic regression analysis to identify predictors of deep venous thrombosis

| Variables | P-value | Exp(B) Odds Ratio | 95% C.I. | |
|-------------------|---------|----------------------|----------|-------|
| | | | Lower | Upper |
| Age | 0.077 | 0.986 | 0.874- | 1.112 |
| BMI | 0.217 | 1.019 | 0.976- | 1.312 |
| CRP | 0.116 | 0.679 | 0.456- | 1.647 |
| D-dimer | <0.001 | 3.645 | 2.384- | 5.776 |
| History of trauma | 0.033 | 0.774 | 0.594- | 0.996 |
| PCT | 0.005 | 1.116 | 1.090- | 1.227 |

BMI: Body mass index, CRP: C- reactive protein, PCT: Plateletcrit



Diagonal segments are produced by ties.

Figure 1: Receiver operating characteristic curve analysis figure for Plateletcrit (cut-off= 0.198, AUC=0.732, $P<0.001$, 70.8% sensitivity, 66.7% specificity)

Discussion

Deep venous thrombosis is the third most common disease among all cardiovascular diseases. This can lead to catastrophic outcomes such as pulmonary embolism as well as clinical conditions such as post-thrombotic syndrome [7, 8]. Therefore, early diagnosis of DVT and initiation of the necessary treatment is extremely important. In this study, we determined that PCT value was an independent predictor in the diagnosis of DVT as well as the D-dimer test, which has been proven useful in the diagnosis of DVT (OR: 1.116, CI 95%: 1.090-1.227, $P=0.005$).

Platelets play a role in important tasks in the human body, such as hemostasis and tissue regeneration. Depending on the increasing number of platelets and activity in the blood, thromboxane synthesis and synthesis of adhesion molecules increase, so that susceptibility to thrombosis occurs [9]. These causes have been the subject of research in the pathogenesis of cardiovascular diseases and their prognosis after treatment. A study by Jahangiri et al. [10] investigated the effect of platelets on stent thrombosis in patients with ilio caval stents. In this study, baseline platelet counts were found to be effective on early stent thrombosis. In a study conducted by Yuksel et al. [11] on the severity of coronary artery disease, high platelet counts were also associated with diffuse atherosclerosis. There are also studies showing that the number of platelets is effective in studies between patients with and without deep vein thrombosis. In a study by Caliskan et al. [12] platelet counts were found to be higher in patients diagnosed with DVT than the control group. In another study constructed similarly to this study, platelet counts were shown in relation to DVT [13].

Mean platelet volume (MPV) is an important indicator for platelet functions showing platelet size. Large platelets contain a higher number of granular structures. These granular structures also contribute to thrombosis by secreting various prothrombotic factors [14]. Therefore, increased MPV values are

an important indicator of platelet functions [15]. Therefore, MPV value has been extensively investigated in cardiovascular diseases. The effect of MPV on restenosis after carotid artery stenting was investigated by Dai et al. [16]. In this study, patients were followed for 12.1 (16.1) months and high MPV values before the procedure were found to be associated with restenosis. In another study by Dundar et al. [17], the prognostic significance of MPV was shown in patients with subarachnoid hemorrhage. Cil et al. [18] found that MPV value was significantly associated with DVT and was found to be an independent predictor in demonstrating intra-hospital DVT. A study of the locations of MPV and D-dimer parameters in the diagnosis of DVT by Canan et al. [19] included 256 patients with suspected lower extremity DVT. The authors found high MPV values in relation to DVT in this study. They also suggested that MPV values may have a specificity-enhancing effect in the diagnostic approach with D-dimer values .

Plateletcrit (PCT) value is a parameter obtained by multiplying the number of platelets and MPV and it shows the total platelet mass in the blood. In a study by Akpınar et al. [20] increased PCT values were found effective in the development of saphenous vein disease after coronary bypass operations. In another study, PCT values were found to be higher in patients with central retinal vein occlusion than in healthy individuals [6]. The relationship of recurrent pregnancy loss with thrombosis is known. Accordingly, the relationship between PCT value and recurrent abortion was investigated by Aydınoglu et al. [21] The authors found that at the end of the study, the cheap and easily available PCT parameter could predict possible recurrent pregnancy losses. In the study conducted in 2017, the relationship between DVT and PCT was investigated. In this study, authors found a significant relationship with the PCT value in female patients with DVT [22].

DVT developing in trauma patients and pulmonary embolism that may occur due to this is the third most common cause of death in trauma patients [23]. The predisposition to post-traumatic thrombosis leads to DVT. Accordingly, in our study, we found the history of trauma in patients with DVT as a predictive predictor for DVT.

Limitations

The most important limitations of our study include its retrospective nature, single-centeredness, and small number of the patients. In addition, although iliac compression syndrome is rarely seen, it has not been possible to distinguish patients with it that may lead to DVT [24]. It is quite difficult to discuss these clinical conditions due to the retrospective nature.

Conclusions

As a result, although thrombosis parameters have been extensively investigated in the diagnosis of DVT, the study investigating the relationship between PCT and DVT has been limited. In this study, we found that PCT value, which can be obtained easily and cheaply from routine blood parameters, may be a predictor in patients with suspected DVT. Multicenter future studies are needed in this regard.

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