The Prognostic Value of Hematological Parameters in Patients with Pulmonary Embolism

Pulmoner Emboli Hastalarında Hematolojik Parametrelerin Prognostik Değeri

Role of Inflammation in Pulmonary Embolism

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Özet

Amaç: PE'li hastaların tanı anındaki ve tedavi sonrasındaki hemogram değerleri incelenerek, hematolojik parametrelerin tedavi yanıtı ve hastalığın prognozu ile ilişkisi araştırılmıştır. Gereç ve Yöntem: Çalışmaya Aralık 2014-Aralık 2015 tarihleri arasında hastanemiz Göğüs Hastalıkları Kliniği'nde PTE tanısı ile yatırılarak tedavi edilmiş toplam 48 hasta alındı. Olgu dosyaları dijital arşiv sisteminden retrospektif olarak incelendi ve demografik verileri, klinik değerlendirmeleri ile tanı anındaki ve tedavi sonrasındaki hemogramları retrospektif olarak değerlendirildi. Hemogram parametrelerinden WBC, NLR, MPV'nin ölçümleri incelendi. İstatistiksel analizler için SPSS 17,0 programı ile Kolmogorov-Smirnov, Mann-Whitney U ve bağımsız grup t testleri kullanıldı. Bulgular: Çalışmamıza alınan toplam 48 hastanın ortalama yaşı 62.68 olup, 27'si (%56.2) erkek idi. Ortalama yatış süresi 9,2 gün olarak bulundu. Tanı anında NLR, MPV ve WBC ortanca değerleri sırasıyla 4.82 (3.04-9.32), 10.2 (7.40-11.8), 9215 (6507.5-13255) olup tedavi sonunda ise; 2.60 (1.82-3.74), 9.3 (7-12.9), 7265 (6125-8872.5) olarak bulundu. NLR, MPV ve WBC değerlerinin tedavi sonrası istatistiksel olarak anlamlı düştüğü saptandı. (p <0,001) Tartışma: Çalışmamızın sonuçları nötrofil lenfosit oranı, ortalama trombosit hacmi ve beyaz kürenin pulmoner embolinin tanısı ve tedavi yanıtını gösteren prognostik inflamatuar belirteçler olabileceğini düşündürmektedir.

Anahtar Kelimeler

Pulmoner Emboli; Beyaz Küre Sayısı; Nötrofil Lenfosit Oranı; Ortalama Trombosit Hacmi

Abstract

Aim: By analyzing the hemogram values of patients with PE during and following the treatment, the relationships of hematological parameters with response to treatment and prognosis of the disease were investigated. Material and Method: Forty-eight patients, who were hospitalized and treated with the diagnosis of PTE in the Pulmonary Diseases Clinic of our hospital between December 2014 and December 2015, were included in the study. The patients' charts, located in the digital archive system, were analyzed retrospectively and demographic characteristics, clinical evaluations, and their hemogram results during and following the treatment were retrospectively evaluated. Among the hemogram parameters, the values of WBC,NLR and MPV were statistically analyzed. For statistical analysis, SPSS 17.0 software and the Kolmogorov-Smirnov test, Mann-Whitney U test and independent sample t test were used. Results: The average age of the 48 patients included in our study was 62.68, and 27 (56.2%) of them were males. The average duration of hospitalization was 9.2 days. The median values of NLR, MPV, and WBC at the time of diagnosis were 4.82 (3.04-9.32), 10.2 (7.40-11.8), and 9215 (6507.5-13255), respectively. Following treatment, these values were 2.60 (1.82-3.74), 9.3 (7-12.9), and 7265 (6125-8872.5), respectively. It was determined that the NLR, MPV, and WBC values were statistically significantly reduced following treatment (p <0,001). Discussion: Our study suggested that NLR,MPV and WBC can be used as prognostic inflammatory indicators for diagnosing and treating pulmonary embolism.

Keywords

Pulmonary Embolism; White Blood Cell Count; Neutrophil Lymphocyte Ratio; Mean Platelet Volume

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Introduction

Pulmonary embolism (PE) is a preventable, important clinical problem with high morbidity and mortality [1]. Simple tests can be used to determine prognosis and to evaluate patients' responses to treatment. Hemogram parameters such as white blood cell count (WBC), platelet count, neutrophil lymphocyte ratio (NLR), and mean platelet volume (MPV) have been recently investigated as inflammatory indicators in numerous disorders [2,3]. In recently conducted studies on patients with PE, the elevation of NLR has been found to be correlated with early mortality [4]. Studies that examine MPV have determined that MPV was increased, platelet count was reduced in pulmonary embolism and these values were associated with the diameter of the right ventricle [5,6].

As far as we know there is no study in the medical literature that investigates the effect of PE treatment on hematological parameters. In this study, by analyzing the hemogram values of patients with PE during and following treatment, the relationships of hematological parameters with response to treatment and prognosis of the disease were investigated.

Material and Method

Forty-eight patients, who were hospitalized and treated with the diagnosis of PE in the Pulmonary Diseases Clinic of our hospital between December 2014 and December 2015 were enrolled in the study. Patients who did not have any clinical signs of infection (such as fever, cough, or sputum) or high laboratory parameters (such as C-reactive protein and procalcitonin) and whose patient charts were available for investigation, were included in the study. Following approval of the local ethics committee, patients' charts were retrospectively analyzed via the digital archive system. Their demographic data (age, gender, medical history), duration of hospital stay, comorbidities, chronic treatments administered, and the units in which they had been followed-up for acute phase and maintenance embolism treatments (clinic/intensive care unit) were recorded. The patients were classified as low mortality (stable hemodynamic status and absence of right ventricular dysfunction); intermediate mortality risk group (stable hemodynamic status and presence of right ventricular dysfunction in radiological or laboratory investigations); and high mortality (unstable hemodynamic status), according to the Turkish Thoracic Society 2015 Consensus Report on Diagnosis and Treatment of Pulmonary Thromboembolism. Patients with low mortality risk were named as Group 1, and patients having intermediate-low, intermediate-high, and high risks were joined into one group and named as Group 2.

The hemogram results of patients who had no identified infections, obtained at the time of diagnosis and as part of discharge from the hospital were retrospectively evaluated. The routine hemogram parameters, white blood cell count (WBC), neutrophil and lymphocyte counts were recorded together with the mean platelet volume (MPV). By dividing the neutrophil count by the lymphocyte count, the neutrophil lymphocyte ratio, which is one of the nonselective inflammatory markers, was calculated.

Statistical analysis

For statistical analysis, SPSS software (Statistical Package for Social Sciences) version 17.0 was used. The Kolmogorov-Smirnov test was used to assess the normality of numeric variables. For the numeric variables that were normally distributed, comparison between two groups was made by independent sample t test and descriptive statistics are presented as mean±standard deviation. For the numeric variables that were not normally distributed, comparison between the two groups was made by the Mann–Whitney U test and descriptive statistics are presented as median (25-75 percentiles). The p values below 0.05 were considered statistically significant.

Results

The average age of the 48 patients enrolled in the study was 62.68 ± 15.88 (30-84), of whom 27 (56.2%) patients were male. The average duration of hospitalization was 9.2 ± 4.64 (1-22) days. When frequencies of risk factors and comorbidities were analyzed, 35 (62.6%) patients were determined to have at least one pathology (Table 1).

Table 1. The Frequency of Risk Factors and Comorbidities in Patients with Pulmonary Embolism

PATHOLOGY	n	(%)
Malignancy	11	22.9
Immobility	11	22.9
History of operation within the last month	9	18.8
Genetic mutation (F5Leiden, Prot.G20210A)	3	6.3
Cerebrovascular event	1	2.1

When grouped in terms of early mortality, 30 patients were in the low-risk group (Group 1), 13 patients were in the intermediate-risk group, and five patients were in the high-risk group for embolism (Group 2) (Table 2). No statistically significant differences were found between the two groups in terms of NLR, MPV, and WBC values at the time of diagnosis (Table 3).

Table 2. Classification of Early Mortality

Mortality Risk	n	%
High	5	10.4
Intermediate - High	4	8.3
Intermediate - Low	9	18.8
Low	30	62.5

Table 3. The Comparison of Hematological Parameters According to Risk Groups

Parameter	Grup 1 (n=30)	Grup 2 (n=18)	p
NLR	6.04 (3.14-9.85)	4.51 (2.64-7.31)	0.277
MPV	10.03±0.90	10.38±0.87	0.186
WBC	9215 (6662.5-12815)	9125 (5695-13820)	0.766

The median values of NLR, MPV, and WBC were 4.82 (3.04-9.32), 10.2 (7.40-11.8) , and 9215 (6507.5-13255), respectively, at the time of diagnosis. Since one patient died at the second hour of treatment, the results of 47 patients were available following treatment. Post-treatment median values of NLR, MPV, and WBC were 2.60 (1.82-3.74), 9.3 (7-12.9), and 7265 (6125-8872.5), respectively; these were statistically significantly lower when compared to the results at the time of diagnosis (Table 4).

Table 4. The Comparison of Pre-treatment and Post-treatment Hemogram Parameters

Parameter	Pre-treatment (n=47)	Post-treatment (n=47)	p
NLR	4.82 (3.04-9.32)	2.60 (1.82-3.74)	< 0.001
MPV	10.14±0.90	9.38±1.11	< 0.001
WBC	9215 (6507.5-13255)	7265 (6125-8872.5)	< 0.001

Discussion

Pulmonary embolism is a disorder with high mortality when left untreated. Establishment of the prognosis and the choice of treatment are made according to the classification based on early mortality risk 1. Until now, clinical scorings such as Geneva scoring, and pulmonary embolism severity index or cardiac markers such as troponin and natriuretic peptide have been used to determine prognosis [7-9].

Although the role of systemic inflammation in PE has been known, its association with prognosis has not been clearly identified. In conducted studies, leucocytes were shown to participate in venous thrombosis by creating endothelial injury [9]. Additionally, NLR is considered to be a simple indicator of subclinical inflammation and is used for prediction of mortality in diseases such as coronary artery disease and cancer [10]. Our study investigated not only clinical scoring systems but also the relationships of laboratory tests, such as NLR, MPV, and WBC, simply determined by complete blood count, with the PE prognosis. When classification was made according to early mortality, no significant differences were found between the low-mortality PE group and the intermediate-high mortality PE group at the time of diagnosis, in terms of NLR, MPV, and WBC. The study conducted by Ermiş et al. on 209 patients with acute pulmonary embolism (APE) and 162 healthy controls, investigated whether MPV was a prognosticindicator in high-risk pulmonary embolism; MPV was found to be unrelated to the severity of embolism (massive, submassive, nonmassive) [11]. Similarly, in our study, a relationship between severity of embolism and MPV was not found. In the study conducted by Kostrubiec et al. on 192 APE patients and 100 healthy controls, no difference was found between the two groups in terms of MPV value. However, when the patients were classified according to low, intermediate and high mortality risks, the MPV values were significantly higher in the intermediate and high-risk groups when compared to the low-risk group. In addition, there was no significant difference between the MPV values of the intermediate and high-risk group and those of healthy controls [12]. Similar to the study by Ermiş et al., they determined that MPV value was higher in patients who died when compared to patients who survived. In both studies, this situation was explained by the possible relationship of MPV with the right ventricular dysfunction and myocardial injury [11,12]. Varol et al., in their study on 107 APE that patients and 70 healthy controls, showed that MPV was higher in APE and this was correlated with the diameter of the right ventricle [13]. We had no healthy control group in our study and therefore, comparisons with a control group were not possible. However, when patients were grouped according to the mortality risk, no significant differences were found between groups in terms of NLR, MPV, and WBC. This situation might be explained by the small number of patients in our study and the fact that the groups were nonhomogeneous.

A study by Kayrak et al. on 359 APE patients, investigated whether NLR was a prognostic indicator for early mortality in APE. In the group that died at the end of the first month of treatment, NLR and WBC were found to be significantly higher when compared to patients who survived. For this reason, it was emphasized that NLR and WBC were simple and cheap tests that predict early mortality (4). In another study conducted by Yeşildağ et al., the relationships of computerized tomography obstruction score (Qanadli obstruction score) with NLR and MPV were investigated in 95 patients, who were diagnosed with PE by computerized tomography pulmonary angiography (CTPA). In this study, when right ventricle / left ventricle short axis ratios and NLR were compared with survival rate and mortality, mortality was significantly related to NLR and MPV [14]. In our study, radiological findings were not evaluated. Since mortality had occurred in only one patient at the second hour of treatment, evaluation was not possible in terms of mortality. Currently, the issues of whether NLR, MPV, and WBC are increased in APE and are indicators of mortality is being investigated; however, there have not been sufficient studies evaluating post-treatment response. In the study conducted by Eren et al. on 209 patients who received treatment for acute coronary syndrome, poor cardiovascular results of NLR and its characteristics for mortality prediction were investigated. The cut-off value of NLR was taken as 4.7 in terms of mortality and the patients were grouped as low (<3.0), intermediate (3.0-4.7) and high (>4.7). Their in-admission, in-hospital, 6th month, and follow-up NLR values were compared to the risk scores named GRACE (Global Registry of Acute Coronary Events) and TIMI (Thrombolysis in Myocardial Infarction); no differences were found between groups in cardiac-related hospitalizations [15]. In our study, it was determined that following treatment, the values of NLR, MPV, and WBC were significantly reduced when compared to the pre-treatment values.

The Limitations of the Study

The retrospective characteristics of our study and the relatively small number of patients when group analysis was performed constituted the limitations of the study. Also, we didn't include healthy control groups in the study; instead, we compared the before-treatment and after-treatment values of NLR, MPV, and WBC in patients with an indication of pulmonary embolism.

Conclusion

The values of NLR, MPV, and WBC were found to be significantly reduced following treatment. We suggest that these parameters are simple, cheap, and easily accessible indicators for demonstrating the response to the treatment of the disease. Since the number of patients is small in our study, more comprehensive, prospective studies are required in order to support our suggestion.

Competing interests

The authors declare that they have no competing interests.

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