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ORIGINAL ARTICLE

Usefulness of admission hematologic parameters as diagnostic tools in acute pulmonary embolism

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Abstract The purpose of this study was to determine the role of red cell distribution width (RDW), neutrophil–lymphocyte ratio (NLR), and platelet–lymphocyte ratio (PLR) in the diagnostic phase of acute pulmonary embolism (PE). We screened 248 consecutive patients who were admitted to the emergency service with PE foremost in the differential diagnosis. Based on spiral computed chest tomography, the patients were divided into two groups. There were 112 confirmed cases of acute PE and 138 patients without PE. Blood samples were obtained within 2 hours of presentation and before starting any medication. There were no significant differences between the PE and the non-PE groups with respect to sex, age, frequency of disease, serum creatinine, sodium, and potassium ($p > 0.05$ for all). NLR, RDW, and PLR were higher in patients with PE than those without PE. High-sensitivity C-reactive protein, D-dimer, and troponin levels were also higher in patients with PE. RDW values were positively correlated with troponin levels ($r = 0.147$, $p = 0.021$). There were no correlations between RDW and NLR, PLR, or D-dimer. NLR had a highly positive correlation with PLR ($r = 0.488$, $p < 0.001$). In multivariate logistic regression analysis, troponin I, D-dimer, high-sensitivity C-reactive protein, and RDW were found to be independent predictors of PE [odds ratio (95% confidence interval) respectively: 5.208 (2.534–10.704), 1.242 (1.094–1.409), 1.005 (1.000–1.010), 1.175 (1.052–1.312)]. In receiver operating characteristic analysis of the patients in the study, RDW >18.9 predicted acute PE with a sensitivity of 20.7% and a specificity of 93.4%. In conclusion, RDW can be considered useful as a diagnostic measure for patients with suspected acute PE.

Conflicts of interest: All authors declare no conflicts of interest.

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Introduction

Acute pulmonary embolism (PE) is a life-threatening and common cardiopulmonary disease with a mortality rate of 15—20% [1]. It usually arises from a thrombus formed in the deep venous system of the lower extremities. It can occlude the pulmonary arterial bed and may lead to a chronic disabling condition, an acute life-threatening illness, or even death. As the clinical presentation for pulmonary embolism is often nonspecific and equivocal, clinical physicians need to pay much more attention to its diagnosis [2]. For this reason, it is prudent to pursue a quick and definitive diagnosis in every suspected case of PE. Because of its wide availability and ability to directly visualize thrombus, computed tomography imaging has become the standard imaging technique for the diagnosis of acute PE [3]. Routine laboratory testing is not useful in proving the presence of venous thrombosis or PE, but may contribute to the evaluation of the differential diagnosis. The diagnostic work ought to be as noninvasive and cost-effective as possible in order to minimize health system expenditures. The utility of plasma measurements of circulating D-dimer, a specific derivative of cross-linked fibrin, has been evaluated extensively as a diagnostic test in suspected PE. The recommended diagnostic pathway for outpatients with a low or intermediate probability of PE is to begin by performing a highly sensitive D-dimer assay [4,5]. Another marker, cardiac troponins, has been evaluated in the setting of acute PE and elevated troponin levels correlate with electrocardiographic and echocardiographic findings of right ventricular pressure overload. Elevated plasma troponin levels have been repeatedly reported as associated with worse prognosis and increased mortality in patients with PE [6,7]. Elevated brain natriuretic peptide has also been shown to be a marker of right ventricular pressure overload and one of the predictors of adverse outcome in patients with acute PE [8,9]. Complete blood count is part of the routine laboratory investigations in most hospitalized patients.

The red cell distribution width (RDW) is a measurement that is obtained by automated hematology analyzers. It reflects the range of the red cell sizes that are measured within a sample. RDW is strongly associated with prognosis in cardiopulmonary disorders such as coronary artery disease (CAD), acute myocardial infarction, acute and chronic heart failure, and pulmonary hypertension [10—15]. Recently it was shown that an elevated neutrophil—lymphocyte ratio (NLR) is related to early mortality in patients with PE [16]. An elevated platelet—lymphocyte ratio (PLR) as a risk factor for arterial obstructive diseases has been evaluated in some studies. It has been shown that elevated PLR is a significant independent predictor of long-term mortality after non-ST elevation myocardial infarction [17]. Gary et al demonstrated that a PLR $>$ 150 proved to be at least comparable to a NLR $>$ 3.95, an already established vascular risk factor, in its association with critical limb ischemia in patients with peripheral arterial occlusive disease [18]. However, the diagnostic value of PLR and NLR in acute PE is unknown. The goal of this study is to investigate the diagnostic value of RDW, NLR, and PLR, measured on admission, in patients suspected of having acute PE.

Materials and methods

This study was approved by the ethics review board of Mersin University School of Medicine. In this study, we retrospectively screened 248 consecutive patients over 18 years who were admitted to hospital with a suspect of PE between January 2011 and May 2013. Exclusion criteria were: active or chronic inflammatory or autoimmune diseases; inflammatory rheumatic disease; anemia; clinical evidence of active infection; active cancer; any hematological diseases; recent blood transfusion; chronic renal disease; and history of chronic obstructive pulmonary disease. According to their spiral computed chest tomography, the patients were divided into two groups: 112 of them had acute PE and 138 patients had no PE.

Biochemical analysis

Blood samples were obtained within 2 hours of presentation before starting any medication and were collected in tripotassium EDTA tubes. All measurements were performed 30 minutes after blood collection by an automatic blood counter (A Sysmex XE-2100; Symex, Kobe, Japan). D-Dimer was measured using Sysmex CA-7000 (Symex), troponin I was measured using Access 2 Immunoassay System (Beckman Coulter Inc., Brea, CA, USA), and high-sensitivity C-reactive protein (hsCRP) was measured using a BN2 model nephlometer.

Statistical analysis

Continuous variables are given as the mean $\pm$ standard deviation; categorical variables were defined as a percentage. A value of $p < 0.05$ was considered significant. Comparisons between groups were carried out using an independent-samples t test. Correlation analyses were performed using the Pearson or Spearman coefficient of correlation. Multivariate logistic regression analysis was used to show the independent predictors for PE. The cut-off levels, sensitivity and specificity values of RDW in PE patients were determined using MedCalc 12.7.0.1 (MedCalc Software, Mariakerke, Belgium). A trial version of SPSS 20.0 software was used for basic statistical analysis (Version 20; SPSS Inc., Chicago, IL, USA).

Results

The baseline characteristics of the study participants are summarized in Table 1. There were no significant differences between the PE and the non-PE groups with respect to sex, age, frequency of disease (i.e. diabetes mellitus, hypertension, smoking, and coronary artery disease), serum creatinine, sodium, and potassium ($p > 0.05$ for all). NLR values were higher in patients with PE than without PE (6.2 ± 2.9 in the PE group vs. 5.4 ± 3.0 in the non-PE group, $p = 0.03$). RDW and PLR values were also higher in patients in the PE group compared to the non-PE group (respectively: 15.9 ± 3.8 vs. 14.8 ± 2.2, $p = 0.005$ and 210 ± 131 vs. 178 ± 107, $p = 0.03$).