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Original Research Article

Mean platelet volume and mean platelet volume/platelet count ratio in risk stratification of pulmonary embolism

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ABSTRACT

Background and objective: Recently, some of the hemogram parameters were reported to predict early death in acute pulmonary embolism (PE). The aim of this study was to investigate the role of mean platelet volume (MPV) and MPV/platelet count ratio (MPV/P), WBC and red cell distribution width (RDW) in risk stratification of patients with acute PE.
Materials and methods: We retrospectively reviewed the medical records of patients with acute PE admitted to the Emergency Department. In addition to the clinical evaluation, the hemogram parameters were measured on admission.
Results: A total of 152 patients were included. Patients with RV dysfunction had significantly higher MPV levels and MPV/P than patients without RV dysfunction. Receiver operating characteristic curve analysis revealed that a MPV cut-off of 7.85 fL provided a sensitivity of 53.3% and a specificity of 68.5%, and a MPV/P cut-off of 0.0339 fL/(10^9/L) provided a sensitivity of 69.6% and a specificity of 65% for the prediction of RV dysfunction. There was a positive correlation between MPV and systolic pulmonary artery pressure (SPAP) and between MPV and RV diameter. There was a positive correlation between MPV/P and SPAP and between MPV/P and RV diameter. The low-risk PE group had lower MPV and MPV/P than the massive PE and submassive PE groups.
Conclusions: MPV and MPV/P were found to be associated with RV dysfunction and clinical severity in acute PE. Low MPV and MPV/P levels may be an indicator of low risk and, high WBC levels may be an indicator of high risk in patients with acute PE. RDW levels may not reflect severity of acute PE.

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1. Introduction

Risk stratification of patients with acute pulmonary embolism (PE) represents an important step and may help to guide the initial therapeutic management. Right ventricular (RV) dysfunction as evaluated by echocardiography is associated with a high mortality risk in patients with acute PE [1]. Patients with RV dysfunction and arterial hypotension require more aggressive therapeutic strategies. In recent years, there has been an increasing interest in the risk stratification of patients with acute PE using standardized blood tests [2].

Acute PE is a consequence of deep vein thrombosis (DVT) in most cases [3]. Thrombosis begins with the aggregation of erythrocytes, fibrin, and platelets. Platelets have a central role in the pathogenesis of thromboembolic disease [4]. Platelets produce proinflammatory molecules, which have prothrombotic activity [5]. Platelet size has been shown to reflect platelet activity [4]. The mean platelet volume (MPV) is a parameter of platelet volume that can be determined routinely in nearly all clinical laboratories, and it is accepted as a marker in determining thrombocyte function [5,6].

Increased MPV in thromboembolic disease is considered an important risk factor [7]. It was found that MPV values were significantly increased in cerebral venous sinus thrombosis patients with brain parenchymal lesions [5]. An elevated MPV is also associated with acute DVT, MPV and the MPV/platelet count ratio (MPV/P) can be considered meaningful laboratory markers for determining the risk of DVT [7,8]. Platelet activation is observed in patients with acute PE [9]. It has been shown that MPV was significantly elevated in acute PE [10]. It was also reported that MPV is an independent predictor of early death in acute PE [11]. In addition, several studies showed the prognostic value of white blood cells (WBC) and red cell distribution width (RDW) in PE [12–15]. However, in the literature, the role of MPV, MPV/P, WBC and RDW in the evaluation of patients with acute PE is less clear. The aim of this study was to investigate the role of MPV, MPV/P, WBC and RDW in risk stratification of patients with acute PE.

2. Materials and methods

2.1. Study design and setting

This study was designed retrospectively by examining the files of all patients with confirmed acute PE who were admitted to the Emergency Department (ED), Ondokuz Mayis University, from January 2008 to December 2012. The study protocol was approved by the local ethics committee.

2.2. Selection of participants

The initial evaluation of the patients included clinical history and physical examination, hemogram parameters, arterial blood gas analysis, chest radiograph, and 12-lead electrocardiography. Patients presenting with clinically suspected PE were referred for further diagnostic workup. The diagnosis of PE was confirmed by contrast-enhanced spiral computed tomography (CT) or a high probability ventilation/perfusion lung scan [2]. The study group consisted of 166 patients with acute PE. Patients with chronic renal or hepatic disease were excluded from the study ($n = 6$). In addition, 8 patients without echocardiographic examination were excluded from the study.

Patients were divided into two groups based on the presence or not of RV dysfunction on the echocardiography. Moreover, patients were classified into three groups: (a) massive PE (RV dysfunction and cardiogenic shock), (b) submassive PE (RV dysfunction and a preserved arterial pressure) and (c) low-risk PE (no RV dysfunction) for risk stratification [16].

2.3. Echocardiography

Transthoracic echocardiography was performed by a cardiologist. Echocardiography for the assessment of RV dysfunction was performed (Vivid 7, GE Vingmed Ultrasound; Horten, Norway) using a 2.5 MHz phased-array transducer with the patients in the left lateral decubitus position, on the same day of diagnosis of acute PE. All parameters were measured according to the recommendations of the American Society of Echocardiography [17]. Patients with at least one of the following findings were diagnosed as having RV dysfunction: RV hypokinesis (asymmetrical or delayed contraction, usually in the RV base), paradoxical septal systolic motion or RV dilatation (end-diastolic diameter >30 mm or right-to-left ventricular end-diastolic diameter ratio ≥1 in an apical 4-chamber view) [18].

2.4. Baseline measurements

Initial hemogram parameters were evaluated in this study. In all patients, venous peripheral blood samples for measurements were drawn on admission. Blood samples were taken into standardized tubes containing dipotassium ethylenediaminetetraacetic acid (EDTA) and stored at room temperature. Blood samples were sent directly to the ED laboratory and analyzed immediately as per standard protocol. Hemogram parameters were analyzed on a fully-automated hematological analyzer, ADVIA 2120 (Siemens Medical Solutions Diagnostics; Tarrytown, NY, USA), within 30 min after blood sampling. According to our laboratory, the reference values of MPV are 6.1–8.9 fL.

2.5. Statistical analysis

All statistical calculations were made using the Statistical Package for the Social Sciences (SPSS) for Windows version 15.0 (SPSS Inc Headquarters, Chicago, IL, USA) software program. To identify the normal distribution, the Kolmogorov–Smirnov test was applied. Values are reported as median (min–max) for quantitative variables. Kruskal–Wallis analysis of variance, Mann–Whitney U, and Bonferroni-corrected Mann–Whitney U tests were used to compare the groups. Receiver operating characteristic (ROC) curves for predicting RV dysfunction were generated from the data. Sensitivity and specificity were also calculated for MPV levels and MPV/P. A P value of <0.05 was accepted as statistically significant for Mann–Whitney U and Kruskal–Wallis analysis