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# Original Contributions

# PLATELET TO LYMPHOCYTE RATIO ON ADMISSION AND PROGNOSIS IN PATIENTS WITH ACUTE CARDIOGENIC PULMONARY EDEMA

Mevlut Demir, MD,* Pinar Turker Duyuler, MD,† Umit Guray, MD,† and Muhammet Cihat Celik, MD†

*Department of Cardiology, Birecik State Hospital, Sanliurfa, Turkey and †Department of Cardiology, Numune Education and Training Hospital, Ankara, Turkey

*Reprint Address:* Mevlut Demir, MD, Department of Cardiology, Birecik State Hospital, Sanliurfa, Turkey 63400

☐ **Abstract—Background:** Acute heart failure is a heterogenous syndrome defined by a number of factors, such as its physiopathology, clinical picture, time of onset, and relation to acute coronary syndrome. Acute cardiogenic pulmonary edema (ACPE) constitutes approximately 10–20% of acute heart failure syndromes, and it is the most dramatic symptom of left heart failure. Platelet to lymphocyte ratio (PLR) is a relatively novel inflammatory marker that can be utilized for prognosis in various disease processes. **Objective:** In this study, we investigated the value of the PLR for the prediction of mortality in patients with ACPE. **Methods:** A total of 115 patients hospitalized with a diagnosis of ACPE were included in this study. The patients were divided into tertile groups according to their PLR values: high (PLR > 194.97), medium (98.3–194.97), and low tertile (PLR < 98.3). **Results:** We compared the PLR groups for in-hospital mortality and total mortality after discharge. Multivariate Cox regression analysis showed that PLR was independently associated with total mortality (hazard ratio 5.657; 95% confidence interval 2.467–12.969; $p < 0.001$). Survival analysis using the Kaplan–Meier curve showed that the high-PLR group had a significantly higher mortality rate than the other groups. **Conclusions:** We showed an association between high PLR and mortality in patients with ACPE. PLR, together with other inflammatory markers and clinical findings, may be used as an adjunctive parameter for the stratification of mortality risk, hospitalization, or discharge criteria scoring. © 2018 Elsevier Inc. All rights reserved.

☐ **Keywords**—cardiogenic pulmonary edema; inflammation; platelet to lymphocyte ratio; prognosis

## INTRODUCTION

Acute heart failure is a heterogenous syndrome defined by a number of factors, such as its physiopathology, clinical picture, time of onset, and relation to acute coronary syndrome. It requires emergency treatment and is related to approximately 6.5 million in-hospital days in the United States [1,2]. Acute cardiogenic pulmonary edema (ACPE) constitutes approximately 10–20% of acute heart failure syndromes, and it is the most dramatic symptom of left heart failure [3]. Patients are most frequently admitted to the emergency department with a severe dyspnea episode and hypoxia ($SO_2 < 90\%$) [4]. This presentation can lead to a high in-hospital death rate, approximately 10–20%, associated with ACPE, particularly if it is associated with acute coronary syndrome [5,6].

Platelet to lymphocyte ratio (PLR) is a relatively novel inflammatory marker. Higher ratios have been found to be associated with some cardiovascular disorders and various other diseases, including some colorectal malignant diseases, obstructive apnea syndrome, essential hypertension, and diabetes mellitus [7–10]. Previous studies have also demonstrated that PLR is linked to higher in-hospital mortality and severity of coronary artery disease, the no-reflow phenomenon, and development of heart failure in patients with ST-segment elevation myocardial infarction (STEMI) [11–14]. Durmuş et al. investigated PLR and neutrophil to lymphocyte ratios (NLR) in patients with heart failure and found that PLR and NLR values were

significantly higher in patients with heart failure than in age-matched controls (15). However, no study has so far evaluated PLR values in ACPE. Therefore, the goal of this study was to investigate the possible relationship between PLR values and total mortality in patients hospitalized with a diagnosis of ACPE.

## MATERIAL AND METHODS

### Patients

In this study, we used our hospital's electronic patient records, information system, and emergency patient examination forms to retrospectively analyze 1546 patients who were admitted to the emergency department with acute severe dyspnea between January 2010 and April 2015. Patients whose data showed unclear complaints on admission were not included in the study. Cardiology was consulted regarding 256 patients who were finally diagnosed with ACPE, and 115 of these met our study's inclusion criteria.

### Inclusion and Exclusion Criteria

The inclusion criteria for this study were admission to the hospital with sudden-onset severe dyspnea; a score of 8–10 on the modified Borg dyspnea scale (score 0 = no dyspnea; score 10 = very severe dyspnea); presence on physical examination of extensive crepitant rales, including in the upper zones of the lungs, as recorded on the emergency examination form; and widespread congestion, shown on a chest x-ray study. The exclusion criteria were presence of acute myocardial infarction (AMI), chronic lung disease, severe valvular disorders, congenital heart disease, renal insufficiency (glomerular filtration rate [GFR] < 30 mL/min/1.73 m$^2$), renal artery stenosis, pheochromocytoma, severe liver insufficiency, malignant neoplasms, infections, or inflammatory diseases. To demonstrate cardiogenic pulmonary edema mortalities independent of the complications of AMI, we excluded suspected AMI by coronary angiography and myocardial perfusion scintigraphy. A total of 141 patients were excluded.

### Data Analysis

All patients underwent routine hematological tests, biochemical analyses, arterial blood gas analyses, electrocardiography, chest x-ray studies, and transthoracic echocardiography. We calculated the left ventricular ejection fractions of the patients using the modified Simpson technique and assessed valvular disorders using portable echocardiography in the emergency department.

We routinely analyzed peripheral venous blood samples from the patients in the hematology laboratory, and complete blood count parameters were calculated by an automated blood counter (Beckman Coulter, Brea, CA).

Urea, creatinine, GFR, alanine aminotransferase, aspartate aminotransferase, total cholesterol, high-density lipoprotein, low-density lipoprotein, total protein, troponin I, and blood glucose levels were analyzed in the biochemistry laboratory for all patients on admission. Although patients with high troponin I values were not excluded, those diagnosed with AMI upon further investigation, including coronary angiography, were excluded. The diagnoses of the patients included in the study were not changed during hospitalization. We obtained the data for analysis from emergency examination forms, the electronic patient information system, and our hospital's archives. We contacted the patients or their relatives by phone to obtain information and control for the parameters found during polyclinic follow-up examinations, and we noted all data on a patient data form. Thirty-nine patients, not including hospital deaths, died during the follow-up period.

We divided the patients into three groups based on their PLR values, as calculated from their complete blood counts at admission: high tertile (PLR > 194.97), medium tertile (98.3–194.97), and low tertile (PLR < 98.3).

### Statistical Analysis

We analyzed the data with SPSS, version 21.0 for Windows (IBM Corp., Armonk, NY). The parametric data

**Table 1. Baseline Clinical, Hematologic Characteristics of the Study Population**

| Characteristics | Mean ± SD | Minimum to Maximum |
|---|---|---|
| Age (years) | 69.3 ± 11.8 | 37–92 |
| Follow-up (months) | 20.8 ± 16.1 | 0.1–63.0 |
| Systolic blood pressure (mm Hg) | 213.5 ± 24.4 | 170–270 |
| Diastolic blood pressure (mm Hg) | 111.1 ± 11.3 | 66–130 |
| LDL (mg/dL) | 115.0 ± 40.9 | 39–291 |
| HDL (mg/dL) | 43.0 ± 12.7 | 8–96 |
| Troponin I (ng/mL) | 0.346 ± 0.648 | 0–2.95 |
| Neutrophils (10$^3$/L) | 9.1 ± 4.0 | 2.6–21.1 |
| Lymphocytes (10$^3$/L) | 2.4 ± 2.4 | 0.2–15.3 |
| Platelets (10$^3$/L) | 248.6 ± 88.0 | 28–603 |
| Ejection fraction (%) | 40.5 ± 14.5 | 10–65 |
| Neutrophil to lymphocyte | 8.1 ± 11.1 | 0.47–99.27 |
| Platelet to lymphocyte ratio | 191.3 ± 164.0 | 11.0–850.0 |
| Sex, n (%) | | |
|   Female | 50 | 43.5 |
|   Male | 65 | 56.5 |
| Hospital mortality, n (%) | 10 | 8.7 |
| Long-term mortality, n (%) | 39 | 33.9 |
| Total mortality, n (%) | 49 | 42.6 |
| Hypertension, n (%) | 88 | 76.5 |
| Diabetes mellitus, n (%) | 46 | 40.0 |
| Hyperlipidemia, n (%) | 49 | 42.6 |
| Smoking, n (%) | 4 | 3.5 |
| Prior cerebrovascular event, n (%) | 10 | 8.7 |
| Prior coronary artery disease, n (%) | 93 | 80.9 |

HDL = high-density lipoprotein; LDL = low-density lipoprotein; SD = standard deviation.