American Journal of Emergency Medicine xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Effect of platelet–lymphocyte ratio and lactate levels obtained on mortality with sepsis and septic shock☆

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ARTICLE INFO

Article history:
Received 28 June 2017
Received in revised form 22 July 2017
Accepted 5 December 2017
Available online xxxx

Keywords:
Emergency treatment
Infection
Severe sepsis

ABSTRACT

Background: Sepsis is a potentially fatal condition with high treatment costs, and is especially common among the elderly population. The emergency management of septic patients has gained importance.
Objective: Herein, we investigated the effect of admission lactate levels and the platelet-lymphocyte ratio (PLR) on the 30-day mortality among patients older than 65 years who were diagnosed with sepsis and septic shock according to the qSOFA criteria at our hospital's emergency department.
Methods: This observational study was conducted retrospectively. We obtained information regarding patients' demographic characteristics, comorbid conditions, hemodynamic parameters at admission, initial treatment needs at the emergency department.
Results: 131 patients received a diagnosis of sepsis and septic shock at our emergency department in two years. Among these, 45% ($n = 59$) of the patients died within 30 days of admission. Forty (30.5%) patients required mechanical ventilation. There was a significant difference between the survival and non-survival groups with regard to systolic and diastolic blood pressures ($p = 0.013$ and 0.045, respectively). There were significant differences between the two groups with respect to the Glasgow Coma Scale score ($p < 0.001$) and BUN levels ($p < 0.001$). The mortality status according to qSOFA scores was revealed a significant difference between the two groups ($p < 0.001$).
Conclusion: Our results showed that the patients who died within 30 days of admission and those who did not had comparable PLR and lactate levels ($p = 0.821$ and 0.120, respectively). We opine that serial lactate measurements would be more useful than a single admission lactate measurement for the prediction of mortality.

1. Introduction

Sepsis is a potentially fatal condition with high treatment costs, and is especially common among the elderly population [1]. Furthermore, the number of patients diagnosed with sepsis has been steadily increasing [2]. As a result of the increased emergency department admissions of patients aged >65 years, the emergency management of septic patients has gained importance [3]. Increased lactate levels have proven useful for the diagnosis of these patients and for the estimation of their prognosis at the emergency department [4].

Based on the definitions of sepsis and septic shock published in 2016, the Sepsis-related Organ Failure Assessment (SOFA) scoring system was formulated [5]. A more practical and simple version of this scoring system for use in emergency department settings has been termed quick SOFA (qSOFA). The latter combines the presence of infection with three other criteria, namely a systolic blood pressure of ≤100 mm Hg, a Glasgow Coma Scale (GCS) score of <15, and a respiratory rate of ≥22 breaths/min. Each criterion is assigned 1 point, and a total score of ≥2 has been reported to be a predictor of a life-threatening infectious condition. qSOFA criteria have been found useful for the prediction of the prognosis without requiring any laboratory test [5]. The combination of the need for vasopressor support to maintain a mean arterial pressure of >75 mm Hg and the presence of a lactate level > 2 mmol/L with ≥2 qSOFA criteria is defined as septic shock.

In addition to lactate levels, biomarkers such as procalcitonin and C-reactive protein are used to diagnose and prognosticate patients with sepsis [6]. However, these tests are more expensive than a complete blood count would be, and procalcitonin assessment is currently not under repayment cover by the Turkish Social Security Institution. The platelet–lymphocyte ratio (PLR), a parameter that can be determined from a complete blood count sample without any additional cost, has also been reported to indicate inflammation [7]. Recent studies have shown that this parameter is elevated in various conditions, including acute mesenteric ischemia, acute exacerbations of chronic obstructive lung disease, rheumatoid arthritis, and renal cell carcinoma [8-11]. Herein, we investigated the effect of admission lactate levels and PLR

☆ This study was presented in an oral session at 4th International Emergency Medicine Congress in Antalya, Turkey, May 18–21, 2017.

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https://doi.org/10.1016/j.ajem.2017.12.010
0735-6757/

on the 30-day mortality among patients older than 65 years who were diagnosed with sepsis and septic shock according to the qSOFA criteria at our hospital's emergency department between August 1, 2014, and August 1, 2016.

2. Materials and methods

This observational study was retrospectively conducted at Baskent University Ankara Hospital and included patients older than 65 years who presented to the emergency department and were diagnosed with sepsis and septic shock between August 1, 2014, and August 1, 2016. Institutional research ethics committee approval was obtained (Project number: KA16/296). We used the hospital automation system and patient archives to obtain information regarding patients' demographic characteristics, comorbid conditions, hemodynamic parameters at admission, initial treatment needs at the emergency department (fluids, vasopressors, blood transfusion, steroid, and antibiotics), and the need for mechanical ventilation and cardiopulmonary resuscitation. We obtained the information on the 30-day mortality via the Central Population Management System.

2.1. Statistical analysis

We analyzed the study data using Microsoft Office 365 and SPSS 17 software packages. The Kolmogorov–Smirnov test was used to assess whether the data pertaining to the following parameters were normally distributed: age; systolic blood pressure; diastolic blood pressure; respiratory rate; GCS score; body temperature; pulse rate; oxygen saturation, lactate, blood urea nitrogen (BUN), creatinine, sodium, potassium, and hemoglobin levels; leukocyte, thrombocyte, neutrophil, and lymphocyte counts; red cell distribution width (RDW); mean platelet volume (MPV); and PLR. The normally distributed variables were age, diastolic and systolic blood pressures, pulse rate, potassium and hemoglobin levels, RDW, and leukocyte, thrombocyte, and neutrophil counts. We compared the variables having normal and non-normal distributions between the deceased and the surviving groups using the independent samples *t*-test and Mann–Whitney *U* test, respectively. We used the chi-squared test to compare qSOFA scores by the mortality status. We performed a logistic regression analysis to determine the independent predictors of mortality. A p value of <0.05 was considered statistically significant for all statistical comparisons.

3. Results

According to the retrospectively obtained results, 131 patients received a diagnosis of sepsis and septic shock at our emergency department between August1, 2014, and August 1, 2016. Among these, 57.3% ($n = 75$) were female and 42% ($n = 56$) were male; 45% ($n = 59$) of the patients died within 30 days of admission.

Forty (30.5%) patients required invasive or noninvasive mechanical ventilation at the emergency department. We summarized the patient distribution according to the GCS score in Table 1. Accordingly, more than half (58%) of the study population had a GCS score of 15. We used the independent samples *t*-test to compare the normally distributed variables, namely age, diastolic blood pressure, pulse rate, potassium and hemoglobin levels, RDW, and leukocyte, thrombocyte, and neutrophil counts, between the patients who died within 30 days of admission and those who survived. This comparison revealed a significant difference between the two groups with regard to systolic and diastolic blood pressures ($p = 0.013$ and 0.045, respectively). We performed the Mann–Whitney *U* test to compare the non-normally distributed variables between the two groups. Accordingly, there were significant differences between the two groups with respect to the GCS score ($p < 0.001$) and BUN levels ($p < 0.001$). By contrast, there were no significant differences in the respiratory rate ($p = 0.503$), body temperature ($p = 0.588$), oxygen saturation levels ($p = 0.172$), creatinine levels ($p = 0.082$), hemoglobin levels ($p = 0.541$), MPV ($p = 0.593$), lymphocyte count ($p = 0.478$), PLR ($p = 0.821$), and lactate levels ($p = 0.120$) between the two groups.

Table 1
The patient distribution according to Glasgow Coma Scale (GCS) score.

GCS score	Frequency (n)	%
3	3	2.3
4	1	0.8
5	5	3.8
6	5	3.8
7	2	1.5
8	5	3.8
9	4	3.1
10	7	5.3
11	8	6.1
12	5	3.8
13	5	3.8
14	5	3.8
15	76	58.0
Total	131	100.0

Table 2 presents the mean ± standard deviation values of the normally distributed variables and median (interquartile range) values of the non-normally distributed variables. The qSOFA scores of the patients are distributed as follows: 0 in 14 (10.7%) patients, 1 in 58 (44.3%), 2 in 40 (30.5%), and 3 in 19 (14.5%).

The most common septic sources were pneumonia (68.7%) and urinary tract infection (45%). The most common comorbidities were hypertension (61.1%), coronary artery disease (27.5%), and diabetes mellitus (26.7%).

Table 3 summarizes the treatment regimens initiated at the emergency department. Accordingly, the most commonly administered treatments were oxygen supplementation (58%), antibiotics (55.7%), and bronchodilators (55%). The mortality status according to qSOFA scores was analyzed using the chi-squared test, which revealed a significant difference between the two groups ($p < 0.001$). There was a positive correlation between the mortality status and the qSOFA scores (Pearson correlation coefficient, 0.321).

None of the parameters was an independent predictor of mortality according to the results of the logistic regression analysis (Table 4).

Table 2
Comparison of the variables between the mortality and non-mortality groups.

Parameter	Mortality (−)*	Mortality (+)*	*p* value
Diastolic (mm Hg)	70.29 ± 22.44	62.59 ± 20.65	0.045
Systolic (mm Hg)	128.36 ± 35.91	111.75 ± 39.12	0.002
Glasgow Coma Scale (score)	15(1)	13(7)	<0.001
Blood urea nitrogen	28.1(33.65)	46.8(54)	<0.001
Age (years)	82.40 ± 7.9	81.90 ± 7.72	0.714
Respiratory rate (/min)	22(10)	24(8)	0.503
Body temperature (°C)	36.9(1.95)	37(1.01)	0.588
Pulse rate (/min)	100.01 ± 22.53	106.61 ± 23.22	0.103
SpO_2 (%)	85(13)	83(20)	0.172
Creatinine (mg/dL)	1.18(1.22)	1.79(1.99)	0.082
Sodium (mmol/L)	135(7)	136(12)	0.498
Potassium (mmol/L)	4.26 ± 0.76	4.47 ± 0.71	0.108
Hemoglobin (g/dL)	12.55 ± 2.41	12.25 ± 2.26	0.541
Leukocyte (thousand/μL)	12.24 ± 7.01	13.77 ± 6.90	0.213
Trombocyte (thousand/μL)	208.11 ± 95.65	217.79 ± 95.42	0.565
Red cell distribution width (%)	15.50 ± 2.59	15.95 ± 2.87	0.774
Mean platelet volume (fL)	7.53(1.43)	7.56(1.57)	0.593
Neutrophyl (thousand/μL)	10.12 ± 6.39	11.62 ± 6.79	0.197
Lymphocyte (thousand/μL)	0.94(0.90)	1.01(1.25)	0.478
Lactate (mmol/L)	1.95(1.60)	2.30(1.80)	0.120
Platelet–lymphocyte ratio	207.60(189.63)	168.31(209.83)	0.821

* Table shows the mean ± standard deviation values for the normally distributed variables and median (interquartile range) values for the non-normally distributed variables.

Please cite this article as: Biyikli E, et al, Effect of platelet–lymphocyte ratio and lactate levels obtained on mortality with sepsis and septic shock, American Journal of Emergency Medicine (2017), https://doi.org/10.1016/j.ajem.2017.12.010