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## Original Article

# Effect of initial lactate level on short-term survival in patients with out-of-hospital cardiac arrest

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## ABSTRACT

**Purpose:** This study evaluated whether serum lactate levels (SLL) at admission in patients with cardiac arrest (CA) can predict successful return of spontaneous circulation (ROSC) or short-term survival, especially within the first 24 h.

**Materials and methods:** This prospective, observational study was conducted in the emergency department (ED) of a training and research hospital from April 2015 through February 2016. It included all patients older than 18 years who presented to the ED during the study period with non-traumatic out-of-hospital cardiac arrest (OHCA). The study measured two outcomes: whether ROSC was achieved and whether short-term survival was achieved. ROSC was defined as the presence of spontaneous circulation for the first hour after cardiopulmonary resuscitation (CPR). Survival was defined as having survived for a minimum of 24 h after ROSC.

**Results:** The study included 140 patients who were admitted to the ED with OHCA. ROSC was achieved in 55 patients (39.3%), and survival for 24 h following CA was achieved in 42 patients (30%). The mean SLL in the ROSC (+) and ROSC (-) groups were  $9.1 \pm 3.2$  mmol/L and  $9.8 \pm 2.9$  mmol/L, respectively. The mean SLL in the survivor and non-survivor groups were  $8.6 \pm 2.9$  mmol/L and  $10 \pm 3.1$  mmol/L, respectively. These differences were not statistically significant ( $p = 0.1$ ). A multivariate regression model assessing the factors that predicted both ROSC and 24-h survival showed the odds ratio (OR) of initial SLL was 1.3 (95% CI: 1.05–1.6) and 1.1 (95% CI: 0.9–1.3), respectively.

**Conclusions:** This study showed that in OHCA patients, SLL on admission was not associated with increased ROSC achievement or 24-h survival.

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## 1. Introduction

Cardiac arrest (CA) events, especially out-of-hospital cardiac arrest (OHCA), remain a major public health problem, with high mortality and morbidity rates.<sup>1,2</sup> Despite advances in resuscitation, the rates of survival and hospital discharge for OHCA patients are lower than 16.2%.<sup>3</sup> Although the prognostic potential of several markers and tools has been studied, it remains difficult to predict

return of spontaneous circulation (ROSC) and short-term survival.<sup>4–6</sup> Previous studies have shown that serum lactate level (SLL) may increase in several critical illnesses, including septic shock, severe trauma, and major surgery.<sup>7–9</sup> It is known that lactate is a product of anaerobic metabolism, and lactic acidosis, which causes hypoxia, can be seen in several diseases. Therefore, in recent years, the potential of SLL on admission to predict survival in CA patients has been studied. However, the varying results of such studies mean that it is still difficult to make definitive decisions based on SLL.<sup>10–13</sup> In addition, in previous studies, the populations have generally consisted only of patients who achieved ROSC after OHCA, not all patients with OHCA. Therefore, we believe that new studies on this topic are warranted, and the present study evaluated

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whether CA patients' SLL on admission can predict ROSC or short-term survival, especially within the first 24 h.

## 2. Materials and methods

This prospective, observational study was conducted in the emergency department (ED) of a training and research hospital from April 2015 through February 2016. The local ethics committee approved the study, and the researchers obtained written informed consent from patients' legally authorized relatives.

### 2.1. Study population

The study included all patients older than 18 years who presented to the ED with OHCA during the study period. It excluded patients younger than 18 years, those who were pregnant, those who presented with CA secondary to trauma, drowning, hypothermia, and drug over-dose, and those who achieved ROSC before reaching the hospital. In addition, patients who did not have any legally authorized relatives were excluded from this study.

### 2.2. Study protocol

When OHCA patients presented to the ED, they were admitted to the resuscitation area and advanced cardiovascular life support (ACLS) was performed on them based on the 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care.<sup>14</sup> While this study was working, update of ACLS 2015 was published. However, this update did not have any important changes which cause change of our study protocol – An independent observer researcher obtained patient characteristics and details regarding the CA in the pre-hospital period from emergency medical service (EMS) providers and patients' relatives. The same researcher also observed and recorded details regarding cardiopulmonary resuscitation (CPR), including drugs used, amount and dosage of defibrillations, duration of CPR, and CPR results (death or ROSC).

In each patient, venous blood samples were obtained within 10 min after the start of CPR by puncturing a femoral vein with heparinized syringes. The SLL was measured with a bedside blood gases analyzer (Techno Medica GASTAT-1800 pH/Blood Gas Analyzer, St. Ingbert, Germany). Other routine blood tests, including whole blood count and biochemistry tests, were performed, and all test results were recorded on the study forms.

The study measured two outcomes: whether ROSC was achieved and whether short-term survival was achieved. ROSC was defined as the presence of spontaneous circulation for the first hour after CPR. Short-term survival was defined as survival for a minimum of 24 h after ROSC. For purposes of statistical analyses, all patients were grouped according to the success of ROSC (ROSC + or ROSC -) and as survivors or non-survivors.

### 2.3. Statistical analyses

Statistical analyses were performed using SPSS version 16.0 (Chicago, IL, USA). The Shapiro-Wilk test was used to assess the normal distribution of all parameters related to patients. Patients' parametric data were expressed as mean values and standard deviation (SD). Non-parametric data were expressed as median values and inter-quartile range (IQR) (25–75%). The Pearson Chi-Square test was used to analyze the groups' categorical data. Continuous parametric group data were analyzed using the Student T-test, and non-parametric group data were analyzed using the Mann-Whitney U test. To determine the predictive value of several variables, a multivariate regression model was created using variables

whose p-value was <0.2 in univariate analyses. The presence of correlation among these variables was analyzed using a Spearman test, and in each pair, the variable that detected correlation with the other variable was excluded from the regression model. To assess the model's goodness of fit, the Hosmer-Lemeshow test was performed. The 95% confidence intervals (95% CIs) were calculated whenever appropriate, and a two-tailed p-value < 0.05 was considered statistically significant.

## 3. Results

The study included 140 patients who were admitted to the ED with OHCA during the study period. The median age was 72 (IQR 25–75%: 63–80), and 74 patients (53%) were male. Shockable rhythm (ventricular fibrillation or ventricular tachycardia) on admission was detected in only 7 patients (5%). When rates of ROSC and survival were evaluated, ROSC was achieved in 55 patients (39.3%) and survival for 24 h after CA was achieved in 42 patients (30%). Table 1 presents all patient demographic data.

When SLL and other patient parameters were evaluated according to whether ROSC was achieved, mean SLE in the ROSC (+) and ROSC (-) groups were  $9.1 \pm 3.2$  mmol/L and  $9.8 \pm 2.9$  mmol/L, respectively. However, this difference was not statistically significant ( $p = 0.1$ ). When differences in other parameters were considered, the presence of witnessed CA was higher in the ROSC (+) group than in the ROSC (-) group (60% and 34%, respectively;  $p = 0.003$ ), but no other parameters had statistically significant differences (Table 2). A multivariate regression model created to assess the factors predicting failure of ROSC showed that SLL and

**Table 1**  
General characteristics of patients.

<b>Sex n (%)</b>	
•Female	66 (47)
•Male	74 (53)
<b>Age median (IQR%25-75)</b>	72 (63 – 80)
<b>Comorbidities n (%)</b>	
•Chronic Hypertension	92 (65.7)
•Coronary Artery Disease	57 (40.7)
•Diabetes Mellitus	48 (34.3)
•Chronic Obstructive Pulmonary Disease	33 (23.6)
•Hyperlipidemia	29 (20.7)
•Congestive Hearth Failure	25 (17.9)
•Malignity	19 (13.6)
•Cerebrovascular disease	9 (6.4)
•Atrial Fibrillation	8 (5.7)
•Parkinson	6 (4.3)
•Chronic Kidney Disease	5 (3.6)
•Epilepsy	4 (2.9)
<b>Witnessed arrest n (%)</b>	
•Presence	62 (44.3)
•Absence	78 (65.7)
<b>Intubation in pre-hospital period n (%)</b>	
•Intubated	58 (41.4)
•Not intubated	82 (58.6)
<b>Initial cardiac rhythm n (%)</b>	
•Asystole	124 (88.6)
•Pulseless Electrical Activity	9 (6.4)
•Ventricular fibrillation/tachycardia	7 (5)
<b>EMS's time of arrival to patient after arrest calling median (IQR%25-75)</b>	10 (5 – 10)
<b>EMS's time of arrival to ED after contact to patient median (IQR%25-75)</b>	5 (5 – 10)
<b>Returned of Spontaneous Circulation n (%)</b>	
•Yes	55 (39.3)
•No	85 (60.7)
<b>24 h survival n (%)</b>	
•Yes	42(30)
•No	98(70)

EMS: Emergency Medical Services, ED: Emergency Department.

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