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Research Article

The Effect of Hemogram and Blood Gas Parameters on Survival in Cardiac Arrest Patients

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Abstract

Objectives: This study aimed to investigate the demographic data of cardiac arrest patients who underwent cardiopulmonary resuscitation (CPR) in the emergency department, and whether there was an association between complete blood count and blood gas parameters and the return of spontaneous circulation (ROSC).

Methods: 126 patients with no missing data were included in the study. Two subgroups were formed as patients undergoing ROSC and those who died. Patients' demographic data, blood gas and complete blood count parameters were recorded.

Results: 62.7% and 37.3% of patients were males and females, respectively, and their mean age was 64 years. 23% of the patients underwent ROSC and were admitted to intensive care, while 77% of them died in the emergency department. Significant differences were found in pH in blood gas, lactate and HCO3 between the patients undergoing ROSC and the patients who died. Furthermore, there were significant differences in neutrophil counts and neutrophil/lymphocyte ratios in the complete blood count between the two groups.

Conclusion: Cardiac arrest is a significant public health problem with high rates of mortality and morbidity. Blood gas and complete blood count parameters evaluated in the emergency department are associated with mortality.

Keywords: Blood gas, cardiac arrest, complete blood count, mortality

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Cardiac arrest refers to a state of absent cardiac activity characterized by unresponsiveness to stimuli, cessation of breathing, and inability to feel a pulse.[1] Cardiopulmonary resuscitation (CPR) is the name given to all procedures performed in cardiac arrest patients.[2] The primary aim of CPR is to identify the reversible causes of arrest and to achieve the return of spontaneous circulation (ROSC). Various tests such as vital signs, electrocardiography, blood gas and complete blood count are used to predict the prognosis and detect the etiology of cardiac arrest during CPR and after ROSC is achieved.[3]

Situations such as unwitnessed arrest, bystanders bringing patients to the hospital without performing CPR in out-of-hospital arrests, non-shockable rhythms, prolonged duration of CPR and advanced age are associated with poor prognosis in patients undergoing cardiopulmonary resuscitation. However, these data sometimes cannot be detected early, and it may sometimes not be possible to take an accurate anamnesis. Thus, clinicians tend to rely more on objective parameters such as PH value, lactate level and base deficit, that can be measured in a blood sample.[4] Diffuse ischemia in the body in cardiac arrest patients leads to

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systemic inflammatory response in tissues. The neutrophil/lymphocyte ratio (NLR), used to determine the severity of systemic inflammation, is associated with sudden cardiac death in patients with cardiac arrest and heart failure.[5, 6]

This study aimed to determine whether there was an association between complete blood count and blood gas parameters and the ROSC in cardiac arrest patients undergoing CPR in the emergency department.

Methods

Patients who presented to the emergency department of Kahramanmaraş Sütçü İmam University Faculty of Medicine Hospital between 01.01.2023 and 30.11.2023 and underwent cardiopulmonary resuscitation were retrospectively examined in this study. Patients with a diagnosis code of cardiopulmonary arrest were found from the hospital automation system (Mia-Med). The total number of patients whose cardiac arrest diagnosis code was processed was 140. Patients with missing data and patients under the age of 18 were excluded from the study. 126 patients who met the study criteria were included in the study. Patients were divided into two subgroups as patients undergoing ROSC and those who died. Demographic data of the patients, whether they were forensic cases, pH, pCO_2, HCO_3, glucose values in blood gas, white blood cell count in complete blood count, neutrophil count, platelet count, neutrophil/lymphocyte ratios and platelet/lymphocyte ratios were recorded. It was investigated whether there were differences between the groups in terms of these data.

In our study, SPSS (Statistical Package for Social Science) program was used for the analyses. Mean and standard deviation were used for continuous variables and percentage values were used for categorical variables for evaluating and presenting demographic data. Median and percentile values were used to evaluate laboratory results. Mann-Whitney U test, one of the non-parametric tests, was performed to examine the relationship between prognosis from categorical variables and laboratory results. The level of significance was considered as $p<0.05$.

Results

126 patients were included in our study. 62.7% (n=79) and 37.3% of patients were males and females, respectively, and their mean age was 64±2 (20-100) years. 23% (n=29) of the patients underwent ROSC and were admitted to intensive care, while 77% (n=97) of them died in the emergency department. While 55.18% (n=16) and 44.82% of the patients hospitalized with ROSC were males and females, respectively, 64.94% (n=63) and 35.06% (n=34) of them who died in the emergency department were males and females, respectively. Forensic case was considered as the cause of cardiac arrest in 17.5% (n=22) of the patients.

The comparison of laboratory parameters between the groups based on the return of spontaneous circulation is presented in Table 1. Upon examining the blood gas parameters, the initial pH value (median) was 7.12 (7.02-7.19) and the final pH value (median) was 7.14 (7.04-7.25) in patients with ROSC, while the initial pH value was 6.97 (6.85-7.18) and the final pH value was 6.88 (6.76-7.04) in patients who died, and pH elevations in the group with ROSC were statistically significant (p=0.043, p=0.001, respectively). The initial pCO_2 value (median) was 56.30 mmHg (33.90-74.15) and the final pCO_2 value (median) was 44.5 mmHg (37.6-63.1) in patients with ROSC, while the initial pCO_2 value was 67.20 mmHg (41.09-82.80) and the final pCO_2 value was 77.2 mmHg (40.4-95.7) in patients who died, and no statistically significant difference was found between the groups in the results. While the initial lactate value (median) was 6.5 mmol/L (4.7-12.8) and the final lactate value (median) was 6.5 mmol/L (4.8-12.9) in the group with ROSC, the initial lactate value (median) was 10.1 mmol/L (6.3-14.6) and the final lactate value (median) was 12.3 mmol/L (10-16) in the group who died. High final lactate values in the exitus group were statistically significant (p=0.043). The initial HCO_3 value (median) was 13.5 mmol/L (11.4-17.3) and the final HCO_3 value was 16 mmol/L (10.4-23.1) in the patient group with ROSC, while the initial HCO_3 value (median) was 10.1 mmol/L (8.1-16.7) and the final HCO_3 value (median) was 8.2 mmol/L (6.1-10) in the exitus group. High final HCO_3 values in the group with ROSC were statistically significant (p=0.001). The glucose value (median) was found to be 215 (137-360) in the group with ROSC and 249 (156-361) in the exitus patient group, and no statistically significant difference was found between the groups in terms of glucose values.

Complete blood count parameters were compared based on the return of spontaneous circulation. The neutrophil count (median) was found to be 8.54 (7.11-11.97) 109/L in the group with ROSC and 6.31 (3.79-11.29) 109/L in the exitus group, and the high neutrophil count in the group with ROSC was statistically significant (p=0.04). The neutrophil/lymphocyte ratio (median) was found to be 2.28 (1.18-5.13) in the group with ROSC and 1.15 (0.65-3.45) in the exitus group. The high Neutrophil/Lymphocyte ratio in the group with ROSC was found to be statistically significant (p=0.023). The comparison of other complete blood count parameters by groups is presented in Table 1, and no statistically significant difference was found between the groups in terms of other parameters.

Table 1. Laboratory Parameters Based on the Return of Spontaneous Circulation

Parameter	Prognosis		P*
	ROSC (Median)	Exitus (Median)	
pH Initial	7.12 [7.02–7.19]	6.97 [6.85–7.18]	**0.043**
pH Final	7.14 [7.04–7.25]	6.88 [6.76–7.04]	**0.001**
pCO_2 Final (mmHg)	56.30 [33.90–74.15]	67.20 [41.09–82.80]	0.242
pCO_2 Final (mmHg)	44.5 [37.6–63.1]	77.2 [40.4–95.7]	0.092
Lactate Initial (mmol/L)	6.5 [4.7–12.8]	10.1 [6.3–14.6]	0.086
Lactate Final (mmol/L)	6.5 [4.8–12.9]	12.3 [10.0–16.0]	**0.043**
HCO_3 Initial (mmol/L)	13.5 [11.40–17.30]	10.1 [8.10–16.70]	0.061
HCO_3 Final (mmol/L)	16.0 [10.4–23.1]	8.2 [6.1–10.0]	**0.001**
Glucose	215 [137–360]	249 [156–361]	0.625
WBC	14.51 [11.71–19.17]	13.68 [9.47–17.58]	0.226
Neutrophil	8.54 [7.11–11.97]	6.31 [3.79–11.29]	**0.04**
Lymphocyte	3.93 [2.08–6.22]	4.84 [2.67–7.11]	0.258
Neutrophil/Lymphocyte	2.28 [1.18–5.13]	1.15 [0.65–3.45]	**0.023**
Platelet	237.5 [162–315.5]	173 [127–277]	0.105
Platelet/Lymphocyte	49.5 [33–105]	39.1 [23–60]	0.98
Immature Granulocyte %	1.80 [0.65–3.75]	1.50 [0.90–3.90]	0.711

p*: Statistically significant ones highlighted.

Discussion

Sudden cardiac arrest is a significant public health problem due to the burden it places on the healthcare system as well as very high mortality and morbidity rates, and it has an incidence of 86.4/100,000 in Europe.[4] This study aimed to present the demographic characteristics of cardiac arrest cases and whether complete blood count and blood gas parameters were related to survival.

In a study conducted by Lin et al., which included a total of 374 cardiac arrest patients, was determined that 72.2% of the patients were male and the mean age was 61.8 years.[7] In a study conducted by Altınbilek et al., it was determined that 59.9% of the cases were male and the mean age was 71.[8] In the study conducted by Dadeh et al., the mean age was found to be 66 years old and 68.1% of the patients were male.[9] Considering the demographic data in our study, 62.7% of the patients were male. The mean age of the patients was 64. These results are similar to other studies. In the study of Başol et al., 12.5% of cardiac arrest cases were considered as forensic cases.[10] In our study, this ratio was found to be 17.5%.

In a study conducted by Kim et al., the mean pH value in blood gas was found to be 6.96 in the patient group with ROSC, and the mean pH value was found to be 6.85 in the exitus group.[11] In our study, the mean initial pH value and the mean final pH value were found to be 7.12 and 7.14, respectively, in the group with ROSC. The mean initial pH value and the mean final pH value were found to be 6.97 and 6.88, respectively, in the exitus patient group. The fact that the pH value was found to be higher in the patient group with ROSC is similar to the study conducted by Kim et al. In the study conducted by Çalbay et al., no statistically significant difference was found in terms of pH values between the patients with ROSC and the patients who died, which is different from our study.[12]

In the study conducted by Timilsina et al., the mean lactate (mmol/L) value was found to be 6.9 in patients with ROSC and 9.9 in patients who died.[13] In the study of Kim et al., the mean lactate value was found to be 11.6 in patients with ROSC and 13.6 in patients who died.[11] In our study, the mean final lactate values were found to be 6.5 in patients with ROSC and 12.3 in patients who died. In our study, similar to other studies, the lactate values were found to be higher in patients who died compared to patients with ROSC.

In a study conducted by Hacımustafaoğlu, the mean HCO_3 (mmol/L) values in blood gas were found to be 17.04 in patients with ROSC and 11.6 in patients who died.[14] In a study conducted by Kanar, the mean HCO_3 values were found to be 14.91 in patients with ROSC and 11.33 in patients who died.[15] In our study, the mean final HCO_3 values was 16, while it was found to be 8.2 in patients who died. Similar to these studies, in our study, the mean HCO_3 values were found to be statistically significantly lower in patients who died.

In a study conducted by Bilge et al., the neutrophil/lymphocyte ratios were evaluated and the mean values were found to be 3.81 in patients with ROSC and 2.28 in patients who died.[3] In our study, the mean neutrophil/lymphocyte ratios were found to be 2.28 in patients with ROSC and 1.15 in patients who died. Similar to this study, in our study, the Neutrophil/Lymphocyte ratios were found to be statistically significantly lower in patients who died.

Conclusion

Cardiac arrest is a significant public health problem with high rates of mortality and morbidity. The data we obtained from our study revealed that pH, lactate, HCO_3, neutrophil count and neutrophil/lymphocyte values can be used as predictions for ROSC. These parameters can be used when deciding on whether to terminate or continue CPR.

Study Limitations

Although the current study is thought to contribute to the literature, there are also some limitations to the study. One of the limitations is that the study is retrospective and there is no data on long-term survival in patients who achieved ROSC. Another limitation is the small sample size.

Disclosures

Ethics Committee Approval: Our study was carried out in accordance with the Declaration of Helsinki and we declare that it complies with the ethical standards of the Republic of Turkey. Ethical approval was obtained from the Ministry of Health of the Republic of Turkey and the Ethics Committee of Kahramanmaraş Sütçü İmam University Faculty of Medicine with the resolution number 01 in session 2024/11 on 22.04.2024.

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