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Early predictors of return of spontaneous circulation in patients undergoing cardiopulmonary resuscitation

Ercan NALBANT[1,*], Mehmet ALTUNTAŞ [2], Ali ÇELİK[2], Özcan YAVAŞİ [2] Gökhan ERSUNAN[2], Özlem BİLİR [2], Gürkan ALTUNTAŞ[2]

[1]Department of Emergency Medicine, Rize State Hospital, Rize, Türkiye
[2]Department of Emergency Medicine, Recep Tayyip Erdoğan University, Faculty of Medicine, Rize, Türkiye

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Abstract

Decisions about when to start, how long to continue and how to end cardiopulmonary resuscitation (CPR) are important in the management of these critically ill patients. The aim of our study is to determine the factors that can help in the early prediction of patients in whom spontaneous circulation can be restored during CPR. Patients who had arrest due to nontraumatic causes were included in the study. The patients whose spontaneous circulation (ROSC) was restored in the emergency service and who were hospitalized in intensive care were included in ROSC (+) group, while the patients who did not have ROSC and who became exitus were included in ROSC (-) group. Patients' demographic characteristics, chronic diseases, places of arrest, admission laboratory values and possible causes of death were compared between ROSC groups. This study was conducted with the retrospective examination of 309, 118 (38.2%) female and 191 (61.8%) male, cardiopulmonary arrest cases. ROSC was achieved in 94 (30.4%) of the patients who underwent CPR. It was found that a 0,1 unit increase in pH value increased the probability of ROSC by 38% [OR: 1,38 (95% CI: 1.22-1.55), p<0.0001], while multivariate logistic regression analysis showed that it could be an independent predictor of ROSC and increased the probability of survival by 0,43 times [Corrected OR: 1.43 (95% CI: 1.13-1.83), p=0.0033]. It was also found with multivariate logistic regression analysis that respiratory causes could be an independent predictor of ROSC and increased the probability of survival by 2.76 times [Corrected OR: 3,76 (95% CI=1,499.53), p=0.0052]. In patients who undergo CPR, pH value in blood gas analysis and the presence of respiratory system diseases as the cause of arrest are important parameters in determining the probability of ROSC.

Keywords: Return of spontaneous circulation, cardiopulmonary resuscitation, emergency medicine, early prediction

1. Introduction

Effective resuscitation for cardiac arrest (CA) patients, which includes early defibrillation appropriate post-arrest care, results in survival and improvement in neurological outcomes (1).

In more than 300.000 cardiac arrest cases that occur each year in the United States of America, survival rates are typically lower than 10% for out-of-hospital cardiac arrests (OHCA) and lower than 20% for in-hospital cardiac arrest (IHCA) (2, 3). In addition, studies have shown that survival is reduced by 10-15% for each minute of cardiac arrest without cardiopulmonary resuscitation (CPR) (4, 5).

Despite many advances in CPR, mortality and morbidity rates are very high after CA. The course of patients after CPR ranges from mild or moderate symptoms to persistent vegetative state or death. Decisions about when to start CPR, how long to apply CPR, how to end CPR and predetermined patient conditions after CPR are important in the management of these critical patients (6). Therefore, there is a need for reliable parameters that can be used as the early predictors of recovery after CA.

The aim of our study is to determine the factors that can enable early prediction of patients in whom spontaneous circulation can be restored during CPR.

2. Materials and Methods

This study was conducted with retrospective examination of patients who underwent CPR in the emergency service of a tertiary hospital between 01.01.2018 and 31.12.2019. Approval was obtained from the local ethics committee for this study (Date: 20.02.2020, Decision number: 2020/25).

2.1. Patient selection

Patients older than 18 years of age who had arrest due to non-major trauma causes and who underwent CPR in the emergency service were included in the study. The patients who had ROSC in the emergency service with CPR and who were hospitalized in intensive care were included in ROSC (+) group, while the patients who did not have ROSC and who became exitus were included in ROSC (-) group.

*Correspondence: dr.nalbant_ercan@hotmail.com

2.2. Data collection

Computer based hospital information management system (HBYS), in which patient records are kept), was used to collect the data required for the study. Demographic features of the patients, their chronic diseases and information about initial laboratory values before arrest were obtained from consultation and epicrisis information obtained from HBYS program. In addition, information about the initial examination and possible causes of death was obtained from patient detailed examination records kept for patients and from patient files and emergency service archive.

2.3. Statistical analysis

Mean, standard deviation (SD), median, interquartile range (ICA), frequency and ratio values were used in the descriptive statistics of data. Distribution of the variables was evaluated with histogram, Q-Q graphs and Shapiro Wilk Test. Mann-Whitney U test was used in the analysis of non-parametric qualitative independent variables, while Student T test was used in the analysis of parametric data. Pearson X^2 or Fisher Exact Test was used in the analysis of qualitative independent data. Factors which were thought to determine survival and the variables which were thought to be important in univariate analysis were included in multivariate logistic regression analysis. Multicorrelation was checked with correlation analysis before and after multiple regression analysis. In univariate and multivariate analyses, probability rates (OR= odds ratio) were calculated with 95% confidence intervals (95% CI). $p<0.05$ was considered as statistically significant in all statistical analysis. Jamovi (version 1.1.6.0; https://jamovi.org) statistical program was used in analyses.

3. Results

This study was conducted with retrospective examination of 309, 118 (38.2%) female and 191 (61.8%) male, cardiopulmonary arrest cases. ROSC was achieved in 94 (30.4%) of the patients who underwent CPR. 39 (41.5%) of the patients who had ROSC were female, while 55 (58.5%) were male (p=0.4296). Statistically significant difference was found in the mean age of patients who underwent CPR in terms of gender (p<0.0001). Table 1 shows the comparison of ROSC states by gender and mean age.

Table 1. Distribution of patients who underwent CPR in terms of gender and mean age

	ROSC			p
	+	-	Total	
Female, n (%)	39 (41.5)	79 (36.7)	118 (38.2)	0.4296*
Age (female), *median (IQR)*	80 (67-85)	80 (70-85)	80 (69-85)	0.8623†
Age (male), *median (IQR)*	68 (60-77)	67 (59-78)	68 (59-77)	0.9566†
Age (total), *median (IQR)*	71 (68-81)	72 (61-68)	72 (61- 81)	0.8986†
	Gender			**p**
	Male	**Female**	**Total**	
Age, *median (IQR)*	68 (59-77)	80 (69-85)	72 (61- 81)	**<0.0001**†

*Pearson's X^2 Test, † Mann-Whitney U Test, CPR; Cardiopulmonary resuscitation, ROSC (+); return of spontaneous circulation, ROSC (-); no return of spontaneous circulation, n; number, %; percentage, m; median age, IQR; interquartile range

It was found that ROSC occurred in 22.6% (n=212) of the patients who had OHCA and in 47.4% (n=97) of the patients who had IHCA (p<0.0001). No statistically significant difference was found between airway applications performed in out-of-hospital environments (p=0.6989). It was found that 36.3% (n=193) of the patients who were intubated in the hospital had ROSC (p=0.039). When CPR duration was compared in terms of the state of having ROSC, it was found that the difference was statistically significant (IH-CPR/min; p<0.0001 OH-CPR/min; p=0.0004). Table 1 shows the comparison of the place of arrest, airway practices, arrest rhythms and CPR durations of patients who underwent CPR in terms of ROSC states.

Table 2. Distribution of place of arrest, airway practices, arrest rhythms and CPR durations of patients who underwent CPR

		ROSC		Total	p
		+	-		
Place of arrest, n (%)	**OH**	48 (22.6)	164 (77.4)	212 (100)	**<0.0001***
	IH	46 (47.4)	51(52.6)	97 (100)	
Airway-OH, n (%)	**ETI**	24 (20.7)	92 (79.3)	116 (100)	0.6989*
	BVM	24 (25.0)	72 (75.0)	96 (100)	
Airway-IH, n (%)	**ETI**	70 (36.3)	123 (63.7)	193 (100)	**0.0039***
Arrest rhythms, n (%)	**Cannot receive shock**	71 (28.5)	178 (71.5)	249 (100)	0.2776†
	Can receive shock	23 (38.3)	37 (61.7)	60 (100)	0.1378†
CPR duration (IQR)	**OH-CPR/min.**	10 (10-20)	20 (10-30)	15 (10-30)	**0.0004** †
	IH- CPR/min.	10 (10-15)	40 (30-45)	35 (20-45)	**<0.0001**†

CPR; Cardiopulmonary resuscitation, ROSC (+); Return of spontaneous circulation, ROSC (-); No return of spontaneous circulation, OH; Out-of- hospital, IH; In hospital, BVM; Bag valve mask, ETI; Endotracheal intubation, m; median, IQR; interquartile range, *Pearson's X2 Test, †Mann-Whitney U Test

When the patients' laboratory parameters were examined, it was found that the differences between pH, pCO_2, pO_2, $SatO_2$, HCO_3, BE, Lactate, Na^+ and K^+ values were statistically significant in terms of ROSC. Table 3 shows the comparison of mean laboratory values of patients who underwent CPR in terms of their ROSC states.

Table 3. Mean laboratory values of patients who underwent CPR

Laboratory values, m (IQR)	ROSC		CPR	p†
	+	-	Total	
pH	7.20 (7.03-7.35)	7.02 (6.86-7.19)	7.09 (6.89-7.25)	**<0.0001**
pCO_2 (mmHg)	45.9 (37.3-61.1)	59.8 (41.5-77.7)	52.9 (39.4-72.3)	**<0.0004**
pO_2 (mmHg)	55.4 (28.5-104.8)	36.8 (21-60.5)	42.7 (27-69.3)	**<0.0001**
$SatO_2$ (%)	80.7 (38.8-95.3)	42.1 (13.2-76.2)	52.5 (16.8-84.4)	**<0.0001**
HCO_3 (mEq/L)	15.9 (11.7-22.8)	11.1 (7.7-16.3)	12.6 (8.3-17.8)	**<0.0001**
BE (mmol/L)	8.2 (0.8-15.3)	14 (7.1-19.2)	12.6 (5.3-18.6)	**<0.0001**
Lactate (mmol/L)	6.8 (3-11.4)	11.7 (8.3-16)	10.6 (5.9-14.9)	**<0.0001**
Glucose (mg/dL)	196 (129-269)	202 (129-294)	198 (129-290)	0.5555
BUN (mg/dL)	56 (40.8-91.3)	55 (36.5-94.5)	55 (37-93)	0.8245
Creatinine (mg/dL)	1.4 (0.93-1.97)	1.5 (1.09-1.99)	1.4 (1.01-1.99)	0.4827
Na^+ (mg/L)	137 (135-140)	139 (135-142)	139 (135-142)	**0.0368**
K^+ (mg/L)	4.6 (3.7-5.4)	5.3 (4.5-6.4)	5 (4.3-6.2)	**<0.0001**
AST (U/L)	40 (26-115)	56 (26-129)	50 (46.3-57)	0.1934
ALT (U/L)	36 (18.6-76)	38 (18-102)	38 (18-87.5)	0.5006
WBC (10^3/uL)	12.4 (9.6-15.4)	11.8 (8.6-15.2)	11.9 (8.8-15.3)	0.3812
HGB (g/dL)	11.7 (9.8-13.6)	12.2 (9.8-13.9)	12 (9.8-3.8)	0.5279
HCT (%)	36.8 (31.1-41.1)	38.5 (31.9-43.9)	37.7 (31.8-43)	0.2491
PLT (10^3/uL)	205 (134-249)	179 (121-234)	194 (124-238)	0.1512

BE; Base extract, CPR; Cardiopulmonary resuscitation, ROSC (+); Return of spontaneous circulation, ROSC (-); No return of spontaneous circulation, m; median, IQR; Interquartile range, †Mann-Whitney U Test

More successful ROSC results were found in patients with a history of CHF and/or CPTD diagnosis (CHF; p=0.0369, COPD; p=0.0069). Of the patients who were considered to have respiratory system diseases as a cause of arrest, 40 (42.6%) were in the group that had ROSC, while 55 (25.6%) were in the group that did not have ROSC (p=0.029). Table 4 shows the comparison of comorbidities and possible arrest causes in patients who underwent CPR in terms of the state of ROSC.

It was found that each one minute increase in out-of-hospital CPR decreased ROSC by 5% [OR: 0.95 (95% CI: 0.92-0.98), p=0.0031]. However, multivariate regression analysis showed that it was not a predictor for ROSC [Corrected OR: 0.98 (95% CI: 0.93-1.02), p=0,2873]. In the IH-ETI group, it was found that the probability of ROSC was 118% higher when compared with patients who were intubated out of the hospital [OR: 2.18 (95% CI: 1.28-3.73), p=0.0044]. Although IH – ETI increased the probability of by ROSC 1.18 times in univariate regression analysis, it was understood in multivariate logistic regression analysis that IH – ETI [corrected OR: OR: 1.01 (95% CI: 0.43-2.35), p=0.9838] was not an independent factor of survival [Corrected 1.01 (95% CI: 0.43-2.35), p=0.9838].

While low and moderate level of correlation was found between pH level in blood gas and Na+ and K+ values measured in biochemistry and out-of-hospital CPR duration (spearman r=-0.19; spearman r=-0.42; spearman r=-0.37; p=0.0014, p<0.001, p<0.001, respectively), strong correlation was found between pCO2, BE, Lactate and HCO3 values in blood level (spearman r=-0.60, p<0.0001; spearman r=0.81, p<0.0001; spearman r=-0.77, p<0.0001; spearman r=0.90, p<0.0001, respectively). pCO_2, BE, Lactate and HCO_3 measurements were not included in multivariate logistic regression model. Since blood gas intake could not be separated as arterial, venous and mixed, PaO_2 and saturation measurements were also not included in the model. 0.1 unit increase in pH values increased the ROSC success rate by 38% [OR: 1.38 (95% CI: 1.22-1.55), p<0.0001]. Similarly, in multivariate regression analysis, it was also found to be an independent predictor of ROSC and it was found to increase the probability of survival by 0.43 times [corrected OR: 1.43 (95% CI: 1.13-1.83), p=0.0033]. An increase of 1 unit in pCO_2 value decreases survival rate by 2% [OR: 0.98 (95% CI: 0.97-0.99), p=0.0006]. An increase of 1 unit in pO_2 value increases survival rate by 1% [OR: 1.01 (95% CI: 1.003-1.01), p=0.0006]. An increase of 1 unit in SatO2 value increases survival rate by 2% [OR: 1.02 (95 CI%: 1.01-1.03), p<0.0001]. An increase of 1 unit in HCO3 increases survival rate by 11% [OR: 1.11 (95% CI: 1.06-1.15), p<0.0001]. An increase of 1 unit in BE increases survival rate by 7% [OR: 1.07 (95% CI: 1.04-1.1), p<0.0001].

It was found that the probability of ROSC in patients who had arrest due to respiratory causes was 15% higher in patients who had arrest due to non-respiratory causes [OR: 2.15 (95% CI: 1.29-3.59), p=0.0032]. Similarly, it was found to be an independent indicator of ROSC in multivariate logistic regression analysis and it was found to increase the probability of survival 2.76 times [corrected OR: 3.76 (95% CI=1.49-9.53), p=0.0052].

The results of univariate and multivariate logistic

regression analysis according to paired comparison tests of ROSC groups (OR, 95% CI) are shown in Table 5.

Table 4. Comorbidities and possible arrest causes of patients who received CPR

	ROSC		CPR	p*
	+	-	Total	
Comorbidities	**n (%)**	**n (%)**	**n (%)**	
HT	65 (69.1)	151 (70.2)	216 (69.9)	0.8485
DM	32 (34)	58 (27)	90 (29)	0.2085
CAD	29 (30.9)	57 (26.5)	86 (28)	0.4336
AF	18 (19.1)	32 (14.9)	50 (16)	0.3489
CHF	20 (21.3)	26 (12.1)	46 (15)	**0.0369**
CVD	14 (14.9)	31 (14.4)	45 (15)	0.9133
Malignity	7 (7.4)	32 (14.9)	39 (13)	0.0701
Alzheimer	10 (10.6)	23 (10.7)	33 (11)	0.9876
COPD	16 (17)	15 (7)	31 (10)	**0.0069**
CRF	7 (7.4)	22 (10.2)	29 (9)	0.4398
VTE	1 (1.1)	7 (3.3)	8 (3)	0.4427 FE
Other	9 (9.5)	25 (11.6)	34 (12)	0.6532
Possible causes of arrest				
Circulatory system diseases	47 (50)	113 (52.6)	160 (51.8)	0.6789
Respiratory system diseases	40 (42.6)	55 (25.6)	95 (30.7)	**0.029**
Metabolic Causes	1 (1.1)	8 (3.7)	9 (2.9)	-
Nervous sensory diseases	1 (1.1)	-	1 (0.3)	-
Other causes	5 (5.3)	3 (1.4)	8 (2.6)	-

CPR; Cardiopulmonary resuscitation, ROSC (+); Return of spontaneous circulation, ROSC (-); No return of spontaneous circulation, HT; Hypertension, DM; Diabetes mellitus, CAD: Coronary artery disease, AF; Atrial fibrillation, CHF; Congestive heart failure, CVD; cerebrovascular disease, COPD; Chronic obstructive pulmonary disease CRF; Chronic renal failure, VTE; Venous thromboembolism, *Pearson's X^2

Table 5. Logistic regression analyses of CPR variables

INDICATORS	Odds Ratio (OR)	p	Corrected OR	p
Respiratory Arrest	2.15 (1.29-3.59)	**0.0032**	3.76 (1.49-9.53)	**0.0052**
COPD	2.74 (1.29-5.8)	**0.0087**	3.09 (0.65-14.64)	0.1559
CHF	1.96 (1.03-3.73)	**0.0392**	1.75 (0.49-6.21)	0.3862
pH*10 (mmHg, 0.1 unit)	1.38 (1.22-1.55)	**<0.0001**	1.43 (1.13-1.83)	**0.0033**
pH_{mmHg} (1 unit of change)	25.09 (7.49-84.08)	**<0.0001**	36.89 (3.3-410)	**0.0033**
pCO_2	0.98 (0.97-0.99)	0.0006	-	-
paO_2	1.01 (1.003-1.01)	0.0006	-	-
$SatO_2$	1.02 (1.01-1.03)	<0.0001	-	-
HCO_3	1.11 (1.06-1.15)	<0.0001	-	-
BE	1.07 (1.04-1.10)	<0.0001	-	-
Lactate	0.89 (0.85-0.93)	<0.0001	-	-
Na^+	0.96 (0.92-0.99)	0.0190	0.95 (0.89-1.02)	0.1641
K^+	0.93 (0.8-1.07)	0.2989	0.75 (0.54-1.03)	0.0721

CHF; Congestive heart failure, COPD; Chronic obstructive pulmonary disease, BE; Base extract, CPR; Cardiopulmonary resuscitation

4. Discussion

Cardiopulmonary resuscitation, early defibrillation and early appropriate resuscitation lead to survival and improved neurological results in arrest patients. Targeted training can improve survival rates in cardiac arrest.

In a cross-sectional study they evaluated the factors affecting CPR success rates, Hajzargarbashi E. al evaluated a total of 190 patients who had undergone CPR, 75 (39.5%) female and 115 (60.5%) male, with a mean age of 69.4 (±17.7). Success (initial success) CPR was reported in 55 (28.9%) patients, while unsuccessful CPR was reported in 135 (71.1%) patients. Only 10 (5.3%) of the 190 patients examined were discharged from the hospital. No significant difference was found between the success of CPR and age (p=0.969) and gender (p=0.062) (7). In a prospective study Herlitz J. et al. examined the demographic characteristics affecting mortality in out-of-hospital cardiac arrests, 19791 patients were included in the study. Mean age of general arrest population was reported as 69 (±14) and 30% of this population was reported to be females. ROSC was reported in 17.3% of the patients (8). In a study Winther-Jensen M. et al. compared out-of-hospital cardiac arrest according to gender, they reported that cardiac arrest developed more in women when compared with men (p=0.04) and female gender was correlated with higher death rate in university analysis (p=0.02). Mean age of female patients (n=761) was found as 66, while mean age of male patients (n=178) was found as 65 and statistically significant difference was found between them (p=0.66) (9). In a study conducted by Torres E. et al., ROSC was reported in 717

(58.1%) of 1234 male arrest cases and in 190 (59.75%) of 318 female arrest cases and no statistically significant correlation was in occurrence of ROSC between genders (p=0.596) (10). The mean age of 136 arrest cases examined by Kim Y. Et al. was 67.5 (53-77.8) and median age was 68 (53-78) in cases who had ROSC and 67 (52.5-77.5) in cases who did not have ROSC and no statistical difference was found between them (p=0.817). In terms of gender, ROSC was reported in 38 (56.7%) of 90 (66.2%) male cases and in 29 (43.3%) of 46 (33.8%) female patients and statistically significant difference was found (11). In our study, 38.2% of the patients were female, while 60.8% were male. ROSC occurred in 94 (30.4%) of the patients who were applied CPR (n=309). Of the patients who were reported to have ROSC, 39 (41.5%) were female, while 55 (58.5%) were male (p=0.4296). The mean age of the female patients who were applied CPR was 80, while the mean age of the male patients who were applied CPR was 68 and the difference between them was statistically significant (p<0.0001). No statistically significant difference was found between the mean ages of the patients who were reported to have ROSC and those who were not (p=0.8986).

In a retrospective study in which Kim Y. et al. examined the role of blood gas analysis during resuscitation in out-of-hospital arrests, median pH was 6.96 (6.8-7.07) for the group that was reported to have ROSC and pH 6.85 (6.8-6.99) for the group that was not reported to have ROSC and statistically significant difference was found (p=0.009). When pCO_2 was examined, median value was found as 74 (55.5-91) mmHg in those who were reported to have spontaneous circulation and as 89.5 (73-112.3) mmHg in those who were not (p<0.001). In the study, according to multivariant regression analysis, the only predictive value was found as pCO_2 in predicting ROSC (OR 0.979; 95% CI 0.960-0.997; p=0.025) and the probability of ROSC was found to be 3.3 times higher when pCO2<75 mmHg (OR 0.302; 95% CI 0.146-0.627; p=0.001) (11). In a prospective study Corral Torres E. et al. examined the relationship between blood gas, ROSC and neurological survival in out-of-hospital non-traumatic arrests, median pH value of patients who had ROSC was found as 7.13, while median pH value of patients who did not have ROSC was found as 7.11 and the difference between was found to be statistically significant (p=0.020). In the multivariate analysis, it was found that low pH level [corrected OR 0.03 (0.002-0.59), p=0.020], high pCO_2 level [corrected OR 1.03 (1.01-1.05), p=0.008] and high K+ level [corrected OR=2.28 (1.43-3.61), p=0.008] were found to decrease ROSC success. Similarly, it was found that low pH level [corrected OR 0.06 (0.02-0.18), p<0.001], high pCO_2 level [corrected OR 1.05 (1.03-1.08), p<0.001], low HCO_3 level [corrected OR 0.97 (0.94-0.999), p=0.044], low BE level [corrected OR=0.96 (0.93-0.98), p<0.001] and high K+ level had a negative effect on neurological recovery (10). In a prospective study by Çalbay A. et al., the relationship between blood gas parameters and end-tidal carbon dioxide prognostic values and ROSC and neurological survival was examined in out-of-hospital cardiac arrests. Median initial pH value was 6.97 in patients who had ROSC and 6.99 in patients who did not have ROSC and the difference was found to be statistically significant (p=0.721). Median pCO_2 was 54.55 mmHg in patients who had ROSC and 68.5 mmHg in patients who died and statistically significant was found (p=0.0012). Median pO_2 value was 51.5 mmHg in patients who had ROSC and 26.85 mmHg in patients who did not have ROSC and the difference was found to be statistically significant (p=0.0006) (12). Similarly, in our arrest population with 309 individuals we included in the study, when blood gas parameters were compared, median pH was 7.20 (7.3-7.35) in patients who had ROSC and 7.02 (6.86-7.19) in patients who did not have ROSC and the difference between was found to be significant (p<0.0001). When pCO_2, pO_2, $SatO_2$, HCO_3, BE blood gas parameters and lactate median values were examined separately for patients who had ROSC and for patients who did not have ROSC, statistically significant difference was found and median and p values were found as 45.9-59.8 mmHg (p<0.0004) for pCO_2, 55.4-36.8 mmHg (p<0.0001) for pO_2, 80.7-42.1% (p<0.0001) for $SatO_2$, 15.9-11.1 mmol/L (p<0.0001) for HCO_3, 8.2-14 mmol/L (p<0.0001) for BE and 6.8-11.7 mmol/L (p<0.0001) for lactate, respectively. Only pH value was found as an independent indicator of spontaneous resuscitation in multivariate logistic regression analysis and it was found to increase survival rate by 0.43 times [corrected OR: 1.43 (95% CI: 1.13-1.83), p=0.0033].

In a study conducted by Hajzargarbashi E. et al., the cause of arrest was reported as internal causes in 51.1% of the patients (7), while the cause of arrest was reported as cardiac problems in 70% of the patients in a study by Herlitz J. et al (8). In a study by Kim Y. et al., when the effects of arrest etiology on ROSC was examined, 37 (55.2%) of 78 (57.4%) patients who had arrest due to cardiogenic causes had ROSC, while 17 (25.4%) of 30 (22.1%) patients who had arrest due to respiratory causes had ROSC and no statistically significant correlation was found between them (p=0.690) (11). In a retrospective, multi-centred, observational study by Orban J., while ROSC success rate was 42% in arrests due to cardiac pathologies, it was found as 19% in arrests due to respiratory pathologies (p<0.001) (13). In our study, while ROSC success rate was 29.4% in arrests due to circulatory system diseases, this rate was found as 42.1% in arrests due to respiratory system diseases. Statistically significant difference was found in respiratory system diseases in terms of ROSC (p=0.029). According to univariate regression analysis, the probability of return of spontaneous circulation will be 115% higher in patients who have arrest due to respiratory causes when compared with the patients who die [OR: 2.15 (95% CI: 1.29-3.59), p=0.0032]. Similarly, it was found as an independent indicator of ROSC in multivariate logistic regression analysis and the probability of survival was found to increase 2.76 times [corrected OR: 3.76 (95% CI: 1.49-9.53), p=0.0052].

Our study has some limitations. Our sample includes both

in-hospital and out-of-hospital cardiac arrest patients. The time between arrest and intervention was not accessed due to the retrospective design of the study. In addition, non-emergency outcome of the patients was not also included in the study, only ROSC success was evaluated within emergency service. Although pH value and especially arrests with respiratory cause are leading in terms of extending or ending CPR duration, different results can be found in different study groups. Although these differences include differences such as geography, ethnicity and demographic characteristics, it is thought that they result from the fact that the patient population covers all of the in-hospital and out-of-hospital arrests.

In this study, pH value, which is the first blood gas parameter evaluated in patients who were applied CPR, was found as the independent indicator of ROSC and it was found to increase the probability of survival 0.43 times. Similarly, respiratory causes were also found as the independent indicator of ROSC and they were found to increase the probability of survival 2.76 times.

Conflict of interest

The author(s) declare no conflicts of interest.

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None to declare.

Authors' contributions

Concept: E.N., M.A., A.Ç., Design: E.N., M.A., Data Collection or Processing: E.N., M.A., G.E., Ö.Y., G.A., Analysis or Interpretation: E.N., M.A., A.Ç., Literature Search: E.N., M.A., Ö.B., G.E., G.A., Writing: E.N., M.A.

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