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Predictive factors of spontaneous circulation return following in-hospital cardiac arrest: a cross-sectional study

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Abstract: **Objective:** Existing predictive models for in-hospital cardiac arrest (IHCA) outcomes are mainly based on out-of-hospital cardiac arrest (OHCA) studies. This study aimed to identify factors that can independently predict the sustained return of spontaneous circulation (ROSC) following IHCA.

Methods: This retrospective cross-sectional study included all patients aged 18 or older who underwent cardiopulmonary resuscitation (CPR) following IHCA in the emergency departments of two general hospitals in Tehran, Iran, from March 2021 to April 2024. The association of patient baseline characteristics, type of cardiac arrest, CPR characteristics, time-related parameters, and laboratory data with sustained ROSC were evaluated using multivariate logistic regression analysis trying to identify independent associated factors of sustained ROSC following IHCA.

Results: 614 patients with a mean age of 68.23±17.65 (range: 18-115) years meeting the eligibility criteria were included (59.28% male). 184 (29.96%) cases experienced sustained ROSC. Multivariate logistic regression analysis revealed a significant association between sustained ROSC and CPR duration less than 30 minutes (coefficient=4.38, 95% CI: 3.70,5.06, P<0.001), arrest due to cardiac etiologies (coefficient=1.05, 95% CI: 0.35,1.74, P=0.003), and administration of IV bicarbonate (coefficient=1.42, 95% CI: 0.72,2.13, P<0.001). Administration of amiodarone showed a borderline association with sustained ROSC (coefficient=1.07, 95% CI: -0.03,2.18, P=0.05).

Conclusion: CPR duration of less than 30 minutes, arrest with cardiac etiologies, administration of bicarbonate and amiodarone were independent predictors of sustained ROSC.

Keywords: Advanced Cardiac Life Support; Cardio-Pulmonary Resuscitation; Spontaneous Circulation Return

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1. Introduction

Cardiac arrest is a serious life-threatening condition characterized by cessation of the patient's heart rhythm. In-hospital cardiac arrest (IHCA) occurs within the confines of a medical center, typically a hospital, and can affect all hospitalized patients with a higher prevalence in intensive care units (ICUs) and emergency departments (1).

The annual incidence rate of IHCA varies widely across studies, typically ranging from 1 to 6 cases per 1000 hospital admissions (2), and in the United States, approximately 300,000 cases are reported annually (3). Despite the significant impact and poor prognosis associated with IHCA (4), it has received considerably less attention in research compared to out-of-hospital cardiac arrest (OHCA), both in terms of treatment (5) and post-cardiopulmonary resuscitation (CPR) care (6). Consequently, IHCA guidelines are often extrapolated from OHCA studies (7-9).

To date, numerous studies have been conducted to develop models that estimate outcomes of cardiac arrest using factors that are shown to be able to lead to favorable outcomes. These studies serve as valuable tools for healthcare professionals, aiding them in decision-making regarding optimal patient care and resource allocation (10). Even within advanced treatment systems, resources are limited during crises. Therefore, the existence of tools to assist physicians in resource allocation to patients with potentially better survival chances remains essential (11).

However, these models are typically based on studies of specific populations with unique demographic, socioeconomic, and healthcare characteristics, raising questions about their generalizability to different patient populations

(12-14). Therefore, it is recommended that these models be adapted to reflect the actual conditions of patients in each region before practical application, utilizing factors that have been shown to be associated with improved outcomes of IHCA in the target population (15).
This study aimed to identify independent factors that can be used for predicting the sustained return of spontaneous circulation (ROSC) following IHCA based on the actual conditions of hospital centers in Iran. The purpose of this study is to provide a framework that can be used to improve the successful triage of patients, allowing for more effective allocation of advanced care during mass incidents. Additionally, successful CPR serves as a critical performance indicator for emergency departments. Therefore, our study can provide a tool to evaluate the performance of hospital emergency departments by using predictive factors present before or during CPR to estimate patients' chances of survival, then comparing the results of CPR performed to assess the departments' performance. Furthermore, it can serve as a valuable tool for assessing different methods of care and treatment for patients experiencing cardiac arrest.

2. Methods

2.1. Study design

This retrospective cross-sectional study was conducted on all patients aged 18 or older with IHCA who underwent CPR in the emergency departments of two general hospitals (Shohadaye Tajrish and Rasool Akram) in Tehran, Iran, from March 2021 to April 2024. Both hospitals are public tertiary centers used for training medical staff and handling referrals. In both centers studied, the CPR leader was an emergency medicine specialist with more than 10 years of experience. To conduct this study, we reviewed the literature and extracted related variables of OHCA outcomes. These variables were then presented to an expert panel, and those that were available, affordable and quickly evaluable were selected. We collected these variables from the electronic patient records of the mentioned hospitals and determined the outcome of each patient regarding successful CPR. Successful CPR was defined as a ROSC maintained for at least 20 minutes without requiring another CPR attempt (16).
This study was approved by the Research Ethics Committees of the Directorate of Health, Rescue, and Treatment of the Police Headquarters of the Islamic Republic of Iran (IR.SBMU.TEB.POLICE.REC.1402.079) and adhered to the ethical principles outlined in the Declaration of Helsinki.

2.2. Participants

All patients aged 18 or older who experienced IHCA and underwent CPR in the emergency department were included in this study. Patients who were not resuscitated in the hospital (e.g., those with a do not resuscitate (DNR) order or resuscitated before hospital arrival) or underwent CPR in a different ward than ED, patients who had undergone CPR at another center before being referred to the studied centers, patients with unclear data before arriving at the studied hospitals, and those who had ROSC before hospital arrival (confirmed by the emergency physician) were excluded.
Missing data were completed, if possible, by contacting the patient or their companions; otherwise, cases with missing key information were excluded. Data was extracted from electronic patient records at both centers.

2.3. Data gathering

This study investigates the impact of pre- and intra-arrest factors on IHCA outcomes. Age, gender, Cardiac arrest due to trauma, underlying diseases, a history of successful CPR, pupillary light reflex and alert, verbal, pain, unresponsive (AVPU) score at admission, occurrence of cardiac arrest in the context of cardiovascular diseases, presence of a shockable rhythm, performance of mechanical CPR, administration of adrenaline, amiodarone, and sodium bicarbonate, time parameters such as the interval between cardiac arrest and the initiation of CPR, the duration of CPR, and the shift during which CPR was performed were collected and were analyzed. By ' Cardiac arrest due to trauma,' we refer to patients who experienced cardiac arrest due to direct trauma to the heart and chest or hemorrhagic shock resulting from trauma. Other types of traumas were not considered. For example, if a patient suffered direct trauma to extremities, provided the complications of which were not considered as a cause for cardiac arrest, or if the patient experienced anaphylactic shock in response to medications during treatment, these cases were not considered traumatic. Cardiac arrest due to cardiac etiologies was defined as cases where the patient's medical history, diagnostic procedures, and consultations with specialists indicated that the arrest was caused by cardiovascular disease or its direct complications. Arrests not attributed to trauma and not meeting the criteria for cardiac etiology, were classified as non-cardiac etiologies.
Additionally, 'underlying disease' refers to chronic conditions mentioned by the patient or their companions upon admission, identified during consultations and diagnostic processes by the treating physician or consulting doctors as reasons for the occurrence of cardiac arrest.
In addition, two sets of laboratory data were analyzed. The first set consisted of tests conducted at the nearest time of blood sampling to the CPR, including serum levels of creatinine, glucose, lactate, and potassium, as well as base excess (BE) and pH values from the venous blood gas (VBG). The second set consisted of at-admission laboratory tests, from which serum potassium levels, BE, and pH values from the VBG were obtained. Acidemia was defined as a pH value below 7.35.
It is noteworthy that in our study centers, all CPRs were performed according to the American Heart Association (AHA) guidelines, and adrenaline was administered in all cases. Moreover, mechanical CPR was not utilized for any patient. Consequently, these two variables were not included in the

analysis.
Data gathering was conducted by a trained general physician under the supervision of an emergency physician.
Successful CPR was defined as sustained ROSC without the need for additional CPR for at least 20 minutes (17). Conversely, CPR was deemed unsuccessful if it failed to achieve ROSC and was subsequently terminated, or if ROSC was achieved but the patient required another resuscitation effort within 20 minutes of the previous attempt.

2.4. Outcome

Sustained ROSC as a successful CPR index was considered as the main outcome of the study. Sustained ROSC was defined as ROSC maintained for at least 20 minutes without requiring another CPR attempt.

2.5. Statistical analysis

The sample size was calculated based on the area under the curve (AUC) from the study by Nan Liu et al. (18). According to this study, the AUC for the cardiac arrest survival score (CRASS score) in predicting unfavorable patient outcomes was 0.963. Considering a 95% confidence interval and applying formula: $N=Z\hat{(}V(AUC))/d\hat{2}$, the minimum required sample size was estimated to be 245 patients. To ensure the study's power, the number of patients included was more than twice the calculated amount (n=614).
The data was analyzed by STATA 17 software. All data were tested for normality before conducting the analysis to ensure the appropriateness of parametric tests. Quantitative data were reported as means and standard deviations, while categorical data were reported as frequencies and percentages. The association between quantitative variables and successful CPR was determined using the t-test, and the association between categorical variables and outcomes was determined using the chi-square test or Fisher's exact test. Subsequently, a multivariate logistic regression model was applied to the variables that showed a significant relationship with sustained ROSC in the univariate analysis (A P value for univariate analysis of less than 0.1 was considered statistically significant) to identify independent predictors. In multivariate analysis, a P-value of less than 0.05 was considered statistically significant.

3. Results

3.1. Baseline characteristics of studied cases

A total of 614 patients who met the eligibility criteria were included in the study (364 (59.28%) male, mean age 68.23 ± 17.65 years). Of these, 246 (40.06%) were 65 years old or younger, while 368 (59.94%) were over 65 years old. Among the included cases, 430 (70.03%) patients had unsuccessful CPR, while 184 (29.97%) patients had successful CPR. The baseline characteristics of the patients studied are presented in table 1. The flow chart of patient selection is shown in figure 1.

3.2. Univariable analysis

The univariable analysis demonstrated a significant association between sustained ROSC and CPR duration (P<0.001), cardiac arrest due to cardiac etiologies (P< 0.001), the presence of shockable heart rhythm (P=0.03), administration of IV bicarbonate (P<0.001), serum glucose level (P=0.003), and BE in the at-admission VBG test (P=0.04)." Additionally, a borderline association was observed between sustained ROSC and serum potassium level (P=0.07) and administration of amiodarone (P=0.06).

3.3. Multivariable analysis

Stepwise multivariate logistic regression revealed that CPR duration less than 30 minutes (coefficient=4.38, 95% CI: 3.70,5.06, P<0.001), cardiac arrest due to cardiac etiologies (coefficient=1.05, 95% CI: 0.35,1.74, P=0.003), and administration of bicarbonate (coefficient=1.42, 95% CI: 0.72,2.13, P<0.001) were independently associated with sustained ROSC following CPR. However, the administration of amiodarone (coefficient=1.07, 95% CI: -0.03,2.18, P=0.05) showed a relatively lower statistical association with sustained ROSC. Details of the multivariable analysis are shown in table 2.

4. Discussion

This study aimed to identify factors associated with sustained ROSC in hospital settings in Iran. We utilized variables identified in previous studies as determinants of CPR outcomes, applicable in critical situations requiring CPR, and calculable in Iranian hospitals.
Univariable analysis highlighted the significance of the presence of a shockable heart rhythm (ventricular fibrillation (VF) and ventricular tachycardia (VT)), administration of amiodaron and bicarbonate, CPR duration, cardiac arrest due to cardiac etiologies, serum level of potassium and glucose in the blood sample obtain closest to the initiation of CPR and BE in the at-admission VBG test. After performing a multivariable analysis and accounting for confounding factors, the following independent predictors of sustained ROSC were identified: CPR duration less than 30 minutes, cardiac cause of arrest, administration of bicarbonate, and administration of amiodarone.
CPR duration was the most significant predictor of successful CPR in this study. Patients ROSC before 30 minutes of resuscitation demonstrated a higher probability of sustained ROSC, aligning with several studies (14, 19-23) that associate prolonged CPR with poorer outcomes. This is likely due to increased hypoxia time, leading to organ damage and patient deterioration.
However, other studies have suggested potential for improved CPR outcomes with longer durations (21,24). It is noteworthy that the average CPR duration in our study appears to be longer than in other studies. This may explain why studies such as S Cooper. et al. (25), with an average CPR duration of 15.6 minutes, set a cutoff at 15 minutes. Sim-

Table 1 Comparison of patient characteristics between cases with and without sustained ROSC following CPR

Variables	Sustained ROSC		P value
	No (n=430)	Yes (n=184)	
Age, year (mean±sd)	68.60±18.02 (n=429)	65.35±16.76 (n=184)	0.42
Male, n (%)	254 (59.07)	110 (59.78)	0.86
Female, n (%)	176 (40.93)	74 (40.22)	
Shockable rhythm, n (%)	65 (15.12)	41 (22.28)	0.03
Non-shockable rhythm, n (%)	365 (84.88)	143 (77.72)	
Cardiac arrest due to trauma, n (%)	49 (11.40)	19 (10.33)	0.69
Cardiac arrest due to non-trauma, n (%)	381 (88.60)	165 (89.67)	
Time from arrest to CPR, minutes (mean±sd)	0.24±1.15 (n=430)	0.23±1.09 (n=184)	0.89
Underlying disease, n (%)	332 (77.21)	142 (77.17)	0.99
No underlying disease, n (%)	98 (22.79)	42 (22.83)	
With administration of amiodaron, n (%)	21 (4.88)	16 (8.74)	0.06
Without administration of amiodaron, n (%)	409 (95.12)	167 (91.26)	
Duration of CPR, minutes (mean±sd)	36.30±11.76 (n=430)	15.70±11.37 (n=184)	<0.001
Pupillary reflex, n (%)	153 (66.52)	67 (63.81)	0.62
Absent pupillary reflex, n (%)	77 (33.48)	38 (36.19)	
Arrest due to cardiac etiology, n (%)	101 (23.54)	72 (39.13)	<0.001
Arrest due to non-cardiac etiology, n (%)	328 (76.46)	112 (60.87)	
AVPU			0.38
A, n (%)	121 (28.67)	47 (26.11)	
V, n (%)	72 (17.06)	40 (22.22)	
P, n (%)	84 (19.91)	39 (21.67)	
U, n (%)	145 (34.36)	54 (30.00)	
Morning shift, n (%)	212 (49.30)	94 (51.09)	0.68
Night Shift, n (%)	218 (50.70)	90 (48.91)	
With history of CPR, n (%)	31 (7.24)	8 (4.40)	0.18
Without history of CPR, n (%)	397 (92.76)	174 (95.60)	
Creatinine, mg/dL	2.49±2.09 (n=415)	2.49±1.79 (n=177)	0.98
BE, mEq/L	-9.64±8.05 (n=383)	-10.28±9.81 (n=170)	0.42
Initial BE, mEq/L	-8.26±8.23 (n=386)	-9.82±9.18 (n=172)	0.04
Lactate, mg/dL	72.33±37.52 (n=36)	55.16±47.37 (n=11)	0.21
Potassium, mEq/L	4.61±1.12 (n=412)	4.43±1.05 (n=178)	0.07
Initial potassium, mEq/L	4.51±1.08 (n=415)	4.41±1.03 (n=180)	0.28
Glucose, mg/dL	172.83± 101.40 (n=377)	203.51± 127.08 (n=161)	0.003
Administration of bicarbonate, n (%)	85 (20.05)	74 (40.44)	<0.001
Without administration of bicarbonate, n (%)	339 (79.95)	109 (59.56)	
Presence of acidemia in tests closest to CPR (PH<7.35), n (%)	101 (26.17)	43 (25.15)	0.80
Normal Ph or alkalosis in tests closest to CPR (Ph ≥ 7.35), n (%)	285 (73.83)	128 (74.85)	
Acidemia in initial lab tests, n (%)	119 (30.51)	42 (24.14)	0.12
Normal Ph or alkalosis in initial lab tests, n (%)	271 (69.49)	132 (75.86)	

Data are presented as mean ± standard deviation or frequency. BE: Base excess; AVPU: (A: Alert; V: Respond to vocal stimulus; P: Respond to painful stimulus; U: Unresponsive)

Table 2 Findings of logistic regression analysis independent predictors of sustained ROSC following CPR

variable	RC	SR	95% CI	P value
CPR duration less than 30 minutes	4.38	0.34	3.70,5.06	< 0.001
Arrest due to cardiac etiologies	1.05	0.35	0.35,1.74	0.003
Bicarbonate administration	1.42	0.36	0.72,2.13	< 0.001
Amiodaron administration	1.07	0.56	-0.03,2.18	0.05

CPR: Cardiopulmonary resuscitation; RC: Regression coefficient; CI: Confidence interval; SR: Standard error

ilarly, Cheema et al. (26) reported average CPR durations of 12.33±12.93 in patients with ROSC and 13.91±27.77 in patients without ROSC, both lower than our study.

Therefore, CPR termination should be based on individual patient conditions and clinical judgment. Furthermore, it appears that CPR duration in some hospitals may be insufficient (24,27).

Another factor strongly associated with sustained ROSC was the occurrence of cardiac arrest due to cardiac etiologies, a finding consistent with numerous studies (23,27,28). In our study, 173 patients (28.17%) experienced cardiac arrest due to cardiac etiologies. This is consistent with research involv-

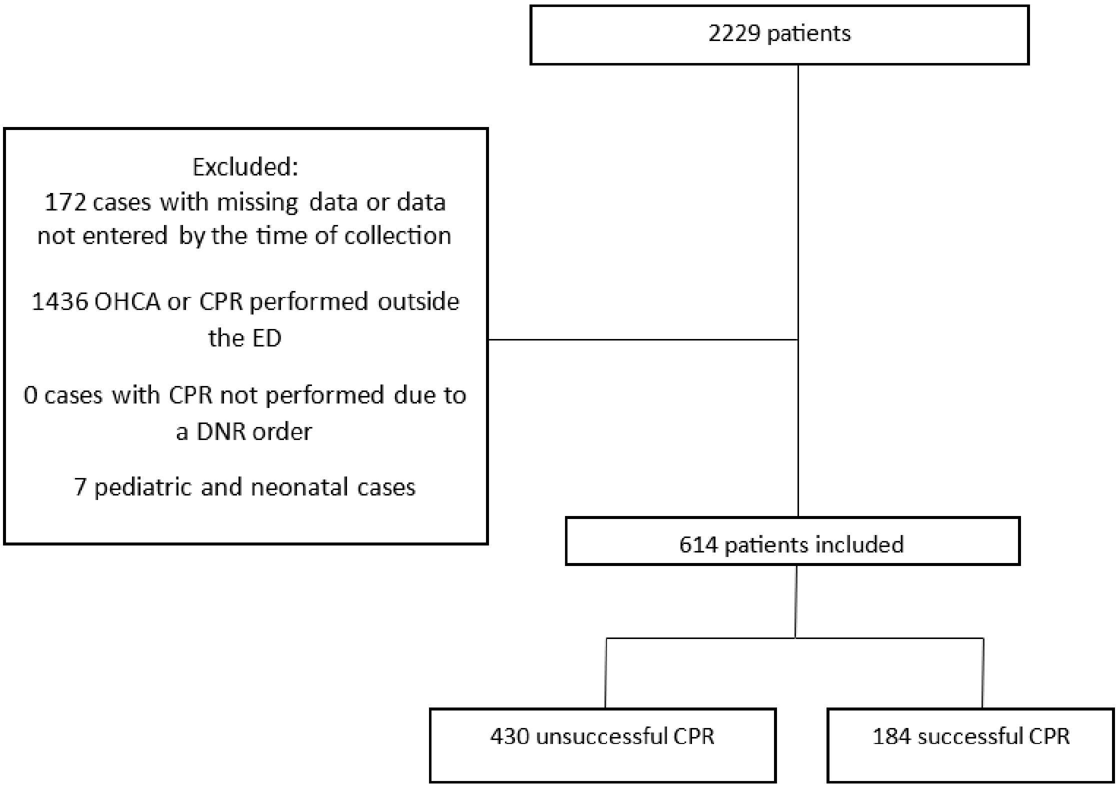

Figure 1 Patient inclusion flowchart

ing 2,852,347 patients with cardiac arrest in the emergency department, indicating that cardiac causes account for about one-third of cases (29). Several reasons may contribute to this favorable outcome. First, cardiac patients typically undergo continuous cardiac monitoring upon admission. They are admitted to CPR rooms equipped with specialized care and resuscitation equipment, with a lower ratio of doctors and nurses to patients. Second, the availability of effective treatments, such as coronary angiography or percutaneous coronary intervention (PCI), may further enhance outcomes because patients experiencing cardiac arrest due to treatable causes have a higher likelihood of achieving sustained ROSC (23,30).

Additionally, patients with a history of cardiac diseases may benefit from collateral vessels, ensuring blood supply to areas affected by ischemia. This collateral circulation may contribute to improved outcomes (30). Lastly, our study revealed that patients whose cardiac arrest was attributed to cardiac etiologies had a higher prevalence of shockable rhythms (VF and VT) compared to other groups. This increased likelihood of shockable rhythms may explain the better outcomes due to timely defibrillation (14,31).

Although the administration of amiodarone demonstrated marginal statistical significance in our analysis, it appears to contribute to sustained ROSC in hospital settings. This supports its recommendation in advanced cardiac life support (ACLS) protocols for arrhythmia control (32,33) and aligns with AHA's class IIb recommendation (LOE B-R) and the European Resuscitation Council (ERC) guidelines (5,33).

Both AHA and ERC guidelines recommend the use of amiodarone in shockable rhythms (VF and VT) after three unsuccessful shocks (34,35).

It should be noted that few studies have examined the effect of amiodarone using IHCA patient data, with most focusing on OHCA cases, in a systematic review by Ali et al. (36) on amiodarone administration across all settings and age groups, out of 14 RCTs and 18 observational studies, only one observational study, conducted on pediatric patients, focused on IHCA data (37).

However, the literature presents a mixed picture regarding amiodarone's efficacy.

A network meta-analysis conducted by Wang et al. (38) addressed the same question and reported that anti-arrhythmic drugs not only improve survival to discharge and favorable neurological outcomes but also highlight amiodarone as the most effective among these drugs, followed by lidocaine.

In the amiodarone versus lidocaine in pre-hospital cardiac arrest due to ventricular fibrillation (ALIVE) and ARREST RCTs, which studied the role of amiodarone in OHCA patients, amiodarone was more effective than lidocaine in increasing survival to hospital admission (39,40). Additionally, in another RCT, the resuscitation outcomes consortium - amiodarone, lidocaine or placebo study (ROC-ALPS), amiodarone administration was associated with increased survival to admission, with no difference from lidocaine (41).

Another cohort study on 14,360 in-hospital cardiac arrest patients with shockable rhythms reported that amiodarone administration was associated with a higher likelihood of ROSC, 24-hour survival, survival to hospital discharge, and better neurological outcomes (42). These studies align with our findings that amiodarone administration improves patient outcomes.

Yet, conflicting evidence exists. For instance, a review study by Vandersmissen et al. (43) examined eight meta-analyses investigating the relationship between amiodarone administration and outcomes. While some studies reported improved survival to hospital admission, none conclusively established a direct association between amiodarone use and overall improved outcomes. Another study on 232 patients with shockable rhythms reported that amiodarone administration had no impact on 30-day mortality or neurological outcomes (44). These results differ from the findings observed in our analysis.

The administration of bicarbonate during CPR remains one of the most controversial topics in medical research. Early studies emphasized the benefits of bicarbonate, leading to its recommendation in the ACLS guidelines in 1976 (45) . However, over time, the number of studies supporting its positive impact on patient outcomes has decreased (46,47). Increasingly, research has shown that bicarbonate administration may not improve outcomes and may even worsen them (48,49). Consequently, the AHA guidelines from 2010 onward have recommended against the routine use of bicarbonate, suggesting its administration only under specific conditions such as hyperkalemia, severe metabolic acidosis, and drug overdose with sodium channel blockers like diphenhydramine and tricyclic antidepressants (TCAs). The 2020 guidelines further restricted its use to drug overdose with sodium channel blockers and as adjunctive therapy in hyperkalemic patients (50-58). Despite these recommendations, bicarbonate is still frequently used during CPR (59), and ERC 2021 guidelines advocate for its use in cases of prolonged CPR (60). It is important to note that few studies have investigated the effect of bicarbonate on IHCA (61), with most research focusing on out-of-hospital cases. One study on in-hospital arrest recommended against its routine use in patients with a pH greater than 7.18 but reported improved outcomes in cases with a pH less than 7.18, particularly during prolonged CPR (62).

There are studies aligned with the present study that have reported the role of bicarbonate in improving patient outcomes. A retrospective study by Roberts et al. on 310 IHCA patients found that the survival rate was low in patients who received bicarbonate, attributing this not to bicarbonate itself, but to the metabolic acidosis for which it was administered (63).

Additionally, a cohort study by Stiell et al. on 529 patients examined the role of drugs used in CPR in patient survival, emphasizing bicarbonate's role in improving outcomes and achieving ROSC in prolonged CPR cases (52). Various studies have reported evidence supporting this conclusion (64,65). A retrospective study by Bar-Joseph et al. found that bicarbonate administration was associated with increased ROSC and improved outcomes, suggesting early and frequent bicarbonate administration (46), a point also noted in another study (66).

On the other hand, numerous studies have reported that bicarbonate has no effect on achieving ROSC or improving patient outcomes (67-69), and may even worsen them (70).

In Overall, while studies generally advise against routine use, they emphasize bicarbonate administration under conditions recommended by the guidelines (71) or suggest new scenarios where bicarbonate might improve outcomes, such as in non-shockable rhythms (72) or prolonged CPR (73).

In the centers under study, CPR is performed according to the AHA 2020 guidelines. The observed correlation between bicarbonate administration and better outcomes in this study does not imply a recommendation for its routine use but rather supports its guideline-directed use. This means that, when prescribed under the specified conditions, bicarbonate can increase the probability of sustained ROSC.

Based on the multivariable analysis, independent factors predicting sustained ROSC defined as ROSC lasting more than 20 minutes without the need for further resuscitation were identified.

5. Limitations

While this study offers valuable insights, several limitations should be acknowledged.

5.1. Study design limitations

The retrospective nature of the study introduces the possibility of selection bias, potentially limiting the generalizability of the results to the broader population of patients experiencing IHCA. Furthermore, missing data on certain variables could affect the results, particularly regarding lactate levels; in one of the studied hospitals, only a very small number of lactate tests were requested for patients, potentially impacting the analysis of this crucial marker.

There is no standardized protocol for ordering specific laboratory tests upon patient arrival. Consequently, some cases lacked initial test results, or specific tests were conducted at different times, which also applies to tests conducted closest to the time of CPR. It was sometimes impossible to determine the interval between when these tests were taken and the patient's arrest, as the recorded time of the test request might contain errors. Additionally, the laboratory personnel and operators recording the results might have inaccuracies in recording the time the test was conducted.

5.2. Information gathering limitations

In the study centers, there was no reliable data registry system. Consequently, researchers encountered limitations regarding incomplete patient information during data collection. Efforts were made to overcome these issues by having a skilled individual collect data under the supervision of a specialist and by gathering the maximum number of accessible variables with the largest possible sample size. Nevertheless, this remains as a limitation of the present study.

For underlying conditions, it would be beneficial to use tools like the Charlson comorbidity index (CCI) for better patient condition descriptions. However, patients requiring CPR often arrive at the emergency department in critical condition, with the medical team's efforts focused on improving their condition and ensuring survival. Additionally, as previously mentioned, the lack of a registry system limits the ability to obtain accurate medical history from such patients. Although efforts were made to overcome these limitations by reviewing all recorded information, such as consultations and lab results, this remains a limitation of the study.

Due to legal considerations, the time interval between cardiac arrest and CPR initiation was recorded as "immediately" in nearly all cases. Estimating this interval accurately is difficult and prone to errors, potentially affecting the analysis of this time-dependent variable.

5.3. Outcome measurement limitations

The study focused on sustained ROSC as the primary outcome, limiting the ability to assess long-term outcomes such as 30-day survival, survival to discharge, and neurological outcomes. These outcomes are crucial for understanding the overall impact of interventions and should be considered in future studies.

It is essential to recognize that this study is a retrospective analysis conducted in centers with specific protocols for treating patients. Therefore, the care and medications provided were not randomized but administered according to guidelines and the judgment of the emergency physician.

5.4. Implications and recommendations for future research

Understanding variables that independently affect sustained ROSC can significantly aid healthcare providers. By examining and potentially modifying changeable factors or adjusting medication administration, patient outcomes may improve. Research in this area is in the early stages in our country due to data and registry system shortages. Our study can serve as a foundation for future research, emphasizing overcoming these limitations, particularly regarding patient comorbidities, confounding variables, and various outcomes.

Research on cardiac arrest patients is limited, and we invite other researchers to conduct more studies in this area to identify independent variables influencing patient outcomes. This could lead to improved diagnostic protocols and treatment interventions, ultimately enhancing patient outcomes.

6. Conclusion

The present study identified independent factors associated with sustained ROSC in patients experiencing cardiac arrest in the emergency department. Our analysis revealed that duration of CPR of less than 30 minutes, cardiac arrest due to cardiac etiology, administration of amiodarone during resuscitation, and administration of bicarbonate in the aforementioned patients are all factors that can contribute to sustained ROSC.

Our study can serve as a guide for designing a comprehensive model to predict successful CPR outcomes in IHCA patients in the emergency department. Additionally, it can be utilized in future studies aimed at improving existing treatments for CPR or in the design and testing of new therapeutic interventions.

7. Declarations

7.1. Acknowledgement

None.

7.2. Authors' contribution

Study design: SS, MY; Data gathering: AS; Analysis: MY; Interpretation of results: all authors; Drafting and revising: all authors.

7.3. Conflict of interest

The authors declare that they have no conflicting interests.

7.4. Funding

None.

7.5. Data availability

The data sets used in this study are available to qualified researchers upon reasonable request.

7.6. Using artificial intelligence chatbots

Chatbots were used for paraphrasing; however, no part of the text was originally generated by chatbots.

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