REUE | Original article

Analysis of factors associated with survival 24 hours after cardiac arrest in a hospital in Colombia

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INTRODUCTION. In-hospital cardiac arrest (IHCA) continues to carry high mortality despite advances in cardiopulmonary resuscitation (CPR) techniques and post-arrest care. The reported incidence rate is approximately 9–10 cases per 1,000 hospitalizations, with hospital discharge survival rates close to 25 %. In Latin America, survival rates remain below 20 %. This study aimed to describe clinical characteristics and resuscitation management in hospitalized adults and identify factors associated with 24-hour survival.

MATERIAL AND METHODS. We conducted an observational, analytical, cross-sectional, retrospective study between 2020 and 2025. A total of 195 patients aged > 18 years with IHCA were included. Pregnant patients, those with do-not-resuscitate orders, and those receiving end-of-life care were excluded. Associations between clinical variables and 24-hour mortality were evaluated using bivariate analyses and Poisson regression to estimate adjusted risk ratios.

RESULTS. The 24-hour mortality was 71 %. Return of spontaneous circulation (ROSC) was independently associated with lower early mortality and was the only significant predictor in the multivariate analysis. In bivariate analysis, other factors associated with greater survival included CPR duration < 10 minutes, an initial shockable rhythm (ventricular fibrillation or pulseless ventricular tachycardia), and the use of defibrillation. Most events occurred in the intensive care unit (44 %), followed by the emergency department (28 %) and general wards (16 %).

CONCLUSIONS. ROSC was the main independent predictor of early survival. Strengthening strategies such as early recognition of clinical deterioration, timely activation of the code blue response, and standardized CPR protocols may improve survival following IHCA.

Keywords: Cross-sectional studies. Cardiac arrest. Cardiopulmonary resuscitation. Hospital mortality.

Análisis de los factores asociados a la supervivencia a las 24 horas tras una parada cardiorrespiratoria, en un hospital de Colombia

INTRODUCCIÓN. El paro cardiorrespiratorio (PCR) intrahospitalario continúa causando alta mortalidad a pesar de los avances en las técnicas de reanimación cardiopulmonar (RCP) y en el manejo postparo. La supervivencia al alta hospitalaria es del 25 %, si bien en Latinoamérica se sitúa por debajo del 20 %. Nuestro objetivo es describir las características clínicas y del manejo durante la RCP en adultos hospitalizados e identificar los factores asociados con la supervivencia en las primeras 24 horas.

MATERIAL Y MÉTODOS. Estudio observacional, analítico, transversal y retrospectivo, realizado entre 2020 y 2025. Se incluyeron 195 pacientes mayores de 18 años con PCR intrahospitalaria, excluyendo gestantes, pacientes con órdenes anticipadas de no reanimación o en cuidados al final de la vida. Se evaluó la asociación entre variables clínicas y la mortalidad en las primeras 24 horas mediante análisis bivariados y un modelo de regresión de Poisson para estimar razones de riesgo ajustadas.

RESULTADOS. La mortalidad a 24 horas fue del 71 %. El retorno a la circulación espontánea (ROSC) se asoció con menor riesgo de muerte temprana y fue el único predictor significativo en el análisis multivariado. En el análisis bivariante, también se asociaron con mayor supervivencia: duración de RCP menor de 10 minutos, ritmo inicial desfibrilable y aplicación de desfibrilación. El 44 % de los eventos ocurrieron en la unidad de cuidados intensivos, seguidos por urgencias (28 %) y hospitalización (16 %).

CONCLUSIONES. El ROSC fue un predictor independiente de supervivencia temprana. Deben realizarse estrategias orientadas a mejorar la detección temprana y la asistencia a la PCR intrahospitalaria que favorezcan la ROSC.

Palabras clave: Estudios transversales. Paro cardiaco. Reanimación cardiopulmonar. Mortalidad hospitalaria.

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Article Information: Received: 26-8-2025. Accepted: 10-10-2025. *Online:* 27-10-2025.
Editor in Charge: Rafael Castro Delgado.

Introduction

In-hospital cardiac arrest (IHCA) continues to be a clinical event with high mortality despite advances in cardiopulmonary resuscitation (CPR) techniques and post-arrest management. In the United States, the incidence is approximately 10 cases per 1,000 hospitalizations, with survival to hospital discharge of 25 %.[1] In Latin America, the figures are less encouraging, with survival rates < 20 %.[2]

One of the most important challenges after achieving return of spontaneous circulation (ROSC) is maintaining patient stability and preventing post-cardiac arrest syndrome, which includes myocardial dysfunction, neurological damage, and multiple organ failure.[3] In particular, the 24-hour mortality rate remains high and constitutes a marker of the quality of resuscitation and immediate management.[4]

Several factors have been associated with higher rates of survival after CPR, including an initial shockable rhythm, shorter duration of CPR, prompt defibrillation when indicated, and appropriate management within the first hours after ROSC.[5,6] However, many of these studies have been conducted in developed countries and in selected populations, highlighting the need to characterize these factors in local contexts and in institutions with different characteristics.

The objective of this study was to characterize in-hospital CPR events in a high-complexity hospital in Colombia and identify clinical and resuscitation management factors associated with survival within the first 24 hours.

Material and methods

We conducted an observational, analytical, cross-sectional, retrospective study in patients who experienced cardiac arrest in inpatient services of a high-complexity institution from 2020 through 2025.

An electronic questionnaire was used to collect data from the health records of participants who met the selection criteria: age ≥ 18 years, admission for any cause except pregnancy or puerperium, and having experienced at least one cardiac arrest during hospitalization. Patients with advance directives for do-not-resuscitate or those receiving end-of-life palliative care were excluded. The term "code blue" refers to the in-hospital alarm system that activates the response team in the event of cardiac arrest, composed of trained personnel whose mission is to intervene as quickly as possible according to care protocols.

The following variables were recorded: demographic (age and sex), characteristics of the code blue (medical or surgical disease, area of care, treatment performed, prior length of stay, response time, resuscitation time, and ICU—intensive care unit—stay, and electrical rhythm of the cardiac arrest). The following dichotomous variables were recorded: ROSC, orotracheal intubation, administration of adrenaline, defibrillation, death within the first 24 hours, and death in the ICU. Cases with incomplete variables were excluded.

The distribution of quantitative variables was assessed using the Kolmogorov–Smirnov test. Results for these variables are expressed as means and SD, or as medians and IQR. Categorical variables are expressed as absolute and relative frequencies (%), accompanied by 95 % CI.

For comparison of quantitative variables between groups defined by the outcome, Student's t-test was applied under the assumption of normality, and the Mann–Whitney test otherwise. Qualitative variables were analyzed using the chi-square test or Fisher's exact test when assumptions for the former were not met. Statistical significance was considered with values of $P > .05$.

Crude risk ratios (RRs) were estimated for qualitative variables using simple Poisson regression models with a logarithmic link function and robust variance estimation (sandwich type). Estimates, their robust standard errors, *P* values, and 95 % CI, for risk ratios are presented.

An initial "intro" model was formulated with variables selected based on the Hosmer–Lemeshow criterion and their statistical significance. Final model coefficients were estimated with robust standard errors, and adjusted RR, and 95 % CI, were calculated. Model assumptions were verified, including absence of multicollinearity (using variance inflation factors, VIF), distribution of Pearson residuals, and assessment of overdispersion.

This study was approved by the research ethics committee of the *Facultad de Medicina de la Universidad Cooperativa de Colombia sede Medellín* (No. 003 of April 30, 2025), registered as code 30042025, by the ad hoc Bioethics Subcommittee of Health Sciences at the Medellín campus.

Results

A total of 195 patients were analyzed, with a mean age of 64 ± 16 years. The proportion of women was 40 % (95 % CI, 33 to 47). Descriptive data are shown in Table 1.

Most events were categorized as medical in origin (90 %; 95 % CI, 84 to 93). Regarding the care area at the time of code blue activation, 44 % occurred in the ICU (95 % CI, 37 to 51), followed by the emergency department (28 %), inpatient wards (16 %), short-stay unit (SSU) (11 %), and surgery (1.5 %).

The median length of stay in general wards before code blue activation was 47 hours (IQR, 3–226). Response time to code blue had a median of 1 minute (IQR, 0.00 to 1.00). The duration of resuscitation, recorded in only 134 patients, showed that 41 % (95 % CI, 33 to 50) received maneuvers between 10 and 20 minutes, 31 % (95 % CI, 23 to 39) between 5 and 10 minutes, and 28 % (95 % CI, 21 to 37) < 5 minutes. No resuscitations > 20 minutes were recorded.

Regarding the initial arrest rhythm, pulseless electrical activity (PEA) was the most frequent (71 %; 95 % CI, 64 to 77), followed by asystole (16 %), pulseless ventricular tachycardia (7.2 %), and ventricular fibrillation (6.2 %). Defibrillation was indicated in 22 % of cases (95 % CI, 15 to 31).

During resuscitation, 56 % of patients (95 % CI, 49 to 63) received drugs and vasopressors, 23 % (95 % CI, 17 to 29) received only drugs, 11 % (95 % CI, 7.4 to 17) received only vasopressors, and in 9.2 % (95 % CI, 5.7 to 14) no treatment was recorded. Only 1 patient received all possible interventions. Adrenaline was used in 95 % of

events (95 % CI, 91 to 98). Orotracheal intubation was performed in 88 % of patients (95 % CI, 82 to 92).

ROSC was achieved in 49 % of cases (95 % CI, 42 to 56). The median ICU stay after code blue was 191 hours (IQR, 76 to 392). Of 44 patients with ICU follow-up, 48 % (95 % CI, 33 to 63) died after their stay in that unit. Finally, the 24-hour mortality rate after resuscitation was 71 % (95 % CI, 64 to 77).

Associations were explored between those who died and those who survived within the first 24 hours after cardiac arrest (n = 138 and 57, respectively). No statistically significant difference in age was observed between both groups (mean: 64 vs 61 years; $P = .2$), nor by sex ($P > .9$) (Table 2).

Moreover, clinical conditions leading to code blue were not significantly different ($P = .7$), nor was the care area at the time of the event ($P = .6$). Types of treatment administered during code blue showed no statistically significant differences ($P = .9$), nor did prior length of stay in general wards (median: 68 vs 35 hours; $P = .2$), or response time to code blue (median: 1.00 minutes in both groups; $P = .5$).

A difference was found in the duration of resuscitation ($P < .001$); patients who died were more frequently resuscitated for 10 to 20 minutes (56 %), whereas among survivors, resuscitation lasting < 10 minutes predominated (84 %).

ROSC was significantly more frequent among survivors (100 % vs 28 %; $P < .001$). Neither the frequency of orotracheal intubation ($P = .3$) nor adrenaline administration ($P < .9$) showed differences between groups. Defibrillation was performed more frequently in the group that survived (35 % vs 16 %; $P = .018$).

Regarding arrest rhythm, significant differences were found ($P = .013$): asystole was more frequent among those who died (19 % vs 8.8 %), whereas ventricular fibrillation was more common among those who survived the first 24 hours (14 % vs 2.9 %).

The regression model included 5 variables. This model explained 44 % of the variance of the outcome, according to the Nagelkerke pseudo-coefficient of determination ($R^2 = 0.44$) (Table 3).

Among the analyzed variables, the only significant coefficient was ROSC. Patients who achieved return of spontaneous circulation showed a significant reduction in the risk of early death (adjusted RR, 0.30; 95 % CI, 0.00–Inf; $P < .001$).

Other variables included in the model did not reach statistical significance in the adjusted model (all had $P < .05$). A cluster analysis using K-means and hierarchical methods was attempted to identify potential unsupervised patterns in the data. However, this analysis was not feasible due to the structure of the dataset, the significant presence of missing values, and the low variance among observations.

Table 1. Sample description

Characteristics	N	N = 195 n (%)	95 % CI
Age [mean (SD)]	195	64 (16)	
Sex [mean (SD)]	195		
Female		78 (40)	33 %, 47 %
Pathology triggering code blue	195		
Medical		175 (90)	84 %, 93 %
Surgical		20 (10)	6.5 %, 16 %
Code blue care area	195		
ICU		85 (44)	37 %, 51 %
SSU		22 (11)	7.4 %, 17 %
Emergency department		54 (28)	22 %, 35 %
Inpatient ward		31 (16)	11 %, 22 %
Surgery		3 (1.5)	0,40 %, 4.8 %
Treatment	195		
All interventions		1 (0.5)	0.03 %, 3.3 %
Drugs and vasopressors		110 (56)	49 %, 63 %
Drugs		44 (23)	17 %, 29 %
Vasopressors		22 (11)	7.4 %, 17 %
None		18 (9.2)	5.7 %, 14 %
Length of stay in general ward until code blue activation (hours) [median (Q1, Q3)]	180	47 (3. 226)	
Code blue response time (minutes) [median (Q1, Q3)]	180	1.00 (0.00. 1.00)	
Resuscitation time	134		
< 5 min		38 (28)	21 %, 37 %
5–10 min		41 (31)	23 %, 39 %
10–20 min		55 (41)	33 %, 50 %
> 20 min		0 (0)	0.00 %, 3.5 %
Return of spontaneous circulation	195		
Yes		95 (49)	42 %, 56 %
Orotracheal intubation	194		
Yes		170 (88)	82 %, 92 %
Adrenaline administration	195		
Yes		186 (95)	91 %, 98 %
Rhythm of CA	195		
Pulseless electrical activity		138 (71)	64 %, 77 %
Asystole		31 (16)	11 %, 22 %
Ventricular fibrillation		12 (6.2)	3.4 %, 11 %
Pulseless ventricular tachycardia		14 (7.2)	4.1 %, 12 %
Defibrillation	119		
Yes		26 (22)	15 %, 31 %
Length of the ICU stay (hours) [median (Q1, Q3)]	57	191 (76. 392)	212, 417
Death after ICU stay	44		
Yes		21 (48)	33 %, 63 %
Death within first 24 hours	195		
Yes		138 (71)	64 %, 77 %

95 % CI: 95 % confidence interval; ICU: intensive care unit; SSU: short-stay unit; CA: cardiac arrest.

Discussion

In this study, the 24-hour in-hospital mortality rate after cardiac arrest reached 71 %, similar to recent studies in other Latin American cohorts, with rates between 65 % and 75 %.[7,8] ROSC was significantly associated with lower early mortality, a finding consistent with previous studies that highlight ROSC as one of the most robust predictors of early and discharge survival.[9]

Furthermore, other factors, such as shorter duration of resuscitation and the presence of an initial shockable rhythm were associated with survival in univariate analysis. These results are consistent with large-scale studies documenting better survival in patients with brief resuscitation and shockable ventricular rhythms.[6,10] However, in our ad-

Table 2. Associations between variables and the outcome: translation

Characteristics	N	Alive N = 57 n (%)	Deceased N = 138 n (%)	*P* value[1]
Age [mean (SD)]	195	61 (17)	64 (16)	.2
Sex [mean (SD)]	195			> .9
Female		23 (40)	55 (40)	
Conditions leading to code blue	195			.7
Medical		52 (91)	123 (89)	
Surgical		5 (8.8)	15 (11)	
Code blue care area	195			.6
ICU		27 (47)	58 (42)	
SSU		6 (11)	16 (12)	
Emergency department		15 (26)	39 (28)	
Inpatient ward		7 (12)	24 (17)	
Surgery		2 (3.5)	1 (0.7)	
Treatment	195			.9
All interventions		0 (0)	1 (0.7)	
Drugs and vasopressors		31 (54)	79 (57)	
Drugs		13 (23)	31 (22)	
Vasopressors		6 (11)	16 (12)	
None		7 (12)	11 (8.0)	
Length of stay in general ward until code blue activation (hours) [median (Q1, Q3)]	180	35 (1. 202)	68 (5. 289)	.2
Code blue response time (minutes) [median (Q1, Q3)]	180	1.00 (0.00. 1.00)	1.00 (0.00. 1.00)	.5
Resuscitation time	134			< .001
< 5 min		21 (42)	17 (20)	
5–10 min		21 (42)	20 (24)	
10–20 min		8 (16)	47 (56)	
> 20 min		0 (0)	0 (0)	
Return of spontaneous circulation	195			< .001
Yes		57 (100)	38 (28)	
Orotracheal intubation	194			.3
Yes		52 (91)	118 (86)	
Adrenaline administration	195			> .9
Yes		55 (96)	131 (95)	
Rhythm of CA	195			.013
Pulseless electrical activity		39 (68)	99 (72)	
Asystole		5 (8.8)	26 (19)	
Ventricular fibrillation		8 (14)	4 (2.9)	
Pulseless ventricular tachycardia		5 (8.8)	9 (6.5)	
Defibrillation	119			.018
Yes		13 (35)	13 (16)	

[1]Welch's t-test; Pearson's chi-square; Fisher's exact test; Wilcoxon rank-sum test.
ICU: intensive care unit; SSU: short-stay unit.
Bold values indicate statistical significance ($P < .05$).

Table 3. Explanatory model of the outcome

Characteristics	RR[c]	RR[a]	CI	*P* value
Age		1	0.00 - Inf	.975
Length of stay until code blue activation (hours)		1	0.00 - Inf	.592
Minutes to code blue response		0.95	0.00 - Inf	.262
Resuscitation time (5–10 min)	1.1	1.06	0.00 - Inf	.798
Resuscitation time (10–20 min)	1.9	1.29	0.00 - Inf	.232
Arrest rhythm:				
Asystole	1.17	1.18	0.00 - Inf	.245
Ventricular fibrillation	0.46	1.02	0.00 - Inf	.966
Pulseless ventricular tachycardia	0.9	0.7	0.00 - Inf	.085
Return of spontaneous circulation: Yes	0.4	0.30	0.00 - Inf	< .001
Nagelkerke R^2	0,44			

CI: confidence interval; RR: risk ratio.
Bold values indicate statistical significance ($P < .05$).

justed analysis, only ROSC remained as an independent predictor. This discrepancy may be explained by the limited sample size and high collinearity among variables.

Unlike some series in which the presence of a shockable rhythm and its consequent early defibrillation explain much of the variability in survival, in our population these factors did not retain statistical significance in the multivariable model.[11,12] This may reflect differences in demographics, comorbidities, and response times in high-complexity hospitals in middle-income countries.

It is possible that other variables, beyond those related to cardiac arrest and resuscitation, may better explain patient outcomes after resuscitation, such as comorbidities, prior functional status, or quality of post-arrest care, which were not considered in this study.

This is due to the retrospective nature of the study and the limited availability of information in health records. However, these factors are recognized in the literature as important determinants of prognosis after resuscitation, and their inclusion in future studies would allow a more comprehensive analysis of both early and late outcomes.

Additionally, the sample size and retrospective cross-sectional design only allow limited exploration of these associations, so findings should be interpreted with caution.

Nevertheless, in practical terms, our findings underscore the importance of optimizing initial resuscitation and processes that facilitate early ROSC, including measures such as continuous CPR training with short retraining intervals (approximately 30 days),[13] availability and rapid response of hospital emergency teams in a standardized manner through checklists,[14] and evidence-based protocolized post-arrest management,[15] given that significant differences in post-arrest management strategies have been observed,[16] in order to improve survival probabilities within the first 24 hours.[17]

Future research should consider multicenter designs with greater statistical power and the inclusion of additional variables, such as biochemical markers of neurological injury and specific post-arrest management strategies.

In conclusion, ROSC was the main predictor of survival within the first 24 hours in patients with in-hospital cardiac arrest. Optimization of response times and resuscitation maneuvers remains key to improving early survival in these patients.

ARTICLE INFORMATION

Conflict of Interest Disclosures: Dr. Jovanny Garcés declares a conflict of interest, as at the time of the study he served as Head of the Emergency Department at *Hospital Manuel Uribe Ángel;* the remaining authors declared no conflict of interest whatsoever.

Funding: The *Universidad Cooperativa de Colombia* funded the researchers' working hours and access to bibliographic databases.

Ethical Responsibilities: The authors have confirmed the maintenance of confidentiality and respect for the patient rights, agreement of publication, and transfer of rights to Revista Española de Urgencias y Emergencias.

Open data availability: Data are available upon request from the corresponding author.

Authors' contributions (CRediT): JAMDO: participated in research conceptualization, methodology design, formal analysis, and manuscript writing. JGM: participated in research conceptualization, data collection, and final manuscript writing. JMGC: participated in research conceptualization, data collection, and final manuscript writing. GAPG: participated in research conceptualization, data collection, and final manuscript writing. NHS: participated in research conceptualization, data collection, and final manuscript writing. AFMV: participated in research conceptualization, data collection, and final manuscript writing.

Use of generative artificial intelligence tools: The authors declare that they did not use AI tools in the preparation of this article.

Article not commissioned by the Editorial Board and with external peer review.

Note of the editors: This is a BOWMAN-generated English translation of the officially indexed Spanish-language article, which should be cited as Rev Esp Urg Emerg. 2026;5:87-91. In this translated version, the editors have supervised the process; however, it cannot be ruled out that some errors resulting from the artificial intelligence translation process may have gone unnoticed.

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