

# A Retrospective Study of Prognostic Indicators of Mortality in In-hospital Cardiac Arrest in a Tertiary Care Emergency Center

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## Abstract

**Aim:** Cardiac arrests are a critical public health issue, especially in developing countries like India, where access to timely advanced medical care is limited. This study aims to determine the predictors of mortality among patients sustaining in-hospital cardiac arrest (IHCA).

**Materials and Methods:** This retrospective observational cohort study in a tertiary hospital emergency department analyzed one-year IHCA patients. Demographics, causes, and outcomes were recorded from institutional database. Data entered in Excel were analyzed using SPSS version 25.0. Multivariate logistic regression was used to identify independent predictors of mortality among patients presenting with IHCA.

**Results:** Among 267 IHCA patients (mean age  $52 \pm 17$  years, male preponderance), hypoxia (43.44%) and coronary thrombosis (25.84%) were the most common reversible causes. Return of spontaneous circulation (ROSC) was achieved in 214 (80.14%) patients, while only 22 (8.23%) had favorable neurological outcomes (mRS  $< 3$ ) at hospital discharge. Logistic regression identified inability to attain ROSC and prolonged resuscitation ( $> 20$  minutes) as independent predictors of mortality.

**Conclusion:** Our study underscores the critical importance of achieving ROSC within 20 minutes, through early management of reversible causes, and consistent high-quality chest compressions, which are pivotal for favorable neurological outcomes among survivors.

**Keywords:** In-hospital cardiac arrest, mortality predictors, return of spontaneous circulation, emergency department, cardiopulmonary resuscitation

## Introduction

Cardiac arrest occurs when the heart stops resulting in a sudden cessation of blood circulation throughout the body. This catastrophic event deprives vital organs, most critically the brain, of oxygen, causing rapid cell death if not immediately addressed (1,2).

Cardiac arrest represents a significant public health concern due to its high incidence and mortality rates (3,4). In India, recent reports suggest that in-hospital cardiac arrest (IHCA) accounts for a significant proportion of emergency department (ED) mortality, yet systematic data remain limited. The survival rates in IHCA ranges between 10 to 20%, as against out-of-hospital cardiac arrest (OHCA) the survival rate was 14.6% (5-7). Despite advancements in

resuscitation techniques and emergency medical services (EMS), survival rates remain alarmingly low, with only a small percentage of individuals achieving full neurological recovery (7,8).

The impact of cardiac arrest extends beyond mortality statistics. Survivors often experience a range of physical, cognitive, and psychological impairments, significantly affecting their quality of life and placing a substantial burden on healthcare systems and families (9,10). This considerable public health burden underscores the critical need for continued research into prevention strategies, improved resuscitation techniques, and optimized post-cardiac arrest care to enhance survival rates and improve long-term outcomes for those affected by this devastating condition (11-15). This study aims to evaluate these predictors of mortality in a large tertiary care ED in South India, thereby



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contributing region-specific evidence to the global literature on cardiac arrest outcomes.

## Materials and Methods

### Study Design and Setting

This is a retrospective observational study conducted in the ED, a 75-bed unit of a large tertiary care referral center in Tamil Nadu, South India. The ED caters to approximately 90,000 patients annually, including both trauma and non-trauma cases. This study was approved ethics committee approval was obtained from the Institutional Review Board (IRB)/Ethics Committee operating under Christian Medical College Vellore (IRB min no: 0624160, date: 12.06.2024). Patient consent was waived, and confidentiality was maintained using unique identifiers and password-protected data entry software, which was accessible to a limited number of users.

### Study Period

The study was conducted over a period of one year, from January 2023 to December 2023.

### Participants

All patients aged 18 years and above who presented to the ED and sustained cardiac arrest were included in the study. Patients with OHCA, incomplete charts, or missing data were excluded from the analysis.

### Variables

Data were gathered from the hospital's electronic database and recorded on a standardized data abstraction sheet. Information collected included baseline characteristics, rhythm at presentation, cause of cardiac arrest (5H/5T), history of primary treatment at another medical center, use of defibrillation, time taken to achieve return of spontaneous circulation (ROSC), presenting complaints, vital signs at presentation, and cardiac arrest outcomes in the ED and hospital.

### Bias

Due to the retrospective nature of the study, neither exposure nor outcome assessment could be controlled.

### Statistical Analysis

Continuous variables were expressed as means with standard deviations, and nominal variables as numbers and percentages. The chi-squared test or Fisher's exact test was used to compare variables with survival outcomes. Statistical significance was defined as a p-value less than 0.05. Logistic regression analysis was performed for significant outcome variables, with results expressed as 95% confidence intervals. Data were entered into Microsoft Excel (version 16.65), and statistical analyses were

performed using the Statistical Package for the Social Sciences (SPSS) for Windows (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0, Armonk, NY).

## Results

During the one-year study period (January 2023-December 2023), our ED received a total of 66,012 patients, including 10,422 trauma victims and 55,590 non-trauma patients. Among them, 267 (0.4%) patients were included after excluding patients with out-of-hospital cardiac arrest, missing charts, and incomplete data (Figure 1).

### Baseline Demographic Characteristics and Vital Signs at Presentation

A total of 267 participants were enrolled in the study (Figure 1). The mean age of the study population was  $52 \pm 17.37$  years. There were 187 (70%) males and 80 (30%) females, with a male-to-female ratio of 2.3:1. The hemodynamic parameters at presentation included a mean heart rate of  $97 \pm 54$  bpm, mean oxygen saturation of  $81 \pm 17\%$ , mean systolic blood pressure of  $117 \pm 36$  mmHg, and mean respiratory rate of  $32 \pm 9$  breaths per minute.

Approximately 249 (93.3%) patients stayed in the ED for less than 6 hours, while 18 (6.7%) had a longer stay of more than 6 hours. The major comorbidities observed were diabetes mellitus (44%), systemic hypertension (42%), malignancy (8%), chronic kidney disease (10.8%), and ischemic heart disease (20.9%) (Table 1).

The most common initial rhythm observed during cardiovascular and pulmonary resuscitation (CPR) in our study population was pulseless electrical activity (PEA) (64%), followed by asystole (23%), ventricular fibrillation (VF) (6.7%), and ventricular tachycardia (5.6%). The defibrillator was used in 76 (28.5%) participants for shockable rhythms. The mean duration of CPR was  $18 \pm 11.5$  minutes after CPR, 240 participants required intubation. Hypoxia was the most common reversible cause of cardiac arrest (43%), followed by coronary thrombosis in 69 (25.8%), acidosis in 29 (10.9%), and hypovolemia in 29 (10.9%). None of the participants experienced cardiac tamponade or hypothermia.

Although 214 (80%) participants achieved ROSC, it was non sustained in 103 (48%) cases. Only 111 (52%) participants attained sustained ROSC. Out of which 29 (10.86) went to LAMA (Table 2). The majority of the study population had a glasgow coma scale score of 3-8 post-CPR. The modified Rankin score (mRS) was calculated at hospital discharge. Only 22 out of 111 had a mRS of  $<3$ , a favorable neurological outcome. About 156 (58%) patients died following cardiac arrest.

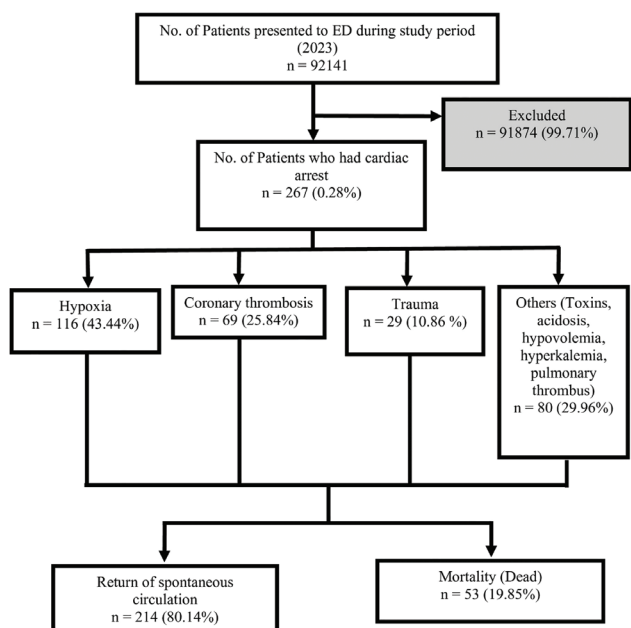


Figure 1. STROBE diagram  
ED: Emergency department

Variable	n=267 (%)	
Age	<40 years	95 (35.58)
	>40 years	172 (64.41)
Gender	Male	187 (70.04)
	Female	80 (29.96)
	Others	0
Duration of ED stay*	Less than 6 hours	249 (93.26)
	More than 6 hours	18 (6.74)
Heart rate	60-100	50 (18.73)
	<60	126 (47.19)
	>100	91 (34.08)
Systolic blood pressure	<90 mmHg	72 (26.96)
	>90 mmHg	195 (73.03)
Respiratory rate	>22	123 (46.06)
	<22	144 (53.93)
Saturation	<80%	165 (61.80)
	>80%	102 (38.20)
qSOFA	<2	32 (11.98)
	>2	235 (88.01)
Comorbidities	Diabetes mellitus	109 (40.82)
	Systemic hypertension	105 (39.32)
	Chronic kidney disease	29 (10.86)
	Malignancy	24 (8.98)

Variable	n=267 (%)	
Reversible cause*	Thrombosis (coronary)	69 (25.84)
	Thrombosis (pulmonary)	3 (1.12)
	Trauma	29 (10.86)
	Toxins	5 (1.87)
	Tamponade (cardiac)	0
	Hydrogen ions (acidosis)	22 (8.23)
	Hypoxia	116 (43.44)
	Hypovolemia	19 (7.11)
	Hyperkalemia	19 (7.11)
Hypothermia	0	
Intubated at presentation	17 (6.36)	
DNI/DNR	32 (11.99)	

\*n=282: Multiple causes per patient were identified, \*ED: Emergency department, qSOFA: Quick sequential organ failure assessment, DNI/DNR: Do not intubate or do not resuscitate

Outcome	No. of patients (percentage)
Admitted	127 (47.56)
LAMA*	87 (32.58)
Dead	53 (19.85)

\*: LAMA: Leave against medical advice, ED: Emergency department

ED Outcome Analysis

Logistic regression analysis identified failure to achieve ROSC as a strong independent predictor of mortality, with an odds ratio (OR) approaching 28 [OR=27.876 (6.27-123.90), p<0.001]. Prolonged cardiopulmonary resuscitation (CPR) duration also emerged as a significant risk factor, with patients undergoing more than 20 minutes of CPR exhibiting a more than five-fold increase in adjusted odds of mortality [OR=5.109 (1.903-13.708), p=0.001]. Conversely, a primary diagnosis of acute coronary syndrome (ACS) demonstrated a protective association [OR=0.132 (0.034-0.509), p=0.021], reinforcing the established notion that cardiac aetiologies are associated with more favourable outcomes in successfully resuscitated patients. Additionally, early intubation [OR=21.89 (4.88-98.98) p<0.001] was linked to markedly improved outcomes, with a 21-fold increase in the odds of survival compared to other interventions (Table 3).

**Table 3. Risk factors for cardiac arrest on multivariate analysis using logistic regression with mortality as outcome variable**

Variable alive n=214 (%)		Mortality		Unadjusted analysis		Adjusted analysis	
		Dead n=53 (%)	OR (95% CI)	p-value	OR (95% CI)	p-value	
Age	<40 yrs	28 (25.2)	42 (26.9)	1.092 (0.627,1.903)	0.756	2.017 (0.841, 4.839)	0.117
	>40 yrs	83 (74.8)	114 (73.1)				
Gender	Male	80 (72.1)	107 (68.6)	1.892 (1.102,3.251)	0.541		
	Female	31 (27.9)	49 (31.4)				
Diagnosis	ACS	27 (24.3)	59 (37.8)	0.132 (0.034,0.509)	0.021		
	Others	84 (75.7)	97 (62.2)				
ED stay	≤6 hr	109 (98.2)	140 (89.7)	6.229 (1.402,27.668)	0.016		
	≥6 hr	2 (1.8)	16 (10.3)				
Inotropes	Yes	102 (91.1)	121 (77.6)	6.836 (3.125,14.958)	.000		
	No	9 (8.1)	35 (22.4)				
Duration of CPR	≤20 min	99 (89.2)	88 (56.4)	6.375 (3.238,12.554)	0.001	5.109 (1.903, 13.708)	0.001
	≥20 min	12 (10.8)	68 (43.6)				
ROSC attained	Yes	110 (99.1)	104 (66.7)	38.653 (12.083, 123.504)	<0.001	27.876 (6.273, 123.902)	<0.001
	No	1 (0.9)	52 (33.3)				
Intubation	Yes	110 (99.1)	130 (83.3)	21.989 (4.888, 98.988)	<0.001		
	No	1 (0.9)	26 (16.7)				

ACS: Acute coronary syndrome, ED: Emergency department, CPR: Cardiovascular and pulmonary resuscitation, ROSC: Return of spontaneous circulation, OR: Odds ratio, CI: Confidence interval

## Discussion

The mean age of the study population (52±17.37 years) and the prominent male predominance (70%) are consistent with demographic trends seen in global cardiac arrest registries (16,17). More critically, the high prevalence of major comorbidities, including diabetes mellitus (44%) and systemic hypertension (42%), signals a patient population with substantial pre-existing cardiovascular risk. This co-morbidity burden is a well-documented driver of poorer outcomes following critical events, complicating successful resuscitation and post-arrest recovery (18).

Hypoxia is the most common reversible cause (43%), underscoring that the primary mechanism of arrest in this setting is often an overwhelming physiological insult rather than a primary electrical event. The high mean respiratory rate (32±9 breaths per minute) and significantly low mean oxygen saturation (81%±17%) at presentation further support this interpretation, suggesting that many patients were in profound respiratory distress immediately prior to arrest.

The observed epidemiological profile of this study cohort, characterized by a staggering prevalence of PEA and asystole

as initial rhythms, strongly reflects the pattern associated with medical-etiology cardiac arrests occurring within the hospital or ED setting, often secondary to respiratory failure or shock these contrasts sharply with the higher incidence of VF typically seen in community-witnessed OHCA (19).

While the achievement of initial ROSC in a high proportion of participants (80%) is technically impressive, the finding that non-sustained ROSC occurred in nearly half of these cases (48%) highlights a crucial challenge. This high rate of hemodynamic collapse in the immediate post-resuscitation phase, leading to an overall mortality rate of 58%, is comparable to international ED-based mortality figures (19,20). It emphasizes that the quality and sustainability of the post-resuscitation state, rather than transient ROSC alone, are the true determinants of survival, necessitating rapid stabilization and targeted post-cardiac arrest care.

The strong conclusions derived from the logistic regression analysis are critical for prognostication and resource allocation. The failure to achieve sustained ROSC emerged as a powerful, independent predictor of mortality, with an OR approaching 28 [OR=27.876 (6.27-123.90), p<0.001] (20). This reaffirms the

necessity of achieving a stable post-resuscitation circulation and serves as a cornerstone criterion used in most guidelines for determining when to terminate resuscitation efforts. Similarly, a prolonged CPR duration (over 20 minutes) was identified as a significant risk factor, multiplying the adjusted odds of mortality by more than fivefold [OR=5.109 (1.903-13.708),  $p=0.001$ ]. This finding supports the clinical doctrine that prolonged resuscitation in the absence of reversible causes often represents efforts directed towards non-reversible underlying pathology (21,22).

Conversely, the observation that a primary diagnosis of ACS demonstrated a protective association [OR=0.132 (0.034-0.509),  $p=0.021$ ] reinforces the established fact that ACS may have appeared protective due to rapid percutaneous coronary intervention availability and the cardiac etiology being more amenable to intervention. We contrasted this with literature reporting higher mortality in ACS, carrying a comparatively higher potential for survival and favorable neurological outcome (19). Furthermore, the finding that early intubation was linked to a markedly improved outcome [OR=21.989 (4.88-98.98),  $p<0.001$ ] is highly relevant given the high rate of hypoxia in this ED population. This result strongly supports an aggressive approach to definitive airway management to correct the most common reversible cause in this specific clinical environment (21-23). However, this positive association must be interpreted within the context of the ED, as the timing of pre-hospital intubation remains a subject of ongoing debate.

Finally, the poor neurological outcome, with only 22 out of 111 sustained ROSC patients achieving a favorable mRS of  $<3$ , underscores the devastating consequence of global cerebral ischemia that characterizes non-shockable rhythms and prolonged low-flow states (18,24-26). This finding emphasizes the critical need for immediate and optimal implementation of high-quality post-cardiac arrest care, including targeted temperature management and meticulous hemodynamic control, to translate sustained ROSC into a meaningful neurological survival.

### Study Limitations

This retrospective study faced challenges, including missing data on variables such as the mode of arrival to the ED and bystander CPR. While it quantifies the overall burden of cardiac arrest and hospital discharge morbidity, it does not fully address long-term morbidity among CPR survivors. Further studies are needed to explore these aspects and enhance the quality of resuscitation to improve the neurological outcome of cardiac arrest survivors.

### Research Implications

Future research should focus on OHCA and emphasize the importance of pre-hospital EMS in improving outcomes.

## Conclusion

This study demonstrates that failure to achieve sustained ROSC and prolonged CPR duration are strong, independent predictors of mortality in IHCA. Early recognition and management of reversible causes, particularly hypoxia combined with timely airway intervention and high-quality chest compressions are essential to improving survival. Although ACS appeared protective in our cohort, this finding highlights the need for further investigation into etiology-specific outcomes.

Strengthening prehospital emergency services and promoting bystander CPR training are vital to ensure early ROSC and better neurological recovery. Future research should extend to long-term outcomes and explore strategies to sustain ROSC beyond the immediate resuscitation phase.

The findings clearly identify the necessity for targeted research to advance pre-hospital resuscitation strategies, aiming to enhance survival rates and neurological outcomes in cardiac arrest patients. Strengthening emergency response systems is essential for better prognosis.

## Ethics

**Ethics Committee Approval:** This study was approved ethics committee approval was obtained from the Institutional Review Board (IRB)/Ethics Committee operating under Christian Medical College Vellore (IRB min no: 0624160, date: 12.06.2024).

**Informed Consent:** This is retrospective study.

## Footnotes

### Authorship Contributions

Surgical and Medical Practices: L.A.J., P.G., G.K.D., V.T.N., Design: L.A.J., P.G., Data Collection or Processing: L.A.J., G.K.D., V.T.N., Analysis or Interpretation: L.A.J., P.G., G.K.D., Literature Search: L.A.J., V.T.N., Writing: L.A.J., P.G., G.K.D.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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