

**Original article:**

**Characteristics and survival rates of patients experience In-hospital cardiac arrest: A retrospective study in a Tertiary care Indian Hospital**

*Porkodi Arjunan<sup>1</sup>, Ramakrishnan Trichur Venkatakrishnan<sup>2</sup>, Shreedevi Gandhamaneni<sup>3</sup>*

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**Introduction:**

Many health care industries worldwide are facing In-hospital cardiac arrest (IHCA) as the leading cause of mortality and investing in treating the patients by code blue team of anesthesia unit.<sup>1</sup> Although there are a number of studies available concentrated mainly on out-of-hospital cardiac arrest (OHCA) very few have focus on IHCA. In the developed countries such as the United States, 200,000 patients experienced cardiac arrest inside the hospital each year<sup>2</sup>. Majority of the studies highlighted the poor prognosis among patients experienced cardiac arrest in the hospital, thereby decreasing the number of patients surviving to hospital discharge between 15 and 20 %<sup>3</sup>. It has been reported that there was no significant difference all over the world in the survival rate to discharge from 1992 to 2005 among patients experienced in-hospital cardiac arrest<sup>4</sup>. The survival rate to hospital discharge has increased from 13.7% during 2000 to 20.7% during 2009 from 374 hospitals as per the 'Get with the guidelines-resuscitation' registry<sup>5</sup>.

One of the indicators of the several research studies carried out to find out the survival rate among the patients experienced IHCA was the in hospital

mortality following IHCA<sup>2-5</sup>. The in-hospital cardiac arrest is one of the preventable conditions when it is detected in advance and initiated the treatment early<sup>6</sup>. Regarding the in-hospital cardiac arrests, some of the ethical issues such as recognizing a cardiac arrest and presence of patient co-morbidity condition lead to medical emergencies<sup>7</sup>.

The definition of incidence of IHCA is based on a systematic review conducted in 41 hospitals involving more than 1 million admissions, happening outside the ICUs of 3.66 per 1000 among adults and 1.14 per 1000 among pediatric patients admitted in the hospitals<sup>8</sup>. Other research findings reported the incidence of cardiac arrest as 45% among adults and 65% among children occur in ICUs<sup>9-10</sup> and one to four arrests per 1,000 patient admissions<sup>11</sup>.

Cardiopulmonary resuscitation is an emergency procedure whereby important measures are carried out among the patients who experience in-hospital cardiac arrest in an attempt to bring back the spontaneous circulation<sup>12</sup>. Numerous research studies revealed that the initial survival rate after cardiopulmonary resuscitation (CPR) among the patients experiencing in-hospital cardiac arrest was

1. Dr. Porkodi Arjunan, M.Sc. Nursing, Ph.D., Reader and HOD, Dept. of Medical Surgical Nursing, Faculty of Nursing, Sri Ramachandra Institute of Higher Education and Research (Deemed to be University), Chennai, India.
2. Dr. Trichur Venkatakrishnan Ramakrishnan, MD, Professor and Head, Department of Emergency Medicine SRIHER (DU), Chennai, India.
3. Dr. Shreedevi Gandhamaneni, Senior consultant, Department of Emergency Medicine, SRIHER (DU), Chennai, India.

**Correspondence to:** Dr. Porkodi Arjunan, RN, RM, Ph.D., Reader and HOD, Department of Medical Surgical Nursing, Faculty of Nursing, Sri Ramachandra Institute of Higher Education and Research (Deemed to be University), Chennai, Tamil Nadu state, India, Email: [porkodi@sriramachandra.edu.in](mailto:porkodi@sriramachandra.edu.in)

up to 50 %. This percentage keeps on decreasing the survival rate during their hospital discharge, ranging from 11 to 37 % with the patients who received successful CPR due to IHCA mostly die before hospital discharge<sup>11,13</sup>.

The cardiac arrest incidence is unexpected in the general wards of the hospital, and the nurse identify it. The nurses have continued to give CPR until the patient gets spontaneous circulation or when the physician terminates the further efforts. Functional outcome after IHCA can be measured using the Cerebral Performance Category (CPC) score.

In the developing countries such as India, very few studies have been conducted to address the IHCA. Therefore, the current study was undertaken retrospectively to assess the characteristics of IHCA and assess the survival rates of patients with cardiac arrest at a tertiary hospital in India.

### **Materials and methods**

This Retrospective explorative study was conducted in Emergency Department of Sri Ramachandra Medical Centre and included all adults above 18 years. Permission was also obtained from the Medical Director and the Head of the Department, Department of Emergency Medicine, Sri Ramachandra Medical centre, and the research team was able to access the medical records only for collecting the data for the study.

Sri Ramachandra Medical centre is one of the biggest tertiary care hospitals situated in the heart of the Chennai city, Tamil Nadu, India. The purpose of this study was to assess the survival rate after in-hospital cardiac arrest, estimate the characteristics of IHCA in Sri Ramachandra Medical centre.

The code blue team that consists of an Emergency medicine physician, Nurse, and Emergency trauma care technician managed the cardiac arrest other than Intensive care unit of Sri Ramachandra Medical Centre. The international standards required an anesthetist to be part of the team and he will be consulted only when the patient is transferred to intensive care unit (ICU). Each cardiac arrest incident used for this study was documented in the register maintained by the emergency department. Using the register, all the patients experienced a code blue event

at Sri Ramachandra Medical Centre were identified. Only the adult patients were included for the study and among them, those who had cardiac arrest in the hospital except in the ICU were included for the study. Patient demographics and clinical variables were identified using the electronic medical record. The details regarding the event were taken directly from the record to determine the outcome, where the data on the following variables were collected; age in years, gender, place of IHCA, first documented heart rhythm. Thereafter, the information on comorbidities was collected by entering the patient's in-patient number in the hospital's electronic patient record. Patients' functional outcome after cardiac arrest was collected using 5-point rating scale of Cerebral Performance Categories Scale (CPC Scale), where CPC- 1-2 meant the patient had good cerebral performance whereas CPC- 3-5 meant the patient had poor cerebral performance.

In the retrospective study, 83 patients who experienced IHCA were included after meeting all the inclusion criteria. A self-reported structured questionnaire was prepared by the research team to assess the patients' socio demographic variables (such as age, gender, diagnosis, comorbid condition, date and time of the arrest noticed, time of EMS activated, presenting cardiac rhythm, duration of CPR, and ABG) from the patients' documents retrospectively from the emergency department.

The data were coded, entered, and analyzed using simple descriptive statistics using Microsoft Excel 2010. Descriptive statistics such as frequency, percentages, mean, and standard deviation were used to report the data.

**Ethical clearance:** The ethics committee of Sri Ramachandra University (IEC-NI/13/AUG /35/62) approved this study.

### **Results**

Out of the 113 study participants, 83(73.45%) adult patients met the study inclusion criteria. A good proportion of the patients was between 56 and 65 years (the mean age 60.85). The majority (71.08%) of the patients was males. CVD were the major diseases diagnosed for this sample and Adrenaline drug was the major drug used for the patients (Table 1).

**Table 1. Distribution of demographic variables (N=83)**

I.	Age in Years	No.	%
a.	<45	8	9.63
b.	46-55	19	22.89
c.	56-65	27	32.53
d.	66-75	17	20.48
e.	76-85	9	10.84
f.	Above 86	3	3.61
II.	Gender		
1.	Male	59	71.08
2.	Female	24	28.91
III.	Pre -existing co morbid condition		
a.	Kidney disease	3	3.61
b.	Respiratory disease	4	4.81
c.	Gastrointestinal dise	6	7.22
d.	Cardiovascular	8	9.63
e.	Liver disease	1	1.20
f.	Neuro disease	2	2.40
IV.	Diagnosis		
GIT		6	7.22
CVS		22	26.50
Kidney		19	22.89
Blood		2	2.40
Respiratory		9	10.84
Reproductive		5	6.02
Neuro		10	12.04
Liver		1	1.20
Ortho		3	3.61
Vascular		3	3.61
Renal		1	1.20
Sepsis		2	2.40

The characteristics of the study participants' in-hospital cardiac arrest event were assessed. Place of cardiac arrest occurred in the ward (40.96%), emergency room (13.25%), and dialysis unit (9.63%). Reasons for hospital admission include cardio (25.30%), Nephro (20.48%), Medicine (19.27%), and neuro(12.04%). Patients 49 (59.03%) had cardiac arrest during the daytime whereas 34 (40.96%) had during the nighttime. Patients 54(65.06%) died before discharging from hospital, 7 (8.43%)

patients were discharged against medical advice, and 22(26.50%) were discharged from hospital. Thirty-eight (45.78%) patients presenting rhythm during cardiac arrest were asystole and 16(19.27%) patients had pulseless electrical activity (PEA) (Table 2).

**Table 2. In-hospital cardiac arrest event characteristics (N=83)**

I.	Place of cardiac arrest	No.	%
	Emergency room	12	14.45
	Ward	59	71.08
	Neuro	4	4.81
	Dialysis unit	8	9.63
II.	Time of day		
	8.00 to 19.59	49	59.03
	20.00 to 7.59	34	40.96
III.	Admission unit		
	Cardio	21	25.30
	Medicine	16	19.27
	Nephro	17	20.48
	Surgery	7	8.43
	Neuro	10	12.04
	Uro	4	4.81
	ER	7	8.43
	OBG	1	1.20
IV.	Outcome		
	Death before discharge	54	65.06
	Against medical advice	7	8.43
	Survival to discharge	22	26.50
V.	Presenting rhythm during arrest		
	Asystole	38	45.78
	Sinus tachycardia	11	13.25
	PEA	16	19.27
	Sinus bradycardia	5	6.02
	VT/VF	13	15.66

The outcome of IHCA has been presented in Table 3. Patients 49 (77%) were intubated following cardiac arrest and connected with mechanical ventilation. Majority 67 (80.72%) received adrenaline and 21(25.30%) bicarbonate as part of the treatment. Majority of the patients 35(42.16%) received CPR for the period between 21 and 40 minutes and 31(37.34%) patients received for the period of 41 to 60 minutes. The CPC score of 76 (91.56%) patients was between 3 and 5.

**Table 3. Outcome of in-hospital cardiac arrest (N=83)**

**Resuscitation Maneuvers**

I.	Intubation	No.	%
	Yes	59	71.08
	No	24	28.91
II.	Bicarbonate		
	Yes	21	25.30
	No	62	74.69
III.	Adrenaline		
	No	16	19.27
	Yes	67	80.72
IV.	Atropine		
	Yes	5	6.02
	No	78	93.97
V.	Treatment		
	Adrenaline	67	80.72
	Bicarbonate	21	25.30
	Atropine	5	6.02
	Dopamine	6	7.22
	Epsolin	1	1.20
	Ca gluconate	12	14.45
	Amiodarrone	4	4.81
VI.	Total time of CPR in minutes		
	0-20	7	8.43
	21-40	35	42.16
	41-60	31	37.34
	61-80	7	8.43
	>80	3	3.61
VII.	Neurological outcome		
	CPC 1-2	7	8.43
	CPC 3-5	76	91.56

**Discussion**

Most of the patients who received successful CPR after in-hospital cardiac arrest died before hospital discharge. In the current study, patients who had in-hospital cardiac arrest were male members between the age group of 56 and 65 years. This suggests that in future the prevalence of in-hospital-cardiac-arrest will increase among the elderly patients with significant comorbidities. Our data demonstrate that majority of the patients were admitted in the hospital for cardiovascular disease or renal disease and were diagnosed to have pre-existing comorbid

disease conditions such as cardiovascular disease and Gastrointestinal disease. This is similar as the other larger retrospective research study conducted by<sup>14</sup> found that cardiac arrest causes to be the culprit in approximately two-third of patients. Similarly, *Khrystyna et al (2018)*<sup>23</sup> reported that cardiovascular diseases were important causes for mortality and morbidity in the elderly. In contrast, another study found that the most common underlying disease was malignancy (114 cases, 48%)<sup>15</sup>.

*Characteristics of an event of in-hospital cardiac arrest*

The current study found that most of the patients had in-hospital-cardiac-arrest in the ward especially during the daytime. Most of the patients died after cardiac arrest before discharge from the hospital and only less than one-third of patients could survive to discharge. Compared to other studies conducted among the patients who survived to hospital discharge, 21 (46.7%) had favourable neurologic status<sup>16</sup>. The research reported that the major causes of IHCA were cardiac causes and hypoxia<sup>17</sup>.

Regarding the survival rate after in-hospital cardiac arrest, 59 (71.08%) patients died after cardiac arrest and 25 % of the study participants survived upto hospital discharge. This is comparatively greater compared to the larger research studies<sup>17</sup>. The chances of survival-to-discharge were 15–20% when CPR was initiated with in-hospital; while out-of-hospital, the CPR chances were even lower rate of survival-to-discharge (5–10%)<sup>18-20</sup>.

We found that the major causes of in-hospital cardiac arrest were cardiovascular and renal diseases. This is supported by the studies conducted at the St. Olav University hospital (SUH) where it was found that the causes of IHCA were dominated by cardiac causes and hypoxia. The study conducted in Asan Medical Center, affiliated to the tertiary care hospital, Seoul, South Korea found that the immediate causes of the IHCAs were the non-cardiac causes. The common non-cardiac cause was acute respiratory insufficiency (40 cases, 16.7%) and the common cardiac cause was pulseless ventricular tachycardia/fibrillation (29 cases, 12.2%).

These results are comparable with other studies. When compared to women, the middle-aged men have more incidence of OHCA. The majority of the male patients had no survival advantage<sup>21</sup>. The investigator<sub>R</sub> reported that women had lower survival rate than men (1.7% vs. 3.2%; OR = 0.55, 95% CI = 0.41 to 0.72)<sup>22</sup>.

The researchers have identified that the presenting rhythm during the in-hospital cardiac arrest was asystole and pulseless electrical activity. This is not very different from PEA or asystole was the first documented rhythm in 71% of episodes. In a study reported that the witnessed cases had pulseless electrical activity as the first documented rhythm whereas the non-witnessed patients had Asystole as the first documented rhythm<sup>15,17</sup>.

#### *Outcome of In-hospital cardiac arrest*

The researchers found it encouraging that emergency medical service was activated immediately and initiated CPR on an average within one minute. The CPR was continued for an average of 22.3 minutes. The results revealed that most of the patients were transferred to ICU, intubated, and connected with ventilator. Almost three-fourth of patients had received CPR immediately following the cardiac arrest. Our data demonstrate that patients were treated with adrenaline, atropine, and or bicarbonate soon after the cardiac arrest.

#### ***Strength of the study***

The strength of the study is that the functional outcome was measured using the Cerebral Performance Category score following the IHCA. Additionally, the study documented and reported the survival rates of the in-hospital cardiac arrests. This information is useful for the organization to evaluate itself if the code blue team may require reconstitution to match with the international standards.

Future studies are needed to evaluate the gender difference in the survival outcome after successful cardiopulmonary resuscitation.

#### **Limitation**

First, the study is based on a single centre, which limits the generalizability of the results. Second, because of a retrospective study design, many risk factors influencing the outcome have not been included in the analysis. Third, the quality of CPR and the treatment protocol were not measured against the standard guidelines.

#### **Implications to practice**

Care after the cardiac arrest is very important for the survival of the patients thereby appropriate patients' need to be shifted to Intensive care unit for higher level care irrespective of the place where the patients

experience arrest. The emergency department can take initiative to establish a unit where all the patients who had outside hospital cardiac arrest or IHCA can be shifted to this unit for further care. The emergency department can consider adding an anesthetist in the code blue team as well as revising the policy for the team who provides care after arrest. The nurses should be trained adequately to identify the cardiac arrest in advance and prevent the incidents of in hospital cardiac arrest. The incidence of arrest can be documented in the patient chart and the details of outcome of CPR following arrest.

#### **Implications to research**

A research study can be undertaken to assess the pre arrest disease condition and parameters contributing for the cardiac arrest thereby the incidence of in-hospital cardiac arrest can be prevented. Future studies are needed to evaluate the gender difference in the survival outcome after successful cardiopulmonary resuscitation.

A follow up study can be done among the survivors to assess their quality of life.

#### **Conclusion**

Early recognition of in-hospital cardiac arrest may provide an opportunity for the health care provider for clinical intervention. The institution can initiate in preparing the legislation on 'Do not resuscitate' orders to minimize the unsuccessful CPR.

**Conflict of interest:** Nil

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#### **Authors's contribution:**

Data gathering and idea owner of this study: .Dr. Porkodi Arjunan

Study design: ... Dr. Trichur Venkatakrishnan Ramakrishnan

Data gathering: .... Dr. Shreedevi Gandhamaneni  
Writing and submitting manuscript: .... Dr. Porkodi Arjunan

Editing and approval of final draft: ... Dr. Porkodi Arjunan

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