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Original Research Article

Clinical outcome of in-hospital cardiac arrest: An observational study in Indian setting

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ABSTRACT

Introduction: The studies on In-Hospital Cardiac Arrest are limited by the fact that most of them are carried out for patient admitted in ICU. Particularly for ward patients, there lies a big void in literature and hence this research study was undertaken in order to study the clinical outcome of in-hospital cardiac arrest for the patients admitted in ward.

Materials and Methods: A hospital based observational study among 119 patients was undertaken to evaluate the clinical outcome of In-Hospital cardiac arrest in patients presented to Deenanath Mangeshkar Hospital & Research Centre, Pune over a period of 2 years.

Results: Male to female ratio of cardiac arrest patients was 1.8:1 with higher incidence in age group 61-70 years (28.6%). 44 patients that were admitted in ward in first place, 25% (11 patients) survived 24 hours post resuscitation and a total of 4 patients were discharged from the hospital. Rest 75 patients required ICU admission initially and were later sent to ward where they sustained a cardiac arrest. 24 patients (32%) from this group survived 24 hours post cardiopulmonary resuscitation and 12 patients (16%) were discharged from the hospital later.Out of 119 patients, 55.5% patients had revival immediately post resuscitation and 44.5% patients died post resuscitation.

Conclusion: Patient with shockable initial rhythm on monitor had better outcomes than non-shockable rhythm so early defibrillation is advised in shockable rhythm. Of all the patients who had a cardiac arrest, those with cardiac causes and electrolytes disturbance as a preceding cause of arrest had a better outcome.

1. Introduction

The acute and unexpected event of In-hospital cardiac arrests (IHCAs) poise a great challenge to any medical practitioner. The outcomes in cases of IHCAs remains poor to such an extent that resuscitation might not be even warranted. Data from the western countries have reported the incidence of IHCA to be 0.78 to 4.60 per 1000 admissions and even the mortality stats are also staggering as deaths reported in such studies are high despite the high-quality cardiopulmonary resuscitation (CPR).[1–7] Due to recent trend in healthcare technology, hospital discharge rate has improved and has been reported to be around 25% in USA and even upto 35% in UK.[5,8,9] The only positive thing that has been reported over the past 20 years about the IHCA is the improvement in the long-term survival of these patients and even the good functional outcomes after one year stands at round 13% for IHCA survivors.[10]

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Survival of the patient with good neurologic outcomes, functional status post arrest and discharge rates depends on multiple variables in terms of affected populations, onset of resuscitation efforts, proximity of trained providers, quality of resuscitation efforts by EMS or other trained personnel. Post arrest care is the common factor irrespective of IHCA or Out-of-hospital cardiac arrest (OHCA) and happens only within hospital setting. The fundamental goal of post-arrest care is to identify and control factors that precipitated the arrest, improve the probability of favourable neurologic recovery and outcomes, and minimise the consequences of cardiac arrest-associated injury and tissue damage. Studies have shown that with proper co-ordination alongside high-quality and comprehensive post-resuscitation care, favourable neurologic outcome can be obtained in terms of survival-to-hospital discharge rate in IHCAs.[11]

IHCA & OHCA has been studied extensively in various parts of the world. But all the studies were done for patient admitted in ICU. Particularly for ward patients, there lies a big void in literature and hence this research study was undertaken in order to study the clinical outcome of in-hospital cardiac arrest for the patients admitted in ward. The main objectives of the study are as follows:

1. To determine occurrence of cardiac arrest in hospitalized patients.
2. To determine percentage of successful resuscitation (patient alive after 24 hrs of resuscitation) after cardiac arrest in non ICU area.
3. To determine outcome of hospitalised patient who had cardiac arrest in non ICU area.

2. Materials and Methods

2.1. Type of study & study site

A hospital based observational study was undertaken to evaluate the clinical outcome of In-Hospital cardiac arrest in patients presented / referred to Deenanath Mangeshkar Hospital and Research Centre, Erandawane, Pune- 411004.

2.2. Study population

The study population included 119 patients admitted to Deenanath Mangeshkar Hospital wards (Non ICU Area); fulfilling the below mentioned inclusion and exclusion criteria.

2.3. Inclusion criteria

1. All Adult patients (age >18 years) who had suffered cardiac arrest when admitted in DM hospital wards.
2. Patient with written informed consent by patient/guardian.

2.4. Exclusion criteria

1. Out of hospital cardiac arrest adult patients brought to hospital Emergency Room.
2. ICU and operation theatre (OT) cardiac arrests.
3. Pregnant patients.

2.5. Study period

The Study was conducted from May 2015 to March 2017.

2.6. Method of study

A predesigned, self-administered proforma was designed keeping the objectives of the study at the centre point. In the construction of the proforma, utmost care was taken to make it broad based, so that all the aspects desired to be studied could be incorporated in its body. Demographic information of the participants including age, sex, personal medical history, initial rhythm on the defibrillator, and other related comorbidities like hypertension, diabetes, chronic obstructive pulmonary disease (COPD), Ischaemic heart disease (IHD), H/o previous cardiac arrest were recorded. Probable cause of cardiac arrest was identified. At Deenanath Mangeshkar Hospital, we have a code blue team to attend to hospitalised patients in non ICU area who suffer a cardiac arrest or who become acutely ill. Emergency department is a part of code blue team in our Hospital. Treatment was administered according to the ACLS (Advanced Cardiac Life Support) guidelines given by the American Heart Association 2015. Therapeutic hypothermia was achieved with cold saline and cold blankets.

2.7. Statistical analysis

The data was collected using a predesigned template which was filled by the concerned physician involved in the immediate treatment of the patient. The collected data variables obtained was compiled by using an excel spreadsheet. Categorical variables like gender, risk factor history like smoking, comorbidities, etc were presented in frequencies and percentages. After appropriate data filtration, the data sheet was transferred and analysed using SPSS (Statistical Package for social sciences) Version 20:0. Comparison and association between qualitative parameters was done using Pearson Chi-square test & Fischer Exact test. $P<0.05$ value was considered statistically significant.

2.8. Subject confidentiality & consent

Informed consent was obtained from the subjects to enrol them in the study and was submitted for the ethical committee clearance. All the patient specific data was kept in strict confidence.

2.9. Financial inputs and funding

All the study related procedures and investigations were done according to the institutional protocol for the patient management. All these expenses were borne by the patient himself/herself. Also this study was not being sponsored by any pharmaceutical company.

3. Results

In our study, there were 75 male patients (63%) and 44 female patients (37%). Male to female ratio of occurrence of cardiac arrest was 1.8:1 with no significant (p>0.05) difference. The probable cause of arrest was cardiac in 46 (38.7%) patients while it was non-cardiac in 73 (61.3%) patients. Out of 46 patients with cardiac cause of arrest, 54.3% were recovered while 45.7% died. Similarly, in 73 patients with non-cardiac cause of arrest, 56.2% were recovered while 43.8% succumbed. In female patients 61.4% had non cardiac cause and 38.6% had cardiac cause of arrest. While within male patients 61.3% had cardiac cause while 38.7% had non cardiac cause of arrest. More than 50% of the patients who had a cardiac arrest belonged to 61 to 80 years of age. As well as 8.4% patients less than 40 years age group had also developed cardiac arrest. There was statistically no significant (p>0.05) difference of cause of cardiac arrest in between the sex of patients and different age groups. The initial rhythm on monitor was asystole for 106 (89.08%) patients, 6 (5.04%) patients each had pulseless electric activity and ventricular tachycardia and only 1 (0.84%) had ventricular fibrillation. Out of 119 patients, 66 (55.5%) patients had revival immediately post resuscitation and 53 (44.5%) patients died post resuscitation. There was statistically no significant (p>0.05) difference of the mortality outcome in the between cardiac and non-cardiac cause of arrest. Out of 119 patients, 7 patients had a shockable rhythm (pulseless VT or VF) and 6 patients out of them survived immediate post resuscitation and 5 patients survived at discharge. While 112 patients had non-shockable initial rhythm and only 60 patients out of them survived immediate post resuscitation; 29 patients survived 24 hours' post-resuscitation and only 11 patients survived at discharge.

4. Discussion

The prospective observational hospital based study was carried out at Deenanath Mangeshkar hospital, Pune on 119 patients to ascertain the clinical outcome of in-hospital cardiac arrest. We also studied associated factors like age, sex, cause of arrest either cardiac or non-cardiac, any comorbidity, time since arrest, initial rhythm on monitor at the start of resuscitation & probable cause of arrest. Successful resuscitation was measured at 24 hours after the episode and at the time of discharge. The patient revived after resuscitation received therapeutic hypothermia. Out of

Table 1: Baseline & clinical characteristics of the subjects.

Variable	Number of patients	Percentage (%)
Gender		
Male	75	63.0
Female	44	37.0
Age group (years)		
≤ 30	5	4.2
31 - 40	5	4.2
41 - 50	9	7.6
51 - 60	14	11.8
61 - 70	34	28.6
71 - 80	30	25.2
> 80	22	18.5
Place of Admission		
Primarily in ward	44	37
ICU to Ward	75	63
Rhythm at Cycle 1		
ASYSTOLE	106	89.08
PEA	6	5.04
V Tach	6	5.04
VFIB	1	0.84
Probable Cause of arrest		
Cardiac	46	38.7
Non cardiac	73	61.3

Table 2: Comparison of Age groups with gender of the study subjects.

Age group (years)	Gender		Total
	Female	Male	
≤30	2	3	5
	4.5%	4.0%	4.2%
31 - 40	1	4	5
	2.3%	5.3%	4.2%
41 - 50	5	4	9
	11.4%	5.3%	7.6%
51 - 60	8	6	14
	18.2%	8.0%	11.8%
61 - 70	9	25	34
	20.5%	33.3%	28.6%
71 - 80	15	15	30
	34.1%	20.0%	25.2%
> 80	4	18	22
	9.1%	24.0%	18.5%
Total	44	75	119
	100.0%	100.0%	100.0%

Chi-Square test: X^2 value = 11.542, p value = 0.073

Table 3: Comparison of cause of arrest in both genders.

Gender	Probable Cause of arrest	
	Cardiac	Non Cardiac
Female	17	27
	38.6%	61.4%
Male	29	46
	38.7%	61.3%
Total	46	73
	38.7%	61.3%

Fischer Exact test: χ^2 =0.001, p value = 0.997

Table 4: Comparison of cause of arrest across different age groups.

Age group (years)	Probable Cause of arrest	
	Cardiac	Non cardiac
≤30	1	4
	20.0%	80.0%
31 - 40	2	3
	40.0%	60.0%
41 - 50	1	8
	11.1%	88.9%
51 - 60	5	9
	35.7%	64.3%
61 - 70	19	15
	55.9%	44.1%
71 - 80	10	20
	33.3%	66.7%
> 80	8	14
	36.4%	63.6%
Total	46	73
	38.7%	61.3%

Chi-Square test: X^2 value = 8.330, p value = 0.215

Table 5: Comparison of outcome with the cause of arrest.

Variables	Cause of arrest		Total	Significance
	Cardiac	Non Cardiac		
Immediate Outcome				
Alive	25	41	66	χ^2
	54.3%	56.2%	55.5%	=0.038, p
Died	21	32	53	value =
	45.7%	43.8%	44.5%	0.852
Outcome after 24 hours Post resuscitation				
Alive	15	20	35	χ^2
	32.6%	27.4%	29.4%	=0.369, p
Died	31	53	84	value =
	67.4%	72.6%	70.6%	0.543
Outcome at discharge				
Discharge At Home	8	8	16	χ^2
	17.4%	11.0%	13.4%	=1.003, p
Died	38	65	103	value =
	82.6%	89.0%	86.6%	0.317

Table 6: Therapeutic Hypothermia Post resuscitation

Hypothermia	Number of patients	Percentage (%)
Present	66	55.5
Absent	53	44.5
Total	119	100.0

Table 7: ROSC: Shockable versus non-shockable rhythm: Immediate after post resuscitation

Rhythm on Monitor	ROSC	No ROSC	Total
Shockable Rhythm	6 (85.7%)	1(14.3%)	7(100%)
Non-Shockable Rhythm	60 (53.6%)	52(46.4%)	112(100%)

Table 8: ROSC: Shockable versus Non-shockable rhythm.

Variable	Survived	Not survived	Total
Survival at 24 hours			
Shockable Rhythm	6 (85.7%)	1(14.3%)	7(100%)
Non-Shockable Rhythm	29 (25.9%)	83(74.1%)	112(100%)
Survival at Discharge			
Shockable Rhythm	5(71.4%)	2(28.6%)	7(100%)
Non-Shockable Rhythm	11(9.8%)	101(90.2%)	112(100%)

Table 9: Comparison of immediate outcome with code blue activation time.

Time since Code Blue Activation and code blue team arrival	Immediate Outcome	
	Died	Alive
1 minute	2	7
	22.2%	77.8%
2 minute	21	36
	36.8%	63.2%
3 minute	28	20
	58.3%	41.7%
4 minute	1	2
	33.3%	66.7%
5 minute	1	1
	50.0%	50.0%
Total	53	66
	44.5%	55.5%

Chi Square test: χ^2 =7.056, p value = 0.133

Table 10: Comparison of 24 hours post resuscitation outcome with code blue activation time.

Time since Code Blue Activation and code blue team arrival	Outcome after 24	
	Died	Alive
1 minute	5	4
	55.6%	44.4%
2 minute	37	20
	64.9%	35.1%
3 minute	38	10
	79.2%	20.8%
4 minute	2	1
	66.7%	33.3%
5 minute	2	0
	100.0%	.0%
Total	84	35
	70.6%	29.4%

Chi Square test: χ^2 =4.421, p value = 0.352

Table 11: Comparison of outcome at discharge with code blue activation time.

Time since Code Blue Activation and code blue team arrival	Outcome	
	Died	Discharge At Home
1 minute	7	2
	77.8%	22.2%
2 minute	46	11
	80.7%	19.3%
3 minute	45	3
	93.8%	6.2%
4 minute	3	-
	100.0%	-
5 minute	2	-
	100.0%	-
Total	103	16
	86.6%	13.4%

Chi Square test: χ^2 =5.186, p value = 0.269

119 patients, 44 patients were female (37%) and 75 patients were male (63%) and male to female ratio of cardiac arrest patients was 1.8:1. 4.2% belonged to the age group <30 years, 4.2% patients belonged to the age group 31-40 years. 7.6 % patients had age 41-50 years. 11.8% patients were in the age group 51-60 years. 28.6% patients were in the age group 61-70 years of age. 25.2% patients were in the age group of 71-80 years. 18.5% patients were in the age group >80 years.

Cardiac arrest remains one of the most unexpected, dramatic, and life-threatening events in medicine. The most common electrical mechanism recorded previously for sudden cardiac arrest was ventricular fibrillation or pulseless sustained ventricular tachycardia. These were the initial rhythm recorded in 60-80% cardiac arrests, with ventricular fibrillation being the far more common of the two. Currently asystole has emerged as the most common mechanism recorded at initial contact (45-50% of cases) followed

Table 12: Probable Causes of cardiac arrest in the study group.

Type	Probable Cause of arrest	Within the cause	Total Cardiac arrest patients
Cardiac	1. Acute Coronary Syndrome & amp;/ Acute Decompensated Heart Failure	29(63.0%)	29(24.4%)
	2. Cardiac Arrythmia	7(15.2%)	7(5.9%)
	3. Ischemic or Dilated Cardiomyopathy	3(6.5%)	3(2.5%)
	4. Aortic Stenosis and LV dysfunction	2(4.3%)	2(1.7%)
	5. Peripartum Cardiomyopathy	2(4.3%)	2(1.7%)
	6. Sudden Cardiac Death	2(4.3%)	2(1.7%)
	7. Aortic Dissection with LV dysfunction	1(2.2%)	1(0.8%)
Non cardiac	1. Aspiration Pneumonia	29(39.7%)	29(24.4%)
	2. Sepsis	14(19.2%)	14(11.8%)
	3. Hyperkalemia	7(9.6%)	7(5.9%)
	4. End Stage Renal Disease	5(6.8%)	5(4.2%)
	5. Pulmonary Embolism	4(5.5%)	4(3.4%)
	6. Chronic Liver Failure	3(4.1%)	3(2.5%)
	7. Respiratory Arrest other than Aspiration	3(4.1%)	3(2.5%)
	8. Hypoglycemic arrest	2(2.7%)	2(1.7%)
	9. Intracranial Hemorrhage	2(2.7%)	2(1.7%)
	10. Metabolic Encephalopathy	1(1.4%)	1(0.8%)
	11. Hypoxic Ischemic Brain Injury	1(1.4%)	1(0.8%)
	12. Shock	1(1.4%)	1(0.8%)
	13. TB Meningitis with multi-organ failure	1(1.4%)	1(0.8%)

Table 13: Cause of arrestin patients that survived immediate after resuscitation.

Probable cause of cardiac arrest	Survived
Aspiration Pneumonia	17
Acute Coronary Syndrome &/ Acute Decompensated Heart Failure	15
Cardiac Arrhythmia	7
Sepsis	6
Hyperkalemia	5
Pulmonary Embolism	3
Chronic Liver Failure	2
Peripartum Cardiomyopathy	2
End Stage Renal Disease	1
Hypoglycemic arrest	1
Hypoxic Ischemic Brain Injury	1
Intracranial Hemorrhage	1
Ischemic or Dilated Cardiomyopathy	1
Metabolic Encephalopathy	1
Respiratory Arrest other than Aspiration	1
Shock	1
TB Meningitis with multiorgan failure	1
Total	66

Table 14: Cause of Arrest in patients that survived at 24 hours.

Probable cause of cardiac arrest	Survived
Acute Coronary Syndrome &/ Acute Decompensated Heart Failure	6
Aspiration Pneumonia	8
Cardiac Arrhythmia	6
Hyperkalemia	4
Hypoglycemic arrest	1
Hypoxic Ischemic Brain Injury	1
Intracranial Hemorrhage	1
Ischemic or Dilated Cardiomyopathy	1
Peripartum Cardiomyopathy	2
Pulmonary Embolism	2
Respiratory Arrest other than Aspiration	1
Sepsis	1
Shock	1
Total	35

Table 15: Cause of Arrest in patients that survived at discharge.

Probable cause of cardiac arrest	Discharged
Acute Coronary Syndrome &/ Acute Decompensated Heart Failure	3
Aspiration Pneumonia	2
Cardiac Arrhythmia	5
Hyperkalemia	3
Hypoglycemic arrest	1
Pulmonary Embolism	1
Respiratory Arrest other than Aspiration	1
Total	16

by pulseless electrical activity and ventricular fibrillation. Undoubtedly, a significant proportion of the asystole cases began as ventricular fibrillation and deteriorated to asystole because of long response times, but there are data suggesting an absolute reduction in ventricular fibrillation as well. Similar incidence reflects in our study too. We had 106 patients (89.08%) with an asystole as initial rhythm on monitor, 6 patients (5.04%) each for pulseless electric activity and ventricular tachycardia respectively & 1 patient (0.84%) had ventricular fibrillation.

Survival rate and neurological recovery of the patient vary widely, depending on whether an arrest was witnessed or unwitnessed and the initial cardiac rhythm during resuscitation. Patients found in a shockable rhythm have a much better prognosis if they are defibrillated early. In overall terms, the prognosis among patients found in a non-shockable rhythm is very poor. In our study, 7 patients had shockable rhythm & 112 patients had non-shockable rhythm. Immediately after resuscitation 6 (85.7%) out of 7 patients who had shockable rhythm survived and 60 (53.6%) out of 112 patients survive who had non-shockable rhythm reflecting (71.43%) patient with shockable initial rhythm had better outcome than patient with non-shockable rhythm (9.8%).

Even among patients with successful return of spontaneous circulation (ROSC) who are admitted to an intensive care unit, survival until hospital discharge has historically been less than 10% as suggested from a recent data pointing towards a steady improved survival of the patients. In our study, 5 (71.43%) out of 7 patients discharged had shockable rhythm and 11 (9.8%) out of 112 patients were discharged who had non-shockable rhythm.

Improvement in the survival rate and neurological outcomes of patients with cardiac arrest have focused on 2 principal areas of treatment. The first is increased education to improve immediate post- Cardiac arrest perfusion via national efforts promoting the 4 links in the chain of survival that include early access to emergency medical care, early cardiopulmonary resuscitation, early defibrillation, and early advanced cardiac life support. The second area is greater emphasis on post-resuscitation care, which includes optimising oxygenation and ventilation, avoiding hypotension (systolic blood pressure <90 mm Hg), treating immediate precipitants of Cardiac arrest such as acute coronary ischemia, and initiating Therapeutic Hypothermia (TH) when appropriate. The American Heart Association, the International Liaison Committee of Resuscitation, and the European Resuscitation Council recently published guidelines and recommendations covering the entire spectrum of post-resuscitation care. This review focuses on the practical aspects of implementing TH, one of the key therapeutic procedures in post-resuscitation care.

TTM which was previously called therapeutic hypothermia is the only intervention that has been shown

to improve neurological outcomes after cardiac arrest. Induced hypothermia should occur soon after ROSC (return of spontaneous circulation). The decision point for the use of therapeutic hypothermia is whether or not the patient can follow commands (Lack of meaningful response to verbal commands). One of the most common methods used for inducing therapeutic hypothermia is a rapid infusion of ice-cold (4° C), isotonic, non-glucose-containing fluid to a volume of 30 ml/kg. The optimum temperature for therapeutic hypothermia is 32-36 ° C (89.6 to 96.8 °F). A single target temperature, within this range, should be selected, achieved, and maintained for at least 24 hours.

During induced TTM, the patient's core temperature should be monitored with any one of the following: oesophageal thermometer, a bladder catheter in the non-anuric patients, or a pulmonary artery catheter if one is already in place. In our study, therapeutic hypothermia was achieved with cold saline and cold blankets. Total of 66 patients (55.5%) out of 119 received therapeutic hypothermia.

Of all the 119 patients who required cardiopulmonary resuscitation, 44 patients were ward admissions in first place. Out of these 44 patients, 25% (11 patients) survived 24 hours post resuscitation and a total of 9% (4 patients) were discharged from the hospital and sent home later. Rest 75 patients required ICU admission initially and were later sent to ward where they sustained a cardiac arrest. 24 patients (32%) from this group survived 24 hours post cardiopulmonary resuscitation and 12 patients (16%) were discharged from the hospital later. From above figures, it is evident that patients who had ICU admission initially had slightly higher incidence of survival at 24 hours post cardio pulmonary resuscitation compared to those who were admitted directly in the ward. Also the incidence of Hospital discharges was slightly better in the patients who required ICU admission initially and later sent to ward where they suffered a cardiac arrest and provided cardiopulmonary resuscitation. Our observations are also limited by the fact that we couldn't recognise exact time period between arrest of patient and activation of code blue. The study is based on a single centre, which limits the generalizability of the results. Many risk factors influencing the outcome have not been included in the analysis. Also, many opted for non-escalation of treatment in view of age and multiple comorbidity. Moreover, the quality of CPR and the treatment protocol were not measured against the standard guidelines.

5. Conclusion

Outcome of in-hospital cardiac arrest patient depends on effectiveness of cardiopulmonary resuscitation, Post ROSC (Return of spontaneous circulation) aggressive hypothermia and other post resuscitation care. Poor outcomes have been seen to be due to multiple co-morbidities and delayed recognition of cardiac arrest. Patient with shockable initial rhythm on monitor had better outcomes than non-shockable, so early defibrillation is advised in shockable rhythm all over world in every protocols. Of all the patients who had a cardiac arrest, those with cardiac causes and electrolytes disturbance as a preceding cause of arrest had a better outcome.

6. Conflict of Interest

There are no conflicts of interest in this article.

7. Source of Funding

None.

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