

Original Article

Out of hospital cardiac arrest resuscitation outcome in North India — CARO study

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BACKGROUND: To evaluate the outcome of cardiopulmonary resuscitation (CPR) in out-of-hospital cardiac arrests (OHCA) in India and factors influencing the outcome.

METHODS: The outcome and related factors like demographics, aspects of the OHCA event, return of spontaneous circulation (ROSC) and survival to discharge, among the 80 adult patients presenting to emergency department experiencing OHCA considered for resuscitation between January 2014 to April 2015, were analyzed, according to the guidelines of the Utstein consensus conference.

RESULTS: The survival rate to hospital admission was 32.5%, the survival rate to hospital discharge was 8.8% and with good cerebral performance category (CPC1) neurological status was 3.8%. Majority of OHCA was seen in elderly individuals between 51 to 60 years, predominately in males. Majority of OHCA were witnessed arrests (56.5%) with 1.3% bystander CPR rate, 92.5% arrests occurred at home, 96% presented with initial non-shockable rhythm and 92.5% with presumed cardiac etiology but survival was better in those who experienced OHCA at public place, in witnessed arrests, in patients who had shockable presenting rhythm and in those where CPR duration was ≤ 20 minutes.

CONCLUSION: Witnessed arrests, early initiation of CPR by bystanders, CPR duration ≤ 20 minutes, initial presenting shockable rhythm, OHCA with non-cardiac etiology are associated with a good outcome. To improve the outcome of CPR and the low survival rates after an OHCA event in India, focused strategies should be designed to set up an emergency medical system (EMS), to boost the rates of bystander CPR and education of the lay public in basic CPR.

KEY WORDS: Out-of-hospital cardiac arrest; Cardiopulmonary resuscitation; Survival to discharge; Shockable rhythm; Bystander CPR; Witnessed arrest; CPR duration; Cardiac etiology

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INTRODUCTION

Out of hospital cardiac arrest (OHCA) is one of the leading cause of death in India. There are very few studies in India, on the outcome after cardiopulmonary resuscitation (CPR) in patients with OHCA. However, due to lack of pre-medical emergency service system (EMS), lack of EMS protocols, limited medical resources and equipment, inadequate infrastructure, lack of emergency medical personnel training, lack of knowledge and skills of CPR among bystanders and in the community; the outcome of OHCA in India will be poor, as compared to

western countries, where EMS systems are an integral part of the health care system, which routinely provides CPR to every victim of cardiac arrest (CA).^[1]

So the ultimate goal of this study is to collect data on outcome of CPR in patients with OHCA, factors influencing the outcome and to identify the strong predictors of these outcomes, which is the need of the hour, to help administrators and medical directors, identify the changes to be made to optimize system interventions and improve CA outcomes. Since this study focuses on outcome of resuscitation in cardiac arrests,

so it has been coined as Cardiac Arrest Resuscitation Outcome (CARO) study.

METHODS

This study was conducted at Department of Emergency Medicine of a multispecialty urban hospitals; well equipped with 24-hour state of the art Emergency Facilities with Ambulance Services & Intensive care units. With institutional approval, all adult patients above the age of 18 years, who suffered out-of-hospital cardiac arrests (OHCA) between January 2014 to April 2015, were taken in this study. A total of 80 cardiac arrests were identified.

Exclusion criteria

Patients under the age of 18 years or with obvious signs of death (e.g., rigor mortis or dependent lividity) or experiencing CA in the hospital setting were excluded from the study.

Using a CPR Performa and the flow chart given below, information was collected on (Figure 1): (1)

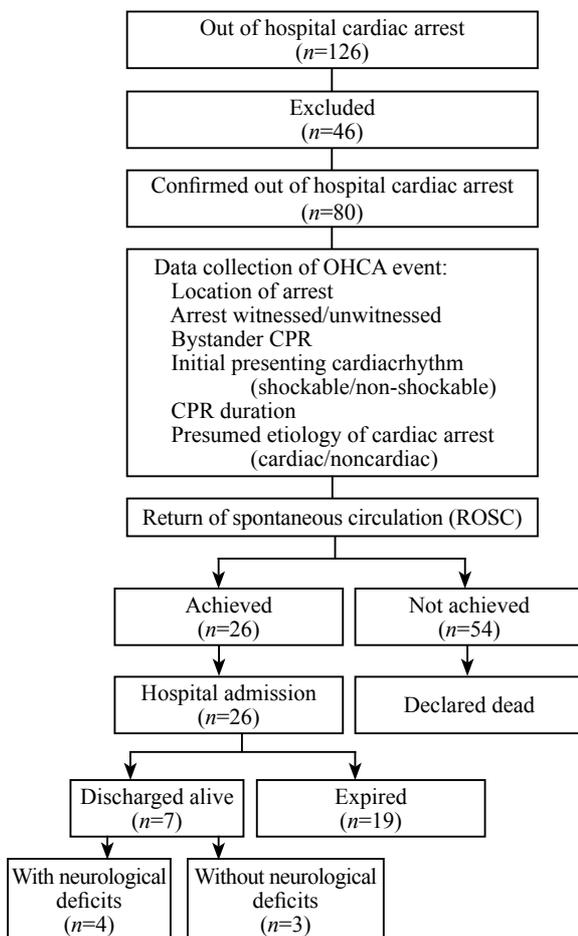


Figure 1. Flow chart of study design.

age, sex, co-morbid conditions and location of CA; (2) whether the arrest was witnessed or not; (3) who initiated CPR (bystander); (4) initial presenting cardiac rhythm (shockable or non-shockable); (5) whether there was a return of spontaneous circulation (ROSC); (6) probable etiology of CA; (7) whether the patient survived to discharge; (8) whether the patient was discharged with or without any neurological deficits.

Data collection

All the data from patients were analysed according to the guidelines of the Utstein consensus conference (Utstein-style definitions).^[2]

Out of hospital cardiac arrest (OHCA)

An OHCA was defined as cessation of cardiac mechanical activity, confirmed by the absence of signs of circulation (no central pulsation, unresponsiveness, and apnea or agonal, gasping respirations)^[3] and that occurs outside of a hospital setting

Location of arrest

Location of arrest was the specific location where the event occurred or the patient was found: place of residence (e.g., home, apartment, back yard of a home); public place (e.g., street, city park, shopping center, sports stadium, entertainment center, airport, railway station, church); others (e.g., hotel room, private office).

Bystander CPR

Bystander CPR was CPR performed by a person who is not responding as part of an organized emergency response system approach to a cardiac arrest. Physicians, nurses, and paramedics may be described as performing bystander CPR if they are not part of the emergency response system involved in the victim's resuscitation.

First monitored rhythm

The first monitored rhythm was the first cardiac rhythm present when a monitor is attached to a patient after CA.

Shockable/non-shockable rhythm

Shockable/non-shockable rhythm was referred to the first monitored rhythm, which when analyzed by the person interpreting the monitor was found to be treatable by attempted defibrillation (i.e., shockable or non-shockable). In general, shockable CA rhythms were further divided into ventricular fibrillation and pulseless ventricular tachycardia. Non-shockable CA rhythms

was categorized as either asystole or pulseless electrical activity (PEA).

Return of spontaneous circulation (ROSC)

ROSC was intended to represent a brief (approximately >30 seconds) restoration of spontaneous circulation that provides evidence of more than an occasional gasp, occasional fleeting palpable pulse, or arterial waveform.

End of event

A resuscitation event is deemed to have ended when death is declared or spontaneous circulation is restored and sustained for 20 minutes or longer.

Survived event to hospital admission

"Survived event" for the OHCA means sustained ROSC with spontaneous circulation until admission and transfer of care to the ICU staff.

Cause of arrest (etiology)

A probable etiology of CA was judged by analyzing the circumstances leading to the event and the patient's past medical history. An arrest was presumed to be of cardiac etiology unless it is known or likely to have been caused by trauma, submersion, drug overdose, asphyxia, exsanguination, or any other non-cardiac cause as best determined by rescuers.

Date of discharge/death

The date of discharge or death was the date on which the patient was discharged from the hospital or was certified dead.

Neurological outcome at discharge from hospital

A simple validated neurological score such as the Cerebral Performance Category (CPC)^[3] was recorded. CPC was assessed at hospital discharge. (1) CPC 1. Good cerebral performance. Conscious, alert, able to work; might have mild neurologic or psychological deficit. (2) CPC 2. Moderate cerebral disability. Conscious, sufficient cerebral function for independent activities of daily life. Able to work in sheltered environment. (3) CPC 3. Severe cerebral disability. Conscious, dependent on others for daily support because of impaired brain function. Ranges from ambulatory state to severe dementia or paralysis. (4) CPC 4. Coma or vegetative state. Any degree of coma without the presence of all brain death criteria. Unawareness, even if appears awake (vegetative state) without interaction with environment; might have spontaneous eye opening and sleep/awake cycles.

RESULTS

Baseline characteristics

Eighty patients suffering from OHCA were identified in this study. Patient's demographics and aspects of the OHCA events are given below (Table 1). The mean age of the 80 patients who suffered OHCA was 63±14.6 years. The population was predominantly composed of elderly individuals with highest percentage of OHCA seen between 51 to 60 years. About 70% of the patients were males and 30% were females ($P<0.001$).

Aspects of the OHCA event

Out of 80 patients, 74 (92.5%) experienced OHCA at residence and only 6 (8.1%) had OHCA at other locations ($P<0.001$) (Table 1). Totally 46 (56.5%) of OHCA were witnessed, out of which 15.2% patients survived; whereas 42.5% were unwitnessed, of which none of them survived ($P=0.017$). Although 46 (56.5%) of OHCA events were witnessed by a bystander, only 1 (1.3%) of these arrests received bystander CPR ($P<0.001$). Three (3.8%) of study population presented with initial shockable rhythm (VF/pulseless VT) and out of which 2 (66.6%) survived; 5 (6.4%) patients survived

Table 1. Patient's demographics and aspects of the OHCA events, *n* (%)

Variables	Experienced OHCA	Survived
Age group		
Mean age (years)	63±14.6	56±9.4
Sex		
Male	56 (70)	6 (10.7)
Female	24 (30)	1 (4.1)
Location of OHCA event		
Residence	74 (92.5)	6 (8.1)
Public place	4 (5)	1 (25)
Others	2 (2.5)	0 (0)
Witnessed OHCA		
Yes	46 (56.5)	7 (15.2)
No	34 (42.5)	0 (0)
Bystander CPR		
Yes	1 (1.2)	1 (100)
No	79 (98.8)	6 (7.5)
Presenting initial cardiac rhythm		
Shockable	3 (3.8)	2 (66.6)
Non-shockable	77 (96.3)	5 (6.4)
CPR duration		
≤30 minutes	47 (59)	7 (15)
>30 minutes	26 (32.5)	0 (0)
Presumed etiology of OHCA		
Cardiac	74 (92.5)	5 (6.7)
Non-cardiac	6 (7.5)	2 (33.3)
ROSC achieved		
Yes	26 (32.5)	7 (26.9)
No	54 (67.5)	0 (0)
Overall survival		
Overall survival to hospital admission	26 (32.5)	
Expired after hospital admission	19 (23.7)	
Survival rate to hospital discharge	7 (8.8)	
Neurological outcome		
CPC 1: Good cerebral performance	3 (3.8)	
CPC 2: Moderate cerebral disability	0 (0)	
CPC 3: Severe cerebral disability	2 (2.5)	
CPC 4: Vegetative state or coma	2 (2.5)	

out of 77 (96.3%) patients who presented with initial non-shockable (asystole/PEA) rhythm ($P<0.001$). CPR duration of 30 minutes was taken as a cut off and it was found that of 47 (59%) of patients with OHCA, who received CPR for a duration of less than or equal to 30 minutes, ROSC was achieved in 32.5% of them whereas not a single patient could be revived in the remaining 26 (32.5%) of patients, who received CPR for a duration of more than 30 minutes ($P=0.013$). The majority of cardiac arrests were of presumed cardiac etiology (74, 92.5%), of which only 6.7% survived. Six (7.5%) of OHCA were of non-cardiac etiologies, of which 33.3% survived ($P=0.02$).

Outcomes

Overall, successful resuscitation (ROSC) was achieved in 26 (32.5%) patients, however only 7 (8.8%) were discharged alive from the hospital and the rest 19 (23.7%) expired after hospital admission (Table 1). Out of the 7 patients discharged alive ($P<0.001$), 3 (3.8%) were discharged with good cerebral performance, 2 (2.5%) were discharged with severe cerebral disability and the rest 2 (2.5%) were discharged in vegetative comatose state.

Predictors of outcome: univariate and multivariate analysis

Univariate analysis of the data examined the effect of the predictor variables on alive at discharge (Table 2). We compared predictors like age <60 years, male sex, initial presenting rhythm, CPR duration of ≤ 20 minutes, non-cardiac etiology with likelihood of being alive at discharge. We found that presenting shockable cardiac rhythm ($P=0.01$), CPR duration of ≤ 20 minutes ($P=0.002$), the arrest with non-cardiac etiology ($P=0.049$), were significantly associated with likelihood of being alive at discharge.

Table 2. Predictors of outcome after CPR (univariate & multivariate analysis)

Predictors	Survival to discharge risk ratio (95%CI)	P value
Univariate analysis		
Age <60 years	2.86 (0.52–15.74)	0.225
Male sex	2.76 (0.31–24.26)	0.360
Presenting rhythm shockable	28.80 (2.21–374.75)	0.010
CPR duration ≤ 30 minutes	14.88 (2.68–82.66)	0.002
Non-cardiac etiology	6.90 (1.00–47.29)	0.049
Multivariate analysis		
Age <60 years	1.24 (0.16–9.72)	0.832
Male sex	2.38 (0.17–33.14)	0.517
Presenting rhythm shockable	48.61 (2.08–1132.47)	0.016
CPR duration ≤ 30 minutes	11.38 (1.11–116.39)	0.040
Non-cardiac etiology	2.04 (0.15–27.90)	0.591

Independent predictors of alive at the time of discharge from the hospital were CPR duration of ≤ 20 minutes ($P=0.04$) and presenting shockable rhythm ($P=0.016$) (Table 2). Bystander CPR and witnessed arrest were important factors influencing on the outcome of CPR in OHCA, these variables could not be introduced into the univariate and multivariate models, probably due to small sample size.

DISCUSSION

In India, there have been very limited data on the outcome of cardiopulmonary resuscitation in out-of-hospital cardiac arrests. Our study has shown that the survival rate to hospital admission was 32.5%, and the overall survival rate to hospital discharge was 8.8% and survival to hospital discharge with good cerebral performance was 3.8%. This figure is slightly higher than in certain previous reports, like an Indian study published in 1999 by Rajaram et al,^[4] which showed the overall survival rate to hospital discharge was 5.9%. If we compare with western countries, where BLS and ACLS protocols and emergency medical services (EMS) are well developed; the overall survival to hospital discharge rate is 9.6% (CARES),^[5] so we are still lagging behind.

One of the major cause of low survival rates for an OHCA event is due to lack of EMS which is an essential part of the overall healthcare system.^[6] Despite tremendous development in the healthcare sector, India is yet to create a single, comprehensive EMS that can be accessed throughout the country; which explains the cause of no significant change in the survival rates for past many decades. In a bid to address this problem, the Centralized Accidents and Trauma Services were set up by the Indian Government in the early 1990s. In spite of having a centralized number "102" and a nationwide expansion, it failed to gain the acceptance equal to western EMS.^[6,7] Moreover, there are no set EMS protocols to follow with regard to patient assessment, triage, transfer and disposition to a medical facility for ambulance or emergency medical personnel.

Low survival rates after an OHCA event are of great public health concern. So to avoid preventable deaths and disabilities, there is an urgent need of a centralized medical emergency body which could provide guidelines for setting up emergency services and should be involved in preparing protocols, imparting technical assistant, training and accreditation of emergency services.^[7]

Our study also evaluated specific factors associated with survival after OHCA, including age, sex, arrest

witnessed by a bystander, bystander CPR, presenting cardiac rhythm, duration of CPR and etiology of arrest.

According to the study results, highest percentage of OHCA was predominantly seen in elderly individuals between 51 to 60 years (33.8%). Advanced age has been shown to be a predictor of poor survival after CPR,^[3,8,9] but in our study though increasing age was negatively associated with survival, but it was not statistically significant. OHCA was more common in males (70%) as compared to females ($P=0.003$). International studies^[4,10] showed that 61.1% to 70.1% were males who experienced OHCA where as Indian study by Rajaram et al showed 66% males. These data do suggest that males are more prone for OHCA than females; but regarding relationship between survival after OHCA and sex of the individual, it was statistically non-significant; further studies with large number of samples in this context are required.

Our study showed that 74 (92.5%) patients out of 80 had OHCA at home out of which 6 (8.1%) survived, whereas four (5%) individuals arrested at public place among whom one received bystander CPR and survived. International data suggested that OHCA at residence were less likely to be witnessed and have poorer outcome,^[10] likewise in our study too, OHCA at home was associated with poor survival outcome as compared to public place.

CPR outcomes were better in witnessed arrests; 57.5% patients had a witnessed OHCA, out of which 15.2% patients survived ($P<0.01$), but no single patient survived from the remaining 42.5% unwitnessed arrests. EMS witnessed OHCA have not been considered for comparison from these studies because of lack of a good EMS service in India.

Studies^[11,12] have shown that bystander CPR is associated with good outcome in OHCA with a significant improvement in survival and alive at discharge as compared with the no bystander CPR. In our study, although 56.5% of OHCA events were witnessed by a bystander, only 1 (1.3%) of these arrests received bystander CPR ($P<0.001$). This is very poor in comparison to the 18%–55% rates reported from the West.^[13] Such a low frequency of bystander CPR is one of the major cause of low survival rates after an OHCA event. Unfortunately in India, bystander CPR rates have remained very low, due to lack of awareness of basic CPR techniques among the communities.^[13] Improving community bystander CPR rates is an important step towards improving OHCA survival. There is an urgent need of national initiatives to strengthen bystander resuscitation attempts and advanced care by educational

campaigns (e.g., brief educational videos, community awareness programs),^[14,15] and implementing school-based training.^[16]

The duration of CPR is a good predictor of outcome as demonstrated by us and numerous others.^[17–19] In our study, CPR duration of 30 minutes was taken as a cut off and it was found that out of 59% patients with OHCA, who received CPR for a duration of less than or equal to 30 minutes, ROSC was achieved in 32.5% of them whereas not a single patient could be revived in the remaining 32.5% of patients, who received CPR for a duration of more than 30 minutes. This shows that the CPR duration of more than 30 minutes in OHCA patients is associated with very poor outcome. An important consideration in outcome prediction in OHCA is the time of collapse until definitive resuscitation intervention begun. However, we were unable to collect correct information as the reported time of CR was often what was recalled by a friend or family member and was likely to be erroneous especially in unwitnessed CR.

Majority of the patients (96%) presented with non-shockable rhythm, whereas only 3 (3.8%) patients presented with initial shockable cardiac rhythm (VT/VF), but patients who had initial shockable presenting rhythm were observed to have better survival ($P<0.001$). These results were identical to the results of earlier studies,^[20,21] which described, survival to hospital discharge was substantially more likely when the first documented rhythm was shockable rather than non-shockable.

Our study also demonstrated that in majority of the OHCA, the etiology was found to be cardiac in origin (92.5%), but good survival outcome was seen in OHCA with non-cardiac etiology ($P<0.001$). Univariate analysis of the data also showed that OHCA with non-cardiac etiology is the one important predictor of survival to discharge after CPR in OHCA.

CONCLUSION

The present data suggest that witnessed arrests, early initiation of CPR by bystanders, CPR duration ≤ 20 minutes, initial presenting shockable rhythm, OHCA with non-cardiac etiology are associated with good outcome after CPR in OHCA. Age and sex did not influence the outcome. To improve the outcome of CPR and the low survival rates after an OHCA event in India, focused strategies should be designed to create a centralized medical emergency body which could provide guidelines for setting up emergency medical system (EMS), preparing emergency protocols, imparting

technical assistant and training. There is also an urgent need of a national initiative to boost the rates of bystander CPR and education of the lay public in basic CPR, which is very critical to improve the survival of OHCA events.

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Contributors: Krishna CK proposed the study and wrote the first draft. All authors read and approved the final version of the paper.

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