Brief Communication

Outcome and predictors of cardiopulmonary resuscitation among patients admitted in Medical Intensive Care Unit in North India

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Abstract

Background: Outcome and predictors of survival after cardiopulmonary resuscitation (CPR) in Intensive Care Units (ICUs) have been extensively studied in western world, but data from developing countries is sparse. **Objectives:** To study the outcome and predictors of survival after CPR in a Medical ICU (MICU) of a tertiary level teaching hospital in North India. **Materials and Methods:** A 1-year prospective cohort study. **Results:** Of 105 in-MICU CPRs, forty patients (38.1%) achieved return of spontaneous circulation (ROSC). Only one patient (0.9%) survived up to hospital discharge. The predictors of ROSC were ventricular tachycardia/ventricular fibrillation as first monitored rhythm, intubation during CPR and CPR duration ≤ 10 min. CPR duration > 10 min was a significant factor for resuscitation failure. **Conclusions:** The rate of survival to hospital discharge after in-MICU CPRs is extremely poor. Our data may aid treating physicians, resuscitation teams, and families in understanding the likely outcome of patients after in-MICU CPRs.

Keywords: Cardiopulmonary resuscitation, Intensive Care Units, outcome study, survival rate, tertiary care

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Introduction

Cardiopulmonary resuscitation (CPR) is a frequently performed intervention in the Medical Intensive Care Unit (MICU). Although ICU population is subjected to additional monitoring, potentially faster detection of cardiopulmonary arrest (CPA), and initiation of CPR, its benefits are offset by higher underlying severity of illness when compared to those not in ICU. Overall survival and functional outcome are extremely poor after in-ICU CPR.[1,2] There are limited studies from resource-limited countries such as India[3-6] which mainly focus on in-hospital CPR rather than in-ICU CPR; though an attempt has been made to triage critically ill patients in ICUs on the basis of a prognostic score.[7] Because of variations in resources in different countries all over the world, application of western data to Indian scenario may not be appropriate.[8] Various factors modifying outcome in Indian population may include undiagnosed premorbid conditions, different disease patterns, inadequate knowledge, and skill among clinicians as well as financial constraints. Therefore, there is a need to study the outcome of in-ICU CPR and its predictors in Indian tertiary care hospitals.

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Materials and Methods

A prospective cohort study was performed on patients who had undergone CPR in MICU of a 1200-bedded tertiary level teaching institute in North India over a period from February 2010 to January 2011. The MICU is equipped with all facilities recommended for providing modernized critical care. Medicine resident doctors are available round the clock along with attending ICU consultant. The resuscitation team comprises ICU consultant, one medicine resident doctor, and two ICU trained nurses. The hospital follows basic life support/advanced cardiac life support (ACLS) guidelines from American Heart Association for training of staff.

The patients having CPA as defined by cessation of cardiac mechanical activity as indicated by the absence of signs of circulation such as central pulse, for example, carotid pulse and patients undergone CPR in MICU were included. The patients having CPA before being shifted to MICU and of age < 14 years were excluded from the study. CPR was performed as per ACLS 2005 algorithm and outcome was measured and reported as per Utstein-style definitions and reporting templates.[9] The duration of CPR in case of no return of spontaneous circulation (ROSC) was determined by clinical decision/opinion of ICU consultant who was leading the resuscitation team.

Data were exported to spreadsheet and statistically analyzed using SPSS version 17 (SPSS, Inc., Chicago IL). Unpaired *t*-test and Chi-squared test were used. Univariate analysis was followed by multivariate logistic regression analysis using stepwise backward selection. The study was approved by the Institutional Ethical Committee and from the affiliated health sciences university.

Results

Baseline characteristics, co-morbidities, and underlying critical illness of patients enrolled are given in Tables 1 and 2, respectively.

Outcome

Of 105 patients having in-MICU CPAs, 40 (38.1%) achieved ROSC, whereas 65 patients (61.9%) did not achieve ROSC [Figure 1]. Out of 40, only one patient (2.5% of those having ROSC and 0.9% of in-MICU CPAs) survived until hospital discharge. The remaining 32 (30.5%) patients expired during ICU stay, and seven patients (6.7%) were discharged against medical advices. These patients were assumed to be expired while analyzing the final outcome.

Table 1: Characteristics of patients who received cardiopulmonary resuscitation in Medical Intensive Care Unit, with stratification by return of spontaneous circulation

Characteristics	All patients (*n*=105)	ROSC		*P*
		Yes (*n*=40)	No (*n*=65)	
Mean age in years (SD)	50.6 (16.9)	50.5 (16.7)	50.7 (17.2)	0.95
Gender, *n* (%)				
Males	75 (71.4)	28 (70.0)	47 (72.3)	0.97
Mean ICU stay in days (SD)	6.0 (6.6)	6.1 (6.7)	5.8 (6.5)	0.82
Mean hospital stay in days (SD)	10.4 (8.7)	9.6 (7.1)	10.9 (9.6)	0.46
Mean APACHE II score (SD), *n*=100	26.3 (10.3)	25.8 (9)	26.6 (11.1)	0.70
First monitored rhythm, *n* (%)				
Pulse less bradycardia	65 (61.9)	25 (62.5)	40 (61.5)	0.91
Asystole	35 (33.3)	11 (27.5)	24 (36.9)	0.43
VT/VF	5 (4.8)	4 (10.0)	1 (1.5)	0.12
Intubation status, *n* (%)				
Intubated during CPR	17 (16.2)	10 (25.0)	7 (10.8)	0.10
Intubated prior to CPR	88 (83.8)	30 (75.0)	58 (89.2)	0.10
Mechanical ventilation prior to CPR, *n* (%)	87 (82.6)	29 (72.5)	58 (89.2)	0.05[a]
Inotropic support prior to CPR, *n* (%)	96 (91.4)	34 (85.0)	62 (95.4)	0.13
Duration of CPR (in min), *n* (%)				
≤10	36 (34.3)	36 (90)	0 (0)	<0.0001[a]
11-20	10 (9.5)	2 (5)	8 (12.3)	0.37
21-30	33 (31.4)	1 (2.5)	32 (49.2)	<0.0001[a]
31-40	7 (6.7)	0 (0)	7 (10.8)	0.08
41-50	10 (9.5)	1 (2.5)	9 (13.8)	0.11
>50	9 (8.6)	0 (0)	9 (13.8)	0.03[a]
Mean (SD)	25.85 (20.7)	7.4 (7.7)	36.9 (16.4)	<0.0001[a]

[a]Significant $P<0.05$. VT/VF: Ventricular tachycardia/ventricular fibrillation; CPR: Cardiopulmonary resuscitation; MICU: Medical Intensive Care Unit; ROSC: Return of spontaneous circulation; SD: Standard deviation; ICU: Intensive Care Unit; APACHE II: Acute Physiology and Chronic Health Evaluation II

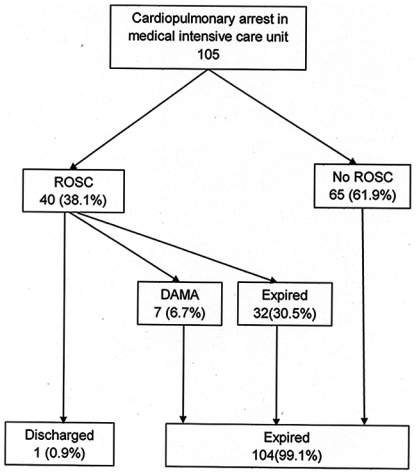

Figure 1: Outcome of cardiopulmonary resuscitation in Medical Intensive Care Unit

Predictors of return of spontaneous circulation: Univariate analysis

Univariate analysis of data [Table 3] examined the effect of the predictor variables on ROSC only

Table 2: Co-morbidities and underlying critical illness of patients who received cardiopulmonary resuscitation in Medical Intensive Care Unit, with stratification by return of spontaneous circulation

	All patients (*n*=105)	ROSC		*P*
		Yes (*n*=40)	No (*n*=65)	
Co-morbidities, *n* (%)				
Hypertension	35 (33.3)	12 (30.0)	13 (20.0)	0.35
Diabetes mellitus	23 (21.9)	13 (32.5)	10 (15.4)	0.06
Cardiac disease	18 (17.1)	6 (15.0)	12 (18.5)	0.84
Malignancy	10 (9.5)	3 (7.5)	7 (10.7)	0.84
Pulmonary disease	10 (9.5)	2 (5.0)	8 (12.3)	0.37
Renal failure	9 (8.6)	6 (15.0)	3 (4.6)	0.13
Underlying critical illness[a], *n* (%)				
Bacterial infections	93 (88.6)	35 (87.5)	58 (89.2)	0.96
Pneumonias	30 (28.6)	13 (32.5)	17 (26.2)	0.63
Unknown focus of sepsis	27 (25.7)	7 (17.5)	20 (30.8)	0.19
Spontaneous bacterial peritonitis	8 (7.6)	1 (2.5)	7 (10.8)	0.23
Cellulitis	6 (5.7)	3 (7.5)	3 (4.6)	0.85
Urinary tract infection	5 (4.8)	3 (7.5)	2 (3.1)	0.57
Tuberculosis	5 (4.8)	4 (10)	1 (1.5)	0.12
Acute gastroenteritis	4 (3.8)	0 (0)	4 (6.2)	0.27
Leptospirosis	3 (2.8)	1 (2.5)	2 (3.1)	0.67
Miscellaneous[b]	5 (4.8)	4 (10)	1 (1.5)	0.12
Gastrointestinal diseases	65 (61.9)	22 (55.0)	43 (66.2)	0.34
Kidney and urinary tract diseases	57 (54.3)	22 (55.0)	35 (53.9)	0.92
Central nervous system diseases	56 (53.3)	18 (45.0)	38 (58.5)	0.25
Respiratory diseases	49 (46.7)	19 (47.5)	30 (46.2)	0.90
Others[c]	29 (27.6)	10 (25.0)	19 (29.2)	0.80
Viral infections[d]	24 (22.8)	7 (17.5)	17 (26.1)	0.43
Cardiovascular diseases	22 (20.9)	8 (20.0)	14 (21.5)	0.94

[a]May be more than one illness in a patient; [b]Includes hepatic abscess, tetanus, gluteal abscess, cholangitis and cryptococcal meningitis; [c]Included hypothyroidism, ankylosing spondylitis, systemic sclerosis, systemic lupus erythematosus, rheumatoid arthritis, aplastic anemia, cytopenias, poisoning, mood disorders, deep vein thrombosis, electric shock; [d]Includes chronic hepatitis B and C, acute viral hepatitis, dengue fever and human immunodeficiency virus infection. ROSC: Return of spontaneous circulation

as only one patient survived to hospital discharge. ROSC was most likely to occur if CPR duration was ≤10 min ($P < 0.0001$) and the patients who were not on mechanical ventilation (odds ratio = 3.14; 95% confidence interval: 1.10–8.95; $P = 0.032$). Other variables did not show any statistical significance on univariate analysis.

Independent predictors of return of spontaneous circulation: Multivariate analysis

All predictors of ROSC were subjected to multivariate logistic regression analysis using stepwise backward selection [Table 4]. The analysis showed CPR duration ≤ 10 min ($P < 0.0001$), ventricular tachycardia/ventricular fibrillation (VT/VF) as first monitored rhythm ($P = 0.031$), and intubated during CPR ($P = 0.037$) as independent predictors of ROSC on final run model of logistic regression (R^2 of 0.868 and 0.861 of first run model and final run model, respectively).

Table 3: Odds of predictors of return of spontaneous circulation after cardiopulmonary resuscitation: Univariate analysis

Predictors	Number (%)		Univariate analysis		
	ROSC cohort (*n*=40)	No ROSC cohort (*n*=65)	OR	95% CI	*P*
ICU stay (days)					
≤6	26 (65)	49 (75.4)	0.60	0.26-1.43	0.254
>6	14 (35)	16 (24.6)	1		
Hospital stay (days)					
≤10	29 (72.5)	40 (61.5)	1.65	0.70-3.87	0.252
>10	11 (27.5)	25 (38.5)	1		
First monitored rhythm					
VT/VF	4 (10.0)	1 (1.5)	7.11	0.77-66.07	0.084
Non-VT/VF	36 (90.0)	64 (98.5)	1		
Intubation status					
Intubated during CPR	10 (25.0)	7 (10.8)	2.76	0.95-7.98	0.060
Intubated prior to CPR	30 (75.0)	58 (89.2)	1		
Mechanical ventilation before CPR					
No	11 (27.5)	7 (10.8)	3.14	1.10-8.95	0.032[a]
Yes	29 (72.5)	58 (89.2)	1		
Inotropic support before CPR					
No	6 (15.0)	3 (4.6)	3.16	0.86-15.50	0.079
Yes	34 (85.0)	62 (95.4)	1		
CPR duration (min)					
≤10	36 (90.0)	0 (0.0)	#		<0.0001[a]
>10	4 (10.0)	65 (100.0)			

[a]Significant $P<0.05$; #Evidently very significant as one cell in 2×2 contingency table has zero value. ROSC: Return of spontaneous circulation; OR: Odds ratio; CI: Confidence interval; ICU: Intensive Care Unit; VT/VF: Ventricular tachycardia/ventricular fibrillation; CPR: Cardiopulmonary resuscitation

Table 4: Independent predictors of return of spontaneous circulation after cardiopulmonary resuscitation: Multivariate analysis

Predictors	First run model		Final run model	
	β	*P*	β	*P*
Constant	0.003	0.98	0.039	0.097
ICU stay	−0.010	0.88		
Hospital stay	−0.035	0.55		
First monitored rhythm	0.182	0.04[a]	0.187	0.031[a]
Intubated during CPR	0.083	0.55	0.104	0.037[a]
Mechanical ventilation	−0.047	0.73		
Inotropic support	0.090	0.25		
Duration of CPR ≤10 min	0.929	<0.0001[a]	0.922	<0.0001[a]
R^2	0.868		0.861	

[a]Significant $P<0.05$. β: Standardized coefficients; R^2: Coefficient of determination; CPR: Cardiopulmonary resuscitation; ICU: Intensive Care Unit

Discussion

This 1-year prospective cohort study demonstrates that in spite of good rate of ROSC (38.1%), survival to hospital discharge after in-MICU CPRs remains poor (0.9%). This is the first prospective analysis from a resource-limited nation such as India to exclusively address the outcome of CPR in MICU mainly comprising noncardiac critically ill patients. There are few studies[3-6]

from resource-limited countries such as India primarily focusing on in-hospital CPRs rather than in-MICU CPRs specifically.

Dutta *et al.* reported that out of 102 CPAs in-hospital, 39 CPAs occurred in ICU over a period of 1 year.[3] The ROSC was achieved in 15 patients (38.5%), but none of them survived up to hospital discharge. In a retrospective study, Khan *et al.* reported that out of 383 CPAs in-hospital, 128 CPAs occurred in ICU over a period of 5 years, out of which only six patients (4.7%) survived up to hospital discharge after in-ICU CPR.[5] The results may have been slightly better as compared to our study because of its longer duration of 5 years. However, the result of a retrospective study has confounding limitations for generalization of the outcome. In another retrospective study, Rajaram *et al.* reported that out of 215 CPAs in-hospital, 64 CPAs occurred in ICU over a period of 2 years, out of which 12.3% survived to hospital discharge.[4] In this study, 56% of CPAs were due to cardiac causes (ischemia, infarction, and congestive heart failure) which probably led to a better outcome as compared to our study.

In a study from Thailand, Suraseranivongse *et al.* reported that out of 639 CPAs occurring in-hospital, 200 CPAs occurred in ICU over a period of 1 year.[6] The rate of ROSC was 1.5 times higher in ICU (69.5%) as compared to other areas of the hospital but authors had not specified survival rate in ICU which would have been low as overall survival rate in this study was just 6.9%.

In resource-intense countries, two studies from American ICUs, one by Tian *et al.*[1] using a large, multicenter database (the National Registry of CPR) and another by Gershengorn *et al.*[2] using the Project IMPACT (Cerner Corporation, Kansas City, Missouri, USA) database reported 15.9% and 15.7% rate of survival to hospital discharge, respectively, but these survivors had considerable quality of life issues at discharge.

The additional monitoring and potentially faster detection of CPA and initiation of CPR in patients in ICU are often offset by underlying severity of illness. This can possibly explain low survival in this study. The patients admitted in MICU were mainly multisystem organ failure critically ill patients and only 20.9% patients had primarily cardiac illness as admitting diagnosis due to the presence of separate cardiac emergency and ICU in our institution. This probably led to the higher proportion of non-VT/VF (95.2%) as first monitored rhythm during CPAs in MICU. Although CPAs having VT/VF as first monitored rhythm in our study shows trend toward better ROSC but ROSC in non-VT/VF rhythms (pulseless bradycardia and asystole) was poor, which is a well-established fact in critical care medicine.

Another factor for low survival to hospital discharge in the current study could be the high mean Acute Physiology and Chronic Health Evaluation II (APACHE II) score (26.3 ± 10.3) in our study group. Such a high APACHE II score (score of 25–29) has 55% predicted mortality rate in ICU population even if they do not have CPA.[10] Patel *et al.* observed that APACHE II score < 24 was associated with better immediate survival after CPR in both ICU and non-ICU setting.[11]

The current study also shows that duration of CPR ≤ 10 min was associated with better rate of ROSC as was also observed by Khan *et al.*[5] Saghafinia *et al.* reported that duration of CPR > 10 min was predictive of significantly decreased survival to discharge.[12] A large multicenter observational study by Goldberger *et al.* reported that for patients achieving ROSC after in-hospital CPRs, the median duration of resuscitation was 12 min compared with 20 min for nonsurvivors but could not define an optimum duration for resuscitation attempts.[13]

In our study, ROSC was better in patients who were intubated during CPR as compared to those who were already on invasive ventilation. Tian *et al.* observed that mechanical ventilation was associated with 40% lower odds of hospital survival after CPR.[1] Huang *et al.* reported poor survival after CPR in patients already intubated and on mechanical ventilation.[14]

Conclusions

In summary, this 1-year prospective cohort study demonstrates that in spite of good ROSC after CPR on primarily noncardiac critically ill patients, rate of survival to hospital discharge remains extremely poor in resource-limited countries such as India. We found VT/VF as first monitored rhythm, intubation during CPR and duration of CPR ≤ 10 min positively correlate with ROSC. Duration of CPR > 10 min shows a significant trend toward resuscitation failure. Our data may aid treating physicians, resuscitation teams, and families of patients in understanding the likely course and prognosis of patients in Indian scenario once they receive CPR in ICUs. The ethical concerns need to be addressed as resource-intense care in MICU has significant financial implications in these patients.

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Conflicts of interest

There are no conflicts of interest.

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