

A 6-year experience of CPR outcomes in an emergency department in Thailand

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Purpose: Sudden cardiac arrest is a common emergency condition found in the emergency department of the hospital. The survival rate of out-of-hospital cardiac arrest patients is 2.0%–10.0% and 7.4%–27.0% percent for in-hospital cardiac arrest patients. The factors for survival outcome are divided into three main groups: patient characteristics, pre-hospital factors, and resuscitated information. The objective of this study was to evaluate the related factors, outcome, and survival rate in patients with cardiac arrest who received cardiopulmonary resuscitation (CPR) at Ramathibodi Emergency Medicine Department. There are limited data for this issue in Thailand and other Asian countries.

Methods: This retrospective study included all patients who were older than 15 years with sudden cardiac arrest and who were resuscitated in the emergency room between January 2005 and December 2010. Descriptive analytic statistics and logistic regressions were used to analyze factors that related to the sustained return of spontaneous circulation (ROSC) and survival at discharge.

Results: There were 181 patients enrolled. The overall sustained ROSC rate was 34.8% and the survival rate at discharge was 11.1%. There were 145 out-of-hospital cardiac arrest patients, in whom the survival rate was 52.4% and the survival to discharge rate was 7.6%. For in-hospital cardiac arrest, there were 36 patients with a survival rate of 86.1% and the survival to discharge rate was 25.0%. Statistically significant factors related to sustained ROSC were good and moderate cerebral performance, in-hospital cardiac arrest, beginning of CPR in less than 30 minutes, and cardiopulmonary cause of arrest. The factors influencing survival to discharge were cardiopulmonary causes of cardiac arrest.

Conclusion: Factors associated with sustained ROSC were functional status before cardiac arrest, location of cardiac arrest, duration of CPR, and cause of cardiac arrest. Survival rate was related to the cause of cardiac arrest.

Keywords: CPR, cardiac arrest, predictors, emergency department

Introduction

Sudden cardiac arrest (SCA) is a fatal condition that needs emergency evaluation and treatment. The survival rate is higher if SCA happens in hospital rather than out of hospital (7.4%–27.0% versus 2.0%–10.0%).^{1–4} Major factors affecting the outcome of SCA include patient characteristics, basic life support, and advanced life support.^{1–17} For example, early cardiopulmonary resuscitation (CPR) within the first minute of the event was associated with a better survival rate.⁶ Even though there are several reports on predictors of CPR outcomes; there are limited data from emergency departments in Thailand and other developing countries. Therapeutic CPR procedures

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or factors that were associated with its outcomes at an emergency department in Thailand were studied.

Materials and methods

The hospital charts of patients aged over 15 years who were diagnosed as SCA, sudden death, unattended death, or received CPR at the Emergency Medicine Department of Ramathibodi hospital were retrospectively reviewed. All patients who met the study criteria between January 2005 and December 2010 were studied.

The emergency department is a section in all hospitals in Thailand. Patients have a right to visit any emergency department in any hospital, regardless of health insurance. All expenses of treatment at the emergency department will be paid for by the Thai government. Ramathibodi Hospital is a university hospital located in the central area of Bangkok, the capital city of Thailand.

Patient characteristics such as age, sex, and previous medical history, Cerebral Performance Categories score (CPC) before cardiac arrest,¹⁸ location of cardiac arrest, bystander witnessed arrest, bystander CPR performed, first documented pulseless rhythm, time interval from collapse/arrival to start of CPR in minutes, CPR duration, time of arrest, the leader of the CPR team, initial cause of cardiac arrest, initial capillary or serum glucose, and total ampules of adrenalin used were recorded. The outcomes of the study were outcomes of CPR, discharge status, and factors associated with CPR outcomes and discharge status.

The outcomes of CPR were categorized as no return of spontaneous circulation (ROSC), do not attempt resuscitation (order in the emergency room), ROSC for more than or equal to 20 minutes or sustained ROSC, death in hospital, or survival at discharge.

The study protocol was approved by the institutional review board of human research, Mahidol University. All analyses were done with STATA 11.0 (StataCorp, College Station, TX, USA). Data are presented as means (standard deviation), median (range), or proportion when appropriate. Tests of correlation between outcome variables and study factors were done by descriptive statistics and univariate analysis. Factors with a *P*-value less than 0.05 were included in multivariate logistic regression analysis to calculate adjusted odds ratio and 95% confidence interval for sustained ROSC more than or equal 20 minutes.

Results

During the study period, there were 247 patients diagnosed as SCA. Twenty-three and 43 patients were excluded, due

to no CPR performed and incomplete data, respectively. In total, 181 patients were studied and included in the analysis. Of those, 107 patients (59.1%) had ROSC of more than 20 minutes; 87 patients (81.3%) died in hospital and 20 patients (18.7%) were alive. Of those patients who died, 44 patients (50.6%) died at the emergency department. Most patients (nine patients or 45.0%) who survived had a CPR score of category 1 as shown in Figure 1.

Characteristics of patients with and without sustained ROSC of more than 20 minutes were compared (Table 1). There were ten factors that were significantly associated with sustained ROSC of more than 20 minutes which were encephalopathy, the CPC score card before cardiac arrest, location of SCA, witnessed SCA, having bystander CPR performed, time to start of CPR, duration of CPR, cause of SCA, initial capillary glucose, and adrenalin use (Table 1). After adjustment by multivariate logistic regression analysis, there were only four factors significantly associated with sustained ROSC of more than 20 minutes as shown in Table 2 which were CPC score before SCA, location of SCA, CPR duration, and initial cause of SCA. In terms of factors associated with being alive or dead, the initial cause of SCA was the only significant factor. Survivors had a higher proportion

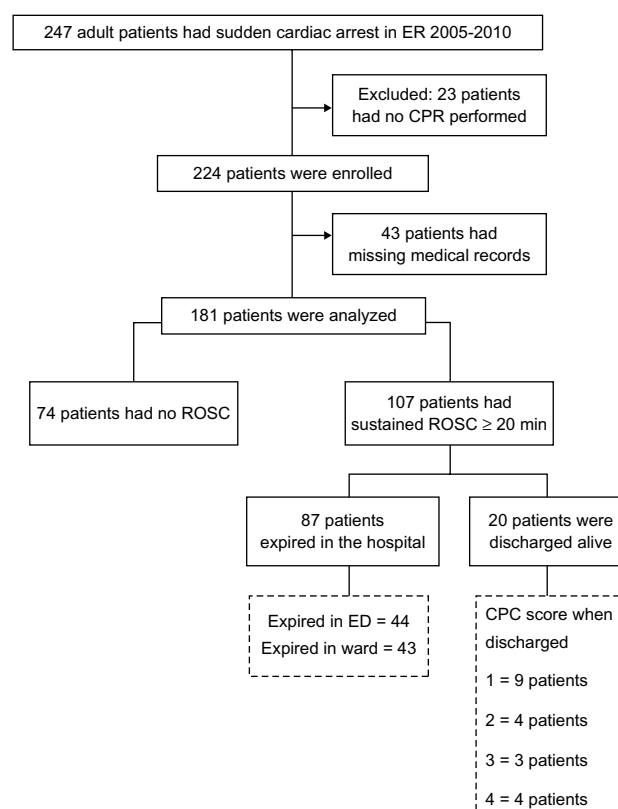


Figure 1 Flow diagram of the study.

Abbreviations: CPC, Cerebral Performance Categories; CPR, cardiopulmonary resuscitation; ED, emergency department; ER, emergency room; ROSC, return of spontaneous circulation.

Table 1 Clinical characteristics of all sudden cardiac arrest patients by sustained ROSC of more than 20 minutes

Characteristics	Sustained ROSC \geq 20 minutes		P-value
	74 failure, n (%)	107 success, n (%)	
Sex			
Male	38 (51.4)	53 (49.5)	0.810
Female	36 (48.7)	54 (50.8)	
Age (years), mean \pm 2 SD	66.2 \pm 17.1	64.0 \pm 17.1	0.401
Medical history*			
Hypertension	39 (52.7)	59 (55.1)	0.746
Diabetes mellitus	23 (31.1)	38 (35.5)	0.535
Encephalopathy	32 (43.2)	26 (24.3)	0.007
Intrinsic heart disease	20 (27.0)	41 (38.3)	0.114
Pulmonary disease	20 (27.0)	33 (30.8)	0.579
Liver disease	6 (8.1)	11 (10.3)	0.622
Renal disease	19 (25.7)	35 (32.7)	0.309
Malignancy	15 (20.3)	23 (21.5)	0.842
Metastatic malignancy	7 (9.5)	16 (15.0)	0.275
Unknown/not collected	12 (16.2)	14 (13.1)	0.555
CPC score before cardiac arrest			<0.001
1 and 2	56 (75.7)	102 (95.3)	
3 and 4	18 (24.3)	5 (4.7)	
Location of cardiac arrest			<0.001
In-hospital	5 (6.8)	31 (29.0)	
Out-of-hospital	69 (93.2)	76 (71.0)	
Witness arrest*	48 (64.9)	91 (85.1)	0.002
Bystander performed CPR*	15 (20.3)	36 (33.7)	0.049
First documented pulseless rhythm			0.140
Nonshockable	65 (87.8)	85 (79.4)	
Shockable	9 (12.2)	22 (20.6)	
Collapse to start CPR (minutes) median (minimum, maximum)	30 (0, 300)	10 (0, 95)	<0.001
Collapse to start CPR			<0.001
< 10 minutes	7 (9.5)	37 (34.6)	
\geq 10 minutes	67 (90.5)	70 (65.4)	
CPR duration (minutes) median (minimum, maximum)	30 (3, 125)	16 (2, 120)	<0.001
CPR duration			<0.001
< 30 minutes	18 (24.3)	82 (76.6)	
\geq 30 minutes	56 (75.7)	25 (23.4)	
Doctor shift			0.403
Night	18 (24.3)	29 (27.1)	
Day	27 (36.5)	29 (27.1)	
Afternoon	29 (39.2)	49 (45.8)	
Team leader			0.113
Staff	18 (24.3)	16 (15.0)	
Resident	56 (75.7)	91 (85.0)	
Initial cause of arrest			<0.001
Cardiopulmonary cause [†]	11 (14.9)	58 (54.2)	
Non-cardiopulmonary [‡]	63 (85.14)	49 (45.79)	

(Continued)

Table 1 (Continued)

Characteristics	Sustained ROSC \geq 20 minutes		P-value
	74 failure, n (%)	107 success, n (%)	
Initial serum glucose (mg %) median (minimum, maximum)	117.5 (15, 500)	152 (11, 514)	0.048
Adrenaline (ampules) median (minimum, maximum)	6 (1, 21)	3 (0, 15)	<0.001
Adrenaline use (ampules)			<0.001
< 5 ampules	17 (34.8)	68 (63.55)	
\geq 5 ampules	57 (77.03)	39 (36.45)	

Notes: *Missing data; [†]acute coronary syndrome (14.9%), hypoxia (14.4%), cardiac arrhythmia (7.2%), massive pulmonary embolism (1.7%); [‡]metabolic cause (6.1%), sepsis (5.5%), hemorrhage, non-trauma (3.3%), neurologic emergency (2.2%), drug toxicity (2.2%), traumatic blunt injury (1.1%), anaphylaxis (0.6%), traumatic penetrating injury (0.6%), unknown/not collected (40.3%).

Abbreviations: CPC, Cerebral Performance Categories; CPR, cardiopulmonary resuscitation; ROSC, return of spontaneous circulation; SD, standard deviation.

of having a cardiopulmonary cause of SCA than non-survivors (80.0% versus 48.3%; $P = 0.010$) as shown in Table 3.

Discussion

The initial cause of SCA was the main factor associated with sustained ROSC of more than 20 minutes and being a survivor of SCA at the emergency department. These causes include acute coronary syndrome, cardiac arrhythmia, massive pulmonary embolism, and hypoxemia. All mentioned disease syndromes have a potential to be corrected if treated promptly. The outcomes of CPR therefore are better than other causes.

The duration of collapse before CPR of less than 10 minutes was another predictor for having sustained ROSC of more than 20 minutes. This finding is comparable to previous studies.^{5,9,10,12} The rate of successful CPR in SCA patients caused by shockable rhythms with defibrillation decreases by 7.0%–10.0% for each minute of delay.¹⁶ A previous study showed that CPR within 15 minutes had better survival outcomes.¹³ This study emphasizes that early CPR within 10 minutes also gave a better outcome of sustained ROSC of more than 20 minutes.

Table 2 Multivariate logistic regression results on factors associated with sustained ROSC of more than 20 minutes

Factors	Adjusted odds ratio (95% CI)
CPC score \leq 2 before arrest	10.80 (2.52–46.28)
Location of arrest: in-hospital	8.55 (2.41–30.30)
CPR duration < 30 minutes	18.93 (7.26–49.38)
Cause of arrest: cardiopulmonary	10.59 (3.89–28.83)

Abbreviations: CI, confidence interval; CPC, Cerebral Performance Categories; CPR, cardiopulmonary resuscitation; ROSC, return of spontaneous circulation.

Table 3 Clinical factors of sudden cardiac arrest patients who died or survived

Factors	Hospital course		P-value
	87 hospital death, n (%)	20 survival to discharge, n (%)	
Encephalopathy	87 (100)	20 (100)	0.621
CPC score before arrest			0.581
1 and 2	82 (94.3)	20 (100)	
3 and 4	5 (5.8)	0 (0)	
Location of arrest			0.080
In-hospital	22 (25.3)	9 (45.0)	
Out-of-hospital	65 (74.7)	11 (55.0)	
Witness arrest	87 (100)	20 (100)	0.493
Bystander performed CPR	87 (100)	20 (100)	0.887
First documented pulseless rhythm			0.356
Nonshockable	71 (81.6)	14 (70.0)	
Shockable	16 (18.4)	6 (30.0)	
Collapse to start CPR			0.108
<10 minutes	27 (31.0)	10 (50.0)	
≥10 minutes	60 (69.0)	10 (50.0)	
CPR duration			0.395
<30 minutes	65 (74.7)	17 (85.0)	
≥30 minutes	22 (25.3)	3 (15.0)	
Initial cause of arrest			0.010*
Cardiopulmonary cause	42 (48.3)	16 (80.0)	
Non-cardiopulmonary	45 (51.7)	4 (20.0)	
Adrenaline use (ampules)			0.238
<5 ampules	53 (60.9)	15 (75.0)	
≥5 ampules	34 (39.1)	5 (25.0)	

Notes: *Standard error = 2.57, OR (95% CI) = 4.29 (1.33–13.86).

Abbreviations: CI, confidence interval; CPC, Cerebral Performance Categories; CPR, cardiopulmonary resuscitation; OR, odds ratio.

In our sample, 76.8% of SCAs were witnessed, but only 28.2% of these witnesses performed CPR. The low rate CPR being performed by bystanders may indicate little knowledge of CPR by the general public. This pre-hospital resuscitation is an important factor for successful CPR as shown by this and previous studies.^{1,2,7–11} CPR training for the public should be emphasized in the Thai population.

Similar to a previous study,¹⁶ the location of SCA, CPR duration, and initial cause of SCA were associated with sustained ROSC of more than 20 minutes. CPC score before SCA was another predictor for sustained ROSC of more than 20 minutes. CPC scores of 1 and 2 had 10.8 times the chance of having successful CPR (Table 2). In addition, a cardiopulmonary cause had a higher chance of successful CPR and survival rate (Tables 2 and 3). Noncardiac causes accounted for 34.1% (276/809) of patients who had out-of-hospital cardiac arrest with a survival rate of 11.3%.¹⁹ The low survival

rate in noncardiac causes was mainly due to an initial asystole rhythm. Ventricular fibrillation or a shockable arrhythmia of cardiopulmonary causes may have better CPR outcomes. In addition, there are community-based interventions such as defibrillators to improve survival rate in those with SCA of cardiac origin.¹⁹

The limitations of this study are the retrospective study design and small numbers of subjects. Missing or incomplete data was the main limitation; 17.0% of patients were excluded due to incomplete data. In this study, causes of cardiac arrest were defined as cardiopulmonary or non-cardiopulmonary causes. Unlike previous reports or guidelines,^{19–23} causes were not well defined. A cardiac cause may be the possible cause of cardiac arrest if there was no obvious identified cause. In this study, 40.0% of patients had unidentified causes of cardiac arrest. Another limitation is the heterogeneous character of the population in the study. The outcomes, however, were statistically significant with respect to the studied variables. The results of this study show that society or public health programs such as training of basic life support or availability of defibrillators in communities are needed to improve CPR outcomes.

Conclusion

The CPC score before SCA, location of SCA, CPR duration, and initial cause of SCA were associated with sustained ROSC for more than 20 minutes for SCA patients treated at the emergency department. Survivors had a higher proportion of having a cardiopulmonary cause of SCA than non-survivors.

Acknowledgment

The authors thank Professor James A Will (University of Wisconsin) for his kind review of the manuscript.

Disclosure

The authors report no conflicts of interest in this work.

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