Evaluation of Related Factors and the Outcome in Cardiac Arrest Resuscitation at Thammasat Emergency Department

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Objective: *In the present study, we aimed to define the factors contributing to patient survival after treatment by cardiopulmonary resuscitation (CPR) following cardiac arrest.*
Material and Method: *Retrospective analysis was performed on cardiac arrest patients (n = 138) who had CPR in the emergency department (ED) at Thammasat University hospital from 2007-2009. Logistic regression was used to analyze factors that related to the sustained return of spontaneous circulation (ROSC) for 20 minutes, survival until discharge, and survival up to 1 month post discharge.*
Results: *The sustained ROSC was 22.5%, survival to discharge 5.6%, and survival from discharge to 1 month 3.6%. Significant factors related to sustained ROSC was the location of cardiac arrest, the cause of arrest, shockable rhythm with defibrillation, the time until chest compression, and CPR duration. The factor influencing survival to discharge was chest compression performed within 15 minutes after cardiac arrest (p = 0.048). No factor however could be attributed to survivability up to 1 month following discharge.*
Conclusion: *Our findings attribute six factors associated to ROSC including the location of arrest, the cause of cardiac arrest, initial cardiac rhythm, shockable rhythm with defibrillation, the time until chest compression and CPR duration. Statistically, resuscitation performed within 15 minutes of cardiac arrest increases the survivability of patients until discharge. However, no factors could be related to the percentage of patients surviving up to 1 month post discharge.*

Keywords: *Cardiopulmonary resuscitation, Outcomes, Factors*

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In Thailand, investigations on patient survival following cardiac arrest and ED resuscitation are limited. In 2006, the National Registry of CPR reported patients who were resuscitated after cardiac arrest have higher rates of death up to 55-67%. This is comparable to research findings conducted in the United Kingdom in 2007, which reported that 71% of resuscitated cardiac arrest patients died soon after CPR[1].

At present, there is a plethora of literature documenting factors contributing to sustained ROSC, and can be divided into 2 groups including factors outside the hospital and factors within the hospital. Factors outside the hospital include patients' condition, witness of arrest and pre-hospital resuscitation[1-5]. Factors within the hospital are monitoring of initial cardiac rhythm, procedures applied during resuscitation, resuscitation team and team commander[6-20]. However, all of these studies do show variance. This is most likely due to each hospital differing in administration, the handling of patients during resuscitation and the roles of a resuscitation team. It has been shown that death rates of resuscitated patients in ED can be key indicators of the quality and efficiency of a hospital. For example if successful resuscitation is performed promptly after the onset of cardiac arrest, not only does a patient's chance of survivability increase, but also the chance to reduce detrimental side effects[1-5]. Therefore studies of factors influencing survival of resuscitated patients are necessary as they can help in the improvement and development of resuscitation team and the organization.

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In this study, we aim to observe the general characteristics, outcomes and factors that influence the survivability of cardiac arrest patients after resuscitation.

Material and Method

Patient population

This retrospective analysis was conducted on cardiac arrest patients (n = 138) who had CPR in the emergency department (ED) at Thammasat University hospital from October 2007 to March 2009. The exclusion criteria was based on physician order DNAR "do not attempt resuscitation" and patients with incomplete medical records. The patients meeting inclusion criteria were divided into 2 groups: group 1 the patients with ROSC $\geq$ 20 minutes. Group 2 the patients deceased during resuscitation or with ROSC of < 20 minutes. The two groups were studied and compared for their distinctive characteristics. A follow-up on group 1 patients was performed to see how they were since the administration to the day of discharge. After discharge a telephone follow-up was initiated with the patients themselves or the relatives to assess patient survivability up to 1 month post discharge.

Statistical analysis

Demographic data was shown as numbers of patients (n), percentage of survivability (%), mean $\pm$ SD and median. The data was analyzed by comparison of continuous variables using unpaired t-test. A stepwise logistic regression analysis was used to select independent predictors to dichotomous dependent variables between sustained ROSC and non-sustained ROSC patients. Significance was accepted at $p < 0.05$.

Results

Of the admitted patients, 138 patients met the criteria for the case study. Thirty-one patients had sustained ROSC of more than 20 minutes and of these, 30 patients (22.5%) were admitted, 1 transferred to another hospital, with 8 surviving to discharge (5.6%), and 5 survived up to 1 month post discharge (3.6%). This is shown in Fig. 1 and demographic data of the subjects in Table 1. The related factors associated with resuscitation of cardiac arrest patient with sustained ROSC are shown in Table 2. A result of this present study in relation to the factors and its impact with sustained ROSC using the univariate analysis, revealed that they were statistically significant ($p < 0.05$) to many key factors, such as in-hospital cardiac arrest with an odd ratio of 3.57 (95%, CI, 1.49-8.57), known causes 6.57 (95% CI, 2.33-18.55), shockable rhythm 3.25 (95% CI, 1.22-8.65) and defibrillation 4.46 (95% CI, 1.58-12.52). The time to the first chest compression was performed

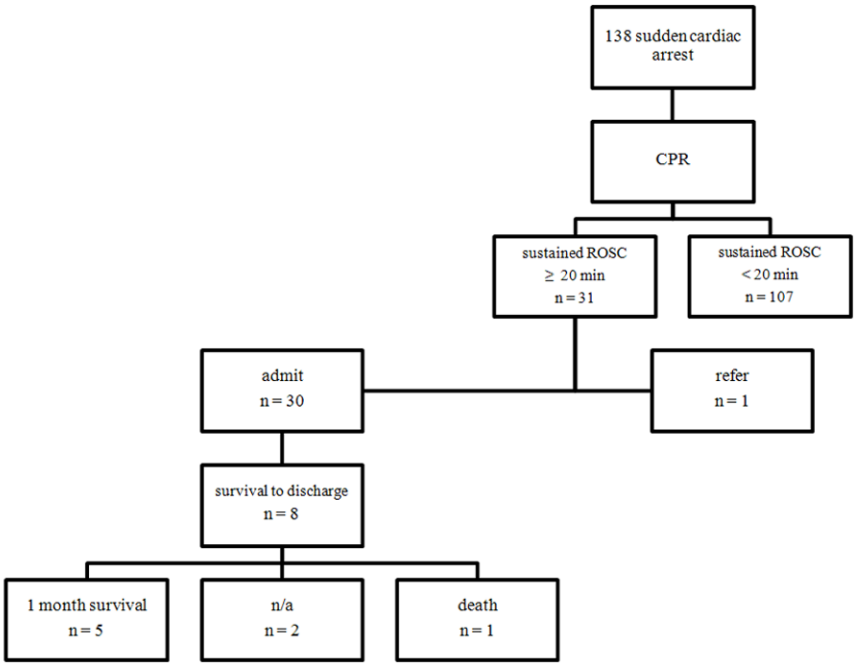

Fig. 1 Flow of the study

Table 1. Characteristics of the cardiac arrest patients

Cardiac arrest patients (n = 138)			
Characteristics	No. (%)	Characteristics	No. (%)
Gender		Suspected cause of arrest	
Male	93 (67.4)	Lethal arrhythmia	26 (18.8)
Female	45 (32.6)	Non arrhythmia	
Age(y/o), mean ± 2SD	49.6 ± 22.5	Hypotension	6 (4.3)
Location of arrest		Respiratory depression	17 (12.3)
Out-of hospital		Metabolic	4 (2.9)
Home	85 (61.5)	AMI	7 (5.1)
Transport	11 (8.0)	Unknown	78 (56.6)
Office	8 (5.8)	Initial rhythm	
Road	3 (2.2)	Shockable	
Hospital		VF	15 (10.9)
ER	31 (22.5)	Pulseless VT	7 (5.1)
Witness arrest		Nonshockable	
Yes	72 (52.2)	Asystole	97 (70.3)
No	66 (47.8)	PEA	17 (12.3)
Prehospital CPR		n/a	2 (1.4)
No	132 (95.6)	Shift	
Yes		Day	54 (39.1)
LR	5 (3.6)	Afternoon	52 (37.7)
HCP	1 (0.7)	Night	32 (23.2)
Mode of transport		Time to 1st chest compression (min),median	
Family	126 (91.3)	(Min-Max)	20 (0-120)
EMS	12 (8.7)	Total CPR times(min), median	
Underlying disease		(Min-Max)	30 (2-180)
None	38 (27.5)	Stop CPR why?	
Unknown	39 (28.2)	ROSC	30 (21.7)
CVS	34 (24.6)	Death	108 (78.3)
CNS	15 (10.9)	ROSC	
Metabolic/endocrine	26 (18.8)	≥20 min	31 (22.5)
ESRD	8 (5.8)	< 20 min	107 (77.5)
Respiratory	11 (8.0)	ED disposition	
Terminal case		Death	107 (77.6)
Yes	21 (15.2)	Refer	1 (0.7)
No	105 (76.1)	Admit with ROSC	
Unknown	12 (8.7)	20 min<ROSC<24 h	8 (5.8)
ACLS intervention		24< ROSC<72 h	1 (0.7)
Complete	138 (100)	≥72h	21 (15.2)
Incomplete	0	Hospital course	
Type of arrest		Death	22 (15.9)
Trauma	27 (19.6)	Discharge	8 (5.6)
Non-trauma	111(80.4)	LOH(day), median(Min-Max)	4.5 (1-29)
Type of trauma		Time to death (day), median(Min-Max)	4.0 (1-21)
Blunt	27 (19.6)	1 mo survival	5 (3.6)
Penetrating	0		

*ER; emergency room, LR; lay rescuer, HCP; health care provider, EMS; emergency medical service,CVS; cardio vascular disease, CNS; central nervous system, ESRD; end stage renal disease, AMI; acute myocardial infraction, VF; ventricular fibrillation, VT; ventricular tachycardia, PEA; pulseless electrical activity, n/a; non access, ROSC; reverse of spontaneous circulation, LOH; length of hospital stay.

Table 2. Related factors associated with sustained ROSC in cardiac arrest patients (n = 138)

Characteristics	Sustained ROSC ≥ 20 min		p-value
	31 Success; n (%)	107 Failure; n (%)	
Gender			
Male	21 (67.7)	72 (67.3)	0.962
Female	10 (32.3)	35 (32.7)	
Age(y/o), mean ± 2SD	52.4 ± 21.2	48.8 ± 22.3	0.426
Location of arrest			
Out-of hospital			
Home	14 (45.2)	71 (66.4)	0.039
Transport	3 (9.7)	8 (7.5)	
Office	1 (3.2)	7 (6.5)	
Road	0	3 (2.8)	
Hospital			
ER	13 (41.9)	18 (16.8)	
Witness arrest			
Yes	21 (67.7)	51 (47.7)	0.052
No	10 (32.3)	56 (52.3)	
Mode of transport			
Family	29 (93.5)	97 (90.7)	0.735
EMS	2 (6.5)	10 (9.3)	
Underlying disease			
None	8 (25.8)	30 (28.0)	0.807
Unknown	8 (25.8)	31 (29.0)	0.730
CVS	9 (29.0)	25 (23.4)	0.519
CNS	3 (9.7)	12 (11.2)	0.809
Metabolic/endocrine	7 (22.6)	15 (14.0)	0.545
ESRD	2 (6.5)	6 (5.6)	0.859
Respiratory	5 (16.1)	6 (5.6)	0.070
Terminal case			
Yes	2 (6.5)	19 (18.7)	0.220
No	25 (80.6)	80 (74.8)	
Unknown	4 (12.9)	8 (7.5)	
Type of arrest			
Trauma	3 (9.7)	24 (22.4)	0.115
Non-trauma	28 (90.3)	83 (77.6)	
Suspected cause of arrest			
Lethal arrhythmia	12 (38.7)	14 (13.0)	0.009
Non arrhythmia			
Hypotension	1 (3.2)	5 (4.7)	
Respiratory	6 (19.4)	11 (10.3)	
Metabolic	1 (3.2)	3 (2.8)	
AMI	2 (6.5)	5 (4.7)	
Unknown	9 (29.0)	69 (64.5)	
Initial rhythm			
Shockable			
VF	8 (25.8)	7 (6.5)	0.002
Pulseless VT	1 (3.2)	6 (5.6)	
Nonshockable			
Asystole	16 (51.6)	81 (75.7)	
PEA	4 (12.9)	13 (12.2)	
n/a	2 (6.5)	0	
Defibrillation			
yes	9 (29.0)	9 (8.4)	0.005
No	22 (71.0)	98 (91.6)	

Table 2. (Cont.)

Characteristics	Sustained ROSC ≥20 min		p-value
	31 Success; n (%)	107 Failure; n (%)	
Shift			
Day	15 (83.4)	39 (36.4)	0.409
Afternoon	11 (35.5)	41 (38.3)	
Night	5 (16.1)	27 (25.3)	
Time to 1st chest compression (min), median(Min-Max)	10.55 (0-30)	22.96 (0-120)	0.001
Time to 1st chest compression (min)			
< 15 min	15 (55.6)	25 (27.5)	0.007
≥ 15 min	12 (44.4)	66 (72.5)	
Total CPR times (min), median (Min-Max)	16.54 (2-60)	43.43 (10-180)	< 0.001
Total CPR times (min)			
< 15 min	13 (41.9)	5 (4.7)	< 0.001
≥ 15 min	18 (58.1)	102 (95.3)	

within the first 15 minutes 3.30 (95% CI, 1.36-8.02) and CPR duration less than 15 minutes 14.73 (95% CI, 4.68-46.38) are shown in Table 3.

Using multivariate analysis with backward logistic regression revealed that the impact of six factors related to resuscitation of cardiac arrest patients with sustained ROSC more than or equal to 20 minutes. The impact of 2 factors is shown in Table 4, being causes of cardiac arrest. These are classified as lethal arrhythmia factor 9.17 (2.64-31.77) and total CPR time less than 15 minutes 12.54 (3.04-51.68). Only one factor influenced survival to discharge, which was the time to the 1st chest compression, being less than 15 minutes (Table 5). No statistically significant factor influencing survival to 1 month was found in this study.

Discussion

The outcome of CPR in this study is much lower when compared to statistic figures of overseas researches. The main cause being that, in developed countries a "pre-hospital care" system was set in place for the emergency teams. From the many researches' studied, it was clear that cardiac arrest patients have a higher chance of survival if chest compression was performed as soon as possible. However, from this study 77.5% of the patients had cardiac arrest outside the hospital and of this 95.6% did not receive pre-hospital basic life support. In countries with successful resuscitation of cardiac arrest patients, it was clear that there is an effective system in place to assist and transport patients, effective hotline center, well equipped ambulance, and a highly skilled and experienced pre-hospital care team. With this system, in some countries advance resuscitation is performed at the location of the arrest[2,16,18,20-22]. In Thailand, however a system for Emergency Medical Service is in a developing stage as there has recently been an Emergency Medical Institution of Thailand established in 2008 with a hotline number 1669. Inside information (as of 30 September 2009) from the institution's report in regards to the call through 1669 only 52.61% if the population uses this number and in Pathumthani-where Thammasat University hospital is located the use of this number is only 32%. This supports the research finding that 91.3% of the patients were transported to the hospital by members of the family. In order for the patients to receive assistance as soon as possible it is very important to promote the use of the hotline number 1669, as well as to expand the zone of this service. However, it is vital that relatives and the general public be educated on first aid and basic resuscitation so necessary assistance can be provided to the patients prior to the medical team arrival. In this aspect, hospital or concerned organization should implement and continue training these people.

The sustained ROSC ≥ 20 minutes is a patient survival success indicator because by this time all of the organs can be recovered to full functionality[1], and was employed in the present study. These groups of patients' rate of survival to discharge are higher than

Table 3. Univariate logistic regression analysis of related factors for sustained ROSC in cardiac arrest patients.

Factors	Coefficient	Standard error	OR (95% CI)	p-value
Location of arrest				
Hospital	1.27	0.44	3.57 (1.49-8.57)	0.004
Out-of-hospital			1	
Suspected cause of arrest				
Lethal arrhythmia (VF, pulseless VT)	1.88	0.53	6.57 (2.33-18.55)	<0.001
Non arrhythmia	1.16	0.51	3.19 (1.16-8.80)	0.025
Unknown			1	
Shockable rhythm				
Yes	1.18	0.50	3.25 (1.22-8.65)	0.018
No			1	
Defibrillation				
Yes	1.49	0.53	4.46 (1.58-12.52)	0.005
No			1	
Time to 1st chest compression				
< 15 min	1.19	0.45	3.30 (1.36-8.02)	0.008
≥ 15 min			1	
Total CPR time				
< 15 min	2.69	0.58	14.73 (4.68-46.38)	<0.001
≥ 15 min			1	

OR, Odds ratio; CI, Confidence interval

Table 4. Multivariate logistic regression analysis of related factors for sustained ROSC in cardiac arrest patients

Factors	Coefficient	Standard error	OR (95% CI)	p-value
Suspected cause of arrest				
Lethal arrhythmia (VF, pulseless VT)	2.22	0.63	9.17 (2.64-31.77)	< 0.001
Non arrhythmia	0.95	0.68	2.58 (0.68-9.75)	0.163
Unknown			1	
Total CPR time				
<15 min	2.53	0.72	12.54 (3.04-51.68)	< 0.001
≥ 15 min			1	

that of resuscitated patients with ROSC less than 20 minutes, which normally die soon after. The percentage of surviving patients also occurred in higher frequency in cases where there was in-hospital cardiac arrest. Patients attended by medical staff are instant unlike that of out of hospital cardiac arrest having to be transported for help. Patients with cardiac arrest, especially in shockable cardiac rhythm such as: pulseless VT and VF, have a high chance of survival if help was given instantly. The results are similar to the overseas studies that if resuscitation is performed within 10 minutes[2,9,10,16,23]. Therefore in crowded locations like department stores and airports an Automatic External Defibrillator (AED) should be available and accessible so that if necessary, can be used on patients if required, prior to the arrival of the medical team. From this research study, no relevant statistic factors were found on factors influencing survival to one month. This may be due to the minimal number of patients fitting the criteria, as well as incomplete information recorded by the registry staff. If provided, more time to gather more samples and with a better recording system, the related factors could be found and may enhance in a greater survival number.

Conclusion

From 138 cardiac arrest patients resuscitated in the ED, 22.5% regained sustained ROSC, 5.6%

Table 5. Related factors associated with survival to discharge

Factors	Hospital course		p-value
	22 hospital death; n (%)	8 Survival to discharge; n (%)	
Location of cardiac arrest			
Hospital	8 (36.4)	5 (62.5)	0.201
Out-of-hospital	14 (63.6)	3 (37.5)	
Witness			
Yes	15 (68.2)	6 (75.0)	0.719
No	7 (31.8)	2 (25.0)	
Suspected cause of arrest			
Lethal arrhythmia	8 (36.4)	3 (37.5)	0.928
Non arrhythmia	7 (31.8)	3 (37.5)	
Unknown	7 (31.8)	2 (25.0)	
Initial rhythm			
Shockable	4 (18.2)	3 (37.5)	0.269
Nonshockable	18 (81.8)	5 (62.5)	
Time to 1st chest compression			
< 15 min	8 (36.4)	7 (87.5)	0.048
≥ 15 min	14 (63.6)	1 (12.5)	

survived to discharge and 3.6% survived up to one month after discharge. Statistically factors influencing sustained ROSC are: the location of arrest, the cause of cardiac arrest, initial cardiac rhythm, shockable rhythm with defibrillation, the time until chest compression and CPR duration. Factors influencing survival to discharge are resuscitation performed within 15 minutes ($p = 0.048$). There was no relevant factor found in regards to one month survival after discharge, however.

Study limitations

From the statistic record of resuscitated patients in the ED of Thammasat University hospital from year 2007 to 2009, there were 353 patients, but only 138 met the criteria for this study. Part of the reason for the small number of patients meeting the criteria is because of an incomplete CPR record form. The form in use today is non-practical as it is not user friendly and is time consumable. Another reason is the misplacing of patient records. If a record is lost, it means a loss of an example. In the future the Utstein template should be applied and circulated for use[24].

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ศึกษาปัจจัย และผลของการกู้ชีพต่อการรอดชีวิตของผู้ป่วยภาวะหัวใจหยุดเต้นเฉียบพลัน ในห้องฉุกเฉินโรงพยาบาลธรรมศาสตร์เฉลิมพระเกียรติ

กัมพล อำนวยพัฒนพล, อุมาพร อุดมทรัพยากุล

วัตถุประสงค์*: เพื่อศึกษาผลของการกู้ชีพและปัจจัยที่มีผลต่อการรอดชีวิตหลังการกู้ชีพ*

วัสดุและวิธีการ*: ศึกษาผลของการกู้ชีพและใช้สถิติช่วยหาปัจจัยที่มีผลต่อการรอดชีวิตของผู้ป่วยภาวะหัวใจหยุดเต้นเฉียบพลัน หลังการกู้ชีพ ระหว่าง ตุลาคม พ.ศ. 2550 ถึง มีนาคม พ.ศ. 2552 โดยวัดความสำเร็จของการกู้ชีพจากการ มีชีพจร และการไหลเวียนกลับคืนมานานกว่าหรือเท่ากับ 20 นาที การมีชีวิตรอดจนสามารถจำหน่ายออกจากโรงพยาบาล และมีชีวิตรอดจนถึงหนึ่งเดือน*

ผลการศึกษา*: มีผู้ป่วยที่ตรงเกณฑ์จำนวน 138 ราย ในจำนวนนี้มีชีพจรและการไหลเวียนกลับคืนมานานมากกว่าหรือเท่ากับ 20 นาที ร้อยละ 22.5 สามารถจำหน่ายออกจากโรงพยาบาลได้ร้อยละ 5.6 และมีชีวิตรอดจนถึงหนึ่งเดือน ร้อยละ 3.6 ปัจจัยที่ทำให้ผู้ป่วยมีชีพจร และการไหลเวียนกลับคืนมานานมากกว่าหรือเท่ากับ 20 นาที ($p < 0.05$) ได้แก่ สถานที่เกิดเหตุ ทราบสาเหตุ ลักษณะคลื่นหัวใจที่สามารถใช้เครื่องช็อกไฟฟ้าหัวใจ การทำการช็อกหัวใจด้วยไฟฟ้า ระยะเวลาที่เริ่มมีการกดหน้าอก ระยะเวลาที่ใช้กู้ชีพ ปัจจัยที่มีผลต่อการรอดชีวิตจนสามารถจำหน่ายออกจากโรงพยาบาลคือการที่ผู้ป่วยได้รับการกดหน้าอกภายใน 15 นาที และไม่พบปัจจัยที่มีผลกับการรอดชีวิต จนถึงหนึ่งเดือน*

สรุป*: ผลของการกู้ชีพ และปัจจัยต่างๆ ที่มีผลต่อการรอดชีวิตของผู้ป่วย หลังการกู้ชีพเป็นข้อมูลที่มีประโยชน์ต่อทีมกู้ชีพในด้านการดูแลรักษา และพัฒนามาตรฐานของการกู้ชีพต่อไป*