Factors Influencing CPR Outcome in Siriraj Hospital†

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Abstract

This prospective study of cardiopulmonary resuscitation was surveyed in Siriraj Hosital from 1 March 1996 to 31 May 1996. In a 3- month-period, 94 resuscitated patients were reported with initial survivors 31 cases (33 %) and 3 patients (3 %) were alive until discharged from the hospital. Most of the resuscitated patients belonged to the emergency department (47 %) with the lowest survival rate (23 %). The common causes of cardiac arrest were heart diseases (31 %) and respiratory failure (21 %). All survivors who were able to be discharged from the hospital had suffered cardiac arrest from heart diseases. After resuscitation, only half of the initial survivors received postarrest care in the intensive care units, the rest remained in general wards and outpatient department. By using logistic regression for multivariate analysis, the survival rate was correlated with locations of CPR, duration of CPR and duration of attempt endotracheal intubation. The initial survival outcome of CPR was not related to sex, age, time of day of CPR, duration of hospitalization before CPR, types of arrhythmia, delay in doctors' arrival and performers of CPR.

Cardiopulmonary resuscitation (CPR) has been practiced since external cardiac massage was described by Kuwenhouen in 1960[1]. With the now widespread teaching of basic and advanced life support to physicians and nursing staffs, together with recent advances in resuscitation equipments, it is expected that improvement of chain of survivals (early access, early CPR, early defibrillation and early advanced care) would result in better outcome from cardiac arrest occurring within hospitals. Previous studies since 1966-1995 showed a success rate of CPR (discharge rate)[2-15] ranging

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from 6-19 per cent. Some survivors were severely neurologically impaired and required expensive long-term medical and domestic care. Nevertheless, there is a tendency that all patients should be considered a candidate for CPR, regardless of their age, underlying conditions or prognosis. Consequently, this will lower the overall success rates and raise the questions of cost-effectiveness and the ethics of resuscitation in terminally ill patients.

To learn about the incidence, outcome and factors influencing CPR outcome including the different characteristics between survivors and non-survivors, we proposed to undertake this prospective study in our institution and compared our results with those of recent published study[2-15] in order to identify any changes which might lead to more successful management, to evaluate the resuscitation skill of personnel and if possible to learn about the factor that may guide the decision whether or not to apply and to continue CPR.

MATERIAL AND METHOD

A prospective survey on cardiopulmonary resuscitation was carried out in Siriraj Hospital from 1 March 1996-31 May 1996. Cardiac arrest was diagnosed clinically on the criteria of absent pulse, cyanosis, loss of consciousness, and absent respiration and/or by electrocardiograph tracing if the patients were monitored. In-patients who suffered from more than one arrest, only the first arrest was included, Cardiac arrest patients with DO NOT RESUSCITATE order were excluded from this study. The patients who had hemodynamic recovery, mean arterial pressure not less than 50 mmHg were determined the initial survivors. Information for the survey was obtained for each patient from special design CPR data sheets and from the patient's hospital medical records. The data were voluntarily recorded by the ward nurse verified each day and subsequently analysed by the MD investigators. In addition, the persons involved in the resuscitation were questioned about events occurring in relation to the arrest and the probable causes. Subsequently, all patient records were reviewed for additional information and outcomes.

Siriraj Hospital is a 2,490 beds general teaching hospital with 117 wards and 21 buildings[16] ; the resuscitation policy consists of guideline for basic and advanced life support[17] initiated by nursing and medical staff immediately available at the scene of arrest. The cardiac arrest team has not yet been established because of the geographic problem and the shortage of manpower.

Statistical analysis

Chi square and Fisher Exact test were used for univariate analysis. Backward stepwise logistic regression and likelihood ratio were used for multivariate analysis. P value less than 0.05 was considered to be statistically significant.

RESULTS

Ninety-four CPRs were voluntarily reported during the three-month survey period, representing 8 CPRs week. The outcome of CPR is shown in Table 1. Of the 94 CPRs, there were 31 (33 %) initial survivors who had circulation reestablished and palpable peripheral pulses. Only 3 (3 %) went home alive, two of these were ambulant and all were able to care for themselves.

Table 1. Outcome of CPR.

	No.of patients	%
Initial success	31	33
- alive after 24 hours	(17)	
- alive after 72 hours	(14)	
- alive after 7 days	(10)	
- alive after 28 days	(4)	
- discharged alive	(3)	
Initial failure (death)	63	67
Total	94	100

Table 2. Outcome of 31 patients who were initially successful resuscitatied.

	No of patients	%
Fully recovered	2	6
Mild brain damage	1	3
Severe brain damage	1	3
Death		
- Progressive hypotension and death within 12 h	11	36
- Progression of original illness and death after 12 h	16	52
Total	31	100

The clinical course subsequent to cardiac arrest of these patients who were initially successful resuscitation is shown in Table 2.

Table 3 describes the sex and age of the patients, the location in the hospital where CPR was conducted, and the duration of hospitalization before CPR. There was no significant sex difference between survivors of CPR and non survivors, nor did sex affect initial survival outcome. The patients ranged from newborn to 96 years (mean 50). Sixty-two per cent of CPR patients were under 65 years old but age did not affect the outcome. Initial resuscitaion was most successful in intensive care units (including CCU) but none of these patients was discharged from the hospital. Most of the CPR patients (64 %) sustained cardiorespiratory arrest after 24 hours of hospitalization but the duration of hospitalization before CPR did not affect the initial survival outcome

Results of CPR in relation to department are shown in Table 3. Most CPR patients belonged to the Emergency Department, the initial survival rate was lowest but survival to discharge rate was highest. The most succesful initial resuscitation was in Obstetric-Gynecological department but no patient was alive to discharge. (all were cancer patients).

Table 4 describes the probable causes of cardiopulmonary arrest. Heart diseases were the commonest cause of arrest (31 %), non-ischemic heart diseases were more common than ischemic heart disease, followed by respiratory failure. The most successful initial resuscitation were attributed to respiratory failure (50 %) and renal failure (50 %) but all the survivors to discharge were related to heart diseases.

Characteristics of the arrest are described and analyzed in Table 5. The initial survival outcome of CPR was dependent on mechanism of the arrest. Forty percent of patients whose arrest was related either to ventricular fibrillation or ventricular tachycardia survived initially compared to only 18 per cent survival in patients whose arrest was related to asystole. But there was no significant difference among mechanism of arrest in survivors to discharge.

Although most of the CPR occurred out of the official hours (0801-1600, 74 %), the initial successful resuscitation and survivors to discharge were not related to time of CPR. Duration of resuscitation was significantly inverse with outcome, only 22 per cent survived initially when duration of CPR was more than 15 minutes, compared to 58 per cent survival in patients whose CPR was of shorter duration.

Tabel 3. Characteristics of patients undergoing CPR.

	No of CPR	Initial survivors	Non survivors	Survivors to discharge	p value
Sex					
Men	52	16 (31 %)	36 (69%)	1	0.774
Women	42	15 (36 %)	27 (64 %)	2	
Age (yr)					
Under 65	58	20 (34 %)	38 (66 %)	1	0.905
65 and over	33	11 (33 %)	22 (67 %)	2	
unknown	3	0 (0 %)	3 (100 %)	0	
Location of CPR					
General wards	40	15 (38 %)	25 (62%)	1	
ER	44	10 (23 %)	34 (77 %)	2	0.056
ICU	10	6 (60 %)	4 (40 %)	0	
Duration of hospitalization before CPR					
less than 24 h	34	11 (32)	23 (68)	2	0.896
24 h or more	60	20 (33)	40 (67)	1	
Department					
OPD (ER)	44	10 (23)	34 (77)	2	
Medicine	36	13 (36)	23 (64)	0	
Surgery	6	3 (50)	3 (50)	1	
Pediatrics	4	2 (50)	2 (50)	0	
OB-GYN	4	3 (75)	1 (25)	0	

Tabel 4. Outcome of CPR in relation to clinical causes.

Causes	No. of CPR	Initial survivors	Non survivors	Survivors to discharge
Heart diseases	29	12 (41 %)	17 (59 %)	3
*MI	*11	*2	*9	*1
*Non-MI	*18	*10	*8	*2
Respiratory failure	20	10 (50 %)	10 (50 %)	0
Metabolic causes	10	2 (20 %)	8 (80 %)	0
Septic shock	9	4 (44 %)	5 (56 %)	0
Trauma	6	0 (0 %)	6 (100 %)	0
Hemorrhage	4	0 (0 %)	4 (100 %)	0
Renal failure	4	2 (50 %)	2 (50 %)	0
Primary cerebral	3	1 (33 %)	2 (67 %)	0
Drug abuse	1	0 (0 %)	1 (100 %)	0
Unknown	8	0 (0 %)	8 (100 %)	0
Total	94	31		3

Table 5. Characteristics of CPR in relation to outcome.

	No. of CPR	Initial survivors	Non survivors	Survivors to discharge	p - value
Mechanism of arrest					
Asystole	33	6 (18 %)	27 (82 %)	1	0.102
VF or VT	30	12 (40 %)	18 (60 %)	1	
EMD	6	2 (33 %)	4 (67 %)	0	
Unknown	25	11 (44 %)	14 (56 %)	1	
Time of Day of CPR					
0801-1600	25	10 (40 %)	15 (60 %)	1	0.62
1601-2400	42	12 (29 %)	30 (71 %)	1	
0001-0800	27	9 (33 %)	18 (67 %)	1	
Duration of CPR					
≤ 15 min	26	15 (58%)	11 (42 %)	1	0.002*
> 15 min	67	15 (22%)	42 (78 %)	1	
Unknown	1	1		1	

VF = Ventricular fibrillation, VT = Ventricular tachycardia, EMD = Electromechanical dissociation

Table 6 describes the outcome of CPR in relation to time delay in CPR initiation and arrival of doctors. Almost all arrests (95 %) received CPR within 4 minutes, only 5 per cent received delayed CPR of more than 4 minutes with 100 per cent mortality. There were no correlation in delay of doctors' arrival and outcome. Most cases had assisted breathing and cardiac massage by doctors, but the initial survival outcome was not different between doctors and nurses. In VF/VT patients, defibrillation therapy did not affect the initial survival outcome, nor did the timing of defibrillation initiation.

The results of multivariate analysis of initial survival outcome and aforementioned factors showed that no significant correlation was found according to sex, age, time of day of CPR, duration of hospitalization before arrest, mechanism of arrest (types of arrhythmia), delay in doctors' arrival and performers of CPR. There was significant correlation with locations of CPR, duration of CPR and duration of attempted endotracheal intubation as shown in Table 7. Initial survival rate was high in ICU, duration of CPR less than 15 minutes and duration of attempted endotracheal tube within and more than 4 minutes. The initial survival outcome

Tabel 6. Outcome of CPR in relation to CPR performance.

	No. of CPR	Initial survivors	Non survivors	p-value
Delay in CPR initiation				
≤ 4 min	88	30 (34)	58 (66)	0.171
> 4 min	5	0 (0)	5 (100)	
* Unknown 1 case				
Delay in arrival of the doctors				
≤ 4 min	80	26 (33)	54 (67)	1.0
> 4 min	14	5 (36)	9 (64)	
Performers of assisted ventilation				
Doctors	46	11 (24)	35 (76)	0.48
Nurses	26	9 (35)	17 (65)	
* Unknown 1 case, 21 patients had already been on ventilator				
Performers of cardiac massage				
Doctors	75	25 (33)	50 (67)	0.619
Nurses	17	4 (24)	13 (76)	
* Unknown 2 cases				
Duration of attempt endotracheal intubation				
≤ 4 min	45	15 (33 %)	30 (67 %)	0.873
> 4 min	23	8 (35 %)	15 (65 %)	
already intubated	24	8 (33 %)	16 (67 %)	
non-intubated	2	0 (0 %)	2 (100 %)	
Defibrillation therapy in VF/VT				
Yes	25	10 (40 %)	15 (60 %)	1.0
No	5	2 (40 %)	3 (60 %)	
Timing of defibrillation				
≤ 10 min	14	7 (50 %)	7 (50 %)	0.414
> 10 min	11	3 (27 %)	8 (73 %)	

Table 7. Significant correlation of survival outcome and aforementioned factors.

Variables	Coefficient of dependence	Significance
Location		0.0012
Ward	- 0.1743	
ER	- 1.8991	
ICU	2.0734	
Duration of CPR		0.0022
≤ 15 minutes	0.8670	
> 15 minutes	- 0.8670	
Duration of attempt endotracheal intubation		0.0216
≤ 4 minutes	2.3482	
> 4 minutes	2.3495	
already intubated	- 0.0629	
non-intubated	- 4.6248	

was lowest in the emergency room, low in general wards duration of CPR more than 15 minutes and the patients who were not intubated.

The outcome of survivors attributed to postarrest care is illustrated in Table 8. Only half of the initial survivors were treated in the intensive care unit. However, the initial survivors managed in the general ward were discharged alive more than those from the ICU

DISCUSSION

The incidence of cardiopulmonary resuscitated patients in this study (94 cases in 3 months) was much different from our retrospective study(16)

Table 8. Outcome of survivors in relation to postarrest care.

Location of postarrest care	Initial survivors	Survivors to discharge
ER	2	0 (0 %)
ward	13	2 (15 %)
ICU	16	1 (6 %)
Total	31	3 (10 %)

(685 cases in 3 months). As expected, the previous results might not be accurate because some data derived by recalling, not by the records. However, this prospective study also had some weak points. Firstly, the CPR data were voluntarily reported so that there might be some hidden incidence. Secondly, there was the limitation of medical record collecting systems in our hospital, CPR records were only available in the emergency room (ER) but we could not find out any detatil in those medical records as our special data sheets. In other departments, it was even more difficult to find out the total incidence of CPR other than those voluntary reports because only dead cases were recorded instead of CPR cases. In order to obtain more accurate data, a specially designed study and special data collecting team other than usual nurses who had a lot of work are recommended.

Studies over the past twenty years of resuscitation surveying in-hospital cardiac arrest [2-15] are summarized in Table 9

The outcome of the recent studies has not improved much more than 30 years ago may be due to more resuscitation attempts in a larger percentage of patients, despite the presence of multiple diseases. Our results were comparable to other studies only with the initial resuscitation rate but the survivals to discharge from the hospital were the lowest. Twenty-seven from 31 initial survivors suffered moderate to severe neurological deterioration afterwards.

Our study indicated that advanced age did not adversely affect outcome. Of patients above 65 year, 33 per cent survived, compared to 34 per cent of younger patients, which agrees with several recent reports[8,12,18]. Resuscitation of patients who arrested in intensive care units showed highly successful but ultimately turned 100 per cent mortality. As confirmed by others,[19] this was not surprising in view of the poor prognosis and multiple medical problems of these patients.

In our studies, most of the patients (47 %) received CPR in the outpatient department. Sixty-four percent of these outpatients arrested outside of the hospital where there were was not enough efficient referral system and well-trained transferring personnel which may have caused the high mortality rate. Even the outpatients arrested in the

Table 9. Summary of studies of resuscitation following in-hospital cardiac arrest.

Authors (Yr)	Reference	Place	No. of CPR	Initial survivors	Left hospital
Sykes, Orr (1966)	2	London	184	31 %	13 %
Stock (1966)	3	Melbourne	59	42 %	13.5 %
Johnson, Tanser (1967)	4	Montreal	552	31.7 %	14.9 %
Wildsmith et al (1972)	5	Edinburg	536	33 %	11.9 %
Lemire, Johnson (1972)	6	Montreal	1204	-	19.1 %
Messert, Quaglieri (1976)	7	Wisconsin	183	22 %	14.2 %
Peatfield (1977)	8	London	1063	32.5 %	8.7 %
Wernberg, Thommassen (1979)	9	Denmark	1172	-	6.1 %
Tweed et al (1980)	10	Winnepeg	2091	41 %	12.5 %
Hershey, Fisher (1982)	11	Cleveland	88	60 %	14 %
Bedell, Delbance (1983)	12	Boston	294	44 %	14 %
Woog, Torzills (1987)	13	Sydney	174	44 %	16 %
Rozenbaum, Shenkman (1988)	14	Tel Aviv	71	41 %	18 %
Saklayen et al (1995)	15	Review 113 published reports	26,095	44 %	14-17 %
Suraseranivongse et al (1997)		Bangkok	94	31 %	3 %

hospital, there was still low initial successful resuscitation. Therefore, it is necessary to have experienced personnel, adequate monitorings and resuscitation equipment including defibrillators, Actually, the physicians in ER are last year medical students (externs), interns or first year residents who have already been trained about CPR. Nevertheless, regular teaching and training for personnel in CPR is mandatory.

The next department with the high number of CPR patients was the Department of Internal Medicine where most of the patients had terminal diseases or critical illnesses and they needed close monitoring but the ratio of personnel (nurses) to severely ill patients was very low and there was not enough monitoring equipment or ICU care to attribute early access for these patients. Although, there was no delay in arrival of the resident, there might be a delay in recognising that the patient had arrested which caused the very poor outcome.

The most common probable cause of arrest was heart disease similar to the previous studies[13,14], but the main heart problems in our results were non-ischemic heart disease, differed from other studies[13,14] that was ischemic heart disease. The outcome until discharged was better than other causes. There were no survivors from trauma cause due to severe multiple trauma, near drowning with ARDS and electric shock, neither were from hemorrhagic causes, i.e. lung hemorrhage and upper GI hemorrhage.

Our results found high initial resuscitation rate for patients in VT/VF (40 %) compared to asystole (18 %) as has been well documented,[5, 9,19] However, if the patient survived a period of asystole, he had a better prognosis than if he was initially resuscitated with VF. When followed until death or discharge, the difference of mechanism of arrest did not affect the subsequent outcome.

No difference in outcome was noted in arrests from VF/VT in spite of defibrillation, neither was the outcome of defibrillation within 10 minutes or later. The probable reason might be associated with severe underlying diseases and incorrect metabolic problems.

The initial time of day which arrest took place did not affect the outcome. It may be because most of the arrests belonged to the medical department and emergency room (ER) where there were residents in charge 24 hours. Therefore, there was no difference in numbers of personnel according to the time.

The initial survival outcome was influenced with the duration of CPR, the survivors from within 15 minutes duration of CPR were higher than those with a duration more than 15 minutes. Longer duration of CPR did give less chance to recover.

Delay in initiation of CPR seemed to affect the outcome because of 100 per cent mortality found in delay of more than 4 minutes group as widely accepted[20,21], but with no statistical significance. Although most of the CPR were performed by doctors, the initial survival outcome of CPR attributed to the performance of assisted ventilation and cardiac massage between doctors and nurses was not different. The regular training of basic life support to nurses did improve their efficiency. Therefore, the delay in arrival of doctors or prolonged duration of endotracheal intubation did not affect the outcome at all.

By using the univariate analysis, we found that only the duration of CPR significantly affected the outcome. However, by multivariate analysis, there were 3 factors, namely the location of CPR, the duration of CPR and the duration of attempted endotracheal intubation, significantly affecting the outcome. The discrepancy in the result of the univariate and multivariate analysis was probably because of the control of other factors in multivariate analysis.

The first significant predictor of survival outcome was location. The location with best outcome was ICU but the worst and worse were emergency room and general wards subsequently. This predictor might be associated with the equipment and experienced personnels which were more available in ICUs than emergency rooms and general wards. The second predictor was inversely correlated with the duration of CPR as the prolonged time induced irriversible cell damage. The last predictor associated with the duration of attempted endotracheal intubation. The worst outcome correlated with non-intubated patients which might have been desperate or unable to intubate. The attempt to resuscitate might be more aggressive in the after arrest-intubated group therefore their prognosis was better.

The mortality after initial successful resuscitation was high, only 3 per cent of resuscitated patients were alive to discharge from the hospital.

Postarrest care including invasive hemodynamic monitoring, adequate oxygenation and ventilation, metabolic balance and cerebral resuscitation are extremely important[22,23]. Further teaching and training are recommended for the improvement of postarrest care especially in general wards because of the limitation of beds in the ICU.

SUMMARY

In a 3-month period, 94 resuscitated patients were reported with 31 patients (33 %) who initially survived. Three patients were alive to discharge from the hospital. The strong predictors correlated with initial survival outcome were the location of CPR, the duration of CPR and the duration of attempted endotracheal intubation. "No CPR" policy should be considered in ICU patients with poor prognosis and severe multiple medical problems.

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ปัจจัยที่มีอิทธิพลต่อผลปฏิบัติการกู้ชีพในโรงพยาบาลศิริราช†

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คณะผู้วิจัยได้ทำการศึกษาปฏิบัติการกู้ชีพ (Cardiopulmonary resuscitation, CPR) ในโรงพยาบาลศิริราช แบบ prospective เพื่อสำรวจอุบัติการณ์และปัจจัยที่มีอิทธิพลต่อผลของปฏิบัติการกู้ชีพในระยะ 3 เดือน ได้รับรายงานการทำ CPR ผู้ป่วยจำนวน 94 ราย ผู้ป่วย 31 ราย (33 %) รอดชีวิตในระยะแรก ผู้ป่วยรอดชีวิตจนสามารถออกจากโรงพยาบาลได้ 3 ราย (3 %) ผู้ป่วยส่วนใหญ่ที่ได้รับ CPR เป็นผู้ป่วยห้องฉุกเฉิน (47 %) และผู้ป่วยในของภาควิชาอายุรศาสตร์ (38 %) โดยผู้ป่วยนอกฉุกเฉินมีอัตรารอดชีวิตต่ำสุด (23 %) โรคที่เป็นสาเหตุของ cardiac arrest อันดับหนึ่งได้แก่โรคหัวใจ (31 %) รองลงมาได้แก่ โรคระบบทางเดินหายใจล้มเหลว (21 %) ผู้ป่วยที่รอดชีวิตจนสามารถช่วยเหลือตัวเองได้ และกลับบ้านได้ทั้ง 3 ราย เป็นผู้ป่วยโรคหัวใจทั้งหมด การดูแลผู้ป่วยที่รอดชีวิตจาก CPR ครึ่งหนึ่งจะได้รับการดูแลในหออภิบาลผู้ป่วยหนัก ผู้ป่วยที่เหลือคงได้รับการดูแลอยู่ที่หน่วยเดิม จากการวิเคราะห์แบบ multivariate analysis โดยใช้ logistic regression พบว่าโอกาสรอดชีวิตจากการทำ CPR มีความสัมพันธ์กับสถานที่ทำ CPR, ระยะเวลาในการทำ CPR และระยะเวลาที่ใช้ในการใส่ท่อช่วยหายใจ ส่วนปัจจัยอื่น ๆ เช่น เพศ, อายุ, ช่วงเวลาที่ทำ CPR, ช่วงเวลาที่อยู่ในโรงพยาบาลก่อน arrest, ชนิดของ arrhythmia, การทำ defibrillation, ระยะเวลาตั้งแต่ arrest จนถึงเริ่ม CPR, ระยะเวลาที่ใช้ในการตามแพทย์ และผู้ปฏิบัติการกู้ชีพ ไม่มีความสัมพันธ์กับโอกาสรอดชีวิตจากการทำ CPR

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† การวิจัยนี้ได้รับเงินสนับสนุนจากทุนศิริราชไซน่าเมดิคัลบอร์ด