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ผลภายหลังการช่วยฟื้นคืนชีพในผู้ป่วยโรคระบบประสาทภายในสถาบันประสาทวิทยา

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[1]กลุ่มงานวิสัญญีวิทยา, [2]กลุ่มภารกิจด้านการพยาบาล สถาบันประสาทวิทยา กรุงเทพฯ ประเทศไทย

Outcomes of Cardiopulmonary Resuscitation in Neurologic-neurosurgical Patients at Prasat Neurological Institute

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บทนำ: ผู้ป่วยโรคระบบประสาทมีพยาธิสรีรวิทยาของการดำเนินโรค และการรักษาโรคที่มีลักษณะเฉพาะแตกต่างจากผู้ป่วยโรคทั่วไป งานวิจัยที่ศึกษาปัจจัยที่มีผลต่อการช่วยฟื้นคืนชีพในผู้ป่วยโรคระบบประสาทนั้นยังมีน้อย ผู้นิพนธ์จึงทำการศึกษาปัจจัยที่มีผลต่อการช่วยฟื้นคืนชีพในผู้ป่วยโรคระบบประสาท ที่สถาบันประสาทวิทยา ประเทศไทย

วิธีการศึกษา: การศึกษาครั้งนี้เป็นการศึกษาวิจัยชนิดเก็บข้อมูลย้อนหลัง รวบรวมข้อมูลของผู้ป่วยทุกรายที่ได้รับการวินิจฉัยโรคทางระบบประสาทร่วมกับมีภาวะหัวใจหยุดเต้นและได้รับการช่วยฟื้นคืนชีพ โดยเก็บข้อมูลจากแบบบันทึกการช่วยฟื้นคืนชีพ และเวชระเบียน ตั้งแต่ ตุลาคม 2548 - กันยายน 2561 เพื่อศึกษาปัจจัยที่มีผลต่อการช่วยฟื้นคืนชีพโดยเฉพาะปัจจัยที่มีความสัมพันธ์ต่ออัตราการกลับมาของการไหลเวียนเลือด และปัจจัยที่มีความสัมพันธ์ต่ออัตราการรอดชีวิตเมื่อจำหน่ายจากโรงพยาบาล รายงานผลการศึกษาโดยใช้สถิติเชิงพรรณา และวิเคราะห์ตัวแปรแบบพหุถดถอยลอจิสติก (Multivariate logistic regression) นำเสนอด้วยค่า Adjusted odds ratios (AOR) ที่ระดับช่วงความเชื่อมั่น 95%

ผลการศึกษา: พบผู้ป่วยหัวใจหยุดเต้นที่ได้รับการช่วยฟื้นคืนชีพรวม 184 คน เป็นเพศชาย 93 คน (50.5 %) อายุเฉลี่ย 61 ± 18 (13-98) ปี ผู้ป่วยที่หัวใจหยุดเต้นร้อยละ 48.9% ได้รับการช่วยฟื้นคืนชีพที่หอผู้ป่วย หอผู้ป่วยวิกฤติ หรือห้องผ่าตัด ซึ่งมีเครื่องมือเฝ้าระวังสัญญาณชีพ โรคระบบประสาทที่พบร่วมกับภาวะหัวใจหยุดเต้นมากที่สุด คือ โรคหลอดเลือดสมอง (41.3%) สาเหตุการตายที่พบมาก

Background: Cardiac arrest in neurologic-neurosurgical patients was different from general patients. Few studies addressed in cardiopulmonary resuscitation (CPR) outcomes and factors associated with the outcome of CPR in neurologic-neurosurgical patients. This study evaluated the outcomes of in-hospital CPR and factors associated with the outcomes of CPR in neurologic-neurosurgical patients in the tertiary neurological center, Thailand.

Methods: This study is a retrospective cohort study, collecting the data of all patients with the primary neurological diagnosis who experienced cardiac arrest and received CPR from October 2005 to September 2018. We performed descriptive and logistic regression analysis to identify the factors affecting CPR. We used the adjusted odds ratios (AOR) and 95% confidence intervals (CI) to report the factors associated with the return of spontaneous circulation (ROSC) and survival to hospital discharge.

Results: There were 184 CPR reports. Ninety-three (50.5%) were male. The mean age was 61±18 (13-98) years. Ninety cardiac arrests (48.9%) occurred in the monitored area. The most common neurological diagnosis was stroke (41.3%). The most common cause of cardiac arrest was sepsis (30.4%). The initial EKG rhythm was asystole (59.8 %). We found ROSC in 98 patients (53.2%). Twenty-one patients (11.4%) discharged from the hospital with the modified Rankin Scale (MRS) mean 3 ± 1 (1-5). Factors associated with survival to discharge was non-asystole rhythms (AOR = 1.2; 95% CI 1.07-1.4; P = 0.003).

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ที่สุดคือ การติดเชื้อในกระแสเลือด (30.4%) คลื่นไฟฟ้าหัวใจที่ตรวจพบมากที่สุดเมื่อเริ่มการช่วยฟื้นคืนชีพ คือ asystole (59.8%) ผลภายหลังการช่วยฟื้นคืนชีพ พบผู้ป่วยมีการกลับมาของการไหลเวียนเลือดจำนวน 98 คน (53.2%) ผู้ป่วยจำนวน 21 คน (11.4%) รอดชีวิตเมื่อจำหน่ายจากโรงพยาบาล ปัจจัยเพียงอย่างเดียวที่มีความสัมพันธ์ต่ออัตราการรอดชีวิตเมื่อจำหน่ายจากโรงพยาบาล คือ คลื่นไฟฟ้าหัวใจไม่เป็น asystole (AOR= 1.2; 95% CI 1.07-1.4; P = 0.003)

สรุป: อัตราการรอดชีวิตเมื่อจำหน่ายจากโรงพยาบาลของผู้ป่วยโรคระบบประสาทที่ได้รับการช่วยฟื้นคืนชีพ คือ ร้อยละ 11.4 โดยมีค่าเฉลี่ยของ The modified Rankin Scale (MRS) ในระดับปานกลาง การตรวจพบคลื่นไฟฟ้าหัวใจไม่เป็น asystole คือปัจจัยเพียงอย่างเดียวที่มีความสัมพันธ์ต่ออัตราการรอดชีวิตเมื่อจำหน่ายจากโรงพยาบาล

คำสำคัญ: การช่วยฟื้นคืนชีพ, หัวใจหยุดเต้น, โรคระบบประสาท, ผลภายหลังการช่วยฟื้นคืนชีพ

Conclusion: The rate of survival to hospital discharge of neurologic-neurosurgical patients was 11.4%. The modified Rankin Scale (MRS) mean of patients who survived was a moderate disability. Non-asystole rhythms were the only factor associated with survival to hospital discharge.

Keywords: cardiopulmonary resuscitation, cardiac arrest, neurological, neurosurgery, outcomes

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Background

Cardiopulmonary arrest is the situation that patients required early and appropriate management. Although Cardiopulmonary resuscitation (CPR) guidelines had developed since 1960,[1] CPR outcomes are still unfavorable. In a retrospective study using data from The National Registry of Cardiopulmonary Resuscitation of United states examined 49,656 CPR. The study reported that the rate of survival to hospital discharge was 15.9%.[2] In Thailand, there were two extensive CPR studies conducted by Suraseranivongse S et al.[3] and Krittayaphong et al.[4] examined 639 and 2,747 CPR in a single university hospital, reported the rate of ROSC in overall patients were 61.7% and 49.8%, the rate of survival to hospital discharge were 6.9% and 7.4% respectively. However, neurologic-neurosurgical patients were different from general patients in the neuropathophysiology, treatment, and prognosis, such as acute stroke patients with insular infarct had a higher incidence of sudden death from the imbalance of sympathetic and parasympathetic tone, cause cardiac arrhythmias and myocardial damage.[5] Therefore, using information from most CPR studies that included general populations might not appropriate. Currently, there are two retrospective CPR studies focus on the associated factors of survival and outcome after CPR in neurologic-neurosurgical patients. Rabinstein AA et al.[6] examined 38 CPR in neurologic-neurosurgical patients, reported that the rate of the return of spontaneous circulation (ROSC) was 61%, and the rate of survival to hospital discharge was 18%. Yi HJ et al.[7] also examined 214 CPR in neurosurgical ICU, reported that the rate of an immediate return of spontaneous circulation was 49%, the rate of survival to hospital discharge was 8.9%.

CPR outcomes varied among centers, which may be due to differences in a cardiac arrest situation, performance of the CPR team, and availability of CPR equipment.[8] In Thailand, Akavipat P et al.[9] studied the database from Perioperative Anesthetic Adverse Events in Thailand (PAAd Thai) study and found 64 (3.0%) events of perioperative cardiac arrest in neurosurgical patients. Fifty percent of neurosurgical patients had the return of spontaneous circulation, and intraoperative bleeding was the primary cause of cardiac arrest. However, the study did not report the survival outcomes of neurosurgical patients. Thus, no reports on CPR outcomes data in neurologic-neurosurgical patients. According to the previous study, the objectives of our

study were to evaluate; (1) the CPR outcomes and (2) the factors associated with CPR outcomes.

Materials and Methods

This study conducted at Prasat Neurological Institute, a tertiary-care hospital. The neurology and neurosurgery training center in Thailand with 300 beds. The CPR Team included neurology or neurosurgery resident, nurse anesthetist, or anesthesiologist staff. Other CPR teams were ward personnel responsible for each ward. The hospital used CPR clinical practice guidelines base on The American Heart Association. Airway equipment and drugs for advanced life support (ALS) were available in an emergency cart for each ward. The defibrillators were available in critical areas such as stroke unit, ICU, emergency room (ER), and operating room (OR) and will carry to general wards after CPR call. Medical staff performed defibrillation. Detail of cardiac resuscitation attempts was recorded in The CPR record form and sent to the CPR committee within 24 hours after cardiac arrest.

Study Population

After the Prasat Neurological Institutional ethics committee approved, a retrospective cohort was studied involving all patients with the primary neurological diagnosis who experienced cardiac arrest and received CPR at Prasat Neurological Institute between October 2005 and September 2018. Cardiac arrest defined as pulseless cardiac arrest. Perioperative cardiac arrest defined as cardiac arrest during intraoperative and the first 24 hours postoperative.

Data Collection

We retrospectively reviewed CPR record form and medical record charts of all patients with the primary neurological diagnosis who received CPR. We included only data from the first CPR attempt. Exclusion criteria were the events with DNAR (do-not-resuscitate) order and the patients whose medical records were incomplete. We recorded patients' demographic information, neurological diagnosis, cause of cardiac arrest, initial cardiac rhythm (asystole, ventricular tachycardia, ventricular fibrillation, pulseless electrical activity), duration of CPR. We evaluated CPR outcomes by record the number of patients who had an immediate return of spontaneous circulation, the number of patients who survived at the time of hospital discharge, and the Modified Rankin Scale (MRS).

Statistical Analysis

All statistical analyses performed by statistical software (SPSS, version 22; IBM SPSS inc. Chicago, IL). We used descriptive statistics to evaluate the study cohort. Data presented as mean $\pm$ standard deviation (SD) for continuous variables and number (percentage) for categorical variables. All variables were analyzed to assess the association with outcomes by using univariate logistic regression analysis. We entered all significant variables from univariate logistic regression analysis into the multivariate logistic regression analysis. However, although the variables of interest were not clinically significant, if the variables had evidence of associated with outcomes, it will be brought into the multivariate logistic regression analysis. We reported the adjusted odds ratios (AOR) and 95% confidence interval (CI). A P-value of 0.05 was considered statistically significant.

Results

Demographics

During the study period, there were two hundred and seven patients who received CPR from the CPR record form sent to the CPR committee. However, 23 medical records were lost. Therefore 184 patients remained for the study. The mean age of the patients was 61 $\pm$ 18 years (range, 13 - 98 years), 50.5% were male. Seventy-eight patients (42.4%) who received CPR had equal or more than two co-morbidities. The most common co-morbidity was cardiovascular disease (54.3%). (Table 1) Ninety-four patients (48.9%) received CPR in the monitored area (The monitored area included inpatient ward with EKG monitor, stroke unit, intensive care unit, and operating room). Patients received CPR during nightshift 69.6%. At the time of cardiac arrest, 64.1% of CPR patients intubated, 59.8% on EKG monitor, and 26.1% on vasopressors. Primary neurological

diagnoses listed in Table 2, the most common admission diagnosis was ischemic stroke (41.3%). We found perioperative cardiac arrest in 11 (5.9%) patients. Two intraoperative cardiac arrests detected during the induction of anesthesia by preceding bradycardia follow by pulseless electrical activity. Another intraoperative cardiac arrest detected in a massive bleeding patient with hypovolemic shock during spine surgery. Two patients who had bradyarrhythmia and received sudden CPR could survive, and discharge from the hospital with the modified Rankin Scale (MRS) showed a moderate disability. A patient who had hypovolemic shock death. Nine patients experienced cardiac arrest in the first 24 hours after the operation. Two patients received CPR at the ward; one patient survived. Six patients received CPR at ICU; two patients survived.

Table 1 Demographics

	CPR patients (n = 184)	ROSC (n = 98)	Survived (n = 21)
Male	93 (50.5)	50 (51.2)	13 (61.9)
Age (years)	61±18	61±19	67±11
Type of disease			
Medicine	104 (56.5)	53 (54)	10 (47.6)
Surgery	80 (43.5)	45 (46)	11 (52.4)
Number of co-morbidity			
No co-morbidity	48 (26.1)	24 (24.5)	7 (33.3)
One co-morbidity	58 (31.5)	29 (29.6)	6 (28.6)
≥Two co-morbidities	78 (42.4)	45 (45.9)	8 (38.1)
Type of co-morbidity			
Cardiovascular	100 (54.3)	53 (54.1)	12 (57.1)
Endocrine	73 (39.7)	45 (45.9)	6 (28.6)
Respiratory	43 (23.4)	23 (23.1)	3 (14.3)
Sepsis	28 (15.2)	16 (16.3)	3 (14.3)
Renal	18 (9.8)	10 (10.2)	1(4.8)
Day shift (8am-4 pm)	56 (30.4)	40 (40.8)	9 (42.8)
Night shift (4 pm-8am)	128 (69.6)	58 (59.2)	12 (57.2)
Monitored area	90 (48.9)	43 (43.8)	7 (33.3)
EKG	110 (59.8)	53 (54)	9 (42.8)
ETT	118 (64.1)	60 (61.2)	9 (42.8)
Mechanical ventilation	113 (61.4)	55 (56.1)	7 (33.3)
Vasopressors	48 (26.1)	15 (15.3)	0 (0.0)

Data present as number (%) or mean ± SD, CPR: cardiopulmonary resuscitation, ROSC: the return of spontaneous circulation, EKG: Electrocardiography, ETT: Endotracheal tube

Table 2 Admission diagnosis of Neurologic-Neurosurgical patients Associated with Outcomes

Admission diagnosis	CPR patients (n = 184)	ROSC (n = 98)	Survived (n = 21)
Stroke	76 (41.3)	44 (44.9)	7 (33.3)
Brain tumor	27 (14.7)	16 (16.3)	1 (4.8)
Encephalitis	17 (9.2)	7 (7.1)	1 (4.8)
Brain/spine abscess	3 (1.6)	1 (1)	1 (4.8)
Spine disease	11 (6)	6 (6.1)	3 (14.3)
Head trauma	11 (6)	3 (3.1)	2 (9.5)
Alzheimer's disease	4 (2.2)	2 (2)	1 (4.8)
Cerebral aneurysm	6 (3.3)	5 (5.1)	2 (9.5)
Guillain-Barré syndrome	5 (2.7)	4 (4.1)	1 (4.8)
Status epilepticus	3 (1.6)	1 (1)	0 (0)
Others	21 (11.4)	9 (9.2)	2 (9.5)

Data present as number (%), CPR: cardiopulmonary resuscitation, ROSC: the return of spontaneous circulation

Cause of cardiac arrest

The most common cause of cardiac arrest was sepsis (30.4%), myocardial infarction (17.9%), and brain herniation (11.4%). (Table 3)

Table 3 Cause of Cardiac arrest in Neurologic-Neurosurgical patients Associated with Outcomes

Cause of Cardiac arrest	CPR patients (n = 184)	ROSC (n = 98)	Survived (n = 21)
Sepsis	56 (30.4)	27 (27.6)	3 (14.3)
Myocardial infarction	33 (17.9)	15 (15.3)	4 (19)
Cardiac arrhythmia	12 (6.5)	8 (8.2)	4 (19)
Congestive heart failure	2 (1.1)	2 (2)	0 (0)
Airway obstruction	11 (6)	8 (8.2)	4 (19)
Pulmonary aspiration	6 (3.3)	5 (5.1)	2 (9.5)
Pulmonary embolism	7 (3.8)	0 (0)	0 (0)
Pneumothorax	6 (3.3)	6 (6.1)	1 (4.8)
Brain herniation	21 (11.4)	11 (11.2)	1 (4.8)
Hypovolemia	4 (2.2)	1 (1)	0 (0)
Hypoglycemia	3 (1.6)	1 (1)	0 (0)
Hyperkalemia	3 (1.6)	2 (2)	1 (4.8)
Metabolic acidosis	7 (3.8)	6 (6.1)	1 (4.8)
Unclear	13 (7.1)	6 (6.1)	0 (0)

Data present as number (%), CPR: cardiopulmonary resuscitation, ROSC: the return of spontaneous circulation

Cardiopulmonary resuscitation events

The most common initial EKG rhythm was asystole (59.8%). The mean CPR duration time was 27 ± 16 minutes (range, 3 - 75 minutes). (Table 4)

Table 4 Cardiopulmonary resuscitation events Associated with Outcome

	CPR patients (n = 184)	ROSC (n = 98)	Survived (n = 21)
Initial EKG rhythm			
Pulseless electrical activity	38 (20.7)	24 (24.5)	9 (42.9)
Asystole	110 (59.8)	51 (52)	1 (4.8)
Ventricular tachycardia	5 (2.7)	4 (4.1)	4 (19)
Ventricular fibrillation	26 (14.1)	15 (15.3)	3 (14.3)
No record	5 (2.7)	4 (4.1)	4 (19)
CPR duration (minutes)	27 ± 16	19 ± 13	11 ± 7

Data present as number (%) or mean ± SD, CPR: Cardiopulmonary resuscitation, ROSC: The return of spontaneous circulation, EKG: Electrocardiography

Outcomes of Cardiopulmonary resuscitation

Ninety-eight patients (53.2%) had the return of spontaneous circulation. Twenty-one patients (11.4%) discharged from the hospital. The mean of the modified Rankin Scale (MRS) of patients who survived was a moderate disability 3 ± 1 (1-5) at discharge. One hundred and sixty-three patients (88.6%) died.

Factors associated with the return of spontaneous circulation

The most common cause of cardiac arrest in patients who had ROSC was sepsis 27 (27.6%), myocardial infarction 16 (16.3%), and brain herniation 11 (11.2%). The most common initial EKG rhythm was asystole 51 (52%). The mean CPR duration time was 19 ± 13 minutes (range, 3-55 minutes). Multivariate logistic regression analysis showed factors associated with ROSC were CPR during dayshift (AOR= 1.2; 95% CI 1.1-1.3; P = 0.001), no vasopressors administered at the time of cardiac arrest (AOR = 1.2; 95% CI 1.1-1.3; P = 0.008) and non-asystole rhythms (AOR =1.1; 95% CI 1.0-1.2; P = 0.036). (Table 5)

Table 5 Univariable logistic regression analysis of ROSC and survived after cardiopulmonary resuscitation

Associated factors	Crude OR	95%CI	P value
ROSC			
No vasopressors administration	1.2	1.1-1.3	0.001*
Dayshift (8am-4pm)	1.1	1.1-1.2	0.001*
Non- asystole rhythm	1.1	1.0-1.2	0.023*
Shockable EKG rhythm (VF/VT)	1.1	0.9-1.2	0.328
Survived			
No vasopressors administration	12.7	0.00	0.998
Dayshift (8am-4pm)	1.1	1.0-1.2	0.194
Non- asystole rhythm	1.2	1.1-1.4	0.001*
Shockable EKG rhythm (VF/VT)	0.9	0.8-1.1	0.739

P value < 0.05* = significance, CPR: cardiopulmonary resuscitation, ROSC: the return of spontaneous circulation, EKG: Electrocardiography, Ventricular fibrillation: VF, Ventricular tachycardia: VT

Factors associated with survival

Sepsis, myocardial infarction, cardiac arrhythmias, and airway obstruction were the cause of cardiac arrest in survived patients. Pulseless electrical activity (PEA) was the most initial EKG rhythm in survived patients. All of the patients who survived had CPR duration of fewer than 30 minutes. The mean CPR duration time was 11±7 minutes (range, 4-25 minutes). Multivariate logistic regression analysis showed that only non-asystole rhythms (AOR = 1.2; 95% CI 1.1-1.4; P = 0.003) were significantly associated with survival to hospital discharge. (Table 6)

Table 6 Multivariable logistic regression analysis of ROSC and survived after cardiopulmonary resuscitation

Associated factors	Adjusted OR	95%CI	P value
ROSC			
No vasopressors administration	1.2	1.1-1.3	0.002*
Dayshift (8am-4pm)	1.2	1.1-1.3	0.001*
Non- asystole rhythm	1.1	1.0-1.2	0.036*
Survived			
Non-asystole rhythm	1.2	1.1-1.4	0.003*

P value < 0.05* = significance, CPR: cardiopulmonary resuscitation, ROSC: the return of spontaneous circulation, EKG: Electrocardiography, Ventricular fibrillation: VF, Ventricular tachycardia: VT

Discussion

The main findings of this study were that among neurologic-neurosurgical patients who received CPR; 1). fifty-three percentage of patients had the return of spontaneous circulation, 2). a small number of patients survived to hospital discharge, 3). survived patients had moderate neurological outcome at discharge and 4). independent factors associated with survived patients were non-asystole rhythms. To the best of our knowledge, this is the first study to investigate CPR outcomes focus on neurologic-neurosurgical patients in Thailand.

In comparison with previous neurological CPR studies, our study showed similar the return of spontaneous circulation rate.[6, 7] However, the survival rates in the present study were lower than the others. The survival rates in our study (11.4%) were comparable with Yi HJ et al. (8.9%)[7] but lower than Rabinstein AA et al. (18%)[6], possibly because of 1). most of CPR patients in our study had asystole as the initial EKG rhythm (59.8%) compare with Rabinstein AA et al. (23.7%).

Asystole was the most EKG rhythm found in the cardiac arrest events associated with poor outcome.[10-14] Patients with shockable EKG rhythms (VF/VT) received early defibrillation had the best outcomes when compared to patients with asystole and PEA.[12, 15, 16] In agreement with previous studies, our study reported that the non-asystole rhythm was the only factor associated with survival to hospital discharge. However, we could not find shockable EKG rhythms (VF/VT) associated with ROSC and survival to hospital discharge. 2). most of CPR patients in our study had cardiac arrests at non-monitored areas, while all survived patients in Rabinstein AA et al. admitted in ICU at the time of cardiac arrests. Insufficient EKG monitor or defibrillator might lead to delay in recognition, resuscitation, and underestimate the incidence of VF/VT in the non-monitored areas because VF/VT would deteriorate into asystole. CPR location in monitored areas such as coronary care unit (CCU)[17], ICU[18-20] or OR[21] reported better predictive of survival.

Cooper S et al.[22] had been reported significant lower survival rates in elderly (age $\geq$ 70 years) patients due to poor hemodynamic reserve. However, age was not an independent factor for survival rates in the present study, and our findings were similar to other studies.[3, 4, 6, 7]

Patients who had daytime cardiac arrests or no vasopressors administration at the time of cardiac arrest had a better ROSC outcome. Daytime cardiac arrests had better outcomes than night time cardiac arrests.[4, 23] It may be related to early detection and management. Patients administered vasopressors at the time of cardiac arrests due to unstable hemodynamic had significantly higher mortality than those who did not have vasopressors administration.[2, 24]

Most of the patients in our study had concurrent underlying disease and sepsis. Both factors had reported as an indicator of the adverse outcome.[4, 6, 7] Only three patients with sepsis (14.3%) in our study could survive to hospital discharge, while patients with myocardial infarction (19%), cardiac arrhythmias (19%), and airway obstruction (19%) survived to hospital discharge. Sepsis patients eventually died as a result of deteriorating symptoms of septic shock, acidosis, and multiple organ failure.[7] Emergency response and proper management of myocardial infarction, cardiac arrhythmias, and airway obstruction[25, 26] were challenging as the causes were reversible if treated rapidly.

The mortality rate significantly increased in patients with the duration of CPR for more than 30 minutes.[7] Similar results have found with our study that all of the patients who survived in our study had CPR duration less than 30 minutes.

Additionally, low survival rates in our report could be inadequate for post-resuscitation management. Because post-cardiac arrest, patients mainly had supportive with prevented secondary brain damage strategy. Even the International Liaison Committee on Resuscitation and American Heart Association declared in 2003[27], and 2010[28] recommend the targeted temperature management (TTM) protocol as an effective neuroprotective therapy in patients after ROSC following

Out-of-Hospital Cardiac Arrest (OHCA) with a shockable rhythm. Then, many of TTM trials studied the benefit of TTM in post-cardiac arrest from other etiologies except OHCA with a shockable rhythm. Recently the International Liaison Committee on Resuscitation and American Heart Association and European Resuscitation Council 2015[29] recommend TTM in patients after ROSC either Out-of-Hospital Cardiac Arrest (OHCA) or In-Hospital Cardiac Arrest (ICHA) with either shockable rhythm or non-shockable rhythm. However, in our hospital, it is still lack of TTM clinical practice guideline. The medical staff involved in CPR and post-resuscitation care should update CPR knowledge, skills, and CPR training to improve CPR techniques and post-resuscitation care.

The limitation of the study was the methodology of retrospective data. We did not have complete data of witness or un-witness arrest, onset time of the cardiac arrest until the CPR team came, the experience of the first CPR person, detail of defibrillation, detail of medication used during CPR and no data of post-resuscitation neurologic function examination. Because of the small sample size of one hospital data, some analysis cannot evaluate for unknown factors. The further prospective cohort study was required to evaluate the CPR outcomes and factors associated outcomes of neurologic-neurological patients.

Conclusion

Despite the initially successful cardiopulmonary resuscitation, the survival rate is low (11.4%) in neurologic-neurosurgical patients. The modified Rankin Scale (MRS) mean of patients who survived was a moderate disability. The only prognostic factor in improving survival to hospital discharge was non-asystole rhythms.

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