

Does the advanced cardiovascular life support (ACLS) training course improve the outcome of resuscitation in the Emergency Department?

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Background The advanced cardiac life support (ACLS) provider course is designed to train medical professionals to master their skills in standard cardiopulmonary resuscitation (CPR) for use in their daily occupation, whether in or out of hospital. This course was set up in 2009 at Maharaj Nakorn Chiang Mai Hospital, Faculty of Medicine, Chiang Mai University for physicians and nurses who work in critical care units.

Objective To assess the impact of ACLS provider course implementation on the survival rate of patients undergoing cardiopulmonary resuscitation in the Emergency Department, Maharaj Nakorn Chiang Mai Hospital.

Method A retrospective study was carried out from January 2006 to December 2008, and January 2010 to December 2012 to compare patient survival rates before and after 2009, when ACLS provider course training was implemented. Primary endpoints included return of spontaneous circulation (ROSC), 24-hour survival and survival to discharge. Data analysis calculated survival outcome by using the Chi-square test, with $p < 0.05$ used as a significance level.

Result Events of cardiac arrest in this study totaled 1,031, of which 486 occurred before the course was implemented. Fifty one percent and 48.81% of these patients had ROSC before and after implementation of the course, respectively ($p = 0.49$), while their survival at 24 hours was 15.43% and 20.73%, respectively ($p = 0.029$), and survival to discharge 7.41% and 8.44%, respectively ($p = 0.56$).

Conclusion The ACLS training course could improve 24-hour survival in hospital for patients who underwent CPR, but did not improve patient survival to discharge. **Chiang Mai Medical Journal 2014;53(1):15-22.**

Keywords: cardiopulmonary resuscitation, advanced cardiovascular life support

The survival rate of cardiopulmonary resuscitation (CPR) has been increased since the first

description of closed chest cardiac massage by Kouwenhoven *et al*^[1] in 1960. The first evidence-

based method of CPR was published in “Standards for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC)^[2]” in 1974. Nevertheless, CPR is a mixture of knowledge, skill, and attitude. Knowing only the theory is not sufficient in performing effective CPR.

Advanced cardiovascular life support (ACLS) training is a certified course of clinical interventions for emergency treatment of cardiac arrest, stroke, acute coronary syndrome, and other life threatening medical emergencies. CPR skill, according to the guideline, is emphasized mostly in ACLS training. It is accepted widely that a person who passes the ACLS course is able to perform CPR. However, few studies have mentioned the effectiveness of the ACLS training program on CPR outcome^[3–7]. The aim of this study was to determine the efficacy of the ACLS training program in short- and long-term outcomes of CPR in the Emergency Department, Maharaj Nakorn Chiang Mai Hospital.

Method

A retrospective study was conducted in Chiang Mai University Tertiary Hospital, Maharaj Nakorn Chiang Mai Hospital, which has 2,267-beds. Data of CPR in the Emergency Department were collected from 2006 to 2008 and 2010 to 2012 before and after 2009, when ACLS provider course training was implemented. The trial was approved by the Institutional Ethics Committee at the Hospital. Before ACLS training, resuscitation had been taught to a minority of resuscitators from lectures and basic life support skill training. The ACLS training conducted in this study took 2 days for 24 medical staff members. The first course was organized by an instructor from the Thai Heart Association under Royal Patronage, and authorized by the American Heart Association. A subsequent course was conducted by a local ACLS instructor from the Thai Heart Association. The course included rigorous hand-on skills, team resuscitation practices, and discussion sessions, followed by a paper and mega-code test (CPR skill test). Medical staff members, who passed both the paper and mega-code tests were then, certified as ACLS providers. In 2009, 8 ACLS provider courses were conducted for all first-year residents, attending staff, and critical care nurses. Eight courses have been arranged every year since 2009.

Selection of participants

Patients older than 13 years, or having a secondary sexual characteristic, and had undergone CPR in the Emergency

Department, were included in this study. Those excluded had signs of irreversible death such as rigor mortis, dependent lividity, decapitation, decomposition, or documentation stating “do not attempt resuscitation (DNAR)”.

CPR data in the emergency room were collected by registration nurses in a CPR record form. It included name, age, presumed cause of arrest, initial rhythms, and place of arrest. Patient outcomes included 24-hour survival, survival to discharge, and cerebral performance category (CPC; Table 2). All patients with “return of spontaneous circulation (ROSC)” were followed up to determine their outcome. Missing data were completed by using an online medical record. All outcomes were presented by using the “Cardiac Arrest and Cardiopulmonary Resuscitation Outcome Reports: Update and Simplification of the Utstein Templates for Resuscitation 2004”^[8].

The calculated sample size of 246.26 events of cardiac arrest per group was required in order to detect a 10% increase of ROSC with 80% power, and two-sided type I error of 0.05, thus allowing a 10% loss of data. In total, 271 events per group were necessary.

All data were entered into an Excel sheet and analyzed by using SPSS software version 17.0. Data analysis comparing the survival outcomes before and after conducting the training courses was performed by using the Pearson Chi-square test or Fisher’s Exact test for the nonparametric test and two sides analysis with a $p < 0.05$ selected as a significance level.

Results

There were 1,031 events of adult cardiac arrest in the Emergency Department. Four hundred and eighty six of them took place during the pre-ACLS training period and the remaining 545 in the post-ACLS training one. Demographic data are shown in Table 1.

Table 2 shows the outcomes of this study. Only 24-hour survival was increased significantly in post-ACLS training (20.73%) when compared to pre-ACLS training (15.43%, $p = 0.029$). ROSC and survival to discharge were almost unaffected ($p = 0.49$ and $p = 0.56$). CPC (Table 3) up to hospital discharge was improved significantly (CPC 1 to 2) in post-ACLS training when compared to pre-ACLS training (7.0% vs 3.1%; $p = 0.005$).

This study reported the outcomes of CPR by using the “Utstein pattern”, as shown in Figure 1, in which the outcomes were divided into “in-hospital cardiac arrest” and “out-of-hospital

Table 1. Characteristic of cardiac arrest

Characteristic	Before ACLS training group (n=486)	After ACLS training group (n=545)	<i>p</i>
Mean age	51.11	54.23	0.028
Sex : no.(%)			0.347
Male	321 (66.05)	340 (62.39)	
Place of Arrest : no.(%)			0.157
In hospital cardiac arrest	164 (33.74)	207 (38.98)	
Out of hospital cardiac arrest	322 (66.26)	338 (62.02)	
Initial Rhythms : no.(%)			
VF/pulseless VT	40 (8.23)	70 (12.84)	0.0198
Asystole	231 (47.53)	169 (31.01)	<0.0001
PEA	214 (44.03)	306 (56.15)	<0.0001
Unknown	1 (0.21)	0	
Etiology : no (%)			
Presumed cardiac	46 (9.47)	79 (14.49)	0.0166
Trauma	158 (32.51)	160 (29.36)	0.2805
Submersion	2 (0.41)	5 (0.92)	0.4569
Respiratory	18 (3.70)	41 (7.52)	0.0102
Toxin	3 (0.62)	1 (0.18)	0.3481
Other non-cardiac	65 (13.37)	92 (16.88)	0.1193
Unknown	194 (39.92)	167 (30.64)	0.0021

Table 2. Outcome : no (%)

ROSC	248(51.03)	266(48.81)	0.495
24 hrs. survival	75 (15.43)	113 (20.73)	0.027
Survival to discharge	36 (7.41)	46 (8.44)	0.535
Neurological outcome : no.(%)			
CPC 1	5 (1.03)	22 (4.04)	0.0028
CPC 2	10 (2.06)	16 (2.96)	0.4292
CPC 3 to 5	21 (4.32)	8 (1.47)	0.0074

cardiac arrest”. Only 24-hour survival in “out-of-hospital cardiac arrest” showed improvement in the post-ACLS training group ($p=0.037$), but no significant change was observed in ROSC and survival to discharge. It was found that after 3 years of ACLS training, survival to discharge was increased slightly from 5.92% to 12.57% (Figure 2).

Table 3. Cerebral performance categories (CPC)^[18]

1	Good cerebral performance: conscious, alert, able to work, might have mild neurologic or psychological deficit.
2	Moderate cerebral disability: conscious, sufficient cerebral function for independent activities of daily life. Able to work in sheltered environment.
3	Severe cerebral disability: conscious, dependent on others for daily support because of impaired brain function. Ranges from ambulatory state to severe dementia or paralysis.
4	Coma or vegetative state: any degree of coma without the presence of all brain death criteria. Unawareness, even if appears awake (vegetative state) without interaction with environment; may have spontaneous eye opening and sleep/awake cycles. Cerebral unresponsiveness.
5	Brain death: apnea, areflexia, EEG silence, etc.

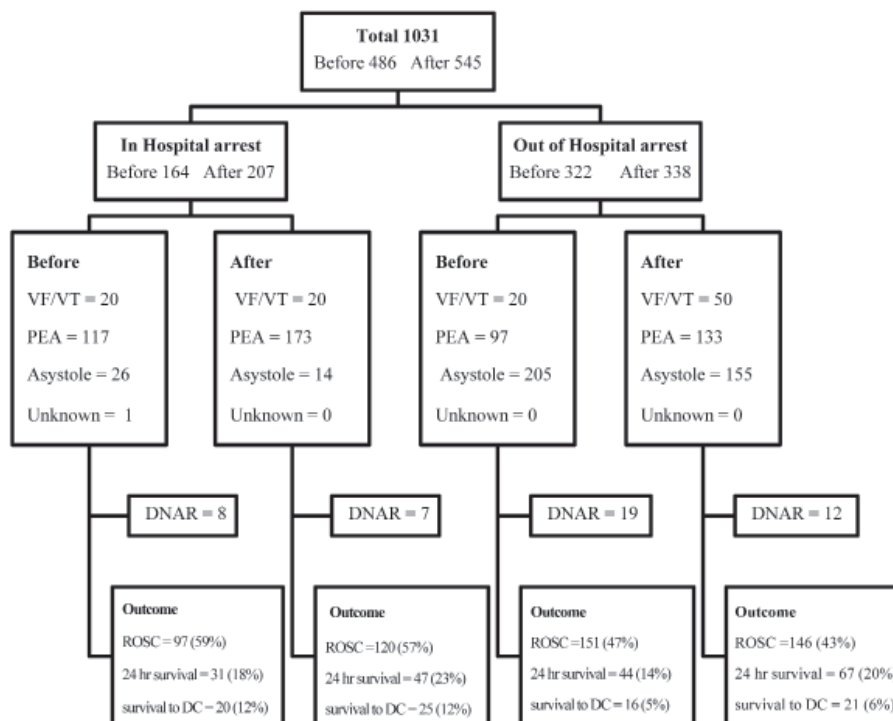


Figure 1. Outcome of CPR according to the Utstien pattern.

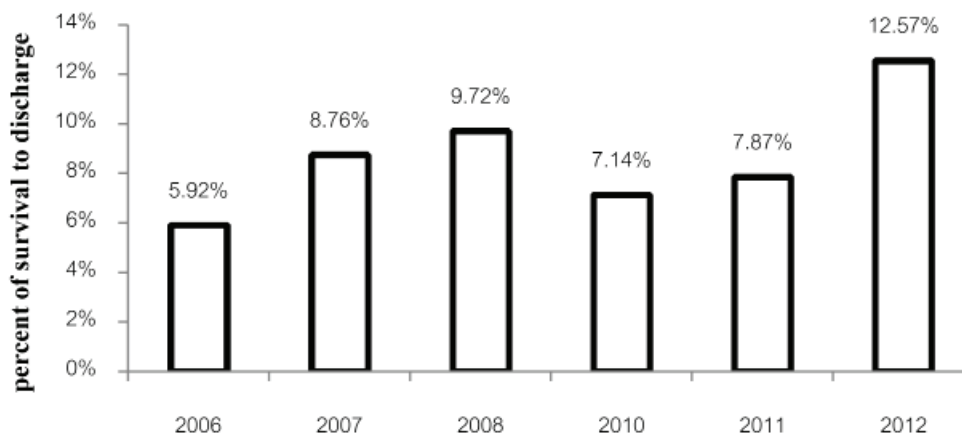


Figure 2. Surviving to discharge patient after ACLS training.

Discussion

This study found that the outcome after ACLS training did not change significantly in the short term, which is in agreement with some previous studies. Camb *et al* reported no significant difference in survival to discharge before (1980-1984) and after ACLS training (1985-1987) in

a rural hospital (36% vs 28%), but attempted resuscitation was increased^[6]. Sander *et al* found a significant improvement in VF/pulseless VT patients (5/30 vs 0/9; $p=0.05$), but no improvement in short or long term survival^[14].

Nevertheless, in terms of neurological outcome, this study showed significant improvement when comparing between the pre-ACLS

and post-ACLS group. Almost all of the previous studies showed that ACLS training could improve CPR outcome in some aspects. Lowenstein *et al* showed a significant increase in ROSC after ACLS training (32% vs 60% respectively; $p = 0.009$), but no difference in survival to discharge^[9]. In a multi-centered prospective cohort, Moretti *et al* found no significant difference in survival to discharge after ACLS training, but they did observe a change in 30 day and 1 year survival ($p < 0.02$ and $p < 0.002$ respectively)^[7]. Soldi *et al* reported an improvement in both ROSC (18.3% vs 28.3%; $p < 0.005$) and survival to discharge (4.2% vs 19.5%; $p < 0.0001$), as observed in the period between 2009 and 2010. In a study on ACLS-trained nurses, who were the first to encounter patients with cardiac arrest, Dane *et al* demonstrated a four-fold increase of survival to discharge (38% vs 10%)^[3].

This study found that after ACLS training courses had been implemented, the rate of ROSC (48.81%) and survival to discharge (8.44%) did not change from pre-ACLS training, however, the CPC outcome was improved significantly. In previous studies, the rate of ROSC was found to be around 15.6% to 69.0% and survival to discharge ranged from 2% to 33%^[10–17]. The rate of ROSC did not improve significantly, and this might be due to the ROSC rate being considered high in this study since pre ACLS training.

It has been more than 50 years since the first closed chest compression was described by Kouwenhoven^[1]. Short and long term CPR survival rates have increased steadily since then. Many studies, including this one, have demonstrated that ACLS training has improved CPR outcome effectively, but other interventions have played pivotal roles, for instance, BLS for public, emergency contact numbers, therapeutic hypothermia, emergency coronary intervention, etc.

Limitation

Retrospective design was the first limitation of this study, which could not form proper experiments to accumulate the data. Also, with this study not being a randomized control trial,

each arm could be unequal, thus possibly having effect on outcomes such as initial rhythms, etiology, age, etc. Furthermore, it was unable to determine whether the team performing CPR were ACLS-trained or not, and what interventions, if any, were done during CPR.

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การอบรมการช่วยฟื้นคืนชีพขั้นสูงมีผลต่ออัตราการรอดชีวิตหรือไม่

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คณะแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่

ความเป็นมา การอบรมช่วยฟื้นคืนชีพขั้นสูงเป็นการอบรมที่จัดขึ้นสำหรับบุคลากรทางการแพทย์เพื่อการมีกรปฏิบัติด้านการช่วยฟื้นคืนชีพที่ดีโดยการเรียนรู้เสมือนจริงสำหรับการนำไปใช้ได้จริงในการทำงาน

วัตถุประสงค์ เพื่อศึกษาประสิทธิผลของการอบรมการช่วยฟื้นคืนชีพว่ามีผลต่อการรอดชีวิตของผู้ป่วยที่ได้รับการช่วยฟื้นคืนชีพในห้องฉุกเฉิน โรงพยาบาลมหาราชนครเชียงใหม่หรือไม่

วิธีการวิจัย การศึกษาแบบย้อนหลังเทียบอัตราการรอดชีวิตก่อนและหลังการอบรมการช่วยฟื้นคืนชีพขั้นสูง ระหว่างปี พ.ศ. 2549 ถึงปี พ.ศ. 2551 และ พ.ศ. 2553 ถึงปี พ.ศ. 2555 ตามลำดับ เป้าหมายหลักของการศึกษา คือ อัตราการชีพจรกลับ อัตราการรอดชีวิตที่ 24 ชั่วโมง และอัตราการรอดชีวิตจนกระทั่งออกจากโรงพยาบาล การวิเคราะห์ข้อมูลโดย chi-square โดยถือค่าการมีนัยสำคัญที่น้อยกว่า 0.05

ผลการวิจัย พบว่าจากการช่วยฟื้นคืนชีพ 1,031 ครั้ง ซึ่งเป็นเหตุการณ์ก่อนการอบรม 486 ครั้ง หลังการอบรม 545 ครั้ง ผู้ป่วยรอดชีวิตร้อยละ 51 และร้อยละ 48.81 ก่อนและหลังการอบรมตามลำดับ ($p=0.49$) อัตราการรอดชีวิตที่ 24 ชั่วโมงร้อยละ 15.43 และร้อยละ 20.73 ตามลำดับ ($p=0.029$) อัตราการรอดชีวิตจนออกจากโรงพยาบาลได้ร้อยละ 7.41 และร้อยละ 8.44 ตามลำดับ ($p=0.56$)

สรุปผลการวิจัย การอบรมการช่วยฟื้นคืนชีพขั้นสูงในโรงพยาบาลทำให้อัตราการรอดชีวิตที่ 24 ชั่วโมงดีขึ้น แต่ไม่ได้ทำให้อัตราการรอดชีวิตจนรอดออกจากโรงพยาบาลดีขึ้น **เชียงใหม่เวชสาร 2557;53(1):15-22.**

คำสำคัญ: การช่วยฟื้นคืนชีพ การอบรมการช่วยฟื้นคืนชีพขั้นสูง

