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An Evaluation of Nurse Anesthetists' Acquisition and Retention of Knowledge and Skill Performance for Brief Basic Life Support and Advanced Cardiac Life Support Training

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ABSTRACT

OBJECTIVE The purpose of this study was to evaluate the acquisition and retention of knowledge and skills of basic (BLS) and advanced cardiac life support (ACLS) for nurse anesthetists at Maharaj Nakorn Chiang Mai Hospital.

METHODS The one-group pretest-posttest design study was used. BLS and ACLS training comprised a brief BLS and ACLS review and practice. Knowledge was assessed by multiple-choice questions. The BLS skills were assessed by observing CPR performance on a Resusci-Anne-skill meter manikin and ACLS skills were evaluated using ACLS scenarios. The knowledge and skills were assessed before and after the training weekly for four weeks, and then at three months after the training ended.

RESULTS A total of 38 nurse anesthetists participated in the study. There were significant increases in BLS and ACLS knowledge and skills after the training. However, there was short retention of BLS and ACLS knowledge and skills at three months after the training. Foreign body airway obstruction and assessing unresponsiveness were the two most common of BLS skills degradation. While the primary and secondary assessment, assessing ACLS algorithms, electrocardiogram recognition and electrical therapy were the common skills performance of ACLS skills degradation.

CONCLUSIONS After the BLS and ACLS training, the knowledge and skills were significantly improved but there was short retention of knowledge and skills at three months after the training. Regular refreshment of CPR education is recommended to enhance the retention of knowledge and practice of nurse anesthetists.

KEYWORDS knowledge and skills retention, nurse anesthetists, acquisition, basic life support, advanced cardiac life support

INTRODUCTION

Cardiac arrest is an emergency condition that requires immediate medical attention to save a life, because there is no blood flow to other parts of the body especially the brain, heart, and kidney as confirmed by the absence of signs of circulation (1). If patients develop early return of spontaneous circulation (ROSC), they have a high probability to survive and have a good brain recovery (2). Compared to other settings of in-hospital cardiac arrest (IHCA), most perioperative cardiac arrest (POCA) is witnessed and

the causes of POCA are usually known and potentially reversible such as medication or anesthesia-related. The overall incidences of POCA in non-cardiac surgery vary between 1.1: 10,000-18:10,000 patients (3,4). The incidences of cardiac arrest are even higher according to the types of surgery such as 163:10,000 in emergency surgery (5) and 110:10000 cases in cardiac surgery (6). Several risk factors related to perioperative cardiac arrest include emergency surgery, age younger or equal to two years, the American Society of Anesthesiologists physical status (ASA PS) 3 and 4, high-risk surgery such as the upper abdomen, brain, thoracic, heart, and major vascular surgery, patients with respiratory and vascular diseases, and patients with preoperative hypotension (5,7). Contrary to other in-hospital cardiac arrest, POCA is often witnessed, and precipitating causes of cardiac arrest are usually recognized. Rapid detection and aggressive management are required to relieve the life-threatening condition during the perioperative period such as anaphylaxis due to medications or severe airway obstruction. As part of a resuscitation team member, nurse anesthetists require a good competency in BLS and ACLS to improve the quality of perioperative care. A previous study found that nurse anesthetists who had been trained in Advanced Cardiovascular Life Support (ACLS) could improve the success rate of CPR in emergency surgical patients by about 75% compared to those without ACLS training (8). Also, any rescue team which had at least one ACLS trained professional personnel could significantly increase short-term and long-term survival rates (9).

Several studies (10-13), reported that the short course ACLS training significantly improved knowledge and skills for nurse anesthetists. They found that knowledge recognition reduced significantly during three months after the training, while skill performance persisted. Recently, our institution has provided BLS and ACLS training to doctors and nurses in the hospital. After completion of the training, nurses receive BLS and ACLS provider cards from Thailand Resuscitation Council which are valid for two years. In the Department of Anesthesiology, some nurse anesthetists have been trained for ACLS only once in the past 10 years of work experience due to insufficient of nurse anesthetists. The study focusing on BLS and ACLS knowledge and skill performance may be useful for hospital administrators to promote regular BLS and ACLS training programs for nurse anesthetists to facilitate their competency in CPR and improve the quality of anesthesia care. Therefore, the purpose of this study was to evaluate the changes of knowledge and skill performance as well as retention for BLS and ACLS knowledge and psychomotor skills after the training in nurse anesthetists.

METHODS

A prospective pre/post interventional design was conducted at the Department of Anesthesiology, Faculty of Medicine, Chiang Mai University between February 2018 and October 2019. This study has been approved by the Research Ethics Committee, Faculty of Medicine, Chiang Mai University, who also waived consent. Inclusion criteria were all qualified nurses on duty who worked in the department for at least one year. The data information of each participant including age, gender, years of experience in anesthesia, and prior training in BLS and ACLS providers were recorded confidentially without identification of the name of the participants. Exclusion criteria were nurse anesthetists who had some medical conditions or physical limitations to perform BLS skills such as serious medical conditions including ischemic heart disease, cancer or pregnancy, osteoarthritis, fractured elbow, spine problems, and nurse anesthetists who worked out of office hours on the CPR training day.

Participants

The participants were 36 nurses who had passed the Nursing Anesthetist Training Program and two nurses who had not yet been trained. Exclusion criteria are noted above. The study flow is presented in Figure 1.

Data collection tools

The data was collected using a structured questionnaire which comprised of two tools which it's approved from the American Heart Association (AHA) and using for attend BLS and ACLS knowledge and skill program in Maharaj Nakorn Chiang Mai Hospital. The first tool

evaluated the nurse anesthetists'BLS and ACLS knowledge. These structured questionnaires contained ten multiple choice questions for BLS and 20 multiple choice questions for ACLS based on the American Heart Association (AHA)/ ERC guidelines of 2015. Each question was given one mark for the correct answer and 0 marks for the incorrect answer. A score of 8 for BLS and 16 for the ACLS written test was accepted as 80% for the pass standard for this study.

The second tool evaluated the nurse's skill performance for BLS and ACLS. The assessment of BLS and ACLS psychomotor skills were evaluated by the combination of BLS and ACLS observational checklist and the CPR skill performance on the Rescue-Anne manikin and recording from the Laerdal skill-meter. BLS skills evaluation included 1) evaluation of the scene safety 2) recognition of the need for help 3) assessment of the unresponsiveness 4) activation of the emergency response 5) establishment of the carotid pulse 6) performing the effective chest compression 7) opening the airway 8) effective rescue breathing 9) using the correct steps for an automated external defibrillator (AED). While, ACLS skill assessment included advanced airway management, electrical therapy, ACLS drug therapy, and leadership for a megacode scenario. Nine ACLS scenarios were used as megacodes which incorporated the four common ACLS algorithms including pulseless arrest (ventricular tachycardia (pulseless VT), ventricular fibrillation (VF), and asystole), tachycardia and bradycardia algorithms in nine different ACLS scenarios were used for all participants. The ACLS psychomotor skills test evaluated the ability of participants the process of assessment identification, planning, and reevaluation during the scenario. The total score was calculated to be present to pass the test. The criteria for passing the test was 80% for BLS and ACLS skill performance for this study.

Quality inspection of research tools

Content validity

The structured questionnaires regarding the knowledge and skills for BLS and ACLS were evaluated independently for content validity by three supervisors. Two of them were senior anesthesiologists who worked in anesthesia for more than ten years who also achieved the instructor certificate in BLS and ACLS by the Thai Resuscitation Council and the other one was a nurse anesthetist who was also a certified BLS and ACLS instructor by the Thai Resuscitation Council. The content validity index was calculated by the average mean score of content validity of three supervisors. The content validity index of this questionnaire was 0.9.

Reliability

Before data collection, the questionnaire was tested for reliability by pilot testing on ten nurse anesthetists as a similar sample with the questionnaire which was approved by supervisors and its reliability was 0.88.

Training programs and data collection

The training program on adult BLS and ACLS following the American Heart Association (AHA) and using in Maharaj Nakon Chiangmai and its approved by anesthesiologist staff and there comprised a four-week course in the form of lectures, instructor-led discussion, and case scenarios. The training sessions were divided into four sections in four weeks: BLS knowledge, ACLS knowledge, BLS skills, and ACLS skills performance. Demonstration of BLS and ACLS performance skills using an adult manikin (4-6 students/session, 60 minutes per session) was conducted by the principal investigator (KS) who is a certified BLS and ACLS instructor by the Thai Resuscitation Council. Each training session lasted 60 minutes.

The assessment of BLS psychomotor skills was evaluated by observation of CPR skill performance on the Rescue-Anne manikin and recording from the Laerdal skill-meter. Before attending the training program each week, all participants took the pre-test examination for evaluating knowledge and skill performance. The details of CPR training and evaluation as follows:

The first week: this section took 60 minutes for reviewing BLS knowledge by an instructor nurse. For the first ten minutes, all participants took the pretest exam for assessment of BLS knowledge for a healthcare provider and the use of automated external defibrillation (AED). Then, the instructor reviewed the BLS knowledge including effective chest compression, open

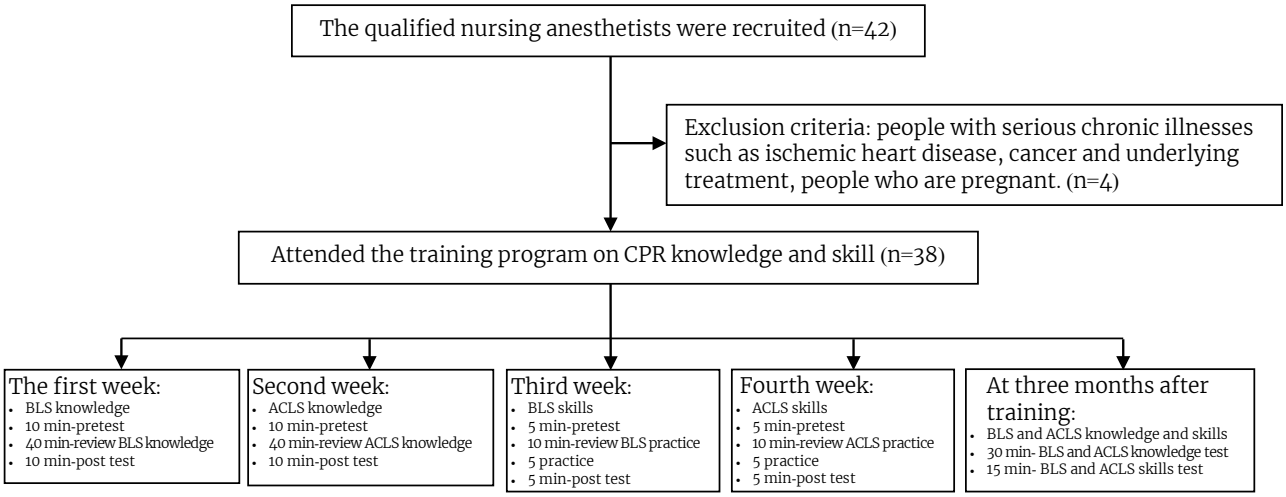

Figure 1. The Study Flow Training Program

airway, airway management, and the use of AED for 40 minutes. The immediate post-test exam was provided to evaluate the change of scores compared to the pretest regarding BLS knowledge and the test lasted ten minutes.

The second week: all participants were provided ACLS knowledge in 60 minutes including this information; In the first ten minutes, all participants took a pre-test examination for ACLS knowledge. Then, the instructor nurse reviewed ACLS knowledge including advanced airway management, ACLS algorithms for pulseless arrest, brady and tachyarrhythmias, route and ACLS drug administration, and post-cardiac arrest care. Then, all participants took the ten-minute post-test examination immediately after the ACLS training using the same examination as the pre-test.

The third week: This section included a pre-test examination, teaching BLS skills, and a post-test examination. Using 40 hours by attending eight hours per day with a total of five days for pre-test and teaching BLS skills including 1) take five minutes for pre-test examination using BLS skills checklist for adult one-rescuer based on AHA 2015 standards. 2) The BLS instructor reviewed all steps for one-rescuer BLS skills for ten minutes and taught two to five participants per group. For the participants who the score below 60 were define to failed the test, the instructor provided immediate feedback for key BLS elements for the individual nurse anesthetists. Then, the participants were requested to perform the test again.

The fourth week: using 40 hours for evaluation and review of ACLS skills as follows: 1) assessing ACLS skills prior teaching for 2-5 people per group within five minutes, 2) The researcher reviewed ACLS skills for twenty minutes for 2-5 people per group and also each person practiced ACLS skills for five minutes, and 3) Each participant had been evaluated for ACLS skills performance after finishing the training session by using one scenario within five minutes. For the participants who failed the test, the ACLS instructor gave immediate feedback of ACLS key elements, and then the participants took the post-test again.

Three months following the BLS and ACLS training program that begin count the time on a post-test in Fourth week program, a re-test was conducted to evaluate the nurse‘s BLS and ACLS knowledge and skills retention. In both tests, the BLS and ACLS written test and the manikin simulation for BLS and ACLS psychomotor skill performance were used as on the pre-test examination. The investigators evaluated and recorded the scores of BLS and ACLS knowledge and skill performance of the individual participant.

Statistical analysis

This study was analyzed using the STATA program version 15.0 (StataCorp, College Station, TX). Categorical data such as gender, education, the number of years of anesthesia service: certified nurse anesthetist, and the experience of CPR training courses, were presented as number

and percentage. While continuous data such as age and the score of knowledge and skills of CPR were presented as mean, and standard deviation. Generalized estimating equation (GEE) - population average model was used to estimate the magnitude of changes of mean scores after adjusting for baseline scores and time points. A p-value < 0.05 is considered statistically significant.

RESULTS

Thirty-eight nurse anesthetists participated in the study. Almost 95% were females. Most of the participants were between 27 and 58 years old with a mean age of 43 years. Seventy-one percent of nurse anesthetists had more than ten years of experience in anesthesia. For the CPR training course. Sixty percent of nurse anesthetists (23 nurses) had not performed CPR during the recent three to four months before the training course as shown in Table 1. The detail of baseline demographics, knowledge and skill assessment are presented below.

Table 1. Demographic data

Demographic data	Frequency (n=38)	Percent
Sex		
- Male	2	5.26
- Female	36	94.74
Age (years): mean±SD	43.1±9.5	
Education		
- Bachelor's degree	38	100
- Certificate for a nurse anesthetist	33	86.8
Years of experience in anesthesia		
- < 10 years	11	29
- ≥ 10 years	27	71
Prior training in CPR		
- BLS certificate	1	2.6
- ACLS certificate	30	79
- BLS and ACLS certificate	7	18.4
The experience of CPR training during a few months before the training		
- No	23	60.5
- Yes	15	39.5

CPR, Cardiopulmonary resuscitation; ACLS, Advanced Cardiovascular Life Support; BLS, Basic Life Support; SD, standard deviation

Outcomes

CPR cognitive knowledge categorized in 2 aspects include

1. Knowledge and skills scores immediately after the training

There was no significant difference in a mean score of BLS (82.7±14.9 vs 78.1±13.0) and ACLS knowledge (43.2±11.2 for the nurse with experience < 10 years vs 46.6±11.7 for those with anesthesia experience ≥ 10 years) according to years of anesthesia service during the pretest. The mean score of BLS and ACLS knowledge increased significantly after the training compared to the pre-training scores (Table 2). Three months after CPR training, the mean scores of BLS and ACLS knowledge decreased significantly compared to scores during immediate training (Table 3). There was a significant increase in mean scores of BLS and ACLS knowledge during three months after CPR training compared to their scores before training (Table 4).

Regarding CPR psychomotor skills, there was no significant difference in the mean score of BLS (80.5±10.8 for nurses with experience < 10 years vs 75.2±11.7 for nurses with experience

Table 2. Knowledge and skills of CPR before and immediately after the cpr training

The knowledge and skills of CPR	T1	T2	Adjusted mean difference (95% CI)*	p-value
	Mean±SD	Mean±SD		
BLS knowledge	79.5±13.5	96.3±5.9	16.8 (12.0-21.6)	< 0.001
ACLS knowledge	45.66±11.51	80.7±14.3	35 (29.3-40.6)	< 0.001
BLS skills	76.7±11.6	94.8±4.8	18.1 (14.9-21.3)	< 0.001
ACLS skills	46.6±12.7	74.3±13.0	27.7 (24.2-31.3)	< 0.001

T1, pre-training; T2, after the training; *Adjusted for baseline value using generalized estimating equation (GEE).
CPR, Cardiopulmonary resuscitation; ACLS, Advanced Cardiovascular Life Support; BLS, Basic Life Support; SD, standard deviation; CI, confidence interval

Table 3. The knowledge and skills of CPR at immediate and 3 months after CPR training

Testing	T2	T3	Adjusted mean difference (95% CI)	*p*-value*
	Mean±SD	Mean±SD		
BLS knowledge	96.3±5.9	86.0±11.7	-10.3 (-14.9, -5.6)	< 0.001
ACLS knowledge	80.7±14.3	68.3±15.9	-12.4 (-40.3, -29.6)	< 0.001
BLS skills	94.8±4.8	82.1±9.0	-12.7 (-15.9, -9.4)	< 0.001
ACLS skills	71.4±13.8	62.3±13.6	-12.0 (-15.3, -8.8)	< 0.001

T2, after the training; T3, at 3 months after the training; *adjusted for baseline value using generalized estimating equation (GEE).
CPR, cardiopulmonary resuscitation; ACLS, Advanced Cardiovascular Life Support; BLS, Basic Life Support; SD, standard deviation; CI, confidence interval

Table 4. Scores of Knowledge and Skills Before and 3 Months After the Training

The knowledge and skills of CPR	T1	T3	Adjusted mean difference (95% CI)*	*p*-value
	Mean±SD	Mean±SD		
BLS knowledge	79.5±13.5	86.0±11.7	6.5 (2.11–11.04)	< 0.001
ACLS knowledge	45.66±11.51	68.3±15.9	22.6 (16.8–28.5)	< 0.001
BLS skills	76.7±11.6	82.1±9.0	5.4 (2.6–8.3)	< 0.001
ACLS skills	46.6±12.7	62.3±13.6	15.7 (11.9–19.5)	< 0.001

T1,pre-training; T3, at 3 months after the training; *adjusted for baseline value using generalized estimating equation (GEE).
CPR, Cardiopulmonary resuscitation; ACLS, Advanced Cardiovascular Life Support; BLS, Basic Life Support; SD, standard deviation; CI, confidence interval

Table 5. BLS and ACLS skills improvement

Skills performance test	T1	T2	Percent changes (%)
BLS skills test			
Assess responsiveness	68.8%	89.9%	21.1
Effective chest compression (rate, depth, and fully recoil)	73.5%	97.9%	24.4
Open the airway	75%	92.4%	17.4
Foreign body airway obstruction (check and remove)	26.3%	73.7%	47.4
Rescue breathing	88.2%	99.3%	11.1
Using of Automated external defibrillation	85%	97.6%	12.6
ACLS skills test			
Primary and secondary assessment	64.5%	87.1%	22.6
Advanced airway management	59.0%	79.7%	20.7
Electrocardiogram recognition	59.5%	87.5%	28.0
Resuscitation drug (correct drugs, dose, preparation and administration)	28.0%	57.7%	29.7
Electrical therapy (mode and energy)	41.6%	68.2%	26.4
Assessing of ACLS Algorithms (Megacode leadership)	60.1%	84.8%	24.7
Post resuscitation care (indication and timing)	42.4%	69.6%	27.2

T1, pre-training; T2, after the training.
ACLS, Advanced Cardiovascular Life Support; BLS, Basic Life Support; AED, Automated external defibrillation; AED, automated external defibrillation.

> 10 years, p = 0.096) and ACLS skills performance according to anesthesia experience during the pre-training (48.1±14.3 for nurses with experience < 10 years vs 46±12.3 for those with anesthesia experience ≥ 10 years, p = 0.633). There was a significant improvement in mean scores of BLS and ACLS skill performance during immediate training compared to their pretest scores (Table 2 and Table 5). After three months, the means scores of both skill performances reduced significantly compared to scores during immediate training (Table 3).

There were significant increases in mean scores of BLS and ACLS skill performance during three months period compared to their pre-training scores (Table 4).

The most degraded skills in performing BLS included check and removal of foreign body airway obstruction (44.7%) and recognition of unresponsiveness (17.6%) (Table 6). While the most degraded skill in performing ACLS was primary and secondary assessment (15.3%), assessing ACLS algorithms (megacode leadership) (11.6%), electrocardiogram recognition (11.1%), and electrical therapy (mode and energy) (11%) (Table 6). There were significant increases in mean scores of BLS and ACLS skill performance during 3 months period compared to their pre-training scores (Table 4).

2. Proportion Passing the Knowledge and Skills Test

2.1 BLS and ACLS knowledge

Before the training, nurse anesthetists who passed the BLS and ACLS knowledge were 34.2% and 2.6%, respectively (Figure 2). The proportion of participants who achieved the passing level increased to 94.7% and 55.2% for BLS and ACLS knowledge tests, respectively. After three months, those who passed the BLS knowledge decreased to 65.8% and 23.7% for the ACLS knowledge test.

2.2 BLS and ACLS Skills

Nurse anesthetists who passed the BLS skill test were 50% and only 2.6% passed the ACLS skill test during the pre-training (Figure 3). Immediately after the training, all participants passed the BLS skills test, while only 34.2% passed the ACLS test. Three months after the training, those who achieved the passing level decreased to 65.8% for BLS skill and 10.6% for ACLS skill test.

DISCUSSION

This study found that there was a significant improvement in BLS and ACLS competency of nurse anesthetists after the training. There was a short retention period of knowledge and skill performance in BLS and ACLS after the training but remained significantly higher than their pre-training values. However, most participants failed to retain the same competency of both components over the three months. These findings are consistent with those of previous studies (9,10,14-17). Although the number of years of service was associated with the successful performance of CPR skills (18), our findings did not detect any difference in skills performance for BLS and ACLS according to years of anesthesia service. In our study, all but one nurse anesthetist could not achieve a

Table 6. BLS and ACLS skills degradation

Skills performance test	T2	T3	Degraded
BLS skills test			
Assess responsiveness	89.9%	72.3%	-17.6%
Effective chest compression (rate, depth, fully recoil)	97.9%	85.3%	-12.6%
Open the airway	92.4%	79.6%	-12.8%
Foreign body airway obstruction (check and remove)	73.7%	29%	-44.7%
Rescue breathing	99.3%	92.1%	- 7.2%
Using of Automated external defibrillation (AED)	97.6%	89.7%	-7.9%
ACLS skills test			
Primary and secondary assessment	87.1%	71.8%	-15.3%
Advanced airway management	79.7%	78.8%	-0.9%
Electrocardiogram recognition	87.5%	76.4%	-11.1%
Resuscitation drug (correct drugs, dose, preparation and administration)	57.7%	54.7%	-3%
Electrical therapy (mode and energy)	68.2%	57.2%	-11%
Assessing of ACLS Algorithms (Megacode leadership)	84.8%	73.2%	-11.6%
Post resuscitation care (indication and timing)	69.6%	67.5%	-2.1%

T2; After the training, T3; at 3 months after the training.
ACLS, Advanced Cardiovascular Life Support; BLS, Basic Life Support; AED, Automated external defibrillation

Figure 2. The knowledge scores for BLS and ACLS

Figure 3. The scores of skills for BLS and ACLS

passing level of ACLS knowledge and skill performance before training. This could be because ninety-five percent of nurses did not attend the hospital ACLS training course during the past five years and eighty-four percent not being actively involved in performing CPR during their daily anesthesia care. Our findings support that regular training and practice are required to maintain participants' competency (19). A previous study proposed that the time frame of CPR knowledge and skills declination varied between three and six months after the training (10). While our study found significant degradation of CPR competency occurred during the three months. These findings corresponded to those of the previous studies (11,13,18). Furthermore, the present study found that both knowledge and skills of BLS and ACLS declined to a similar degree during three months after the training. However, some controversial findings between the discrepancy of cognitive knowledge and skills performance degradation had been proposed. Most previous studies proposed that CPR skill performance seems to decline faster compared to cognitive knowledge over the same period (10). This finding was contrary to those of previous studies. Boonmak et al. reported that ACLS skills persisted significantly longer than the cognitive knowledge in nurse anesthetists (13). Whereas Broomfield et al. found no significant difference between knowledge and skills deterioration (20).

Previous studies reported that there was a significant increase in CPR knowledge following the CPR training (21). This was supported from the findings of our study as more participants could pass the standard level of BLS and ACLS knowledge test compared to the pre-training values. Although CPR training increased the scores of BLS and ACLS knowledge significantly, most of our nurse anesthetists could not pass the ACLS knowledge test. This corresponded to the findings of a few studies (11,20). CPR training programs could not only have a positive effect on the student's performance but also lead them to feel tired from an information overload during the period of the training course (11). Knowledge testing declined slower compared to the skills test. Participants require a clear and mental perception of information before they can gain their cognition and understand which is contrary to the skill performance (20).

This study found that year of anesthesia service did not relate to BLS and ACLS skills performance. And there did not find any other factor despite year of anesthesia service that related to cognition of knowledge and performance skill degradation. While nurse anesthe-

tists who worked in anesthesia for less than ten years performed better scores but there was no significant difference. This was consistent with the finding of a previous study (22). Before the training, the initial skill performance of BLS and ACLS was 50% and 100% failure rate. The two most common steps of poorest BLS skill performance included checking and removing foreign bodies and recognition of unresponsiveness. These results differed from the findings of other studies which found that depth of chest compression and ventilatory volume were the common poorest BLS skills performance (11). This would be possible that our nurse anesthetists usually have a good competency in airway management and providing ventilation compared to participants in other studies. Whereas the use of resuscitation drugs (preparation and administration) followed by the use of a biphasic manual defibrillator (mode and energy) were the two areas of poorest ACLS skills performance. In BLS skills, all nurse anesthetists could pass the standard level of BLS skills after the training. Whereas only 34% of nurse anesthetists achieved the passing level of ACLS skills. A significant acquisition of BLS and ACLS psychomotor skills demonstrated the positive training effect which was consistent with the findings of previous studies (11). However, 63% of nurse anesthetists and only 10.6% could pass the BLS and ACLS skills test three months after the training course. The most degradation of BLS skills in our study was the assessment of foreign-body airway obstruction and the recognition of unresponsiveness. Whereas the most degradation of ACLS skills in this study included the primary and secondary assessment, the assessment of ACLS algorithms, electrocardiogram recognition, and electrical therapy (mode and energy). For the electrocardiogram recognition, and electrical therapy, it may be more nurse anesthetists not found the crisis situation of cardiac arrest in perioperative cardiac arrest commonly and they did not re-knowledge regularly. These findings were different from those of a previous study (18). They found that the need for resuscitation and depth of chest compression were the two most degraded BLS skills performance. Whereas the primary and secondary assessment and pharmacology were the two most commons ACLS skills degradation (18).

The finding of this study showed that there was short retention of both knowledge and skill performance of BLS and ACLS after the short training course of BLS and ACLS for nurse anesthetists. Our nurse anesthetists had a greater lack of ACLS knowledge and skills than we expected before the training. A significant decline of both knowledge and skills performance occurred for BLS and ACLS during the three months after CPR training. The authors also demonstrated the poorest and the most common degradation BLS and ACLS skills performance. There were some limitations in our study. First, this study was conducted at a tertiary hospital with a one setting. This might not be generalized to other institutions which have the different program in BLS and ACLS training for nurse anesthetists. Second, a short review of BLS and ACLS 2015 AHA guidelines, hands-on training in BLS and ACLS case scenarios were taught by a senior BLS and ACLS certified instructor nurse who had experience in CPR training for more than ten years of CPR education. However, the efficacy of this technique might be limited. Several techniques of CPR education including video-self instruction and computer-based teaching tools are recommended to improve the performance and retention of CPR skills and knowledge (10). Third, this study did not evaluate the level of self-confidence of nurse anesthetists which was strongly associated with the proficiency of resuscitation skills in previous studies (12,18). Finally, this study found an increase in knowledge and skill acquisition and retention after CPR training. Nevertheless, the authors could not relate the outcomes of CPR training with the short and long-term survival rate. While a few studies found that increased numbers of ACLS-trained rescuers were strongly associated with the return of spontaneous circulation rate (8,9,23). The advantages of this study include an increase in knowledge and skills of BLS and ACLS training for nurse anesthetists who may be first witnesses of perioperative cardiac arrest. The refresher training should be considered and set up regularly to maintain retention of knowledge and skills of BLS and ACLS. An improvement of CPR knowledge and skills of nurse anesthetists may help increased better outcomes of patients during perioperative care.

CONCLUSIONS

This study demonstrated a significant improvement in knowledge and skills performance after a brief BLS and ACLS training. However, there was short retention among nurse anesthetists at three months after CPR training. The refresher training is required to facilitate retention of knowledge and skills which may help improve the outcome of resuscitation during anesthesia care.

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CONFLICTS OF INTEREST

The author reports no conflict of interest in this work.

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