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Evaluation of BLS skills by a BLS training program for pharmacy students — activation of the EMS system, rescue breathing, and AED operation —

Tomomi INOUE[1)*], Shuho YAEGASHI[1], Ryuzo KYUKAWA[2)], Shunji ISHIWATA[1)], Hiroshi NONOGI[3)], Takeshi KOTAKE[1)]

Division of Medical Pharmaceutics & Therapeutics, Kindai University School of Pharmacy, Higashiosaka, Osaka, Japan[1)]
Konan Fire Department, Ritto, Shiga, Japan[2)]
ICU Center, Shizuoka General Hospital, Shizuoka, Shizuoka, Japan[3)]

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ABSTRACT

We held an "American Heart Association (AHA) Family & Friends® CPR Course and assessed both the quality of basic life support (BLS) performed by 798 fourth-year students who were matriculated in the Faculty of Pharmacy before and after the course and investigated the usefulness and limitations of these education methods.

After training, all assessments by an AHA-certified instructor indicating significantly higher implementation rates in activation of the emergency medical service (EMS) system (Pre-training: 88.9%, Post-training: 99.6%), rescue breathing (Pre-: 35.7%, Post-: 78.0%), and requested an automated external defibrillator(AED)(Pre-: 75.7%, Post-: 99.7%) ($p<0.05$).

Investigation of the mean times significantly reduced after the training($p<0.05$), the mean times until activation of the EMS system (Pre-:13.5 ± 8.7 s, Post-:9.2 ± 28.5 s), the mean times interruption in chest compressions (Pre-:10.6±5.8 s, Post-:9.0±4.9 s) and the mean time from the arrival of the AED until the first shock (Pre-:76.5±16.5 s, Post-:54.7±8.1 s).

The BLS skills significantly improved as a result of the training. However, the implementation rate for rescue breathing was lower than that for other skills. We believe the reason for this was the fact that because learning rescue breathing skills require fewer repetitions than learning other skills, the instructor was unable to provide sufficient individual corrective instruction because of a large number of students. This suggests that future rescue breathing skills training sessions should revise their methods and number of students.

Introduction

The 6-year pharmaceutical education program includes a practical pharmacist training curriculum requiring two 11-week practicums, one each at a hospital and a pharmacy, during the fifth year. To learn the tasks a pharmacist performs through direct contact with patients during their training at the hospital and pharmacy, fourth-year students take a "Practical Skills Class" in which they learn the required skills and knowledge prior to participate in these training. In addition to preparing medicines to fill prescriptions, students at many universities also learn basic life support (BLS) in order to be able to handle patient emergencies as a professional medical practitioner[1,2)]. Moreover, there has been demand in recent years for active participation of pharmacists in emergency rooms and intensive care units. As a result, many pharmacists recognize the need for emergency-related training

*Corresponding author. Tel. : +81-6-4307-3621
E-mail : tinoue@phar.kindai.ac.jp

Table 1. CPR training program

- Hands Only CPR
- Adult chest compressions
- Activation of the emergency medical service(EMS) system
- AED operation
- 1-Rescuer adult BLS
- Adult choking relief
- Child chest compressions
- Open the airway and rescue breathing
- 1-Rescuer Child BLS
- Child choking relief
- 1-Rescuer adult BLS using AED

courses, such as BLS courses[3].

Here we report the effectiveness of BLS courses and training attended by fourth-year students on improving knowledge of life-saving techniques and desire to engage in life-saving tasks using CPR and automated external defibrillator (AED)[4]. We also held an "American Heart Association (AHA) Family & Friends® CPR Course[5]" and assessed both the quality of CPR performed omit the chest compression and AED operation skills by students before and after the course using the 2015 JRC Guidelines and investigated the usefulness and limitations of these education methods.

Methods

1. Subjects

Study subjects were 798 fourth-year students who were matriculated in the Faculty of Pharmacy, Kindai University between 2011 and 2015.

2. Training contents

After a 90-min introductory lecture, the AHA Family & Friends® CPR Course (for adults and children) based on the 2010 Guidelines[5] was held (Table 1). The CPR training manikin used was a CPR & AED Personal Training Kit (Laerdal Medical Japan, Tokyo, Japan). Each student used one simple-type manikin (Fig. 1). Before and after the training session, the skills of each student in the "Adult CPR & AED skill test" were assessed in private booths set up for this purpose. Objective assessments of the quality of BLS performed were conducted by an AHA-certified instructor (Fig. 2).

Fig. 1. CPR training using one simple-type manikin

Fig. 2. Objective assessments of BLS performed by instructor

3. Outcome measures (Table 2)

1) Activation of the emergency medical service (EMS) system

An AHA-certified instructor assessed whether students performed three items, "checking for response and breathing", "Activation of the EMS system" and "requesting an AED", in accordance with the AHA BLS for Healthcare Provider Course skills test and acceptance criteria[6].

Time measurements using a stopwatch were made from activation of the EMS system until the request for AED was completed.

2) Rescue breathing

Rescue breathing during which an AHA-certified instructor could confirm the rise of the chest was performed twice for the purpose of assessment. The time during which chest compression was interrupted in order to perform rescue breathing was measured using a stopwatch.

3) AED operation

An AHA-certified instructor assessed the following five items according to the same criteria as previous studies: 1. Turn the power on; 2. Affix the pads in the

Table 2. Outcome measures

	Outcome measures	Assessments by an AHA instructor	Measurement using a stopwatch
CPR	Checking for response and breathing	○	
	Times until activation of the EMS system, and the request for AED		○
	Activation of the EMS system, and requesting an AED	○	
	Times interruption in chest compressions		○
AED	Turn the power on and affix the pads in the correct positions	○	
	Stand clear from the subject and allow AED to analyze the subject's heart rhythm	○	
	If AED indicates that a shock is necessary, stand clear again and deliver a shock	○	
	Time from arrival of AED until shock delivery		○
	Resume CPR after delivering the shock	○	

correct positions; 3. Stand clear from the subject and allow AED to analyze the subject's heart rhythm; 4. If AED indicates that a shock is necessary, stand clear again and deliver a shock; and 5. Resume CPR after delivering the shock. The time from AED arrival to until shock delivery was measured using a stopwatch.

4. Statistical method

Students who did not attend the training, activation of the EMS system and use the AED were excluded from analysis.

Implementation rates for activation of the EMS system, rescue breathing, and AED operation before and after the training were analyzed using McNemar's test, and gender differences were made using the chi-square test. The paired t-test was used to analyze the mean time from activation of the EMS system until the AED request was completed, mean time from AED arrival to shock delivery, before and after the training comparisons were made using the paired t-test. Gender differences were made using the non-paired t-test. The level of statistical significance was set at $P < 0.05$.

5. Ethical considerations

The present study was conducted in accordance with the Ethical Guidelines for Epidemiological Research and the Act on the Protection of Personal Information. This study was approved by the Institutional Review Board of the Faculty of Pharmacy, Kindai University.

Results

1. Subjects

A total of 781 (315 males, 466 females) of the 798 fourth-year students in the Faculty of Pharmacy, Kindai University attended the training. In total, 738 students (297 males, 441 females) had attended some type of BLS course prior to the training and 32 (11 males, 21 females) had not attended any BLS course. For 11 (7 males, 4 females) students, it was unknown whether they had attended any BLS course.

2. Assessment results

1) Activation of the EMS system

1-1) Pre- vs. post-training assessment

Prior to the training, 81.1% confirmed the patient's response and breathing, 88.9% activated the EMS system, and 75.7% requested an AED. After the training, 95.4% confirmed the patient's response and breathing, 99.6% activated the EMS system, and 99.7% requested an AED, indicating significantly higher implementation rates (Table 3). Investigation of the mean times until activation of the EMS system indicated that the mean time prior to the training was 13.5 ± 8.7 s, whereas the mean time had significantly decreased to 9.2 ± 28.5 s after the training, indicating that students had learned the importance of prompt activation of the EMS system (Table 4).

1-2) Gender differences

Prior to the training, females had a significantly higher implementation rate for activation of the EMS system and requesting an AED. However, there were no significant differences in the pre- and post-training

Table 3. Assessment results by an AHA instructor

Outcome measures	Implementation rate(%) 【n=781】						P Value		
	All		Male		Female		Pre- vs. Post-	Male vs. Female	
	Pre-training	Post-training	Pre-training	Post-training	Pre-training	Post-training		Pre-training	Post-training
Checking for response and breathing	81.1 【781】	95.4 【781】	81.3 【315】	95.6 【315】	80.9 【466】	95.3 【466】	P<0.05	P=0.90	P=0.85
Activation of the EMS system	88.9 【781】	99.6 【781】	86.0 【315】	99.1 【315】	90.8 【466】	100.0 【466】	P<0.05	P<0.05	P=0.08
Requesting an AED	75.7 【780】	99.7 【781】	67.6 【315】	99.4 【315】	81.1 【465】	100.0 【466】	P<0.05	P<0.05	P=0.15
Effective rescue breathing	35.7 【743】	78.0 【780】	40.6 【300】	84.1 【315】	32.4 【443】	73.8 【465】	P<0.05	P<0.05	P<0.05
Rescue breathing within 10s	64.2 【247】	86.0 【247】	64.8 【128】	63.5 【265】	86.8 【151】	85.5 【344】	P<0.05	P=0.83	P=0.64
Turn the power on	94.0 【777】	98.7 【781】	93.9 【315】	97.8 【315】	94.0 【462】	99.4 【466】	P<0.05	P=0.62	P=0.09
Affix the pads in the correct positions	66.5 【762】	86.9 【779】	65.4 【309】	86.7 【313】	67.2 【455】	87.1 【466】	P<0.05	P=0.54	P=0.97
Stand clear from the subject and allow AED to analyze the subject's heart rhythm	45.4 【764】	85.0 【764】	47.1 【308】	84.4 【314】	44.2 【458】	85.4 【465】	P<0.05	P=0.40	P=0.65
If AED indicates that a shock is necessary, stand clear again and deliver a shock	79.7 【779】	93.3 【781】	78.3 【314】	94.6 【315】	80.7 【465】	92.5 【466】	P<0.05	P=0.43	P=0.23
Resume CPR after delivering the shock	59.8 【777】	92.6 【777】	59.2 【314】	91.8 【315】	60.1 【463】	93.1 【466】	P<0.05	P=0.78	P=0.47

confirmation of the patient's response and breathing or in the pre- and post-training mean times until activation of the EMS system (Tables 3, 4).

2) Rescue breathing

2-1) Pre- vs. post-training assessment

Investigation of the rate of which the subjects were able to implement effective rescue breathing twice revealed a rate of 35.7% prior to the training; however, the rate significantly increased to 78.0% after the training ($P < 0.05$; Table 3). Among the students who were able to effectively implement rescue breathing twice, the percentage of those who were able to implement rescue breathing within 10 s was 64.2% prior to the training, and this significantly increased to 86.0% after the training ($P < 0.05$; Table 3). The mean time's interruption in chest compressions was 10.6 ± 5.8 s prior to the training, and this significantly reduced to 9.0 ± 4.9 s after the training ($P < 0.05$; Table 4).

2-2) Gender differences

Both before and after the training, males had significantly higher effective rescue breathing implementation rates than females ($P < 0.05$; Tables 3 and 5). Investigation of students who were able to effectively implement rescue breathing twice revealed no significant differences between males and females for the rate at which rescue breathing was implemented within 10 s or the mean interruption duration (Table 4).

3) AED operation

3-1) Pre- vs. post-training comparisons

Investigation of implementation rates for all relevant items prior to the training indicated that 94% of students were able to turn the power on, 66.5% were able to affix the pads in the correct locations, 45.4% were able to stand clear of the patient and allow AED to analyze the heart rhythm, 79.7% were able to once again stand clear of the patient and deliver a shock when AED indicated that a shock was necessary, and 59.8% were able to resume chest compression after a single shock was delivered. After the training, the implementation rates for all these items showed significant increases ($P < 0.05$ for all; Table 3).

Investigation of the mean time from the arrival of the AED until the first shock indicated that the mean time of 76.5 ± 16.5 s had been significantly reduced to 54.7 ± 8.1 s after the training ($P < 0.05$; Table 4).

3-2) Gender differences

Investigation of all AED operation items and the mean time from the arrival of the AED until the first shock

Table 4. Outcome measures

Outcome measures	Mean times (s) ±SD【n=781】						P Value		
	All		Male		Female		Pre- vs. Post-	Male vs. Female	
	Pre-training	Post-training	Pre-training	Post-training	Pre-training	Post-training		Pre-training	Post-training
Times until activation of the EMS system and the request for AED	13.5 ± 8.7【697】	9.2 ± 28.5【697】	14.1 ± 8.8【275】	10.6 ± 42.0【314】	13.1 ± 8.6【424】	8.08 ± 5.6【465】	P<0.05	P=0.13	P=0.20
Times interruption in chest compressions	10.6 ± 5.8【247】	9.0 ± 4.9【247】	10.5 ± 4.1【128】	9.0 ± 2.5【265】	11.0 ± 6.8【151】	9.5 ± 5.5【344】	P<0.05	P=0.45	P=0.17
Time from arrival of AED until shock delivery	76.5 ± 16.5【758】	54.7 ± 8.1【758】	77.7 ± 17.9【308】	55.0 ± 8.0【315】	75.8 ± 15.4【451】	54.6 ± 8.2【465】	P<0.05	P=0.13	P=0.43

indicated no significant differences between males and females (Tables 3, 4).

Discussion

The present study was conducted as part of the practicum for fourth-year students at this university, who will have many opportunities to come into contact with patients as part of their BLS training during fifth-year hospital and pharmacy practicums.

As all subjects were fourth-year students, 94.5% of students had previously taken BLS courses and many students had taken first aid courses as part of their driver's education or as a first-year education course.

In order to allow for repetitive practical skills training in a short time, each student utilized a simple-type CPR training manikin and their studies followed the AHA Family & Friends® Course, which is designed for the lay rescuer.

The present study was conducted over a 5-year period from 2011 to 2015. Although the training was taught and students' skills were assessed in accordance with the 2010 Guidelines, because the 2015 JRC Guidelines contain revisions to the BLS algorithms for the lay rescuer[7)], the results of the present analyses of student assessments are discussed below within the context of the 2015 JRC Guidelines.

The mean time between checking for a response and activation of the EMS system was at least 13 s prior to the training; however, the mean time was reduced to <10 s after the training, indicating that students had learned the need to activate quickly. In addition, the implementation rate for activation of the EMS system was higher in females than in males prior to the training, which suggests that females, who may be less confident in their physical strength, tended to request help more frequently than males. However, after the training, both males and females demonstrated that they were aware of the importance of activation of the EMS system.

The results of the present study indicate that the implementation rate of effective rescue breathing was significantly improved as a result of the training and the duration of the interruption of chest compression fell to a mean of <10 s after the training. However, the implementation rate for rescue breathing was lower than that for other skills. We believe the reason for this was the fact that because learning rescue breathing skills require fewer repetitions than learning other skills, the instructor was unable to provide sufficient individual corrective instruction because of a large number of students. This suggests that future rescue breathing skills training sessions should revise their methods and number of students.

Gender differences indicated that males had significantly higher implementation rates; however, we believe the difference in mean tidal volumes was likely due to the differences between the pulmonary capacity of males and females. Thus, we believe that studies of methods for improving the effectiveness of rescue breathing by females are required.

There were no differences between males and females in terms of AED operation, and in both cases, the implementation rate showed significant improvement as a result of the training. The DVD utilized in the training only provided an explanation of the method of using AED, and because the students had no time to practice while watching the DVD, they were able to practice using the AED once after they had finished watching the DVD. Since the AED kit that comes with the manikins they used did not have a vocal-instruction function, the students listened to a single vocal instruction played at a central location in the practice area as they practiced on their own. Students practiced operating the AED only once, and the researchers noticed a tendency of the students to be unable to practice calling aloud "Stand clear!" in order to ensure safety. In addition, because the chests of the practice manikins were thin, they were unable to sufficiently ensure that the AED pads were affixed properly in the left axillary region. This may have been related to the low post-training implementation rates for this skill.

In the present study, we conducted BLS training for fourth-year students prior to their hospital and pharmacy practicums. Assessing each skill separately was helpful in mentally preparing them to be medical professionals.

In 2011, the Japan Society for Emergency Medicine launched its Emergency- Certified Pharmacist System. This system provides emergency cases that include pharmaceutical interventions and recommends prior experience with BLS as a pre-requisite for taking the certification test. In addition, the number of pharmacists who have become Emergency-Certified Pharmacists and subsequently come to be involved in emergencies is increasing[8]. Thus, we believe that there is a need for the widespread use of a variety of training simulations for skills such as BLS, advanced cardiovascular life support, and physical assessments in order to train pharmacists to be able to provide initial care to patients experiencing emergencies and to share knowledge and cooperate with doctors, nurses, and other medical staffs.

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要　旨

薬学部学生を対象とした一次救命処置（BLS）実習実施による手技の評価　ー　通報、人工呼吸、AED 操作　ー

井上　知美[1)]，八重樫　柊穂[1)]，久川　隆造[2)]，石渡　俊二[1)]，野々木　宏[3)]，小竹　武[1)]

近畿大学薬学部医療薬学科臨床薬学部門医療薬剤学分野[1)]
湖南広域消防局[2)]
静岡県立総合病院集中治療センター[3)]

薬学部 4 年次生 798 名を対象とし、「アメリカ心臓協会（AHA）ファミリー＆フレンズコース」での一次救命処置（BLS）実習による教育の有用性と問題点を検討した。AHA 認定インストラクターによる実習前後の評価では、救急対応システム通報（前：88.9％、後：99.6％）、人工呼吸（前：35.7％、後：78.0％）、自動体外式除細動器（AED）要請（前：75.7％、後：99.7％）など、すべての実施評価項目に関して、実習後の実施率が有意に向上した（$p<0.05$）。さらに、通報・AED 要請終了までの時間（前：13.5 ± 8.7 秒、後：9.2 ± 28.5 秒）、胸骨圧迫の中断時間（前：10.6 ± 5.8 秒、後：9.0 ± 4.9 秒）、AED 到着後からショックまでの平均時間（前：76.5 ± 16.5 秒、後：54.7 ± 8.1 秒）についても実習後に有意に短くなった（$p<0.05$）。実習実施により手技の向上が示されたが、人工呼吸の評価項目は実施率が低い結果となった。人工呼吸の実技練習は胸骨圧迫の実技練習より回数が少ないことや、人工呼吸の実技に際し、インストラクターによる個々の実技修正が大人数でのトレーニングでは十分に実施できないことが原因であると考えられ、今後、実習内容や実施規模による人工呼吸の手技習得の検討が示唆された。

キーワード：薬学教育 , 心肺蘇生法 , 自動体外式除細動器 , トレーニング

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