Effectiveness of combining manual external defibrillator and automated external defibrillator training for third-year nurse students

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Article info

Purpose: To assess the effectiveness of automated external defibrillator (AED) and manual external defibrillator (MED) training for third-year nurse students.

Methods: We conducted post-demonstration and post-practice evaluation for MED defibrillation, and pre-training, post-demonstration, and post-practice evaluation for AED defibrillation.

Results: Following MED training, time and confidence to defibrillate were improved significantly post-practice ($p < 0.001, p < 0.001$, respectively). In post-demonstration and post-practice evaluation, most students placed electrodes correctly (84.21% vs. 80.70%), cleared before defibrillation (75.44% vs. 89.47%), and performed cardiopulmonary resuscitation immediately after defibrillation (81.81% vs. 94.44%); the evaluations were not statistically different ($p = 0.806, p = 0.094, p = 0.198$, respectively). For AED training, time and confidence to defibrillate post-demonstration and post-practice were significantly improved ($p < 0.001, p < 0.001; p < 0.001, p < 0.001$, respectively) compared to that of pre-training; there was no obvious difference between the post-demonstration and post-practice evaluation ($p = 0.235, p = 0.346$, respectively). Post-AED demonstration, most students could place electrodes correctly (85.96%), clear (91.23%), and perform CPR immediately after defibrillation (85.96%), which remained at a high level post-practice (94.74%, 85.96%, 82.46%, respectively); there was no significant difference between the two evaluations ($p = 0.203, p = 0.557, p = 0.776$, respectively).

Conclusion: Combining MED and AED defibrillation training is effective and feasible for third-year nurse students. Minimal training is effective for AED, while MED requires additional practice.

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1. Introduction

Sudden cardiac arrest (SCA) is one of the most critical situations in public health. SCA incidence is quite high in both developed and developing countries, i.e. France, North America, and China [1–3]. Cardiopulmonary resuscitation (CPR) combined with defibrillation within 3–5 min of collapse can produce a survival rate as high as 49–75% [4,5]. Each minute of delay before defibrillation reduces the probability of survival to discharge by 10–12% [6,7]. In recent years, many researchers have focused on out-of-hospital cardiac arrest (OHCA), while in-hospital cardiac arrest (IHCA) has not received the same level of focused research [8]. As reported, one-third of in-hospital SCA cases are not appropriately defibrillated within the recommended time, i.e. within 3 min of arrest [9]. Documented survival rates for IHCA range from 0% to 42%; major studies report about 20% survival to discharge rates [10–13]. Moreover, survival rates are lower in general units than that in critical care areas [14]. Nurses are always the main force of medical staff to be involved in IHCA. A study indicated that almost every nurse would be willing to receive training in advanced cardiac life support (ACLS) [15]. Another study concluded that it is reasonable for nurse students to have an understanding of lifesaving clinical skills and the ability to perform procedures such as defibrillation before their clinical practice [16]. However, it was found that nurses’ CPR and defibrillation skills, namely CPR-skills, are poor [17]. One study found that only 22.7% of nurse students felt confident about defibrillation [18]. As the role of nurses continues to expand, defibrillation should become an expected rather than extended nursing role [19]. The purpose of this study was to assess the effectiveness of defibrillation training on third-year nurse students.

2. Methods

2.1. Setting and participants

The training course was held at the Second Military Medical University (SMMU) skill centre in Shanghai, China. All third-year nurse students from SMMU were invited to participate in the study. They had learnt the theory of emergency nursing and had finished the study of the vast majority of specialised nursing courses, including medical and surgical nursing. None of them had used a manual external defibrillator (MED) or automated external defibrillator (AED) or had received prior training.

2.2. Training and evaluation

Considering the handling and safety of an AED, all participants were firstly asked to perform AED defibrillation without receiving any training or tips. Then, they attended a 1-h AED course and a 1-h MED course separately, which were conducted by four experienced instructors who had been engaged for more than 10 years in teaching basic life support and advanced life support skills. All participants took turns receiving training in six groups of eight and a group of nine. The instructors introduced the working principles of AED/MED and the key points of AED/MED application, and then demonstrated how to operate AED/MED. Immediately after demonstration, an evaluation was carried out in the same setting (post-demonstration). All participants practised AED and MED defibrillation separately for 30 min after demonstration. The third evaluation was conducted the day after all students had finished their practice (post-practice).

To ensure accuracy of evaluations, two reviewers recorded the performance of defibrillation together with a self-designed evaluation form. The time and confidence to shock, safety, and operation immediately after defibrillation were evaluated. The time to shock (in seconds) was counted from unzipping the defibrillator or switching on the defibrillator to pressing the button to shock with a stopwatch by a reviewer. Participants’ confidence to shock was evaluated using 0–10 numeric rating scores (0 represents no confidence at all; 10 represents full confidence): low (0–4), medium [5–7], high [8–10]. The reviewer explained the scores and their meaning to the participants, and then participants were asked to self-evaluate their confidence to defibrillate before the performance. Safety was evaluated by whether participants had cleared everyone or not before shock.

2.3. Equipment

The Laerdal AED trainer and Metrax GmbH (PRIMEDIC™ Defibi) MED were used. The AED guided users with voice prompts once it was switched on, and had diagram prompts on the electrode slices; the MED functions with manual paddles. A manikin was used for all scenarios and was placed on a standard-height bed.

2.4. Data analysis

Data were entered into SPSS17.0 statistical software. Descriptive statistics including proportions were calculated. Statistical significance was set at p = 0.05. Continuous data were analysed using Student’s t-test or the Mann–Whitney U-test; categorical data were analysed using the chi-square test.

2.5. Ethical considerations

The study received ethical approval from SMMU, and oral informed consent was obtained from all participants. In addition, all participants were free to refuse study participation or to withdraw from the study at any time. The study was conducted on 23–25 June 2013.

3. Results

A total 57 complete data were collected from the students who participated in the training programme.

3.1. Time to first shock

For MED, the mean time to first shock at post-demonstration evaluation was 63.93 ± 19.44 s; post-practice, it was 42.67 ± 10.89 s. There was a significant difference (p < 0.001) between the two evaluations (Table 1).
The mean time to first shock before AED training (pre-training) was 66.91 ± 15.21 s; post-demonstration and post-practice, it was 48.51 ± 6.79 s and 46.50 ± 7.53 s, respectively. The pre-training time was significantly different from that of post-demonstration and post-practice (p < 0.001; p < 0.001, respectively); there was no significant difference between post-demonstration and post-practice times (p = 0.06).

Further comparison determined that the post-demonstration mean time to first shock for AED defibrillation was much shorter than that for MED defibrillation (p < 0.001). However, the post-practice mean time to first shock for MED defibrillation was greatly reduced and was significantly shorter than that of AED defibrillation (p = 0.004).

3.2. Confidence

On post-demonstration evaluation, the mean confidence for MED defibrillation was 3.93 ± 1.07; post-practice, it increased to 7.69 ± 1.19, and the improvement was statistically significant (p < 0.001).

In comparison with that of MED training, the confidence scores for AED defibrillation were higher, ranging from 7.60 ± 1.17 to 8.64 ± 0.92. Pre-training evaluation confidence was significantly different from that of post-demonstration and post-practice (p < 0.001; p < 0.001, respectively). There was no significant difference between post-demonstration and post-practice scores (p = 0.45).

When the confidence scores were compared, there were significant differences between post-demonstration and post-practice evaluation for AED and MED defibrillation (p < 0.001; p < 0.001, respectively).

3.3. Electrode placement

Post-demonstration evaluation of MED defibrillation determined that most participants (84.21%, n = 48) placed the electrodes correctly; post-practice, 46 participants (80.70%) placed the electrodes correctly. The two evaluations were not significantly different (p = 0.81).

For AED defibrillation, 59.65% (n = 34) of participants placed the electrodes correctly without training. Accuracy increased to 85.96% (n = 49) immediately after demonstration, and remained high (94.74%, n = 54) after practice. The differences were both clinically and statistically significant (p = 0.003, p < 0.001, respectively) between pre-training and the post-demonstration and post-practice evaluations. There was no significant difference between the post-demonstration and post-practice evaluations (p = 0.20).

Post-demonstration, there was no significant difference between AED and MED defibrillation regarding electrode placement (p = 0.274), while the accuracy rate of electrode placement for AED was much higher than that of MED after practice (p = 0.037).

3.4. Safety

Most participants cleared everyone before shock (80.70%, n = 46), while 8.77% (n = 5) cleared only themselves on post-demonstration evaluation of MED defibrillation. In the post-practice evaluation, the majority of participants (92.98%, n = 53) cleared everyone. There was no significant difference between the two evaluations (p = 0.094).

For AED defibrillation, about half of the participants (50.88%, n = 29) only cleared themselves, five participants (8.77%) cleared everyone, and 40.35% (n = 23) failed to clear anyone before defibrillation in pre-training. In the post-demonstration and post-practice evaluation, most participants (91.23%, n = 52; 85.96%, n = 49, respectively) cleared everyone, while only a few (5.26%, 7.02%, respectively) failed to clear anyone. There were significant differences between the pre-training findings and that of the two post-training evaluations (p < 0.001; p < 0.001, respectively). There was no significant difference between post-demonstration and post-practice evaluation (p = 0.56).

In both post-demonstration and post-practice evaluation, the rate to clear before shock was not significantly different (p = 0.766; p = 0.130, respectively) between MED and AED defibrillation.

3.5. Operation immediately after defibrillation

Post-demonstrating and post-practice, the majority of participants (81.81%, n = 4 5; 94.44%, n = 51, respectively) performed CPR immediately after MED defibrillation. The rate of CPR performance immediately after defibrillation was significantly higher after practice (p = 0.042).

Before AED training, about 14.04% (n = 8) of participants performed CPR immediately after defibrillation, while most participants performed CPR post-demonstration and post-practice (85.96%, n = 49; 89.47%, n = 51, respectively). There were significant differences between the pre- and post-training evaluations (p < 0.001 vs. p < 0.001). However, the post-demonstration and post-practice evaluations were not significantly different (p = 0.78).

The CPR performance rate immediately after MED or AED defibrillation were not significantly different in both post-

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<th>Table 1 – Time and confidence to defibrillate.</th>
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N = 57 subjects in each training.
demonstration and post-practice evaluations (p = 0.835; p = 0.066, respectively).

4. Discussion

Early defibrillation is the single most important therapy for shockable SCA. The interval between the onset of SCA and the delivery of the first shock is a determinant of survival [20]. In China, nurses seldom use defibrillators even though they are always the first medical staff to discover SCA, mainly because they lack awareness and competence to defibrillate. It was found that 80% of nurses lacked the confidence to defibrillate [21], which can influence willingness to defibrillate and whether the procedure can be performed. By enhancing both participant competence and confidence, defibrillation training can indirectly increase their willingness to defibrillate; this is supported by several studies [22,23]. A study demonstrated that AED training increased the proportion of people willing to use an AED from 71% to 91% [24]. Another study [25] found that more than 90% of nurses and medical students declined to perform AED defibrillation because they did not know what an AED is and/or how to use it; 57% refused to defibrillate because they did not know how to use one correctly [14]. Thus, defibrillation courses are necessary, even for AED defibrillation. After defibrillation training, there was an obvious decrease in the time to shock, improved operation accuracy, and increased confidence, especially for MED.

Compared with AED, the interruptions of MED in CPR and pre-shock pauses are shorter. Our study supports this with the finding that, after practice, the time to first shock for MED was shorter than that for AED. Unlike AED, MED does not have voice prompts. A qualified person who uses a MED can deliver a shock without waiting for the prompts. Hence, it is a defibrillator appropriate for medical staff. However, one requirement for medical staff to use MEDs is to recognise the shockable heart rhythms, which can be difficult for doctors and nurses who did not major in cardiology, emergency medicine, or critical care [26]. Thus, many studies support the premise that only competent medical staff should use MEDs to deliver a shock. One study found that the frequency of inappropriate shocks delivered by healthcare professionals was higher, which cannot be prevented by a higher formal level of education [27]. Another study on pre-hospital defibrillation modes recommended MED as a preferred option only for paramedics who have received appropriate training [28]. As nurse students are generally not trained in ACLS, they may lack the knowledge and experience to analyse electrocardiograms (ECG) and are unable to decide whether defibrillation is needed [29]. Therefore, we suggest that if no competent medical staff is on scene to instruct them, nurse students should not use MED, but use AED instead.

The 2013 consensus statement of the American Heart Association recommended that all hospital staff should be able to recognise SCA, call for help, perform chest compressions, and use an AED at the level of a bystander until staff with training in the care of patients with SCA respond to the event [8]. AEDs can be used by anyone who has brief CPR training. It can help to analyse the ECG of a patient and determine whether they can/should be shocked. However, automated rhythm analysis can increase compression interruption compared with MED defibrillation [30,31]. If possible, nurse students should use an MED rather than AED. Thus, we instructed nurse students in both MED and AED use during our course to facilitate their selection of the appropriate defibrillator by considering actual situations.

In this study, all participants could complete AED defibrillation in 90 s even without training. However, the time to first shock, electrode placement, safety to defibrillate, and CPR implementation rate immediately after defibrillation required improvement. These parameters improved significantly post-demonstration, but did not improve much after practice, which indicated that minimal training might be sufficient for junior nurse students to master AED defibrillation. As it has been demonstrated that AED is reliable and simple, laypersons can successfully operate the device with minimal training [32]. Moreover, Beckers et al. [33] conducted a 15-min AED course for medical freshmen, following which the time to shock and accuracy rate of electrode placement improved significantly, and skill retention after six months was good. Compared with traditional training methods, minimal training can be effective and time-saving.

Unlike AED training, MED practice after demonstration was necessary to enhance participant confidence and to decrease time to first shock. Thus, practice after the MED demonstration is indispensable. On post-demonstration evaluation, we also found that participant confidence in using MED was lower than that for AED. This may be because the participants were all nurse students without clinical experience who had never before used an MED, a more complicated defibrillation machine than AED. However, the accuracy of electrode placement and safety (clear before defibrillation) did not improve after practice, which was similar to the findings of AED training. These findings indicate that most participants can master MED immediately after demonstration even without practice, but much more practice with MED is necessary for participants to increase their confidence to defibrillate and the CPR implementation rate immediately after defibrillation, and decrease the time to first shock.

5. Conclusion

This study tested the effectiveness of combining MED and AED training for nurse students. The training improves both competence and confidence effectively. MED defibrillation requires more practice before the skill is mastered, while AED defibrillation can be performed very well immediately after minimal training. There are also some limitations to our study. Firstly, the sample size was small. Secondly, the ECG analytical ability of nurse students before MED defibrillation was not evaluated. The retention of defibrillation was also not explored, and we did not track the influence of training on the nurse students’ intern practice.

Conflicts of interest

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REFERENCES


