Effects of different types of feedback on **cardiopulmonary resuscitation** (CPR) skills among nursing students**– a pilot study**

Abstract

Background: During the last 20 years there have been different approaches to teaching nurse students CPR, including video self-instruction and self-instruction learning. Receiving CPR with compressions of adequate depth and frequency, and ventilations of adequate volume improves the chance of survival. The aim of this study was to evaluate effects of different types of feedback on CPR skills among nursing students.

Methods: A pilot study with an explorative approach including 30 nurse students. Students was randomized in three groups; 1) instructor-led training followed by self-training without feedback, 2) self-training with visual graphic feedback, and 3) self-training with voice advisory manikin (VAM). Outcomes were correct compression deep, frequency, hand position and release, and correct ventilation volume and flow. If performance was correct to 70%, students were considered to have reached approved level. The students also answered questions about theoretical knowledge about CPR.

Results: In technical skills, group 2 had significant higher level of correct ventilation volume compared with the other group. Both group 1 and 3 did not reach the level of 70% correct performance. Group 1 and 2 had significant higher level of correct deep of compressions compared with group 3 which did not reach the 70% level. There was no difference in performance between groups in other parameters.

Conclusion: This pilot study suggests that visual graphic feedback is promising and seemed to be more effective than self-training with voice advisory manikin and instructor-led training with followed self-training without feedback.

Key words:

Feedback, Nursing Students, CPR

1 Introduction

Each year approximately 10,000 persons are hit by sudden cardiac arrest out of hospital in Sweden, treatment is started on approximately 4,000 and of these, only approximately 400 persons survive (Swedish Resuscitation Council, 2011). Receiving CPR with compressions of adequate depth and frequency, and ventilations of adequate volume improves the chance of survival [1]. During the last 20 years there have been different approaches to teaching nurse students CPR, including video self-instruction and self-instruction learning [2, 3]. Different types of manikins have also been used to improve CPR among nursing students [4]. CPR training is a difficult task. Studies have shown that immediately after a course, performance of CPR is not optimal and the knowledge decreases rapidly [5].

When training CPR it has been found that visual feedback with auditory guidance yields a better performance than manikins with no feedback in both lay persons and health care professionals [6, 7]. It is also found that voice advisory manikin (VAM) yields better CPR performance compared to instructor-led training in lay persons [8]. Cason et al [9] describes that visual feedback yields a greater percentage of correct compression among health care professionals than VAM or no feedback at all. According to CPR training among nursing and paramedic students, it has been found that students training CPR using VAM performed more compressions with adequate depth and ventilations with adequate volume compared with students who received no feedback [10] or had instructor-led training [4]. However, Rappolo et al [11] found that medical students who trained with instructors did better with CPR then those who trained with VAM. The difference was, however, related to automated external defibrillator (AED) and bag valve mask (BVM). When comparing other parameters, the groups were not significantly different. As far as we have found, no study has compared CPR training using VAM with using visual feedback among nursing students.

At the Department of Nursing at Umeå University, nursing students underwent 1.5 hours of basic CPR training in their first term, watching an interactive DVD with hands-on training with Mini-Anne®. During training, an instructor was present to answer questions and guide the performance if necessary. The students voluntarily continued their training with Resusci Anne SkillGuide (Laerdal Medical, Stavanger Norway). For the examination in CPR, the manikin Resusci Anne Skill Guide was used. There was a requirement from both students and teachers to have manikins that gave more distinct feedback to ensure high quality CPR after training. In literature, VAM has been found to increase CPR quality among students but there is limited knowledge about the efficacy of manikins with visual graphic feedback. Therefore, manikins giving different forms of feedback were tested in a pilot study. The aim was to evaluate the effects of different types of feedback on CPR skills among nursing students.

2 Method

This study was a pilot study with an explorative approach and was completed in September 2011 on the Nursing program at Department of Nursing, Umeå University.

2.1 Participants

Students on the Nursing program and Diagnostic Radiology Nursing program were invited to participate. The inclusion criterion was to not have taken any course in CPR after secondary school education. Nursing students in the first course of the Nursing Program and Program in Radiology Nursing were invited and about 45 nursing students attended an information meeting where the randomization was performed. All students received a closed envelope and in 30 envelopes there was information about study group assignments (group 1, 2 or 3) and training instructions. The remaining envelopes were empty and those students receiving empty envelope followed the curriculum in the nursing program.

2.2 Procedure

The training followed guidelines of the Swedish Resuscitation Council 2005. The guidelines imply giving 30 compressions at a rate of 100 per minute and a depth of 4-6 cm. Two ventilations with a volume of 500-600 ml each follow compressions. All groups started training with Mini-Anne (Laerdal Medical, Stavanger Norway). Mini-Anne is a concept that includes watching an interactive video while training on an inflatable doll with head and chest. Group 1 had an instructor present when they watched the video and trained, the instructor answered questions and guided performance if necessary. Groups 2 and 3 trained using the same concept but without an instructor and all groups continued training with other manikins as described below.

Group 1; self-training with manikin without feedback

After instructor-led training using Mini-Anne, the students voluntarily trained with Resusci Anne SkillGuide during two weeks. The full body manikin “Rescusi Anne Skillguide” (Laerdal Medical, Stavanger Norway) has a display with red and green lights guiding correct performance. However the feedback was experienced by students and teachers to be arbitrary and the manikins were often used without the light display. We therefore consider this manikin to be without feedback.

Group 2; Self-training with graphic feedback

After self-training using Mini-Anne, they voluntarily continued their training with a manikin with graphic feedback during two weeks. The manikin was a Resusci Anne Skillreporter that was connected to a computer with the software”Laerdal PC SkillReporting System” (Laerdal Medical, Stavanger Norway). During training, the CPR was recorded in the computer program and the students got feedback about compression and ventilation performance by graphic and numerical data. The compressions were assessed in four parameters; rate, compression depth, correct hand position and complete release between compressions. Ventilations were assessed according to volume and flow frequency.

Group 3; Self-training with voice advisory manikin (VAM)

After self-training using Mini-Anne, they voluntarily continued their training on a manikin which in this study is called VAM. This manikin consists of a Resusci Anne Skillreporter connected to a computer with software “Resusci Anne Skill Station” (Laerdal Medical, Stavanger Norway). The computer program guided the students during practice and gave real-time voice feedback such as “start the ventilation” and “a little more air” during practice. After the performance the students could see the number of correctly performed ventilations and compressions.

2.3 Assessment

After two weeks during which students had the opportunity to practice on their own, they performed CPR with the authors present to assess the performance by starting the session at the computer. The authors were blinded to group assignment and did not to give advice to the student during CPR. During the assessment Resusci Anne PC SkillReporting system was used. The manikins used in the three groups were estimated to be equivalent except for the feedback system. The students achieved a pass when reaching a minimum of 70% correct performances in the different parts of the documented compression and ventilation data.

The students were asked about age, gender, education, work experience, how much they have been practicing during the study period and which manikin they had used. To find out if students training with an instructor received more theoretical knowledge, they also performed a test with six questions. The questions were taken from a questionnaire used in Södersved- Kjellestedt et al [12] about how to perform CPR and were suggested as relevant for students that are training basic CPR. The correct answer to question gave 1 point (min/max 0-6 points, a higher score indicates better CPR knowledge). The students were also asked to answer an open question about their experiences of practice and manikins.

2.4 Data analysis

When analyzing the performance skills, a limit for accepted skills was set at 70% correct performed actions.

In the analysis we used the Statistical Package for Social Sciences (SPSS) for Windows, version 19.0 (SPSS Inc., Chicago, IL, USA). The data was analyzed with descriptive analyses, chi-2 test, Fisher's exact test and Kruska Wallis Test. The level of significance was set to 5%. The questions about experiences of practice and manikins were analyzed by manifest qualitative content analysis[13]. The answers were analyzed group by group in order to describe experiences in relation to different feedback modalities. The answers were divided in meaning units and coded. The codes where compared with respect to similarities and differences and were sorted formulated in categories.

3 Result

There were 26 women and 4 men aged between 18 and 27 with a median of 20 years who participated. Of 30 participants, 19 (60%) had no previous work experience. There was no difference between groups in median age (p .643) or work experience (p .097) (Table 1).

Around 47% reported to have trained three hours or less and 50% reported to have trained between 3 and 5 hours, 3% had been training more than 5 hours. There was no significant difference between groups in time used for training (p .454) even though group 3 reported the highest number of hours of training and group 1 reported the lowest number of hours of training. When answering questions about how to perform CPR, there was no significant difference (p .931) although group 2 had the highest median points (Table 1).

When assessing technical skills, group 2 had a significantly higher level of correct ventilation volume compared with the other groups. Both groups 1 and 3 did not reach the level of 70% correct performance. Groups 1 and 2 had a significantly higher level of correct depth of compressions compared with group 3 which did not reach the 70% level. There was no difference in performance between groups in other parameters (Table 2).

Open questions

In the following section, result categories are highlighted in italics. The answers from all groups contained expressions of *satisfaction with the self-training* but also a requirement for *more supervision from teachers*. Even group 1 which had supervision asked for more supervision.

Group 1

Students in group 1 expressed that *knowing CPR gives a feeling of security* but the training with *Mini-Anne and Resusci Anne Skill Guide did not give enough feedback* which made the students uncertain if their performance was correct. Students expressed dissatisfaction with the manikin *Mini-Anne which was too unrealistic* and it was suggested that it should be excluded from training.

Group 2

In group 2, students expressed satisfaction with the manikin and expressed a wish that this manikin could *be made accessible for all students*. The students found it *useful to train together* and the manikin gave *detailed feedback, which gave an effective training*. However, they expressed both *easiness and difficulties in following the instructions* and asked for *more theoretical CPR knowledge*.

Group 3

The students in group 3 expressed that they found it *useful to train together* and it was *good to have auditory feedback*. They found the *training easy and enjoyable* and *the manikin realistic*. However, they experienced the feedback to be different when training individual parts compared to training whole series of compressions and ventilations.

4 Discussion

The aim in this study was to evaluate the effects of different types of feedback on CPR skills among nursing students. The result indicates that self-training with Mini-Anne and manikin with graphic feedback (group 2) gave the highest quality of CPR skills after training compared with Mini-Anne with supervision by teacher and manikin with no feedback (group 1) or self-training with Mini-Anne and manikin with VAM (group 3). This is in line with Cason et al[9] who found that receiving visual feedback from watching a display with compression depth and rate gave better CPR performance compared to receiving auditory feedback or no feedback at all.

We also found that training with VAM generated lower CPR quality than training with an instructor and self-training without feedback, despite the VAM group having seemed to spend more time on training than the instructor-led training group. These findings contradict Kardong-Edgren et al [4] study which showed that students who had trained CPR with a VAM performed more compressions with an adequate depth and correct hand placement, and also performed more ventilations with adequate volume compared to the students that had trained with an instructor using the same manikins without voice advisor. In Kardong-Edgren et al [4], however, those who participated in instructor-led training had 4 hours of training while the VAM group trained on their own; no amount of time on training was presented. The skill assessment was done immediately after the training course. In our study, all groups had the opportunity to train on their own for two weeks before the skill assessment. Maybe the amount of training can explain the difference in the results. Training with an instructor probably means receiving less feedback compared to VAM, which gives momentary feedback during the course of the whole training session. The amount of feedback from an instructor partly relies on how many students are supervised in each group; this was not presented in Kardong-Edgren et al [4]. Further, even if the students receive face-to-face training with an instructor it is difficult for the instructor to visual assess compressions depth and ventilation volume which make the feedback less exact. Maybe it is, as Kardong-Edgren et al [4] suggests, that self-training gives the students the opportunity to adapt the practice to their individual needs. Maybe the difference between Kardong-Edgren et al [4] and our results depend on the possibility of self-training. In our study the students expressed that the momentary auditory feedback was helpful during training. However, the students expressed that VAM was not stable in giving responses in the different phases of training. This could be one explanation to the low quality skills in group three. Another speculation is that the students become used to having momentary feedback during CPR and rely heavily on the voice corrections. When not receiving auditory feedback they may become insecure. Feedback is found to have a powerful influence on learning but Hattie and Timperley [14] found in an evidence-based synthesis related to the power of feedback, that too much and very specific feedback in relation to task performance can have an adverse effect. Instead of obtaining an understanding of the task performance and incorporate higher level responses it can lead to a trial-and-error strategy. Is it possible that VAM gives too much feedback and the students become more independent when training with visual graphic feedback? However, it has been found that CPR quality during actual cardiac arrest was improved by using real time CPR –sensing and audio visual feedback [15]. If this equipment will be part of standard procedure in healthcare than training with VAM would probably be preferable. To further enhance CPR training feedback could be combined with debriefing which was found by Dine and colleagues [16] as a potent tool in CPR training.

In the answers to the open questions it emerged that the students thought that it was useful to train together. Training together was not part of the instructions but during training we discovered that the students supported each other. Peer learning has been found to be an effective educational tool to enhance practical skill learning [17] and may be taken in consideration as an educational tool in CPR training for nurse students.

All the groups in our study asked for more instructor-led training, even those who already had received instructor-led training. In accordance with other studies [cf. 4], nursing students in our study that trained with instructors did not display the best CPR skills. Further, Montgomery et al. [18] found that those who trained with instructors were more pleased with their CPR training than those using VAM but did not display the best CPR skills. Being satisfied with the training is therefore not comparable with high-quality skills. It is possible that the students receive other skills that not are discovered when technical skills in relation to compression and ventilations are assessed as they are in our study. Those components, however, have to be seen as fundamental in CPR.

5 Limitations

One limitation in this study is the small study sample. In the analysis we used a robust analysis method and despite the small sample there were significant differences between the groups. The findings are also supported by findings from other studies. Both groups II and III trained with Resusci Anne Skillreporter manikins connected to computers and their skills were assessed on one of the manikins. Group II which had trained on the manikin used in the assessment also showed the highest CPR quality. Although the manikins are supposed to be comparable, maybe there are individual differences in the manikins that complicate comparison. In our study we found that the students trained together. Since this was found in all groups, it probably did not interfere with the comparison between the groups. However, it may hamper comparisons of level of quality in CPR skills with other studies using the corresponding manikins. There are reasons for interpreting our findings with caution but there are indications which motivate further research.

6 Conclusion

This pilot study suggests that visual graphic feedback is promising and seemed to be more effective than self-training with VAM and instructor-led training with subsequent self-training without feedback. Training CPR with an instructor has been found to generate satisfied students but does not automatically mean high quality skills. It is most likely that the repeated training with feedback is central to gaining high quality skills. Type of feedback may have an impact and this study suggests that graphic feedback gives higher quality in CPR skills than momentary voice-assisted feedback and no feedback at all. This has to be evaluated further.

7 Conflict of interest

The equipment for VAM and graphic feedback groups were provided by Laerdal Medical Corporation at no cost. However, Laerdal Medical Corporation was not involved in the study design, data collection and analysis or writing the manuscript.

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Table 1. Background characteristics of participants, amount of CPR training and test results .

	Grupp 1 N=10	Grupp 2 N=10	Grupp 3 N=10	P-value
Women (n)	8	8	10	.315 [a]
Age (median)	20	22	20	.643 [b]
Work experience (month)	10	1	11	.097 [b]
Earlier experiences of CPR (n)	1	1	3	.383[a]
Training CPR (n)				
• 0 – 3 hours	6	5	3	
• 3 – 5 hours	4	4	7	
• 5 hours or more	0	1	0	
Theoretical knowledge (median)	5.0	5.5	5.0	.931 [b]

Group 1; Instructor lead introduction, no feedback manikin

Group 2; Self training, graphic feedback manikin

Group 3: Self training, VAM

[a]Chi-2 test,

[b] Kruska Wallis Test

Table 2. Median of correct performed actions, limit of 70% to reach level of expectable quality in skills.

	Grupp 1 %	Grupp 2 %	Grupp 3 %	P-value [a]
Correct ventilation volume	47,5	100	56	.009[b]
Correct ventilation flow	100	100	100	.330
Correct compression frequency	97,5	97	82,5	.619
Correct compression deep	87,5	88	21,5	.018[b]
Correct hand position	100	100	100	.126
Correct hand release	100	100	100	1.0

Group 1; Instructor lead introduction, no feedback manikin

Group 2; Self training, graphic feedback manikin

Group 3: Self training, VAM

[a] Kruska Wallis Test, level of significance 0.05

[b] Significant difference between groups