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The Effectiveness of Cardiopulmonary Resuscitation Training Using Feedback System on Chest Compression: A Comparative Study Between Doctor and Nurse

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Abstract

High-quality chest compression, adequate depth and rate, and minimal interruption are needed to improve the survival rate of cardiopulmonary resuscitation (CPR). Currently, CPR training with feedback system is considered to give high-quality CPR. Although doctor and nurse have a different educational background, both professions require proficiency in delivering CPR. This study aimed to compare the effectiveness of CPR training with a feedback system to the quality, depth, and rate of chest compression between doctors and nurses. This study was a cross-sectional study that involved 16 doctors and 19 nurses in CPR training with CPR feedback system. The quality, depth, and rate of chest compression performing by a group of doctors and a group of nurses were analyzed before and after CPR training. Data were collected and analyzed statistically. The results show that in the nurse group, there was a significant difference in quality, depth, and rate of compression before and after the training (p=0.000, p=0.000, p=0.000). In the doctor group, there was a significant difference of depth and quality of chest compression before and after the training (p=0.010, p=0.001). When comparing doctor and nurse group after training, no significant differences were observed in doing CPR (p=0.310, p=0.288, p=0.440).

1. Introduction

Every year, millions of patients worldwide experience cardiac arrest and need immediate cardiopulmonary resuscitation (CPR). Immediate diagnosis of cardiac arrest, call for help, and high-quality CPR are keys to the success of cardiac arrest survival rate [1].

Quality of chest compression is one of the CPR success keys; thus, effective training is needed to improve participants' competency. Kouenhoven *et al*. introduced chest compression in 1960 for the first time [2]. Furthermore, it was developed into the depth, rate,

and location of chest compression. Quality of chest compression is therefore determined by depth, the rate of compression, and location of hand placement [3].

Many novel approaches have been studied to improve training and to maintain retentions of CPR skill rather than traditional instruction. The approaches include automated voice advisory manikin system and automated testing combined with automated retraining [4, 5]. One of the novel approaches is the CPR with a feedback system which enables us to review the chest compression quality performed by the participant.

Feedback of the CPR quality can be provided through feedback devices, using vocal or visual information [6]. This training technique is useful to improve CPR skill [7]. The feedback device can improve CPR quality in terms of depth and rate of compression [8]. The visual feedback device is better than audio feedback or without feedback device at all [9].

Although doctors and nurses have a different educational background, both professions are the frontline of CPR in a hospital and require a competence of high-quality CPR. This study aimed to compare the effectiveness of CPR training with a feedback system in the quality, depth, and rate of chest compression between doctors and nurses.

2. Material and Methods

This was a cross-sectional study conducted at Simulation-Based Medical Education and Research Center, IMERI Universitas Indonesia, Indonesia. After informed consent was signed, 16 doctors and 19 nurses from 17 hospitals in and around the city of Jakarta were included in chest compression training (Figure 1). Before the training, quality, rate, and depth of chest compression of all participants were recorded in two cycles. At the time, participants only had prior knowledge regarding the resuscitation method they had before. The participants did not have any information on how to use feedback system in performing CPR. After data were taken, all participants attended a lecture and skill training with CPR feedback system of R Series® Monitor/Defibrillator (Zoll Inc., USA). The lecture was given in 20 minutes consisted of basic theory and the way to perform high-quality chest compression. After the lecture, participants were trained in the skill station for 10 minutes that focused on performing high-quality chest compression. After these interventions, the performance data of participants' quality, rate, and depth of chest compression were examined in 2 cycles. For feedback, a reusable plastic oval pad (Q-CPR pad) was attached to the manikin's chest with single-use adhesive pads in addition to the standard multifunction electrode pads. All assessments were completed on a CPR feedback system of R Series® Monitor/Defibrillator that allowed data variables

to be downloaded and further analyzed using statistical programming. The collected variables were average compression depth, average compression rate, and quality of compression.

Data were expressed in numeric scale (depth and rate of compression) and percentage (quality of compression). The collected data were analyzed by using Statistical Package for Social Sciences Software version 20.0 (SPSS Inc. Chicago, IL). Comparison of data (depth, rate, and quality of CPR) between doctors and nurses were analyzed by unpaired t-test if data were normally distributed and Mann-Whitney test if data were not normally distributed. Data comparison between before and after training on each group was done by using paired t-test if data were normally distributed and Wilcoxon if data were not normally distributed. The difference was considered statistically significant if $p< 0.05$.

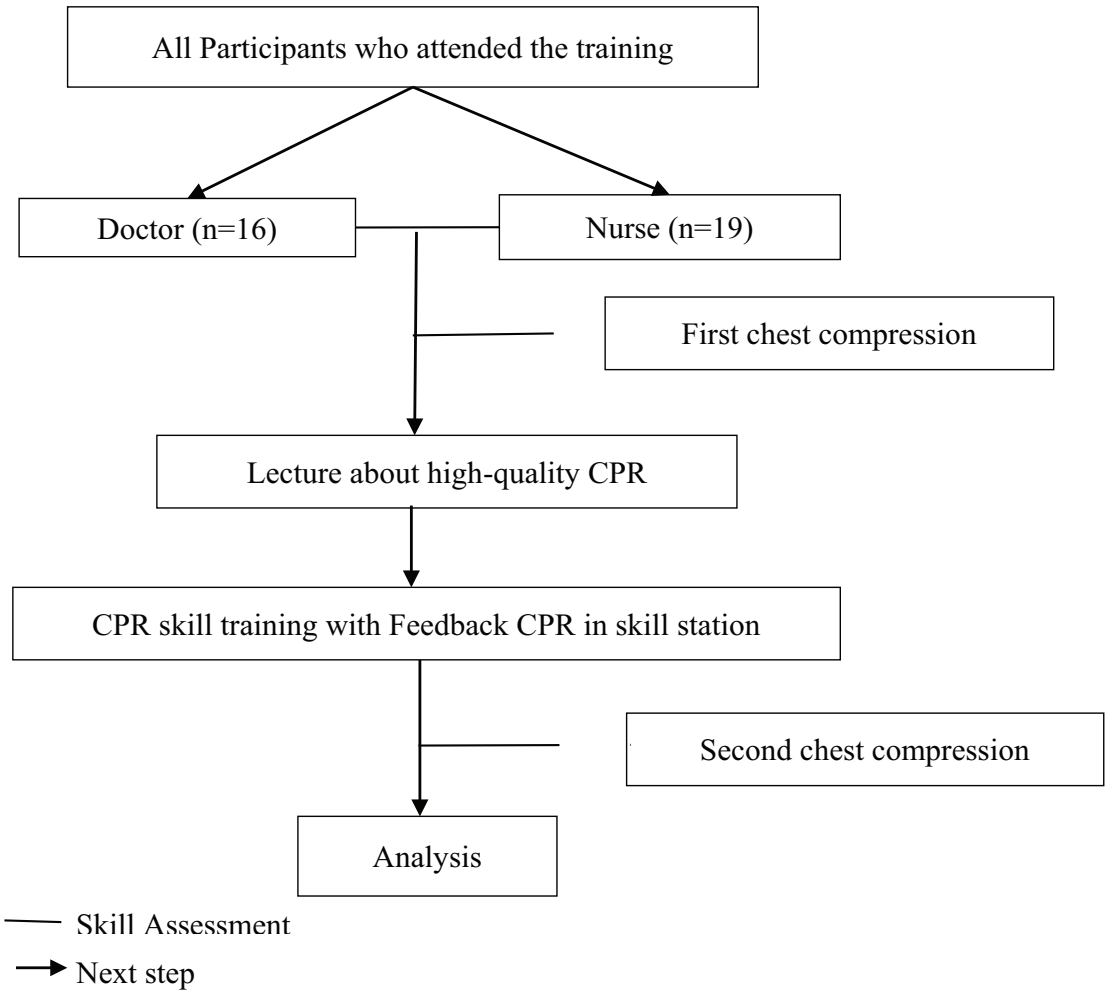

Figure 1: Flow diagram of the subjects. All participants consist of doctors and nurses that will do chest compression before CPR lecture and after CPR training.;

3. Results

Characteristics of the population in this study are shown in Table 1. There are 42.1% of nurses and 25% of doctors who never took life support course, yet 62.48% of nurses do CPR at their work unit more than once a month, compared to 37.5% doctors. Most of the doctors and nurses work in their work unit for less than 5 years.

TABLE 1: Demographic characteristics of the subjects.

Variable	Groups	
	Doctor (n = 16)	Nurse(n = 19)
Sex, n (%)		
Male	4 (25)	8 (42.1)
Female	12 (75)	11 (57.9)
Age (years)[a]	36.50 ± 10.34	32.00 ± 7.87
Last life support course, n (%)		
Never	4 (25)	8 (42.11)
< 5 years	6 (37.5)	3 (15.78)
> 5 years	6 (37.5)	8 (42.11)
Frequent of Doing CPR, n (%)		
Never	3 (18.75)	4 (21.05)
< 1 /month	7 (43.75)	2 (10.53)
> 1 /month	6 (37.5)	13 (68.42)
[a]Data are mean ± standard deviation.		

3.1. Comparison of chest compression between nurses and doctors

3.1.1. Before the intervention

Data from the first compression (before the lecture and training of high-quality CPR with feedback system) can be seen in Table 2. Depth and rate of the first compression in both groups have not achieved the standard of American Heart Association (AHA) 2015 (Depth= 5-6 cm, rate=100-120/min, quality=60-80%) [10]. Quality of chest compression in both groups is 0.000. The three variables are not significantly different in both groups (Table 2.)

3.1.2. After the intervention

Nurse group shows a significant increase in the achievement of depth (p=0.000), rate (p=0.000), and quality (p=0.000) of chest compression after the lecture and training of

Table 2: Comparison of variables of chest compression between doctor and nurse group before the intervention.

Variable			Profession		*p*-value
	Doctor	Achievement (%)	Nurse	Achievement (%)	
Depth	4.57 (1.5-5.84)[a]	83	3.20 (1.4-5.84)[a]	58.2	0.101[c]
Rate	128.05 ± 23.43[b]	116.4	136.89 ± 10.54[b]	124.4	0.149[d]
Quality	0.000 (0.00-19.49)[a]	0	0.000 (0.00-12.61)[a]	0	0.504[c]
[a] Data are median (minimum-maximum).					
[b]Data are mean ± standard deviation.					
[c]Analysed by Mann-Whitney test.					
[d]Analysed by unpaired T-test.					

high-quality CPR with a feedback system. Yet, the quality has not achieved the standard (Table 3).

Table 3: Chest compression in the nurse group before and after the intervention.

Variable	Chest Compression		*p*-value
	First	Second	
Depth	3.2 (1.4-5.84)[a]	5.25 ± 0.39[b]	0.000[c]
Rate	136.88 ± 10.54[b]	119.615 ± 9.25[b]	0.000[d]
Quality	0.000 (0.000-12.61)[a]	44.09 ± 31.27[b]	0.000[c]
[a]Data are median (minimum-maximum).			
[b]Data are mean ± standard deviation.			
[c]Analysed by Wilcoxon test.			
[d]Analysed by paired T-test.			

Doctor group shows a significant increase in the achievement of depth and quality of chest compression before and after the training with feedback system (p=0.01, p=0.001). There is no significant difference in chest compression rate before and after the training (Table 4).

Table 4: Chest compression in the doctor group before and after the intervention.

Variable	Chest Compression		*p-value*
	First	Second	
Depth	4.57 (1.50-5.84)[a]	5.08±0.54[b]	0.010[c]
Rate	128.05 ± 23.43[b]	121.681±5.53[b]	0.251[d]
Quality	0.000 (0.000-19.49)[a]	33.72±27.61[b]	0.001[c]
[a] Data are median (minimum-maximum).			
[b] Data are mean ± standard deviation.			
[c]Analysed by Wilcoxon test.			
[d]Analysed by paired T-test.			

3.2. Comparison of chest compression between doctor and nurse group after the intervention

There is no significant different chest compression (depth, rate, and quality) between doctor and nurse group after lecture and skill station in the training with feedback system (Table 5).

TABLE 5: Comparison of variables of chest compression between doctor and nurse group after the intervention.

Variable		Profession			*p-value*
	Doctor[a]	Achievement (%)	Nurse[a]	Achievement (%)	
Depth	5.08±0.54	92.36	5.25±0.39	95.45	0.288[b]
Rate	121.68±5.53	110.61	119.62±9.25	108.74	0.440[b]
Quality	33.72±27.61	48.17	44.09±31.27	62.99	0.310[b]

[a] Data mean are ± standard deviation.

[b]Analysed by unpaired T-test.

4. Discussion

This study collected chest compression data in 2 cycles to ensure that participants were not exhausted which could lead to a bias. Based on the characteristics of the subject and data analyzed before the training, the majority of the subjects had graduated from college, taken life support course, and been commonly doing life support. However, they had not achieved the standard of AHA 2015. This is in accordance with previous studies in the nurse as study subject that showed retention of CPR skill was not more than one week after course [11, 12]. Partipajak *et al.* showed that retention of CPR skill in medical student group was just 3 months [13]. Routine training is recommended to ensure both doctors and nurses have the competence to perform chest compression.

Generally, both doctor and nurse groups had shown significantly better performance to perform CPR after receiving the lecture and skill training. Although the subjects had the lecture and skill training in a short period of time, they could perform CPR as the AHA 2015 standard. The use of the feedback system might guide the subjects to perform standardized resuscitation since they could see or listen to the feedback given through the devices. However, the rate of CPR in the doctor group before and after using the feedback system was not significant.

In doctor and nurse group, most of the subjects did chest compression too fast (>120/min). Performing chest compression too fast could lead to rescuer fatigue and it

decreased the quality of chest compression [14]. CPR training, therefore, should entail proper technique to ensure the rate of CPR is in accordance with the guideline.

In medical education, mastering skill needs time and repetitive training to achieve CPR competency [15, 16]. The more complicated the skills, the more repetitive trainings are needed. In this study, the nurse group achieved the standard of AHA 2015 (depth and rate). Meanwhile, the doctor group only achieved depth standard of AHA 2015. Both groups failed to achieve high-quality chest compression. CPR training should, therefore, emphasize that high-quality CPR can be achieved by conducting longer and repetitiveCPR training.

The strength of our study is that, to our knowledge, this is the first study in Indonesia that studied the effectivity of CPR training using feedback system in doctors and nurses. This study, however, has several limitations. First, training of chest compression was conducted in a short of time, thus, although it achieved the minimum standard, subjects could not perform a high-quality CPR. Future study is needed to determine the ideal length of CPR training to achieve optimal competence and retention skill. Second, we did not assess participants' retention of CPR skill after a certain period of time.

5. Conclusion

CPR training using feedback system improves the depth, rate, and quality of compression in the nurse group. Meanwhile, no improvement was found in the doctor group. When two groups were compared after training, there was no significant difference in doing CPR.

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