The Effect of Using a Assistant Pad when Doing Chest Compression During Cardiopulmonary Resuscitation

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Abstract

We propose a effectiveness of the assistant pad during cardiopulmonary resuscitation and provide basic data for high quality cardiopulmonary resuscitation. The subjects of the study were 28 students in the emergency department who completed the BLS Health Care-Provider under the experimental study by the randomized crossover design. Data were analyzed by using SPSS 20.0 Version. The results of this study showed that chest compressions using assistant pads decreased pain and fatigue than normal chest compressions, and the depth of chest compressions was deeper than normal depth. The results of this study shows that the use of assistant pads between the one hand and the other hand during cardiopulmonary resuscitation may increase accuracy and depth were improved. Therefore intensive indicator also improved. However, with regard to the use of assistant pads, further studies will be needed to identify the potential for clinical use.

▸ Keyword : Cardiopulmonary Resuscitation, Chest Compression, Assistant Pad, Fatigue

I. Introduction

Among the cardiac disorders the cardiac arrest is the third leading cause of death every year and is unpredictable[1]. In particular, sudden death occurs in 50% of patients with coronary artery disease[2]. When look at the incidence of cardiac arrest, Per 100,000 population, 52.5 in Asia, 86.4 in Europe, and 112.9 in Australia[3]. In Korea, 41.4 people in 2008, 44.8 people in 2010, and 46.3 people in 2013, etc. numbers are have been steadily increasing[4]. Approximately 60-80% of patients with cardiac arrest occur in homes, public places, and multiple-use facilities[5]. If cardiopulmonary resuscitation(CPR) is performed promptly by the first eyewitness in the event of a cardiac arrest, the survival rate of the patient can be increased[6,7].

When cardiac arrest occurs, the CPR is a technique that maintains coronary perfusion pressure and cerebral blood flow. Among the C, especially chest compressions are a very important technique[8,9], which can maintain circulation in a common and effective way[10]. This also affects the patient's spontaneous circulation recovery and neurological prognosis [9,11].

For effective chest compression, the floor must be rigid and in a place where the rescuer can sit on his knees[12], placing one palm in the compression position and overtopping the other palm, compressing the chest with the reaction of both hands and waist[13,14]. And, the elbow should not be bent and straightened also the palm should not fall off from the chest bone when[15]. In this way, in order to perform high quality CPR, if advanced airway maintenance is performed, after

performing the chest compression for 2 minutes at a rate of at least 100 times per minute with maintaining the correct posture of the arm, and alternate the role of the rescuer is recommended[16,17]. In addition, non-trained individuals are advised to perform continuous chest compressions without rescue breathing[18,19]. The chest compression method, which has been performed so far, is put pressure on the patient's chest with a pair of hands [14]. However, this can cause pain by the weight of the rescuer in the overlapping lower hand during chest compressions. And the fatigue of the rescuer also increases, therefore decrease in the quality of the chest compression can be occurred[20,21]. Based on these results, using the assistant pad produced by the present researcher, this study will compare the quality of chest compressions during cardiopulmonary resuscitation (CPR). And to use as a basic data to provide physical elements of effective CPR.

II. Methodology

1. Study design

This study is an experimental study using a randomized crossover design to compare the quality of chest compressions using assistant pads during CPR. The study design is shown in Figure 1.
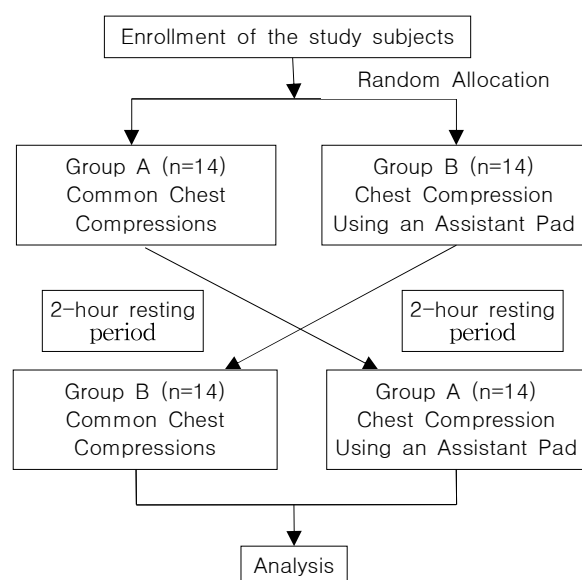

Fig. 1. Research design

2. Study Object

The subjects of this study were 28 persons. Prior to this experiment, preliminary experiments were conducted and the number of subjects was selected by using G ∗ Power 3.1. Effective Size was the minimum of 27 subjects who applied 80% power at 0.05 significance level, and the final 28 subjects were selected considering the omission due to errors during the experiment. The criteria for the selection of the subjects were as follows: First, those who understood the purpose of the study and agreed to the participation through written consent; Second, those who passed the BLS Health Care-Provider from AHA and KACPR; Third, those who did not have physical and mental disabilities were selected.

3. Study Protocol

The selected subjects were informed about the purpose of the study and the implementation process before the study. And the study was performed. Among the sample numbers which made by fitting the experimental group, one number was selected. And the odd numbers were assigned to normal chest compressions, and even numbers were assigned to groups using assistant pad between palm and hand. With this way, each 14 people were assigned. The subjects underwent chest compressions for 2 minutes using the each assigned method, through the resting for 2 hours after chest compression, minimizing the fatigue of previous chest compression. After resting, the chest pressure was performed for 2 minutes by changing the chest pressure method. All subjects were subjected to chest compressions using both methods. To prevent errors in the experiment, the subject could not see the monitor screen during chest compressions and did not give any instruction or explanation during the experiment.

4. Data Collection and Tool
4.1 Survey Tool

The general characteristics (sex, age, height, weight) of the subjects and pain and fatigue felt by the subjects during chest compressions were directly entered in a self-report format. Visual Analogue Scale [22] was used to measure subjective pain and fatigue during chest compressions from 1 point to 10 points after each chest compression was completed. After each chest compression, the pain level was indicated by 1 to 10 points on both ends of the line to indicate the current

pain status. Fatigue for chest compression was 1 point for "not difficult" and 10 points for "hard" And the score was used. In addition, when the chest was pressed, let the write the preferences about chest pressure using the assistant pad and the general chest pressure.

4.2 Assistant Pad

The assistant pad used in this study means that made of silicone material and is made to fit between the palm and the back of the hand of the rescuer.

4.3 Quality of Chest Compression

To perform this experiment, a manikin (Resusci® Anne Skill Reporter ™) for practical evaluation by using PC was used. Through an average of two-minute chest compressions, data on the rate and depth of chest compression, and chest compression and relaxation ratio(mean chest compression / mean chest relaxation ratio) were used.

5. Data Analysis

The collected data were analyzed by using SPSS Ver. 20.0 for Win statistics program. The subjects' gender, age, height (cm), body weight (kg), and chest compression method were evaluated by means of mean and standard deviation, and to compare for between two groups (velocity, compression depth, compression versus relaxation ratio, pain intensity, fatigue), the Paired t-test was used. The significance level of all analyzes was set at 0.05.

III. Results

1. General characteristics of subjects

Among the 28 subjects, 16 (57.1%) were male and 12 (42.8%) were female. The mean age was 23.65 ± 2.31 years, the mean height was 170.58 ± 7.14 cm, and the mean body weight was 63.42 ± 10.44 kg[Table 1].

Table 1. General characteristics of the subjects

Characteristics	Category	N(%)/M±SD
Gender	Male	16(57.1)
	Female	12(42.8)
Age(year)		23.65±2.31
Height(cm)		170.58±7.14
Weight(kg)		63.42±10.44

2. Quality of Chest Compression by Use of Assistant Pad

According to the use of assistant pads or not, Table 2 shows the results of measuring and comparing the quality of chest compressions after performing chest compressions. According to the use of assistant pads, mean chest compressions did not show any significant difference(p<.392). The mean depth of chest compressions was significantly deeper than that of normal chest compressions(p<.007) and the ratio of mean chest compression to relaxation was also statistically significant (p<.021) [Table 2].

3. Pain and Fatigue Dgree during Chest Compression With using Assistant Pad

As a result of comparing the degree of pain according to whether or not the assistant pad was used when performing chest compression, the chest pressure (5.23 ± 1.10) using the assistant pad showed less pain (p<.001) than the general chest pressure (8.19 ± 1.20). Also, as a result of comparing fatigue with 10 point scale, compression using ancillary pads (5.12 ± 0.76) showed lower fatigue than general chest compressions (8.62 ± 1.02) (p<.001) [Table 3].

4. Preference of Chest Compression Method

As a result of examining the preference of chest compression the assistant pad and the general method, assistant pads was 20 (71.4%), in general was 8 (28.6%), the use of supplementary pads showed a higher preference [Table 4].

Table 2 Quality of Chest Compression by Use of Assistant Pad

Characteristics	Common Chest Compression	Chest Compression Using an Assistant Pad	t	p
Chest Compression rate, min	109.26±2.94	108.80±1.13	0.871	0.392
Mean depth, mm	50.23±6.98	53.26±5.54	−2.918	0.007
Chest Compression vs. Relaxation Ratio	0.89±0.18	1.01±0.14	−2.474	0.021

Table 3 Pain and Fatigue Degree during Chest Compression with using Assistant Pad

Characteristics	Common Chest Compressions	Chest Compression Using an Assistant Pad	t	p
Pain Degree	8.19±1.20	5.23±1.10	7.83	<0.001
Fatigue Degree	8.62±1.02	5.12±0.76	−13.08	<0.001

IV. Discussion

When a cardiac arrest occurs, If cardiopulmonary resuscitation is performed promptly by the first witness, the survival rate of the patient can be increased[6,7]. And at this time, high quality chest compression of the rescuer is the most important factor.

The results of this study showed that the use of assistant pads during chest compressions resulted in significantly less pain than general chest compressions. With keeping the chest compression posture which need the body weight of rescuer[14], and using an assistant pad between the palm and the other back of his hand, it let maintain the chest compression posture stably, also, through the buffering action that absorbs the shocks in compression and relaxation, pain could be reduced. Because the general chest compression method compresses one palm and other palms[13,14], a skilled rescuer also causes pain in the back of the hand after chest compression. Especially in the case of untrained general people, bruising may cause on the back of the hand as well as pain. Therefore, based on this, the use of the assistant pad may be useful for CPR training in general people and it reducing the pain of the palm of the rescuer. Therefore, more effective chest compressions can be performed than the conventional method. Cardiopulmonary resuscitation with high chest compressions or high compression to ventilation rate may increase chest compressions, so it can be expected to increase the fatigue and make down the quality of the rescuer [23]. This also reduces the pain felt on the back of the hand when using the assistant pad, and the assistant pad which made of silicone material minimized the positional change of the overlapping hands, and fatigue could be reduced because it was able to compress the chest regularly and with the same force. Studies on the fatigue of the rescuer during chest compression have been consistently conducted [15,20,21], and it is important to minimize the fatigue of the rescuer for high quality chest compressions. However, this experiment is a subjective evaluation of the rescuer. Therefore, it is necessary to study more objective indicators of pain and fatigue. As a result of chest compressions, when the chest was compressed by using the assistant pad, the mean depth was 53.26 ± 5.54 mm. it was deeper than 50.23 ± 6.98 mm checked by normal chest compressions. When using the assistant pad, a stable, accurate chest compression posture can be maintained, and stronger pressure is delivered to the chest of the mannequin, which indicates that high quality chest compression was performed. In the past, the type of equipment was different [8,24], adding more physical elements and more power was delivered to the chest bones of the mannequin, it showed that the resulting in a deeper chest compression. However, like this study, existing researches are also a virtual research using mannequins, so it may be difficult to generalize the results because it may cause different results when applied to real people.

An important element of effective chest compression is the depth of chest compression, velocity, and complete relaxation after compression[25]. In this experiment, we found that the ratio of compression versus relaxation was better with using the assistant pad. Inadequate relaxation of the chest pressure causes an increase in airway pressure and a decrease in venous return. As a result, it causing a reduction in perfusion pressure of coronary artery and cerebral artery[26]. Thus, the use of assistant pads may improve the ratio of compression to relaxation, which is a qualitative index of chest compressions.

Table 4. Preference of Chest Compression Method

Characteristics	Common Chest Compressions	Chest Compression Using an Assistant Pad
Preference	8(28.6%)	20(71.4%)

As a result of investigating the preferred method of chest compression, 20(71.4%) chest compressions by

using an assistant pad and 8(28.6%) common chest compressions. It shows that the chest compressions using an assistant pad was higher preference. I believe that this is because the use of the assistant pad reduces the pain of the back of the hand, reduces fatigue, and maintains the chest pressure in a stable posture.

The limitations of this study are not actual clinical studies but virtual studies using mannequins, which may be different from the actual cardiac arrest conditions, and further studies are needed to apply them to clinical practice. In addition, this study compared the results of chest compressions performed for 2 minutes, and it may be different from the actual CPR state that should be maintained for a long time. Therefore, it is necessary to carry out research that can supplement this.

Ⅴ. Conclusions

Based on the results of this study, if the assistant pad applied to between the overlapping palms and the back of the hand during the CPR, the pain and fatigue were reduced, and the chest compressive average depth improved and the quality of chest compressions also improved. However, additional research on the use of assistant pads may be necessary to identify the potential for clinical use.

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