Cardiopulmonary Resuscitation Performance may Improve with Consideration of Performer’s Characteristics

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Abstract

Background: In basic life support, chest compressions are a very important and basic skill. Acquiring the ability to perform chest compressions is affected by individual characteristics such as physique and physical strength, although all persons can learn to perform Cardiopulmonary Resuscitation (CPR), including chest compressions. The aim of this study was to examine differences in physique between males and females and Basic Life Support (BLS) skill using a portable manikin with automated corrective feedback.

Methods: Participants were 120 fourth-year preclinical dental school students (87 males, 33 females). For skill assessment, students performed chest compressions and single rescuer CPR using a Laerdal Resusci Anne Skill Reporter TM manikin for 2 minutes each before and after CPR. Outcome measures were (1) compression depth (mm), (2) compression rate (number of compressions per minute), (3) compression release depth (recoil, mm), and (4) hand position before and after the BLS course.

Results: After the BLS course, compression depth and rate improved significantly. Both before and after the BLS course, male students performed deeper chest compressions than female students. In females, the duration of acceptable chest compressions was significantly shorter than in males.

Conclusion: CPR performance was significantly different between males and females, probably due to differences in physique. Therefore, it is necessary for individualized instruction adapted to the learner’s characteristics.

Keywords: Resuscitation; Basic life support; Chest compression

Introduction

Basic Life Support (BLS) is a level of medical care provided for victims of life-threatening illnesses or injuries until they can receive comprehensive medical care at a hospital. It can be provided by trained medical personnel, including emergency medical technicians and paramedics, and by qualified bystanders. Therefore, it is very important to acquire BLS skills. However, studies have documented that the quality of cardiopulmonary resuscitation (CPR) even by nurses and physicians is often poor, even when they have been trained in CPR [1-6].

It has been reported that the acquisition of chest compression skills is affected by individual characteristics such as physique and physical strength, but all persons are capable of learning CPR, including chest compression [7-9]. In particular, differences in physique between males and females is very important; a previous study showed that chest compression quality over 15 minutes performed by females was lower and females is very important; a previous study showed that chest compression quality was significantly poorer than in males.

As such, it is important for the acquisition of CPR skills.

The recent development of a new device that can objectively evaluate BLS skills [11] leads to the possibility of more effective BLS instruction. The aim of this study was to examine differences in physique between males and females and BLS skill using a portable manikin with automated corrective feedback.

Methods

Participants

The participants were 120 fourth-year preclinical dental school students (87 males, 33 females). This study was approved by the university’s Institutional Review Board. Each student provided written consent for study participation. Before the study, all of them attended a BLS course by the Japanese Association for Acute Medicine. At first, instruction for chest compression was performed using a practice-while-watching method. Next, instruction included scenario training if a maneuver was insufficient.

Assessment of CPR psychomotor skills

For the skills assessment, students performed compressions and single rescuer CPR using a Laerdal Resusci Anne Skill Reporter TM manikin before and after CPR for 2 minutes each. Outcome measures were (1) compression depth (mm), (2) compression rate (number of compressions per minute), (3) compression release depth (recoil, mm), and (4) hand position. The acceptable range of CPR was 1) a single minimum compression depth of ≥ 50 mm, 2) an optimal target range of 100 and 120 compressions per minute, and 3) hand position on the lower half of the sternum, based on American Heart Association guidelines [12].

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Hand position, compression depth, compression rate, and recoil

Appropriate performance of each skill was assessed during 2 minutes of CPR. Regarding hand position, all participants used the correct

| Sex (n) | Male | Female | p value |
|---------|------|--------|---------|
| Age (years) | 24 (22-25) | 23 (22-25) | 0.38 |
| Height (cm) | 170 (168-174.5) | 158 (155-161) | < 0.001 |
| Weight (kg) | 69 (62-81.5) | 53.3 (46-62.1) | < 0.001 |
| BMI (kg/m²) | 24 (21-26.6) | 20.1 (19.3-22.3) | < 0.001 |

Values are medians (interquartile range); BMI: Body Mass Index.

Table 1: Characteristics of the Study Participants.
hand position after the BLS course. After the BLS course, compression depth was significantly deeper than before the course (Figure 1A). Although the compression rate was faster than the acceptable range of 100 to 120 compressions per minute before and after the BLS course, it was significantly slower and closer to the acceptable range after the BLS course (Figure 1B). There were no significant differences in recoil before and after the BLS course (Figure 1C).

Comparisons by gender

Before the BLS course, males performed significantly deeper compressions than females (Figure 2A). The compression rate and depth of recoil were slower and shallower for females than for males (Figure 2B and 2C). After the BLS course, males had significantly higher compression depth than females (Figure 3A). Recoil depth was shallower for females than for males (Figure 3B). There were no significant differences in compression rate between males and females (Figure 3C).

Correlation between chest compression characteristics and physique after the BLS course

In males, compression depth and recoil were weakly but significantly correlated with height and weight (Table 2A). On the other hand, compression depth was significantly correlated with height in females ($r=0.63$, $p<0.001$) (Table 2B). In addition, compression depth was weakly but significantly correlated with weight in females ($r=0.37$, $p<0.05$).

Change in chest compressions over 2 minutes after the BLS course

Chest compression depth gradually became shallower over time for 96.7% of study participants (Figure 4A). Compression recoil and rate did not change over time. Among the 116 students (83 males and 33 females) for whom chest compression depth gradually became more shallow, there were 88 students (73 males and 15 females) who performed acceptable chest compressions at the start. There were 48 students (45 males and 3 females) who performed acceptable chest compressions continuously for 2 minutes.

The group that initially performed acceptable chest compressions but whose chest compression depth became shallower was further investigated. Females had a significantly shorter duration of acceptable chest compressions than males (Figure 4B).
In conclusion, the present study showed CPR performance varied significantly between males and females, which were probably due to differences in physique. Therefore, individualized instruction adapted to the learner's characteristics is necessary.

**Study Limitation**

Since the sample size was small, further study is required. In the current study, chest compression was performed on springs inside a manikin, which compress in a linear fashion. However, during actual clinical conditions, chest compressions are non-linear, which is a substantial difference between the conditions in this study and actual clinical practice [21].

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