A Comparison of Compression Rates on the Quality of Cardiopulmonary Resuscitation

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Purpose: In cardiopulmonary resuscitation (CPR) there are different opinions on the compression rate that should be applied. The aim of this study was to compare the total number of adequate compressions delivered during a five-minute period among four groups of lay persons (≥139 min⁻¹, 129-138, 114-128, and <114).

Methods: This study represents a secondary data analysis from our previous research about the influence of age on fatigue during CPR. Participants were asked to perform chest compressions (without rescue breaths) at a rate of >100 times/minute and a depth of >5 cm for five minutes. A total of 86 participants were then divided into four groups based on their mean compression rate. Age, sex, and body mass index were analyzed as factors affecting the compression rates.

Results: The group delivering a compression rate above 139 compressions min⁻¹ performed better than those delivering below 114 compressions min⁻¹ (p=0.03). There was no significant difference in the mean compression depth (p=0.13), percentage of incomplete chest recoil (p=0.277), or the percentage of incorrect hand positioning (p=0.091). All participants (except five) performed chest compressions at a rate above 100 compressions min⁻¹.

Conclusion: Our results suggest that a chest compression rate above 139 compressions min⁻¹ does not deteriorate the quality of compressions compared to a lower chest compression rate (below 114 min⁻¹) during a five-minute period. Most untrained lay people performed chest compressions well, within a range of 100~150 min⁻¹.

Key Words: Cardiopulmonary Resuscitation, Heart Massage, Fatigue

Introduction

Basic life support (BLS) is an essential part of the survival chain for victims of sudden cardiac arrest and has a significant impact on the survival and outcome of patients8). BLS significantly increases the chances for survival of victims of out-of-hospital cardiac arrest (OHCA), if performed as promptly as possible2). According to the guidelines of the American Heart Association (AHA), as revised in 2010, an emphasis has been placed on the high quality of chest compressions as "push hard, push fast"4). Many factors effect the quality of compressions, but opinions about rate differ.

The number of chest compressions delivered per minute is an important determinant of the return of spontaneous circulation (ROSC) and also of neurological intact survival2). In OHCA, untrained lay rescuers should provide Hands only CPR, and thus, the number of chest compressions is proportional to the compression rate. In 2010 the American Heart Association (AHA) emphasized the "push hard, push fast" doctrine of BLS, and stipulated a rate of above 100 contractions/min-1, without an upper limit8). In contrast, the European resuscitation council (ERC) did recommend an upper limit, as below 120 min-19). Concern about rescuer’s fatigue and deterioration of the quality of compressions was a concern at a rate above 120 min-1. However, there is insufficient evidence to recommend a specific upper limit for rate8).
Due to this uncertainty within such a crucial subject, we asked: ‘does a faster compression rate deteriorate the quality of chest compressions by an untrained lay person’. The aim of this study was to compare the total number of adequate compressions delivered during a 5 minute period among four groups of lay persons using hands only CPR, using the mean compression rates quartile (≥ 139 min⁻¹, 129-138 min⁻¹, 114-128 min⁻¹, and < 114 min⁻¹).

Materials and Methods

1. Study design

This study was secondary data analysis, using data from our previous research about rescuer’s fatigue by age. Analysis was conducted after approval of the institutional review board (IRB No: 2012-SCMC-013-00) and written informed consent was waived by the participants.

The research was conducted from October 1 to December 31, 2010. The local government in Gyeongsang Namdo has annually contracted the Changwon Emergency Medical Information Center for the BLS education program, which has aimed to provide the inhabitants of this province with more BLS training. The subjects participating in this educational program included nursery school teachers, soldiers, businessmen, and railway officials, however, health care professionals were not included within this educational program. During this period, 12 BLS training classes for non-medical trainees were held at the Changwon Emergency Medical Information Center, which was overseen by the university in an urban area. The usual attendance for each class ranged from 20 to 100. The lead instructor was a board-certified emergency medicine physician. All teaching assistants were AHA-certified BLS instructors, or possessed a certificate as a BLS provider. Each class was composed of the same curriculum. Each education class consisted of two regular courses: a 3-h theoretical lecture with general first aid and BLS and a 2-h practice session for BLS training. In the last part of each lecture, a hands-only CPR class was taught according to the AHA Science Advisory recommendations issued in 2008⁸. A demonstration of hands-only CPR was given by a teaching assistant without practice by the students. Thus, every education course was based on the same circumstances. Upon completion of the theoretical lecture, this study was conducted using students who submitted a written informed consent form prior to participation. The subjects in this study included all of those to whom the exclusion criteria did not apply. The exclusion criteria were (1) cardiovascular, pulmonary, or cerebro-vascular conditions precluding the ability to provide even a moderate effort; (2) the occurrence of non-traumatic chest pain within the last year; (3) participants who complained of cardiovascular disease symptoms, i.e., dizziness, dyspnea, or chest pain during the study; (4) participants who could not continue the chest compressions for more than two minutes. Participants were asked to perform chest compressions for nine minutes without rescue breaths on a Recording Resuscitation Anne Manikin (Laerdal Medical Corp., Stavanger, Norway), according to the methods provided by the AHA Science Advisory⁹. As recommended by these guidelines, participants were instructed to perform chest compressions at a rate >100/minute and at a depth of >5 cm. No comments about the quality of chest compressions were made to the participants during the study.

2. Outcome measurement

86/91 of the participants who completed over 5 minutes of compression were analyzed in this study. The participants were asked to performing chest compression as ‘push hard, push fast’, and thus, the rate of compression varied from one to another. The data of the participants were classified according to the mean compression rates quartile (≥139/min⁻¹, 129–138/min⁻¹, 114–128/min⁻¹, and <114 min⁻¹), and the data of these four groups were compared. We assessed the possible cofactors of age, gender, height and weight, and considered these factors in statistical analysis.

The primary outcome was the total number of adequate chest compressions during 5 minutes of the four groups. The secondary outcomes were other parameters of chest compressions and changes over 5 minutes between >120 and ≤120 min⁻¹ groups (i.e. (1) the mean number of adequate chest compressions over time, (2) the mean compression depth over time, (3) the mean proportion of incomplete chest recoil over time, (4) the mean proportion of incorrect hand position over time, (5) decay point and also the distribution of the mean com-