Continuous cardiopulmonary resuscitation training compared to single training by laypersons

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Abstract

Background. Compression-Only Cardiopulmonary Resuscitation (COCPR) has been broadly studied during the last few years and specially introduced into lay rescuers' training. The aim of the study was to compare the quality of COCPR performed by laypersons (Group A) who attended a single cardiopulmonary resuscitation (CPR) training course, and those (Group B) who underwent regular CPR training every 6 months.

Methods. Both groups completed the "Heartsaver CPR AED" course of the American Heart Association. After 30 minutes they were required to perform COCPR on a manikin with a skills reporter system.

Results. Comparing the 76 once only trained laypersons to the 74 continuously trained lay rescuers, we found that average age (20 versus 40 years old), male gender (54% versus 93%), body mass index (BMI) (24.9 versus 27.3 kg/m^2) and regular physical exercise (55% versus 36%) proved significant predictors, $p<0.01$, $p<0.01$, $p<0.01$ and $p=0.04$

respectively. Regarding COCPR-quality, the percentage of efficient chest compressions (43% versus 58%), average depth of compression (45 versus 50 mm) and percentage of error-free compressions (36% versus 50%) indicated a significant statistical difference, with p=0.01, p=0.01 and p<0.01 respectively. However, the average frequency of compressions per minute (121 versus 124), the percentage of correct hand positioning during chest compressions (87% versus 90%) and the average duty cycle (47% versus 45%) did not display a significant difference.

Conclusion. The continuous CPR training group obtained better results regarding quality of chest compressions when compared with single CPR training.

Key words: cardiac massage, cardiopulmonary resuscitation, out-of-hospital cardiac arrest, emergency medicine, resuscitation

Introduction

According to the World Health Organization, (1) ischemic heart diseases (IHDs) are still the major cause of global death, responsible for approximately seven million deaths annually. IHDs corresponded to 96,386 deaths in Brazil, accounting for 9% of all deaths in 2009, which places it first on the list of reasons for out-of-hospital cardiac arrest (OHCA). (2)

Ventricular fibrillation is the most frequent type of OHCA, and IHDs are precisely the preeminent stake. (3) Successful OHCA resuscitation depends on a series of life-saving actions that improve the chances of survival, such as immediate recognition of cardiac arrest, activation of emergency response system, early cardiopulmonary resuscitation (CPR) and early defibrillation that is mainly performed by bystanders who are mostly laypersons. (4) Currently, there are several places with public access to defibrillation programs in which lay people can help in the care of a victim of cardiac arrest. (5-7)

Recent observational studies of OHCA revealed that Compression-Only Cardiopulmonary Resuscitation (COCPR) has equivalent or even greater results when compared to conventional CPR (assuming a compression-

to-ventilation ratio of 30:2) in adult patients, especially in regard to neurological benefits. (8-13) In addition, COCPR is a less complex technique which enables laypersons to execute the procedure more accurately, and therefore is extremely recommended whenever sudden collapse occurs. (13) For this reason, it is remarkably important to teach CPR not only to health care staff but to laypersons. However, studies show that CPR skills are lost after a certain period of time and highlight the importance of continuous training. (14-17) The main objective of this study was to compare, based on the quality of chest compressions , the difference between CPR continuous training and CPR single training by lay rescuers.

Materials and Methods

Study design

This is a prospective, observational study. It respects the Declaration of Helsinki and was approved by the Ethics Committee in Research of the Faculty of Medicine Foundation – ICESP, Sao Paulo University, FMUSP, CAAE: 09495112.5.0000.0065. The volunteers agreed to take part in the study and signed a Free and Clarified Consent Form designed by the National Health Council.

Participants

The research enrolled 76 laypersons (Group A), and 74 lay rescuers (Group B). Group A consisted of university students in the area of health. Group B consisted of security guards who perform continual brief CPR-training (60 min), every six months.

Materials

Besides Identification Forms, materials used to collect data were Laerdal Resusci-Anne Skills Reporter Manikin (Laerdal Medical, Norway) connected to a computer system that analyzes the data and a “Heartsaver CPR AED” training course DVD by the American Heart Association (AHA). This is a standard course given by basic life support instructors, and respects the maximum of six students to each instructor. Resusci-Anne Skills Reporter Manikin is an adult CPR training manikin gadget that analyzes and evaluates the execution of chest compressions, hand

positioning, compressions per minute ratio and depth of compressions in addition to other data. Volunteers' weight was calculated using a Plenna Acqua Sim 09190 Digital Scale, and their height using a tape measure positioned on the wall.

Data collection

In order, to update certificates, lay rescuers undergo CPR training every two years between September 2006 and December 2012, through the "Heartsaver CPR AED" training course by AHA. Moreover, they perform continual brief CPR-training (60 min), every six months. We included lay rescuers (security guards) with at least one previous "Heartsaver CPR AED" training course and excluded laypersons that had performed it. We also excluded lay rescuers who had initiated health science degrees in-between the training courses.

Data were collected as follows: Group A received for the first time the "Heartsaver CPR AED" training course. The same course was administered to Group B as a certificate revalidation, but obeying the same standards of Group A's course.

Later, weight and height were measured and the Identification Form, containing personal data, was completed.. In order to allow the volunteer to rest from the physical activity applied during the training course, a thirty minute rest was granted before the evaluation of chest compressions. The volunteer then performed COCPR for two minutes on a Resusci-Anne Skills Reporter Manikin (figure 1). During the data collection time frame, no interruptions or interferences in the volunteer's COCPR technique, or correction of it, were allowed.

The quality of thoracic compressions was analysed using PC SkillReporting System software connected to a Resusci-Anne Skills Reporter Manikin. Outcomes included hand positioning, frequency, depth and duty cycle of compressions. Parameters used were according to the current Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. (18,19)

The term duty cycle refers to the time spent to compress the thorax, assessing the gap between two compressions; measuring the time taken

between the beginning of one compression until the beginning of the next compression. The coronary flow is in part determined by the duty cycle. Even though the average value, enough to provide adequate coronary and brain perfusion, is between 20–50%, a 50% duty cycle is recommended, as it is very easy to perform.

Statistical analysis

Statistical differences between the two groups were analyzed using the Student's-t test for independent samples. Categorical data were analyzed using the Chi-squared test. Variable correlations were analyzed using Pearson's test. Continuous variables were presented through average standard deviation and the categorical variables were presented in frequency (%). Statistical significance was set at $p<0.05$ with a confidence interval of 95%. Analyses were performed using SPSS Ver.12 (SPSS, Inc., Chicago, IL).

Results

Sample characteristics

Comparing the laypersons's profile (Group A) with the lay rescuer's (Group B), the average age was 20.82±3.93 versus 40.91±9.93 respectively ($p<0.001$). The percentage of men was 53.95% versus 93.24% ($p<0.001$). The average BMI was 24.91±4.53 versus 27.29±3.85 kg/m^2 ($p<0.001$) and the percentage that regularly performed physical exercise was 55.25% versus 36.49% ($p=0.043$). The average training done by the rescuers was 4.28±1.89 courses. It is possible to observe the sample's characteristics in more detail in table 1.

CPR performance

In regard to COCPR-quality, performed for two minutes, the following parameters were found among Groups A and B, respectively: average frequency of 121 versus 124 compressions per minute ($p=0.057$), percentage of correct hand positioning during chest compressions 87.41% versus 90.43% ($p=0.329$) and a duty cycle average percentage of 47.67% versus 45.52% ($p=0.067$). No significant statistical difference was demonstrated. However, comparing the percentage of compressions performed with adequate depth (43.29% versus 58.29%), average depth

of compressions (45.11 versus 50.37 millimeters) and the percentage of error-free compressions (36.43% versus 50.22%), a significant statistical difference was found with p=0.012, p=0.019 and p=0.009, respectively. Chest compression parameters compared to its respective standard deviation are shown in table 2.

Discussion

The current study demonstrates that continued CPR training ensures the best quality of COCPR. Even though Group A did not achieve the best outcomes in important parameters – in only a single training – aspects such as hand positioning and frequency of compressions received good results. These numbers confirm findings in previous publications involving lay rescuers that proved the improvement of CPR performance through a compact, single CPR training session or simple instructions sent to mobile phones. (20-23)

A significant, adequate depth of compression percentage – observed in Group B – reaffirm the efficiency of continual training, as it has a positive effect in providing satisfactory coronary perfusion, one of the main criteria for spontaneous return of circulation in cardiac arrest victims. (24,25)

In prior CPR-quality studies, it is clear that satisfactory depth of compression is the hardest parameter to accomplish. (20,26-28) In this study, less than 60% of lay rescuers could perform it properly. Thus, it is supposed, that to perform COCPR for longer than two minutes generates great fatigue in the rescuer who executes it. In order not to affect chest compression quality,, many studies advise the use of feedback devices during CPR execution. (29-33) These tools might assist the rescuer during chest compressions, allowing assessment of quality and helping to decide whether to improve the compressions or call a substitute, contributing to a successful assistance.

Lastly, this study attempts to reinforce the necessity of continual CPR training for healthcare professionals and populations in general, consequently increasing the survival rate of OHCA. As important as

training, is the dissemination of knowledge in CPR for the lay population.

The present study has some limitations. First, this study used a manikin. A compression graded “adequate” by Resusci Anne may not correlate with a clinically effective compression, and the rescuer’s attitude during a simulated situation may differ from an actual cardiac arrest. Second, the heterogeneity of the two groups; overall elderly age and male gender predominance in the lay rescuer’s group; and only a single round of COCPR (and not repeated rounds of CPR) that does not mimic clinical practice. These differences may have affected the results and require further investigation.

In conclusion, the continual CPR training group obtained better results, in regard to quality of chest compressions, when compared with single CPR training, especially in regard to the depth of chest compression. A single CPR training attended by laypersons presented good outcomes; nevertheless it could have exhibited greater results if they had continual training during their lives.

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Acknowledgements

We thank all students and lay rescuers of Sao Paulo Metro that participated in this study.

Table 1. Characteristics of the study sample.

Characteristics	Group A (Laypersons)	Group B (Lay Rescuers)
Total (n)	76	74
Age Average	20.82±3.93	40.91 ±9.93
Oldest	35	60
Youngest	17	22
Male Gender (%)	54%	93%
BMI Average (kg/m^2)	24.91 ±4.43	27.29 ±3.85
Highest BMI (kg/m^2)	38.64	38.87
Lowest BMI (kg/m^2)	16.80	19.38
Regular Physical Exercise (%)	55.25%	36.49%
Average no. of CPR courses	1	4.28 ±1.89

BMI, Body Mass Index; CPR, Cardiopulmonary resuscitation.

Table 2. Parameters of Compression-only Cardiopulmonary Resuscitation (CPR) performed during two minutes.

Parameters	Laypersons (single CPR training)	Lay Rescuers (Continual CPR training)	"*p*"
Average Frequency (compr./min)	121 ±21	124 ±11	0.057
Correct Hand	87.4 ±29	90.4 ±23	0.329

Positioning (%)			
Average *duty cycle* (%)	47.6 ±7	45.5 ±6	0.067
Adequate Depth (%)	43.2 ±43	58.2 ±40	0.012
Average depth (mm)	44.1 ±12	50.3 ±7	0.019
Error-free compressions (%)	36.4 ±41	50.2 ±39	0.009

Figure 1. Volunteer doing thoracic compressions on a Resusci-Anne Skills Reporter Manikin.

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