Resuscitation 85 (2014) 112–118

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Simulation and education

Effects of repetitive or intensified instructions in telephone assisted, bystander cardiopulmonary resuscitation: An investigator-blinded, 4-armed, randomized, factorial simulation trial☆

R. van Tulder[a], D. Roth[a], M. Krammel[b], R. Laggner[a], B. Heidinger[a], C. Kienbacher[a], H. Novosad[c], C. Chwojka[c], C. Havel[a,*], F. Sterz[a], W. Schreiber[a], H. Herkner[a]

[a] Department of Emergency Medicine, Medical University of Vienna, Austria
[b] Department of General Anaesthesiology, Intensive Care and Pain Management, Austria
[c] NOTRUF NOE GmbH, Emergency Call and Coordination Centre, Lower Austria, Austria

ARTICLE INFO

Article history:
Received 12 March 2013
Received in revised form 8 August 2013
Accepted 14 August 2013

Keywords:
Cardiopulmonary resuscitation
Out of hospital cardiac arrest
Chest compression
Manikin
Telephone

ABSTRACT

Background: Compression depth is frequently suboptimal in cardiopulmonary resuscitation (CPR). We investigated effects of intensified wording and/or repetitive target depth instructions on compression depth in telephone-assisted, protocol driven, bystander CPR on a simulation manikin.

Methods: Thirty-two volunteers performed 10 min of compression only-CPR in a prospective, investigator-blinded, 4-armed, factorial setting. Participants were randomized either to standard wording ("push down firmly 5 cm"), intensified wording ("it is very important to push down 5 cm every time") or standard or intensified wording repeated every 20 s. Three dispatchers were randomized to give these instructions. Primary outcome was relative compression depth (absolute compression depth minus leaning depth). Secondary outcomes were absolute distance, hands-off times as well as BORG-scale and nine-hole peg test (NHPT), pulse rate and blood pressure to reflect physical exertion. We applied a random effects linear regression model.

Results: Relative compression depth was 35 ± 10 mm (standard) versus 31 ± 11 mm (intensified wording) versus 25 ± 8 mm (repeated standard) and 31 ± 14 mm (repeated intensified wording).

Adjusted for design, body mass index and female sex, intensified wording and repetition led to decreased compression depth of 13 (95%CI −25to −1) mm ($p = 0.04$) and 9 (95%CI −21 to 3) mm ($p = 0.13$), respectively. Secondary outcomes regarding intensified wording showed significant differences for absolute distance (43 ± 2 versus 20 (95%CI 3–37) mm; $p = 0.01$) and hands-off times (60 ± 40 versus 157 (95%CI 63–251) s; $p = 0.04$).

Conclusion: In protocol driven, telephone-assisted, bystander CPR, intensified wording and/or repetitive target depth instruction will not improve compression depth compared to the standard instruction.

1. Introduction

Telephone-assisted, bystander cardiopulmonary resuscitation (CPR) has received more and more attention in resuscitation research since it has been recognized as the anchor link of the chain of survival.[1] The importance has been underlined by a scientific statement of the American Heart Association (AHA)[2] and also by the European Resuscitation Council (ERC) guidelines 2010 on CPR[3] encouraging dispatchers to provide verbal prompts for bystanders faced with a cardiac arrest victim. Several studies have shown the benefit of the so-called dispatch assisted life support on outcome of out-of hospital cardiac arrest (OOHCA).[4–6] However, quality of chest compressions remains of specific concern as favourable (neurological) outcome is essentially linked to compression depth.[7] Therefore, considerable research is undertaken to improve compression depth not only in telephone CPR.

Currently, for protocol driven telephone-assisted, bystander CPR the medical priority dispatch system (MPDS®) provided by the International Academy of Emergency Dispatch (IAED – Salt Lake City, UT, USA) is used in 2855 dispatch centres of 43 countries worldwide. According to the AHA guideline on CPR it advises to "push down firmly 5 cm".

By now, it is unknown whether this or another phrase is appropriate to transport the essential information to achieve adequate

☆ A Spanish translated version of the summary of this article appears as Appendix in the final online version at http://dx.doi.org/10.1016/j.resuscitation.2013.08.010.

* Corresponding author at: Department of Emergency Medicine, University of Vienna, Waehringerguer 18-20/6D, A-1090 Vienna, Austria.
Tel.: +43 (1) 40400 1964; fax: +43 (1) 40400 1965.
E-mail address: christof.havel@meduniwien.ac.at (C. Havel).

0300-9572/$ – see front matter © 2013 Elsevier Ireland Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.resuscitation.2013.08.010

compression depth. The current study was set out to evaluate the effectiveness of an intensified wording and/or repetitive target depth instruction in a simulated, telephone-assisted, compression-only, bystander CPR. We hypothesized that an intensified wording and/or the continuously repeated target depth instruction results in an improved compression depth compared to the standard instruction set.

2. Methods

2.1. Trial design

The study was planned as a prospective, investigator-blinded, randomized, 4-armed, factorial trial (www.controlled-trials.com/ISRCTN85521420). The ethical committee of the Medical University Vienna approved the protocol.

2.2. Participants

The study was conducted at a central shopping mall in Vienna, on July 17, 2012. Visitors of the shopping mall were asked to participate voluntarily. Volunteers at the age or older than 18 years of age were eligible for randomization, if they had no advanced life support education or recent basic life support training. In Austria, almost all adults had a first aid course because this is mandatory to obtain a driving license. Based on the knowledge that first aid skills abate nearly to baseline after 6 months,[8–10] we included individuals without recent first aid course (<6 months). Health care professionals (Paramedics, Nurses, Physicians) were also excluded. Further exclusion criteria were a baseline hypertension of systolic blood pressure (SBP) >160 mm Hg as well as restricted capacity for physical exercise and pregnancy.

2.3. Study setting

After informed consent participants' demographic and baseline data were recorded.

In advance of the study we assessed individual motor fitness status using, the Physical Fitness Questionnaire (FFB-Mot).[11] Values from FFB-Mot amount to 117 ± 11 points in a normal standard population.

The study was performed in a separated part of the shopping mall. For the study scenario we used a Resusci Anne® Simulator manikin (Laerdal Medical AS, Norway). Telephone instructions were given following the MPDS® protocol, version 12.2.

We investigated two interventions and a combination of both versus standard the instruction. One intervention was comprised of an intensified wording prompted: "It is very important to push down the chest firmly 5 cm every time!" (*"Es ist besonders wichtig, dass Sie wirklich jedes Mal den Brustkorb 5 cm tief eindrücken!*) The other intervention was repeating the instruction every 20 s. According to the factorial design this resulted in four distinct study groups.

Every participant called the emergency dispatch centre using a cell phone (Apple iPhone 4GS, Cupertino, CA, USA) with a reserved number simulating an emergency call for suspected cardiac arrest. The study telephone was equipped with earphones, which allowed both blinding data assessors for group assignment and avoiding participants' distractions by handling the telephone. Three dispatchers were randomized to give the differing instructions. The dispatchers were remotely located in an emergency dispatch centre 45 km away from the study setting.

By expecting the new incoming simulated emergency call the dispatchers were requested to open the next sequential numbered envelope, assigning the dispatcher and also the participant to either one of the four previously described groups.

The assigned dispatcher gave protocol driven instructions for compression only-CPR via telephone following the instructions found in the envelope. All participants had to perform 10 min of compression only-CPR, which approximately represents the usual EMS response time in Austria.[12]

According to MPDS® guidelines, participants were instructed to count their chest compressions loudly at minute 1, 3, 5, 7 and 9. Guideline conform frequency of chest compressions should be assured by the dispatcher using a metronome comparing the participants counting every second minute.

The assumed null-hypothesis was that, intensified and/or repetitive target depth instruction would result in equal compression depth.

2.4. Outcome

Primary Outcome was defined as relative chest compression depth, which represents the absolute compression depth minus the leaning depth in millimetres, measured as mean per minute by the manikin to reflect quality of CPR.

Additional quality measures reported by the manikin such as absolute distance (compression depth × compression per minute × 10 min in metres), hands-off time to CPR start (seconds) and cumulative hands-off times (seconds per 10 min) served as secondary outcomes, as well as changes in participants' vital signs reflecting physical strain (Δ pulse rate, Δ systolic and diastolic blood pressure, Δ NHPT and Δ BORG).

We used a standard pulsoximetry sensor to measure pulse rate and an upper-arm cuff oscillometric device for blood pressure, both provided by a LIFEPAK® 12 Defibrillator/Monitor (Medtronic Physiocontrol, Redmond, WA, USA) Pulse rate and blood pressure were measured before and immediately after the study.

To measure perceived exertion we used a BORG scale[13] between 6 (no exertion) and 20 (maximal exertion). At study entry the BORG scale was explicitly explained to all participants. A data assessor asked for BORG values at minute 2, 4, 6, 8 and 10 during the scenario showing the scale to the CPR provider. No other communications between participants and study staff or dispatcher occurred.

The Laerdal® Resusci Anne Simulator manikin transferred the participant's performance data into a computerized database where measurements of performance variables were standardized and recorded.

After completing the study written data sheets were double entered by trained data assessors into a MS Excel 2009 database (Microsoft, Redmond, CA, USA).

2.5. Sample size

To detect a difference of 5 mm in chest compression at a standard deviation of 3.5 mm at a significance level of 5% with a power of 90%, we needed 32 participants overall (8 per group). We have chosen 5 mm because an increase of 5 mm in compression depth was associated with a 99% increase in the odds of shock success[14] and compression depth correlates well with outcome.[7]

2.6. Randomization

We used a randomization sequence using a 1:1 ratio in blocks of four to allocate dispatchers. The allocation was concealed until start of each experiment using sequentially numbered opaque sealed envelope.

2.7. Implementation

Participants were blinded for the outcome of the study. Study staff and data assessors were blinded to group assignment, which was ensured by giving the selected instructions via earphones.