The Journal of Emergency Medicine, Vol. 48, No. 4, pp. 436–444, 2015

0736-4679/$ - see front matter

ELSEVIER

http://dx.doi.org/10.1016/j.jemermed.2014.12.034

Selected Topics: Prehospital Care

DOMINANT HAND POSITION IMPROVES THE QUALITY OF EXTERNAL CHEST COMPRESSION: A MANIKIN STUDY BASED ON 2010 CPR GUIDELINES

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□ **Abstract—Background: The 2010 cardiopulmonary resuscitation (CPR) guidelines increased the importance of external chest compression. However, the best hand position to be the compressing one has not been identified. Objectives: To investigate the effects of dominant or nondominant external chest compression hand position during CPR. Methods: Medical students performed five cycles of conventional CPR and completed one questionnaire. The CPR performances were manually evaluated, and detailed aspects of the external chest compression quality were assessed via the SimMan® Essential system (Laerdal China Ltd., Hangzhou, China). Results: One hundred fifty-seven students participated in the nondominant hand (NH) group, and 68 students participated in the dominant hand (DH) group. The manual evaluations revealed no differences between the two groups. The proportion of chest compressions "above 100 cpm [compressions per minute]" was higher in the DH group than in the NH group (97% vs. 92%, respectively, $p = 0.002$). The frequency distributions of the chest compression rates were also significantly different between the two groups ($p < 0.0001$). The distribution of the NH group was concentrated within "130–139" cpm, whereas this distribution was concentrated within "140–149" cpm in the DH group. The chest compression depth of the DH group was deeper than that of the NH group ($p = 0.001$). The depth of the fifth cycle was significantly decreased compared with those of cycles 1, 2, and 3 in the NH group. A greater number of full chest recoils were observed in the NH group ($p = 0.02$). Conclusion: The dominant hand position during CPR was associated with a higher chest compression rate, a greater chest compression depth, and delayed fatigue.** © **2015 Elsevier Inc.**

□ **Keywords—cardiopulmonary resuscitation (CPR); dominant hand; chest compression; fatigue; manikin**

INTRODUCTION

External chest compression is the core of cardiopulmonary resuscitation (CPR). For over 40 years, researchers have been seeking the best manipulations for increasing the quality of CPR during sudden cardiac arrest, and the International Liaison Committee on Resuscitation renews its guidelines every 5 years (1,2). The American Heart Association (AHA) 2010 CPR guidelines recommend that the CPR sequence be changed to compression-airway-breathing (C-A-B), which increases the attention placed on the importance of chest compression (3). Moreover, the AHA also recommends "pushing hard and pushing fast."

The guidelines for external chest compression suggest "placing the heel of one hand on the center (middle) of the victim's chest and the heel of the other hand on top of the first so that the hands are overlapped and parallel" (3). Which hand should be used as the compressing hand (i.e., the lower hand that is in contact with the sternum)

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RECEIVED: 10 June 2014; FINAL SUBMISSION RECEIVED: 28 September 2014;
ACCEPTED: 21 December 2014

has not been identified. Kundra et al. showed that chest compressions are performed with fewer errors (i.e., the number of correct chest compressions is higher, and the compression depths and hand locations are better according to the 1998 European Resuscitation Council guidelines) when the dominant hand is in contact with the sternum of the Laerdal Skillmeter Resusci Anne (Laerdal China Ltd., Hangzhou, China) (4). Nikandish et al. found that positioning the dominant hand in contact with the sternum may increase the total number of the correct chest compressions during 5 min of hands-only CPR according to the European Resuscitation Council or AHA 2005 CPR guidelines when CPR is practiced on a recording Resusci Anne, but this difference was not statistically significant (5). Both of these studies were conducted based on the older CPR guidelines, which recommended that providers compress at a rate of approximately 100 compressions per minute (cpm), produce a compression depth of 40–50 mm, and that the compression to ventilation ratio be 15:2 (1998 guidelines) or 30:2 (2005 guidelines). Using an advanced manikin, the SimMan® Essential (Laerdal China Ltd.), we sought to record the parameters of CPR quality more objectively than the manikins used in the two previous studies. And meanwhile, we tried to explore whether the position of the dominant hand would influence the quality of external chest compression according to the new CPR guidelines using this objective simulation system and to learn more about the position of the dominant hand during CPR.

MATERIALS AND METHODS

Participants

All the medical students in the clinical department of our university who took a course in "Emergency Medicine" participated during the 2013/2014 academic year in their first standard CPR courses. The students had no previous experience using the SimMan Essential manikin. The study was approved by the Clinical Department of our university.

Study Procedures

As shown in Figure 1, the participants had received training in CPR skills via a formal classroom lecture that introduced the basic knowledge and skills with a PowerPoint presentation (Microsoft Corporation, Redmond, WA) and video, and repeatedly practiced their skills on a Resusci Anne (Laerdal China Ltd.) under the supervision of AHA-certificated Basic Life Support (BLS) instructors. During the courses, the instructors taught the hand placement according to the recommendations of the guidelines.

Within 1 week of the training, all participants took a CPR test that was based on the criteria of the CPR skill test in the Objective Structural Clinical Examination of our school. The participants were tested in ascending order of their student ID numbers and were presented with a simulated scenario of witnessing an adult collapse in the out-of-hospital setting. The manipulations were performed on the SimMan Essential. The participants were all asked to complete five cycles of complete conventional single-rescuer CPR on the manikin's right side of approach.

The performances of the participants were manually evaluated by an AHA-certificated BLS instructor according to the CPR Objective Structural Clinical Examination criteria (a standard template) at the scene. Each performance was exhibited as a score (the full mark of the criteria is 100). Simultaneously, two observers recorded the results on the SimMan Essential tablet personal computer remotely in another room. The computer showed objective parameters of the CPR performances. We focused on the chest compression-related parameters, including chest compression rate, chest compression depth, and the chest recoil of every cycle. The students, monitors, and observers were all blind to the aims of the study. Finally, the students were required to complete one questionnaire that included nine single-choice questions. The participants indicated their general characteristics, dominant hands, their choices of compressing hands, and self-assessments of the quality of the CPR they had given (see Appendix). During the whole procedure of the study, the organizer of the study was at the scene to monitor and observe the test flow, including the occurrence of changing hand in contact with the sternum during CPR.

Next, two researchers collected the scores, the manikin results, and the questionnaires. The participants were then divided into two groups. A nondominant hand group (NH group) included those who had used their nondominant hand as the compressing hand (i.e., the lower hand that was in contact with the sternum). A dominant hand group (DH group) included those who used their dominant hand as the compressing hand.

Statistical Analyses

The data are expressed as the means ± the SD and numbers or percentages. Evaluations of the distributions of the variables were performed using Levene's test for homogeneity of variances. Comparisons of two means were performed using *t*-tests, comparisons of several means were performed using analyses of variance and least-significant difference tests, and comparisons of several percentages were performed using chi-squared tests or Fisher's exact tests, as appropriate. Statistical analyses were performed using SPSS software (SPSS 13.0,