The Journal of Emergency Medicine, Vol. 46, No. 5, pp. 643–649, 2014

0736-4679/$ - see front matter

ELSEVIER

http://dx.doi.org/10.1016/j.jemermed.2013.08.085

Selected Topics: Prehospital Care

THE MOST EFFECTIVE RESCUER'S POSITION FOR CARDIOPULMONARY RESUSCITATION PROVIDED TO PATIENTS ON BEDS: A RANDOMIZED, CONTROLLED, CROSSOVER MANNEQUIN STUDY

Chong Kun Hong, MD,*†[1] Sang O Park, MD,‡[1] Han Ho Jeong, PHD,§ Jung Hyun Kim, PHD,§ Na Kyoung Lee, RN,* Kyoung Yul Lee, PHD,|| Younghwan Lee, MD,¶ Jun Ho Lee, MD,* and Seong Youn Hwang, MD*

*Department of Emergency Medicine, Sungkyunkwan University School of Medicine, Samsung Changwon Hospital, Changwon, Republic of Korea, †Department of Emergency Medicine, Daejin Medical Center, Bundang Jesaeng General Hospital, Sungnam, Republic of Korea, ‡Department of Emergency Medicine, Konkuk University School of Medicine, Konkuk University Medical Center, Seoul, Republic of Korea, §Department of Emergency Medical Technology, Masan University, Changwon, Republic of Korea, ||Department of Physical Education, Kyungnam University, Changwon, Republic of Korea, and ¶Department of Emergency Medicine, Hallym Sacred Heart Hospital, School of Medicine, Hallym University, Anyang, Republic of Korea

Reprint Address: Seong Youn Hwang, MD, Department of Emergency Medicine, Sungkyunkwan University School of Medicine, Samsung Changwon Hospital, Changwon 630-522, Republic of Korea

☐ **Abstract—Background: The effectiveness of chest compressions for cardiopulmonary resuscitation (CPR) is affected by the rescuer's position with respect to the patient. In hospitals, chest compressions are typically performed while standing beside the patient, who is placed on a bed. Study Objectives: To compare the effectiveness of chest compressions, performed on a bed during 2 min of CPR, among three different rescuer positions: standing, on a footstool, or kneeling on the bed. Methods: We performed a crossover randomized simulation trial. Participants were recruited from among students in the Department of Paramedics from July to August 2011. Thirty-eight participants were enrolled, and they performed chest compressions on a mannequin for 2 min in each of the three different positions, with a 1-week interval between each position. Results: The number of adequate compressions (depth > 50 mm) and the mean compression depth were significantly greater in the kneeling and footstool positions than in the standing position, but there was no significant difference between the kneeling and footstool positions. There were no significant differences in the compression rate, the percentage of correctly released compressions, and the percentage of compressions performed using the correct hand position among the three rescuer positions. Conclusion: The mean compression depth and the number of adequate compressions were greater for both the kneeling and footstool positions than for the standing position during 2 min of CPR. We recommend kneeling on a bed or standing on a footstool as the rescuer positions during hospital CPR on a bed.**

☐ **Keywords—cardiopulmonary resuscitation; heart massage; beds; position; fatigue**

INTRODUCTION

Effective chest compressions are essential for providing blood flow during cardiopulmonary resuscitation (CPR). For this reason, the 2010 guidelines of the American Heart Association (AHA) for CPR and emergency cardiovascular care emphasize the "push hard and push fast" technique, which requires compressions of at least 5 cm in depth at a rate of at least 100 compressions per minute (1). During CPR, it is common for the quality of

[1] Chong Kun Hong and Sang O Park are the first authors, who contributed equally to the study.

RECEIVED: 14 November 2012; FINAL SUBMISSION RECEIVED: 10 June 2013;
ACCEPTED: 16 August 2013

chest compressions to decline over time due to rescuer fatigue (2). Onset of rescuer fatigue can vary by rescuer characteristics such as gender, age, and body mass index (3,4). However, nonrescuer factors can also significantly influence onset of rescuer fatigue. Difference of CPR method (30:2 CPR vs. compression-only CPR) or rescuer position at the site of arrest can affect the level of rescuer fatigue and the quality of chest compressions (3,5–7).

Cardiac arrest patients in out-of-hospital situations almost always undergo CPR while lying on a floor, but in the case of in-hospital cardiac arrest (IHCA), chest compressions are typically performed with the patient lying on a bed (1). However, the depth of chest compressions when performed on a bed has been found to be significantly shallower than that in CPR performed on the floor (6,7). Even though the standing position is the fundamental position for CPR in cases of IHCA, footstools and kneeling positions are also available in hospital settings. Numerous reports have highlighted the inefficiency of the standing position compared to the kneeling or footstool position (8–10). However, in previous reports, rescuers performed CPR according to the 2005 AHA guidelines, which recommended a depth of 38–50 mm. The guidance for chest compression depth changed in the 2010 CPR guidelines, and it is not clear which position is most effective for maximizing chest compression force for cardiac arrest patients who are placed on a bed in the IHCA setting under the 2010 CPR guidelines.

We performed a randomized, controlled, crossover trial to determine the ideal rescuer position when the patient is lying on a bed, according to the 2010 AHA CPR guidelines. We tested the hypothesis that there are differences in the total number of adequate chest compressions completed during 2 minutes of CPR in 3 different positions, and also precisely evaluated any time-dependent deterioration in compression depth among the three positions during 2 min of uninterrupted compressions.

MATERIALS AND METHODS

We conducted a randomized, controlled, crossover study to compare the performance of three different rescuer positions: standing beside the bed, standing on a footstool, and kneeling on the bed. This study was approved by the Institutional Review Board (IRB) at our hospital. Written informed consent was obtained from each participant, and this study conformed to the principles outlined in the Declaration of Helsinki (IRB No. 2011-SCMC-067-01).

As the number of adequate chest compressions performed was the primary end point of the study, it was problematic to determine the minimum number of participants required to test our hypothesis prior to study initiation. Therefore, before participants were recruited, we conducted a pilot test with 10 students to calculate the sample size required. These students were excluded from participating in the subsequent study. We hypothesized that there is a difference in the total number of adequate chest compressions performed during 2 min of CPR in the three positions; a difference was defined as a difference > 10 adequate chest compressions. In the pilot study, the standard deviation of the differences in the adequate number of compressions among the three positions was 53.76. With an α level of 0.05 and a power of 80%, a sample size of 38 participants was determined to be sufficient for evaluating the hypothesis. Given an anticipated dropout rate of 10%, we enrolled 42 participants on a first-come, first-served basis. Participants were recruited through announcements at the Department of Paramedics and Nursing at Masan University, Republic of Korea from July 15 to August 30, 2011. Eligible participants were either nursing or paramedic students who were Basic Life Support providers certified by the Korean Association of CPR within the past 2 years. Those who had a previous cardiac or respiratory disease and were unable to perform chest compressions for 2 min were excluded.

After being given a description of the study methods, the participants were allowed to practice chest compressions on a mannequin (Resusci Anne® SkillReporter™; Laerdal Medical Corporation, Stavanger, Norway) in each of the three different positions. While performing chest compressions, the participants received feedback via a laptop running the Laerdal PC Skill Reporting System software (Laerdal Medical Corporation) regarding the depth of the compressions and the positioning and releasing of their hands. After the practice session, the procedure was performed three times, once for each test position, with 1-week intervals between each position to minimize any carry-over effect. We used shuffling cards to randomize the order of the three positions. To establish the order that the three positions were tested in for each participant, the six different possible test sequences were marked on the backs of cards. On the back of each card was a description of the order, designated using letters from A to F, with each letter representing one of the three possible test positions. At the first session after the practice session, participants pulled their card from an envelope. Participants could see the symbols (A to F), whereas the researcher could only see the matched code representing the sequences. Because the participants were blinded to the sequence they were assigned, for every session except for the last, the participants were unaware of their chest compression position until the sequence began. The participants performed uninterrupted chest compressions on the same mannequin with an advanced airway inserted for 2 min, thus