American Journal of Emergency Medicine 34 (2016) 274–277

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

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

Brief Report

Effect of a backboard on compression depth during cardiac arrest in the ED: a simulation study

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ARTICLE INFO

Article history:
Received 4 September 2015
Received in revised form 17 October 2015
Accepted 21 October 2015

ABSTRACT

Research Purpose: We evaluated the impact of a backboard on chest compression depth during cardiac arrest practice sessions conducted using a high-fidelity mannequin on a standard emergency department stretcher.
Methods: Forty-three health care trainees completed cardiac resuscitation simulations requiring 2 minutes of uninterrupted chest compressions. Twenty-one were randomly allocated to the intervention group in which a backboard was concealed by placement between the stretcher mattress and a top sheet and, 22 were allocated to the control group in which no backboard was placed. The mannequin software automatically recorded mean chest compression depth in 10-second intervals for the 2 minutes of compressions.
Results: The backboard group achieved a mean compression depth of 41.2 mm (95% confidence interval, 37.8-44.6). The no-backboard group's mean compression depth was 41.4 mm (95% confidence interval, 38.7-44.2). Most subjects in both groups did not achieve the 50-mm compression depth threshold recommended by the American Heart Association.
Conclusions: Use of a backboard as an adjunct during cardiopulmonary resuscitation of a simulated patient lying on a standard emergency department stretcher did not improve the mean chest compression depth achieved by advanced life support rescuers. Most rescuers did not achieve the minimum compression depth of 50 mm recommended by the American Heart Association.

1. Introduction

The initial guidelines for cardiopulmonary resuscitation published in the *Journal of the American Medical Association* in 1974 as the "Standards for Cardiopulmonary Resuscitation (CPR) and Emergency Cardiac Care (ECC)" [1] provided the foundation for CPR and Advanced Cardiac Life Support (ACLS) training. In the 2005 update of these standards, greater emphasis was placed on high-quality chest compressions during CPR [2] including definitions for appropriate compression rate, depth of compression, recoil, and maximum acceptable time limits for interruption of continuous compressions. In 2010, the American Heart Association (AHA) again emphasized "prompt high-quality CPR with minimal interruptions" as "The foundation of successful ACLS" [3]. Time is a critical factor in CPR and interruptions in chest compressions have been shown to decrease the successful defibrillation rate [4]. A delay of as little as 15 seconds has been shown to compromise the rate of successful resuscitation and increase adverse outcomes if return of spontaneous circulation is achieved [5]. Actions, such as placing a backboard, which lead to delays in initiating chest compressions or interruptions after compressions have started, can only be accepted if the action serves to improve chest compression performance.

The AHA currently recommends the placement of a backboard before starting chest compressions in a hospital setting, but acknowledges a weak basis for this recommendation stating, "we have traditionally recommended the use of a backboard despite insufficient evidence for or against the use of backboards during CPR" [6]. Previous studies have addressed CPR performance on a variety of support surfaces [7] including air mattresses before and after deflation [8]. Although some studies conclude that backboards can improve chest compressions [9–11], others suggest that backboards do not improve chest compression quality and can cause adverse outcomes by delaying compressions unnecessarily [12]. We did not find any studies that specifically evaluated the impact of backboard use for patients on a standard 10-cm foam mattress used on emergency department stretchers.

We performed a randomized, controlled, single-blinded study using a high-fidelity simulation mannequin to compare the mean compression depth achieved by subjects during 2 minutes of CPR in an experimental group (backboard placed under the simulation mannequin) and a control group (no backboard in place). We hypothesized that the use of a backboard underneath the simulation mannequin in this setting would not increase the mean compression depth.

2. Methods

This study was reviewed and approved by our university institutional review board as an exempt protocol. After approval, we measured and recorded chest compression data from 43 health care trainees completing high-fidelity simulation practice in cardiac arrest scenarios. Each scenario

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http://dx.doi.org/10.1016/j.ajem.2015.10.035
0735-6757/

Fig. 1. SimMan Essential on emergency department stretcher during backboard placement.

included a SimMan Essential (Laerdal, Norway) mannequin on an emergency department stretcher (Stryker Medical, Portage, MI) with a standard 10-cm foam mattress (Fig. 1) and required at least one 2-minute sequence of chest compressions in accordance with the AHA guidelines. Subjects were recruited from trainees including physician assistant students, fourth-year medical students, and first-year emergency medicine residents participating in resuscitation practice in our simulation laboratory. All subjects had completed CPR and ACLS training prior to participation in the simulation sessions. Subjects were informed that automatically recorded data from the mannequin would be evaluated as part of a research project, but the specific nature of the data being assessed was not revealed to the subjects.

Subjects were allocated, using a random number generator, to either the intervention group in which a backboard was placed under the mannequin prior to the simulation or to a control group in which no backboard was used. The backboard was placed between the stretcher mattress and a top sheet prior to the subjects entering the room, so as not to be readily apparent to subjects in the intervention group. Neither group was informed that backboards were being used in any of the scenarios.

Prior to each simulation day, we reviewed the institutional review board–approved cover letter with all subjects and gave them a written copy. Before each simulation scenario, the trainees were oriented to the room and equipment. We instructed them to complete all resuscitations in accordance with AHA standards and to do everything they would do in an actual cardiac arrest. During the 2-minute episodes of chest compressions, the mannequin software automatically recorded mean compression depth in 10-second segments.

2.1. Statistics

Each individual's chest compression depths were averaged over the course of the first 100 seconds of the 120-second compression sequence. These results were subsequently transferred to an Excel spread sheet (Microsoft, Redmond, WA) for analysis. The mean chest compression depth with 95% confidence intervals (CIs) was determined for the intervention group and the control group. A *t* test assuming equal variance (homoscedastic) was used to compare the means, and a *P* value less than .05 was considered statistically significant. We calculated that a sample size of 19 subjects per group was required to detect a 5-mm difference in compression depth between groups with an α of .05 and a power of 0.80.

3. Results

All of the 43 eligible trainees consented to participate in the study. Twenty-one were allocated to the backboard group and 22 were allocated to the group without a backboard (Fig. 2). There was no significant difference in mean depth of chest compressions between the 2 groups. The mean compression depth of the backboard group was 41.2 mm (95% CI, 37.8-44.6). The mean compression depth of the no-backboard group was 41.4 mm (95% CI, 38.7-44.2; Fig. 3).

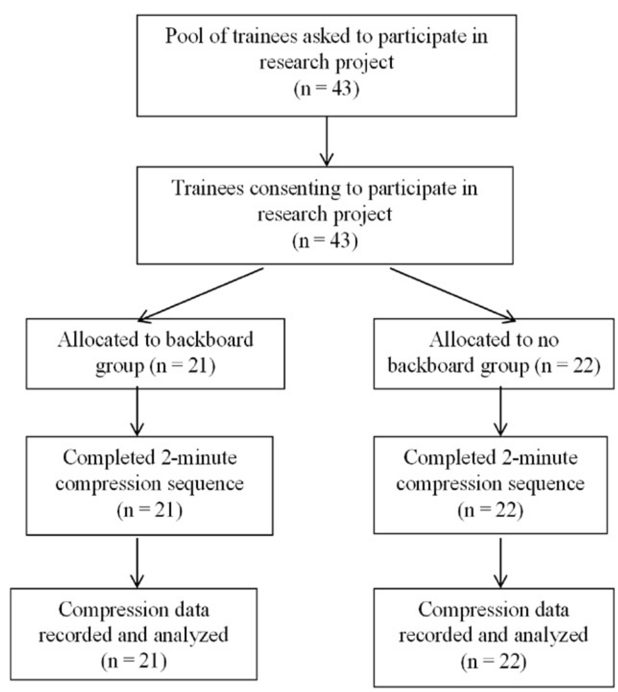

Fig. 2. CONSORT flowchart.