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Selected Topics: Prehospital Care

Effect of Coaching with Repetitive Verbal Encouragements on Dispatch-Assisted Cardiopulmonary Resuscitation: A Randomized Simulation Study

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☐ Abstract—Background: Current guidelines emphasize the assistance of the emergency dispatcher in bystander cardiopulmonary resusitation (CPR). Its quality, however, has varied across cases. Objective: To determine the effect of repetitive coaching by dispatchers using verbal encouragement on the quality of lay-rescuer CPR. Methods: We conducted a dispatch-assisted CPR (DACPR) simulation study. Participants with no CPR training within the previous year were assigned randomly to 1 of 2 DACPR simulations. One was the No Coaching Group: callers were told to perform CPR and the dispatcher periodically confirmed that the caller was performing CPR. The second group was the Coaching Group: the dispatcher repetitively coached, encouraged, and counted aloud using a metronome. Participants performed CPR for 2 min under instruction from the study dispatcher. Parameters including chest compression depth, rate, and chest compression fraction were recorded by video camera and CPR manikin. Results: Forty-nine participants 20 to 50 years of age were recruited, and 48 completed the simulation (Coaching Group, n = 27; No Coaching Group, n = 21). The chest compression fraction was higher in the Coaching Group (99.4% vs. 93.0%, $p = 0.005$) and no participants interrupted chest compression more than 10 s in this group. When comparing the average depth of each 30-s period in each group, the depth increased over time in the Coaching Group (40.9 mm, 43.9 mm, 44.1 mm, and 42.8 mm), while it slightly decreased in the No Coaching Group (40.6 mm, 40.1 mm, 39.4 mm, and 39.8 mm). Conclusions: Repetitive verbal encouragements augmented chest compression depth with less-hands off time. Continuous coaching by dispatchers can optimize lay-rescuer CPR.

☐ Keywords—Cardiac arrest; cardiopulmonary resuscitation; chest compression; dispatcher instruction; simulation

Introduction

With advancements in resuscitation procedure and increased social awareness, the survival rate from sudden out-of-hospital cardiac arrest (OHCA) has been improving. However, the rate of survival with favorable neurologic outcomes still remains below 10% (1–3). Among the resuscitation procedures, bystander cardiopulmonary resuscitation (BCPR) is one of the most essential (4). The chance of survival decreases 7% to 10% (5) per minute if immediate CPR is not started. Recently, CPR by emergency callers under instructions from telecommunicators or emergency medical dispatchers has been a key component of emergency medical service (EMS) prearrival CPR. Many studies showed that the frequency of telephone CPR or dispatch-assisted CPR (DACPR) has increased, and it accounts for the majority of BCPR (6–8). The impact of DACPR on survival after OHCA is reported to be equivalent or superior to that of BCPR without dispatch assistance (9–11). Other sources, however, claim that its impact on survival is as low as that of no BCPR

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(8,12). These inconsistencies can be attributed to several factors, including dispatchers' failure or delay in recognizing cardiac arrest (13). Another key factor could be the quality of CPR administered by lay rescuers under dispatch instruction. Various simulation studies have shown that the quality of DACPR is generally suboptimal regarding rate, fraction, and especially depth (14–16). Thus, it is assumed that the quality of CPR by callers under the instruction of dispatchers can be the cause of, or at least contribute strongly to, the inconsistencies (8,12). Improving the quality of DACPR can increase survival rate after OHCA. However, CPR instruction that can maximize the quality of DACPR remains to be explored. Because dispatchers cannot see rescuers performing CPR or give feedback on the quality of chest compressions, they can at least encourage rescuers to maximize their performance. We hypothesized that verbal encouragement for lay rescuers performing chest compressions can maximize the quality of CPR. We conducted a simulation study to explore the effect of repetitive and continuous verbal encouragement on DACPR.

Materials and Methods

Study Design

We conducted a randomized CPR simulation study. This study was approved by the Ethics Committee of Nara Medical University and adhered to the tenets of the Declaration of Helsinki. The study subjects were hospital administrative staff (non–health care professionals) who had never taken any CPR courses or had not taken the courses within a year before this study. We recruited them through an announcement on the hospital bulletin board. Written informed consent was obtained from each participant.

Randomization

Participants were randomly assigned to the date each simulation was to be held by a computer, with 3 to 6 participants per date. Simulations were to be held until the target number of participants in each group was reached. Participants were blinded to the allocation until they started the simulations.

Standard DACPR Simulation (No Coaching Group)

A standardized DACPR instruction script was used to direct CPR in this group. The standard DACPR instruction is based on the protocol of the Japanese Fire and Disaster Management Agency (Appendix 1).

Revised DACPR Simulation (Coaching Group)

This group performed CPR under the DACPR instructions revised by the study authors. These instructions consist of the standard DACPR instruction along with continuous verbal encouragement to provide deeper chest compressions along with a metronome set at 100 beats/min (Appendix 1).

DACPR Simulation

Both study groups performed a 2-min CPR simulation exercise in a small room at Nara Medical University. Inside this room, a manikin and a cordless extension phone were placed on a hard floor. Neither an automated external defibrillator nor another rescuer was available in this simulation. After being given basic instructions for the simulation, the study participants found a manikin in the room, acted as a rescuer, and made an emergency call (119, the emergency telephone number in Japan) from the extension phone. The investigator operating the video camera and QCPR recording was in the same room with the participants performing CPR but was not allowed to have a conversation with participants. The other investigator playing the role of the EMS dispatcher providing dispatch instruction was in a separate room and was blinded to the participants performing CPR.

Many studies and guidelines have shown that rescuers become fatigued after 2 min of CPR. In order to gather the necessary subjects, we decided to conduct a 2-min simulation that would be easy to participate in for the participants.

Data Collection and Outcome

Data on chest compression performance (mean depth [mm], rate [compressions/min {cpm}], and fraction) were collected from the manikin (Resusci Anne QCPR; Laerdal, Norway). Each simulation was recorded with a video camera (HDR-AS200V; Sony, Japan). The frequency of interruptions to CPR lasting >10 s were measured independently by 2 study investigators.

Statistics

Sample size was calculated based on our preliminary data and previous studies (14,16). To test a 6-mm difference in chest compression depth with 80% power and significance level of 0.05, we set a sample size of 30 in each group after accounting for a 1% to 2% dropout rate.

The primary outcome of interest in this study was chest compression depth. The secondary outcome was the development of compression depth over the duration of the simulation. We observed the trends of the compression

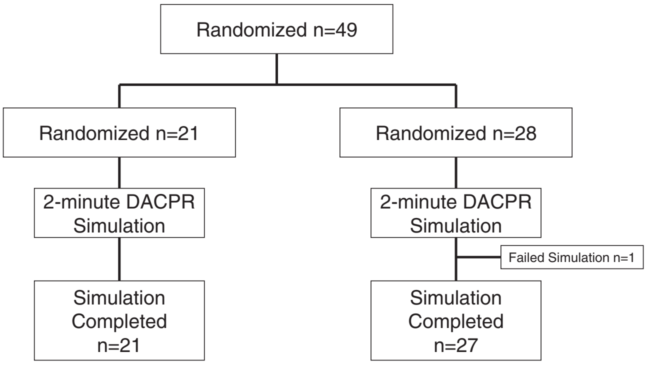

Figure 1. Study randomization. DACPR = dispatch-assisted cardiopulmonary resuscitation.

Table 1. Quality of Chest Compressions.

	Coaching Group (N=21)	No Coaching Group (N=27)	P values
No. of Total Chest Compressions	204.1±8.6	197.2±30.5	0.319[§]
Average Chest Compression rate, (per minute)	102.5±3.5	109.1±10.0	**0.006[§]**
Chest Compression Fraction (%)	99.1±2.1	94.4±8.3	**0.013[§]**
Interruption of Chest Compression >10 sec., n(%)	0 (0)	6 (22.2)	**0.014[‡]**
Average chest compression depth, (mm)	43.0±13.8	41.5±12.3	0.695[§]

Numbers are presented as average±standard deviations. § Student's t-test, ‡ Fischer's exact test.

depths by dividing simulation results into four 30-s periods.

The Student t and paired t tests were used for continuous variables, and the chi-squared test was used for categorical variables. P values < 0.05 were considered significant. All statistical analyses were performed with SPSS software (version 25.0; SPSS Inc., Chicago, IL).

Results

Because of social restrictions on gatherings, we could not collect a sufficient number of study participants, and the study was halted when 49 participants were enrolled. As a result, of the 49 participants 20 to 50 years of age, 21 were randomly assigned to the Coaching Group (10 men) and 28 to the No Coaching Group (17 men). One male participant in the No Coaching Group failed to complete the simulation, and a total of 48 study participants were analyzed (Figure 1). No participants claimed any discomfort after the simulations.

Table 1 shows the quality parameters of chest compressions in both groups. The number of chest compressions during the simulation were comparable between the 2 groups. The average chest compression rates in both groups were within the range of guideline recommendation. In the Coaching Group, however, the rates were much closer to approximately 100/min as the study dispatcher counted out loud to a metronome set at 100 beats/min (102 ± 3.5 vs. 109 ± 10.0, $p = 0.006$).

Six participants in the No Coaching Group interrupted chest compressions for >10 s. On the other hand, no participants in the Coaching Group interrupted chest compression. The chest compression fraction was also higher (99.1% ± 2.1% vs. 94.0% ± 8.3%, $p = 0.014$) in the Coaching Group.

The average chest compression depth in both groups did not achieve the guideline recommendation and showed no significant difference: 43.0 ± 13.8 mm in the Coaching Group and 41.5 ± 12.3 mm in the No Coaching Group.

Figure 2 shows the trends of mean compression depth every 30 s in both groups. There was no statistically difference in the depth of chest compression in both groups during the 30-, 60-, 90-, and 120-s periods. The mean compression depth of the Coaching Group, however, tended to increase, while that of the No Coaching Group decreased. But the chest compression depth in the Coaching Group was not maintained toward the end of the simulation and began to decrease after 90 s.

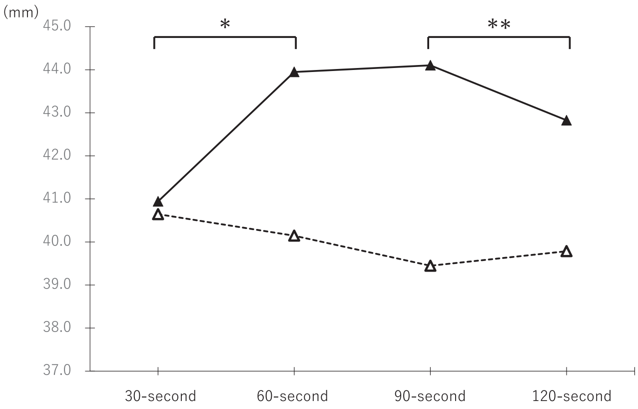

Figure 2. Average compression depth at 30-s intervals
Y- and X-axes represent chest compression depth (mm) and 30-s periods, respectively. Average compression depth improved in the Coaching Group (solid line) over 30–60 s (*p=0.002), while it decreased over 90–120-s (p=0.021). Compression depth did not improve in the No Coaching group (dotted line). *, ** Paired-t test.**

Discussion

This DACPR simulation study shows that continuous coaching with verbal encouragement can augment chest compression depth and chest compression fraction. This study emphasizes the role of the dispatcher not only as a provider of CPR instruction but also as a motivator whose goal is for the caller to perform high-quality CPR.

While many studies have shown that DACPR accounts for the majority of BCPR and can contribute to favorable neurologic outcomes (6–8), these results are based on yes/no data of DACPR studies that use the Utstein guideline (17). The quality of CPR by lay rescuer under dispatch instruction remains to be evaluated. However, because it is impossible for dispatchers to directly observe how lay rescuers perform CPR and to give them feedback during the DACPR process, assertive dispatch instruction, such as verbal encouragements to push much harder, has some potential positive impact on survival outcome. Dispatchers generally give encouragements to motivate the caller until EMS arrival. Our study, however, indicates that dispatchers have a possibly more concrete influence on performance with repetitive and continuous verbal encouragement to "push much harder" and can optimize lay rescuer CPR.

Studies have shown that giving continuous coaching can improve the quality of lay rescuer CPR. For instance, Birkenes et al. reported that continuous coaching with encouragement resulted in a more appropriate rate and less hands-off time in CPR administered by lay persons 10 months after they received CPR training (18). In our study, no participants in the Coaching Group interrupted chest compressions over 10 s, with a chest compression fraction of 99.1%. It is plausible that with repetitive verbal encouragements rescuers will be less likely to stop chest compressions if they feel fatigued.

Participants in both groups provided chest compressions at the rate the guideline recommends; however, the average rate in the Coaching Group was closer to 100/min than in the No Coaching group. Faster chest compression rates may compromise chest compression depth (19). Previous studies report that, without guidance, rescuers provide chest compressions at the rate outside the recommended range. Using a metronome rhythm is a simple solution, and studies support its effect on accurate chest compression rates (20,21).

Regarding the optimal chest compression depth, several studies have investigated various instructions. Mirza et al. investigated the effect of the simplified instruction "push as hard as you can" by comparing its effect to that of the standard instruction "push down firmly 5.0 cm"; a more positive effect on chest compression depth was observed with the simplified instruction (14). The authors of the study theorized that the simplified instruction eliminated any judgment rescuers may have been making on how hard they must push in order not to breach the 5-cm limit and instead let them focus on delivering deep, forceful compressions. However, their study also sometimes showed failure to achieve the depth of 4.0 cm; another study investigating the same simplified script displayed a similar failure (16).

In addition to simplifying the instructions, encouraging rescuers to perform more effective CPR can maximize the quality of resuscitation. Recent studies (20,22,23) investigated the effect of verbal encouragement—"cheering up" the caller—on compression depth. A positive effect on chest compression depth was observed, with participants under verbal encouragement achieving >4.5 cm. The novel feature of our study was to instruct the rescuer to provide deeper compressions, as if the dispatcher was watching the rescuer performing CPR inadequately and was encouraging corrective action. As mentioned above, lay rescuers' chest compressions tend to generally be shallower than is recommended. When taking this into consideration, it is plausible that the instruction should not just be "push hard," but should include repetitive instruction to push much harder with verbal encouragement, with the ultimate goal of optimizing lay rescuers' chest compressions. Our study also indicates that dispatcher's repetitive verbal encouragements can let lay rescuers achieve CPR with less hands-off time.

Limitations

The first study limitation is that we were unable to collect a sufficient number of participants. Therefore, based on our power analysis, we could not determine that DACPR instruction with coaching is superior to a standard script regarding chest compression depth. Nevertheless, we showed that the study's coaching script successfully optimized the chest compressions of the participants in the Coaching Group. Our second limitation was the relatively short CPR simulation (2 min). The time interval between call and ambulance arrival in Japan is approximately 8 to 9 min (24). Our study results showed that it generally takes 2 to 3 min to start DACPR, meaning that, on average, lay rescuers must perform DACPR for at least 5 min. This suggests, however, that compression depth can likely become gradually shallower towards 120 s of CPR because of rescuer fatigue (25). Finally, our study results cannot be generalized, as the participants were mostly young. Further studies should focus on elderly rescuers who are spouses of patients with OHCA, most of whom collapse at their residences (26).

Conclusions

This simulation study showed the positive effect of coaching by the dispatcher using verbal encouragements during DACPR in terms of augmenting chest compression depth and less interruption. Adding these repetitive encouragements can maximize the quality of DACPR and optimize the chance of survival in patients with OHCA.

Data Availability

The study data is available from the authors upon reasonable request.

Supplementary materials

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.jemermed.2022.05.010.

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ARTICLE SUMMARY

1. Why is this topic important?

Dispatch-assisted cardiopulmonary resuscitation (DACPR) accounts for the majority of layperson-performed CPR before ambulance arrival, and it is crucial that emergency dispatchers provide effective CPR instructions to lay rescuers to maximize CPR quality.

2. What does this study attempt to show?

This study shows an effective DACPR instruction method that can lead to improved outcomes of patients with sudden cardiac arrest.

3. What are the key findings?

This randomized simulation study showed that repetitive verbal encouragements, as if the dispatcher were watching the rescuer perform CPR, can better augment the lay rescuer's techniques, such as compression depth and compression fraction, when compared with instruction without encouragement.

4. How is patient care impacted?

With these encouragements, DACPR may improve the neurologic outcome of patients with sudden cardiac arrest in the community.