Improvement in chest compression quality performed by paramedics and evaluated with a real-time feedback device: Randomized trial

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INTRODUCTION

One of the leading causes of death in Europe is sudden cardiac arrest (SCA) (67–170 cases per 100 000 inhabitants annually) [1]. Approximately one-third of resuscitation cases result in a spontaneous return of circulation, and only 8% of patients survive to discharge from the hospital [2]. For adults, chest compressions are the priority in SCA. The 2021 guidelines of the European Resuscitation Council (ERC) underline the need for high-quality cardiopulmonary resuscitation (CPR). The 2020 American Heart Association (AHA) guidelines also emphasize the importance of proper depth, rate, and chest relaxation [3].

This study aimed to assess the impact of real-time feedback devices on the quality of CPR performed by paramedics. A hypothesis was tested that the use of a real-time feedback device may improve the quality of CPR performed by paramedics compared to CPR without a real-time feedback device.

METHODS

One hundred and sixty-one healthy volunteers signed up for the study. A study was conducted with paramedics and non-paramedics (different medical professions). Voluntary participants were randomly assigned to two equal-sized groups: a group of paramedics who performed CPR with a feedback device (test group) and a group that performed CPR without this device (control group). Low-fidelity simulation with a feedback device was used as an investigational method for research. The study used the simple randomization method with a computerized list of random numbers. Before the study, each person had 2 minutes to learn the rules (to get familiar with the mannequin and practice chest compressions) and instructions for use of the CPRmeter 2 (Laerdal Medical, Stavanger, Norway), which is a hand-held device measuring the quality of CPR and providing feedback.

Each participant was to perform 2 minutes of CPR. Little Anne QCPR mannequins (Laerdal Medical) with "QCPR Instructor" software were used for the study.

After participants performed CPR, an overall final score was computed, which consisted of the compression, ventilation, and Flow Fraction scores (percentage of the time where compressions were given).

Statistical analysis

A *P*-value <0.05 was accepted as statistically significant. All the calculations were carried out using STATISTICA software version 13.3 (StatSoft, Inc., Tulsa, OK, US). For continuous variables, the Shapiro-Wilk test was applied as the first step in checking the normality of distribution. The Mann-Whitney U test was performed for the data with the observed distribution other than normal. For some values, a one-tailed test of the proportion between the two structure indices was performed.

Table 1. Parameters of cardiopulmonary resuscitation by randomization group

Parameter	Feedback device group, % of correctness			IQR	Non-feedback device group, % of correctness			IQR	*P*-value
	Median	Min	Max		Median	Min	Max		
CPR overall score	95.42	70	99.79	86–98	91.88	55	99.17	80–97	0.01
Chest relaxation	100	9	100	100–100	100	14	100	90–100	<0.001
Compression rate	94	0	100	77–99	79	0	100	22–98	0.002
Flow fraction	76	67	80	73–78	75	64	80	72–77	0.07
Breaths	100	0	100	89–100	100	0	100	100–100	0.1
Depth, mm	100	74	100	99–100	100	31	100	99–100	0.6

Abbreviation: CPR, cardiopulmonary resuscitation

The results are presented as the median, minimum, and maximum values and as a number and percentage (%).

RESULTS AND DISCUSSION

The study was conducted with 161 volunteers (142 paramedics and 19 non-paramedics). Only the results obtained by paramedics were taken into account. The study group comprised 101 men and 41 women (71.13% vs. 28.87%). The comparison of the two groups — the feedback device group (71 participants) and the non-feedback device group (71 participants) showed statistically significant differences in the results.

The obtained results are presented in Table 1. The group using the feedback device had better overall CPR scores compared to the group without this device — 95.42 (70–99.79) vs. 91.88 (55–99.17), $P = 0.01$. The compression-rate parameter also showed a benefit from using the feedback device. The feedback device group recorded a median score of 94 (0–100) while the non-feedback device group recorded a median score of 79 (0–100) ($P = 0.02$). The median value of the chest-relaxation parameter in both compared groups was 100 ($P < 0.001$); however, in the group of paramedics with the feedback device, 54 participants (76.06%) achieved a 100% result, while in the group of paramedics without such a device, this result was achieved by 37 participants (52.11%) ($P = 0.0015$, one-sided test of proportions). There were no statistically significant differences in the results in the remaining categories.

The results of systematic analysis comparing the use of devices giving feedback in real time during simulated and real CPR indicated the possibility of using the feedback device to improve CPR skill acquisition and individual elements of chest compression technique that raise CPR quality [4].

Similar results were obtained in a study by Iskrzycki et al. [6]. The median CPR quality score during a 2-minute CPR session without feedback was 69 (33–77) compared with 84 (55–93) [5].

ERC and AHA guidelines already recommend the use of real-time feedback devices for training purposes [3], but they are still not popular in Poland. The 2021 International Liaison Committee on Resuscitation CPR Feedback Devices in Training Systematic Review suggests using devices that provide feedback on details on compressions during CPR training. Although it is a weak recommendation with low-certainty evidence [6].

The role of high-quality chest compressions is also important due to the lack of current recommendations for the routine use of mechanical chest compression devices by resuscitation teams. Mechanical chest compressions should be considered only if high-performance manual chest compressions are not practical or compromise safe transport [1].

The other benefit of using real-time feedback devices is that the same device can be used for training and life support in real circumstances. The results of real CPR studies comparing feedback device (audiovisual) vs. standard CPR show the significantly increased depth (40 mm vs. 38 mm; $P = 0.005$), and reduced percentage of incomplete release (10% vs. 15%; $P < 0.001$) [7].

In addition, in the field of medical education related to resuscitation training, devices like CPRmeter2 can be useful tools to use on different mannequins and in medical simulation scenarios with different levels of fidelity [8].

Interestingly, in terms of the depth of chest compressions, the results in both groups were so good that no statistically significant differences were obtained ($P = 0.6$). The median in both groups was 100%, which suggests that this parameter requires constant monitoring but no specific changes. The analysis of the results suggests that this could be due to the high competence of paramedics in the field of chest compressions in everyday professional practice. It is also important that the study participants realized that depth may be one of the parameters assessed during the study. Interestingly, another paramedic study in Poland found that the use of real-time feedback devices increased depth accuracy during CPR, which our study did not confirm [9].

Similar results in terms of the compression rate were also obtained by Polish firefighters when performing CPR after exercise. Fatigue has a statistically significant impact on the frequency and depth of chest compressions [10].

In terms of limitations, the study did not analyze results by participants' professional experience. In terms of assessing the representativeness of the study, it should also be noted that all participants were volunteers.

Taking into account the annual number of SCAs in Poland, which is approximately 27 000 (69.7 CPR attempts per 100 000 inhabitants) [11], the use of readily available devices to improve the quality of chest compressions can be of significant importance.

Article information

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