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Improvement in paramedics chest compression quality with use of real-time feedback device: Randomized trial

Short title: Paramedics chest compression quality measurement randomized trial

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INTRODUCTION

One of the leading causes of death in Europe is sudden cardiac arrest (SCA) (67–170 people per 100 000 inhabitants annually) [1]. Approximately 1/3 of resuscitation cases result in a spontaneous return of circulation, and only 8% of patients survive discharge from the hospital [2]. For adults, chest compressions are the priority in SCA. The guidelines of the European

Resuscitation Council (ERC) of 2021 maintain the need to strive for high-quality cardiopulmonary resuscitation (CPR). The 2020 American Heart Association (AHA) guidelines also emphasize the proper depth, rate and chest relaxation [3].

The aim of this study was to assess the impact of real-time feedback device on the quality of CPR performed by paramedics. The hypothesis was tested that the use of real-time feedback device improves the quality of CPR performed by paramedics compared to CPR without a real-time feedback device.

METHODS

161 healthy volunteers signed up for the study. A study was conducted with paramedics and not-paramedics (different medical professions). Willing participants were randomly assigned to two equal groups (of the same size) of people: 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 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 examination, each person had 2 minutes to learn the rules (familiarized with the mannequin and was able to check chest compressions) and learn the instructions for use of the CPRmeter2 (Laerdal Medical, Norway) – the hand-held device which measures the quality of CPR and providing feedback.

Each participant was to perform 2 minutes of CPR. Little Anne QCPR mannequins (Laerdal Medical, Norway) with the software "QCPR Instructor" were used for the study. The group selected for the feedback study used the CPRmeter2 device.

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

The participants were randomly divided into two groups: a group of paramedics who performed CPR with real-time feedback device (test group) and a group that performed CPR without this device (control group).

Statistical analysis

A *P*-value <0.05 was accepted as statistically significant. All the calculations were carried out using STATISTICA software ver.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. The results are presented as the median, minimum and maximum value and as a number and percentage (%).

RESULTS

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

The results obtained are presented in Table 1. The group using the feedback device had a better overall CPR score 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 a feedback device. The feedback device group recorded a median of 94 (0–100) with a score of 79 (0–100) for the non-feedback device group ($P = 0.02$). The median value of the chest relaxation parameter in both compared groups was 100 ($P < 0.001$), however, in the group of paramedics with a feedback device, 54 people (76.06%) achieved a 100% result, while in the group of paramedics without such a device, this result was achieved by 37 people (52.11%) ($P = 0.0015$, one-sided test of proportions). There were no statistically significant differences in the results in the remaining categories.

DISCUSSION

The results of the systematic analysis conducted on the comparison of the use of devices giving feedback in real time during simulated and real CPR indicated the possibility of improving the acquisition of CPR skills and the improvement of individual elements that make improve CPR quality with use of feedback device [4].

Similar results were obtained in the study by Iskrzycki L. 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 as an external devices they are still not popular in Poland. The 2021 ILCOR CPR Feedback Devices in Training Systematic Review suggests the use of devices that provide feedback on compressions details during CPR training. Although it is 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 compromises safety issues [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. 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 the 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 an useful tool and can be used 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 does not require any 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 participants of the study 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 does not have the distribution of participants' professional experience. In terms of assessing the representativeness of the study, it should also be noted that volunteers participated in the study.

Taking into account the annual number of SCA in Poland, which is approx. 27 000 (CPR attempts was 69.7 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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Table 1. Parameters of cardiopulmonary resuscitation by randomization group

Parameter	Feedback device group, % of correctness				Non-feedback device group, % of correctness				
	Median	Min	Max	IQR	Median	Min	Max	IQR	*P*-value
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	100	74	100	99–100	100	31	100	99–100	0.6

Abbreviation: CPR, cardiopulmonary resuscitation