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PRACA ORYGINALNA
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Your smartphone can save someone's life

Twój smartfon może uratować komuś życie

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ABSTRACT

INTRODUCTION: Each year in Europe there are about 350 thousand deaths recorded, following sudden cardiac arrest (SCA). To reduce this number, new methods are being looked for to assist non-medical people in CPR. The objective of this contribution is to compare the efficacy of cardio-pulmonary resuscitation and its compliance with the BLS algorithm in persons showing no medical background, using generally available means of support.

MATERIAL AND METHODS: The conducted randomized pilot study comprised 50 volunteers with no medical background. The participants were randomized into two test groups. Group 1 – with smartphone applications, Group 2 – no support.

RESULTS: The persons making use of mobile application support showed better compliance with the initial steps of the algorithm. Improved chest compression quality was also observed, in particular regarding the cHOT parameter. Statistically, the application users also proved better in evaluating the victim's breathing.

CONCLUSIONS: A smartphone application may be helpful in first aid procedures performed by people with no medical background, mainly for the common use of this type of mobile phones. It is recommended to extend the scope of knowledge of AED defibrillators.

KEY WORDS
smartphone, CPR, BLS

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STRESZCZENIE

WSTĘP: Każdego roku w Europie dochodzi do około 350 tysięcy zgonów po nieskutecznej resuscytacji krążeniowo-oddechowej (RKO). Dążąc do zmniejszenia liczby zgonów, poszukuje się nowych metod wsparcia osób bez wykształcenia medycznego przy wykonywaniu RKO. Celem pracy jest porównanie skuteczności wykonania resuscytacji krążeniowo-oddechowej oraz zgodności z algorytmem BLS przez osoby bez wykształcenia medycznego, z wykorzystaniem ogólnodostępnych metod wsparcia.

MATERIAŁ I METODY: Przeprowadzono pilotażowe, randomizowane badanie, do którego zrekrutowano 50 ochotników bez wykształcenia medycznego. Uczestnicy zostali zrandomizowani do dwóch grup badawczych: Grupa 1 – posiadająca aplikację na smartfone, Grupa 2 – brak wsparcia.

WYNIKI: Osoby korzystające ze wsparcia w postaci aplikacji mobilnej wykazywali większą zgodność przy wykonywaniu początkowych kroków algorytmu. Stwierdzono również poprawę parametrów opisujących jakość ucisków klatki piersiowej, szczególnie parametru cHOT. Osoby korzystające z pomocy aplikacji również statystycznie lepiej oceniały oddech poszkodowanego.

WNIOSKI: Aplikacja mobilna na smartfona może pomóc w udzieleniu pierwszej pomocy osobom bez wykształcenia medycznego, dzięki dużej popularności telefonów typu smartfon. Zaleca się szerzenie wiedzy na temat defibrylatorów AED.

SŁOWA KLUCZOWE

smartfon, BLS, RKO

INTRODUCTION

Each year in Europe 350 thousand people die on account of ineffective or lack of resuscitation in sudden cardiac arrest (SCA) [1]. Resuscitation quality, which depends mostly on chest compression depth and frequency as well as on an immediate emergency call, undoubtedly influences the survival of patients in out-of-hospital SCA [2].

Modern electronic devices with pressure sensors, accelerometers and metronomes, like CPREs, Phillips Q-CPR, TrueCPR, PocketCPR may assist resuscitation, providing feedback on CPR (*Cardiopulmonary Resuscitation*) quality. Their usefulness has already been proven [3,4]. Rescue teams are often well equipped, however, bystanders usually carry no such devices. Most the young people, however, use cell phones with multi-task operation systems (smartphones). Many helpful smartphone applications are available on the market, including software with step-by-step CPR algorithms showing the right sequence of actions, with the aid of voice commands. So far, few scientific articles describing the use of smartphones during CPR have been published [5,6]. It is worth mentioning that efforts have been started to use cell phones to locate individuals trained in BLS (*Basic Life Support*) who are nearest the site of an accident and who could help immediately [7].

Most people should be trained to perform effective CPR during out-of-hospital SCA incidents. Unfortunately, the skills gained during BLS courses are forgotten after some longer periods [8,9,10]. Nevertheless, it might appear possible that people using modern devices who were never trained, or had been trained years ago, would be able to perform CPR more effectively than those with no such assistance.

The aim of this study is to verify the effective implementation of cardiopulmonary resuscitation and BLS algorithm compliance in people without medical background, using a mobile application.

MATERIALS AND METHODS

Study protocol

In June, 2015 we recruited 50 volunteers, aged between 19 to 47 years (mean 21, SD = 6) to a prospective, randomized study.

The inclusion criterion was the ability to use a smartphone easily. The exclusion criteria were any kinds of medical training (e.g. physicians, medical students, nurses, etc.), BLS training within the previous 12 months, pregnancy and physical dysfunction to a moderate effort. None of the participants had ever taken part in any real resuscitation procedures.

Having signed the written informed consent, the participants were randomized into two study groups:

- Group 1 – 25 participants – received smartphone with a mobile application (Save Life; pol. Ratuj Życie, ver. 2.0, Prophone, Android OS).
- Group 2 – 25 participants – no support during CPR.

The study used a free application guiding the user step by step through the CPR algorithm (accordance with the Guidelines of the European Resuscitation Council 2010). The authors recognize it as the most user-friendly among similar free applications.

To evaluate the quality of CPR, two Ambu®Man phantoms (ver 1.12. Ambu, Ballerup, Denmark) with average chest resistance were used. The phantoms were placed on a hard surface in two separate rooms so that the participants could not see each other. Both mannequins were connected to two identical PCs (Dell Vostro 3550). The quality of CPR was analysed with Ambu® CPR Software (Version 3.1.1, Ambu®, Ballerup, Denmark) dedicated to registering data from the mannequins and storing it in the database.

Course of study

Upon entering the study room, the participants received information about the situation: "You are in a shopping centre and you can see a man in his fifties who has just sunk to the ground. The environment is safe. There are some bystanders available."

Group 1 participants received the support and each of them was allowed 30 seconds to get acquainted with the application. The only information the instructor gave during the study was the status of the victim. The scenario lasted for 5 minutes. The end of the scenario and the end of the study was signalled by the statement: "Medical Rescue Team took over the victim!"

Measurement

The evaluated study parameters were: HOT (Hands Off Time), cHOT (corrected Hands Off Time) [11], quality of chest compressions (depth and frequency), compliance with the BLS algorithm (checking consciousness, check breathing, ask for help, ask for AED, time to chest compressions start).

Statistical Analysis

The database was prepared in an Excel spreadsheet package Microsoft Office 2010 (Microsoft Corporation, Redmond, Washington, USA). Statistical calculations were performed using the statistical package Statistica 12.5 PL (StatSoft Poland, Cracow, Poland). The results were presented as mean values ± standard deviation. The normality of the distribution of the received results was checked with the Shapiro-Wilk test. The homogeneity of variance was evaluated with the Levene test. To compare the quantitative variables, the parametric Student's t-test with an independent variation estimation was used. Nominal data were compared with the Chi-square test with Yates's correction. A p value lower than 0.05 was accepted as statistically significant.

RESULTS

The participants randomized to the group with support with a smartphone were subjectively more calm during the scenario. Only one person from Group 1 showed problems with the application. Other respondents passed smoothly through the successive stages of the application. The performance in Group 1 (support) was characterized by greater compatibility with the initial steps of the algorithm, as compared to Group 2 (no support) (Tab. I). However, it is worth mentioning that only a few people in the study checked breathing correctly (9 and 4). In the study, breathing was considered checked if the participant performed the head tilt and checked for 8–12 seconds. There was a statistically significant longer time to assess breathing in Group 1 (support) compared to Group 2 (no support) (Tab. II). The results also disclosed little awareness of automatic external defibrillators (AED) in the study group. In Group 2, without the support, none of the participants asked for the device. In the supported Group 1, only two participants asked about an AED, despite explicit information provided by the application.

Table I. Parameters describing compliance with initial steps of algorithm
Tabela I. Parametry opisujące zgodność wykonywania początkowych kroków algorytmu

Parameters	Group 1 N (%)	Group 2 N (%)	p
Check consciousness	24 (96%)	17 (68%)	**< 0.05**
Correctly check breath	9 (36%)	4 (16%)	0.197
Call for help	23 (92%)	20 (80%)	0.415
Call for AED	2 (8%)	0 (0%)	0.470

None of the available applications has a module allowing for the analysis of qualitative chest compression parameters. Evaluation of the above parameters showed no significant differences between the Groups (Tab. 2). In the assessed HOT parameter, which is the total length of chest compressions time, no significant differences were found between the groups. The cHOT parameter and time of chest compressions decreased by the time the chest compressions started, showing statistically significantly lower values in Group 1 than in Group 2. This means shorter breaks during chest compression, thus a better quality of CPR performed. However, there was a statistically significantly longer time to start chest compressions in Group 1 (support) than in Group 2 (no support). This was because the voice and visual commands used in the applications lasted 180 seconds. There was no statistical difference in the mean frequency of compression and number of compressions performed with normal relaxation. Nonetheless, the chest compressions were statistically deeper in Group 1 (support) than in Group 2 (no support).

Table II. Parameters describing quality of chest compressions
Tabela II. Parametry opisujące jakość ucisków klatki piersiowej

Parameters	Group 1 Mean ± SD	Group 2 Mean ± SD	p
HOT (sec)	192.07 ± 49.05	161.36 ± 81.83	0.198
cHOT (sec)	68.00 ± 27.30	130.31 ± 89.51	**< 0.001**
Time of breath evaluation (sec)	10.11 ± 4.29	5.78 ± 3.73	**< 0.05**
Time to call for help (sec)	51.79 ± 38.50	39.97 ± 42.66	0.462
Time to start CPR (sec)	121.15 ± 34.47	35.11 ± 21.77	**< 0.001**
Mean chest compression frequency	106.92 ± 21.75	114.65 ± 36.78	0.089
Mean chest compression depth	62.12 ± 8.29	47.91 ± 16.55	**< 0.001**
% chest compression with correct relaxation	81.97 ± 25.05	87.42 ± 23.37	0.135

DISCUSSION

Up to 80% of cardiac arrest incidents take place at home and among bystanders [12]. It means that one is quite likely to witness such an incident happening to in someone we know and care about. A great number of people do not know how to administer CPR. In this survey one half of the participants had never taken part in any first aid training programme.
The obtained results showed a statistically significant difference in the depth of chest compressions between the groups. The latest resuscitation guidelines, ERC 2015, indicate that a device emitting sound may improve the frequency of chest compressions while negatively affecting the depth of chest compressions [13]. In our study, there was no deterioration in the depth of compressions despite the sound emitted by the application. In contrast, there was statistically significantly deeper chest compression in the group with the smartphones. The study revealed no statistical difference in the mean frequency of chest compressions. In both groups, the average frequencies were within the range recommended by the guidelines, i.e. 100–120 compressions per minute. The key influence on the victim's chance of survival is the time to start chest compressions and the time to the first shock [14]. In the study the time to call for help was longer in the group with the mobile application. However, this was made up for by the help in correct assessment of the patient's condition by almost all participants in the study (group 1), consequently calling for help. There was only was one person who showed problems with the application. Only two participants asked for AED. This was surprising as the application commands were clear. It means that the participants deliberately ignored them. This shows how small public awareness is of the mentioned devices. Similar conclusions were reached in the surveys by Christ et al. [15].
AEDs, as well as mobile applications, are programmed to help the rescuer follow the CPR + AED algorithm. Global studies confirm the improvement in CPR quality parameters such as chest compressions and HOT with the voice commands [16]. Therefore, students should be taught about such devices during their programmes and encouraged to use them.
The guidelines of the European Resuscitation Council allow chest compressions without performing ventilation if a rescuer cannot or is unable to perform ventilation. In this study every attempt to perform rescue breaths was ineffective and inadequate. Only 13 participants checked breathing adequately (9 of Group 1 and 4 from Group 2). This is consistent with the results taking into account the latest ILCOR guidelines [14,17,18].
There are many methods of support in administering CPR. The results indicate the potential role of mobile applications in life-saving. The results show better quality cardiopulmonary resuscitation with the mobile application. It may lead the rescuer through the steps of the algorithm and call for a medical rescue team. This is an undeniable advantage of the application over many other types of support as most people have already got a smartphone and operate in a more and more intuitive manner.

SUMMARY

A smartphone application may be helpful in first aid procedures performed by people with no medical background, mainly for the common use of this type of mobile phones. The application guides the user through the subsequent steps of the algorithm, assisting in a stressful situation. The results also showed a very low level of public awareness of AED devices. The knowledge about AED should be introduced at every opportunity.

Conflict Of Interest

All the authors declare no conflict of interest. All the authors read and approved the final manuscript.

Ethical Approval

This study does not require approval by the Bioethical Committee of the Medical University of Silesia. All the participants completed and signed the informed consent prior to this study. The study was designed in accordance with the statement of Human and Animal Rights.
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Author's contribution

Study designe – A. Duława, M. Jędrzejek, J. Lewin-Kowalik
Data collection – M. Jędrzejek, K. Rybczyk, A. Plewka
Data interpretation – A. Duława, M. Jędrzejek
Statistical analysis – A. Plewka
Manuscript preparation – A. Duława, A. Plewka
Literature research – A. Własczuk

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