



# Impact of basic life support training on knowledge of cardiac patients about first aid for out-of-hospital cardiac arrest

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## Abstract

**Background** Basic life support (BLS) is one of the most efficient ways to improve out-of-hospital cardiac arrest (OHCA) victims' outcomes. Resuscitation initiated by a random witness of OHCA is essential to increase the chances of survival.

**Aim** To assess the impact of BLS training in cardiac patients on knowledge about first aid for OHCA.

**Materials and methods** The study group consisted of 68 participants who completed a questionnaire prior to BLS training. Forty-three of them then filled out the same questionnaire again after the BLS course. Participants' knowledge was assessed with a self-designed questionnaire, which comprised 41 questions divided into six domains, namely legal aspects, resuscitation technique, resuscitation algorithm, knowledge about using an automated external defibrillator (AED), "calling for help" knowledge and identifying sudden cardiac arrest.

**Results** The average score before the BLS course was lower compared with final results ( $43.8\% \pm 15.6\%$  vs.  $68.6\% \pm 22.7\%$  [% of max. score],  $p = 0.001$ ). The best scores, both before and after the BLS course, were gained in the "calling for help" knowledge ( $79.5\% \pm 33.5\%$  vs.  $80.4\% \pm 17.4\%$  [% of max. score],  $p = 0.5$ ) and "knowledge about using AEDs" domains ( $62.4\% \pm 35.2\%$  vs.  $74.7\% \pm 29.3\%$  [% of max. score],  $p = 0.1$ ). Patients who completed first aid courses gained better scores in the "knowledge about using an AED" domain ( $93.3\% \pm 14.9\%$  vs.  $58.6\% \pm 35.4\%$  [% of max. score],  $p = 0.02$ ). No differences between the other domains and overall scores were reported (total score:  $48\% \pm 12\%$  vs.  $42\% \pm 17.5\%$  [% of max. score],  $p = 0.5$ ).

**Conclusion** General knowledge about BLS is poor. BLS training in cardiac patients improves knowledge about first aid for OHCA. Education and hands-on training are crucial to improve outcomes.

**Keywords** Cardiopulmonary resuscitation · First aid course · Knowledge evaluation · Out-of-hospital cardiac arrest

## Introduction

Out-of-hospital cardiac arrest (OHCA) is one of the leading causes of death worldwide. The average incidence among adults is approximately 75–96 cases per 100,000 inhabitants per year (Berdowski et al. 2010; Luc et al. 2019). The predominant cause of OHCA in developing

countries is cardiovascular disease (CVD) (Davies and Thomas 1984; Engdahl et al. 2002). Despite a decrease in the incidence of CVD and better diagnostic and therapeutic methods, outcomes after OHCA remain poor. On average, every tenth patient who suffers from OHCA survives to discharge but most of these patients are cognitively impaired, especially in terms of memory, attention deficits, and executive functioning (Atwood et al. 2005; Berdowski et al. 2010; Hawkes et al. 2017; Mędrzycka-Dąbrowska et al. 2018). The most effective way to improve survival is early recognition of cardiac arrest and immediate cardiopulmonary resuscitation (CPR) with early defibrillation given by bystanders (Bobrow et al. 2010; Han et al. 2019; Iwami et al. 2009, 2012; Valenzuela et al. 2000). The European Resuscitation Council (ERC) has developed Basic Life Support (BLS) guidelines, which provide life-saving procedures that can be used even by lay people until cardiac arrest victims can be given professional medical

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care. Unfortunately, many bystanders do not provide CPR (Bouland et al. 2017; Krammel et al. 2018; Nurnberger et al. 2013). Previous studies have demonstrated that overall population knowledge about BLS and first aid is relatively poor (Özbilgin et al. 2015; Rajapakse et al. 2010). While it has been shown that BLS training improves knowledge, CPR quality, awareness and willingness to help OHCA victims (Lund-Kordahl et al. 2019; Pehlivan et al. 2019; Villalobos et al. 2019); however, there is a paucity of data regarding BLS knowledge and BLS training among cardiac patients. Thus, we sought to evaluate the impact of BLS training in cardiac patients on knowledge about first aid for OHCA.

## Methods

The study group consisted of 68 patients with stable angina admitted to the Department of Cardiology and Cardiovascular Interventions, University Hospital in Krakow for elective percutaneous coronary intervention. Before discharge, all patients filled out a questionnaire, which was administered with explanations by trained medical researcher. Then, two weeks after discharge, the BLS course was conducted by a certified ERC instructor. After training, participants were asked to fill out the questionnaire again. The questionnaire comprised 41 questions, the first 16 relating to general information such as age, sex, marital status, education, participation in first aid courses in the past, attitude to providing CPR and opinion about compulsory BLS courses. The second section consisted of 25 exam questions, each with only one correct answer. The questionnaire was divided into six domains covering legal aspects, resuscitation technique, resuscitation algorithm knowledge, knowledge about using AEDs, “calling for help” knowledge, and identifying sudden cardiac arrest. BLS training as well as the self-designed questionnaire were prepared based on the current ERC guidelines (Perkins et al. 2018). Signed informed consent was obtained from all study participants. Standard descriptive statistical methods were used. The normality of the data was assessed with the Shapiro–Wilk test. Quantitative variables were described using means and standard deviations, or medians and interquartile ranges (IQR). Categorical variables were presented as percentages and a direct comparison between the groups was done using the Chi-square test. One-way analysis with unpaired two-sample T-tests (for normal distribution) or the Mann–Whitney U test (for non-normally distributed data) was applied for quantitative variables. The level of statistical significance was set at  $p < 0.05$ . All analyses were conducted with STATISTICA version 13 software (StatSoft Inc., Krakow, Poland).

## Results

The majority of participants were married (57.4%), female (72%), pensioners (86.8%), and with a higher level of education (73.5%) — Table 1. Only around every tenth respondent (8.9%) had attended a first aid course in the past. The main reasons for non-participation were lack of BLS courses in the neighborhood (33.8%) and fear of providing first aid (20.5%). The vast majority believed that first aid course participation should be compulsory for adults and would like to take part in BLS training themselves in the future (95.6% and 97.1%, respectively). Although more than half of the participants rated their knowledge of first aid for OHCA as “good” (52.9%), on the other hand, most stated that population’s knowledge of first aid for OHCA is insufficient (94.1%). Only 19.1% had ever been witnesses of CPR provided to OHCA victims, and none had performed it personally (Table 2). Of all included patients, 39.7% declared they would not start CPR during OHCA before BLS training. There was no increase in terms of willingness to provide first aid after BLS training (Table 3). As presented in Table 4, higher total scores were observed after BLS training ( $43.8\% \pm 15.6\%$  vs.  $68.6\% \pm 22.7\%$  [% of max. score],  $p = 0.001$ ). The best pre- and post-course scores were for the “calling for help” knowledge ( $79.5\% \pm 33.5\%$  vs.  $80.4\% \pm 17.4\%$  [% of max. score],  $p = 0.5$ ) and “knowledge about using AEDs” domains ( $62.4\% \pm 35.2\%$  vs.  $74.7\% \pm 29.3\%$  [% of max. score],  $p = 0.1$ ). Moreover, participants who had attended previous first aid courses prior to the study gained better scores in the pre-training questionnaire for

**Table 1** Baseline characteristics of study group

Variable	n = 68
Age (years)	68 ± 6.3
Female	49 (72.0%)
Male	19 (28.0%)
Marital status	
Single	5 (7.3%)
Married	39 (57.4%)
Widow/widower	17 (25.0%)
Divorced	7 (10.3%)
Occupation	
Pensioner	59 (86.8%)
Annuitant	2 (2.9%)
Worker	7 (10.3%)
Unemployed	0
Educational status	
Secondary education	18 (26.5%)
Higher education	50 (73.5%)

n: number of participants

**Table 2** Participation in first aid trainings and attitude and awareness about basic life support prior to first aid training

Variable	n = 68
Previous participation in first aid course	6 (8.9%)
Reasons for non-participation (more than one answer allowed)	
fear of providing first aid	14 (20.5%)
lack of time	5 (7.4%)
lack of BLS courses in neighborhood	23 (33.8%)
Agreement with compulsory first aid courses (yes/no)	65/3 (95.6/4.4%)
Wish for deeper BLS exploration (yes/no)	66/2 (97.1/2.9%)
Would you apply BLS if necessary?	
yes, of course	0
probably not, since afraid of making mistake	14 (20.6%)
probably not, due to lack of knowledge	8 (11.8%)
only make an emergency call	10 (14.7%)
no	27 (39.7%)
Is level of knowledge about first aid in OHCA in the population adequate? (yes/no)	4/64 (5.9/94.1%)
Self-assessment knowledge about first aid in OHCA:	
very good	7 (10.3%)
good	36 (52.9%)
average	16 (23.5%)
weak	9 (13.2%)
Have you ever witnessed CPR? (yes/no)	13/55 (19.1/80.9%)
Have you ever performed CPR? (yes/no)	0/68 (0/100%)

BLS: basic life support; OHCA: out-of-hospital cardiac arrest; CPR: cardiopulmonary resuscitation; n: number of participants

“knowledge about using AEDs” ( $93.3\% \pm 14.9\%$  vs.  $58.6\% \pm 35.4\%$  [% of max. score],  $p = 0.02$ ) with no differences between the remaining domains and overall score. Participants who agreed with compulsory first aid courses had significantly better scores in “resuscitation technique” and “resuscitation algorithm knowledge” and better overall scores compared to those who disagreed ( $34.5\% \pm 18.1\%$  vs.  $5.6\% \pm 7.9\%$  [% of max. score],  $p = 0.04$ ;  $36.5\% \pm 17.1\%$  vs.  $8.3\% \pm 11.8\%$  [% of max. score],  $p = 0.04$ ;  $45.2\% \pm 14.4\%$  vs.  $13.3\% \pm 16.2\%$  [% of max. score],  $p = 0.01$ , respectively). Interestingly, patients who believed that levels of knowledge about BLS among adults is generally adequate had significantly worse results in “resuscitation algorithm knowledge” ( $11.1\% \pm$

$19.3\%$  vs.  $37.1\% \pm 16.7\%$  [% of max. score],  $p = 0.04$ ). However, there was no difference in terms of their overall score ( $23.0\% \pm 22.5\%$  vs.  $45.0\% \pm 14.9\%$  [% of max. score],  $p = 0.05$ ) (Table 5).

### Discussion

Our study demonstrated that overall knowledge about first aid for cardiac arrest victims is not satisfactory. The average score from our self-designed questionnaire before BLS training was only  $10.9 \pm 3.9$  points with 43.8% correct answers. However, participation in first aid courses improves knowledge about first aid for OHCA. Our results are consistent with other

**Table 3** Willingness to give basic life support

	Before BLS training (n = 68)	After BLS training (n = 43)	p value
Would you apply BLS if necessary?			0.6
yes, of course	0	2 (4.7%)	
probably not, since afraid of making mistake	14 (20.6%)	9 (20.9%)	
probably not, due to lack of knowledge	8 (11.8%)	0	
only make an emergency call	10 (14.7%)	5 (11.6%)	
no	27 (39.7%)	17 (39.5%)	

BLS: basic life support; n: number of participants

**Table 4** Assessment of knowledge before and after basic life support training (% of correct answers)

Domain	Before training	After training	<i>p</i> value
Average score	43.8 ± 15.6	68.6 ± 22.7	0.001
Legal aspects	38.9 ± 19.9	53.6 ± 29.3	0.01
Resuscitation technique	33.0 ± 18.8	50.2 ± 21.0	0.001
Resuscitation algorithm knowledge	36.0 ± 17.8	49.3 ± 25.2	0.003
Knowledge about using AED	62.4 ± 35.2	74.7 ± 29.3	0.1
“Calling for help” knowledge	79.5 ± 33.5	80.4 ± 17.4	0.5
Identifying sudden cardiac arrest	35.4 ± 20.7	58.0 ± 23.6	0.05

AED: automated external defibrillator

studies suggesting insufficient levels of knowledge in the general population (Goniewicz et al. 2002; Özbilgin et al. 2015; Rajapakse et al. 2010). In our study, only 8.9% of all participants had attended first aid courses in the past. However, our results contradict those of a study conducted in Poland in 2000 suggesting that approximately 75% of the Polish population has received CPR training (Rasmus and Czekajlo 2000). The most popular sources of knowledge about first aid are obligatory CPR training in workplaces, driving schools, secondary and high schools. However, those courses are insufficient due to scarce training time. The inability to gain knowledge and experience was mainly related to a lack of opportunities to take part in first aid training. This shortcoming also seems to be the main reason for the variance and low levels of knowledge about first aid found in our study group. A low level of knowledge about first aid for OHCA was also related to attitude to applying CPR. In a previous study, the majority of individuals who were witnesses of sudden cardiac arrest hesitated to perform CPR mainly due to a lack of proper knowledge and fear of making a mistake (Özbilgin et al. 2015). We observed similar results in our study. Before the BLS course, most participants were hesitant and nearly 40% said they would not start CPR for OHCA. On the other hand, nearly all the participants agreed with obligatory first aid courses and would also like to train their own BLS skills. Our study

revealed that BLS training in cardiac patients significantly improves knowledge about first aid in OHCA. Similar results in other populations have been observed in multiple studies (Lund-Kordahl et al. 2019; Mohamed 2017; Villalobos et al. 2019; Wingen et al. 2018). We observed improvement of knowledge in all domains of first aid in OHCA. Before and after BLS training, participants scored best for “calling for help” and AED usage. The common emergency telephone number in the European Union is “112” and has been advertised in the media as a universal call number for all emergency units for several years now. A similarly high profile can be observed for AEDs, which can be found in many public places and are advertised in social campaigns. The worst results were for recognition of sudden cardiac arrest, and CPR technique and algorithm, where participants gave only approximately 30% correct answers. Nevertheless, we observed significant improvements in these domains after BLS training, which may confirm the importance of education. Individuals who had participated in first aid training in the past had better knowledge mainly about AED utilization (93% correct answers) in contrast to identifying sudden cardiac arrest (28% correct answers). Apart from the undeniable impact of BLS training on overall and specific knowledge about first aid in OHCA, it is also essential to point out its significance for bystanders’ attitude and awareness. Tanigawa et al. (2011)

**Table 5** Pre-training knowledge (% of correct answers)

	Previous participation in first aid course			Agreement with compulsory first aid courses			Is level of knowledge about first aid in OHCA in the population adequate?		
	yes	no	<i>p</i> value	yes	no	<i>p</i> value	yes	no	<i>p</i> value
Legal aspects	48.0 ± 11.0	37.6 ± 21.1	0.2	40.0 ± 20.0	20.0 ± 0.0	0.1	46.7 ± 23.1	38.3 ± 20.2	0.5
Resuscitation technique	40.0 ± 12.7	32.0 ± 19.8	0.3	34.5 ± 18.1	5.6 ± 7.9	0.04	14.8 ± 17.0	34.6 ± 18.3	0.09
Resuscitation algorithm knowledge	43.3 ± 9.1	33.8 ± 18.9	0.2	36.5 ± 17.1	8.3 ± 11.8	0.04	11.1 ± 19.3	37.1 ± 16.7	0.04
Knowledge about using AEDs	93.3 ± 14.9	58.6 ± 35.4	0.02	64.0 ± 34.6	33.3 ± 47.1	0.3	44.4 ± 38.5	64.8 ± 35.2	0.3
“Calling for help” knowledge	80.0 ± 18.3	78.8 ± 36.2	0.9	81.1 ± 32.0	50.0 ± 70.7	0.5	44.4 ± 38.5	81.9 ± 32.7	0.09
Identifying sudden cardiac arrest	28.0 ± 22.8	35.8 ± 20.5	0.4	36.2 ± 20.5	20.0 ± 28.3	0.3	20.0 ± 20.0	36.0 ± 20.5	0.2
Overall score	48.0 ± 12.0	42.0 ± 17.5	0.5	45.2 ± 14.4	13.3 ± 16.2	0.01	23.0 ± 22.5	45.0 ± 14.9	0.05

OHCA: out-of-hospital cardiac arrest; AED: automated external defibrillator

reported that after CPR training, bystanders were three times more likely to apply CPR for OHCA victims than those without CPR training. Conversely, we did not observe similar results in our study. The insufficient sample size might partially explain this outcome. Unfortunately, a single BLS training session is not enough to maintain dexterity. In a recent study, 70% of participants had received CPR training more than ten years ago, explaining the poor level of knowledge about resuscitation that was observed (Rajapakse et al. 2010). Improving and maintaining BLS knowledge at a satisfactory level might be achieved only with regular courses, which could be logistically difficult or even impossible. However, applications on smartphones and tablets and the use of virtual reality, broadcasts on TV, or BLS training in workplaces could be a solution (Atkins 2012; Cerezo Espinosa et al. 2019; Vancini et al. 2019). The social and medical benefit from high levels of knowledge of the BLS algorithm in the general population is inestimable; thus, widespread training should be considered. Our study has some limitations. The most important is its non-randomized design with all the potential for bias. Thus, there is a tendency for unmeasured confounders affecting the outcome. Furthermore, the small sample size limits the generalizability of results. Another potential drawback is that the study was conducted in a big academic city. We suspect that in rural areas, results might be worse. Despite these limitations, the presented data affect important issues and demonstrate that even a single BLS training session among cardiac patients improves their knowledge about first aid for OHCA.

## Conclusion

BLS training improves knowledge about first aid for OHCA in cardiac patients. However, general knowledge about BLS prior to the course was poor, which underlines the importance of education and hands-on training to improve outcomes.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s10389-020-01442-5>.

**Authors' contributions** All authors contributed to the study conception, design, material preparation, data collection and analysis. The first draft of the manuscript was written by Bartosz Partyński and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

**Data availability** The datasets generated during and analyzed during the current study are available from the corresponding author on reasonable request.

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethics approval** All procedures performed in the study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments. The study was approved by the Bioethics Committee of the Jagiellonian University.

**Consent to participate** Informed consent was obtained from all individual participants included in the study.

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