ORIGINAL ARTICLE

Bystanders' cardiopulmonary resuscitation involvement in the treatment of out-of-hospital cardiac arrest events and educational status regarding basic life support measures and automated external defibrillator usage among residents in Canton Sarajevo, Bosnia and Herzegovina

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ABSTRACT

Aim To investigate bystanders' CPR involvement in out-of-hospital cardiac arrest (OHCA) events, their current knowledge regarding OHCA and BLS measures, their willingness to learn BLS measures with the usage of AEDs, as well as current practices.

Methods This cross-sectional study included: data regarding all OHCA events treated at the Emergency Medical Service of Canton Sarajevo between January 2015 and December 2019, and an online anonymous questionnaire that examined knowledge, attitudes and practices regarding basic life support (BLS) and automated external defibrillators (AEDs).

Results A total of 328 (24.0 %) of 1362 OHCA events achieved the return of spontaneous circulation (ROSC). OHCA incidence was 62/100.000 inhabitants per year. Male gender (p=0.043) and younger age (p<0.001) were significantly associated with obtaining ROSC. Only 44 (3.2%) OHCA events were assisted by bystanders, who were mostly medical professionals 38 (86.4%), followed by close family members 6 (13.6%). There was no report of AED usage. BLS and AED knowledge test score was in the range 12.0-89.8% with generally poor knowledge. Our residents agreed that BLS measurements are essential, 1604 (86.7 %) and that BLS should be a part of their curriculum, 1678 (90.7 %).

Conclusion The prevalence of OHCA events in Bosnia and Herzegovina is similar to the region; ROSC among OHCA events was lower than European average, but among highest in the region. There was an extremely low rate of bystander engagement and no AEDs usage. Governmental institutions and health agencies should intervene to increase population knowledge thus increasing OHCA survival rate.

Key words: CPR, heart arrest, out-of-hospital cardiac arrest, return of spontaneous circulation

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INTRODUCTION

Out of hospital cardiac arrest (OHCA) as a third leading cause of global mortality, represents cessation of cardiac mechanical activity which occurred outside of the hospital setting and is confirmed by absence of circulation signs. This entity, which can be caused by cardiac (predominately coronary artery disease) (1) and noncardiac causes (trauma, drowning, burns, asphyxia or intoxication), affects more than 350.000 patients in Europe annually (2) with a variable survival rate varying from region to region and a European average of 11.7% (3). An immediate recognition of OHCA, activation of an emergency response team, early cardiopulmonary resuscitation, early defibrillation, effective advanced life support and integrated treatment represent a chain of actions needed to successfully treat this condition (4). Data from various studies show that the outcome of OHCA depends not only on medical expertise, equipment, medications, age, sex and type of rhythm (shockable or not shockable) during the resuscitation, but also on factors on the field such as bystanders' cardiopulmonary resuscitation (CPR), prehospital use of automated external defibrillators (AED), location of the OHCA event and witnesses on the scene of OHCA (5).

Even though, some of the medical literature (6) exclusively associates OHCA survival rate with hospital and advanced life sustaining treatments, literature constantly emphasizes the importance of basic life support (BLS) knowledge and usage of AEDs among bystanders, as well as the role of emergency medical dispatch centres in coordinating bystanders' CPR and AED usage which play a critical role in the OHCA outcome or life or death (7).

Data regarding OHCA, bystanders' CPR involvement and usage of AEDs in Bosnia and Herzegovina (B&H) and in the region are scarce. Additionally, B&H has just recently started installing AEDs in places of mass social gatherings and education of its general population regarding BLS.

The aim of this study was to investigate bystanders' CPR involvement in OHCA events, their current knowledges regarding OHCA and BLS measures, their willingness to learn BLS measures with the usage of AEDs, as well as current practices seen on the terrain in Canton Sarajevo, Bosnia and Herzegovina.

PATIENTS AND METHODS

Patients and study design

This cross-sectional study included two parts: data regarding all OHCA events in Canton Sarajevo treated by the Emergency Medical Service of Canton Sarajevo between January 2015 and December 2019 and an online anonymous questionnaire which examined current knowledge, attitudes and practices towards BLS and AEDs of the general population of Canton Sarajevo.

The study was approved by the Ethical Committee of the Emergency Medical Service of Canton Sarajevo and done in accordance with all amendments of the Helsinki Declaration.

In the first part of the study all patients who had OHCA and were treated by the Emergency Medical Service of Canton Sarajevo were included. Subjects included in the second part of study were general population of Canton Sarajevo; exclusion criteria were: not being a citizen of Canton Sarajevo and/or not fully filling the questionnaire and/or being younger than 18 years.

Methods

Data collected for all OHCA cases from official protocols of the Emergency Medical Service of Canton Sarajevo from the period between January 2015 and December 2019 for the first part of studies included patients' gender, age, place of residence (urban/rural), time of arrival of the Emergency Medical Response Team, bystander's profile, CPR involvement and usage of AEDs.

The second part of the study included a questionnaire based on an Indian study (8), which was tailored to local characteristics, new European Resuscitation Council guideline 2020, translated to Bosnian/Croatian/Serbian language and distributed via social media platforms (Facebook, WhatsApp, Viber and web site of the Emergency Medical Service of Canton Sarajevo) to the residents of Canton Sarajevo. The questionnaire included four parts: demographic characteristics (gender, age, education, profession and previously finished life support courses), 13 knowledge questions regarding BLS and AED usage (Table 1), 3 questions regarding resuscitation attitudes and 2 questions regarding practices towards resuscitation and life support events (Table 2). All

subjects were informed about the objectives of the study, their voluntary participation, including an online informed consent and details on how to fill in the questionnaire.

Statistical analysis

Collected data were summarized and descriptive statistics were run. Normal distributed data were displayed in frequencies and percentages (mean ± standard deviation), while data with non-normal distribution were presented with median (25^{th}, 75^{th} percentile). To asses various variables in association with certain phenomena independent samples t test, Mann Whitney U test or χ^2 test as appropriate were conducted. Statistical significance level was set at $p<0.05$ (two-sided).

RESULTS

During the period from January 2015 to December 2019, a total of 1362 OHCA events occurred in Canton Sarajevo, of which 328 (24.0 %) obtained return of spontaneous circulation (ROSC), whereas 1034 (76.0 %) were unsuccessful resuscitations.

Table 1. Knowledge of residents of Canton Sarajevo related to basic life support (BLS) measures and automated external defibrillator (AED) usage

Knowledge test questions	Answers	Correct answer rate (%)
What does the abbreviation BLS stand for?	Best Life Support Basic Life Support Basic Life Services	80.3
Proper BLS checklist and protocol during the initial assessment is:	Airway, Breathing, Circulation Breathing, Circulation, Airway Circulation, Airway, Breathing	43.5
A proper place to check presence of pulse in adults during the initial assessments is:	Carotid artery Brachial artery Ulnar artery	83.3
A proper place to provide chest compressions during the cardiopulmonary resuscitation (CPR) is:	Left part of the thorax Right part of the thorax Central part of the thorax on lower half of the sternum Central part of the thorax on upper half of the sternum	89.8
How deep should chest compression be?	2-3cm 3-4cm 4-5cm 5-6cm	31.3
How fast should chest compression be provided?	<60/min 60-80/min 80-100/min 100-120/min	22.9
A proper chest compression to ventilation ratio in adult CPR is:	15:1 15:2 30:1 30:2	46.8
When you find a person without conciseness in the middle of the road, your first response is:	Open the airway Start chest compressions Check safety and call EMS Give two initial breaths	50.3
If a person is not responding to your call, even after you touch him/her, call him/her, what is your reaction?	Start CPR Call emergency service Position the person in the recovery position Observe the person	64.7
What does the abbreviation AED stand for?	Automated External Defibrillator Automated Electrical Defibrillator Advanced Electrical Defibrillator	59.3
Proper usage of AEDs consists of next phases:	Take AED, connect electrodes, shock the patient, analyse rhythm, check pulse Take AED, connect electrodes, check safety, check pulse, analyse rhythm, shock Check safety, Check pulse, take AED, connect electrodes, analyse rhythm, shock	12.0
Severe obstruction of airway includes everything, but	Poor gas exchange High pitched tones while inhaling Unable to cry Wheezing between coughing Abdominal crunch	39.6
If you and your friend are having lunch in the cafeteria and suddenly your friend starts chocking, what would you do?	Chest compressions Confirm that there was an aspiration of the food bolus by talking to him and force him to cough Back slaps	19.0

A 5-year period analysis showed similar prevalence of OHCA per year in association with gender, age, emergency medical team (EMT) response time and bystanders' involvement (Table 3).

Patients undergoing resuscitations were predominantly males, 905 (66.4 %), of which 233 (71.0 %) for ROSC and 672 (64.9 %) for unsuccessful resuscitations. When compared to females, male patients were significantly associated with obtaining ROSC (p=0.043) (Table 3).

Median age of patients was 65.0 (54.0; 77.0), 64.0 (53.0; 74.0) for ROSC and 68.0 (55.0; 77.0) for unsuccessful resuscitations. Being younger was significantly associated with obtaining ROSC, when age was compared between the ROSC group and unsuccessful resuscitations, 64.0 (53.0;74.0) and 68.0 (55.0;77.0), respectively (p<0.001) (Table 3).

After initial contact with the dispatch of the Emergency Medical Department of Canton Sarajevo, only 44 (3.2%) of 1382 OHCA events were assisted by bystanders, which were mostly medical professionals (medical doctors, medical technicians and emergency medical technicians), 38 (86.4%), followed by close family members, six (13.6%). There was no noticed usage of AEDs in OHCA events.

Mean response time of EMT was 6.64±2.71, that was 5.61±2.31 for ROSC and 7.33±3.22 for unsuccessful resuscitations. Faster response time was significantly associated with obtaining ROSC comparing to unsuccessful resuscitations, 5.61±2.31 and 7.33±3.22, respectively (p<0.001). All 1362 (100.0 %) OHCA events during the observed period occurred in the urban part of Canton Sarajevo (Table 3).

The study questionnaire was distributed to 1850 residents of Canton Sarajevo who were mostly females, 1240 (67.0%), with a mean age 33.30±11.29, having high school or bachelor's degree, 831 (44.9%) and 472 (25.5%), respectively; being engaged in intellectual labour, 1062 (57.4%) and living in an urban environment, 1621 (87.6%). Residents of Canton Sarajevo have reported being already knowledgeable and educated in Basic Life Support and Advanced

Table 2. Attitudes and practices of residents of Canton Sarajevo towards basic life support (BLS) measures and automated external defibrillator (AED) usage

Attitudes	Answer	No (%)
Do you agree that BLS is important?	Agree	86.7
	Disagree	0.6
	I don't know	12.7
Do you agree that everyone should have BLS as a part of their curriculum?	Agree	90.7
	Disagree	3.3
	I don't know	6.0
Would you voluntarily be a part of theoretical and practical BLS training?	Yes	91.9
	No	3.2
	I don't know	4.9
Practices		
Have you ever provided BLS measures to a person in OHCA event?	Yes	22.7
	No	75.6
Have you ever given mouth to mouth ventilation in OHCA events?	Yes	24.0
	No	86.0

Table 3. Gender, age, emergency medical team (EMT) response time and bystanders' involvement in out-of-hospital cardiac arrest (OHCA) events in Canton Sarajevo in the period January 2015 to December 2019 in comparison to return of spontaneous circulation (ROSC) group and unsuccessful resuscitations

Success of resuscitation	Year (No of subjects)					Total (1362)	p
	2015 (251)	**2016** (315)	**2017** (287)	**2018** (284)	**2019** (225)		
Male/Female (No; %)							
ROSC	46 (18.3) /6 (6.3)	61 (19.4) /25 (7.9)	41 (14.2) /20 (6.9)	39 (13.7) /24 (8.4)	46 (20.4) /10 (4.4)	233 (17.1) /95 (6.9)	0.043
Unsuccessful resuscitation	120 (47.8) /69 (27.6)	138 (43.8/91 (28.9)	154 (54.7) /72 (24.2)	141 (49.6) /80 (28.3)	119 (52.8) /50 (22.4)	672 (49.3) /362 (26.7)	
Age median (25th, 75th quartile) (years)							
ROSC	64.0 (55.0;74.0)	63.0 (57.0; 75.0)	63.0 (56.0; 74.0)	64.0 (53.0; 73.0)	65.0 (52.0; 72.0)	64.0 (53.0; 74.0	<0.001
Unsuccessful resuscitation	66.0 (55.0;76.0)	69.0 (56.0; 77.0)	67.0 (57.0; 79.0)	68.0 (55.0; 76.0)	67.0 (53.0; 75.0)	68.0 (55.0; 77.0)	
Response time (mean±SD) (minutes)							
ROSC	5.4±2.2	5.7±2.4	6.1±2.1	5.6±2.6	5.0±2.5	5.61±2.31	<0.001
Unsuccessful resuscitation	7.3±3.5	7.7±2.9	7.2±3.1	7.8±3.0	6.6±3.1	7.33±3.22	
Bystander involvement (No; %)							
ROSC	1 (16.6)	4 (44.4)	3 (30.0)	3 (50.0)	5 (38.4)	16 (100.0)	N/A
Unsuccessful resuscitation	5 (83.4)	5 (54.6)	7 (70.0)	3 (50.0)	8 (51.6)	28 (100.0)	

N/A, not applicable;

Life Support Measures, 734 (39.7%) and 213 (11.5%), respectively.

Knowledge test scores correct rates ranged from 12.0% to 89.8%. Residents showed poor knowledge scores regarding the quality of chest compression, 579 (31.3%) residents knowing proper chest compression deepness, 424 (22.9%) knowing proper chest compression pace and 866 (46.8%) knowing proper chest compression to ventilation ratio. More than half of the residents knew what AED stood for, 1098 (59.3%); only 222 (12.0%) knew how to properly use AEDs in case of a cardiac arrest. Regarding the severe airway obstruction, 733 (39.6%) residents knew to identify symptoms of this entity, of which 351 (19.0%) knew how to properly help an individual in this state (Table 1)**.**

Residents showed relatively optimistic attitudes, with 1604 (86.7%) who agreed that BLS measures were important, and 1678 (90.7 %) stating that BLS should be a part of their curriculum. Residents also showed huge willingness to voluntarily learn BLS and AED usage, 1700 (91.9%) (Table 2).

Poor practices towards OHCA events were noticed in 420 (22.7%) residents providing BLS measures, and 444 (24.0%) giving mouth to mouth ventilation in OHCA events (Table 2).

DISCUSSION

To our knowledge, this is the first study in Bosnia and Herzegovina which investigated bystanders' CPR involvement in OHCA events, their current knowledge regarding OHCA and BLS measures, their willingness to learn BLS measures with the usage of AEDs, as well as current practices seen on the terrain. Our study showed that during the period of January 2015 to December 2019 in Canton Sarajevo, there were 328 (24.0 %) ROSC resuscitations and 1034 (76.0 %) unsuccessful resuscitations in OHCA events. Male and younger patients, as well as a faster EMS reaction time were significantly associated with obtaining ROSC in OHCA events. Critically low rate of bystanders' involvement and no AEDs usage was documented in OHCA events. Residents exhibited poor knowledge regarding BLS measures, generally enthusiastic attitudes with willingness to develop and learn these lifesaving skills and poor practices in OHCA events.

Compared to the data from EuReCA ONE study (9), OHCA incidence in our population confirmed by EMS of 62/100.000 inhabitants per year is similar to the regional countries (Croatia 62/100.000, Serbia 183/100.000 and Slovenia 69/100.000). The prevalence of achieving ROSC among OHCA events was lower than for overall European countries (24.0% vs. 28.6%) (9), but it is among highest in the region (lower than Slovenia and higher than Croatia and Serbia). It could be explained by critically low or no bystanders' involvement in OHCA events, poor knowledge and no previous training in providing BLS measures among bystanders and unavailable and poor distribution of AEDs in the region (9).

The majority of our patients were males (66.4%), and older age (65.0) which is similar to the EuReCa ONE study, 66.3% and 66.0 years, respectively (9). Females have significantly smaller chance of receiving resuscitation treatment by EMS probably because of higher female life expectancy than males leading to higher likelihood for them to be widowed and/or living alone thus more likely to have an unwitnessed cardiac arrest and losing crucial time for resuscitation. Additionally, females receive a smaller rate of CPR by bystanders as a result of longer OHCA recognition due to nonspecific symptoms (fatigue, fainting, vomiting and neck or jaw pain) and they benefit less than males with overall lower OHCA survival rate (10).

One of the more changeable factors significantly determining OHCA outcome was EMS reaction time, which was faster in our ROSC events compared to the optimal response time threshold (5. 6 min vs 6.2 min) (11) and could be one of the determining factors for a good overall OHCA survival rate in our region.

Our study demonstrated overall very low bystanders' CPR involvement and no AEDs usage event though AEDs are prevalent in OHCA events (3.2%), which is alarmingly low compared to the European average data (50.0%) (9); it could be attributed to poor BLS knowledge, not knowing whether CPR should be provided, no previous BLS measures and AED training and poor AEDs network and distribution. This fact was also proved in the online questionary (second part of our study). The majority of bystanders who were involved in OHCA events, were medical profe-

ssionals, which further emphasizes the need for overall population education and further development of AED network, which will consequently improve overall OHCA event survival rate and help us reach the European average.

Even though more than a third of the patients have reported that they already know BLS measures and how to use AEDs, our study showed very poor knowledge regarding critical points in providing CPR (quality and quantity of delivered chest compressions, AED usage manual and even dealing with severe obstruction of the airway). Similar findings were found in the region, and worldwide (12-14) and all were associated with reduced overall OHCA event survival rate. According to one research, BLS training clearly improved the quality of CPR, potentially boosting probability of reaching ROSC, and it was considerably superior to CPR performed by unskilled rescuers with dispatcher direction (15). Contrary to the BLS knowledge, residents of Canton Sarajevo had generally very optimistic and enthusiastic attitudes with more than 90% of them willing to learn essential skills needed in provision of these measures even on a voluntarily basis and proposing that BLS should be a part of their curriculum. As a result of such poor knowledge, practices of our residents were also poor.

Our study had several limitations. Firstly, the cross-sectional study prevents us from inferring causality. Secondly, the data taken from the Emergency Medical Service Protocols had few information regarding bystanders' educational profile and measures taken, while the EMS service came to the OHCA event. Future studies should be done prospectively with more data taken into consideration, as well as potential bias and confounding factors. Lastly, the second part of the study was done during COVID-19 quarantine times with an online questionnaire, which limited some parts of the population with no internet connection, or certain online accounts to access the questionnaire thus giving us a full picture of our population.

In conclusion, our study has shown that the prevalence of OHCA events in Bosnia and Herzegovina is similar to the region, that achieving ROSC among OHCA events was lower than the European average, but among highest in the region, and that factors associated with the outcome of OHCA were similar in our population to the European. There was an alarmingly low rate of bystanders' involvement and no AEDs usage in the observed period with very low BLS and AEDs usage knowledge, relatively optimistic attitudes and poor practices. Governmental institutions and health agencies should intervene to drastically increase overall population knowledge thus increasing its practices and overall OHCA survival rate in our country.

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