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Evaluation of performing resuscitation skills in accordance with Advanced Life Support protocol by students of the final year of medical faculty Medical University of Warsaw

Ocena umiejętności praktycznych w zakresie resuscytacji wśród studentów ostatniego roku kierunku lekarskiego Warszawskiego Uniwersytetu Medycznego

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Abstract

Introduction. One of the basic skills acquired during medical studies is the ability to lead and participate in cardiopulmonary resuscitation. Education of sudden states diagnosis and technical activities during resuscitation is based on the Advanced Life Support (ALS) protocol in accordance with the Guidelines of the European Resuscitation Council. The last-year students of medical faculties took part in simulated Medical Emergency Teams (METs) scenario of cardiac arrest. Analysis of audiovisual recordings of activities undertaken during resuscitation was performed to evaluate the practical skills required for resuscitation.

Material and methods. The studied group of students took part in a simulated emergency scenario during which there was an irreversible cardiac arrest. The instructor assessed selected parameters of the work of 37 METs.

Results. The first element of scenario was to treat bradycardia which occurred at the beginning. 17 METs (less than 49%) took any action to treat it, 12 METs (slightly over 32%) administered atropine. The next step was to diagnoses and treat adequately cardiac arrest. 15 of METs (40.5%) reacted within 10 s, 10 METs (67.5%) in 11–20 s, and 9 METs (13.51%) took any activity during 21–40 s.

Among the therapeutic measures required by the ALS protocol, at the moment of cardiac arrest 12 METs — just over 32% checked the presence of the breath, the most METs (100%) gave adrenaline, 29 METs (slightly more than 78%) performed airway, 27 METs (less than 73%) called the resuscitation team.

Conclusion. The lack of students' skills of the proceedings in accordance with the guidelines of the ALS protocol in terms of treatment of bradycardia and during cardiopulmonary resuscitation suggests to put greater emphasis on teaching both basic and advanced life support activities as general medical skills, gradually throughout the undergraduate training during the whole medical education.

Key words: Advanced Life Support protocol, medical emergency team, bradycardia, practical skills

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Introduction

The ability to deal with emergencies is one of the fundamental medical skills. Programs of all medical studies contain courses encompassing this field of knowledge, with a special focus on cardiac arrest. Doctors are expected to be professional and possess up-to-date knowledge on management of life-threatening conditions. Basic Life Support (BLS) course takes place in the first year of medical studies, and in the following years this topic is expanded to include the algorithms of advanced life support during internal medicine, emergency pediatrics, emergency medicine as well as anesthetics and intensive therapy courses. Teaching the principles of the diagnosis of cardiac arrest and cardiopulmonary resuscitation based on adult ALS protocols by the European Resuscitation Council (ERC) [Advanced Life Support Protocol (ALS) 2015: www.erc.com] is a mandatory component of those courses. It provides the skills to treat cardiac arrest of various etiologies, and to manage conditions leading to cardiac arrest. In addition to teaching substantive skills, also non-substantive skills are taught, such as communication within the therapeutic team or working under the guidance of a team leader [1]. Current guidelines recommend that one should participate in life support refresher courses more than once a year. In accordance with the regulations of the Minister of Science and Higher Education regarding the standards of training, every medical graduate should know the existing protocols to a degree, which would allow identification of conditions leading to cardiac arrest, be able to treat them and actively participate in cardiopulmonary resuscitation as a team member (TM) or team leader (TL) [2]. A study conducted at the center for medical simulations aimed to determine the level of technical skills pertaining to the ALS protocol among 6th-year students of the 1st and 2nd Faculty of Medicine (now the Faculty of Medicine).

Material and methods

Place and time of study

Study was conducted at the center of medical simulation (CMS) during the period May–June 2018 during a 6-week course "Specialty selected by the student", which encompassed two of the following: internal diseases, surgery, gynecology and obstetrics, pediatrics, psychiatry, anesthetics and intensive therapy, emergency medicine, radiology, urology, as chosen by the student. All students, regardless of the chosen subject, participated in uniform CMS courses, devoted largely to medical communication and role-playing in various medical scenarios. These classes were mandatory. Each day, 14 to 35 students participated in 3 simulation subgroups.

Study group and design

The study group consisted of students in the 6th-year of medical studies at the 1st and 2nd Faculty of Medicine. At the beginning of the course, all students were verbally informed about the assumptions and objectives of the study by two instructors. Students were then asked to give their written consent to participate in the study. The study included persons who consented to it, including participation in audiovisual recordings. The Bioethical Committee was informed of the study.

After the students completed their consent forms, an hour-long seminar on communication skills in medical practice was conducted for all student groups taking part in the classes before the start of simulation sessions. After the seminar, students were divided into three subgroups, which took turns participating in three scenarios, rotating between the simulations within the simulation center. The order of participation in the scenarios was unimportant. The following clinical scenarios were conducted during the course:

- scenario no. 1 — providing information on a serious diagnosis to a patient with advanced testicular cancer;
- scenario no. 2 — dealing with a life-threatening situation during cardiac arrest according to the current guidelines, with components of team communication and providing information to patient's family;
- scenario no. 3 — dealing with refusal by a doctor to admit a patient after an episode of loss of consciousness to the hospital.

The goal of this work is to assess students' medical skills related to scenario no. 2 [3].

Simulation scenario

Scenario no. 2 depicting a situation in the emergency room was used to conduct our observation. The scenario involved a 70-year-old patient with past medical history of hypertension and ongoing abdominal pain radiating to the pelvis who was brought into the district hospital by the Medical Emergency Team (MET), with deteriorating consciousness and worsening hypotonia. The cause of his condition is ruptured abdominal aortic aneurysm, which the students were not informed about. The students were asked to form therapeutic teams (TT) consisting of 4 people: TL and TM. Students not actively participating in the scenario were observing the activities of the TT in real time from the adjoining debriefing room equipped with an audiovisual system. Before participating in the scenario, students confirmed that they were familiar with the rules of operating an advanced patient simulator (SimMan 3G, Laerdal, USA) and advanced hospital Emergency Department (ED) environment simulator, which was necessary to conduct the scenario evaluated in this study. The students themselves decided on the division of roles within the

TT. The participants of the scenario were given detailed information about the place where the scenario was conducted (emergency room of a district hospital near Warsaw with limited diagnostic and therapeutic possibilities) and patient's condition, which was assessed by the MET at the time they were called to patient's home. This information was also written on the emergency medical system assessment card, which the students received for inspection.

After receiving the above information from the instructor, the team had 3 minutes to prepare for work. Subsequently, TT was invited to the ER simulation room in order to perform medical activities. Undisclosed to students, the scenario assumed significant deterioration of patient's medical condition during their medical activities relative to the information provided by the MET.

The simulation scenario assumed irreversible cardiac arrest regardless of the actions undertaken by the team (which were, however, assessed with regard to the compliance with ALS protocol) and therapeutic team's decision to discontinue resuscitation and pronounce death.

Checklists used to analyze the audiovisual recording

After the classes, recordings of simulation session were subject to analysis. Selected elements of the 2015 ALS European Resuscitation Council guidelines [1] were analyzed, including:

- time since bradycardia to administration of medication. According to the current guidelines, bradycardia is defined as heart rate below 60/min. To avoid doubt, under simulated conditions heart rate shown on the electrocardiogram (ECG) monitor was below 40/min. Taking into account the ALS protocol stating the need for immediate treatment of bradycardia in case of worrying symptoms in addition to slow heart rate, worsening hypotonia was included in the scenario. In the absence of clear guidelines regarding the timing of intervention for bradycardia in the ALS protocol, arbitrary time frames for intervention were assumed in our study: 0–30 s, 31–60 s and 61 s and more;
- time from the appearance of asystole on the ECG monitor to starting resuscitation defined as chest compressions. According to the ALS protocol, when arrest is suspected, confirmation should be done as soon as possible, and cardiopulmonary resuscitation should be started. Confirmation should not take more than 10 s. Taking the above into account as well as the fact that during the scenario patient simulator was connected to ECG monitoring, pulse oximetry and non-invasive blood pressure monitoring, we arbitrarily assumed time frames from the appearance of asystole on the monitor until the start of chest compressions: 0–10 s, 11–20 s, 21–40 s, 41–60 s:
- checking for breath;
- heart rate check on the common carotid artery or femoral artery;
- call for resuscitation team;
- adrenaline;
- call for a specialist other than an anesthetist/resuscitation team;
- secure airway;
- ultrasound examination of the abdominal cavity according to eFAST protocol (extended Focused Assessment with Sonography for Trauma) to exclude the presence of free fluid in the abdominal cavity suggestive of bleeding into the abdomen;
- identifying the need for transfusion and ordering red blood cell (RBC) concentrate.

Results

Thirty-seven out of 44 of the therapeutic teams *i.e.*, a total of 148 people, consented to audiovisual recordings. Therefore, 148 participants were assessed on the basis of audiovisual recording. The analysis was divided into two parts to verify the actions undertaken in the case of bradycardia and asystole. In the first stage, we identified the teams that took appropriate action for bradycardia and indicated the time from the onset of bradycardia to administration of the drug. Of the 37 evaluated teams, only 17 (45.94%) initiated pharmacological treatment of bradycardia. Among the drugs used were the following:

- atropine administered by 12 teams (32.43%);
- other medicines, including adrenaline, norepinephrine, dobutamine, dopamine and bicarbonate, each administered by 1 team (5 teams in total — 13.51%).

The remaining 20 TTs (54.05%) did not attempt any pharmacological treatment until the appearance of asystole on the ECG monitor. Among the 17 TTs that reacted to the onset of bradycardia with pharmacotherapy:

- 5 teams (13.51%) undertook action within 30 s, all gave atropine;
- 6 teams (16.22%) acted between 31 and 60 s, of which 3 teams gave atropine;
- 6 teams (16.22%) acted after 60 s, 4 of which administered atropine.

Subsequently, we assessed the response time from the moment asystole appeared on the ECG monitor to commencing resuscitation.

Occurrence of asystole prompted reaction within arbitrarily assumed time intervals:

- 15 TTs (10.54%) reacted within 0–10 s;
- 10 TTs (27.03%) reacted in 11–20 s;
- 9 TTs (24.32%) reacted in 21–40 s;
- 1 TTs (2.7%) reacted in 41–60 s;
- 2 TTs (5.4%) did not take any action in response to asystole.

Diagnostic and therapeutic measures taken by TTs:

- 37 TTs (100%) used ECG monitoring, non-invasive blood pressure monitoring and pulse oximetry;
- 12 TTs (32.43%) checked for breath;
- 18 TTs (48.65%) checked for pulse on common carotid artery or femoral artery;
- 29 TTs (78.73%) secured the airway;
- 37 TTs (100%) administered adrenaline, including 27 (72.97%) more than once;
- 27 TTs (72.97%) called the resuscitation team;
- 17 TTs (45.94%) identified the need for transfusion and ordered RBCs;
- 13 TTs (35.13%) called a specialist other than an anaesthetist/resuscitation team.

Discussion

Students of the last year of medical school should have the skills that allow undertaking fast, efficient and appropriate therapeutic response to emergency situations. The simulation room and clinical scenarios enable reproduction of clinical situations encountered by healthcare professionals in everyday practice as faithfully as possible [4]. In the designed scenario, the actions undertaken by TT should closely follow the applicable guidelines. Diagnosis of a life-threatening condition calls for increased supervision, regular and thorough monitoring of patient's clinical condition and appropriate decision-making. The role of the team leader is to allocate tasks and anticipate subsequent steps [5]. It prevents the occurrence of adverse events and reduces reaction time if patient's clinical condition changes. An example of such an action is monitoring of hemodynamic parameters, early diagnosis of bradycardia and implementation of treatment. Careful monitoring of patient's condition facilitates appropriate diagnosis of cardiac arrest. In this scenario, students should be able to undoubtedly recognize bradycardia defined as heart rate below 60/min, consider its potential reversible causes, and use atropine as first-line treatment [6]. Given that only 17 of 37 TTs took action in response to bradycardia it should be considered whether the students analyzed cardiomonitor's record in sufficient detail and if they were able to recognize bradycardia despite clear ECG evidence. As many as 20 TTs did not react to it in any way, which may signify inability to make the diagnosis or lack of skills relating to pharmacological management.

The key to the decision to implement resuscitation is the diagnosis of cardiac arrest. This skill is taught as part of the BLS protocol during first aid classes for 1st-year medical students. According to the protocol, cardiac arrest should be recognized in a patient who is unconscious, unresponsive to stimuli and not breathing. Heart rate monitoring, which was provided by the CMS during the scenario, is helpful in such situations. In this study, all TTs connected ECG monitoring, non-invasive blood pressure monitoring and pulse oximetry. Only 12 of 37 TTs remembered the check for breathing as part of the diagnosis of cardiac arrest. It indicates lack of habit of checking for breathing in the event of circulatory compromise. Lack of careful monitoring of vital signs and possibly lack of thorough analysis of cardiomonitor's recording led to delayed diagnosis of cardiac arrest, thus leading to delay in implementation of appropriate treatment, which according to ALS protocol, is commencement of resuscitation.

Undoubtedly, stress experienced by the students as they undertook action during the simulation is one of the factors influencing the study results. Analysis of stress levels during resuscitation indicates that cardiac arrest is a highly stressful situation [7, 8]. That is why it seems so important to limit the amount of additional stress related to uncertainty regarding the skills of those involved in resuscitation. This is possible with a frequent repetition of resuscitation training. Deterioration of acquired skills within 3 to 12 months of training is a fact confirmed in research studies and an argument in favor of such an action [9–11]. It should be also noted that such a phenomenon was observed among trained professionals, therefore it should be expected that this problem can be even more marked in case of students. At the same time, given the learning curve effect, use of simulations to strengthen practical skills at the stage of medical studies seems to be very beneficial from the point of view of patient safety [12]. Non-technical resuscitation skills, including communication and ability to work in a team or as a leader also seem to play an additional role, which is the subject of further research [13].

Taking into consideration the results obtained in this study, we would like to emphasize the need for repetition of ALS protocols throughout the entire duration of medical studies. It requires modification of current curricula to enforce continuing education promoting acquisition of habits that enable proper diagnosis of medical emergencies and knowledge of standards for the treatment of life-threatening conditions.

Conclusions

Analysis of data from the refractory cardiac arrest scenario indicates that none of the therapeutic teams fully followed the ALS guidelines for the treatment of bradycardia and cardiopulmonary resuscitation. Teaching both basic and advanced resuscitation skills should be conducted on regular basis during undergraduate medical education. Repeatability of training in the subsequent years should ensure that the skills are acquired and maintained on a level enabling safe and effective resuscitation.

Conflict of interest

The authors declared no conflict of interest.

Streszczenie

Wstęp. Postępowanie w stanach nagłych stanowi jedną z podstawowych umiejętności, którą powinni nabyć studenci na wszystkich kierunkach medycznych. Podstawą nauczania rozpoznawania stanów zagrożenia życia, w tym rozpoznawania zatrzymania krążenia i prowadzenia resuscytacji krążeniowo-oddechowej, są wytyczne *Advanced Life Support* (ALS) Europejskiej Rady Resuscytacji. W ramach badania oceniono stopień wykorzystania wiedzy i umiejętności praktycznych w zakresie resuscytacji przez studentów VI roku kierunku lekarskiego.

Materiał i metody. Badana grupa studentów brała udział w symulowanym scenariuszu zdarzenia krytycznego, w trakcie którego dochodziło do nieodwracalnego zatrzymania krążenia. Na podstawie nagrania audiowizualnego instruktor oceniał wybrane merytoryczne parametry pracy 37 czteroosobowych zespołów terapeutycznych (ZT).

Wyniki. Pierwszym ocenianym elementem scenariusza było podjęcie leczenia bradykardii. Jakiekolwiek działania w tym zakresie podjęło 17 ZT (niecałe 49%), a 12 ZT (nieco ponad 32%) podało atropinę. Kolejnym, następującym po bradykardii, stałym elementem było wystąpienie nieodwracalanego zatrzymania krążenia w mechanizmie asystolii. W ciągu 10 s na asystolię zareagowało 15 ZT (40,5%), w czasie 11–20 s — 10 ZT (67,5%), natomiast 9 ZT (13,51%) podjęło działania w ciągu 21–40 s.

W momencie wystąpienia zatrzymania krążenia tylko 12 ZT (nieco ponad 32%) sprawdziło obecność oddechu jako kryterium rozpoznania zatrzymania krążenia, wszystkie ZT (100%) podały adrenalinę, 29 ZT (nieco ponad 78%) dokonało przyrządowego udrożnienia dróg oddechowych, 27 ZT (niecałe 73%) wezwało zespół resuscytacyjny.

Wnioski. Ograniczone umiejętności studentów w zakresie postępowania zgodnie z wytycznymi protokołu ALS leczenia bradykardii oraz w trakcie prowadzenia resuscytacji krążeniowo-oddechowej sugeruje konieczność przywiązywania większej wagi do nauczania zarówno podstawowych, jak i zaawansowanych czynności resuscytacyjnych jako umiejętności ogólnolekarskich, sukcesywnie w czasie całego szkolenia przeddyplomowego na kierunku lekarskim.

Słowa kluczowe: protokół *Advanced Life Support*, zespół terapeutyczny, bradykardia, umiejętności praktyczne

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