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Methodology of Teaching Resuscitation to People without Medical Education

Viktor I. Mukhin[1], Svetlana A. Mukhina[1], Irina S. Zimina[1], Olga V. Polozova[1], Maria N. Gavrilova[1], Valentina V. Bakhtina[1]
[1]Mari State University, Lenin Square 1, Yoshkar-Ola city, 424000, Russia

Abstract: *The rate of sudden cardiac arrest mortality is increasing nowadays. At the moment, based on the developed legislation, people without medical education are taught the first aid rules, including resuscitation procedures. The number of students increases every year, but training has no significant effect, which is due to the fact that, on the one hand, teachers do not have sufficient basic medical knowledge, and on the other hand, training is based on the method developed for health professionals. The paper deals with the methodology of the cardiopulmonary resuscitation algorithm for people without medical education developed and introduced into the learning process by the Candidate of Medical Sciences, Associate Professor Viktor Mukhin. The paper aims to test the effectiveness of the modified methodology of teaching the required first aid minimum– cardiopulmonary resuscitation algorithm to students and different population groups. The suggested structural and logical algorithm of resuscitation, including a substantiated sequence of stages of resuscitation procedures, in a stressful situation, is the most effective in achieving the ultimate outcome in providing first aid by any person.*
Keywords: *cardiopulmonary resuscitation, sudden cardiac arrest, first aid, clinical death, resuscitation methodology.*

INTRODUCTION

One of the world's leading causes of mortality is sudden cardiac arrest (SCA). In the Russian Federation, the sudden cardiac arrest mortality rate is around 250,000-300,000 people per year. The annual SCA rate, caused by ventricular fibrillation, is 17 per 100,000 cases, including 21.2% of patients surviving until hospital discharge. The Covid-19 pandemic contributed to a rise in mortality for the last two years among people at the age of 30-74. The indicators, obtained before 2020, show progressive reduction in heart disease mortality. But, after the pandemic of coronavirus in 2020, the cardiovascular disease mortality at the age of 35-54 increased by 12%, by 7.8% among the people at the age of 55-74, and by 11.2% among the risk-factor population. The supplied statistics determine the importance and topicality of considering first aid problems in sudden cardiac arrest death.

It is essential that as many citizens as possible should be able to provide high-quality and effective first aid. People living in civil society must be calm and sure that every passer-by will be able to help them. About 80% of cases when cardiopulmonary resuscitation is necessary occur outside the healthcare center (in the street, at home, at secondary or higher education institutions, in crowded places). Young population groups are socially active and visit public places most often. The time for successful resuscitation of the person with cardiac arrest is extremely limited – 3–5 minutes from the moment of cardiac arrest. On average, survival chances decrease by 10% every minute.

The witness' ability to provide first aid to the affected person immediately and correctly is a key factor that determines the chances for a favorable outcome when out-of-hospital cardiac arrest occurs. Basic cardiopulmonary resuscitation performed by the witness of cardiac arrest slows down the dying process, which considerably increases the probability of the ambulance's arrival before the coming of irreversible death, and early application of an automated external defibrillator by the witness can restore cardiac function before the arrival of specialists [3, 9, 11].

Despite the fact that the importance of providing first aid to save the life of the affected people with cardiac arrest has been confirmed by numerous research papers and intensification of witnesses' participation in providing aid has been actively advocated by the international resuscitation community for decades, actual indicators of the frequency of cardiopulmonary resuscitation performed by the witnesses of cardiac arrest in many countries remain extremely low. Timely and skillful first aid for people injured in road traffic accidents prevents further deterioration in the human body condition and can have a positive impact on the whole process of further treatment and rehabilitation

The Federal law "On Education in the Russian Federation", article 41 "Student Health Protection"

includes the paragraph on teaching first aid skills to educators.

At the moment, first aid is defined as "... a set of actions aimed at preserving and supporting life and health of the affected people and conducted in accidents, injuries, traumas, poisoning, and other conditions and diseases threatening the life and health of the affected people, until medical aid is provided". In its essence, it aims at eliminating life-threatening events as well as at preventing further injuries and possible complications [3, 4, 6].

The sequence of first aid measures determines a universal first aid algorithm approved on November 23, 2022 by the Ministry of Health of Russia. In an emergency situation, it helps brace oneself quickly and implement a sequence of simple manipulations to save the affected person's life. The Ministry of Health of Russia suggests following the specified algorithm in teaching first aid skills to people obliged to provide first aid in accordance with the Federal Law or special rules and to other people who have the right to provide it. At the moment, the first aid procedure has been adopted in the new wording. The main purpose of the suggested changes is to simplify the methodology of cardiopulmonary resuscitation (CPR), which adversely affects its effectiveness. The number of students increases every year, but, as practice shows, the teaching methods have no significant effect, which is due to the teachers' insufficient competence, shortage of medical personnel, and lack of trainees' basic medical knowledge. The teachers base themselves upon the method developed for health professionals, are not skilled in determining the clinical death condition, and do not have any knowledge of heart and lung physiology.

The algorithm is a unified first aid technique used in all the conditions threatening human life, where resuscitation procedures as such are of particular importance. The need arises to perform a consistent sequence of manipulations, including diagnosis of clinical death, preparation for resuscitation procedures and artificial lung ventilation and closed-chest cardiac massage as such [1].

The resuscitation algorithm requires consistent actions, and deviation from its principal stages can make resuscitation ineffective [6]. The most efficient, classical scheme of resuscitation procedures was suggested by the American anesthesiologist and resuscitationist Peter Safar. In the literature, it is known as "Safar's Alphabet."

A (Airways) – airway management;

B (Breathing) – breathing support (ALV);

C (Circulation) – blood circulation support (closed-chest cardiac massage).

There is still a serious problem related to the fact that resuscitation methodology is intended for people with medical education and includes the mastering of rather complicated diagnostic techniques such as taking carotid pulse and pupillary light reflex. Average people find it difficult to meet timing requirements (10 seconds) to assess life functions in the affected person. Therefore, taking pulse on the carotid or other arteries [8] has been considered "loss of time" in recent years. In this case, the only alternative is continuous and high-quality closed-chest cardiac massage with a rate of 100–120 compressions per minute. This has become especially relevant with high infection load and under- preparation for manipulation. Moreover, such signs as the pupillary diameter change and skin cyanosis are not always indications for resuscitation. Pupillary dilation, as a sign of cerebral hypoxia, is known to manifest itself 0.5–1 minute after cardiac arrest. Some medicinal drugs can also influence the pupil width. Besides, the color of skin can change depending on the Hb level in the blood [10].

Time limitation stipulates the consistence of actions in determining the signs of life in the affected person. The change in the above-listed signs becomes important for assessing the effectiveness of resuscitation procedures being conducted. Irreversible changes in the cerebral cortex occur only 3-5 minutes later under normal temperature. Statistically, resuscitation procedures, performed within the first three minutes, are successful in 94% of cases, within 4 minutes - only in 75% of cases, and within 5 minutes - only in 6% [1, 2]. If more than 10 minutes pass from the time of the clinical death, the affected person cannot usually be saved.

Inherently, basic cardiopulmonary resuscitation is an initial stage of resuscitation, when average people, on the one hand, have to provide first aid to the affected person, and on the other hand, are unprepared for high-quality manipulations without special devices. Unfortunately, the specified authors recommend that artificial lung ventilation (ALV) is continued when the pulse appears until the lasting relief of the affected person's state. This statement brings some vagueness into the consistent stages of resuscitation

by non-specialists.

The simplest way to determine clinical death is an accessible method for determining consciousness and breathing. But there are states when a weak indeterminate heartbeat persists if there is hard-to-determine shallow breathing. Paradoxically, active resuscitation of a living person can worsen heart performance, even leading to permanent cardiac arrest. In other words, resuscitation of a living person can lead to death.

The paper aims to test the effectiveness of the modified methodology of teaching the required first aid minimum – cardiopulmonary resuscitation algorithm to students and different population groups, in accordance with the outlined requirements.

MATERIALS AND METHODS

The study was conducted at Mari State University. Taking into consideration the complexity of perception of the algorithm of resuscitation procedures by students without special medical education, the Candidate of Medical Sciences, Associate Professor Viktor Mukhin has developed a cardiopulmonary resuscitation methodology that clearly defines the sequence of stages of diagnosis, preparation and cardiopulmonary resuscitation procedure as such. The consistent methodology helps standardize the CPR process, which ensures consistency of actions: all the rescuers and health professionals follow the same protocols, which reduces the possibility of errors. Besides, standardized procedures are easier to study, which increases the level of specialists' competence. Quick and correct diagnosis of the affected person's state helps begin resuscitation more quickly, and the consistent sequence of operations helps avoid skipping the most important stages such as chest compression and artificial respiration.

The methodology suggests studying the algorithm as a table that consists of three columns (resuscitation stages), each specifying four mandatory and most important paragraphs (see Table 1).

Table 1

Algorithm of Resuscitation Stages

Diagnosis of clinical death	Preparation for resuscitation	Resuscitation
1. Determination of consciousness "What has happened?"	1. Positioning on a hard surface	1. Closed-chest cardiac massage
2. Carotid pulse	2. Removing clothes from the chest and neck	2. Artificial respiration
3. Breathing	3. Jaw thrust	3. Taking carotid pulse
4. Pupillary light reflex	4. Checking the oral cavity, tongue thrust	4. Continuation of resuscitation cycles (30 min.)

The 3×4 table structure makes the information on cardiopulmonary resuscitation more compact and facilitates the memorization and retrieval from memory of four mandatory operations at each stage. The column implementation sequence is evident, including diagnosis, preparation and resuscitation as such.

Training according to the suggested methodology must always start with theoretical substantiation of each stage and its description. Then all the stages are demonstrated on a phantom simulator, and the correctness of implementation of each stage to achieve effective result is discussed. Then trainees implement all the stages on a simulator themselves, saying out loud their actions. We must accept the fact that first aid, and especially resuscitation procedures are performed under stress, and we should remember that the first minutes are the most effective in saving human lives [4, 5]. Therefore, it is important that people have certain skills in performing actions according to the algorithm [7]. This scheme helps learn the resuscitation algorithm and put it into practice rather easily. It was put to the test during classes. It is evident that the effect of resuscitation procedures performed by people with medical education will be considerably different from the effect of procedures performed by people without medical education. More often, the latter have faint and half-forgotten knowledge of human anatomy and physiology from the school curriculum. The survey finds out that students have no idea of the possibility of resumption of cardiac activity with simple chest compression during cardio resuscitation. When performing artificial respiration, there is no concept of emergent oxygen deficiency in cardiac muscles and impossibility of

heart contraction. Rescuers must show knowledge of changes occurring in the body while performing resuscitation procedures in a simple way, and they must be done by a teacher with medical education. Even such facts as chest compression force must be drilled only on a phantom simulator. The specified pressure in resuscitation manuals is 6 cm. Is it possible to determine such a figure almost without practical skills?

As a rule, clinical death generates stress in a person without medical education, and their skills, acquired during theoretical training, are lost.

The study aims to create the simplest methodology of resuscitation procedures that includes all stages and adherence to the algorithm. Classes were conducted when teaching the Health and Safety and Basic Medical Knowledge courses and giving continuing education courses in caregiving, Youth Leaders Training, etc. In the beginning, we introduce all the basic concepts such as first aid, resuscitation, clinical and biological death, signs, etc. Then all the stages and actions of the resuscitation algorithm are studied theoretically according to the table, in great detail, with explanation, practical demonstration and consolidation. Then the teacher demonstrates all the procedures on a phantom simulator. And only after that does each student drill the resuscitation algorithm according to the scheme developed by the authors, saying out loud their actions.

We have been testing this scheme for several years. The observations show that students learn it effectively. Students understand the essence of the algorithm, and the table helps memorize it.

To perform the tasks, we tested students' retained knowledge using the suggested test. We chose an experimental group (EG) of students, who learned the algorithm of resuscitation according to the developed scheme, and the second (control) group (CG) that was not trained according to the presented methodology (but it should be noted that among them were students who got the status of rescuers and took a first aid course). The test included 30 questions about basic concepts and the algorithm of cardiopulmonary resuscitation. It should be noted that the test was conducted half a year after completing the basic medical knowledge course.

RESULTS AND DISCUSSION

The analysis of the obtained results showed that there were 13% of students with a low level of knowledge, 60% with an average level of knowledge, and 27% with a high level of knowledge in the experimental group. In the control group, there were no students showing a high level of knowledge, 85% had a low level, and 15% had an average level (see Figures 1 and 2).

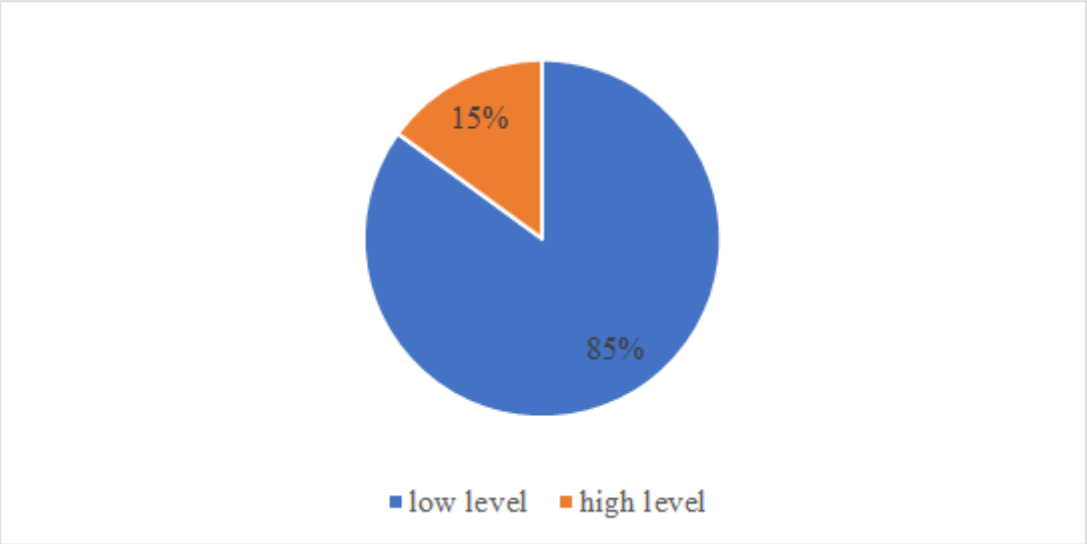

Figure 1: Level of student knowledge (in %) of resuscitation in the control group

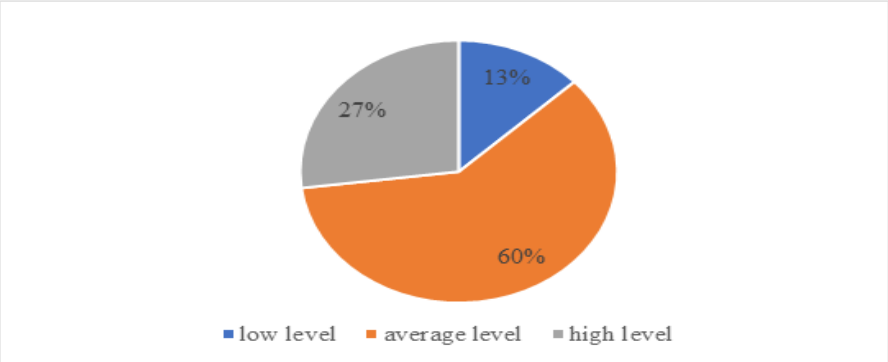

Figure 2: Level of student knowledge (in %) of resuscitation in the experimental group

The conducted statistical analysis showed a significant difference in the obtained results, i.e. the difference is statistically significant (P< 0.01).

We conducted a comparative analysis of the answers to the questions about resuscitation stages. 93% of students in the experimental group and 84% in the control group gave the right answer to the question about the algorithm of actions in cardiopulmonary resuscitation. 80% of respondents in the experimental group and 46% in the control group understand what is included in the stage of preparation for cardiopulmonary resuscitation. The stage of preparation for cardiopulmonary resuscitation was correctly described by 67% of respondents in the experimental group and only 7.7% of students in the control group. 100% of students in the experimental group and 46% in the control group knew what was included in the stage of diagnosis for cardiopulmonary resuscitation. 93% of students in the experimental group and 46% in the control group were able to correctly describe the sequence of stages of resuscitation procedures. 87% of respondents in the experimental group and 61.5% in the control group were able to answer what was included in the diagnosis of clinical death. 93% of respondents in the experimental group and 38.5% in the control group were able to correctly determine what was included in the main resuscitation stages. At the same time, it should be noted that the second (control) group did not study according to this scheme, but 45% of students in this group had a rescuer certificate, i.e. they passed a first aid exam. It is evident that rescuers can face challenges during resuscitation procedures. As practice shows, this happens not only due to lack of experience and stress in an emergency situation, but also, which is equally important, due to lack of clear guidelines, which hampers the implementation of all the required stages. Besides, lack of regular practice can decrease self-confidence.

During the experimental work, we also conducted research among the students of the medical institute getting basic medical knowledge as part of the Health and Safety course in the second year of study, i.e. at the level of providing non-professional first aid. The research findings are presented in Figure 3.

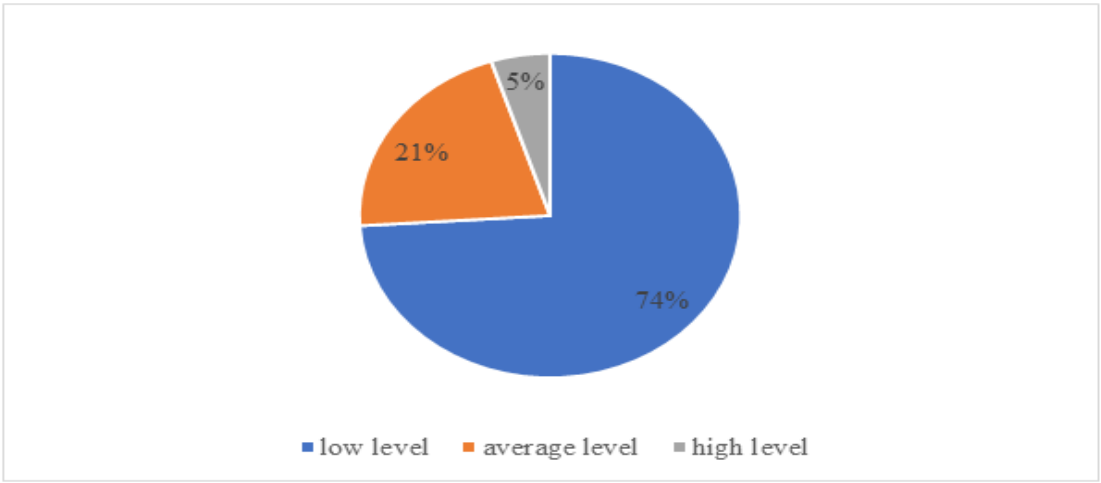

Figure 3: Level of student knowledge (in %) of resuscitation in the experimental group

We found out that all students (100%) had learned the algorithm of the stage of clinical death diagnosis, 84% had correctly determined the algorithm of actions in cardiopulmonary resuscitation, and only 37%

had correctly noted that the algorithm of cardiopulmonary resuscitation included three stages: diagnosis, preparation, and resuscitation.

Only 8% of students know which actions are included in the stage of diagnosis, namely indications for cardiopulmonary resuscitation. Just over half of respondents (53%) correctly determined the sequence of stages of the developed algorithm of resuscitation procedures. Only 16% of future health professionals pointed out that it was necessary to perform resuscitation on a hard surface. 63% of students know the signs of clinical death and 47% correctly determined the sequence of actions in cardiopulmonary resuscitation

CONCLUSIONS

The obtained research findings can serve as a confirmation of the fact that the structural and logical scheme of cardiopulmonary resuscitation and the applied teaching methodology for its implementation, suggested by Viktor Mukhin, gives a positive valid result of the acquisition by non-medical students. The algorithm of resuscitation as a table that consists of three columns (diagnosis, preparation and cardiopulmonary resuscitation as such), each containing four paragraphs of mandatory manipulations, makes it easy for people without medical education to learn how to provide the required minimum first aid - cardiopulmonary resuscitation (on the principle of learning the multiplication table). The use of the standardized methodology will help track resuscitation results more easily and identify the aspects to enhance. Such a systematic approach will help collect data for analyzing and improving the methodologies. Practical application of this consistent methodology will help rescuers feel more confident in emergency situations and will help them focus on performing the tasks rather than on uncertainty. By following the approved protocols, rescuers can act more decisively and effectively. The use of the suggested methodology of cardiopulmonary resuscitation with a consistent sequence of stages is an important step towards the increased quality of first aid and increased chances of survival of the affected people. This not only improves the resuscitation results, but also contributes to professional development of rescuers and health professionals.

If the person providing aid is in a stressful situation, the simple resuscitation algorithm, including consecutive stages of resuscitation procedures, is the most efficient algorithm for saving the affected person's life.

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