

Current Methodological Recommendations on Conducting Basic Cardiopulmonary Resuscitation in Case of Extra-Hospital Cardiac Arrest

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Abstract: *One of the most urgent situations that nurses face is cardiac arrest. Knowledge of cardiopulmonary resuscitation (CPR) is necessary for survival after nosocomial or community-acquired cardiac arrest. The two main factors determining survival after cardiopulmonary arrest are the immediate initiation of CPR and early activation of the survival chain.*

Keywords: *basic cardiopulmonary resuscitation (CPR), standard cardiopulmonary resuscitation (C-CPR), only-compression cardiopulmonary resuscitation (TC-CPR), cardiac arrest, basic CPR measures, automatic external defibrillator (AED), autoresuscitation.*

The concept of basic cardiopulmonary resuscitation Sudden cardiac arrest remains the leading cause of death in many countries around the world. According to new data from the American Heart Association, approximately 88% of sudden cardiac arrests occur in the community, and the critical factor in preserving life in such a situation is the timely performance of high-quality basic cardiopulmonary resuscitation (CPR). The outcome of the situation largely depends on it. Cardiopulmonary resuscitation (CPR) is a set of measures aimed at revitalization in case of circulatory and respiratory arrest. CPR can be divided into two large stages: primary, or basic CPR, which is performed at the scene without the use of special equipment and medicines, and specialized, or extended CPR, which is performed by professional medical professionals. The main task of basic or primary CPR is the elementary maintenance of life in cardiac arrest, and the goal is to ensure the circulation of oxygenated blood, deliver it to the brain and thus keep the brain alive until the start of specialized care, in particular, before the onset of defibrillation. Basic CPR should be started immediately if the victim has no signs of life: consciousness, purposeful movements, normal breathing, or they are questionable. Timely cardiopulmonary resuscitation can increase the chances of survival by two or four times. There are two known methods of basic cardiopulmonary resuscitation. This is the time-tested traditional or standard cardiopulmonary resuscitation (C-CPR) with chest wall compression and mechanical ventilation, and the second method is resuscitation by chest compressions alone without mechanical ventilation, called compression-only cardiopulmonary resuscitation (TC-CPR). TC-CPR emerged as an alternative to C-CPR and aims to simplify CPR and maximize the involvement of bystanders in the provision of basic resuscitation care. Without basic CPR for cardiac arrest in an out-of-hospital setting, the victim has no chance of survival, so any CPR is preferable to inaction. The main signs of out-of-hospital cardiac arrest and the sequence of actions in the provision of basic resuscitation care. To provide effective resuscitation care in out-of-hospital settings, early detection of cardiac arrest is extremely important on the basis of a clear knowledge of the main signs of cardiac arrest. Direct indications for the immediate initiation of basic CPR are the absence of consciousness and the absence of normal breathing. Skin discoloration, pallor, or cyanosis are not

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diagnostic criteria for cardiac arrest. As soon as a critical situation is detected, after making sure that the victim and everyone around him are safe, they begin to check the response of the victim and whether he has normal breathing after opening the airways. If the victim does not react and does not have normal breathing, professional help is called, delivery of an Automatic External Defibrillator (AED) and chest compressions are immediately initiated. If the caregiver is trained and willing to perform mouth-to-mouth ventilation, then after 30 compressions, he performs 2 artificial respirations and then continues CPR in a ratio of 30: 2. If you are unable or unwilling to perform artificial respiration, only chest compressions are performed. After the AED is delivered, the electrodes are attached to the victim's chest and an electric discharge is applied. Taking into account the ubiquity of mobile phones for the recognition of cardiac arrest in the victim and the performance of resuscitation measures, persons without professional medical training are recommended to receive dispatching assistance from the emergency medical service on the speakerphone. When providing resuscitation care to an adult victim with signs of cardiac arrest, the general sequence of actions in out-of-hospital conditions is as follows:

SAFETY → CHECKING THE REACTION OF THE VICTIM → OPENING THE AIRWAY → BREATHING TEST → CALLING PROFESSIONAL HELP → CHEST COMPRESSION → ARTIFICIAL RESPIRATION → CPR 30:2 → AED

Despite the fact that for clarity the algorithm is presented in the form of a linear sequence of actions, it has been established that the first steps to check the reaction of the victim, open the airways, check the breath and call the emergency dispatcher can be performed simultaneously or in rapid succession. To check the reaction of the victim, you should slightly shake him by the shoulders and ask loudly: "Are you okay?". If the victim does not react, open the airways, straightening the neck and raising the chin. "By observing, listening, and feeling," they check for normal breathing. In the first minutes after cardiac arrest, the victim may have very weak breathing, or agonal breathing may be detected in the form of rare, slow, noisy sighs characteristic of the early stages of cardiac arrest. Agonal breathing in cardiac arrest can have up to 40% of victims. Such breathing is equated with the absence of normal breathing. Short generalized convulsions can also serve as the first manifestation of cardiac arrest, so it is recommended to carefully evaluate breathing in a victim with convulsions. When assessing the condition of the victim by non-professionals, there is no need to check the pulse on the main arteries. It has been proven that palpation of the pulse on the carotid artery (or any other main artery) is not accurate enough to determine the presence or absence of blood circulation. And in the case of an assessment of the condition of the victim by trained professional rescuers, no more than 10 seconds are spent on determining the pulse, and in order not to delay the onset of chest compressions, it is recommended to check the presence of a pulse and breathing at the same time. The main activities of standard cardiopulmonary resuscitation, their sequence and method of implementation. The main measures of standard cardiopulmonary resuscitation (C-CPR) include: closed heart massage (C - circulation), airway patency (A - airway) and artificial ventilation (B - breathing). This sequence of measures is defined as the C-A-B algorithm of cardiopulmonary resuscitation. The first and most important step in this sequence is a closed heart massage through chest compressions. After that, the airways are opened and the lungs are mechanically ventilated. The logic of this sequence is based on the fact that after a cardiac arrest, the blood remains oxygenated for a few minutes and can keep the brain alive while ensuring the circulation of oxygenated blood. It is very important that in the process of C-CPR, the time of interruption of compressions for artificial respiration is minimal. The fundamental problem of artificial maintenance of blood circulation in cardiac arrest is a very low (less

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than 30% of normal) level of cardiac output created by chest compression, which leads to a rather low level of cerebral (30 - 60% of normal) and coronary (5 - 20% of normal) blood flow. During chest compressions, coronary pressure rises gradually, and with each successive pause required for artificial respiration, it decreases rapidly. A minimum of 20 continuous compressions are required to achieve the highest possible level of systemic hemodynamics. Studies have shown that the most effective ratio is the number of chest compressions and artificial breaths, equal to 30. The correct implementation of basic resuscitation measures, the exact observance of the specific parameters of chest compressions and mechanical ventilation largely determines the final result of resuscitation.

The victim is placed on a hard surface on his back. Kneeling on the side of the victim, the resuscitator places the base of one palm in the center of the victim's chest (the lower half of the victim's sternum is considered the center), and the base of the other palm is placed on top of the first. The resuscitator lifts the fingers so that the pressure falls on the sternum, and not on the ribs of the victim. The arms should be perpendicular to the surface of the victim's chest and not bent at the elbow joints, so that when pressure is applied to the sternum, not only the strength of the arms, but also the weight of the body is used. If the victim is in a confined space, compressions can be performed from behind the victim's head. Compression of the chest of an adult resuscitated is performed with such force that the sternum goes down by at least 5 cm, but not more than 6 cm. After each compression, the chest is completely freed from pressure and, without losing contact between the hands and the sternum, is allowed to completely straighten the chest wall. In no case should the hands of the resuscitator interfere with the expansion of the chest to its original size. Full chest straightening improves venous return and increases the effectiveness of CPR. The frequency of compressions should be at least 100-120 / min. After 30 chest compressions, the airways are opened and the mechanical ventilation is used. Placing his hand on the forehead of the victim, the resuscitator gently tilts the victim's head back and with the tips of his fingers placed under the chin, raises the lower jaw, thus opening the airways. Further, to carry out artificial ventilation of the lungs using the mouth-to-mouth method with the thumb and index fingers of the hand lying on the forehead of the victim, the resuscitator squeezes the wings of the nose and opens the victim's mouth, while keeping the chin raised. Having taken a normal breath, the resuscitator tightly, hermetically covers the victim's mouth with his open mouth and evenly blows air, while observing the excursion of the anterior wall of the chest. About 1 second is spent on blowing, which provides an effective artificial inhalation, as with normal breathing. After blowing air, keeping the victim's head unbent and his chin raised, the resuscitator immediately releases the victim's mouth, controls the passive exhalation by the fall of the anterior chest wall and by the sound of the outgoing air. Then the resuscitator performs another blow (after inhaling air) into the victim's mouth to get a total of two artificial breaths. It is important that the duration of exhalation of the victim is approximately twice the duration of inhalation (the ratio of inhalation and exhalation is 1: 2), otherwise the exhalation of the victim will not be complete in relation to the removal of carbon dioxide. Two artificial breaths spend no more than 10 seconds to minimize the time of interruption of chest compressions.

Next, move the hands to the correct position in the center of the victim's chest and perform the next 30 compressions. Continue chest compressions and artificial breaths in a ratio of 30: 2. Compression cardiopulmonary resuscitation alone Another type of basic cardiopulmonary resuscitation is compression cardiopulmonary resuscitation (TC-CPR) only, which emerged as an alternative to standard cardiopulmonary resuscitation (C-CPR) for out-of-hospital cardiac arrest and includes only chest compressions, without mouth-to-mouth ventilation. The adoption of TC-CPR is

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associated with a higher survival rate and is aimed at simplifying CPR for rescuers and health workers, as well as maximizing the involvement of others in the provision of resuscitation care for out-of-hospital cardiac arrest. This strategy of basic cardiopulmonary resuscitation is now attracting more and more attention. Only compression cardiopulmonary resuscitation (TC-CPR) is recommended for non-medical professionals who are unwilling or unable to perform mouth-to-mouth artificial respiration. The absence of the need for direct contact with the victim to perform artificial respiration using the mouth-to-mouth method increases the number of people wishing to provide resuscitation care in case of cardiac arrest and thus leads to the maximum involvement of others in the provision of resuscitation care before the arrival of professionals, creating prerequisites for increasing the survival rate. An important argument in favor of the new resuscitation approach is also the fact that with this method of CPR, chest compressions are not interrupted for artificial respiration and, therefore, the circulation of oxygenated blood and the delivery of oxygen to the cells of the brain, heart and other organs do not stop. The question of whether traditional CPR with compression and ventilation is preferable to compression CPR alone in a situation where resuscitation care is provided by a non-professional remains open. There is no evidence in favor of the effectiveness of one or another method of basic cardiopulmonary resuscitation. However, it is known that TC-CPR is not used in the case of basic resuscitation care for children aged 8 years and younger, drowning, as well as cardiac arrest as a result of a drug overdose. Both artificial respiration and chest compression are critical to the success of resuscitation of such victims, so they undergo standard cardiopulmonary resuscitation (C-CPR) when providing resuscitation care. Features of basic cardiopulmonary resuscitation in children. Basic resuscitation measures in children who have lost consciousness and the ability to breathe normally are basically the same as those for adults⁶⁵⁰. However, the choice of the method of basic CPR, the algorithm and parameters for performing resuscitation measures must correspond to the age norm of the resuscitated person (Table 1). Children under one year of age, before starting chest compressions, need to take 5 initial breaths in order to eliminate the lack of oxygen and excess carbon dioxide in the tissues as quickly as possible and then perform chest compressions and artificial ventilation using the mouth-to-mouth and nose method in a ratio of 30: 2. Chest compressions for children under 1 year of age are performed with two fingers (index and middle) at a level below the nipple line to the width of one finger or with the first phalanges of the first two fingers of the hands, fixing the back of the newborn with the rest of the fingers. Compress the chest to at least a third of its depth, providing a compression depth of 4 cm and a frequency of 100 / min. Children from 1 year to 8 years of chest compression perform one or two hands at the level of the lower third of the sternum. The depth of compression should be 5 cm. Shocks should be rhythmic, not strong, but sharp. The frequency of tremors is 100 / in min. The ratio of chest compressions and mechanical ventilation is 30: 2. Artificial ventilation of the lungs in children under 1 year of age is carried out by the mouth-to-mouth and nose method. In this case, the child lies on his back, on a small roller under his back and shoulder girdle. The head is thrown back. The resuscitator carefully fixes the head with his right hand, taking a small breath, gently, but hermetically covers the child's mouth and nose with his open mouth and blows in air. To prevent damage to the child's lungs, the caregiver blows air with less force than an adult and carefully monitors the respiratory movements of the anterior chest wall. After blowing, the resuscitator immediately releases the child's mouth and nose and controls passive exhalation. Injection frequency 1 /3-4 sec. The duration of inhalation is about 1 second, as in adults. For children from 1 year to 8 years old, artificial ventilation of the lungs is carried out by the mouth-to-mouth method with a frequency of 1 / 3-4 seconds. with blowing a smaller volume of air than an adult.

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Cardiopulmonary resuscitation in special conditions of the scene of the accident - in case of drowning, electrical injury, during incidents with a large number of victims.

Drowning is a process that leads to primary respiratory impairment when immersed in a liquid medium. This general definition was adopted at the suggestion of a group of experts at the International Congress on Drowning in Amsterdam (2002) in order to clarify the many (>20) existing definitions of drowning. It reflects the essence of the process, and the terms "wet drowning", "dry drowning", "active or passive drowning", "paradrowning", "secondary drowning" and "silent or silent drowning" are set aside in favor of the general term "drowning". Drowning causes severe oxygen deficiency (asphyxia) and can lead to asphyxial cardiac arrest, brain damage, and death. Immersion in water for more than 10 minutes is associated with an unfavorable outcome. Immersion in icy water can increase the survival window and justifies the prolongation of search and rescue actions. In the case of drowning, rapid extraction from the water and the initiation of CPR are critical. The priority of resuscitation strategies in such situations is oxygenation and ventilation, so only compression cardiopulmonary resuscitation (TC-CPR) in case of drowning is rejected. Artificial ventilation of the lungs should be started already in the water. Five primary injections in water are the beginning of basic resuscitation care. The duration of each injection should be at least 1 second, to overcome airway resistance. After removing the drowning person from the water, he is placed on a hard surface and chest compressions and artificial respiration are performed in a ratio of 30: 2. If possible, the use of an automatic external defibrillator (AED) is desirable. Electric shock is relatively rare, but has the potential to cause severe multiple organ injuries with high lethality and complications. When performing CPR for victims of electric shock, it is important to observe safety measures and, first of all, release the victim from contact with electric current. You can not approach the victim without making sure that all power sources are turned off.

During incidents with a large number of victims exceeding the resources of rescuers, CPR is not applied to victims who do not show signs of life and have no chance of rescue.⁶⁵⁶ Such a recommendation is related to the need to rationally use the limited resources available in situations with mass casualties and to provide assistance, first of all, to those victims who, as a result of triage, have a chance of salvation. Foreign body airway obstruction (ODPIT) In some cases, basic CPR may be necessary in the case of severe airway obstruction by a foreign body. Airway obstruction caused by foreign bodies is an emergency. Foreign bodies can cause both mild and severe airway obstruction. If the victim is able to speak, cough and breathe, he has a slight obstruction. He should be instructed to cough, as coughing creates high pressure in the airways, which can contribute to the expulsion of a foreign body. If the victim loses the ability to speak, cough, if he is weakened and breathes with difficulty or does not breathe at all, then he has severe airway obstruction. In children older than one year and adults with severe obstruction and still preserved consciousness, it is necessary to immediately eliminate the obstruction by a blow to the back, and if this does not help to clear the airways by pushing into the abdomen. Blows to an adult victim are applied with the base of the palm between the shoulder blades. In this case, the victim should be tilted forward so that the object of obstruction when displaced comes out of the mouth, and does not fall back into the respiratory tract. To perform abdominal tremors, standing behind the victim and grasping the area of the upper abdomen of the victim and tilting it, make 5 sharp thrusts in and up. Thus, alternate 5 blows on the back and 5 abdominal tremors. The combination of these actions increases the likelihood of success.

In the event that the victim loses consciousness at some point during airway obstruction, he is carefully lowered to the ground and standard CPR begins with chest compressions. A sharp compression of the chest increases the pressure in the airways more than abdominal tremors. After 30

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compressions, 2 artificial breaths are performed and continue until the victim comes to his senses and begins to breathe normally. At the same time, the emergency service is called. Application of an automatic external defibrillator Only basic cardiopulmonary resuscitation rarely starts the work of the heart, since even against the background of a closed heart massage, hypoxia of the heart muscle progresses rapidly. The probability of restoration of cardiac activity is significantly affected by the application of an electric discharge using an automatic external defibrillator (AED). Early defibrillation, performed within 3-5 minutes after the development of cardiac arrest, increases survival to 50-70%. AEDs are safe and effective even when used by individuals with little or no training. AEDs make it possible to defibrillate many minutes before professional help arrives. Even before the AED is delivered, if signs of cardiac arrest are detected, chest compressions should be started immediately.

Long-lasting, high-quality chest compressions significantly increase the chance of salvation during defibrillation. Once the AED is delivered, it is turned on and electrodes are attached to the victim's chest. If there is more than one rescuer, then an assistant does this, and the rescuer continues CPR. After making sure that none of the others, including rescuers, touches the victim, the rescuer presses the discharge button. After that, the rescuer immediately resumes CPR and continues according to voice and visual prompts or instructions from the emergency dispatcher. Interruption of chest compressions for defibrillator discharge should not exceed 5 seconds. After each attempt at defibrillation, CPR is continued for 2 minutes, then a pause is made to quickly assess the rhythm and check for possible signs of revival. Standard AEDs are suitable for use in children over 8 years of age. For children from 1 year to 8 years old, pediatric electrodes with an energy dose regulator are used, or a pediatric defibrillator, if possible. It is recommended to introduce AEDs in public places, institutions, crowded places. It is believed that it is economically feasible to place AEDs in areas where one cardiac arrest can be expected in 5 years.

Performance indicators and duration of baseline CPR. Indicators of the effectiveness of basic cardiopulmonary resuscitation are:

- pink color of the skin (especially the face);
- constriction of the pupils;
- the appearance of spontaneous breathing and cardiac activity.

If in the process of CPR there are signs of life (purposeful movements, normal breathing or cough), which gradually increase, resuscitation measures continue until the restoration of spontaneous blood circulation and the complete restoration of adequate breathing. After the restoration of spontaneous breathing and blood circulation, consciousness does not return in all cases. And then the victim is placed in a stable lateral position to prevent asphyxia from retraction of the tongue. If, despite the whole complex of resuscitation measures, the victim does not show signs of life, then chest compression and artificial respiration are stopped, and the victim is recognized as dead. The moment of termination of resuscitation is considered the time of the onset of biological death. However, to date, the medical literature has described cases of restoration of spontaneous blood circulation after cardiac arrest and cessation of unsuccessful CPR. The phenomenon of delayed recovery of spontaneous blood circulation after the cessation of CPR is called autoresuscitation, or the Lazarus phenomenon. The term "Lazarus phenomenon" is borrowed from the story of the biblical character Lazarus, who was resurrected by Jesus Christ four days after his death. The transition from life to death is a complex physiological process. Death is usually established on the basis of either irreversible cessation of brain function or cessation of circulatory and respiratory functions.

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However, given that the Lazarus phenomenon can occur, death should not be ascertained immediately after CPR has stopped, it takes some time (about 10 minutes or longer) to verify and confirm death. Today, there is no consensus on the recommended waiting time for possible autoresuscitation to ascertain death after CPR cessation. According to some foreign studies, this period of time ranges from 2 to 10 minutes. The question of determining the time of death after the termination of unsuccessful CPR is of particular relevance in the modern world in connection with the medical practice of collecting donor organs for transplantation. The practice of extracting donor organs for transplantation requires a clear knowledge of scientifically confirmed data on the length of time required to confirm death. Viable organs can only be taken from dead patients. Thus, further research is needed to reliably determine the boundaries of autoresuscitation time.

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