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Current aspects of cardiopulmonary resuscitation

Key words: *cardiopulmonary resuscitation, artificial ventilation.*

Knowledge of current principles of emergency medical care is important for physicians of all specialties. Each physician must provide emergency medical care to patients regardless of the underlying cause of the terminal condition, guided by contemporary recommendations and international guidelines [1, 8]. A significant number of patients requiring emergency care die because untimely or inadequacy of treatment. It is known that lack of assistance to victims in severe condition for 1 hour after injury increases the number of deaths by 30%, for 3 hours – 60% and for 6 hours – 90 % [5].

Often the health and life of the patient depends on the timeliness and quality of care in various diseases, traumatic injuries, accidents, poisoning, etc. [5]. According to the WHO data about 2 % of died due to accidents in peaceful time, could be saved if they receive timely first aid [11]. Existing legislation in Ukraine provides criminal penalties for not providing care to the person who is in a life threatening condition [1].

Cardiopulmonary resuscitation (CPR) is a complex of therapeutic measures to restore vital functions that are used in cases of cardiac and pulmonary arrest.

It is necessary to ensure that the victim, all the witnesses and you yourself **are safe** before the CPR.

Assessment of the general condition of the patient.

The initial examination of the patient and identification of a state that has a direct threat to his life should not last more than 10 seconds and include: assessment of the general condition of the patient, assessment of consciousness and examination in the “ABCC” principle:

- A – examination of airway.
- B – assessment of breathing.
- C – circulation condition.

C’ – in patients with suspected spine injury – observation of the cervical spine and imposition of a cervical collar.

It is necessary to establish the degree of threatening to the victim’s (patient’s) life **during a preliminary assessment**. In case of action of various damaging factors you need to stop their influence (interrupt contact with electrical voltage, release hung with loops, restore airway during asphyxia, etc.) or call the rescue service (in case of accidents). If there is an injury first step must be to stop arterial bleeding by pressing the artery to the bone above the injury site, followed by imposing arterial tourniquet or twist above the wound. It is necessary to specify when the tourniquet was imposed, because the duration of imposing should be 30-40 minutes, the next step is to loosen the tourniquet for a few minutes, evaluate the severity of bleeding and in case of necessary to impose it again. If the patient has proper breathing and cardiovascular system function in the absence of consciousness, it is necessary to ensure a safe posture of the victim. Unconscious victim should be returned to the side. Patients with fractures of the spine and pelvic bones require certain position - on hard surfaces and with bent legs, respectively. It is contraindicated to throw head in patients with trauma of cervical spine! During the first-aid to these patients you must use of fixing «collar» on the neck area.

Examination’s algorithm of victims and conduct basic CPR

Algorithm for the initial evaluation and providing assistance is presented in the Figure 1.

In practical terms, cardiopulmonary resuscitation (CPR) can be divided into 2 stages:

1. Basic Life Support (Basic CPR) –basic resuscitative measures that may be conducted by nonprofessional rescuers

and medical workers who are forced to carry out resuscitation without any specific equipment [1].

2. Advanced Cardiovascular Life Support (extended CPR) – special resuscitative measures that may be performed by trained and equipped with the necessary equipment and medical supplies medical personnel (emergency medical services, doctors of resuscitation and intensive care department) [1].

The whole complex of extended CPR may be divided into three stages, each of which has its own purpose and consecutive phases.

The first stage – elementary life support of patient (victim). Immediate oxygenation is the main purpose of it. Its consecutive phases: monitoring and recovery of the airway, artificial maintenance of circulation and respiration.

The second stage – the further support of life. The restoration of an independent circulation is the main objective of this stage. Its subsequent stage: medical therapy, electrocardiography (or elektrokardioskopiya), defibrillation.

The third stage – the continued support of life, whose main goal is cerebral resuscitation and post resuscitation intensive care. The assessment of the patient (determination of the cause of circulatory arrest and its elimination), recovery of consciousness and improve the work of the CNS, intensive therapy aimed at correcting the disturbed functions of other organs and systems are the objectives of this phase.

The basic measures of CPR include the following steps:

1. Determination of consciousness of the victim. You must **check out his reaction**: shake the shoulders and ask loudly about his health, for example, “What happened?”, “What’s bothering you?”

2. If the patient responds to the question you’ll know more about his condition and if it is necessary you should call medical assistance.

Criteria for calling resuscitation team	
The airways	Threat to their permeability
Breathing	All cases of apnea Respiratory rate < 5 per minute, respiratory rate > 36 per minute.
Blood circulation	All cases of sudden circulatory arrest Pulse < 40 per minute, pulse > 140 per minute Systolic blood pressure < 90 mm Hg
Neurological	The sudden deterioration of the consciousness Reducing the number of points on the Glasgow Coma Scale for more than 2 Relapsing or persistent convulsions
Other	Each patient without above mentioned criteria but whose condition is the matter of concern

3. If the patient does not respond to the question you need call for help. At the same time it is necessary to determine the presence of respiration: using **vision** – to assess movements of the chest, **hearing** – to try to feel the breath sounds at the mouth of the patient and the **touch** – the movement of air on

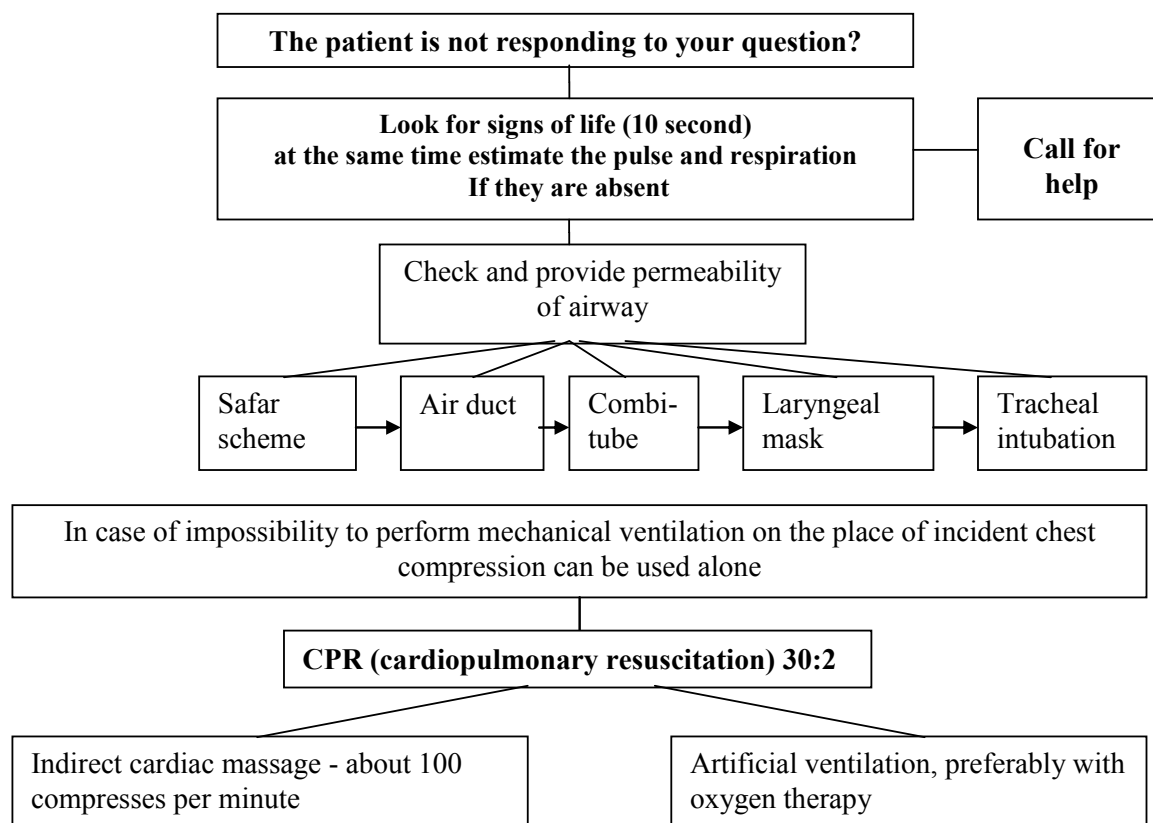


Figure 1. Algorithm of the initial evaluation and assistance

the cheek (Figure 2) [2]. During the first minutes the patient can breathe superficial or rarely sigh that cannot be evaluated as correct breathing. At the same time it is necessary to determine the carotid pulse (it is not required for non-medical staff because of frequent errors in its assessment according to the contemporary guidelines) [1].

You should spend no more than 10 seconds for the initial assessment of the victim by the algorithm « ABCC' » [9, 11].

If breathing is normal: you must give the victim a safe posture (preferably on the side), ask for help or call for emergency medical help and continue to control his general condition.

If breathing is not correct: you have to ask for help and ask for the emergency medical call (if there's nobody there, then call yourself), turn the victim on his back and put it on a hard surface, and immediately begin compressing the chest (indirect cardiac massage), combining the chest compressions with artificial ventilation: **to carry the chest compressions and rescue breaths in a ratio of 30: 2** (according to the European Resuscitation Council recommendations) [1]. **You should also minimize interruptions that occur after 30 chest compressions**, and before the mechanical ventilation or defibrillation [1].

It is necessary to restore and provide permeability of airway. If passive movements of the chest like in normal breathing are not occurring during mechanical ventilation, you should check the mouth of the victim before the next attempt of ventilation and, if it is necessary, cleanse it, remove artificial dental prostheses and check restoration of airway's permeability.

If the independent breathing is appeared in patient, you can for a moment stop CPR and assess its condition. In case of the appearance of spontaneous breathing signs mechanical ventilation cannot be immediately stopped and must be continued until spontaneous breathing frequency will amount 12–15 per minute. If it is possible, the rhythm of artificial breaths must be syncing with renewable acts of patient's breathing [7].

Identification of rib fractures at the stage of the primary and secondary examination, as well as those that have emerged during CPR **is not a contraindication** to perform indirect cardiac massage.

Carrying out ventilation by the method of “mouth-to-nose”



Figure 2. Assessment of breathing [2]

is as effective way of ventilation as “mouth to mouth”. This method should be used in cases where the victim's mouth is seriously damaged and it is difficult to maintain enough density of contact by the method of “mouth to mouth” [7].

Recent studies have shown that the effective **compressions of the chest** in the first few minutes after the circulatory arrest may be as effective as a combination of ventilation and chest compressions. Therefore rescuers without medical training should be encouraged to perform only chest compressions [1, 9]. In case of impossibility for some reason carry out rescue breaths (the chest compressing is effective **within 5 minutes**).

The papillary constriction, the normalization of skin color, the detection of arterial pulsations which is simultaneous with cardiac massage and passive movements of the chest while performing mechanical ventilation **are the signs of right performed CPR** [5].

Recommendations of the European Resuscitation Council [1] have proposed the following changes for carrying out CPR:

- For a finding of clinical death and carrying out CPR is enough to establish the fact of respiratory arrest.
- To place the hand in the middle of the chest is recommended at carrying out compressions on the chest (to reduce the time for searching additional landmarks).
- Rescue breath should be done no more than 1 second.
- The ratio between the number of compresses of the chest and mechanical ventilation in adults should be 30 : 2 and does not depend on the number of rescuers. The same ratio can be used in children. In children aged 10–12 years the chest compressing carried out with one hand. The chest compressing carried out by the tips of two fingers and the ratio of compresses and breathing must be 3: 1 in newborns and infants (90 compress and 30 breaths per 1 min).
- The carrying out CPR should begin after the establishment of circulatory arrest with performance 30 chest compresses.
- In the case of sudden cardiac arrest it is necessary to use immediately electroimpulse therapy. The precordial thump can be applied in the first 10 sec in cases of the absence of a defibrillator, but it is not compulsory and can be performed only by experienced medical professional.
- If there is more than one rescuer on the place of incident, they must also change roles every 2 minutes (with minimal interruptions) for the effective resuscitation.

Indirect cardiac massage

Cardiac massage – this is a mechanical influence on the heart after its arrest in order to restore its work and support of continuous blood circulatory. All cases of cardiac arrest are the indications for cardiac massage. The main features of sudden cardiac arrest include: loss of consciousness, respiratory arrest or appearance of rarely and convulsive breaths, absence of carotid pulse, dilated pupils and severe pale skin [11].

The indirect cardiac massage will be the most successful if it starts immediately after cardiac arrest. Mechanism of its action is that during compression of the chest the heart is compressed so the blood of his chambers is ejected into the vessel. After the cessation of cardiac compression chambers of the heart dilate and receive blood.

The effectiveness of indirect heart massage depends on the right choice of location of compression on the sternum (lower half of the sternum – 2 fingers above the xiphoid process, Figure 3). Rescuer's hands should be located as follows: proximal part of the palm of one hand set on the lower half of the sternum, and the palm of the other hand lies on the dorsum of the first perpendicularly to its axis, the fingers of the first hand should be slightly raised up and not put pressure on the chest of victim (the fingers of both hands may also be compound into the lock) [5, 9].

Hands should be straight at the elbows. Rescuer should stand high enough (if the patient lying not on the floor), as if his body is looming over the victim and putting pressure on sternum, not only with the efforts of the hands, but with the weight of whole the body (Figure 4). Pressing force should be such that the displacement of the sternum toward the spine was at least 4–5 cm (Figure 5). The optimal frequency of chest compressions should be 100 per 1 min [9, 1].

The second stage of the CPR involves performing pharmacological and electro impulse therapy [10].

There are two routes of medical drugs administration – intravenous and intraosseous. Intravenous injection is carried out in the central or peripheral vein. Intraosseous drug administration provides their concentration in plasma, which is the same with intravenous administration. The use of mechanical devices for intraosseous administration of drugs provides simplicity and accessibility of this input method.

Endotracheal and intracardiac routes of drugs administration are not recommended during CPR!

The success of resuscitation depends largely on the early ECG - diagnosis. It is important to establish the main cause and mechanism of circulatory arrest, because this affects into the adoption of appropriate method of resuscitation. The CPR effectiveness is depended on the electromechanical activity of the heart (detection of stable or persistent asystole, ventricular fibrillation (VF) or ventricular tachycardia (VT), the development of electromechanical dissociation or hemodynamically ineffective rhythm). The positive outcome of CPR is the lowest in cases of asystole or refractory VF/VT.

The effectiveness of CPR will be more successful if you can actively influence the primary cause of circulatory arrest.

For CPR the next drugs are used:

1. In case of asystole – adrenaline IV 1 mg (1 ml of 0.1 % solution of epinephrine hydrochloride) every 3–5 min.;

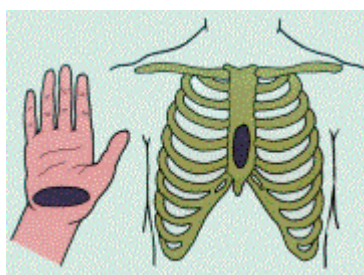


Figure 3. Location point of compression on the sternum [2]

In case of blood circulation arrest caused by VF or VT epinephrine is administered after the third discharge ineffective electrical defibrillation at a dose of 1 mg IV. If the ventricular fibrillation is persisted on the ECG, epinephrine will be administered in the same dose every 3–5 minutes during the whole period of CPR.

2. In case of VF or VT, which are refractory to electric therapy (ineffective after the third discharge electrical defibrillation) amiodarone (cordarone) is administered at an initial dose of 300 mg (diluted in 20 ml of physiological solution). If it is necessary, amiodaron may be re-injected at a dose of 150 mg. After the restoration of hemodynamically effective cardiac rate amiodaron must be continued by intravenous drip at a dose of 900 mg per day.

3. Lidocaine – 100 mg is the starting dose, if it is necessary, lidocaine may be administered an additional bolus 50 mg (total dose should not exceed 3mg/kg per hour). In case of the absence of amiodarone lidocaine can be used as an alternative medicine. Lidocaine should not be used as a supplement to amiodarone.

The use of atropine during CPR is not recommended!

The efficiency of electrical defibrillation of the heart is provided compliance with three main conditions: correct arrangement of electrodes, enough force of electrodes pressing (within 8 kg) and the obligatory use linings moistened with hypertonic solution [5, 10]. During defibrillation, none of the participants of resuscitation should not touch the patient and (or) bed!

After the restoration of an independent circulation, the third stage of CPR (continued life support) begins.

Cardiopulmonary resuscitation should last at least 30-40 minutes [5, 11]. Resuscitation measures should be carried out a long in cases of: drowning, hypothermia, overdose of medication, VF or VT with intermittent normal rhythm. **CPR is carried out in place of incident until the arrival of emergency medical care or to signs of biological death** (pallor mortis, rigor mortis, mitigation of eyeballs, dryness of the cornea and livor mortis).



Figure 4. Carrying out a chest compression [2]

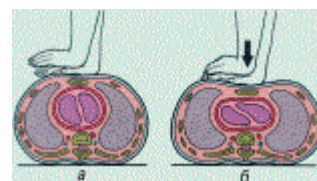


Figure 5. A chest compression with a depth of 4–5 cm [2]

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СОВРЕМЕННЫЕ АСПЕКТЫ ПРОВЕДЕНИЯ СЕРДЕЧНО-ЛЕГОЧНОЙ РЕАНИМАЦИИ

П. Ф. Дудка, Д. В. Добрянский,
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Резюме. Владение современными принципами оказания неотложной медицинской помощи актуально для врачей всех специальностей. Каждый врач обязан оказывать неотложную медицинскую помощь больному, независимо от первопричины терминального состояния, руководствуясь современными стандартами и международными протоколами. В работе освещены особенности проведения сердечно-легочной реанимации на догоспитальном этапе оказания неотложной медицинской помощи.

Ключевые слова: сердечно-легочная реанимация, искусственная вентиляция легких.

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CURRENT ASPECTS OF CARDIOPULMONARY RESUSCITATION

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Abstract. Knowledge of current principles of emergency medical care is important for physicians of all specialties. Each physician must provide emergency medical care to patients regardless of the underlying cause of the terminal condition, guided by contemporary recommendations and international guidelines. This article highlights the contemporary features of cardiopulmonary resuscitation in emergency outpatient care.

Key words: cardiopulmonary resuscitation, artificial ventilation.

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