

# EMERGENCY MEDICAL SERVICE

RATOWNICTWO MEDYCZNE



**METHOD OF ERYTHROCYTE PROTECTION IN URGENT CARDIAC SURGERY**

**POSSIBILITIES OF DIAGNOSIS AND TREATMENT  
OF ACUTE AND CHRONIC BRAIN ISCHEMIA**

**ANALYSIS OF ORGANIZATIONAL COMPONENTS OF EMERGENCY MEDICAL  
CARE FOR PATIENTS WITH ACUTE CORONARY SYNDROME**

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RATOWNICTWO MEDYCZNE





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### All-Ukrainian scientific-practical correspondence conference with international participation "Emergency and urgent medicine in Ukraine: organizational, legal, clinical aspects"

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# PREDICTION MODEL OF PROBABILITY ESTIMATE OF FATAL CASES IN INFANTS WITH CONGENITAL MALFORMATIONS IN SURGICAL INTERVENTIONS

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## Abstract

**Aim:** To evaluate different types of combined anesthesia in surgical correction of congenital malformations in infants and to develop a prediction model of the association of risk factors and fatal cases in chosen methods of anesthesia care.

**Material and methods:** The retrospective study included newborns and infants with congenital malformations, who received and continued phased surgical treatment. Determination of risk factors was performed by the method of simple logistic regression with the calculation of the odds ratio (OR), 95% confidence interval (95% CI).

**Results:** A total of 150 children were included in the study. The risk factors for deaths in the surgical correction of congenital malformations in children have been established, a prognostic model has been created.

**Conclusions:** To prevent fatal cases in various types of surgery and options for anesthesia care of newborns and infants with CM, it is advisable to more closely monitor the cerebral, peripheral oximetry at all stages of treatment and timely correct the impaired condition of the child.

## Key words

congenital malformations,  
infants,  
prediction model,  
surgical intervention

## INTRODUCTION

Congenital malformations (CM) are among the most common pathologies in newborns and infants and require surgical correction in the first hours, days of life or during the year. No surgery is possible without modern methods of anesthesia, which are effective and safe for the patient. The main task of anesthesia is to control the stress response of the body to surgical aggression to improve treatment outcomes in the future. Providing quality anesthesia care for surgical correction of congenital malformations of the internal organs and the postoperative period in newborns and infants is complicated by certain risk factors (perinatal period, anamnestic data of childbirth, early neonatal period, etc.), comorbidities and background conditions.

Among the diseases that complicate anesthesia, and are characteristic of infants with CM in the early neonatal period, the most common are intrauterine infection, perinatal lesions of the central nervous system, cardiovascular and respiratory failure [1-3].

Stressful effects on the body of an infants with CM in severe concomitant and background pathologies, which are surgical trauma and anesthesia, causes activation of the neuroendocrine system, which seeks to bring metabolism, homeostasis in sync with the changed conditions of the organism. Hormonal, meta-

bolic changes can cause changes in systemic hemodynamics, cerebral circulation, cerebral oxygenation etc. The complex neuro-humoral response of the body to stress is not always absolute and optimal, so it requires direct monitoring and timely correction at all stages of anesthesia. Therefore, the study of risk factors and their impact on the functional indicators of the body when assigning anesthesia at all stages of surgery will help prevent complications and fatal cases in infants.

## AIM

To evaluate different types of combined anesthesia in surgical correction of congenital malformations in infants and to develop a prediction model of the association of risk factors and fatal cases in chosen methods of anesthesia care.

## MATERIAL AND METHODS

The retrospective study included newborns with surgical CM, as well as infants who received and continued phased surgical treatment for CM in the city of Dnipro during 2019. The study did not involve infants with urgent surgical pathology, as well as infants in the agonal state.

In the presented study, 3 types of combined anesthesia were analyzed:  
type I – inhalation (sevoran) + regional anesthesia;

type II – inhalation (sevoran) + intravenous analgesia (fentanyl);

type III – total intravenous anesthesia with 2 drugs: analgesic (fentanyl) and medical sleep on the background of intravenous injection of hypnotics (20% sodium oxybutyrate), depending on the type of surgery: thoracic, urological, abdominal.

The distribution of infants into groups was performed non-selectively retrospectively depending on the type of surgery and the type of combined anesthesia.

Retrospective assessment was performed in the following stages:

- 1) before surgical treatment and anesthesia (stage I),
- 2) introduction of the infants to general anesthesia (stage II),
- 3) traumatic stage of the operation: the middle of the operation or the most painful stage of surgery (stage III),
- 4) postoperative period (within 1 hour after transportation of the infant to the intensive care unit) (stage IV),
- 5) 24 hours after surgery (stage V).

Determination of risk factors was performed by the method of simple logistic regression with the calculation of the odds ratio (OR), 95% confidence interval (95% CI) [4]. The dependent variable was the result of the operation: – survived; – died. The following variables were independent (after preventive, careful analysis):

1. Functional indicators of vital activity of the organism according to the time of operation: peripheral (SpO<sub>2</sub>, %), cerebral (rSO<sub>2</sub>, %) oximetry.
2. Biological: age.
3. Medical: blood pressure.

When developing prediction models, the equation was taken as a basis, which assumes that fatal cases (P) are associated with predictors by the formula:

$$P = \alpha + B1X1 + B2X2 + \dots + BnXn$$

The coefficient  $\alpha$  indicates the value of the result in the case when all predictors will be equal to 0. The coefficient B1 is a coefficient that describes the change in the risk of death when changing the risk factor X1 per unit.

In the prediction models, the independent variable is the fatal cases; the dependent ordinary variables are the prognostic variables, the reliable associations of which are proved by a simple regression logistic analysis. The odds ratio (OR), 95% confidence interval (95% CI) and the coefficient  $\beta$  were calculated, which describes the change in the risk of developing the disease when the unit of a certain risk factor changes, and its error (m) [4].

Among the chosen methods of monitoring cerebral function throughout the anesthesia care was – NIRS (near-infrared spectroscopy). This method of cerebral oximetry (CO) is based on the principle of optical spectroscopy using infrared light in the range from 650 to 1100 nm [5]. The CO method allows to assess the oxidative status (hemoglobin oxygen saturation) mainly in the blood of cerebral venous vessels, which allows to qualitatively monitor the state of cerebral blood flow in infant at all stages before, during and after surgery, and indicators to be used as control analytes [6-7].

## RESULTS

According to the nature of CM, infants with the pathology presented in Table I took part in the study. The most common congenital malformations were intestinal obstruction (24%) and abdominal tumors (21.3%). A total of 150 children were included in the study.

Congenital diseases in children who required surgical treatment were distributed as follows: abdominal surgery – 98 (67%), thoracic – 26 (18%), urological – 23 (15%). During surgical interventions

Table 1. Types of congenital malformations in children, abs. (%).

Congenital malformations	Malformations	Obstruction	Embryonica	Gastroschisis	Tumors	Intestinal вадн	Ano-rectal	Lung defects	Together
Number of children	14 (9,3)	36 (24)	7 (4,7)	9 (6)	32 (21,3)	14 (9,3)	17 (11,3)	21 (14)	150 (100)

Table 2. Defined associations between types of surgeries and fatal cases in I, II, III groups.

Risk factors	Fatal cases	Survived	Odds ratio (CI 95%)	P
<b>Thoracic</b>	2 (6,3)	24 (93,8)	1,037 (0,211-5,240)	0,614
<b>Urological and abdominal</b>	9 (8,5)	112 (91,5)		
<b>Urological</b>	0 (0,0)	23 (100,0)	1,097 (1,039-1,159)	0,143
<b>Thoracic abdominal</b>	11 (8,9)	113 (91,1)		
<b>Abdominal</b>	9 (9,2)	89 (90,8)		
<b>Urological thoracic</b>	2 (4,1)	47 (95,9)	2,376(0,493-11,450)	0,224

Table 3. Definitions and ranks of prognostic variables associated with fatal cases.

Prognostic variables	Definitions and ranks	Prognostic variables	Definitions and ranks
SpO <sub>2</sub> (I stage)	1 – norm, 0 – abnormal	SBP (I stage) elevated	1 – norm, 0 – abnormal
SpO <sub>2</sub> (II stage)	1 – norm, 0 – abnormal	SBP (I stage) reduced	1 – norm, 0 – abnormal
SpO <sub>2</sub> (III stage)	1 – norm, 0 – abnormal	SBP (II stage) elevated	1 – norm, 0 – abnormal
SpO <sub>2</sub> (IV stage)	1 – norm, 0 – abnormal	SBP (II stage) reduced	1 – norm, 0 – abnormal
Age	1 – up to 28 months, 0 – after 28 months.	SBP (III stage) elevated	1 – norm, 0 – abnormal
rSO <sub>2</sub> right (I stage)	1 – norm, 0 – abnormal	SBP (III stage) reduced	1 – norm, 0 – abnormal
rSO <sub>2</sub> left (I stage)	1 – norm, 0 – abnormal	SBP (IV stage) elevated	1 – norm, 0 – abnormal
rSO <sub>2</sub> right (II stage)	1 – norm, 0 – abnormal	SBP (IV stage) reduced	1 – norm, 0 – abnormal
rSO <sub>2</sub> left (II stage)	1 – norm, 0 – abnormal	DBP (I stage) elevated	1 – norm, 0 – abnormal
rSO <sub>2</sub> right (III stage)	1 – norm, 0 – abnormal	DBP (I stage) reduced	1 – norm, 0 – abnormal
rSO <sub>2</sub> left (III stage)	1 – norm, 0 – abnormal	DBP (II stage) elevated	1 – norm, 0 – abnormal
rSO <sub>2</sub> right (IV stage)	1 – norm, 0 – abnormal	DBP (II stage) reduced	1 – norm, 0 – abnormal
rSO <sub>2</sub> left (IV stage)	1 – norm, 0 – abnormal	DBP (III stage) elevated	1 – norm, 0 – abnormal
rSO <sub>2</sub> right (V stage)	1 – norm, 0 – abnormal		
rSO <sub>2</sub> left (V stage)	1 – norm, 0 – abnormal		

for congenital malformations, indicated types of anesthesia I, II, III had an equal distribution – 33.3%.

The results of the retrospective analysis show that in thoracic surgeries the combined anesthesia with sevoran and fentanyl was most often used – 20.4%. In abdominal surgeries, the most widely used anesthetic support was sevoran and regional anesthesia – 69.4%, while in urological surgeries combined total intravenous anesthesia with 2 drugs ranked first – 18.4%. Probable differences between types of anesthesia in different surgical interventions for congenital pathologies were not found (p = 0.863). In addition, in determining the associations between the types of surgery and fatal cases, no dependencies were found as well.

When determining the associations between the types of surgery and deaths, no dependencies were found. The data are presented in Table 2.

To identify risk factors 41 prognostic variables were considered, which are related to the determination of risk factors for fatal case. The identified reliable factors associated with fatal cases in simple logistic regression analysis were subjected to step-by-step multiple logistic regression analysis to identify reliable risk factors, which were then included in prediction models that formed the basis for criteria for identifying high-risk fatal cases. The data are presented in Table 3.

- In our study, among social and medical-demographic factors in a simple logistic regression analysis, only social status was significant: if parents are workers, the chance of detecting CM increases (OR 1.4 [95% CI 1.034-2.097]).
- It is further established the most significant functional indicators of the body's vital functions at the stages of anesthesia support. Thus, in a simple logistic regression analysis, the chance of fatal case decreases if the indicators are reduced by 20%

from the norm in stage III of the surgical intervention – rSO<sub>2</sub> of the right cerebral hemisphere of the infant (OR 0.833 [95% CI 0.748-0.928]) p≤0.001; rSO<sub>2</sub> of the left cerebral hemisphere of the infant (OR 0.810 [95% CI 0.715-0.918]) p≤0.001.

- In determining the association between blood pressure and fatal case, no dependencies were found.
- Taking into account the obtained data, the data that are significant in a simple logistic equation were filled into the predicting model, namely: SpO<sub>2</sub> (I – IV stages); rSO<sub>2</sub> of the right cerebral hemisphere (stage II); rSO<sub>2</sub> of the left cerebral hemisphere (stage II); rSO<sub>2</sub> of the right cerebral hemisphere (stage IV); rSO<sub>2</sub> of the left cerebral hemisphere (stage IV); rSO<sub>2</sub> of the right cerebral hemisphere (stage III); rSO<sub>2</sub> of the left cerebral hemisphere (stage III). After the assessment, the most significant in this model are the predictors that increase the risk of fatal case in children:
- SpO<sub>2</sub> – the chances of fatal case are 2.7 times higher if the patient has a reduced level of initial SpO<sub>2</sub> in types I and III anesthesia -Exp. (β) = 2.704 [95% CI 1.10-8.733] p = 0.02;
- SpO<sub>2</sub>- the chances of fatal case are 7.2 times higher if the patient has a reduced level of SpO<sub>2</sub> at the stage of introduction to general anesthesia in all types of anesthesia – Exp. (β) = 7.246 [95% CI 4.81-15.621] p = 0.03;
- SpO<sub>2</sub> – the chances of fatal case are 4.6 times increased at low levels of SpO<sub>2</sub> at the stage of maximum surgical trauma in all types of anesthesia – Exp. (β) = 4.563 [95% CI 7.89-19.827] p = 0.03;
- rSO<sub>2</sub> of the left cerebral hemisphere – the chances of fatal case are 2.4 times increased with a decrease in the rate of introduction to general anes-



Table 4. Prediction model for groups I, II, III associated with risk factors for functional indicators of the body and fatal cases.

Predictors	B	Standard error	Wald	Exp (β)	95% CI for Exp (β)		p
					Upper	Low	
SpO <sub>2</sub> (I)	1,545	1,231	0,968	2,704	1, 10	8,733	0,02
SpO <sub>2</sub> (II)	1,963	1,586	1,752	7,246	4,81	15,621	0,03
SpO <sub>2</sub> (III)	2,79	2,31	1,962	4,563	7,89	19,827	0,03
SpO <sub>2</sub> (IV)	0,904	1,239	0,969	1,986	0,614	13,458	0,590
rSO <sub>2</sub> left (II)	0,921	1,384	1,864	2,386	2,896	12,021	0,04
rSO <sub>2</sub> right (II)	1,936	0,968	1,421	1,807	1,364	8,435	0,02
rSO <sub>2</sub> right (III)	1,764	3,425	1,83	4,128	1,368	8,528	0,006
rSO <sub>2</sub> left (III)	0,830	1,367	0,844	1,230	0,64	28,038-	0,07
rSO <sub>2</sub> right (IV)	0,430	1,269	0,365	1,383	0,95	4,203	0,201
rSO <sub>2</sub> left (IV)	1,536	1,269	1,432	1,182	0,258	7,252	0,40

thetia in all types of anesthesia – Exp. (β) = 2.386 [95% CI 2.896-12.021] p = 0.04;

- rSO<sub>2</sub> of the right cerebral hemisphere – the chances of fatal case increase 1.8 times with a decrease in the rate of introduction to general anesthesia in all types of anesthesia – Exp. (β) = 1.807 [95% CI 1.364-8.435] p = 0.02;
- rSO<sub>2</sub> of the right cerebral hemisphere – the chances of fatal case increase 4.1 times with a significant decrease in the rate at the stage of maximum surgical trauma – Exp. (β) = 4.128 [95% CI 1.368-8.528] p = 0.006.
- Other indicators turned out to be confounding (from the Latin *confundere* – to mix together), i.e. they distort the influence of factors on the outcome of surgery – fatal case.
- The results of the developed prediction model are presented in Table 4. Therewith, the sensitivity (Sensitivity) of our model is 79.20%, specificity (Specificity) – 84.80%.

## DISCUSSION

As a result of a retrospective comparative evaluation of 3 different types of anesthetic care of newborns with surgical CM and infants who received and continued staged surgical treatment for CM, it was found that the most common congenital anomalies were intestinal obstruction (24%) and abdominal tumors (21.3%). Congenital diseases in children who required surgical treatment were distributed as follows: abdominal surgery – 98 (67%), thoracic – 26 (18%), urological – 23 (15%). In the case of surgical interventions for congenital malformations, the types of combined anesthesia had an equal distribution – 33.3%.

During the study it was found that in thoracic surgery most often combined anesthesia with sevoran and fentanyl – 20.4% is used. During abdominal surgeries, the most widely used anesthetic support was sevoran and regional anesthesia – 69.4%, while in urological

surgeries combined total intravenous anesthesia with 2 drugs ranked first – 18.4%. Significant differences between types of anesthesia in different surgical interventions for congenital pathologies, associations between types of surgery and fatal cases were not detected (p = 0.863).

After a simple logistic regression analysis, the identified risk factors that increased and/or reduced the chance of fatal case were introduced into the prediction model. In the end, it was found that the following increase the risk of fatal case in children: SpO<sub>2</sub> – 2.7 times with a decrease in the level before surgery in I and III types of anesthesia (Exp. (B) = 2.704 [95% CI 1.10-8.733] p = 0.02); 7.2 times in decrease in the stage of introduction to general anesthesia in all types of anesthesia (Exp. (β) = 7.246 [95% CI 4.81-15.621] p = 0.03); 4.6 times at a reduced level at the stage of maximum surgical trauma in all types of anesthesia (Exp. (β) = 4.563 [95% CI 7.89-19.827] p = 0.03); rSO<sub>2</sub> of the left cerebral hemisphere of the child – 2.4 times with a decrease in the stage of introduction to general anesthesia in all types of anesthesia (Exp. (β) = 2.386 [95% CI 2.896-12.021] p = 0.04); rSO<sub>2</sub> of the right cerebral hemisphere of the child – 1.8 times with a decrease in the stage of introduction to general anesthesia in all types of anesthesia (Exp. (β) = 1.807 [95% CI 1.364-8.435] p = 0.02); 4.1 times with a significant decrease at the stage of maximum surgical trauma (Exp. (β) = 4.128 [95% CI 1.368-8.528] p = 0.006). The sensitivity of the presented model is 79.20%, specificity – 84.80%.

## CONCLUSIONS

To prevent fatal cases in various types of surgery and options for anesthesia care of newborns and infants with CM, it is advisable to more closely monitor the cerebral, peripheral oximetry at all stages of treatment and timely correct the impaired condition of the child.

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# PERCUTANEOUS TRANSHEPATIC CHOLANGIOGRAPHY IN THE DIAGNOSTICS OF COMMON BILE DUCT DISEASES COMPLICATED BY OBSTRUCTIVE JAUNDICE\*

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## Abstract

## Key words

**Aim:** Evaluation of the effectiveness of percutaneous transhepatic cholangiography in the diagnostics of bile duct diseases complicated by obstructive jaundice.

**Material and methods:** This article presents the experience of using percutaneous transhepatic cholangiography in 88 patients with benign and malignant common bile duct diseases complicated by obstructive jaundice.

**Results:** Methods of direct contrasting of the biliary tract make it possible to visualize choledocholithiasis with 86.5% accuracy, with 84.1% common bile duct strictures, with 87.8% stricture of biliodigestive anastomosis and with 97.5% accuracy of cholangiocarcinomas.

**Conclusions:** Direct antegrade bile duct enhancement should be used if ERCPG has low explanatory value. PTCG in case of "endoscopically complicated forms" of choledocholithiasis, CBD and BDA strictures and cholangiocarcinomas enhances all bile duct sections and helps assess the level and completeness of biliary blockade. Following PTCG, measures can be taken to achieve biliary decompression regardless of OJ genesis.

obstructive jaundice percutaneous, common bile duct diseases, transhepatic cholangiography

## INTRODUCTION

The outcome of the treatment of common bile duct (CBD) diseases complicated by obstructive jaundice (OJ) depend on the precise and timely diagnostics of OJ causes and bile duct obstruction level [1]. Errors in the diagnostics of CBD diseases complicated by OJ occur in 10-42% of cases [2, 3].

Clinical findings and results of laboratory tests determine indications to the administration of instrumental diagnostic techniques. The precision of screening ultrasound test is 73-86% for the detection of biliary blockade and 33-84% for the determination of its nature 33-84% [4, 5].

The precision of MRI combined with MRCP for the detection of the same parameters is 92-97% [5, 6].

The use of multislice CT (MSCT) is appropriate for detecting the localization and spread of the tumor process in OJ with malignant etiology. The use of intravenous bolus tracking increases the diagnostic effectiveness of this method and helps detect the invasion of the tumor process in major blood vessels. The precision of this method for the detection of obstruction is 81%, the result is comparable with

similar data for ultrasound tests, and the explanatory value of MSCT for prior determination of tumor resectability and the diagnostic precision of the method are 37-88% [7, 8].

In the absence of technical capacities or in case of their low explanatory value, antegrade or retrograde methods of direct bile duct enhancement: PTCG and ERCPG – the precision of these techniques reaches 89-98% [9-11].

The choice between PTCG and ERCPG depends on the presence or presence of biliary hypertension, predicted obstruction level, level of dilation (it is recommended to use PTCG in case of the proximal level of common bile duct blockade), and technical capacities of health care institutions. In case of a "diagnostic" dead end, the administration of both direct methods of bile duct enhancement is recommended in order to specify proximal or distal obstruction level and to choose the correct treatment technique [12].

Difficulties related to the differential diagnostics of bile duct diseases complicated by obstructive jaundice determined the aim of this study.

## AIM

Evaluation of the effectiveness of percutaneous transhepatic cholangiography in the diagnostics of bile duct diseases complicated by obstructive jaundice.

## MATERIAL AND METHODS

For the period from 2011 to 2017, 88 patients with benign and malignant common bile duct diseases complicated by obstructive jaundice received in-patient treatment at the facilities of the Department of Surgery No. 1 of Kharkiv National Medical University at the clinic of State Institution “V.T. Zaycev Institute of General and Urgent Surgery of the National Academy of Medical Sciences of Ukraine”.

Percutaneous interventions involving intra- and extrahepatic bile ducts were performed using the standard technique in an X-ray operating room using the Integris Allura 12 angiographic unit made by Philips (Netherlands). “Tight” enhancement of bile ducts was performed using water-soluble radiopaque substances – Triombrastum. Bile ducts were drained under ultrasonographic control using the Toshiba aplio 400 (Japan) ultrasound scanner with convex and puncture sensors (3.5 MHz) and a “Chiba” needle. After a successful percutaneous transhepatic cholangiography PTCG and if there were indications for biliary decompression, PTCD was immediately performed using the Seldinger technique [14].

In this case, PTCG was considered as the first examination step. The explanatory value of the diagnostic tests was determined taking into account sensitivity, specificity and precision based on commonly used formulae [15-18].

## RESULTS AND DISCUSSION

Choledocholithiasis was diagnosed in 6 (6.8%), common bile duct strictures in 2 (2.3%), strictures of biliodigestive anastomoses in 7 (8%) patients, as well as cholangiocarcinomas of different localization according to the Bismuth-Corlette classification [13].

PTCG was performed in 82 (%) patients. Repeated PTCG was performed in 20 (%) patients. The need for repeated examinations was due to the replacement of cholangiodrainage; in some observations no signs of biliary hypertension were noted, so only first-time PTCG was taken into account in comparative analysis.

Indications to PTCG included hyperbilirubine-mia, dilation of lobular and segmental hepatic ducts according to ultrasound and MSCT results, clinical signs of malignant neoplasms of HPD organs, suspected benign CBD stricture and valvular calculus of distal CBD section in patients who cannot undergo ERCPG and EPST.

The CBD blockade level was determined in 80 (97.5%) cases. At the initial stages, PTCG was performed with the aim of differential diagnostics of OJ, determining of the level of biliary blockade and deciding on the possibility of PTCD.

The diagnosis was confirmed if inadequate bile passage was detected in the form of lumen constriction, filling defect with bile duct dilation above the biliary blockade level. Determining the cause of OJ was based on such X-ray evidence as the nature of the blockade (complete or incomplete), its level, length, stump shape or filling defect, nature of the contours of the constricted CBD section.

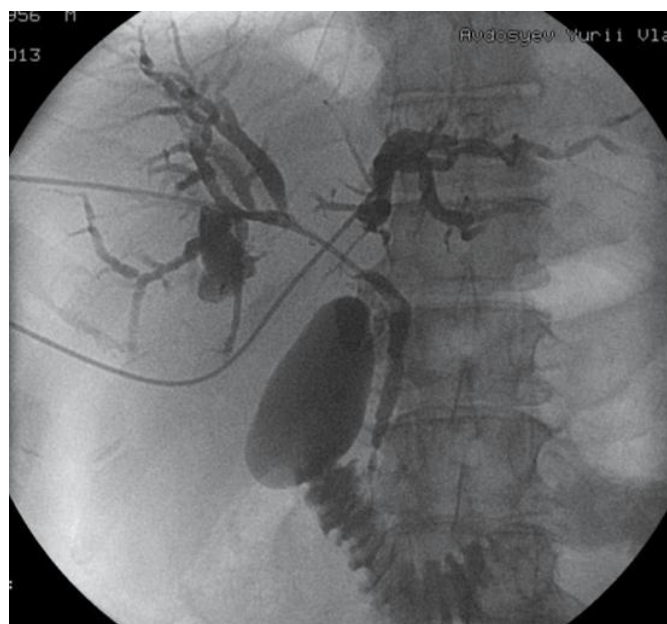


Fig. 1. Cholangiogram for a patient after separate PTCD – complete separation of hepatic ducts to the subsegmental level

On the resulting cholangiograms, the diameter of segmental and lobular hepatic ducts was from 4 to 12 mm and from 6 to 14 mm, respectively (on average 7.8 mm and 9.6 mm, respectively), and of CBD ducts from 8 to 21 mm (on average 13.8 mm). These results were insignificantly higher than based on ultrasound and MSCT data, which is associated with additional dilation of ducts when the enhancement substance is administered during cholangiography. The presence or absence of mutual patency of lobular hepatic ducts was established during the PTCG. It was observed in 11 (13.4%) of patients that only one hepatic lobe was filled with the enhancement substance. However, after the rechanneling of the tumor obstacle, external-internal PTCD and arresting cholangitis, adequate drainage of both hepatic lobes was achieved in 5 (6.1%) out of 11 (13.4%) patients. If adequate drainage could not be achieved, separate drainage of both lobular hepatic ducts was performed. Figure 1 shows a cholangiogram of a patient with Type IV cholangiocarcinoma, which indicates a complete separation of hepatic ducts to the subsegmental level.

The nature and level of obstruction found in most of the patients – 80 (97.6%), and only in 2 (2.4%) patients the interpretation of the PTCG was false.

In case of cholangiography through a puncture needle, partial passage of the enhancement substance in the duodenum was found in 59 (71.9%) patients, and complete occlusion was noted in 23 (28%) patients. However, following the insertion of a catheter to the predicted site of complete tumor blockade and

PTCG, partial passage of the enhancement substance through the stricture zone was observed in another 8 (9.75%) patients. Thus, complete biliary blockade was found in 15 (18.3%) patients, and incomplete blockade in 67 (81.7%) patients.

False negative results of PTCD were related to radiological signs that reminded benign stenosis of the distal CBD section. Proximal CBD blockade was found in 59 (71.9%) patients. Biliary blockade below the bladder duct was found in 23 (28%) patients, and it was conventionally considered to be distal blockade. The figures show cholangiograms with proximal (Fig. 2) and distal levels (Fig. 3) of biliary blockade.

According to the literature, the appearance of the blockade on X-ray in case of CBD diseases complicated by OJ is not strictly specific, which may be due to the varying spread of the pathological process, presence of small inclusions, spread-like masses and inflammatory edema [12].

Based on the obtained results, the sensitivity, specificity and general diagnostic precision for most frequent CBD diseases were calculated. Differential diagnostics of HPD organs using PTCG is complicated. For pancreatic head tumors, the X-ray evidence includes complete CBD block with the stump of a conical, semi-circular or club-shaped form, often with uneven and unclear contours.

When the obstruction level extended from the lower to the middle third of the CBD, the enhancement substance filled the gallbladder, if present, and proximal bile duct sections. False negative results



Fig. 2. Cholangiogram – proximal level of biliary blockade in the porta hepatis.



Fig. 3. Cholangiogram – distal level of biliary blockade in the pancreatic CBD section.

were associated with radiological signs that reminded benign stenosis of the distal CBD section or choledocholithiasis. The sensitivity was 98.5%. There were 3 (6.7%) false positive results. In 1 (1.2%) case, the CBD stricture was treated as cholangiocarcinoma.

Cholangiocarcinomas of the distal CBD section was found in 6 (7.3%) patients. The CBD stump often had a conical shape, the stenosis was up to 2 cm long. There were 2 (2.4%) false negative results when the tumor was thought to be a calculus.

The CBD tumor stricture and complete biliary blockade with the spread of the tumor process to lobular ducts, and the branching of lobular and segmental ducts created a different picture reminding of other diseases accompanied by biliary hypertension. The specificity was 92.8%.

In general, reliable positive conclusion concerning the etiology of OJ based on the PTCG were made in 97.5% of cases.

In 36 (43.9%) patients with PTCD or PTCS (82 patients), follow-up fistula cholangiodrainage was performed 5-7 days after the drainage. The radiological data after the PTCG and fistulography were consistent.

An absolute contraindication to PTCG is the intolerance of enhancement substances and marked dis-

orders of the coagulative system. The results of the analysis of the diagnostic effectiveness of PTCG are presented in Table 1.

Particular attention should be paid to the patients who previously underwent surgeries on biliary organs and had BDAs. In case of a choledochoduodenal anastomosis, it is very difficult to examine bile ducts because of the very quick evacuation of the enhancement fluid into the intestinal lumen. We used an indwelling catheter, which, after being inserted into bile ducts, expanded prior to the BDA and retained the enhancement fluid in the bile duct.

BDA structure using PTCG were found in 5 (6.1%) patients. The reflux of the intestinal contents to the bile duct through the anastomosis contributes to the development of cholangitis, inflammation, and, as a result, formation of the scarred BDA stricture. Fig. 4 shows a cholangiogram indicating a BDA stricture.

The diagnosis based on the PTCG data was correct in 97.5% of patients. A false diagnosis was made in 2 (2.5%) patients; false positive conclusions were made for 8 (9.8%) patients, and false negative conclusions for 5 (6.1%) patients.

Analyzing the results of PTCG administration in 82 patients, we have found that this technique helps

Table 1. Analysis of the diagnostic effectiveness of PTCG.

OJ genesis	Sensitivity	Specificity	Precision
Choledocholithiasis	80%	98.5%	86.5%
CBD strictures	66.6%	95.7%	84.1%
BDA strictures	71.4%	95.7%	87.8%
Cholangiocarcinomas	98.5%	92.8%	97.5%



Fig. 4. Cholangiogram– BDA stricture and multiple intrahepatic bilomas.

diagnose cholangiocarcinomas, CBD strictures and choledocholithiasis.

Summarizing the above, it can be stated that ultrasound tests should be primarily used for CBD diseases complicated by OJ. USD showed the highest diagnostic precision for benign diseases, particularly for choledocholithiasis. In case of low explanatory value, MSCT should be used. The use of MCST is not reasonable in the presence of non-opaque calculi. MSCT showed the highest diagnostic precision for malignant bile duct neoplasms, and it is a common technique for diagnosing the spread of the tumor and its invasion in the adjacent anatomic structures and major blood vessels.

## CONCLUSIONS

Among direct bile duct enhancement techniques, ERCPG is used for benign CBD diseases. However, it is not always possible to perform, and, in case of a failed EPST attempt, ERCPG causes the development of acute pancreatitis and purulent cholangitis.

Direct antegrade bile duct enhancement should be used if ERCPG has low explanatory value. PTCG in case of “endoscopically complicated forms” of choledocholithiasis, CBD and BDA strictures and cholangiocarcinomas enhances all bile duct sections and helps assess the level and completeness of biliary blockade. Following PTCG, measures can be taken to achieve biliary decompression regardless of OJ genesis.

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# METHOD OF ERYTHROCYTE PROTECTION IN URGENT CARDIAC SURGERY

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## Abstract

**Aim:** The use of a simple, safe and convenient method of treatment extracorporeal circuit with «adaptation composition» (AdC) for the reduction of negative impact on the state of erythrocytes and tissue hypoxia.

**Material and methods:** The research included 150 patients. They were divided into two groups. The first group included patients who underwent surgery with the treatment of an extracorporeal circuit by AdC, the second group was the control group. Complete blood count parameters, plasma free hemoglobin concentration, erythrocyte mechanical and osmotic resistance, erythrocyte membrane permeability and acid hemolysis were studied.

**Results:** Use of AdC prevents adsorption the blood cells on the surface of the extracorporeal circuit and protects the erythrocytes during cardiopulmonary bypass in urgent cardiac surgery.

**Conclusions:** The treatment of oxygenator with AdC reduces the negative influence CPB on state of RBC. Membranes of erythrocytes were more resistant to traumatic factors in the group with AdC.

## Key words

Cardiopulmonary bypass, adaptation composition, complete blood count, erythrocytes, hemolysis, erythrocyte resistance.

## INTRODUCTION

Modern extracorporeal technologies aim to improve hemocompatibility, although not always perfect. The main problem is that the patient's body "considers" exogenous material as foreign [1]. Cell membranes are the first target when are influenced by immune response and hypoxia, their changes can serve as an early signal of the pathological process. Contact of blood with the oxygenator surface, cardiopulmonary bypass can cause changes in the membranes of erythrocytes and, accordingly, disturbances in the gas transport function of blood and hemolysis [2]. The normal function of erythrocytes during cardiopulmonary bypass is of the essence. A special biological function is performed by the erythrocyte membrane as a universal model that reflects the state of the membranes of the whole organism. Erythrocytes are the most accessible object for research [3]. The resistance of erythrocytes to various influences is due to the state of their cell membrane. Normal permeability of the cytomembrane is the main condition for cellular homeostasis. Reduced resistance of erythrocytes in hypoxia and as a reaction to blood contact with the oxygenator surface can lead to increased hemolysis and postperfusion complications. This is especially important in patients with cardiac emergency conditions, with low cardiac output and initial pronounced tissue hypoxia.

Induced hemolysis is one of the standard ways to assess the condition erythrocytes for their resistance to

external influences. Acid hemolysis, osmotic and mechanical resistance of erythrocytes are the widely used methods for examining erythrocyte membranes [4]. The complete blood count (CBC) is one of the most common laboratory tests performed in daily practice. Hemoglobin (Hb), hematocrit (Ht), mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW) give us a quick assessment of the state of erythrocytes [5].

## AIM

Taking into account the problem of biocompatibility of the extracorporeal circuit this study was aimed at developing the most biocompatible components to decrease intraoperative hemolysis and tissue hypoxia. To assess the functional state of erythrocytes as an important marker reflecting the tendency of pathological processes in cells during CPB. The research targeted to increase the efficiency of CPB by reducing the negative impact of perfusion on the state of RBC due to the use of AdC.

## MATERIAL AND METHODS

The study included 150 patients undergoing cardiac surgery with CPB. They were divided into two groups. The first group (Gr1, n=75) included patients who underwent surgery with the treatment of an extracorporeal circuit by adaptation composition, the sec-

Table 1. The distribution of patients into groups.

Parameters	Gr1 (n=75) *	Gr2 (n=75) *
<b>Gender: male</b>	62 (82.7%)	61 (81.3%)
<b>female</b>	13 (17.3%)	14 (18.7%)
<b>Age (M±SD), years</b>	61.92 ± 8.41	63.05 ± 8.89
<b>Weight (M±SD), kg</b>	91.36 ± 15.23	87.67 ± 16.41
<b>NYHA** functional class:</b>		
<b>Class II</b>	6 (8.0%)	6 (8.0%)
<b>Class III</b>	55 (73.3%)	57 (76.0%)
<b>Class IV</b>	14 (18.7%)	12 (16%)
<b>Surgical operations***:</b>		
<b>CABG</b>	56 (74.7%)	57 (76%)
<b>CABG+РАЛЖ</b>	3 (4%)	4 (5.4%)
<b>AVR</b>	6 (8%)	5 (6.6%)
<b>AVR+CABG</b>	3 (4%)	2 (2.7%)
<b>MVR</b>	5 (6.6%)	4 (5.3%)
<b>MVR+CABG</b>	2 (2.7%)	3 (4%)
<b>CPB-time (M±m), min</b>	96.27 ± 18.98	98.4±19.8

Note:

\* the difference in parameters in groups by test  $\chi^2$  is statistically no significant ( $p > 0,05$ );

\*\* NYHA – New York Heart Association Classification

\*\*\* CABG – coronary artery bypass grafting, LVAR – left ventricular aneurysm resection, AVR – aortic valve replacement, MVR – mitral valve replacement.

ond group (Gr2, n=75) was the control group. The distribution of patients into groups is presented in table I.

Management during on-pump CABG surgery includes aortic cross-clamping followed by fibrillation and aortic cross-clamping followed by crystalloid cardioplegia during aortic and mitral valve replacement.

The perfusion system used a membrane oxygenator, roller pump, nonpulsatile flow, and the primed circuit 1.3 – 1.6 l to achieve moderate hemodilution ( $Ht - 25 \pm 2$  g/l). Hyperosmolar prime volume with an osmolarity of 510.9 mosmol/l was used [6]. The mean flow index and mean arterial blood pressure were targeted at 2.5 L /min/m<sup>2</sup> and 60–80 mmHg, correspondingly. CPB was administrated in conditions with moderate systemic hypothermia (32 – 33°C).

In our previous study [7] it was shown that the patient autoalbumin capable creates a protective layer on the surface of the oxygenator membrane and tubes. The method was proposed for treating the oxygenator contour with «adaptation composition» (AdC) before CPB to create a protective albumin layer of the patient. The oxygenator was treated with AdC according to our proposed method [8,9].

The study of tube segments in both groups after the CPB was performed on an optical microscope Carl Zeiss Nu-2E (Germany) which is equipped with a digital system of registration and image processing with digital increase in depth of field and construction of

3D terrain maps. Segments of the corresponding tubes 5 x 5 mm were scanned over the entire area.

According to the study protocol, patient blood was sampling at 4 stages of surgery: before surgery, at 10 min. CPB-time, at 60 min. CPB-time (rewarming stage) and after separation from CPB.

Several parameters were studied. Complete blood cell count (CBC) gives clearer and more accurate results. We studied such indicators as: hemoglobin (Hb), hematocrit (Ht), erythrocytes (RBC), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) mean cell hemoglobin concentration (MCHC), red cell width distribution (RDW) [5]. Plasma free hemoglobin (plfHb) concentration was measured using the hemoglobin cyanide method [10]. Erythrocytes osmotic resistance was carried out by the method of determining the time up to 50% hemolysis of a blood sample in a buffer hypotonic glycerol-saline mixture in one tube [11]. The method of Y.V. Ganitkevich, L.I. Chernenko was used for mechanical resistance of erythrocytes [4] The result was expressed as % of hemolyzed cells after mechanical exposure. Erythrocyte membrane permeability (EMP) was determined using the method of urea hemolysis [12]. The concentration of urea in a series of buffered hypotonic solutions was increased and there was studied the degree of hemolysis. Acid hemolysis was determined by I.A. Terskov and I.I. Gitelzon [13].

Table 2. Characteristics of CBC and the level of the hemolysis in Gr1 (n = 75) and Gr 2 (n = 75).

Parameter	Mean ± SD								p
	Before CPB (*)		10 min. CPB-time (#)		60 min. CPB-time (&) (the warming stage)		After CPB (\$)		
	Gr1	Gr2	Gr1	Gr2	Gr1	Gr2	Gr1	Gr2	
<b>RBC</b>	4.50±0.63 #&\$	4.71±0.58 #&\$	3.18±0.60 *	3.14±0.48 *\$	3.06±0.55 *	3.19±0.57 *\$	3.52±0.60 *&	3.61±0.62 *#&	<0.001
<b>Hb, g/l</b>	129.7±17.23 #&\$	134.4±16.50 #&\$	87.17±15.11 *\$	85.57±12.64 *\$	88.31±12.91 *\$	89.39±13.77 *\$	101.1±15.89 *#&	103.1±14.97 *#&	<0.001
<b>Ht, %</b>	38.95±5.41 #&\$	40.11±5.06 #&\$	26.01±4.54 *\$	25.45±3.73 *\$	25.17±4.29 *\$Δ	28.83±5.19 *\$Δ	29.76±4.14 *#&Δ	32.92±6.06 *#&Δ	<0.001
<b>plfHb</b>	0.14±0.07 &\$	0.15±0.09 &\$	0.17±0.08 &\$	0.18±0.07 &\$	0.29±0.12 *#&\$Δ	0.42±0.17 *#&\$Δ	0.45±0.15 *#&Δ	0.59±0.22 *#&Δ	<0.001
<b>MCV, fl</b>	86.74±3.94 #	85.18±4.14 #&\$	82.33±5.26 *	81.23±7.71 *&\$	83.14±4.47 Δ	90.03±5.76 #Δ	85.76±4.41 Δ	91.49±6.49 *#Δ	<0.001
<b>MCH, pg</b>	28.56±1.39	28.37±1.65	27.57±1.96	27.30±1.96	28.72±2.13	28.09±2.28	28.71±1.82	28.51±2.22	<0.001
<b>MCHC, g/l</b>	333.4±9.55 &	335.6±12.6&\$	335.5±11.4 &	336.3±19.45 &\$	351.5±16.86 *#Δ	314.6±22.57 *#Δ	339.9±13.45 Δ	323.1±23.93 *#Δ	<0.001
<b>RDW %</b>	13.44±1.24	13.43±1.45 &\$	13.32±1.31	13.25±1.25 \$	13.78±1.27 Δ	12.39±1.33 *\$Δ	13.39±1.32 Δ	14.75±1.68 *#&Δ	<0.001
<b>RDWa, fl</b>	76.21±5.62	75.93±7.16 &\$	75.40±5.11	76.17±7.77 &\$	75.88±6.07 Δ	81.94±12.03 *#&\$Δ	77.10±5.43 Δ	87.22±14.29 *#&Δ	<0.001

Notes:

\* – the difference in parameters before CPB is statistically significant (p&lt;0.05); # – the difference in parameters at 10 min.

CPB-time is statistically significant (p&lt;0.05);

&amp; – the difference in parameters at 60 min. CPB-time is statistically significant (p&lt;0.05);

\$ – the difference in parameters at 60 min. CPB-time is statistically significant (p&lt;0.05);

Δ – the difference in parameters between Gr1 and Gr2 at a certain stage of CPB is statistically significant (p&lt;0.05).

This research complied with the ethic committee approval and written informed consent was obtained from patients. The authors adhere to the principles contained in the Declaration of Helsinki, as well as in the Interdisciplinary Principles and Guidelines for the Use of Animals in Research, Testing and Education, published by the Special Committee on Animal Research at the New York Academy of Sciences. The study was carried out in accordance with the principles of ethics.

«MedStart» software program was used for the statistical analyses (licence certificate v. 4. MS 000070-06.07.2009, Y.Y. Liakh, V.G. Gurianov). We checked for normality of data before further analysis. The significance of differences between more than two groups was checked by ANOVA method, the significance of the differences between the two groups was examined by the Student's t-test. Group differences were considered statistically significant with a p-value of < 0.05.

## RESULTS AND DISCUSSION

The tube segments have been studied (Fig.1). In the case of untreated by AdC on the inner surface of the tubes was found a significant number of blood cells. Platelets, erythrocytes and lymphocytes were found on the surface.

When comparing 3D images of cells and cytology of blood in Gr2 (Fig.1a) it is possible to tell that the internal surface of tubes adsorbs on itself blood cells and in case of lymphocytes their activation occurs. It indicates that the contact surface of the tubes causes the patient's blood to react to exogenous material. The use of AdC virtually eliminates the adsorption of cells on it. When comparing Fig.1 (a) and (b), the advantage of using AdC is clearly visible. Almost no cells are fixed on the treated surface. The image in Fig.1 (b) could be characterized as the presence of a cluster of cells, but in mathematical image processing in the 3D dimension (Fig. 1 b) this "cluster" was a surface defect.

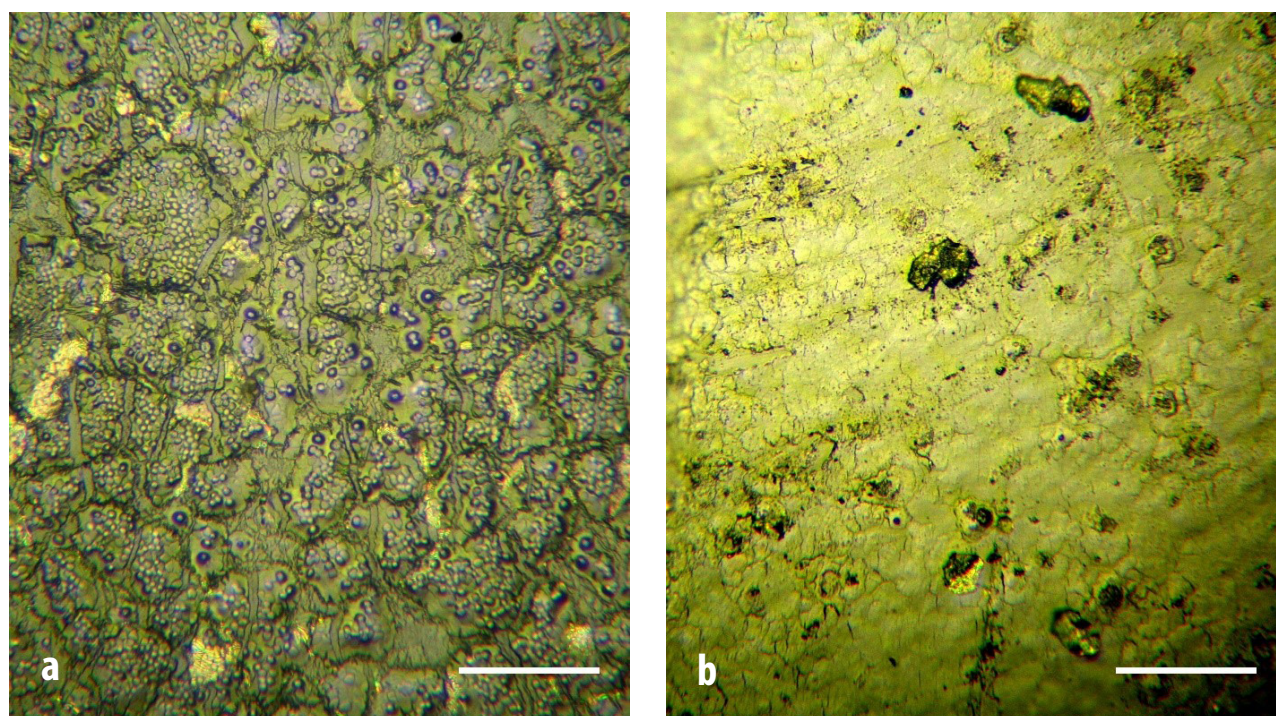


Fig.1. The tube segments without and with the treatment by AdC after CPB.

a. the tube segment after CPB without the treatment by AdC.

b. the tube segment after CPB with the treatment by AdC.

Before CPB there was no statistically significant difference in all parameters when comparing the two groups.

The results of the study showed significant difference in Hb, Ht and RBC before CPB and at 10 min. cardiopulmonary bypass time (CPB-time) both Gr 1 and Gr 2 ( $p < 0.01$ ). There was no significant difference in any parameters at 10 min. CPB-time between Gr1 and Gr 2 (Tab.II).

At 10 min. CPB in both groups MCV decreases statistically significantly relative to baseline ( $p < 0.01$ ) and there is no significant difference in MCV at 10 min. CPB-time between Gr 1 and Gr 2 ( $p=0.23$ ). There is no significant difference in there is no significant difference in MCHC ( $p=1,00$ ), RDW% ( $p=1,00$ ), RDWa ( $p=1,00$ ) at 10 min. CPB-time between Gr 1 and Gr 2.

Ht2 (Gr 2) is higher at 60 min. CPB-time ( $p < 0.01$ ) and after CPB ( $p = 0.01$ ) than Ht1 (Gr1), at the same time Hb and RBC were not a significant difference between both groups at these stages of the surgery ( $p=1.00$ ). The study revealed that MCV 2 (Gr2) at 60 min. CPB-time was significantly increased than MCV2 at 10 min. CPB-time and before CPB ( $p < 0.01$ ), there was similar dynamic of MCV2 before and after CPB ( $p < 0.01$ ). The tendency for a larger increase in MCV2 is observed at the warming stage ( $p < 0.01$ ) and after CPB ( $p < 0.01$ ) compared to MCV1. After decreasing in MCV1 at 10 min. CPB-time ( $p < 0.01$ ), MCV1 returns to its baseline values after separation from CPB ( $p = 0.98$ ). Increasing in MCHC 1 ( $p < 0.01$ ) and decreasing in MCHC 2 ( $p < 0.001$ ) at 60 min. CPB-time was revealed. There is significant difference in MCHC at 60 min. CPB-

Table 3. Parameters of erythrocyte resistance before and after CPB.

Parameter		Mean $\pm$ SD		p*
		Gr 1 (n=75)	Gr 2 (n=75)	
Mechanical resistance of erythrocytes, %	Before CPB	55.62 $\pm$ 19.8	58.62 $\pm$ 19.8	0.74
	After CPB	70.4 $\pm$ 13.92	79.83 $\pm$ 15.68	<0.01
Time of acid hemolysis 50% of erythrocytes, sec.	Before CPB	235.6 $\pm$ 39.18	228.1 $\pm$ 36.49	0.6
	After CPB	153.2 $\pm$ 21.68	132.9 $\pm$ 33.04	<0.01
Osmotic resistance of erythrocytes, sec.	Before CPB	491.6 $\pm$ 245.3	456.9 $\pm$ 239.7	0.79
	After CPB	368.9 $\pm$ 200.3	247.3 $\pm$ 129.4	<0.01

Notes:

\* significance level  $p < 0.05$ . Student's test.

Table 4. Parameters of erythrocyte membrane permeability (EMP) for urea solution.

№ tube	Mean ± SD					
	EMP %, before CPB			EMP %, after CPB		
	Gr 1 (n=75)	Gr2 (n=75)	p***	Gr 1 (n=75)	Gr2 (n=75)	p***
1(40:60)*	43.12±4.62	43.83± 4.19	0.34	43.98±4.99	44.21±4.06	0.77
2 (45:55)*	47.35±4.82	47.92±4.4	0.47	46.83±5.43	52.05±6.14	<0.01
3 (50:50)*	69.23±9.21	70.19±8.54	0.52	66.13±6.92	74.91±7.51	<0.01
4 (55:45)*	81.43±7.83	82.14±7.73	0.59	76.98±5.49	85.58±5.00	<0.01
5 (60:40)*	88.06±5.88	89.16±6.03	0.27	87.82±5.77	91.10±4.20	<0.01
6 (65:35)*	93.77±4.46	94.20±4.59	0.59	94.97±3.71	95.84±3.49	0.14
7 (etalon)**	100	100	1.00	100	100	1.0

Notes:

\* The ratio of hypotonic solutions of urea and sodium chloride.

\*\* Etalon is the content of the tube is 100% urea solution.

\*\*\* Significance level  $p < 0.05$ . Student's test.

time between Gr 1 and Gr 2 ( $p < 0.01$ ). Parameter of MCHC 2 at 60 min. CPB-time is lower than MCHC 2 before CPB and at 10 min. CPB-time ( $p < 0.01$ ). Compared with the baseline parameters at 60 min. CPB-time in Gr2 there is a significant decrease RDW% 2 ( $p < 0.01$ ) and increase RDWa 2 ( $p < 0.01$ ). Compared with the 60 min. CPB-time at after CPB in Gr2 there is a tendency to increase RDWa ( $p = 0.05$ ) and a significant increase RDW% 2 ( $p < 0.01$ ). Analysis RDW% and RDWa demonstrated the significant increases in RDW% 2 before and after CPB ( $p < 0.01$ ) and RDWa 2 before and after CPB ( $p < 0.01$ ). The dynamics of RDW% 1 and RDWa1 is not statistically significant at all stages of the surgery. Examination of results at 60 min. CPB-time showed significantly increased RDWa and decreased RDW% in patients with Gr 2 compared with patients with Gr 1 ( $p < 0.01$ ).

The study of MCHC before CPB and after CPB showed that MCHC1 is higher than MCHC2 ( $p < 0.01$ ). Parameters of MCV2 and Ht2 are higher than MCV1 ( $p < 0.01$ ) and Ht1 ( $p = 0.03$ ) at stage after separation from CPB. After CPB there are no statistically significant difference in Hb, RBC both groups.

The dynamics of MCH is not statistically significant both in Gr2 and in Gr1 at all stages of the surgery (Tab. 2).

Hemolysis during extracorporeal circulation is the result of the destruction of the RBC membrane with the breakdown and release of plasma free hemoglobin. There are no significant differences in the level of hemolysis between the before CPB and at 10 min. CPB-time in both groups ( $p = 1.00$ ), starting from 60 min. CPB-time and after CPB hemolysis was higher in Gr2 ( $p < 0.01$ ).

After separation from CPB (Tab.III), there were the best mechanical, osmotic resistance of erythrocytes in Gr 1 ( $p < 0.01$ ). The same situation with the time of acid hemolysis 50% of erythrocytes in Gr1 ( $p < 0.01$ ) after CPB.

The analysis of erythrocyte membrane permeability (EMP) for urea solution revealed that the level of 50% erythrocytes hemolysis in urea solution after CPB starting from dilution of hypotonic solutions of urea and sodium chloride in a ratio of 45:55 was higher in Gr 2, the same tendency remained in dilution 55:45, 60:40 (Tab. 4).

Conducted investigations demonstrated that lower levels of hemolysis, greater resistance to mechanical hemolysis, ORE, EMP, and acid hemolysis in Gr1 be caused by AdC protection.

Level of Hb, Ht and RBC at 10 min. CPB-time in both groups was decline due to hemodilution, because MCH was not changed comparing to before CPB ( $p = 1.0$ ). At this stage MCV was decreased by hyperosmolar prime which had equally impact on RBC in both groups.

We assume the increase in MCV2 at 60 min. CPB-time and after CPB connected with swelling of the cells and their membranes because there was no statistically significant difference between MCH1 before and after CPB but there was a relative decrease in MCHC 1 after perfusion ( $p < 0.01$ ). MCHC is a parameter that reflects the RBC hydration state and is dependent on RBC volume, RBC membrane loss, and water content. The ratio of various populations of red blood cells changes in the first minutes and hours of acute blood state [14]. The increase in MCV2, RDWa2 with simultaneous decrease MCHC2 may be related

to an increase in reticulocyte content in the peripheral blood. Dynamic of RDW%2 occurs possibly due to more destruction macro – and microcytes on oxygenator membranes at 60 min. CPB-time and manifest by changing the size (anisocytosis) and shape (poikilocytosis) of RBC after CPB. It is consistent with higher hemolysis in Gr 2 compared with Gr 1.

## CONCLUSIONS

1. Blood circulation in the extracorporeal circuit during CPB leads to adsorption on the contact surface tubes of blood cells. This reduces the functional activity of erythrocytes exacerbating tissue hypoxia. This is of particular importance in urgent cardiac surgery.

2. Use of AdC according to the methodical recommendations for treatment of the extracorporeal circuit tubes prevents adsorption on it of blood cells.
3. In the group with AdC means of MCV, RDW% and RDWa were more stable and after CPB corresponded to the original parameters.
4. Hemolysis after CPB was more significant in Gr2 where the treatment of the extracorporeal tubes was not carried out.
5. The use of AdC increases the mechanical, osmotic resistance of erythrocytes, and time of acid hemolysis of 50% of erythrocytes, that indicated less lesion of erythrocytes and more resistance of erythrocytes to the action of traumatic factors.

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#### CONFLICT OF INTEREST

Authors declare no conflict of interest.

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# POSSIBILITIES OF DIAGNOSIS AND TREATMENT OF ACUTE AND CHRONIC BRAIN ISCHEMIA

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## Abstract

**Aim:** To study the formation of pathological brain systems and their transformation during treatment in patients with acute and chronic cerebral ischemia, using the method of quantitative EEG with wavelet analysis.

**Material and methods:** In the period from 2016 to 2020, 120 people aged 40 to 68 years with CSI and IS were comprehensively examined in dynamics. Patients underwent quantitative EEG (qEEG) with wavelet analysis on days 1, 7, 14, 21, 28. In addition to the protocol, one group of patients received ethylmethylhydroxyridoxine succinate.

**Results:** The formation of a new system with a decrease or disappearance of the dominant frequency in the delta range, the appearance of a dominant frequency in the theta range and a subdominant frequency in the alpha range indicates the restoration of brain function. The applied course of neurometabolic therapy leads to such a change in the EEG wavelet graphs after 3-4 weeks in 86.6% of patients. And in the control group, similar changes occur during this period only in 53.3% of patients.

**Conclusions:** To assess the effectiveness of treatment of acute and chronic cerebral ischemia, it is advisable to use a complex of amplitude-time representation of an EEG signal using continuous wavelet transform. The effectiveness of neurometabolic therapy aimed at eliminating mitochondrial dysfunction can be assessed using the method of quantitative EEG with wavelet transformation, to study the formation and destruction of stable pathological brain systems in patients with cerebral ischemia.

## Key words

acute and chronic cerebral ischemia, quantitative EEG, pathological systems of the brain

## INTRODUCTION

The issue of cerebrovascular diseases is one of the most socially significant in the modern world. Chronic and acute forms of cerebral circulation disorders have high rate of mortality and disability, lead to significant deterioration in the quality of life of people [1]. Cerebral ischemia is a pathological condition caused by an acute or chronic disturbance of blood circulation in the cerebral vessels. Stroke is a disease that refers to emergencies, accompanied by the development of acute cerebral ischemia (ACI). Chronic cerebral ischemia (CCI) is a slowly progressive dysfunction caused by diffuse or small focal brain tissue damage in conditions of long-standing cerebral insufficiency. An equivalent concept in international literature is the term "moderate cognitive impairment" (MCI).

With many etiological factors in the development of cerebral ischemia, its pathogenesis fits into the concept of the formation of stable pathological systems in the central nervous system, formulated by G.N. Kryzhanovsky. It has been shown that in the pathogenesis of cerebral ischemia syndrome, an important role is played by the inclusion of mechanisms for the development of pathological neuroplasticity

– new erroneous interneuronal connections appear, which did not appear in normal cases. With insufficient cerebral blood supply to anoxia, an earlier and more pronounced damage to the inhibitory mechanisms of the central nervous system occurs, and not excitatory. Generators of pathologically enhanced excitation are formed, which are a key link in the formation of stable pathological brain systems and become resistant to various influences [2].

The levels of brain integration in norm and pathology can be assessed by the EEG method. For the analysis of the electroencephalogram (EEG), both traditional statistical methods and Fourier analysis methods are used, as well as more modern methods of quantitative EEG (qEEG) with wavelet analysis. The wavelet transform is capable of providing a two-dimensional scan of the studied one-dimensional signal, while its frequency and coordinate are considered as independent variables. The use of the wavelet transform makes it possible to significantly expand the possibilities of digital processing of random signals, create effective algorithms for compression and noise reduction of signals.

The fastest alternative way to correct tissue hypoxia is succinate oxidase oxidation, which is achieved



through an increase in the activity of succinate dehydrogenase and an improvement in the penetration of exogenous succinate into the mitochondria of the cell.

The drug ethylmethylhydroxypyridine succinate (2-ethyl-6-methyl-3-hydroxypyridine succinate), a structural analogue of vitamin B6 and succinic acid (succinate), is a modern antioxidant. Ethylmethylhydroxypyridine succinate activates the endogenous antioxidant system of superoxide dismutase and ceruloplasmin, prevents a decrease in the activity of glutathione-dependent enzymes (glutathione peroxidase, glutathione reductase), as a result of which the activity of oxidative stress processes significantly decreases.

It enhances the compensatory activation of aerobic glycolysis and reduces the degree of inhibition of oxidative processes in the Krebs cycle under hypoxic conditions with an increase in ATP and creatine phosphate, activates the energy-synthesizing function of mitochondria.

It is widely used in the complex therapy of acute and chronic disorders of cerebral circulation, cognitive disorders of atherosclerotic genesis and other diseases of the nervous system [3].

#### AIM

To study the formation of pathological brain systems and their transformation during treatment in pa-

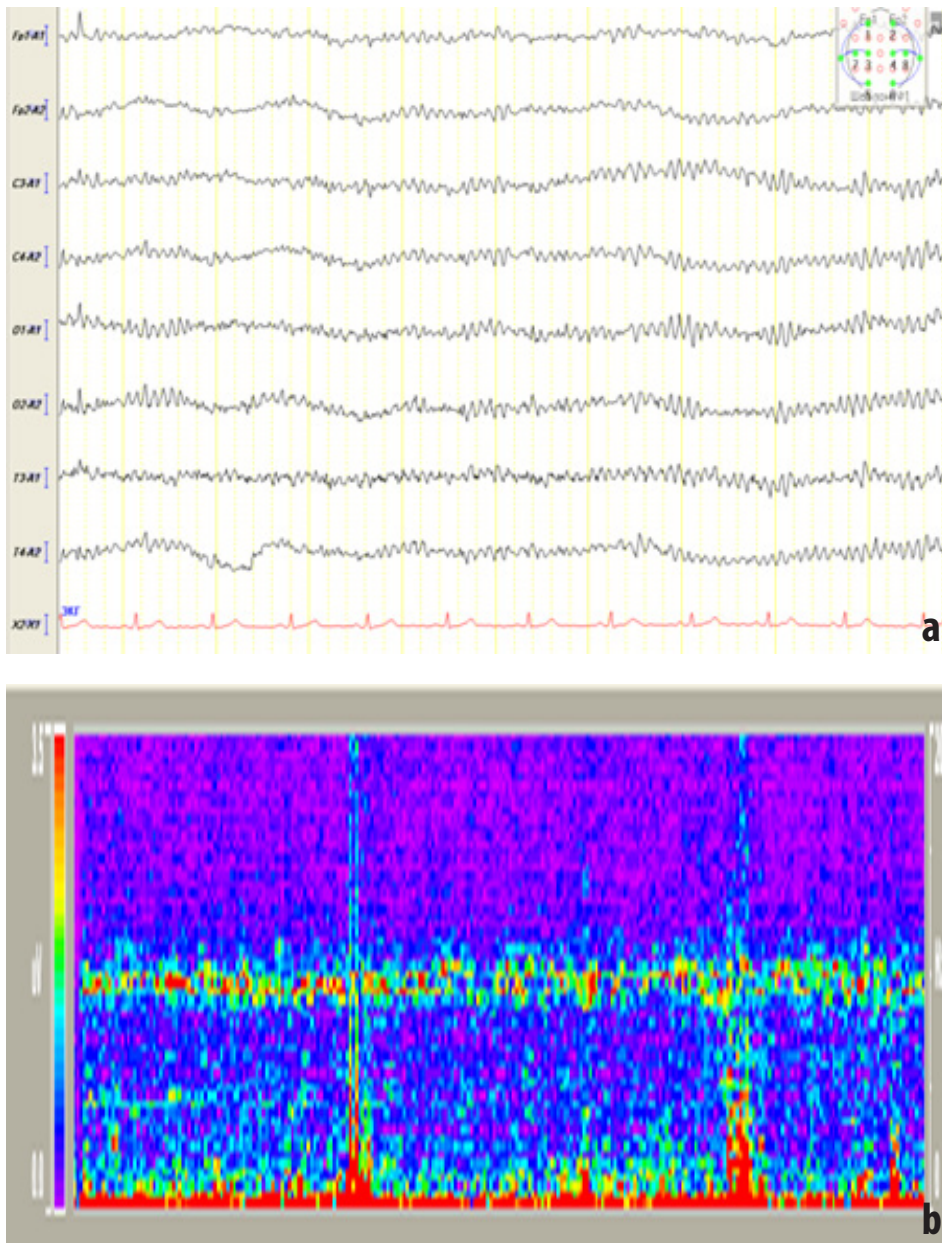


Fig. 1 (a, b). EEG that fits into the concept of “norm”. Amplitude-time representation of a non-stationary signal and its continuous wavelet transform result (two-dimensional representation of a three-dimensional graph). The dominance of the spectral power in the alpha range.

tients with acute and chronic cerebral ischemia, using the method of quantitative EEG with wavelet analysis.

### MATERIAL AND METHODS

In the period from 2016 to 2020, 120 people aged 40 to 68 years were comprehensively examined in dynamics. The patients were divided into four groups, statistically comparable in terms of the underlying disease, sex and age. The first group consisted of 28 patients with CCI grade 2. without concomitant hypertension, the second – 39 patients with CCI 2 grade. with concomitant hypertension, the third – 21 patients with CCI 2 grade. and a history of stroke. The fourth group included 32 patients (18 men and 14 women)

with a diagnosis of ischemic stroke (IS). The fifth group included 15 patients with IS and 15 patients with CCI. Among the examined patients there were 47 men and 73 women. The control group (CG) of healthy volunteers consisted of 20 people (7 men and 13 women).

Inclusion criteria: men and women aged 40 to 68 years, the presence of acute and chronic ischemic cerebrovascular disease, confirmed by the data of general clinical, clinical neurological, laboratory, instrumental examination, consent to the study.

Exclusion criteria: patients with IS and a level of impaired consciousness on admission on the Glasgow coma scale of less than 7 points, the presence of bilateral fixed mydriasis, uncorrected mean arte-

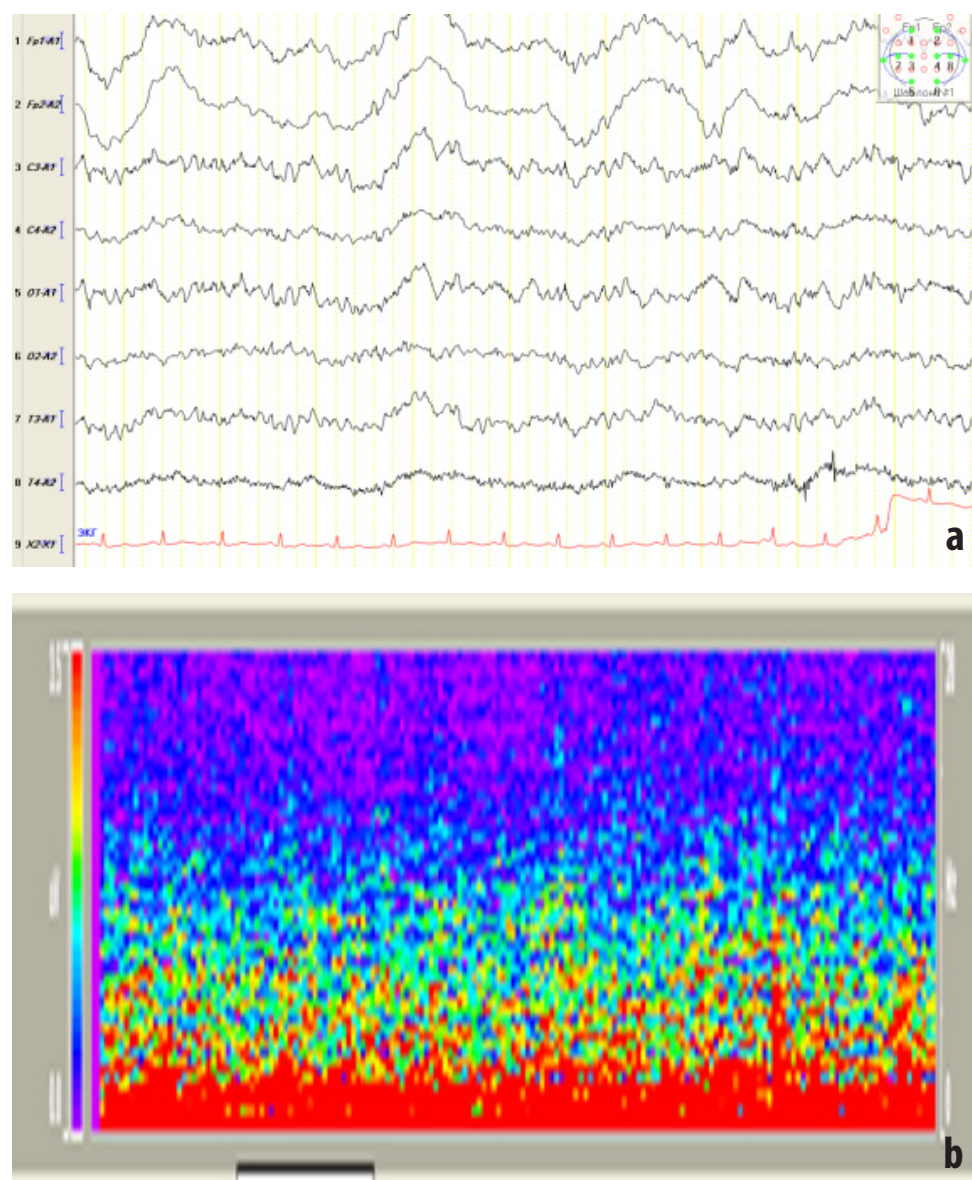


Fig. 2 (a, b). EEG of a patient with IS (1<sup>st</sup> day). Amplitude-time representation of a non-stationary signal and its result of continuous wavelet transform. Signs of the destruction of the old system, the process of forming a new system (pathological).

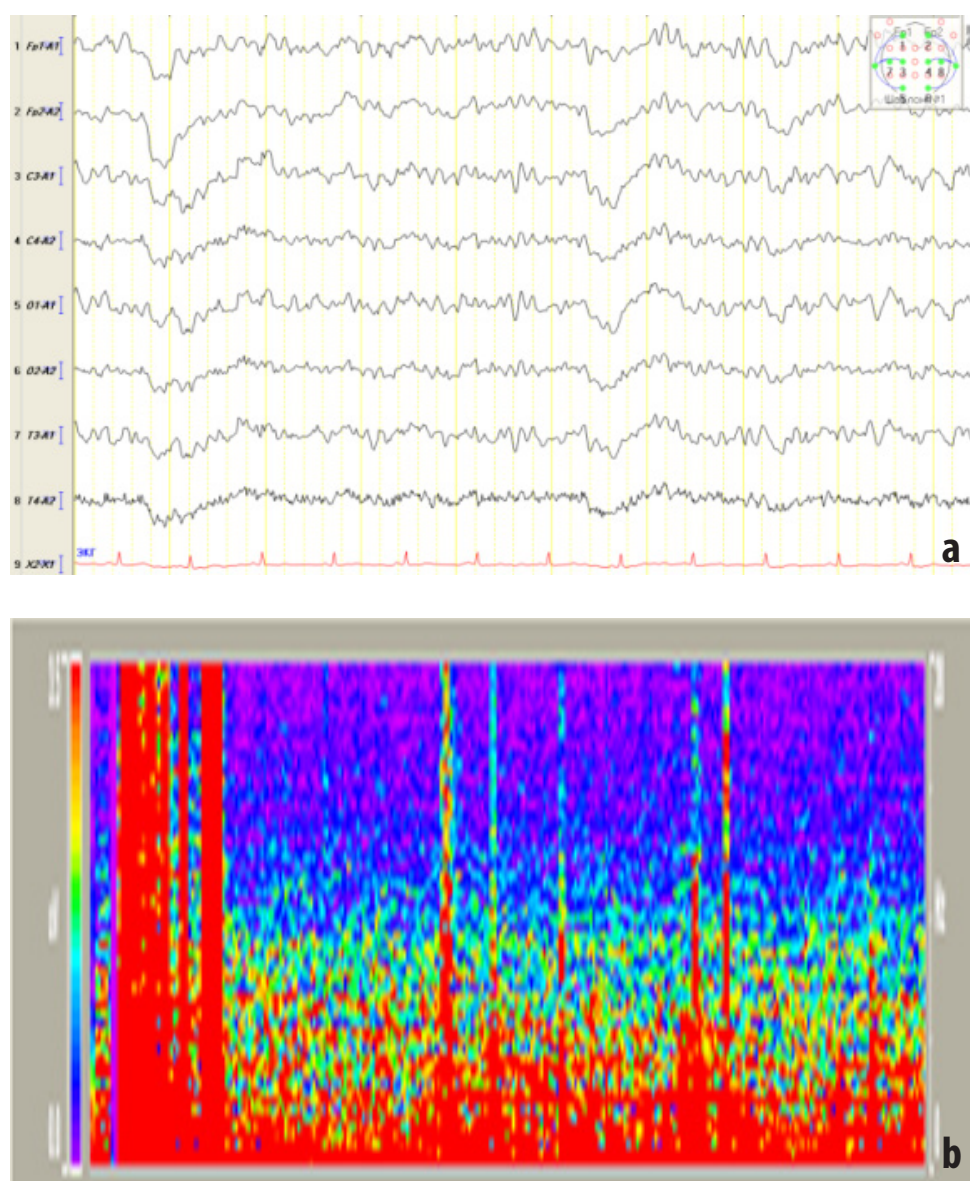


Fig. 3 (a, b). EEG of a patient with IS (7<sup>th</sup> day). Amplitude-time representation of a non-stationary signal and its result of continuous wavelet transform. A new pathological system with a pronounced dominance of power in the delta and theta ranges is being formed.

rial pressure on admission less than 90 mm Hg, SpO<sub>2</sub> at admission <93%, patients with CCI without focal neurological symptoms, patients with concomitant uncompensated diseases or acute conditions that can significantly affect the study results.

Informed consent was obtained from all patients to participate in the study.

Duplex scanning of extra- and intracranial vessels of the brain was carried out, with the help of which stenosis and deformation of the vessels of the head and neck, their hemodynamic significance, thickness and homogeneity of the intima-media complex, and the presence of atherosclerotic changes were detected.

The correction group (15 patients with grade 2 CCI and 15 patients with IS) received ethylmethylhydroxypyridine asuccinate (Mexicor) in addition to

the standard treatment protocol. In patients with IS, the drug was administered intravenously 2-3 times a day, 200 mg (2 ampoules) for 4 days, then intramuscularly for 10 days, 100 mg (1 ampoule) 3 times a day, then 300 mg orally 3 times a day within 7 days. In patients with CCI 2 st. the drug was administered orally at 300 mg 3 times a day for 21 days. 80 patients with ACF (comparison group) received therapy according to the standard protocol.

Patients underwent quantitative EEG (qEEG) with wavelet analysis on days 1, 7, 14, 21, 28. The duration of treatment was 4 weeks. Brain biopotentials were recorded using a TredexExpert computer electroencephalograph. To analyze the EEG, we used the amplitude-time representation of a non-stationary signal and its result of continuous wavelet transfor-

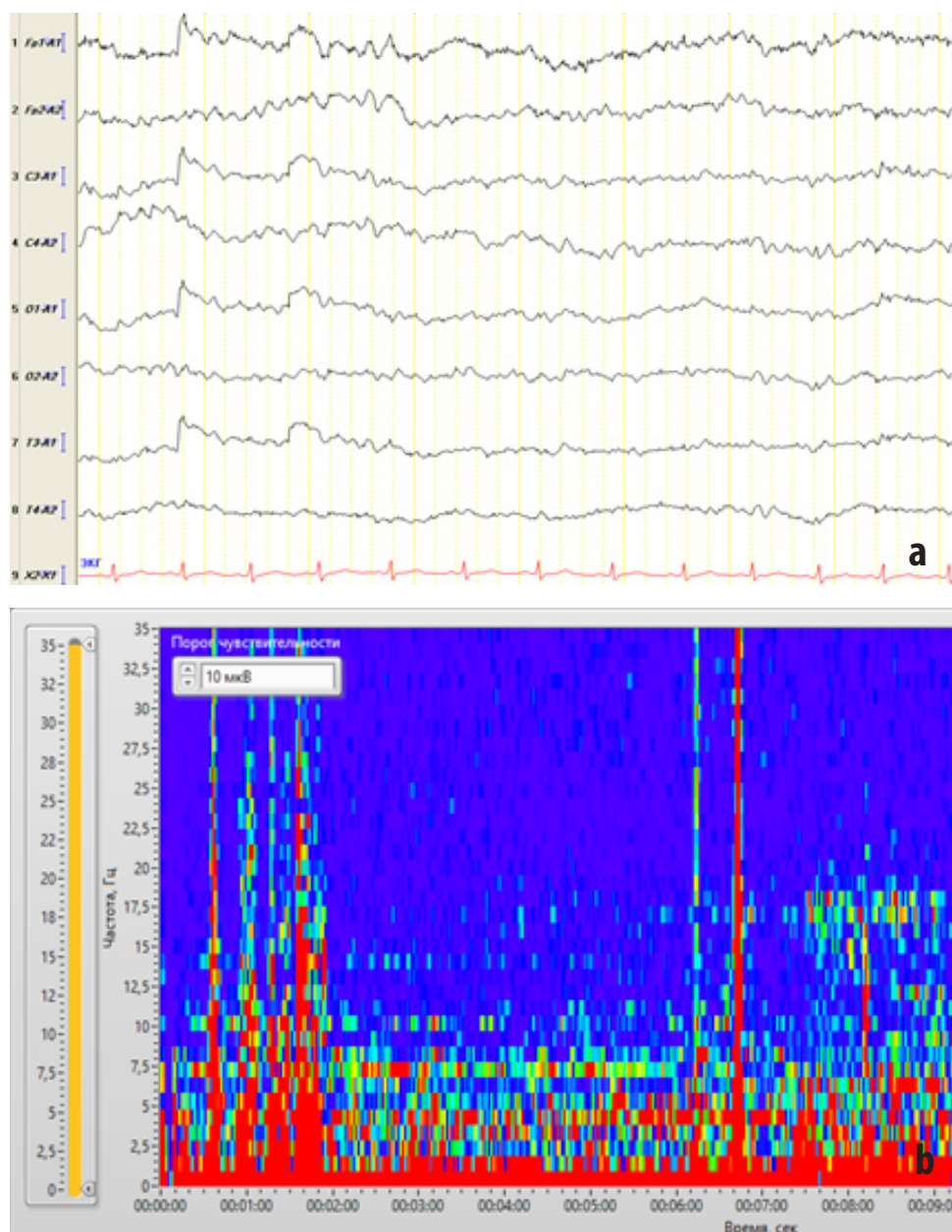


Fig. 4 (a, b). EEG of a patient with IS (28<sup>th</sup> day). The wavelet graph characterizes the process of formation of a new pathological system that is rather labile, the outcome of the formation of which depends on the effectiveness of treatment.

mation [4]. Statistical data processing was carried out using the MedStat program.

Study design: open-label prospective case-control study.

## RESULTS AND DISCUSSION

As a result of the neurological examination of the studied patients, among all neurological disorders, coordination disorders and pyramidal insufficiency prevailed – 43.3% and 23.3% in patients with CCI of group 1, 33.3% and 11.1% in patients with CCI of group 2 respectively. Cognitive (77%) and emotional (77%) disorders were more often detected in patients with CCI of group 3.

According to the results of the assessment of subjective and objective neurological symptoms in patients of the first group, 63.3% were cephalic, 56.6% vestibular, 30% cerebrosthenic, 26.6% mnestic syndromes and 23.3% had anxiety-depressive disorders.

Among the patients of the second group, 63.9% were cephalic, 44.4% vestibular, 47.2% cerebrasthenic, 17% mnestic syndromes, 22.2% had anxiety-depressive disorders and 16.7% pyramidal insufficiency.

Among patients of the third group who had an ischemic stroke against the background of arterial hypertension and cerebral atherosclerosis, vestibulo-atactic syndrome (68.2%), cephalic (72.7%), cerebrosthenic (91%), mnestic (81.8%) were observed

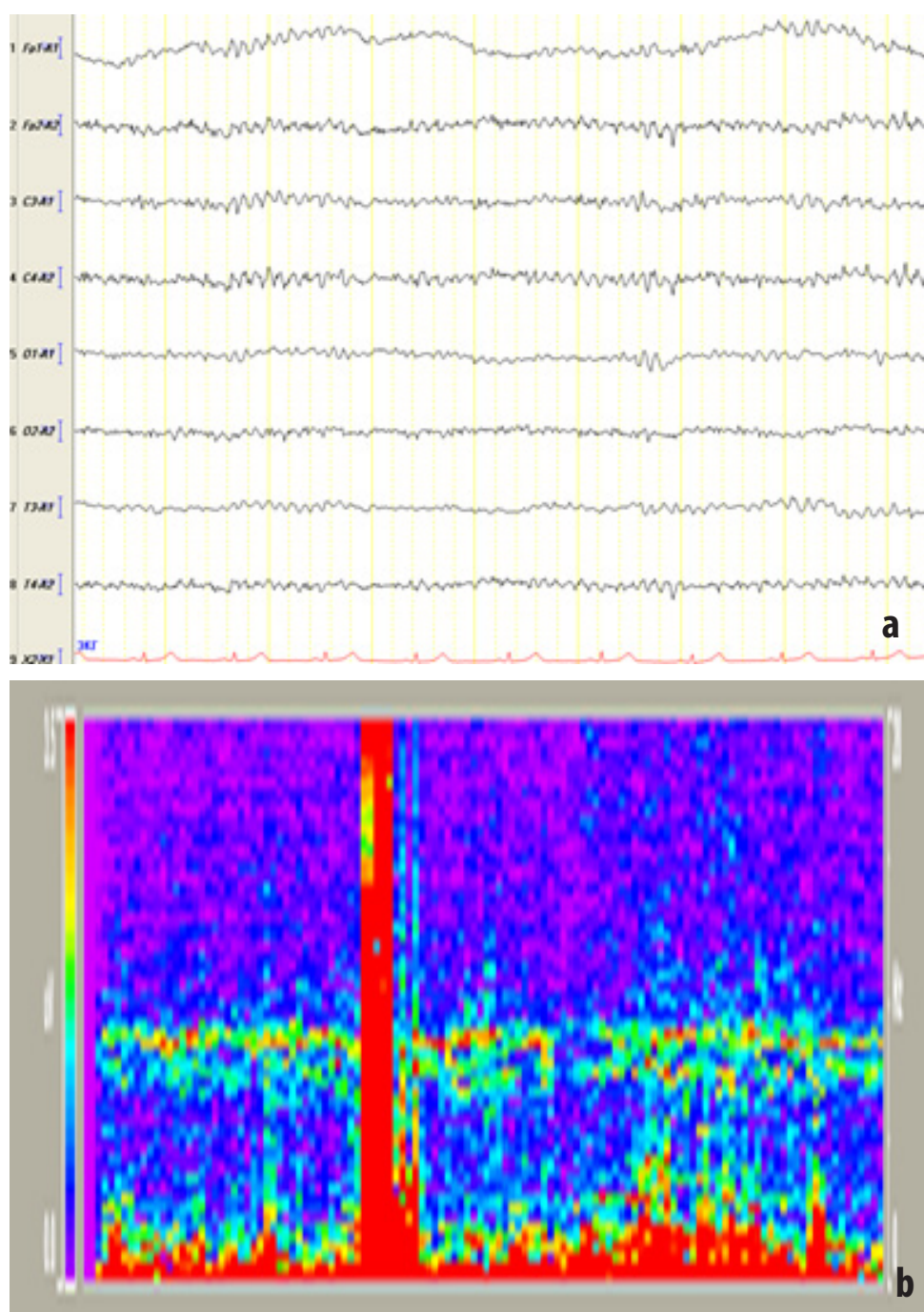


Fig. 5 (a, b). EEG of a patient with grade 2 CCI with a history of stroke (1<sup>st</sup> day). Amplitude-time representation of a non-stationary signal and its result of continuous wavelet transform. A pathological system is formed with a pronounced dominance of power in the delta range.

and were observed alarmingly. depressive disorders (77.3%).

In patients of the fourth group, in 29.2% of patients with IS, the level of neurological deficit was recorded at 8-10 GCS points, which corresponded to moderate brain injury. In 68.8% of patients, the level of neurological deficit was recorded at 11 or more points on the GCS, which corresponded to mild brain injury. The average range of values of neurological deficit assessed by Scandinavian Stroke Scale (SSS) ranged between

14 and 16 in both study and comparison groups. When comparing the study and comparison groups ( $\chi^2$  test, Wilcoxon-Whitney-Mann (WW) test, Kruskal-Wallis rank test (KKU)  $p > 0.05$ ), it was found that the differences in the levels of impairment of consciousness according to GCS were not statistically significant in the first day – stage I of the study ( $p > 0.05$ ).

The formation and destruction of stable pathological systems of the brain in patients with stroke, transient disorders of cerebral circulation, CCI of the

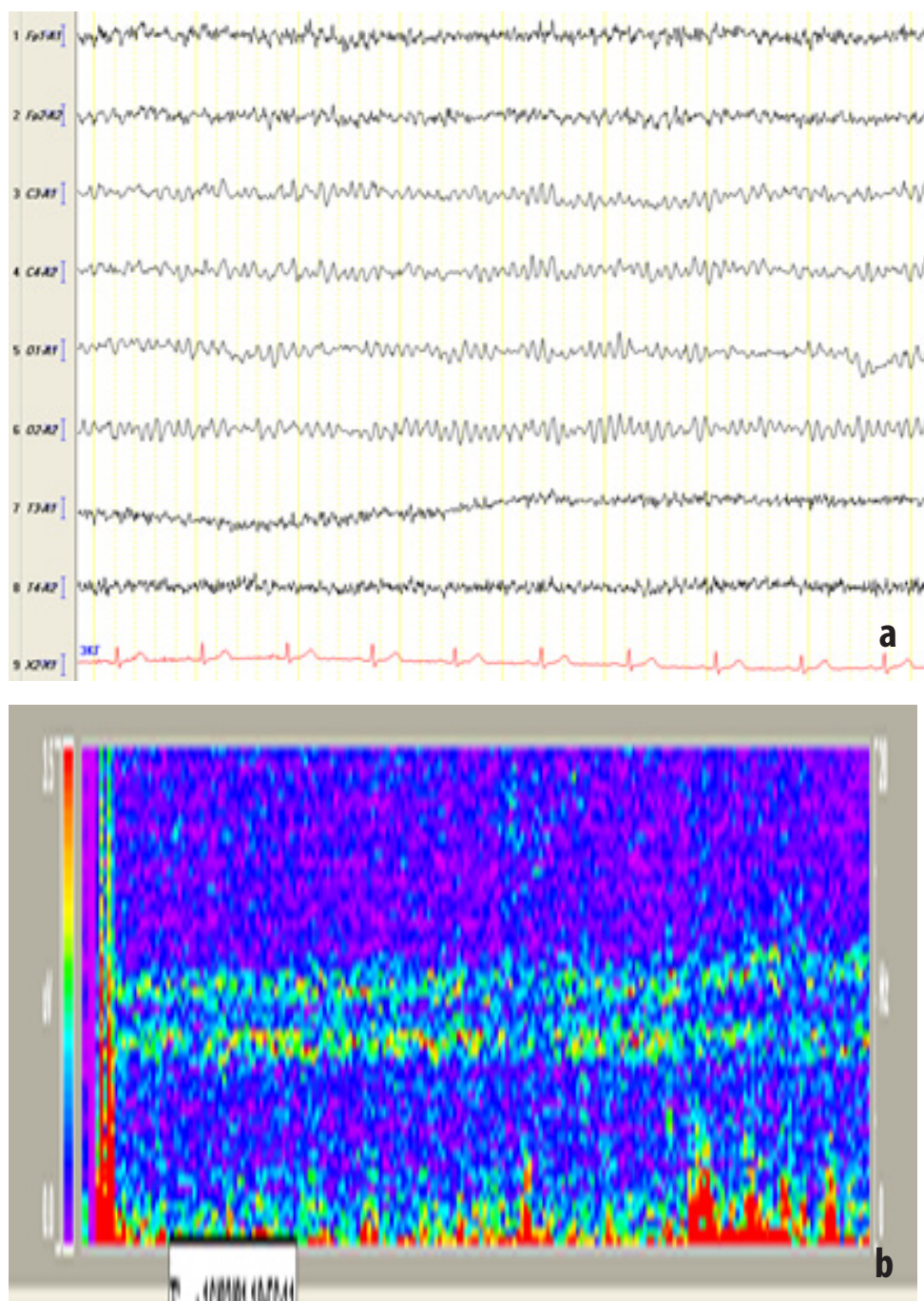


Fig. 6 (a, b). EEG of a patient with grade 2 CCI with a history of stroke (21<sup>st</sup> day). Amplitude-time representation of a non-stationary signal and its result of continuous wavelet transform. A new system has been formed – the dominant frequency (theta-range) and the subdominant frequency (alpha-range).

2nd stage were studied using the method of quantitative EEG with a wavelet transform of a stationary EEG signal [4].

Our research revealed that EEG-healthy volunteers after wavelet transformation (Fig. 1) were characterized by “minimal frequency and amplitude diversity” with a pronounced dominance of power in the alpha range, which is a sign of functional integrity and stability of the single central nervous system.

For patients with IS (Fig. 2 a, b), a high level of disorganization of the EEG pattern was established during the initial examination. An insignificant variety with a dominance in the delta range with a minimum amplitude and frequency graphic representation was established. A more pronounced variety of frequency representation, variability in time (“haze” over the level of dominant activity) are signs of destruction of the old system, the process of formation

of a new system (pathological). It was during this period that wider opportunities for therapy would be available – the ability to influence the formation of a new system with minimal pathological deviations.

According to a number of authors, a decrease in the frequency range should be considered as a manifestation of exclusion of microsystems of neurons from the pool of the central nervous system, that is, signs of destruction of the old system and the process of formation of a new, more low-organized, i.e. pathological system. According to the general theory of systems, the scientific and methodological concept of studying objects that are systems, the “law of experience” (according to William Ashby) states that a secondary, additional “change in the value of a system parameter makes it possible to reduce diversity to a new, lower level” [5].

The appearance on the wavelet graph at the 2nd stage of the study (Fig. 3) of multiple non-stationary fragments, which is accompanied by an increase in the frequency range, should be interpreted as the involvement of new groups of cells (microsystems of neurons) in the generation of the EEG phenomenon, that is, as a positive effect impact on the pathological system with the expansion of its capabilities and functionality (Fig. 3 a, b).

At 4-5 stages of the study, a moderate level of disorganization with dominance in delta and subdominance in theta or alpha ranges with a pronounced amplitude and frequency graphic representation of these rhythms was typical, which should be regarded as the simultaneous reciprocal functioning of several subsystems (Fig. 4).

In patients with developed stage 2 CCI with stroke, a history of pronounced monotony of frequency representation, the stability of the dominant theta and delta rhythms are signs of an already formed pathological, more simplified system than the original system (Fig. 5) (according to systems theory). This is manifested by the presence of non-stationary fragments with a decrease both in their frequency range and with a decrease in the specific power of the EEG signal, which should be interpreted as a pronounced prevalence of synchronization of the activity of the cellular pool that generates EEG waves, simultaneously with limiting the volume of neural ensembles (microsystems of neurons) involved in the formation of EEG.

There are limited therapeutic options, since it is difficult to influence a rigidly formed pathological system. The addition of the protocol for the treatment of patients with IS and CCI in the correction groups with a complex of medication containing ethylmethylhydroxypyridine succinate led to a correction of the neuropsychological status in both IS and chronic cerebral ischemia. After 21 days of intensive therapy, signs of an already formed pathological system appeared, which is characterized by the fact that, along with the dominant frequency (theta rhythm), a subdominant frequency appeared in the alpha range. It is important to note the sharp decrease in delta activity (Fig. 6).

The formation of a new system with a decrease or disappearance of the dominant frequency in the delta range, the appearance of a dominant frequency in the theta range and a subdominant frequency in the alpha range indicates the restoration of brain function. The applied course of neurometabolic therapy leads to such a change in the EEG wavelet graphs after 3-4 weeks in 86.6% of patients. And in the control group, similar changes occur during this period only in 53.3% of patients.

## CONCLUSIONS

1. To assess the effectiveness of treatment of acute and chronic cerebral ischemia, it is advisable to use a complex of amplitude-time representation of an EEG signal using continuous wavelet transform.
2. A decrease or disappearance of the dominant frequency in the delta range, the appearance of a dominant frequency in the theta range, the appearance on the EEG wavelet graph in parallel with the dominant frequency of the subdominant frequency in the alpha range should be considered a positive effect of therapy when influencing the formed pathological system.
3. The use of ethylmethylhydroxypyridine succinate in the complex therapy of cerebral ischemia increases the chance of restoring the functional integrity and stability of the central nervous system.
4. The effectiveness of neurometabolic therapy aimed at eliminating mitochondrial dysfunction can be assessed using the method of quantitative EEG with wavelet transformation, to study the formation and destruction of stable pathological brain systems in patients with cerebral ischemia.

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# MODERN CONCEPT OF RENDERING AID TO WOMEN WITH OVARIAN HEMORRHAGES

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## Abstract

**Aim:** Analysis of modern medical care for women with ovarian hemorrhage, determination of the main diagnostic criteria that influence the choice of treatment tactics and further prognosis of the outcome of treatment of ovarian apoplexy.

**Material and methods:** The provision of medical care to 888 women with ovarian apoplexy. Depending on the volume of hemoperitoneum, all patients were divided into three groups.: Group I – 480 (54.0%) women in whom intra-abdominal bleeding did not exceed 200 ml; Group II – 283 (31.8%) patients with hemoperitoneum ranged from 200 to 500 ml; Group III – 125 (14.1%) patients with hemoperitoneum volume greater than 500 ml.

**Results:** According to the data of the transvaginal US, a linear dependence was observed between the level of free liquid and the volume of hemoperitoneum ( $r=0.63$ ,  $p<0.05$ ). In 792 (89.2%) patients the diagnosis of apoplexy of the ovary and intraperitoneal hemorrhage was made to surgical intervention- on the basis of clinical picture and US data. The most frequently performed hemostatic operation was resection of the ovary – 477 (77.2%) interventions. The average volume of hemoperitoneum discovered in patients with AO, in absence of the adhesive process was ( $273.5\pm 21.3$ ) ml, whereas in patients with the expressed adhesive process of the small pelvis organs it was ( $141.4\pm 35.5$ ) ml. The cause of AO was the corpus luteum or cyst of the corpus luteum in more than the half of the cases – 348 (56.3%).

**Conclusions:** The manifestation of the clinical symptoms in apoplexy of the ovaries depends on the volume of intraperitoneal hemorrhage. The application of laparoscopy as a main therapeutic and prophylactic method in AO allows to preserve, and sometimes to restore the reproductive function of a woman and to reduce the rate of the disease relapse development.

## Key words

laparoscopy,  
apoplexy,  
hemoperitoneum,  
treatment of ovarian hemorrhages

## INTRODUCTION

The pathologic states, which require rendering emergency aid, take a special place in the structure of gynecological diseases. More than half of urgent gynecological operations are performed for acute gynecological pathology, complicated by intraperitoneal hemorrhage [1; 2]. Apoplexy of the ovary (AO) occupies the second place among the causes of intraperitoneal hemorrhages in the work of the gynecological hospital, giving place only to the disturbed ectopic pregnancy [3]. Videoendoscopic technologies have been “the gold standard” of diagnosis and treatment of the practically entire urgent gynecological pathology, including apoplexy of the ovary already for a period of several decades [2; 4; 5; 6]. In the individual clinical cases the sudden pathologic rupture of the ovarian tissue is not accompanied by extensional hemoperitoneum, and hemorrhage neither exceeds the limits of the ovarian capsule nor is accompanied by minimum intraabdominal hemorrhage. Patients with the localized intraovarian hemorrhage or insignificant intraperi-

toneal hemorrhage, which is controlled, in presence of the moderate pain syndrome, require conservative treatment [7; 8].

## AIM

The aim of our study was the analysis of rendering aid to women with apoplexy of the ovary, determination of the basic clinical, laboratory and ultrasonic criteria, which influenced the choice of therapeutic tactics, evaluation of the immediate and long-term results of treatment of ovarian hemorrhages.

## MATERIAL AND METHODS

To achieve this aim we have analyzed aid to 888 women with AO, who referred to the clinic of gynecology of the military medical clinical center of the Southern region of Odesa and in gynecology department of the City Clinical Hospital № 1 of Odesa in the last 8 years. All patients were divided in three basic groups depending on the volume of hemoperitoneum, revealed intraoperatively or established by noninvasive methods of examination.

I group was composed of 480 (54.0%) patients whose volume of hemoperitoneum did not exceed 200 ml and it was considered as minimum; II group consisted of 283 (31.8%) women with moderate intraperitoneal hemorrhage ranged from 200 to 500 ml; III group was formed by 125 (14.1%) patients whose amount of blood in the abdomen exceeded 500 ml, we considered this hemorrhage as significant. The main group I consisted of IC group (treated conservatively) – 270 (30.4%) women whose attack of ovarian apoplexy was treated by drugs; and IL group (treated laparoscopically) – 210 (23.6%) patients whose main diagnostic and treating measure was laparoscopic intervention. Of the women who were subject to conservative therapy, 105 (38.8%) patients were given out-patient treatment; 108 (40.0%) patients of IC group after cessation of ovarian hemorrhage and obtaining the course of drug therapy during the period from 1 to 7 weeks were operated on laparoscopically for the diagnostic and therapeutic purpose in the so-called “cold” period. These patients were united in I’C’LC subgroup. The patients of IC group who could be followed up to fix long-term results of treatment, were united in ICLT subgroup.

In referring to the center patients were made general clinical, biochemical studies of the blood, urine, urotest for pregnancy, a bacterioscopic and bacteriological study of discharge from the vagina and cervical canal. Ultrasonic examination of the abdominal and small pelvis organs was made by the apparatus ALOKA-650 and SA-8000 SE, vaginal sensor with a frequency of 6.0-7.5 MHz.

Surgical intervention was performed either immediately after the establishment of the diagnosis of apoplexy of the ovary and hospitalization of the patient or after an attempt of the conservative treatment, and also in absence of the possibility to exclude another threatening acute surgical and gynecological pathology. Laparoscopy was performed employing the conventional procedure under the endotracheal anesthesia with the use of mono- and bipolar electro-surgical technology [2]. The women of III group were performed the retransfusion of the autologous blood intraoperatively employing our own developed procedure [4] in absence of contraindications. Statistical processing of the results obtained was made by the software Statistica 5.5 (Stat soft inc., the USA).

All ultrasonic images of the ovaries were divided into 3 types depending on the presence of dense and liquid components on the scan in the tumor-like formation. Type I – tumor-like formation with dense, solid, amorphous hyperechogenic contents. Type II –

reticulated or sponge-like pattern is noticeable with the filamentary strips, which pass in different directions against the dense, amorphous hypoechogenic background. Type III – the echogenic formation of the irregular shape was observed in the ovary from 20 to 35 mm in diameter with a slit-shaped cavity.

The volume of free liquid was determined with the aid of transvaginal echograms of the small pelvis made in the saggital plane, which were also divided into three types. Type 1 – the level of liquid does not rise above the internal opening of the uterus. Type 2 – the echogenic strip of liquid reaches the middle body of the uterus. Type 3 – the level of free liquid is at the level of the uterus body and higher.

## RESULTS AND DISCUSSION

The age of the observed patients varied from 17 to 55 years (on an average –  $(28.3 \pm 5.2)$ ). Pelvic pain was a leading clinical symptom in all patients. Intense acute pain was more frequently encountered in patients with moderate and great blood loss (62.2 and 92.3% respectively). In 285 (70.0%) patients of II and III groups the pain attack appeared in the second phase of the menstrual cycle (MC), while in 324 (67.6%) patients of I group the disease developed in the middle of MC. The hospitalized patients of I group with the expressed pain syndrome – 287 (76.5%) women – were characterized by early reference for medical aid (during the first 2 years from the beginning of the attack).

When insignificant nagging pelvic pain and stable geodynamics with the medical aid was observed in reference to the centre, the conservative treatment of the formed cystic hemorrhagic formation of the ovary (CHFO) was carried out under the out-patient conditions. The general state of all women of I group was estimated as satisfactory. The average indices of hemodynamics and red blood in the patients of this group were similar: pulse –  $(72 \pm 8)$  per 1 min, SAP-  $(124 \pm 6)$  mm Hg, DAP –  $(70 \pm 8)$  mm Hg, hemoglobin –  $(121 \pm 16)$  g/l.

In the women of II group the pain syndrome had a persisting character and was intensified in time. More than half of these patients noted persistent irradiation of pain in the rectum and perineum. The state of the patients as those of I group, was estimated as satisfactory because of absence of the visible hemodynamic disturbances and changes in the red blood: pulse –  $(86 \pm 8)$  per 1 min, SAP-  $(122 \pm 6)$  mm Hg, DAP –  $(68 \pm 8)$  mm Hg, hemoglobin –  $(118 \pm 16)$  g/l.

The state of the patients of III group was estimated as satisfactory only in 5 (4.0%) patients, of moderate severity in 57 (45.5%) patients and severe – in

63 (50.4%). The average indices of hemodynamics and red blood in patients of III group were similar: pulse – (104±8) per 1 min, SAP – (87±6) mm Hg, DAP – (68±8) mm Hg, hemoglobin – (74±12) g/l.

According to the US data a linear dependence between the level of free liquid regarding the uterus and volume of hemoperitoneum was revealed intraoperatively ( $r=0.63$ ,  $p<0.05$ ). Thus, in 90 (43.3%) women, whose intraabdominal hemorrhage did not exceed 200 ml, were observed by echograms of the type 1, and in 63 (30.0%) cases of the IL group free liquid on the echograms was not revealed at all. In all cases of intraperitoneal hemorrhage with the volume more than 200 ml on the transvaginal echograms made in the saggital plane, a column of free liquid was fixed. In the women of II group the echograms of the type 2 – 198 (70.3%) cases were most frequently observed. When intraperitoneal hemorrhage reached more than 500 ml, all ultrasonic images were of the type 3. In 18 (14.4%) patients of III group US study revealed hyperechogenic free liquid with the echoheterogenic sections in the vesicouterine space and around the ovaries.

In 70.0% of women of I group with the significant pain attack ultrasonic image of CHFO corresponded to the type I. The echogram of the type II was encountered in the majority of cases – 80.0% – in the patients with insignificant pain syndrome who mostly had out-patient treatment. In 281 (68.9%) woman with moderate and significant hemoperitoneum there was observed the ultrasonic image of the type III.

On the whole in 792 (89.2%) patients the diagnosis of apoplexy of the ovary and intraperitoneal hemorrhage was made before surgical intervention on the basis of the clinical picture and US data. In the remaining cases – 92 (10.4%) it was necessary to perform diagnostic laparoscopy for confirming the diagnosis.

When according to the US data and laboratory indices the volume of the blood in the abdomen did not exceed 200 ml, the hemodynamically stable patients were started conservative treatment, accomplishing dynamic observation with the ultrasonic monitoring. The hemostatic therapy was the first to administer: etamzilat (dicinon), adroxon, menadione, the solution of calcium chloride, tranexan and aminocaproic acids. To reduce the intensity of pelvic pains non-steroid antipyretic drugs were administered – both in injections and rectal suppositories. When the pain attack peak has already passed and in refusal to be observed at the in-patient department, out-patient treatment with the obligatory medical examination and ultrasonic monitoring was administered on the following day.

After disappearance of danger of the prolonged intraperitoneal hemorrhage further out-patient therapeutic measures were taken, directed at the resolution of the formed CHFO. Taking into account the important role of the infectious inflammatory processes of the small pelvis organs in the development of the tumor-like processes of the ovaries as one of the probable sources of AO, we give antibacterial therapy from the moment of CHFO formation considering the revealed pathogenic agents. To block the pathologic secretion of the gonadotropic hormones the hormonal drugs were administered (combined oral contraceptives or synthetic progestins). According to our observations, up to 90% of CHFO regressed after the first period, which was controlled by the transvaginal US. In case of absence of CHFO regress more than 50% patients were performed laparoscopic intervention.

All patients of II and III groups as well as 210 women of IL group were subject to urgent laparoscopic intervention. The most frequently performed hemostatic operation was resection of the ovary – 477 (77.2%) interventions. In 65 (10.5%) cases the uterine appendages were removed on the side of affection because of the significant destruction of the ovarian tissue by the pathologic process or development of the suppurative inflammatory process in ovarian hematoma, which involved practically the entire ovarian tissue. Diagnostic laparoscopy was performed in case the cause of insignificant hemorrhage in the small pelvis and expressed pain syndrome was pathologic ovulation.

There was no revealed adhesive process during the operation in the small pelvis and abdominal cavity in 398 (64.5%) patients; I-II degree of the manifested adhesive process was found in 146 (23.6%) patients. The manifested adhesive process of the small pelvis organs of III-IV degree was present in 74 (11.9%) patients. The larger volume of intraperitoneal hemorrhage was observed more frequently in the patients in absence of adhesive process in ovarian hemorrhages than in the patients with the accompanying adhesive process. Thus, the average volume of hemoperitoneum found in the patients with AO, in absence of the adhesive process was (273.5±21.3) ml, while in the patients with the expressed adhesive process of the small pelvis organs it was (141.4±35.5) ml. The cause of AO in more than the half of the cases – 348 (56.3%) was the corpus luteum or cyst of the corpus luteum. A considerably less frequent cause of ovarian intraperitoneal hemorrhage was other benign tumors and tumor-like formations of the ovaries (serous, follicular, endometrioid cyst).

Besides hemostatic intervention on the ovarian tissue the majority of patients – 348 (56.3%) were performed additional surgical intervention to eliminate the accompanying pathology of the small pelvis organs. The average duration of the surgical intervention was (41.3±1.8) min – from 15 to 110 min. In the postoperative period the basic method of anesthetization was the application of nonsteroid analgesics during the first two days. After surgery the patients were in the hospital from 1 to 3 days, on an average (1.9±0.1) day.

During the operation the most frequent intraoperative finding in the patients of I“C”LC subgroup was the adhesive process of the small pelvis, caused by previous acute inflammatory diseases and open surgical intervention. The adhesive process of I-II degree was revealed in 18 (16.9%) patients of this group, and of III-IV degree – in 39 (36.4%) cases. The formation of persisting CHFO against the background of external endometriosis was detected in 35 (32.1%) women of this group, endometriosis of the peritoneum of I-II degree – in 19 (17.5%) patients, and of III-IV degree in 17 (15.7%) women of I“C”LC subgroup.

After obtaining the results of the histological study further antirelapse therapy was carried out taking into account the morphological structure of the source of ovarian hemorrhage. The monophasic low-dose combined oral contraceptives (COC) in the cyclic regimen from 3 to 12 mo, depending on the reproductive intentions of the patient were used for the prevention of relapses of apoplexy from the follicular cysts of the ovary. If the patient was revealed endometrioid cyst or endometriosis of other localization, the depot – drugs of the gonadotropin-releasing- hormone (aGnRH) agonists were obligatory used in the treatment for the period from 2 to 4 mo. After successful therapy by the preparations of aGnRH, depending on the reproductive intentions of the patient, the long-term therapy with COC or synthetic progestins was used. The latter (noretisteron acetate, didrogesteron) were administered to the patients with cysts of the corpus luteum. When the woman had reproductive intentions in the near

future there was used antirelapse therapy with didrogesteron (dufaston) given on the 16th day of MC with the daily dose of 20-40 mg for the period from 10 days to 6 mo. Every 6-9 mo of therapy with COC or synthetic progestins interruption in the hormonal therapy was made during the period from 3 to 5 mo. During the interruption there were used plant and vitamin preparations (remens, tocopherol acetate, gincohel), utilized for the regulation of the hormonal homeostasis of a woman.

We succeeded in following up the long-term results of treatment in 487 patients (of I group – 231 women, of II group – 144 patients and of III group – 53 patients). The long-term results of treatment of ICLT, IL and I“C”LC subgroups were observed in 58, 100 and 73 patients respectively. The average duration of the patients' follow up was 31.7 mo (from 12 to 47 mo). The long-term results of treatment of AO were evaluated according to the state of the woman's reproductive function and development of the disease relapse (Table1).

According to the data obtained, the greatest incidence of relapse of apoplexy of the ovary, formation of CHFO and most prolonged period of subfertility were observed in the women of ICLT subgroup. The desired uterine pregnancy began more frequently in the patients of IL, II and III groups – 74 (74.0%), 105 (72.7%) and 39 (73.8%) cases respectively. Within the period of the observation 34 (58.6%) women conceived of those treated conservatively. In the subgroup I“C”LC two thirds of the observed patients conceived – 45 (61.6%). Reduction in the reproductive function in the women of this subgroup is explained by high rate of the extensive adhesive process, observed before the operation. The average period between the treatment of AO and the desired pregnancy was approximately identical in laparoscopically operated women and made 7.5; 7.4; 7.5; 7.8 mo. For IL, I“C”LC, II and III groups respectively, and in women ICLT subgroup this index increased to 9.5 mo.

Relapse of ovarian hemorrhage in the form of CHFO formation was observed in 14 (24.1%) patients of ICLT subgroup, in 21 (14.5%) women of II

Table 1. Long-term results of treatment of apoplexy of the ovary.

The indices investigated	I group, n = 231			II group, n=144	III group, n=53
	IK group, n=58	IL group, n=100	I“C”LC group, n=73		
<b>Reproductive function:</b>					
- they became pregnant	34 (58.6%)	74 (74.0%)	45 (61.6%)	105 (72.7%)	39 (73.8%)
- the period of subfertility, mo	9.5	7.5	7.4	7.5	7.8
<b>Relapse of apoplexy of the ovary and formation of CHFO</b>	14 (24.1%)	-	-	21 (14.5%)	8 (15.0%)

group and in 8 (15.0%) patients of III group. Within the period of the observation of AO and CHFO relapses were not observed in patients of IL and I“C”LT group. 3 (5.1%) patients of ICLT subgroups had to be performed laparoscopic intervention. AO was controlled conservatively in the remaining patients; 8 (13.7%) patients of ICLT subgroup agreed to diagnostic laparoscopy in a year after AO attack due to recurrence of the cystic formations, during which 5 women were revealed the adhesive process of the II-III degree of extension, 4 had external endometriosis of II degree.

## CONCLUSIONS

Thus, the manifestation of the clinical symptoms in apoplexy of the ovaries depends on the volume of intraperitoneal hemorrhage. The data analysis of transvaginal echography allows to determine quantitatively, with a high degree of accuracy the volume

of intraabdominal hemorrhage and the morphological state of the affected ovary. Noninvasive diagnosis of the volume of hemoperitoneum in AO is used for differentiated selection of patients for the conservative or surgical treatment. Taking into account the fact that the adhesive process and endometriosis of the small pelvis peritoneum frequently accompanies ovarian hemorrhages, especially those clinical forms, which are subject to the conservative treatment (hemoperitoneum up to 200 ml), they can be one of the most probable causes of AO. Taking into account this, laparoscopy is a “gold standard” not only in diagnosis and treatment of AO, but also in prevention of possible ovarian hemorrhages. The application of laparoscopy as a main therapeutic and prophylactic method in AO allows to preserve and sometimes to restore reproductive function in almost 4 of 5 women with AO and reduce the rate of AO and CHFO relapse development.

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Prospects for further research are to study the long-term results of treatment, as well as the cost-effectiveness of the proposed method of prevention of complications during operations on the pelvic organs.

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# ANALYSIS OF ORGANIZATIONAL COMPONENTS OF EMERGENCY MEDICAL CARE FOR PATIENTS WITH ACUTE CORONARY SYNDROME IN POLTAVA REGION OF UKRAINE

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## Abstract

**The aim** of our research was to study the structure of patients with acute coronary syndrome and determine the organizational components of medical care for patients with suspected acute coronary syndrome in Poltava region.

**Material and methods:** For our study was on the one hand statistical reports of health care institutions for 2016-2018, and on the other – a survey of doctors and paramedics of emergency medical care teams on tactics management of patients with AMI. The methodological apparatus used to achieve the set goals was based on the determination of relative values and analysis of time series.

**Results:** The number of patients hospitalized with acute coronary syndrome is growing every year: from 82 people in 2012 to 489 in 2018. According to the monitoring conducted in Poltava region, emergency medical care for patients with acute coronary syndrome with ST segment elevation in 2018 in the cities was provided in the amount of 717, while in rural areas – 288.

**Conclusions:** Data from the analysis of emergency medical care for patients with acute coronary syndrome showed that among patients with ST-segment elevation, urban residents predominate; in 90.6% of cases, the time to the patient's hospitalization was less than 120 minutes.

## Key words

cardiovascular diseases, emergency medical care, myocardial infarction, acute coronary syndrome

## INTRODUCTION

Analysis of modern literature sources shows that the current demographic situation in Ukraine is extremely complex and is characterized by a rapid decline in population [1, 2]. Diseases of the circulatory system are one of the most common pathologies in the structure of the overall morbidity of the population of Ukraine and occupy one of the leading positions in the structure of primary disability and overall mortality, which is one of the most serious threats to national security.

Diseases of the circulatory system form a 67% structure of mortality and 23% of the structure of disability in the Ukrainian population, so the treatment of myocardial infarction is extremely important, as this pathology is one of the main causes of premature mortality and disability at global, regional and national levels. [3, 4].

According to the Ministry of Health of Ukraine, more than 50,000 heart attacks and almost 100,000 strokes are registered in Ukraine annually. According to mortality statistics, more than 1,000 people die per day in Ukraine: the average is 1,167 people per day, which is more than 400,000 people a year. To better understand the extent of the problem, this level of mortality in 2 years causes losses equal to the popula-

tion of Lviv or Dnipro. Particular attention needs to be paid to the fact that 108,000 people die each year as a result of untimely emergency medical care [5].

In Ukraine, from acute myocardial infarction, in 48 thousand patients, 20% of patients die annually, while in European countries – 5% [6, 7]. According to official statistics, in only in January 2020, in result of diseases of the circulatory system were died 36,341 people, including 25,053 from coronary heart disease, 398 from alcoholic cardiomyopathy, and 7,122 from cerebrovascular diseases. The incidence of acute myocardial infarction has increased by 17.5% over the past 10 years, which indicates that diseases of the circulatory system are a medical and social problem, as it leads to high mortality of patients of working age and reduced life expectancy. [8, 9]. These data, no doubt, are alarming and draw attention to the quality of medical care by physicians of therapeutical, cardiological, cardio-surgical specialties, as well as emergency specialists [10, 11].

One of the most promising and rapidly advancing fields in medical science is cardiac surgery [12, 13]. Today it is impossible to imagine the treatment of patients with congenital and acquired heart defects, coronary heart disease and complex cardiac arrhythmias without surgery [14-16].

**AIM**

The aim of our research was to study the structure of patients with acute coronary syndrome and determine the organizational components of medical care for patients with suspected acute coronary syndrome in Poltava region.

**MATERIAL AND METHODS**

The material for our study was on the one hand statistical reports of health care institutions (standard form №22) for 2016-2018, and on the other – a survey of doctors and paramedics of emergency medical care teams (number of respondents n = 412) on tactics management of patients with AMI. The methodological apparatus used to achieve the set goals was based on the determination of relative values and analysis of time series. Processing of statistical information and preparation of graphical presentation of data was carried out using the standard package MS Office 2016.

**RESULTS AND DISCUSSION**

The Poltava region has a population of 1,439,000 peoples, among which 1,800-1900 patients with acute myocardial infarction are registered annually. The number of patients hospitalized with acute coronary syndrome is growing every year: from 82 people in 2012 to 489 in 2018, the growth rate is 4.9%. Analyzing patients with acute myocardial infarction depending on the place of residence, it is seen that the proportion of rural and urban residents during this period was subject to fluctuations (Fig. 1). If at the beginning of the observation among patients with acute coronary syndrome significantly prevailed the share of cases from rural areas (67.1% in 2012), in 2015 most of them were from the city (61.5%), then from 2016 this ratio is almost equal, although a small percentage prevails in the case of rural residents (47.2% of urban and 52.8% of rural). On average, during the study period, 121.0 ± 31.5 cases were

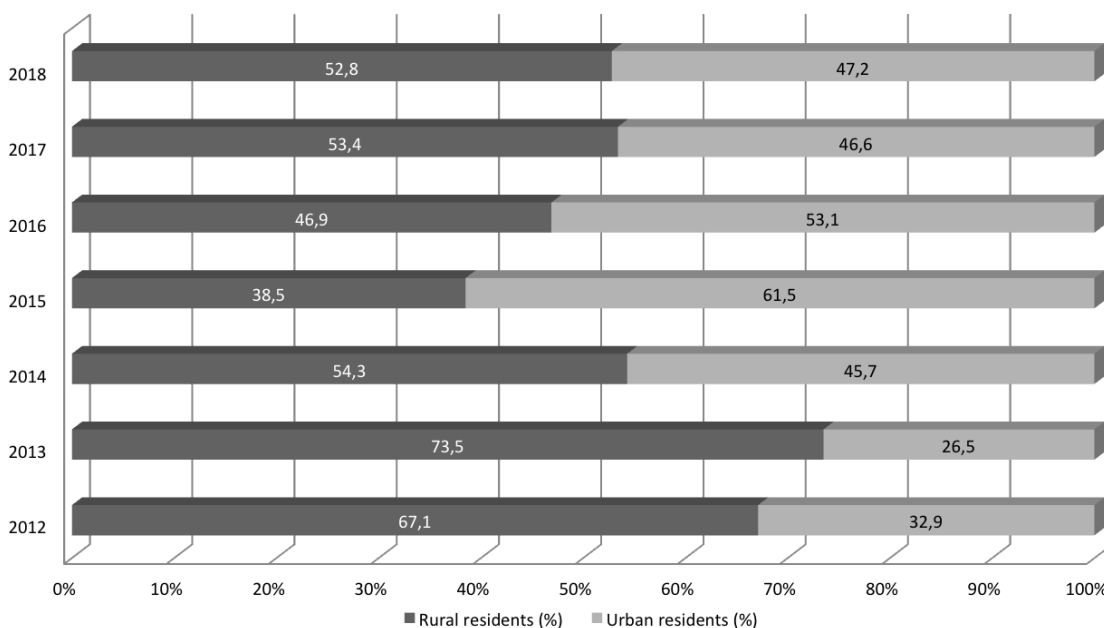


Fig. 1. Dynamics of the proportion of patients in rural and urban areas with a diagnosis of acute coronary syndrome treated in cardio-interventional departments of Poltava region (in 2012-2018).

Table 1. The structure of patients with acute coronary syndrome in 2012-2018, treated in cardio-interventional departments of Poltava region.

	2012	2013	2014	2015	2016	2017	2018
Acute transmural myocardial infarction of anterior wall (I21.0)	27	13	10	45	33	30	70
Acute transmural myocardial infarction of inferior wall (I21.1)	27	22	16	66	111	69	137
Acute transmural myocardial infarction of other sites (I21.2)	4	11	15	35	113	97	123
Acute transmural myocardial infarction of unspecified site (I21.3)	0	0	0	0	0	2	0
Acute subendocardial myocardial infarction (I21.4)	8	8	4	14	45	34	60
Subsequent myocardial infarction of anterior wall (I22.0)	5	14	4	11	6	13	12
Subsequent myocardial infarction of inferior wall (I22.1)	3	8	3	12	30	22	19
Subsequent myocardial infarction of other sites (I22.8)	8	7	18	23	33	72	68



determined in rural residents against  $113.5 \pm 32.9$  in urban residents, which did not differ significantly ( $p = 0.32$ ). As shown in the works of domestic scientists [17, 18], mostly patients with acute coronary syndrome who live in rural areas are less aware of the risk factors for myocardial infarction, have less access to tertiary care, then it becomes clear that the relationship between rural and urban residents with an advantage over rural ones.

Examining the structure of patients diagnosed with acute coronary syndrome, we found the following features of the distribution. Acute transmural myocardial infarction of anterior wall (I21.0) for all years was  $32.5 \pm 2.8$  cases per year, the highest figure was in 2015, when it was 45 cases, the overall growth rate was 38.5%. Acute transmural myocardial infarction of inferior wall (I21.1): the average value during 2012 – 2018 –  $64.0 \pm 6.8$  cases per year, the highest level was in 2018 – 137 cases, the overall growth rate -19.7%. Acute transmural myocardial infarction of other sites (I21.2) revealed significant differences in the number of this nosology: from 4 cases in 2012 to 123 cases in 2018, the growth rate of 3.2%. Such fluctuations in the number of patients are obviously due to errors in the diagnosis. Acute transmural myocardial infarction of unspecified site (I21.3) – such a diagnosis was established 2 times only in 2017. Acute subendocardial myocardial infarction (I21.4), on average for all years is  $24.7 \pm 3.6$  cases per year, the highest in 2018 – 60 cases, the overall growth rate -13.3%. Subsequent myocardial infarction of anterior wall (I22.0) averages  $9.2 \pm 1.0$  cases per year, the overall growth rate of 41.6%; subsequent myocardial infarction of inferior wall (I22.1) –  $13.8 \pm 2.0$  cases per year, the overall growth rate – 15.7%; subsequent myocardial infarction of other sites (I22.8) –  $32.7 \pm 3.5$  cases per year, the overall growth rate – 11.7%. (Tab. 1). Therefore, the largest number of cases are acute transmural myocardial infarction of inferior wall, in second place is acute transmural myocardial infarction in other localizations. This nosological group of acute coronary syndrome has a high chance of endangering the patient's life, as necrosis spreads to the entire thickness of the heart muscle from the endocardium to the epicardium and contributes to severe complications and a high probability of death.

Given the danger of acute coronary syndrome as an acute form of coronary heart disease, the main goal of treatment in the early stages is pathogenetic therapy, which begins with antithrombotic intervention. If this procedure is performed in the first 2 hours

after the onset of anginal attack, it allows not only to restore blood flow, but also to cause the reversal of myocardial infarction. Even carried out at a later date, thrombolysis, although it does not prevent the development of necrosis, but still allows to reduce its area and prevent the formation of aneurysms and heart failure in the distant periods of myocardial infarction. Cardiovascular risk stratification emphasizes that patients with ST-segment elevation acute coronary syndrome are considered high-risk patients and require urgent reperfusion therapy if signs of acute ischemia persist [19, 20].

According to the order of the Ministry of Health of Ukraine dated 02.07.2014 № 455 “On approval and implementation of medical and technological documents for standardization of medical care in acute coronary syndrome with ST-segment elevation”, the Unified Clinical Protocol of emergency, primary, secondary (specialized) and tertiary (highly specialized) medical care “Acute coronary syndrome with elevation of the ST segment” was approved [21]. The algorithm of action according to the protocol largely depends on the awareness of the patient and his relatives, who should call for emergency medical care, and the professional actions of the ambulance doctor and cardiac surgeons.

Clear interaction in the prehospital and hospital stages of treatment for acute coronary syndromes should be aimed at myocardial revascularization by reperfusion therapy by percutaneous intervention (it is desirable to perform the procedure within 120 minutes after the first call for medical care) in the first 24 hours after acute coronary heart disease with ST-segment elevation and no later than 72 hours in acute coronary syndrome without ST-segment elevation. Great importance is attached to thrombolytic therapy, which should be started as soon as possible (less than 30 minutes) after the diagnosis of acute coronary syndrome. In practice, prehospital thrombolytic therapy is preferred [22, 23]. If a patient with acute coronary syndrome is delivered to the catheterization laboratory in 90-120 minutes, percutaneous intervention without prehospital thrombolysis is preferred.

In accordance with the order of the Ministry of Health of Ukraine dated 28.09.2017 № 1181 “On approval of the Procedure for providing medical care and hospitalization of patients with acute coronary syndrome with elevation of ST segment by emergency medical teams” much attention is paid to monitoring and assessing emergency medical care to patients with acute coronary syndrome with elevation of the ST segment, information about which is transferred to the state institution “Ukrainian Scientific and Prac-

tical Center for Emergency Care and Disaster Medicine of the Ministry of Health of Ukraine”.

According to the monitoring conducted in Poltava region, emergency medical care for patients with acute coronary syndrome with ST segment elevation in 2018 in the cities was provided in the amount of 717 (71.4%), while in rural areas – 288 (28.6%) , which may indicate a lack of awareness of rural residents about the problem of acute coronary syndrome (Fig. 2). Comparing the composition of the teams that visited the patient, it was determined that there were medical teams in 496 (49.3%) cases and paramed-

ics – 509 (50.6%) (Fig. 3). This ratio of medical and paramedic teams indicates a clear implementation of the protocol algorithm, which did not depend on the level of medical education.

Analysis of the results of medical care for patients with acute coronary syndrome with elevation of the ST segment at the prehospital stage by ambulance crews found: patients transported to health care facilities with the possibility of percutaneous coronary interventions were 319 (36.3%), without possibilities of percutaneous coronary interventions – 559 (63.6%) (Fig. 4).

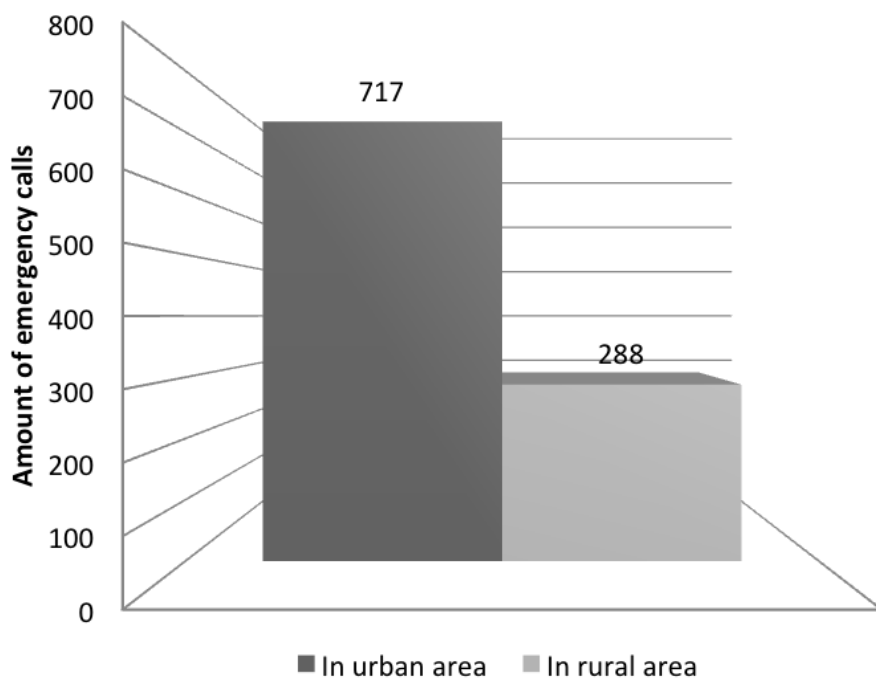


Fig. 2. The number of visits of emergency medical teams to patients with acute coronary syndrome with ST-segment elevation in urban and rural areas (in 2018).

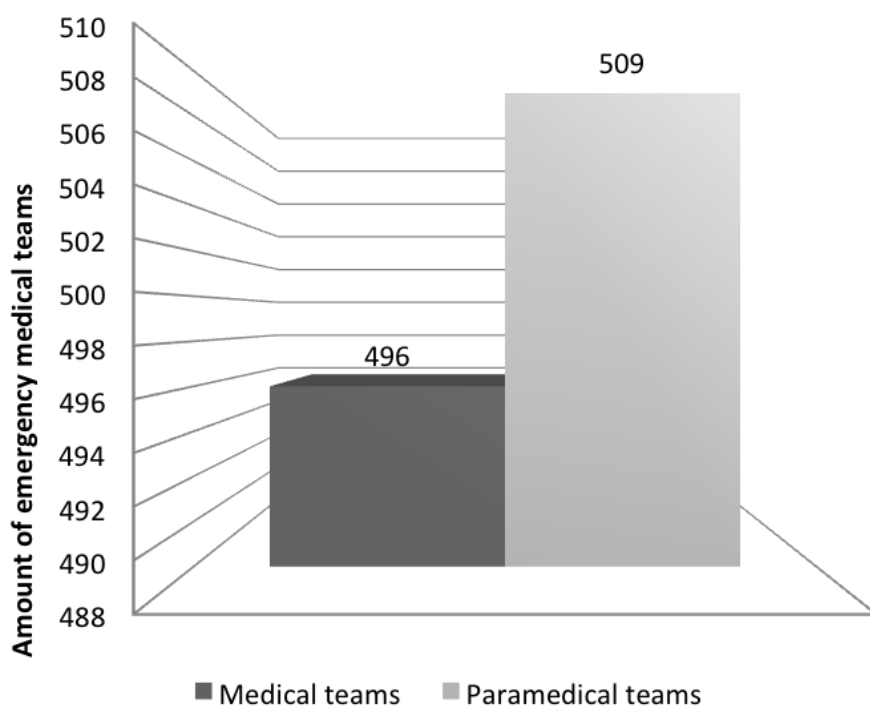


Fig. 3. Type of emergency medical teams that visited patients with acute coronary syndrome with ST segment elevation (in 2018).

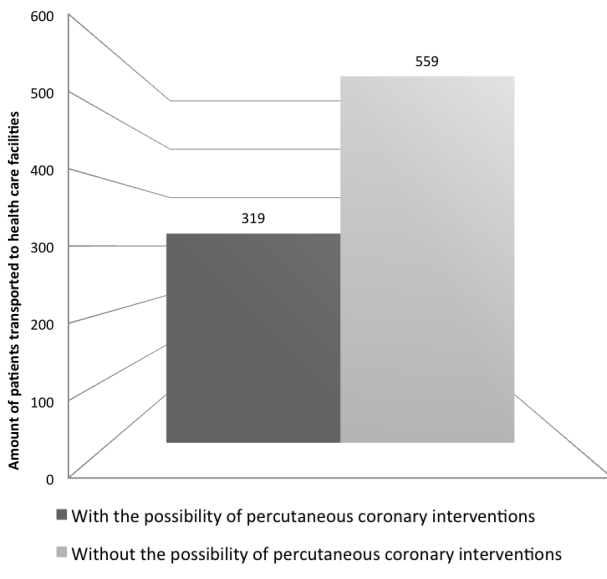


Fig. 4. The structure of hospitalizations of patients with acute coronary syndrome depending on the possibility of percutaneous interventions (in 2018).

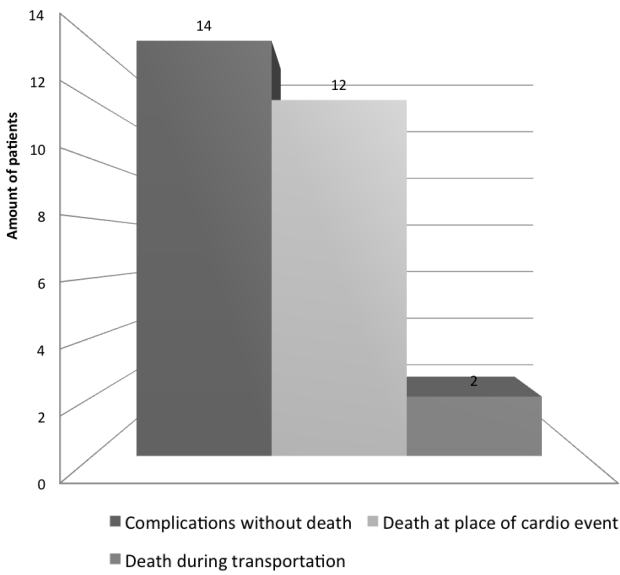


Fig. 5. Complications that occurred during the transportation of patients with acute coronary syndrome (in 2018).

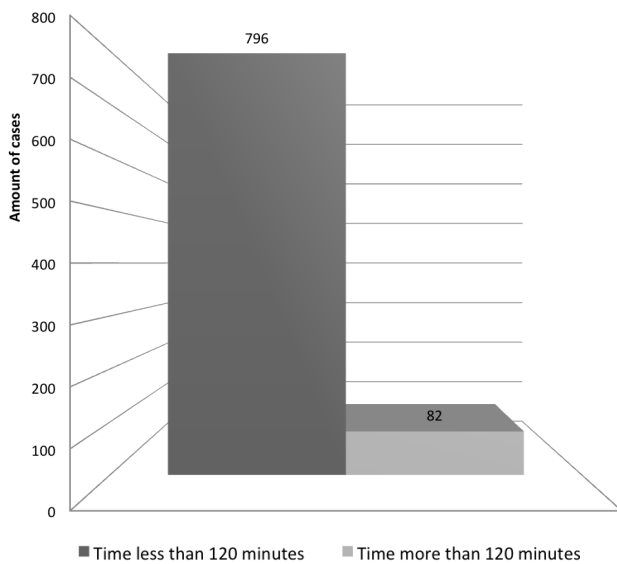


Fig. 6. Distribution of ambulance calls to patients with acute coronary syndrome depending on the time of arrival to patients and their transportation to hospital wards (in 2018).

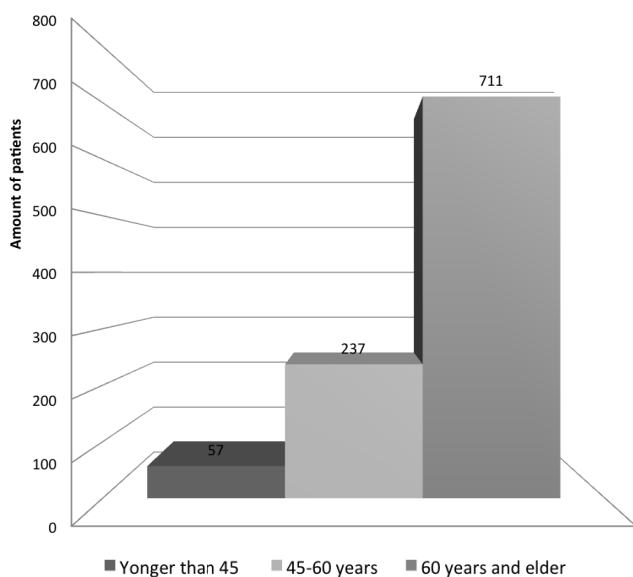


Fig. 7. Distribution of transported patients with acute coronary syndrome by age (in 2018).

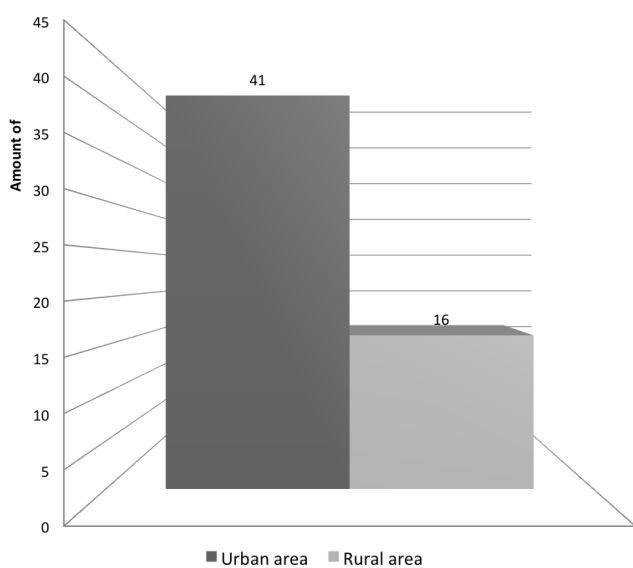


Fig. 8. The number of fibrinolytic procedures performed at the prehospital stage.

During the transportation of patients to hospital care facilities, there were 28 complications in providing care. Among them, 12 fatalities at the place of cardio event (42.9%) and fatalities during transportation – 2 (7.1%). Such lethality before the start of medical care may indicate the inefficiency of the arrival of both the emergency medical team and the inefficiency of relatives or the patient when calling the emergency service, or the severity of the patient's condition (Fig. 5).

After analyzing the time spent from the time of departure of the emergency medical team to the scene of the call to hospitalization with the possibility of percutaneous coronary interventions, we found: the time spent on call service was less than 120 minutes in 796 (90.6%) cases, more than 120 minutes in 82 (10.3%) cases (Fig. 6).

According to the age structure of patients with acute coronary syndrome with ST-segment elevation, it was found that patients younger than 45 years were – 57 (5.8%) people; aged 45 to 60 – 237 (23.5%) people; over 60 years – 711 (70.7%) people (Fig. 7).

Examining the data on pre-hospital fibrinolytic procedures for patients with acute coronary syndrome, it was found that they were performed more often in cities – 41 (71.9%) cases, against 16 (28%) – in rural areas (Fig. 8). Timely implementation of these procedures can suspend the development of acute myocardial infarction.

In response to the challenges of time, namely the use of modern cardiac surgery technologies, emergency medical teams were equipped with new medical equipment: received and used 100 units of electrocardiographs with remote ECG transmission

Table 2. Consultative and diagnostic assistance based on telemedicine technologies in Poltava region.

Telemedicine technologies		2016	2017	2018	Growth rate (%)
Accepted ECG	Total at the central station	4915	5424	4840	-1,52
	"Unet"	3688	3619	3095	-16,0
	"Telecard"	1227	1805	1745	42,2
<b>Total ECG consulted</b>		<b>7466</b>	<b>6159</b>	<b>5690</b>	<b>-23,7</b>

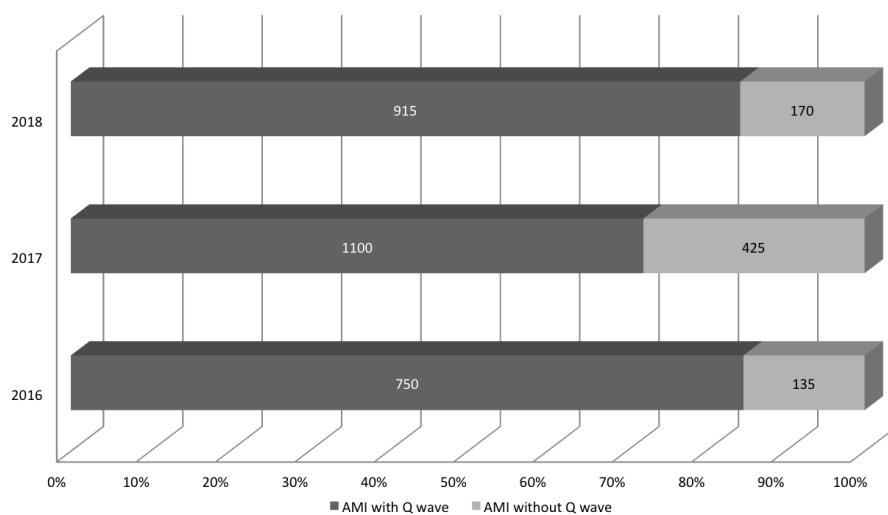


Fig. 9. The number of ECGs on which AMI (with and without Q wave) was diagnosed using telemedicine technologies in 2016-2018.

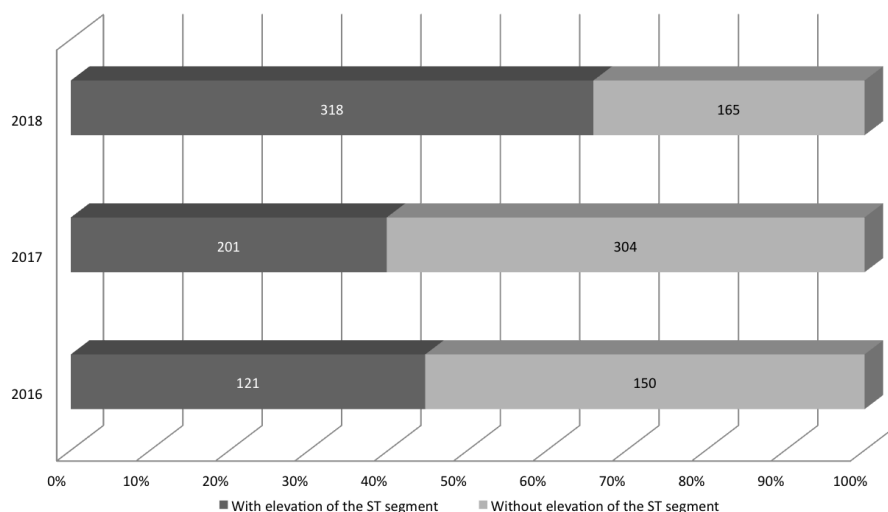


Fig. 10. The number of acute coronary syndromes with elevation and without elevation of the ST segment diagnosed by using of telemedicine technologies for 2016-2018.

SE-301. In 2018, a modern telemedicine center for on-line emergency counseling was developed in Poltava oblast, where two central stations of the "Telecard" system and one station of the "Yunet" system operate for receiving an ECG by telephone. The analysis of the system of use of the "Telecard" transmitter shows its ease of use by personnel, accessibility in use by ordinary citizens, mobility in the transmission of ECG via mobile, landline and radiotelephones, radio station, as well as satellite communication. The reliability and convenience of this system is indicated

by the fact that it is possible to restore the last ECG; the database has the ability to import and export ECG files; ECG decoding is possible without printing; possible change of voltage and ECG speed, which is adjusted accordingly when printing the ECG; there are functions for measuring intervals, analysis of PQRST complexes, heart rate is automatically calculated, etc.

In the region, the network of tele-ECG system "Telecard" is 4 stations. At these stations ECG are received from 131 peripheral devices – transmitters. All central district hospitals have transmitters. In ad-

dition to the above, the transmitters of the “Telecard” system are also available in rural areas. In addition, in the regional center there is a station of the “Yunet” system, which receives ECG from ECG-devices “Ucard – 100”, which meets the international standard of information transmission ISO 11073-91064: 2009 (SCP-ECG). It stipulates that the ECG transmission should be accompanied by such information as patient data, doctor, examination conditions. As this station is the most qualitative and modern, in the Poltava region transition to its application is conducted (Tab. 2). Thus, in 2018, ECG transmission was performed from 67 “Ucard-100” devices (58 devices in 2017 and 36 in 2016).

In 2018, telemedicine devices received 885 ECGs with AMI (in 2017 – 1525 and in 2016 – 1085), which is 17.1% of all transmitted ECGs. Of these, 750 ECG – AMI with Q wave (in 2017 – 1100 and in 2016 – 915), which is 84.8% of the total number of ECGs with AMI (Fig. 9).

In addition, the telemedicine center recorded the ECG of patients with acute coronary syndrome. ECG with acute coronary syndrome was recorded 483 (in 2017 – 505 ECG and in 2016 – 271 ECG) (Fig. 10), including ECG of patients with acute coronary syndrome with elevation of the ST segment received – 318 (in 2017 – 201 ECG and in 2016 – 121 ECG).

## CONCLUSIONS

Thus, the study found that the growth rate of the number of patients hospitalized with acute coronary syndrome increased 4.9 times: from 82 people in 2012 to 489 in 2018. It is determined that on average there are  $121.0 \pm 31.5$  cases among the rural population against  $113.5 \pm 32.9$  among the urban population.

Analysis of the nosological structure revealed that the most common form of coronary syndrome is acute transmural myocardial infarction of inferior wall.

Data from the analysis of emergency medical care for patients with acute coronary syndrome showed that among patients with ST-segment elevation, urban residents predominate (71.4%); in 90.6% of cases, the time from the departure of the emergency medical team to the patient’s hospitalization was less than 120 minutes; by age structure, the largest proportion of patients was older than 60 years (70.7%).

It is proved that the amount of consulting and diagnostic care based on telemedicine technologies is growing due to the UNET station which meets the international standard of information transfer ISO 11073-91064: 2009 (SCP-ECG), which allows to carry out remote diagnostics thereby minimizing the need for cardiologists. remote areas and unjustified transportation of patients who have been misdiagnosed with AMI.

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# THE IMPORTANCE OF CARNITINE AND ITS METABOLISM IN NEWBORN: LITERATURE REVIEW AND CLINICAL CASE

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## Abstract

**Aim:** To analyze the literature on the processes of formation of endogenous and exogenous carnitine, its metabolism and function in the newborn.

**Material and methods:** The literature data and international clinical recommendations for pathological conditions leading to primary and secondary carnitine deficiency have been retrospectively analyzed. A clinical case of a child with suspected systemic carnitine deficiency is presented.

**Conclusions:** Depending on the reasons that led to carnitine deficiency, there are primary and secondary carnitine deficiency. Primary carnitine deficiency is a rare condition that can lead to metabolic decompensation, muscular and cardiac myopathy, and sudden death. Secondary carnitine deficiency can be caused by a genetically determined congenital metabolic defect, insufficient substrate intake, acquired disorder, immaturity of the biochemical pathway in premature infants, renal failure or iatrogenic exposure. Familiarization with the main causes of carnitine deficiency in newborns will more effectively detect and correct the clinical manifestations of this condition.

## Key words

newborns,  
carnitine metabolism,  
carnitine deficiency

## INTRODUCTION

Amino acids and glucose are the main energy substrates for the development of the fetus during the intrauterine period. They cross the placenta and accumulate partially for the postnatal development of a newborn. A child actively uses prenatal glycogen and fat stores after birth. Lipids are the key source of energy for newborns during postnatal period [1].

Fatty acids (FA) can cross the placenta. But constant flow of glucose and amino acids make tissues of the fetus almost unable to oxidize FA, which get stored as triglycerides in liver and adipose tissue [2]. Production of energy out of lipids depends on the considerable symbiosis of certain ferments and transporters. Fatty acids oxidation and ATP synthesis in mitochondria is the final and one of the most important stages of this process. ATP synthesis level depends on the flow of fatty acids inside mitochondria. Carnitine is a key member of this process. It transports long-chain fatty acids to mitochondria through their membrane where their  $\beta$ -oxidation goes to acetyl-CoA in the citric acid cycle (TCA cycle), and serves as a source of energy for ATP synthesis. Presence and accessibility of carnitine can be essential for a newborn during postnatal period of life [3].

## AIM

The aim is to analyze the role of carnitine for newborns, its metabolic features, to appreciate the importance of its laboratory definition and implementation of deficiency correction by the clinical case of a child with system disorders.

## MATERIAL AND METHODS

Literature data and international clinical recommendations concerning pathological conditions that cause primary and secondary carnitine deficiency have been retrospectively analyzed. A clinical case of a child with the systemic carnitine deficiency has been provided.

## REVIEW AND DISCUSSION

Body's need for  $\beta$ -oxidation of fatty acids rapidly grows in the context of the increased need for energy in newborns after birth. This process is impossible without carnitine [4].

Carnitine is a natural amino acid related to "B" vitamins which is synthesized in the body, takes active part in transportation of long-chain fatty acids to mitochondria through cell membrane, and provides support of coenzyme A (CoA). This compound is found in striated muscle tissue, myocardium, brain, liver,

and kidneys. Endogenous formation of carnitine out of gamma-butyrobetaine occurs in the cells of liver and kidneys by transforming lysine. Methionine is a donor of methyl groups [5].

Food and own proteins of the muscle system are a source of carnitine. It has anabolic, antihypoxic, and antithyroid features; activates fat metabolism, stimulates regeneration, increases appetite, and provides energy making functioning of the body cells possible. Endogenous synthesis of 10-20% of carnitine isn't enough for the full provision of the daily body need. That's why the rest of it must be provided exogenously with food mainly of animal origin [6].

There is primary and secondary carnitine deficiency depending on the reasons which cause it. Primary carnitine deficiency or systemic primary carnitine deficiency (SPCD) has autosomal-recessive type of inheritance. SPCD occurs as the result of mutation in SLC22A5 gene which is located in 5q31.1 chromosome, and codes sodium-dependant transporter of carnitine (OCTN2). OCTN2 is expressed in the cells of liver, heart, kidneys, and fibroblasts of skin. Primary carnitine deficiency is a rare condition that can lead to metabolic decompensation, muscle and heart myopathy, and sudden infant death. There are 2 forms of PCD: severe neonatal (cardiomyopathic) which is characterized by high risk of SIDS, and infant (hepatic) form of disease [7].

Clinical symptoms of carnitine deficiency are rather nonspecific which makes the diagnostic process complicated along with qualified medical care assistance promptly and in full [8].

Manifestation terms of the disease are from 1 month to 7 years (2 years on average). The main symptom in early childhood is hypoketotic hypoglycemic encephalopathy (lethargy, sleepiness, seizures, repeated vomiting), hepatomegaly, and cardiomyopathy. Children often have intercurrent illnesses and psychomotor underdevelopment. Older children have signs of skeletal myopathy, myocardial failure, and gastrointestinal tract disorders (abdominal pain, diarrhea) [9].

Systemic primary carnitine deficiency in children is characterized by very low levels of free and total carnitine in plasma, lipid myopathy with microvesicular accumulation of lipids in liver and muscles, presence of carnitine in urine. Treatment of SPCD includes diet therapy: frequent regular feeding at least 8 times per day. Energetic balance of food intake must consist of proteins (12-14%), carbs (58-68%), and fat (18-30%). The diet must include medium-chain triglycerides in the form of oils. It's necessary to start taking carnitine as soon as possible to prevent per-

manent brain and internal organs damage. It's recommended to take carnitine under control of carnitine concentration in blood plasma in the dynamics. In case of metabolic crisis intensive care, hemodialysis or peritoneal dialysis must be provided [10].

Carnitine uptake defect in children (CUD) is characterized by high mortality due to central nervous system, heart, and liver damage. Long-term prognosis can be favourable in case of substitution therapy with carnitine preparations [11].

Secondary carnitine deficiency can be caused by genetically determined inborn errors of metabolism, acquired defect or iatrogenic effect (taking valproate or Zidovudine preparations, hemodialysis). The most common reason of secondary carnitine deficiency is congenital metabolic disorders (CMD) caused by disorder of fatty acids oxidation in mitochondria or organic aciduria. Metabolic block which occurs in these conditions leads to accumulation of metabolites acyl-CoA, that are esterificated by carnitine with its deficiency [12]. Intermediate metabolites (acylcarnitines) get stored in the bodily fluids and have toxic effects on tissues of the brain, heart, and liver. They suppress ferments of gluconeogenesis and urine formation cycle; and have signs of acute encephalopathy (hypotension, lethargy, sleepiness, coma) and bouts of vomiting. Tonic or clonic seizures, signs of heart or liver failure can be observed. Moreover, one of the most widespread reasons is insufficient exogenous taking of carnitine with food [13].

Carnitine deficiency or fermentative defect can lead to metabolic crisis development. Decompensation condition caused by unfavourable factors that increase the process of cell catabolism with the depletion of carbs and activation of fat metabolism, intoxication of fatty acids  $\beta$ -oxidation as a reserve source. Manifestation of clinical signs is connected with prolonged fasting and conditions that increase catabolism processes such as fever, infections, vaccination, physical and emotional exertion [14].

The situation is compounded in preterm infants by insufficient transplacental transfer of carnitine which is carried out mostly during the 3rd trimester of pregnancy, immaturity of ferments of carnitine synthesis, and its decreased reabsorption in kidneys. It's also known that energy consumption of the body increases when there is a severe respiratory insufficiency especially amid bacterial infection. That's why metabolism of carnitine which takes part in fat metabolism as a source of energy deserves attention especially in preterm newborns and infants with perinatal pathology [15].

Here is the clinical case of a child with systemic primary carnitine deficiency. The child named A. was

born from the second pregnancy and first vaginal delivery in anterior position in 35 weeks of gestation. A score on Apgar scale of 6 to 7, birth weight is 1,8 kg, height is 43 cm, head circumference is 30 cm, thorax circumference is 29 cm. The child is too small for gestation term according to the schedule of centyl type. The general condition of the child is critical since birth, respiratory support with mechanical ventilation; expressed hypotension; hepatomegaly; decreased tolerance for enteral nutrition. The child was in critical condition several times during the treatment in the ICU of newborns. The child was getting intensive care in full with the following stabilization of its condition during bouts of apnea, bronchospasm, asystole, and decompensation of hemodynamics.

According to laboratory studies: anemia, leucocytosis, thrombocytopenia, and hyperbilirubinemia. X-ray of thoracic organs showed interstitial edema of lungs and cardio-torakal index – 0,69; echo – cardiomegaly, a patent ductus arteriosus. The additional laboratory study revealed a decreased level of free carnitine – 4,2 mmol/L (N=7,8-84  $\mu$ mol/L). Thanks to primary prescription of carnitine at a dose of 100

mg/kg/day the child showed positive dynamics and stable regression of pathological conditions.

During hospital treatment the child underwent a complex of clinical laboratory, instrumental examination methods, consulting of specialists, treatment according to clinical protocols and standards of medical care. The child was referred to molecular genetic analysis of SLC22A5 gene. Systemic primary carnitine deficiency was confirmed.

## CONCLUSIONS

Understanding of the carnitine metabolism and definition of the main reasons of carnitine deficiency in newborns with perinatal pathology or in preterm newborns can help to solve some problems which occur during adaptation period especially during intensive growth and development of children. The necessity of the routine use of carnitine preparations to prevent carnitine deficiency isn't proved. That's why it's very important for doctors to use differential diagnosis for singling out conditions when treatment with carnitine preparations will improve prognosis for children.

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## **ABSTRACT BOOK**

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**ANALYSIS OF THE STATE OF EMERGENCY MEDICAL CARE IN UKRAINE***Inna V. Bielikova, Iryna A. Holovanova, Maksym V. Khorosh, Anatoiy V. Kostrikov*

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**Introduction**

Due to the changes in the assessment criteria for the urgency of cases, that implemented in Ukraine, and in connection with the adoption of the Order of the Cabinet of Ministers of Ukraine "On the standards of arrival of emergency (ambulance) teams at the place of an accident" raises the question of community awareness of changes in health care and the importance of timely seeking of the medical care in appropriate health care facilities.

**The aim**

The aim is to analyze the organization of emergency medical care and the reasons for the visits of ambulance teams in Ukraine.

**Material and methods**

The materials were the reporting forms of ambulance and emergency medical services of Ukraine. Methods of descriptive statistics were used.

**Results**

From 2020 in Ukraine, the dispatcher of the emergency service assesses the patient's health as: 1) critical (when there is an immediate threat to life, the need for resuscitation and is accompanied by shortness of breath, inefficient breathing, signs of massive blood loss / bleeding); 2) emergency calls (treatment of patients or victims of emergencies that threaten human life and health and can lead to a sharp deterioration of the patient's condition); 3) non-emergency calls (treatment of the victim or patient whose health is not urgent and the postponement of medical care will not lead to deterioration of health, but such a person needs to be assessed by a health professional and can be referred to a general practitioner).

According to the Ministry of Health, in 2019 there were 29 emergency medical care institutions in Ukraine (in 2017 – 33; 2016 – 40), including 28 independent institutions (in 2017 – 33; 2018 – 38) and one that is part of other institutions (Kyiv). In total, 4391 doctors (2017 – 4825 people; 2016 – 4911), 15815 paramedics and nurses (in 2017 – 16136; 2016 – 16137) work in these emergency care facilities.

The total number of ambulance calls in Ukraine – 8,059,161 (2017 – 9465 137; 2016 – 10,091,801), among it: 846,861 (10.5%) – were unsubstantiated (2017 – 604539; 2016 – 554,072). In the structure of the reasons for the departures of ambulance in Ukraine as a whole, there are: accidents, injuries and poisonings – 636237 (9.26%); sudden diseases and conditions – 4,936,583 (71.86%); visits to chronic patients – 343,072 (4.99%); unsubstantiated departures – 226,048 (3.29%); outpatient births and pathology of pregnancy – 33,348 (0.48%); transportation of patients, parturients to medical institutions and trauma centers – 253952 (3.69%); unsuccessful departures – 300079 (4.37%). These indicators have regional differences and vary within the country.

**Conclusions**

Thus, it is established, that the number of health care facilities providing emergency medical care is declining, and there is a decrease in the number of doctors, paramedics, nurses. Analysis of the reasons for the departures of emergency medical teams indicates that: in general, the number of departures in Ukraine is decreasing, however, at the same time, in 2019 the number of unfounded calls is increasing (compared to 2016 by 15%). In the structure of the reasons for ambulance departures, 71.86% are due to sudden diseases and conditions. It can be assumed, that the growth of unjustified ambulance calls is due to the insufficient level of public awareness about the health risks and, as a consequence, to the increased level of anxiety of patients about the severity of their own health.

**Key words:** Emergency medical care, medical awareness of the population, health care personnel.

**RESULTS AND TREATMENT OF MYASTHENIC CRISIS IN PATIENTS WITH GENERALIZED MYASTHENIA IN THE POSTOPERATIVE PERIOD***Valeriy V. Boyko<sup>1,2</sup>, Dmytro V. Minukhin<sup>1</sup>, Olena M. Klimova<sup>2</sup>, Olena V. Lavynskaya<sup>2</sup>, Denis O. Yevtushenko<sup>1</sup>, Kateryna V. Ponomareva<sup>1</sup>, Vasyl V. Kritzak<sup>2</sup>*<sup>1</sup> KHARKIV NATIONAL MEDICAL UNIVERSITY, KHARKIV, UKRAINE<sup>2</sup> STATE INSTITUTION "INSTITUTE OF GENERAL AND EMERGENCY SURGERY NAMED AFTER VT ZAITSEV NAMS OF UKRAINE", KHARKIV, UKRAINE**Introduction**

Myasthenic crisis is a sudden sharp deterioration of a patient with myasthenia gravis with severe muscle weakness, respiratory and swallowing disorders, which often leads to death (Sanadze AG, 2017; Kotov SV, 2016). According to the leading myasthenic centers, the mortality rate in generalized myasthenia is generally 2.2–3.5%, and in myasthenic crisis it can reach the level of 4.7–9.3%. The frequency of myasthenic crisis ranges from 15 to 27%, and in the postoperative period can reach 47% of cases.

**The aim**

Clarification of the frequency and causes of death in myasthenic crisis in the postoperative period, determining the main areas of treatment.

**Material and methods**

The analysis of fatal cases during myasthenic crisis in patients with generalized myasthenia gravis, who were treated at the State Institution "Institute of General and Emergency Surgery named after VT Zaitsev NAMS of Ukraine" for 19 years (from 2000 to 2019) was performed.

**Results**

Over 19 years, 309 patients with generalized myasthenia gravis were treated, myasthenic crisis developed in 57 (18.24%) patients, of whom 48 (15.4%) in the early postoperative period. Among all patients with crisis, death occurred in 9 (15.8%) patients, in operated patients – 7 (14.7%) cases. All patients were older than 55 years. Causes of death: 3 (33.3%) cases – myocardial infarction, 5 (55.6%) – bilateral pneumonia, 1 (11.1%) – pulmonary embolism. All deceased were diagnosed with concomitant diseases: hypertension, coronary heart disease, chronic obstructive pulmonary disease.

All patients were treated with glucocorticoids, intravenous human immunoglobulin, plasmapheresis, potassium supplements. The use of anticholinesterase drugs in the event of a crisis was decided in favor of their temporary withdrawal, because increasing their dose provokes coronary vasospasm and can lead to myocardial infarction.

**Conclusions**

Myasthenic crisis is a life-threatening condition. Of the 309 patients with generalized myasthenia gravis, crises developed in 18.24%, and in the postoperative period in 15.4% of patients. The total and postoperative mortality during the crisis was 15.8 and 14.7%, respectively. Concomitant pathology was the main predictor of complications. The following treatment protocol for myasthenic crisis should be considered and recommended: 1) adjuvant respiratory therapy or artificial lung ventilation; 2) cancellation of anticholinesterase drugs; 3) monitoring of cardiac activity; 4) detection and treatment of infectious complications; 5) prevention of thromboembolic complications. Methods of specific therapy are: 1) plasmapheresis; 2) intravenous administration of human immunoglobulin; 3) high doses of glucocorticoids.

**Key words:** generalized myasthenia gravis, myasthenic crisis, treatment of myasthenic crisis.

**EMOTIONAL STATUS OF PATIENTS WITH ACUTE MYOCARDIAL INFARCTION AMONG RESIDENTS OF POLTAVA REGION***Iryna A. Holovanova, Vyacheslav M. Zhdan, Grigory A. Oksak, Tetiana V. Pluzhnikova, Oksana I. Krasnova, Natalia A. Lyakhova*

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**Introduction**

Emotional reactions of each patient to the fact of the disease are different. It is difficult for a person with any disease to control their emotions, to be able to understand their emotional experiences, to manage their emotional state. To date, the subjective, emotional state of a patient diagnosed with an acute myocardial infarction remains unnoticed. The article is devoted to the study of the interaction of emotional and cognitive processes. The author pays special attention to the role of emotional state and the relationship between emotions and cognitive abilities in patients with acute myocardial infarction during hospitalization.

**The aim**

Aim: to analyze the emotional state of a patient with acute myocardial infarction during hospitalization.

**Material and methods**

The work used: bibliosemantic, sociological, medical and statistical methods.

**Results**

Before hospitalization, patients were interviewed retrospectively about how they felt at each stage from the onset of symptoms to their tertiary hospitalization. Every patient in an acute condition needs outside help. We interviewed not only patients, but also their relatives or close people who were nearby at that difficult time and accompanied patients to the tertiary level. In the initial stages, when symptoms suddenly appeared, a call to the emergency medical service (EMD) was made and during the diagnosis almost all patients together with the patient's family felt anxiety, embarrassment, fear of death (98%). Anxious-depressed mood was observed with obsessive negative thoughts about one's personality, one's own condition and future life. With courage and concentration, patients and those who accompanied them agreed to hospitalization and cardio-intervention (28% and 38%, respectively). During the transportation of patients alone and accompanied by family, their was haunted by fear and doubt. Patients and their families had hope (14% and 20%, respectively) were in the cardiology unit. However, patients, together with emergency workers, showed little conversion of negative emotions into positive ones Excessive emotional experiences cause significant changes in cognitive processes and have a disorganizing effect. To overcome excessive anxiety, fear and anxiety, to regulate their own emotions in patients with acute myocardial infarction during hospitalization, a developed "Emotion Map of the route of a patient with acute myocardial infarction" was proposed. Map includes intervention in the form of emotional support by emergency medical staff.

**Conclusions**

It is necessary to explain to the patient and his companion what really happens at each stage. This will have a positive effect on the transformation of negative emotions into positive ones. The health care professional increases cognitive abilities and thus modifies the patient's behavior from insecurity to concentration, which in turn will have a positive effect on the patient's commitment to cardio interventions.

**Key words:** Acute myocardial infarction, emotional status



## STAFFING FOR THE CENTER OF EMERGENCY MEDICAL AID OF THE CHERKASY REGION

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## КАДРОВОЕ ОБЕСПЕЧЕНИЕ ЦЕНТРА ЭКСТРЕННОЙ МЕДИЦИНСКОЙ ПОМОЩИ ЧЕРКАССКОЙ ОБЛАСТИ

*Оксана И. Краснова, Наталья А. Ляхова, Татьяна В. Плужникова, Мария М. Безбородько, Олег Г. Краснов*

УКРАИНСКАЯ МЕДИЦИНСКАЯ СТОМАТОЛОГИЧЕСКАЯ АКАДЕМИЯ, ПОЛТАВА, УКРАИНА

### Введение

Кадровые ресурсы важное звено в обеспечении деятельности системы здравоохранения страны. Одним из приоритетных направлений развития системы здравоохранения, является обеспечение высококвалифицированными специалистами экстренной медицинской помощи.

### Цель исследования

Цель: изучение состояния кадрового потенциала системы экстренной медицинской помощи Черкасской области.

### Материалы и методы

Применялся статистический метод и метод системного подхода. Материалом исследования послужили статистические данные Управления государственной статистики Украины и Черкасской области.

### Результаты

Экстренная медицинская помощь (ЭМП) населению на догоспитальном этапе в Черкасской области предоставляется Центром экстренной медицинской помощи и медицины катастроф. В структуру Центра входят: 5 станций скорой медицинской помощи и структурные подразделения (Черкасская, Смелянская, Уманская, Звенигородская, Левобережная), 16 подстанций скорой медицинской помощи, 18 пунктов постоянного базирования бригад, 7 пунктов временного базирования бригад.

По состоянию на 01.01.2020 в Центре утверждено 1584,0 штатных должностей, из них, врачебные – 124,75 (2018 – 133,25), должности младших специалистов с медицинским образованием – 792,25 (2018 г. – 787,75), младшего медицинского персонала – 64,5 (2018 г. – 64,75), другого персонала – 602,5 (2018 г. – 598,25), из них – 505,25 (2018 г. – 505,25) должностей водителей скорой медицинской помощи.

Следует отметить, что врачами служба ЭМП обеспечена недостаточно, обеспеченность штатными должностями врачей составляет лишь 1,0 (2018 г. – 1,1) на 10 тыс. населения. Также проблемным вопросом остается то, что подстанции скорой медицинской помощи Драбовская, Каменская, Лисянский, Жашковская, Корсунь-Шевченковский, Маньковская и Монастырищенская вообще не имеют врачебных бригад, а это в свою очередь влияет на качество оказания медицинской помощи населению на догоспитальном этапе.

### Выводы

Реформа ЭМП должна быть направлена на повышение эффективности использования трудовых ресурсов. Руководителям региональных управлений здравоохранения необходимо постоянно контролировать состояние обеспеченности трудовыми ресурсами службы ЭМП и разрабатывать на основе существующих государственных программ кадровую политику, используя юридические и финансовые механизмы.

**Ключевые слова:** система здравоохранения, кадры, экстренная медицинская помощь, реформирование системы здравоохранения.

**Key words:** health care system, personnel, emergency medical care, health care reform.

**ORGANIZATIONAL FORMS OF EMERGENCY PRIMARY MEDICAL CARE IN FOREIGN COUNTRIES**

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**ОРГАНІЗАЦІЙНІ ФОРМИ НАДАННЯ НЕВІДКЛАДНОЇ ПЕРВИННОЇ МЕДИЧНОЇ ДОПОМОГИ В ЗАРУБІЖНИХ КРАЇНАХ**

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**Вступ**

Надання первинної медичної допомоги (ПМД) цілодобово є важливою потребою пацієнтів і в Україні, і в зарубіжних країнах. В документі з охорони здоров'я «The Organisation of Out-of-Hours Primary Care in OECD Countries» № 89 (2016) надання ПМД розділено на дві часові категорії: 1) надання ПМД у визначені робочі години лікаря/команди ПМД; 2) надання ПМД поза цими годинами.

**Мета дослідження**

Мета: проаналізувати організаційні моделі (форми) надання первинної медичної допомоги в позаробочі години в зарубіжних країнах.

**Матеріали та методи**

Аналіз наукової літератури, нормативно-правових актів; методи: бібліосемантичний, контент-аналіз, системного аналізу.

**Результати**

Основні форми організації надання ПМД в позаробочі години в зарубіжних країнах: 1) Послуги на основі практик ПМД (Practice-based services). Лікарі в приймають власних пацієнтів в позаробочі години. 2. Ротаційні групи (Rota groups) Лікарі по чергово (на основі ротації) здійснюють прийом пацієнтів (своїх та один одного) в позаробочі години. 3. Замісні послуги (Deputising services). Комерційні організації наймають лікарів та медсестер для надання ПМД в позаробочі години. 4. Відділення екстреної медичної допомоги в закладах охорони здоров'я (Emergency departments). Надання послуг ПМД пацієнтам (в НЕ невідкладних станах) у відділеннях ЕМД в закладах охорони здоров'я. 5. Кабінети ПМД: клініки/кабінети пішої доступності, кабінети незначних травм та центри термінової допомоги. (Walk-in primary care centres, minor injury units and urgent care centres). Заклади, куди пацієнти можуть звертатися без попереднього запису у разі незначних травм або захворювань. 6. Кооперативи лікарів ЗП/СМ (General practice cooperatives). Групи ПМД, що надають медичну допомогу в регіоні. 7. Медичні клініки/кабінети в торгових центрах (Retail or medical clinics located within retail stores). Медичні клініки/кабінети, розташовані в торгових центрах, у яких працюють медсестри та інші медичні працівники.

Найбільшими викликами для організації ПМД в позаробочі години, навіть у розвинених країнах, залишається недостатня фінансова винагорода за таку роботу, дефіцит медичного персоналу ПМД, недостатня організаційна і ресурсна підтримка з боку влади і місцевого врядування. Це може призводити до перенавантаження, професійного вигорання і відтоку медичних працівників, що надають ПМД.

**Висновки**

Надання послуг ПМД у позаробочий час може мати певні обмеження і недоліки: 1) відсутність попереднього запису, триваліший час очікування перед прийомом лікаря, черга пацієнтів із різними захворюваннями і станами; 2) неможливість вільного вибору лікаря; 3) нетривалий час на консультацію, вирішення лише гострих проблем; 4) відсутність у лікаря повної інформації щодо пацієнта, щодо попередньої медичної допомоги, наявності хронічних захворювань і їх динаміки, застосування лікарських засобів тощо.

**Ключові слова:** первинна медична допомога, невідкладна допомога

**Key words:** primary care, emergency care

## TREATMENT OF ODONTOGENIC PHLEGMONS IN PATIENTS TAKING INTO ACCOUNT THE BIORITHM OF LIFE

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### Introduction

A chronotype is a construct that captures a person's circadian phenotype, whether it is a morning or evening behavioral preference, or a subjective measure based on the timing of reported behavior.

### The aim

The aim of our study was to establish how the biological rhythm of man affects the reparative functions of the body in terms of odontogenic purulent-inflammatory diseases of the maxillofacial localization, namely wound cleansing and healing.

### Material and methods

A total of 40 patients with odontogenic phlegmons of maxillofacial localization (1-3 cell spaces), aged 40 to 60 years, without systemic chronic diseases, regardless of gender, participated in the study. 20 patients with morning chronotype and 20 patients with evening chronotype.

### Results

Patients were divided into 2 groups, each of which included 2 subgroups, namely:

1 group (20 patients) with morning chronotype:

- a. Opening and drainage of phlegmon in the morning (from 06:00 to 12:00) – 10 patients;
- b. Opening and drainage of phlegmon in the evening (from 15:00 to 21:00) – 10 patients.

2 group (20 patients) with evening chronotype:

- a. Opening and drainage of phlegmon in the morning (from 06:00 to 12:00) – 10 patients;
- b. Opening and drainage of phlegmon in the evening (from 15:00 to 21:00) – 10 patients.

Treatment of patients of all study groups was performed according to the standard protocol of medical care, opening and drainage of phlegmons of maxillofacial localization and medical treatment were performed. The methods of treatment of patients were the same for all experimental groups. Assessment of the clinical condition of patients was performed on the 1st, 3rd, 5th and 7th day after surgery.

### Conclusions

Purulent-inflammatory diseases of the maxillofacial area, the most effective results were observed in patients of the morning chronotype who underwent surgery. At the same time, significant clinical changes were recorded on the 5th and 7th day in the absence of these changes in comparison between the groups on the 1st and 3rd day. That is, we can assume that the morning chronotype of circadian rhythm has an impact on the course of reparative processes, but this is expressed in the later stages of reparative regeneration.

**Key words:** Phlegmone, chronotype, biological rhythm, treatment.

## HIGHLIGHTS OF HIV POST-EXPOSURE EMERGENCY PROPHYLAXIS IN DENTISTS ON THE WORKING PROCESS

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### Introduction

There is an epidemic spread of HIV infection, an increase of patients with HIV. Such a problem leads to increase in the number of probable professional contacts of dentists and HIV infected patients. It is necessary for doctor to treat all the patients as potentially infected and to handle to dental instruments which are contaminated with HIV-infected biological liquids with caution, when providing dental care.

### The aim

Aim of our work is to consider the basic principles of first aid of dentist after the contact with a potential source of HIV infection.

### Material and methods

Viewing, organizing and summarizing of legal acts, instructions, orders regarding the above-mentioned problem.

### Results

It is necessary to carry out emergency post-exposure prophylaxis immediately if there was a contact of the dentist with a source of potential HIV infection, while providing dental care to an HIV-infected patient.

First aid involves thorough cleansing the surface wick contacted with potential HIV infection:

a) in case of injury with a needle or other sharp instrument contaminated human blood or biological materials:

– the place of contact should be washed with soap and water;

– the injured surface should be cleaned under running water for several minutes or until the bleeding stops. The damaged area is treated with disinfectant gel or hand washing solution in the absence of running water. It is not allowed squeezing or friction of the damaged area, squeezing out or suction of blood from the wound, using a solution of ethyl alcohol, iodine, hydrogen peroxide;

b) the place of contact should be washed with soap and water in case of contact of intact skin with blood or other potentially dangerous biological liquids;

c) dead tissue should be removed and the wound should be treated with disinfectant (20% aqueous solution of chlorhexidine bigluconate, 3% hydrogen peroxide) and antibiotic therapy should be prescribed in case of a bite with a violation of the integrity of the skin;

d) the eye is washed with water or saline in case of contact with blood or other potentially dangerous biological liquids in the eyes;

e) liquid that has entered the oral cavity should be splited out, the oral cavity should be washed several times with water or saline in case of contact with blood or other potentially dangerous biological liquids with the mucous membrane of the oral cavity; using soap or disinfectant solutions for rinsing the oral cavity is not allowed.

First aid is organized and carried out immediately after termination or interruption of contact with a source of potential HIV infection.

### Conclusions

The dentist should strictly follow the rules for performing all medical manipulations, taking into account anti-epidemic and hygienic standards in order to reduce the risk of infection on working place.

**Key words:** dentist, HIV infection, injury, disinfectant.

**RECOMMENDATIONS FOR THE PREVENTION OF EMERGENCY STATES AT THE CHILDREN'S ADMISSION AT THE DENTIST***Olga V. Shesukova, Anna S. Mosiienko, Tatiana V. Polishchuk*

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**РЕКОМЕНДАЦІЇ ЩО ДО ПОПЕРЕДЖЕННЯ НЕВІДКЛАДНИХ СТАНІВ НА ДИТЯЧОМУ ПРИЙОМІ У ЛІКАРЯ-СТОМАТОЛОГА***Ольга В. Шешукова, Анна С. Мосієнко, Тетяна В. Поліщук*

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**Вступ**

В Україні перше відвідування лікаря-стоматолога проводиться з 3-х річного віку. На практиці значна кількість дітей звертається до стоматолога раніше, вперше в зв'язку з надзвичайними ситуаціями, такими як: труднощі з прорізуванням зубів, біль через карієс та його ускладнення, травма зуба та іншими.

**Мета дослідження**

Визначити фактори, які можуть попередити виникнення невідкладних станів на дитячому прийомі у лікаря-стоматолога.

**Матеріали і методи**

Аналіз наукової літератури та клінічних протоколів; методи: бібліосемантичний, контент-аналіз, системного аналізу.

**Результати**

Дитячий лікар стоматолог для запобігання надання невідкладних станів повинен з перших секунд контакту з маленьким пацієнтом встановлювати психологічний контакт, тому як дитина вже перебуває в страху.

Наступним етапом в попередженні виникнення невідкладних станів є знання, чого очікувати від пацієнта на основі його історії хвороби. Заповнення в історії хвороби «Анкет» перед початком будь-якого стоматологічного лікування є обов'язковим. Анкета може бути заповнена батьками пацієнта або законним опікуном. Історія хвороби може заповнюватись як в друкованому варіанті, так і в електронному.

Після заповнення історії хвороби лікар стоматолог повинен переходити до фізичного огляду. Медичний огляд, який проводять дитячі стоматологи, можна розділити на дві частини. Перша частина огляду складається з таких речей, як простий огляд пацієнта. Шляхом спостереження дитячий стоматолог може визначити, чи є у пацієнта різні серйозні захворювання, такі як ожиріння, жовтяниця, екзофтальм, утруднення дихання (астма) або пороки серця; можуть бути визначені навіть такі стани, як аутизм, синдром дефіциту уваги і гіперактивності. Друга частина медичного огляду складається з таких речей, як запис артеріального тиску, частоти пульсу, дихання, росту, ваги, індексу маси тіла.

Потім дитячий стоматолог повинен переглянути заповнену анкету з батьками (опікунами) пацієнта і задати питання про будь-які медичні проблеми, про які повідомлялося. За допомогою діалогу між батьками (опікунами) та лікарем, стоматолог намагається визначити значення будь-якого зареєстрованого захворювання для пропонуваного седативного засобу. Наприклад, якщо у пацієнта відмічається астма, то аналіз історії хвороби включатиме такі питання: «Коли був останній напад?»; «Як часто пацієнт відчуває напади?»; «Чи є якісь конкретні тригери?».

**Висновок**

Отже, можна зробити висновок, що необхідність детального збору історії хвороби та фізичного огляду, повинна займати своє місце не тільки для поставлення діагнозу пацієнту, а й для попередження виникнення невідкладних станів на дитячому прийомі у лікаря-стоматолога нехтувати деякими пунктами ми, як лікарі, не маємо права.

**Ключові слова:** невідкладний стан, діти, рекомендації, дитячий прийом.

**Key words:** emergency, children, recommendations, children's reception.

## FUNCTIONAL FEATURES OF THE DENTAL AND GENERAL SOMATIC STATUS OF PATIENTS IN TERMS OF THE MOST COMMON COMMON COMPLICATIONS IN DENTAL PRACTICE

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## ФУНКЦИОНАЛЬНЫЕ ОСОБЕННОСТИ СТОМАТОЛОГИЧЕСКОГО И ОБЩЕСОМАТИЧЕСКОГО СТАТУСА ПАЦИЕНТОВ В АСПЕКТЕ НАИБОЛЕЕ РАСПРОСТРАНЁННЫХ ОБЩИХ ОСЛОЖНЕНИЙ В СТОМАТОЛОГИЧЕСКОЙ ПРАКТИКЕ

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### Вступление

Посещение врача-стоматолога всегда и для всех без исключения пациентов довольно сильный психологический и стрессорный фактор, что не редко провоцирует осложнения общего характера. Известно, что не менее 32-37% пациентов стоматологического приема имеют в анамнезе различной тяжести компенсированные общесоматические заболевания, что и обуславливает необходимость знаний и умений по оказанию экстренной первичной неотложной помощи.

### Цель исследования

Изучить функциональные особенности стоматологического и общесоматического статуса пациентов в аспекте наиболее распространённых общих осложнений в стоматологической практике.

### Материалы и методы

На момент проведения данного научно-практического исследования нами учитывались габитус пациентов и сингулярность их функционального статуса.

### Результаты

Габитус – особенности телосложения, осанки, цвета кожи, выражения лица и др., по которым можно судить о состоянии здоровья человека, имеющихся у него заболеваниях, или о предрасположенности к каким-либо заболеваниям. Габитус пациента определяет: состояние сознания пациента, уровень артериального давления, характер и частоту дыхания, частоту сердечных сокращений, состояние кранио-цервикального комплекса и всей простуры.

В процессе этого оперативного контроля состояния пациента повышается актуальность дифференцировки органических и функциональных аспектов патологии.

Не менее важным феноменом в аспекте развития общих осложнений на стоматологическом приеме, изучаемый в академической антропологии и медицине, который способствует более целостному восприятию человека – сингулярность функционального статуса.

С точки зрения биофизики, человек сингулярность – это открытая, многокомпонентная, многоуровневая интегрированная система, каждый компонент которой, и вся система в целом, обладают способностью к саморегуляции.

### Выводы

Таким образом, в каждый момент времени функциональная активность отдельных органов и систем человека непредсказуема, а общий функциональный статус неповторим, сингулярен. Учитывая этот фактор, при оценке состояния пациента важно воспринимать общую картину, с целенаправленным контролем основных вышеуказанных систем.

**Ключевые слова:** пациент, габитус, кранио-цервикальный комплекс.

**Key words:** patient, habitus, cranio-cervical complex.

## THE USE OF PLACENTAL CRYOEXTRACT TO PREVENT THE FORMATION OF PATHOLOGICAL SCARS IN PATIENTS WITH DIFFERENT TYPES OF CHRONOTYPE

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### ВИКОРИСТАННЯ КРІОЕКСТРАКТУ ПЛАЦЕНТИ ДЛЯ ПРОФІЛАКТИКИ УТВОРЕННЯ ПАТОЛОГІЧНИХ РУБЦІВ У ПАЦІЄНТІВ З РІЗНИМ ТИПОМ ХРОНОТИПУ

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#### Вступ

Для визначення індивідуальних особливостей організації добових ритмів був запропонований термін «хронотип», який стає дедалі популярнішим у дослідженнях в сфері медицини. Згідно аналізу даних літератури, біологічний ритм впливає не тільки на психічний стан, ожиріння, а на стан людини в цілому.

#### Мета дослідження

Метою нашого дослідження було встановити, як біологічний ритм людини може впливати на репаративні функції організму, а саме загоєння рани та утворення рубця.

#### Матеріали і методи

Дослідження проводилися на базі відділення щелепно-лицьової хірургії на базі КП «Полтавська обласна клінічна лікарня ім. М.В. Скліфосовського Полтавської обласної ради». Всього в дослідженні прийняло участь 16 пацієнтів. З пацієнтами під час госпіталізації проводилися співбесіда, а також проводилося анкетування для визначення хронотипу. Пацієнти були розподілені на 2 групи: 1 група (7 осіб) – пацієнти з ранковим хронотипом, яким оперативне втручання проводилося з ранку. 2 група складалася з 9 пацієнтів, яким оперативне втручання проводилося близько 15:00. Для вивчення матеріалів нами був проведений аналіз та огляд пацієнтів на 90-у добу після планового оперативного втручання з приводу вроджених кіст шиї та пухлиноподібних утворень шкіри голови та шиї. Для отримання результатів та для оцінки загоєння рани і якості формування післяопераційного рубця ми використовували стандартизовану таблицю, яка була розроблена співробітниками кафедри.

П-1 – Васкуляризація ( від 0 – 2 балів);

П-2 – Пігментація ( від 0 – 2 балів);

П-3 – Висота рубця ( від 0 – 2 балів);

П-4 – Поверхня ( від 0 – 2 балів);

П-5 – Щільність рубця ( від 0 – 2 балів);

П-6 – Суб'єктивні відчуття пацієнта (свербіж) ( від 0 – 2 балів);

П-7 – Суб'єктивні відчуття пацієнта (біль) ( від 0 – 2 балів).

#### Результати

Результати оцінки рубців, що формуються на 90 день у 1 першій групі (ранковий хронотип) були такі: П-1(0,1±0,14); П-2(0,2±0,18); П-3(1); П-4 (1,4±0,20), П-5(0,7±0,18), П-6 (0,2±0,18), П-7 (0,2±0,18), а загальний показник балів для 1 групи становив – (0,4±0,15). Стосовно 2 групи (вечірній хронотип), показники були такими : П-1(0,2±0,14); П-2(0,6±0,16); П-3(1,1±0,11); П-4 (1,3±0,16), П-5(1,1±0,11), П-6 (0,5±0,17), П-7 (0,6±0,16), а загальний показник балів для 2 групи складав – (0,7±0,15). Згідно даних на 90-у добу клінічного дослідження ми могли спостерігати вірогідну різницю в порівнянні післяопераційних рубців, а саме у пацієнтів з ранковим хронотипом та у пацієнтів з вечірнім хронотипом вона складала 42%. Показники П-1, П-3, П-4 майже не відрізнялись, показники П-2, П-5, П-6 та П-7 були кращі у першій групі на 66%, 36%, 6%, 66%.

#### Висновки

Згідно отриманих результатів на 90-у добу ми можемо з вірогідністю стверджувати, що загоєння рани та утворення патологічного відбувалося краще у пацієнтів з ранковим хронотипом порівняно з пацієнтами вечірнього хронотипу.

**Ключові слова:** хронотип, рубець, інтраопераційна профілактика.

**Key words:** chronotype, scar, intraoperative prophylaxis

## EMERGENCY CARE FOR CHILDREN WITH ACUTE TEETH INJURY

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## НЕВІДКЛАДНА ДОПОМОГА ДІТЯМ З ГОСТРОЮ ТРАВМОЮ ЗУБІВ

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УКРАЇНЬСЬКА МЕДИЧНА СТОМАТОЛОГІЧНА АКАДЕМІЯ, ПОЛТАВА, УКРАЇНА

### Вступ

Серед причин втрати зубів у дітей травма зубів посідає друге місце після карієсу. Травма зуба може супроводжуватися порушеннями мікроциркуляції пульпи, ступінь якої не завжди вдається визначити. Ішемія, порушення кровообігу, пошкодження апікальних судин можуть порушити ріст і формування кореня зуба. За статистикою серед усіх видів травм зубів 80% припадає на фронтальну групу, з якої приблизно половину займають ушкодження верхніх центральних різців.

### Мета дослідження

Мета: проаналізувати застосовані діагностичні та лікувальні заходи при гострій травмі зубів та їх ефективність.

### Матеріали та методи

Об'єктом дослідження стали 31 дитина віком 8-12 років із гострою травмою тимчасових і постійних зубів. Обстеження та лікування проводилось в клініці кафедри дитячої стоматології на базі міської дитячої стоматологічної поліклініки м. Полтави.

### Результати

Тактика лікаря-стоматолога при курації гострих травм постійних зубів повинна обиратися залежно від типу травми. Незначна зміна положення при вивиху постійного зуба потребує іммобілізації зуба за допомогою шинування скловолоконним шнуром чи стрічкою та фіксації фотополімерним композитним матеріалом без репозиції. Значне зміщення зуба потребувало безпосередньої репозиції та іммобілізації шляхом описаної методики. Такі діти потребують тривалого спостереження з визначенням динаміки змін за допомогою рентгенологічного дослідження та проведення термо-і електроодонтодіагностики для фіксацію стану пульпи, періодонту та кісткової тканини.

Аналіз отриманих нами результатів дозволив з'ясувати, що для збереження постійного травмованого зуба повинен застосовуватися комплекс сучасної спеціалізованої допомоги постраждалим дітям, якій сприяє забезпечення в подальшому оптимального формування зубощелепного апарату. За наявності травматичної дислокації зуба та перелома коронки зуба чи його кореня, травмований зуб може бути збережений за умов надання безпосередньої кваліфікованої спеціалізованої стоматологічної допомоги.

### Висновки

У забезпеченні оптимального процесу реабілітації травмованої дитини значну роль відіграє постійна адекватна іммобілізація пошкодженого зуба у найраніший час після травмуванн постійного зуба. Надійною шинуючою конструкцією при лікуванні травмованих постійних зубів у дітей можемо рекомендувати скловолоконні шини.

**Ключові слова:** діти, гостра травма зуба, невідкладна допомога

**Key words:** children, acute tooth trauma, emergency care



## PROBLEMS OF DIAGNOSIS OF SYNCOPE CONDITIONS IN THE AMBULATORY PRACTICE OF A DENTAL SURGEON

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### **Introduction**

Recently and often, patients who have a chronic stress state, pronounced psycho-emotional stress, depressive states and diseases of the nervous system of various origins turn to a dental surgeon in a polyclinic. It is no secret that a visit to a dental surgeon for most patients is associated with pain (sometimes severe) and bloody manipulations, which causes an increase in psycho-emotional reactions.

### **The aim**

To investigate the causes of reflex fainting in a patient during an appointment with a dental surgeon

### **Material and methods**

Study of scientific literature on the topic; methods: bibliosemantic, system analysis

### **Results**

Patients develop reflex syncope most often as a result of reflex spasm of peripheral vessels and a acute decrease in blood flow to the heart and, consequently, to the brain.

One should also take into account the fact that very often patients stay in the dental chair for a long time with their heads thrown back. This head position for patients over 50 years old may not only cause syncope, but may be more serious disorders of cerebral circulation.

According to our data, syncope is most common in women over 63 years old who have diseases of the cardiovascular system.

For patients of this age group, fainting should be differentiated with the manifestations of such diseases: epilepsy, metabolic disorders (hypoglycemia, hypoxia), vertebrobasilar transient ischemic attack, as well as intoxication with a local anesthetic if it was administered intravascularly.

How to assess the patient's condition on time if the doctor has a busy schedule of patient appointments? The recommendations of the European Association of cardiologists regulate the doctor's actions if a patient has syncope of any genesis.

Examination of the patient necessarily includes: medical history carefully collect, physical examination, it is necessary to measure blood pressure in a standing position and the electrocardiography.

### **Conclusions**

Is it possible to do this in a dental clinic? There is no gold standard as an algorithm of actions in this situation. However, it is necessary to develop a procedure for the doctor's actions at an outpatient dental appointment. Algorithm for diagnostics and emergency care for syncope conditions of various genesis in collaboration with cardiologists, neurologists and other specialties.

**Key words:** surgical dental appointment, reflex syncope.