43. Soumerai T.E., Donoghue M.T.A., Bandlamudi C. et al. Clinical Utility of Prospective Molecular Characterization in Advanced Endometrial Cancer. Clin Cancer Res. 2018 Dec 1;24(23):5939-5947. DOI: 10.1158/1078-0432.CCR-18-0412

44. Sung H., Ferlay J., Siegel R.L. et al. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. CA Cancer J Clin. 2021 May;71(3):209-249. DOI: 10.3322/caac.21660

45. Tanaka S., Miki Y., Hashimoto C. et al. The role of 5α-reductase type 1 associated with intratumoral dihydrotestosterone concentrations in human endometrial carcinoma. Mol. Cell. Endocrinol. 2015;401:56–64. DOI: 10.1016/j.mce.2014.11.022

46. Tangen I.L., Onyango T.B., Kopperud R. et al. Androgen receptor as potential therapeutic target in metastatic endometrial cancer. Oncotarget. 2016;7:49289-49298. DOI: 10.18632/oncotarget.10334

47. Walsh D.M., Hokenstad A.N., Chen J. et al. Postmenopause as a key factor in the composition of the Endometrial Cancer Microbiome (ECbiome). Sci Rep. 2019 Dec 16;9(1):19213. DOI: 10.1038/s41598-019-55720-8

48. Zadeh S.L., Duska L.R., Mills A.M. Androgen Receptor Expression in Endometrial Carcinoma. Int. J. Gynecol. Pathol. 2018;37:167–173. DOI: 10.1097/PGP.0000000000000401

49. Zimmerman M., Zimmerman-Kogadeeva M., Wegman R. et al. Mapping drug metabolism in the human microbiome with gut bacteria and their genes. Nature. June 2019;570 (7762): 462-467. DOI: 10.1038/s41586-019-1291-3

DOI 10.25789/YMJ.2024.85.25

UDC 616.366-002-036.11-089

A.A. Yashnov, M.M. Vinokurov, O.G. Konovalova, N.B. Yashnova

ACUTE CHOLECYSTITIS: PROBLEMS OF CLASSIFICATION AND WAYS OF SOLUTION

Acute cholecystitis undoubtedly remains an urgent problem of urgent abdominal surgery. The incidence of this nosology is 160 thousand cases per year. Postoperative mortality is in the range of 1,2-1,4%. Currently, the classification of acute cholecystitis, which is based on the Tokyo agreements, has received active distribution and use. However, this classification does not allow us to determine the degree of destructive process in the wall of the gallbladder. This often leads to a prolongation of the duration of conservative therapy and an increase in the percentage of intraoperative and postoperative complications. In this publication, we have tried to characterize the available classifications of acute cholecystitis, taking into account the advantages and disadvantages. And also, to propose a more rational classification from the point of view of a practical surgeon.

Keywords: cholelithiasis, acute cholecystitis, classification, destructive forms, gallstone disease, diagnosis.

Acute cholecystitis is one of the most common diseases in emergency abdominal surgery. According to A. Revishvili, the incidence of acute cholecystitis in the last 5 years is about 160 thousand cases per year. At the same time, operational activity in relation to this nosology increases, the frequency of which reaches 60-63%. At the same time, postoperative mortality is in the range of 1,2-1,4%, and in some regions 3-5% [13]. There is a problem of a high percentage of both intraoperative (10-15%) and postoperative complications (15-20%) [1,3,8,9]. Along with this, the frequency of purulent-septic postoperative complications reaches 7-15% [1].

It is known that currently there are a number of classifications of acute cholecystitis. The classification developed by V. Savelyev has found wide application in Russia. Savelyev divides acute cholecystitis into uncomplicated and complicated. The first variant includes the following forms: catarrhal, phlegmonous, gangrenous. Complicated, in turn, occurs in 10-15% of cases and includes complications such as mechanical jaundice, perivesical infiltration, perivesical abscess, gallbladder perforation, peritonitis, cholangitis, external and internal fistulas, empyema or dropsy of the gallbladder. Uncomplicated cholecystitis, according to V. Savelyev's classification, is primary due to thrombosis of the cystic artery, and secondary caused by an infectious agent [2]. It should be noted that, undoubtedly, this classification makes sense in operated patients. At the same time, at the time of admission of the patient to the hospital, we do not have the opportunity to establish a certain form of uncomplicated cholecystitis due to the large range of criteria. Along with the lack of clear criteria for the establishment of one form or another, there are no recommendations for the management of patients with a specific variant of this disease.

According to the pathogenesis, acute cholecystitis is divided into obturation, enzymatic and vascular. From the point of view of a practical surgeon, this division of acute cholecystitis has no value and is of particular interest only for theoretical medicine.

April 1, 2006 becomes a key date in the adoption of a new classification of acute cholecystitis, developed by a group of leading hepatologist surgeons in the Japanese capital. This classification is based on 3 groups of severity of acute cholecystitis [15,20]:

I st (mild stage) is characterized by the absence of multiple organ dysfunction and mild inflammatory changes in the gallbladder in patients with acute cholecystitis.

II st (moderate stage) was based on the following criteria: significant inflammatory changes in the gallbladder (emphysematous cholecystitis, gangrenous cholecystitis, peripusal abscess, biliary peritonitis), duration of the disease over 72 hours, leukocytosis over 18 $x10^9$/L.

III st (severe stage) is characterized by disorders in vital organs or systems: neurological disorders (decreased level of consciousness); renal insufficiency (oliguria, creatinine > 2 mg/dl (177 mmol/l); hepatic dysfunction (INR > 1.5); respiratory failure (PaO2/FiO2 ratio < 300); cardiovascular insufficiency (hypotension requiring correction with dopamine at a

YASHNOV Alexey Alexandrovich – MD; Associate Professor of Cadre of the Faculty of Surgery with the course of cadre of HBO in CHMA; alexyashnov@mail.ru; (https://orcid.org/0000-0001-6881-4455); **VINOKUROV Mikhail Mikhailovich** – MD, Professor; Head of the Department of Faculty Surgery, Urology, Oncology and Otolaryngology of the Federal State Budgetary Educational Institution of Higher Education, Academician of the Academy of Sciences of the Republic of Sakha (Yakutia); mmv_mi@rambler.ru, (https://orcid.org/0000-0002-1235-6560); **KONOVALOVA Olga Gennadievna** – Candidate of Medical Sciences, Associate Professor of human resources with the course of URO HBO in CHMA; konovalovaolgagen@yandex.ru, (https://orcid.org/0000-0002-5601-9558); **YASHNOVA Nadezhda Borisovna** – assistant of the Department of Neurology with the course of CHSBI CHMA; nadezhday1990@yandex.ru, (https://orcid.org / 0000-0002-5761-8376)

dose of ≥ 5 mg / kg per minute or any dose of dobutamine); disorders in the hemostasis system (thrombocytopenia less than 100 x 10^9 / l).

The authors of this classification have established that in the mild stage, surgical treatment (cholecystectomy) is considered a safe intervention. In patients at a moderate stage, performing cholecystectomy can lead to serious adverse consequences. In the severe stage, surgical treatment is dangerous due to the high anesthesiological and operational risk and can be performed with the correction of these disorders.

In 2013, 2018, the Tokyo Agreements (TG13) are being revised and improved [18,19,21,22,23,24]. From this point on, acute cholecystitis should be divided into 3 stages: III st. (severe stage) is accompanied by impaired function of one or more organs or systems (cardiovascular insufficiency: hypotension requiring the administration of dopamine more than 5 mcg / kg per minute or any dose of norepinephrine; neurological insufficiency: decreased level of consciousness; respiratory insufficiency: PaO2/FiO2 less than 300; renal insufficiency: oliguria, creatine level in blood more than 2.0 mg/dl; hepatic insufficiency: liver dysfunction in excess of 1.5; hematological insufficiency: thrombocytopenia <100,000/mm3). For II St. (moderate stage) the patient is characterized by the presence of one of the criteria: leukocytosis > 18,000/mm3; severe pain in the right hypochondrium with muscle tension; duration from the onset of the disease is more than 72 hours and/or signs of local inflammation (gangrenous cholecystitis, peripubular abscess, hepatic abscess, biliary peritonitis, emphysematous cholecystitis). At the same time, I st. (mild stage) is indicated if the patient does not fall under the criteria of "grade III" or "grade II" acute cholecystitis and is characterized by the presence of acute cholecystitis in the patient without any organ dysfunction and moderate inflammatory changes in the gallbladder. The Tokyo classification was taken as a basis for the development of the domestic NCR "Acute cholecystitis" 2021-2023 [11]. M. Yokoe in his publication shows a direct correlation between the severity of acute cholecystitis and 30-day mortality. He noted that the mortality rate in patients with mild acute cholecystitis is 1.1%, moderate – 0.8%, and severe — 5.4%. If there is a violation of the function of a vital organ or system, then mortality in patients with severe course reaches 3.1%, two organs or systems — 7.8%, three — 18.2% and six — 25.0% [25].

In her scientific study, which includes 10 randomized and 14 non-randomized trials and covers 1,841 patients, Charlotte Lozen (2017) indicates that conservative therapy is effective in 87% of patients with acute calculous cholecystitis and 96% with mild Grad1 [16]. In his study, M. Kossovich (2020) shows the effectiveness of conservative therapy in patients with mild acute cholecystitis and indicates the absence of complications in this group of patients during elective cholecystectomy in the long-term "cold" period after 3 months. The author argues that with a positive effect of conservative treatment, the operation should be performed no earlier than after several months [4]. At the same time, the Tokyo agreements interpret to us information about the safety of cholecystectomy in patients with mild degrees. In fact, as already described above, there is a problem of a high percentage of intraoperative and postoperative complications. Any surgeon will certainly agree on the safety of cholecystectomy in the "cold" period, after the inflammation in the gallbladder has subsided. In her research, L. Koishibaeva (2017) shows that the quality of life of patients who underwent cholecystectomy for acute cholecystitis is 1,1 times lower than in patients with chronic cholecystitis [5]. This author notes that in patients who underwent cholecystectomy during planned hospitalization, the quality of life is 1.1 times higher than in the group where the same surgical intervention was performed during emergency hospitalization. Along with this, surgical treatment should be performed immediately in patients with destructive forms of acute cholecystitis, which directly threaten the patient's life. At the same time, there are no criteria that could accurately identify the destruction of the gallbladder wall in a timely manner, and therefore the time of surgical intervention is delayed. In 2015, Peter Ambe analyzed the charts of 138 patients with varying degrees of severity of acute cholecystitis according to the Tokyo Agreements and found a discrepancy between mild severity (I St.) and intraoperative picture. The conclusions of this scientist were confirmed by histological examination [14].

One of the disadvantages of the Tokyo classification is that a group of patients with acute cholecystitis and simultaneous damage to the bile ducts is not singled out separately. In his publication, I. Natroshvili points out that the methods of treatment of this group of patients may differ significantly [10]. We also believe that in the Tokyo Recommendations and the national clinical guidelines of the Russian Society of Surgeons, it is necessary to identify a group of patients with acute destructive cholecystitis. In a number of studies using criteria for the severity of acute cholecystitis, the treatment outcomes of these patients are taken into account in the general group, but the treatment methods may differ significantly. Special difficulties may arise when solving tactical issues in a group of elderly people with severe concomitant pathology.

It should be noted that new possibilities for the classification of acute cholecystitis are currently being sought.

In particular, in his publications, I. Buriev pointed out the need to change the existing classification. The author noted that such research methods as ultrasound, CT and MRI combined can make it possible to visualize the depth of destruction of the gallbladder wall at the level of the submucosal or musculoserous layer [12]. At the same time, such a view of the structure of things will only allow us to approach the morphological classification of the severity of destruction at the preoperative stage. There are isolated studies by domestic and foreign scientists that are devoted to studying the results of clinical and laboratory studies, ultrasound, CT, and MRI data in patients with acute cholecystitis and make it possible to assess the severity of the disease [6,7,17]. At the same time, it should be taken into account the fact that hospitals are not equipped with computer and magnetic resonance imaging at all levels, which makes it difficult to diagnose destructive cholecystitis in a timely manner.

From our point of view, a rational approach to the classification of acute cholecystitis is to identify two main groups: non-destructive (catarrhal) and destructive. For a practical surgeon, this unit would make it possible to determine the therapeutic tactics.

Acute destructive cholecystitis should be diagnosed based on the following data:

- clinical:

√ positive symptoms: Kera, Murphy, Grekova-Ortner;

√ fever above 38℃;

- laboratory:

√ leukocytosis is more than 11x10^9/l;

√ increase in creatine phosphokinase values of more than 250 units/l, lactate dehydrogenase of more than 290 units/l;

√ reduction of gamma glutamyltransferase concentration of less than 100 U/l and alkaline phosphatase of less than 150 U/l;

√ the concentration of total immunoglobulin is more than 450 IU/ml.

■ instrumental:

● ultrasound data:

√ hyperechogenicity of bile,

√ a symptom of drooping,

√ the layering of the gallbladder wall;

● CT scan data:

√ sandwich symptom,

√ intramural accumulation of gas,

√ accumulation of gas in the lumen of the gallbladder.

To diagnose destructive cholecystitis, there must be a combination of at least 2 signs (marked with √) from each data group. Destructive cholecystitis can be complicated by the development of: perivesical infiltration, perivesical abscess, perforation of the gallbladder, biliary peritonitis, external and internal fistulas, empyema of the gallbladder. The diagnosis of destructive cholecystitis implies performing surgery within 2 hours from the moment of diagnosis. In patients with severe concomitant pathology and in persons with high anesthesiological risk, minimally invasive interventions (drainage of the gallbladder under ultrasound guidance, cholecystostomy, etc.) have shown some effectiveness. In "safe" patients, surgical intervention should begin with laparoscopic cholecystectomy, if it is impossible, an alternative may be cholecystectomy from a mini-access or performing traditional laparotomic cholecystectomy. In the presence of infiltration in the cervical region and the inability to perform cholecystectomy, it is recommended to resect the gallbladder according to Pribraman or Hartmann's pocket in order to avoid traumatization of vital structures and prevent the development of severe intraoperative and postoperative complications.

In the absence of criteria for the destruction of the gallbladder wall, a diagnosis should be made: Acute catarrhal cholecystitis. When establishing this diagnosis, treatment should be conservative with dynamic monitoring, and surgical treatment in such patients is safer to perform as planned. If the development of destruction of the gallbladder wall is suspected, surgical treatment must be performed urgently. It is important that in patients with catarrhal cholecystitis, conservative treatment is successful in 97% of cases.

Similarly, there is a problem of complications of acute cholecystitis, which are also given insufficient attention in national clinical guidelines. We will try to highlight this problem in future publications.

References

1. Bautkin, A.V., Cherkasov M.F., Eleev A.A. Problema intra-i posleoperatsionnykh oslozhnenii pri lechenii ostrogo kal'kuleznogo kholetsistita i sposoby ikh profilaktiki [The problem of intra- and postoperative complications in the treatment of acute calculous cholecystitis and methods of their prevention]. Meditsinskii vestnik Yuga Rossii [Medical Bulletin of the South of Russia. 2012; 3: 4-6 (In Russ.).]

2. Beburishvili A.G. Zhelchnaya gipertenziya i ostryi kholetsistit [Biliary hypertension and acute cholecystitis]. 80 lektsii po khirurgii pod redaktsiei V.S. Savelieva [80 lectures on surgery edited by V.S. Savelyev. Moscow: Litera, 2008; 388-400 (In Russ.).]

3. Egorova E.A. [et al.] Vozmozhnosti luchevykh metodov v diagnostike oslozhnennykh form kholetsistita (obzor literatury i klinicheskie nablyudeniya) [The possibilities of radiation methods in the diagnosis of complicated forms of cholecystitis (literature review and clinical observations). Radiologiya-praktika [Radiology practice. 2016; 5:26–41 (In Russ.).]

4. Kossovich M.A. [et al.] Vybor optimal'nykh srokov vypolneniya operativnogo vmeshatel'stva pri ostrom kal'kuleznom kholetsistite [Choosing the optimal timing of surgical intervention in acute calculous cholecystitis]. Khirurgiya. Zhurnal im. N.I. Pirogova [Surgery. Pirogov Journal. 2020; 3: 56-60 (In Russ.).] https://doi.org /10.17116/hirurgia202003156.

5. Koishibaeva L.M., Turgunov E.M., Sukhanova A.A. Sravnenie urovnya kachestva zhizni patsientov do i cherez 6 mesyatsev posle kholetsistehktomii [Comparison of the quality of life of patients before and 6 months after cholecystectomy]. Meditsinskii zhurnal Zapadnogo Kazakhstana [Medical Journal of Western Kazakhstan. 2018; 1(57): 52-57 (In Russ.).]

6. Kudryavtseva A.V. Komp'yuterno-tomograficheskaya diagnostika ostrogo kholetsistita [Computed tomographic diagnostics of acute cholecystitis]. Congress of the Russian Society of Radiologists and Radiologists [Kongress rossiiskogo obshchestva rentgenologov i radiologov. Moskva. 2019; 101–102 (In Russ.).]

7. Borodetsky B.M. [et al.]. Magnitno-rezonansnaya kholangiopankreatografiya v klinicheskoi praktike. Sravnitel'naya otsenka luchevykh metodov diagnostiki i vliyanie magnitno-rezonansnoi kholangiopankreatografii na taktiku vedeniya patsienta v statsionare [Magnetic resonance cholangiopancreatography in clinical practice. Comparative evaluation of radiation diagnostic methods and the influence of magnetic resonance cholangiopancreatography on the tactics of patient management in the hospital]. Rossiiskii ehlektronnyi zhurnal luchevoi diagnostiki [Russian Electronic Journal of Radiation Diagnostics. 2016; 6 (1): 48-54 (In Russ.).] https://doi.org / 10.18411/a-2016-005.

8. Malakhova I.G., Shklyaev A.E., Utkin I.Yu. Ostryi kholangit, oslozhnennyi biliarnym sepsisom: klinicheskii sluchai s blagopriyatnym [Acute cholangitis complicated by biliary sepsis: a clinical case with a favorable]. Arkhiv" vnutrennei meditsiny [Archive of Internal Medicine. 2016; 6 (4): 65-69 (In Russ.).] https://doi.org /10.20514/2226-6704-2016-6-4-65-69.

9. Makhmadov F.I., Karimov P.S., Mirbegiev D., Makhmaderov H.S. K voprosu o kholetsistehtomii pri ostrom kal'kuleznom kholetsistite u bol'nykh s vysokim operatsionno-anesteziologicheskim riskom [On the issue of cholecystectomy in acute calculous cholecystitis in patients with high surgical and anesthetic risk]. Vestnik Akademii meditsinskikh nauk Tadzhikistana [Bulletin of the Academy of Medical Sciences of Tajikistan. 2019; 9; 1(29): 40-46 (In Russ.).] https://doi.org /10.31712/2221-7355-2019-9-1-40-46.

10. Natroshvili I.G., Prudkov M.I. Naskol'ko aktivnoi dolzhna byt' khirurgicheskaya taktika u bol'nykh ostrym kholetsistitom (po rezul'tatam prospektivnogo mnogotsentrovogo issledovaniya) [How active should surgical tactics be in patients with acute cholecystitis (according to the results of a prospective multicenter study). Vestnik Rossiiskogo universiteta druzhby narodov. Seriya: Meditsina [Bulletin of the Peoples' Friendship University of Russia. Series: Medicine. 2019; 23(2): 156-167 (In Russ.).] https://doi.org / 10.22363/2313-0245-2019-23-2-156-167.

11. Beburishvili A.G. [et al.]. Natsional'nye klinicheskie rekomendatsii. Ostryi kholetsistit. Prinyaty na XII S"ezde khirurgov Rossii «Aktual'nye voprosy khirurgil» (g. Rostov-na-Donu, 7-9 oktyabrya 2015 g.) [National clinical guidelines. Acute cholecystitis. Adopted at the XII Congress of Surgeons of Russia "Topical issues of surgery" (Rostov-on-Don, October 7-9, 2015). Moscow. 2015: 20 (In Russ.).]

12. Buriev I.M. [et al.]. Ul'trazvukovaya i kliniko-laboratornaya diagnostika istinnykh morfologicheskikh form ostrogo kholetsistita: neobkhodimost' smeny klassifikatsii [Ultrasound and clinical and laboratory diagnostics of true morphological forms of acute cholecystitis: the need to change the classification]. Annaly khirurgicheskoi gepatologii [Annals of surgical hepatology. 2020; 25 (3): 55-62 (In Russ.).] https://doi.org / 10.16931/1995-5464.2020355-62.

13. Revishvili A.Sh. [et al.] Khirurgicheskaya pomoshch' v Rossiiskoi Federatsii v period pandemii – osnovnye itogi 2020 goda [Surgical care in the Russian Federation during the pandemic – the main results of 2020]. Khirurgiya. Zhurnal im N.I. Pirogova [Surgery. N.I. Pirogov Journal. 2021; 12: 5-14 (In Russ.).] https://doi.org /10.17116/hirurgia2021 1215.

14. Ambe P.C., Christ H., Wassenberg D. Does the Tokyo guidelines predict the extent of gallbladder inflammation in patients with acute cholecystitis? A single center retrospective analysis. BMC Gastroenterology. 2015; 15(1): 142. https://doi.org / 10.1186/s12876-015-0365-4.

15. Cheng W.C. [et al.] Assessing clinical outcomes of patients with acute calculous cholecystitis in addition to the Tokyo grading: A retrospective study. Kaohsiung Journal of Medical Sciences. 2014; 30 (9): 459-465. https://doi.org / j.kjms.2014.05.005.

16. C.S. Loozen [et al.]. Conservative treatment of acute cholecystitis: a systematic review and pooled analysis. Surg Endosc. 2017; 31(2): 504-515. doi: 10.1007/s00464-016-5011-x.

17. Dili A., Bertrand C. Laparoscopic ultrasonography as an alternative to intraoperative cholangiography during laparoscopic cholecystectomy. World journal of gastroenterology. 2017; 23 (29): 5438–5450. https://doi.org / 10.3748/wjg.v23.i29.5438.

18. Hayasaki A. [et al.] Factor analysis influencing postoperative hospital stay and medical costs for patients with definite, suspected, or unmatched diagnosis of acute cholecystitis according to the Tokyo Guidelines 2013. Gastroenterology Research and Practice. 2016; 2016: 7675953. https://doi.org /10.1155/2016/7675953.

19. Inoue K. [et al.]. Risk factors for difficulty of laparoscopic cholecystectomy in grade II acute cholecystitis according to the Tokyo guidelines 2013. BMC surgery. 2017; 17(1): 114. https://doi.org / 10.1186/s12893-017-0319-6.

20. Bouassida M. [et al.] The severity grading of acute cholecystitis following the Tokyo Guidelines is the most powerful predictive factor for conversion from laparoscopic 213 cholecystectomy to open cholecystectomy. Journal of Visceral Surgery. 2017; 154(4): 239–243. https://doi.org / 10.1016/j.jviscsurg.2016.11.007.

21. Wakabayashi G. [et al.] Tokyo Guidelines 2018 surgical management of acute cholecystitis: safe steps in laparoscopic cholecystectomy for acute cholecystitis (with videos). Journal of Hepato-Biliary-Pancreatic Sciences. 2018; 25(1): 73–86. https://doi.org /10.1002/jhbp.517.

22. Gomi H. [et al.] Tokyo Guidelines 2018: antimicrobial therapy for acute cholangitis and cholecystitis. J Hepatobiliary Pancreat Sci. 2018; 25: 3–16.

23. Yokoe M. [et al.]. Tokyo Guidelines 2018: diagnostic criteria and severity grading of acute cholecystitis (with videos). Journal of Hepato-Biliary-Pancreatic Sciences. 2018; 25(1): 41–54. https://doi.org / 10.1002/jhbp.515.

24. Okamoto K. [et al.] Tokyo Guidelines 2018: flowchart for the management of acute cholecystitis. Journal of Hepato-Biliary-Pancreatic Sciences. 2018; 25(1): 55–72. https://doi.org /10.1002/jhbp.516.

25. Yokoe M. [et al.] Validation of TG13 severity grading in acute cholecystitis: Japan-Taiwan collaborative study for acute cholecystitis. Journal of HepatoBiliary-Pancreatic Sciences. 2017; 24(6): 338–345. https://doi.org /10.1002/jhbp.457.

POINT OF VIEW

N.I. Mikulyak, I.A. Sorokin, L.A. Sorokina, P.A. Poluboyarinov

THE EFFECT OF CONSUMPTION OF *CHLORELLA VULGARIS* SUSPENSION ON HEMATOLOGIC AND BIOCHEMICAL INDICES OF HUMAN BLOOD

DOI 10.25789/YMJ.2024.85.26

UDC 615.036

Studies of the effect of the use of preparations with microalgae C.vulgaris on the human body are important due to its wide distribution and the presence of a large number of biologically active substances. We investigated biochemical and hematologic indices of a group of persons after a course of microalgae suspension reception. There were immunomodulatory effects, expressed as an increase in LYM% and a decrease in ESR, cellular rejuvenation primarily among healthy men, and trends toward increased ALB and TP at younger ages. After 50 years of age, a tendency for GLU levels to decrease after the course was detected. There was an increase in CREA and UREA, which may be related to both improved availability of protein compounds and the composition of the microalgae growth medium, which requires further investigation.

Keywords: suspension, chlorella vulgaris, hematology, biochemistry, age, sex, health status.

Introduction. Interest in the study of C.vulgaris as a promising source of essential and nutritional substances emerged in the 1950s and was linked to the world food crisis [6]. Recently, interest in studying the effects of consuming this microalgae on the human body has only been increasing. This is due to the fact that products with C.vulgaris have a unique composition, which includes a set of all essential amino acids, mineral compounds, dietary fiber, polyunsaturated fatty acids, vitamins [5], including D2 and B12, which are absent in plant foods [1], and other compounds. Consumption of such a quantity of biologically active substances certainly has an effect on the human body, which requires its more extended and in-depth study through various methods of research.

All manufactured forms of the drug can be divided into those in which the chlorella is preserved in its natural state and those in which it is destroyed mechanically. The most common preparations contain destroyed strains of C.vulgaris. This fact is due to the fact that microalgae cells cannot be digested by humans because of the cellulose cell wall, which reduces the digestibility of proteins [1]. Nevertheless, even in its natural state in suspension, C.vulgaris is capable of producing effects on the human body.

The aim of this work is to investigate the effect of C.vulgaris suspension consumption on human blood parameters to identify patterns to its use.

Material and methods of research. The study was conducted on 34 volunteers volunteers. For 30 days (course) they took C.vulgaris suspension of IFR strain №C-111 200 ml in the morning on an empty stomach. The density of the suspension was 60 million microalgae per 1 ml. Every 10 days, volunteers were given 2 liters (2 bottles) of C.vulgaris suspension for the specified period. The study was conducted under the condition that volunteers signed informed consent, in accordance with all provisions of the Declaration of Helsinki and was approved by the local ethical committee at Penza State University. 28 people were able to complete the course. Among the reasons for discontinuing the course, volunteers cited the following: unpleasant organoleptic properties, increased diuresis. At the beginning of the study, before the reception of C.vulgaris suspension, as well as at the end of the course, whole blood sampling was performed. The following indices of general and biochemical blood analysis were investigated: WBC, RBC, HGB, HCT, MCV, MCH, MCHC, PDW, MPV, P-LCR, PCT, PLT, LYM%, MXD%, NEUT%, LYM#, MXD#, NEUT#, RDW-

MIKULYAK Nadezhda Ivanovna – MD, Associate Professor, Head of the Department of Human Physiology, Penza State University Medical Institute, normphys@mail.ru, https://orcid.org/0000-0001-8473-5781; **SOROKIN Ilya Alexandrovich** – student, Penza State University Medical Institute, iluh30072001@yandex.ru, 89374251310, https://orcid.org/0000-0003-4206-0653; **SOROKINA Larisa Aleksandrovna** – PhD, Head of Clinical and Diagnostic Laboratory, K.R. Evgrafov Regional Psychiatric Hospital, sorlora@mail.ru, 89273673531, https://orcid.org/0009-0006-8953-5184; **POLUBOYARINOV Pavel Arkadyevich** – Candidate of Agricultural Sciences, Associate Professor Department of General and Clinical Pharmacology, Penza State University Medical Institute, poluboyarinovpavel@yandex.ru, https://orcid.org/0000-0001-9870-0272