DOI 10.25789/YMJ.2025.92.03

УДК 616.12-008.46-06

A.S. Ankudinov, J. T.- B. Galsanova, A.L.- N. Zhamyandabayeva

CHARACTERISTICS OF LABORATORY PARAMETERS AND MORPHOFUNCTIONAL PARAMETERS OF ECHOCARDIOGRAPHY OF PATIENTS WITH CHRONIC HEART FAILURE ON THE BACKGROUND OF CHEMOTHERAPY FOR BREAST CANCER IN THE REPUBLIC OF BURYATIA

A study of echocardiographic parameters of the myocardium in patients with chronic heart failure (CHF) undergoing chemotherapy for breast cancer was conducted. The level of C-reactive protein (CRP) was assessed, and possible associations of chemotherapy with echocardiography parameters were evaluated. In the study group, statistically significant associations of CRP were found with such indicators as the blood flow rate in the late diastole caused by atrial contraction, the level of systolic pressure in the pulmonary artery and the left ventricular ejection fraction. Significant differences in these parameters were revealed compared with patients with CHF without cancer.

Keywords: chronic heart failure, breast malignancy, C-reactive protein, chemotherapy, diastolic dysfunction

For citation: Ankudinov A.S., Galsanova J.T.-B., Zhamyandabayeva A.L.-N. Characteristics of Laboratory Parameters and Morphofunctional Echocardiography in Patients with Chronic Heart Failure on the Background of Chemotherapy for Breast Cancer in the Republic of Buryatia. Yakut Medical Journal. 2025; 92(4): 17-20. https://doi.org/10.25789/YMJ.2025.92.03

Introduction. Patients with chronic heart failure (CHF) have an increased risk of cardiotoxic effects during cancer treatment. To date, there are two types of cardiotoxicity: irreversible – this type of cardiotoxicity is characteristic of the use of anthracycline antibiotics and chemotherapy. The irreversible effect is characterized by a violation of the contractile function of the myocardium due to the death of cardiomyocytes. Reversible – damage to mitochondria and proteins responsible for myocardial contraction [5, 6, 10]. Anthracyclines, trastuzumab, alkylating agents, antimetabolites, tyrosine kinase inhibitors, angiogenesis inhibitors, checkpoint inhibitors, and proteasome inhibitors have the most pronounced cardiotoxic effects [9, 12]. The detailed mechanisms of the development and progression of CHF against the background of antitumor therapy are being actively studied. Known factors include activation of inflammatory cytokines, oxidative stress, mitochondrial damage, free radical production, and destruction of DNA and cardiomyocyte membranes [16]. Echocardiography is the leading technique for changes in myocardial contractility in patients with CHF on the background of chemotherapy. However, the changes obtained are morphological and, as a rule, may not change significantly at the initial stage of neoplasm therapy. Immunological markers are actively discussed, but they may not be available due to technical and economic reasons. From the point of view of practical healthcare, the use of routine methods is an urgent task, especially important for patients living in remote areas of the Russian Federation. Natriuretic peptides, troponins, and C-reactive protein (CRP) are one of the most accessible prognostic markers for patients with CHF on the background of chemotherapy. The most accessible marker in outpatient settings is CRP, which has both diagnostic properties in oncological pathology and is also associated with the progression of heart failure [11].

The aim: study was to conduct a comparative analysis of morphofunctional parameters and laboratory parameters of patients with CHF on the background

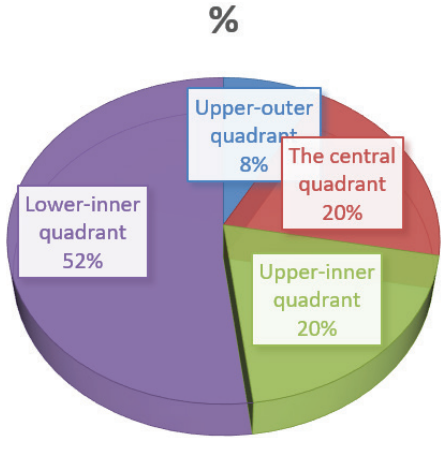

Fig. 1. Characteristics of anatomical localization of breast cancer

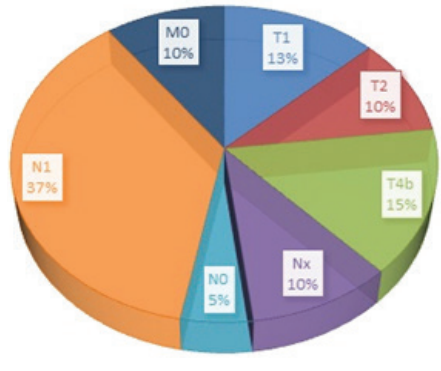

Fig. 2. Distribution of patients according to the classification of Tumor Nodulus Metastasis

ANKUDINOV Andrey Sergeevich – Doctor of Medical Sciences, Professor of IGMU, e-mail: andruhin.box@ya.ru, ORCID: 0000-0002-5188-7997; **GALSANOVA Jargalma Tumen-Bairovna** – therapist of outpatient clinic No. 6, e-mail: dr.galsanova@mail.ru, ORCID: 0009-0002-5441-1836; **ZHAMYANDABAYEVA Albina Lubsan-Nimaevna** – head of the Department No. 3 of Outpatient Clinic No. 6, alinaarsalan@gmail.com, ORCID: 0009-0009-4923-1436

Table 1

List of medications used for chemotherapy

Drug	% of application
Pertuzumab 11	11
Anastrozole 25	25
Paclitaxel 9	9
Paclitaxel+carboplatin 24	24
Zoledronic acid+anastrozole 5	5
Doxorubicin+ cyclophosphamide 14	14
Goserelin+triptorelin+ buserelin 12	12

of chemotherapy for breast cancer and to search for possible associations of chemotherapy with the above parameters.

Materials and methods of research. The study design is a single-stage cohort study. The examined subjects are patients suffering from CHF, ischemic etiology, undergoing routine examination in a polyclinic. The study group consisted of patients with CHF, confirmed on the basis of laboratory and instrumental studies (N–terminal natriuretic peptide, transthoracic echocardiography) with a preserved left ventricular ejection fraction (LVEF) of 50% or more and moderately reduced LVEF (from 41 to 49%) undergoing chemotherapy for breast cancer (Fig. 1) The comparison group consisted of 20 patients with CHF without cancer. Exclusion criteria: CHF with reduced LVEF (40% or less); terminal cancer (multiple metastases, cachexia); intolerance to chemotherapy; surgical treatment of malignant neoplasm; refusal to participate in the study.

The average age of the participants was 64.66 (61.0-69.00) and 67.66 (60-70) years, respectively (p=0.001). The distribution of the studied group of patients according to the classification of Tumor Nodulus Metastasis (TNM) is shown in fig. 2.

The list of drugs used for chemotherapy is presented in Table 2.

There were no statistically significant differences in the frequency of chemotherapy courses. CHF treatment was carried out taking into account modern clinical recommendations and included modern groups of drugs: ace inhibitors, ARA-2, beta blockers, statins.

A comparative assessment of laboratory parameters and parameters of

Table 2

Comparative analysis of laboratory parameters

CHF				CHF with cancer			p
Parametrs	Median	Q1	Q3	Median	Q1	Q3	
ALT, Unit/l	18.49	11.21	21.08	17.63	14.29	18.33	0.530
AST, Unit/l	20.47	13.5	46.26	20.36	15.43	21.04	0.672
Total protein g/l	73.3	68.51	74.2	68.8	65.23	76.83	0.380
Total bilirubin mmol/l	12.56	8.5	13.25	11.51	5.39	12.7	0.781
Glucose, mmol/l	5.67	5.26	6.32	5.45	4.5	5.7	0.234
Iron, mmol/l	12.4	10.9	13.4	11.2	10.4	12.3	0.493
Creatinine, mmol/l	94.70	77	102.03	76.99	66.7	88.21	0.008
Uric acid, mmol/l	354.6	280.69	343.12	332.07	302.54	365.89	0.354
Urea, mmol/l	7.2	5.04	9.4	4.37	3.59	5.35	0.001
LDL, mmol/l	2.04	1.85	2.96	2.6	2.4	2.9	0.365
Total cholesterol, mmol/l	4.76	3.76	5.5	5.37	4.66	6.14	0.011
HDL, mmol/l	1.72	1.38	2.1	1.29	1.07	1.5	0.001
GFR, ml/min/1.73 m^2	83.07	75.24	88.71	87.64	84.5	97.36	0.395
CRP, mg/l	2.29	1.11	4.45	18.45	12.3	23.6	0.001
Red blood cells, 10-12/l	4.36	3.91	4.9	4.43	4.18	4.58	0.727
Hematocrit, 10^9/l	38.63	37.2	43.8	49.58	35.4	42.3	0.345
Hemoglobin, g/l	114	105	144	131.76	118	143	0.045
White blood cells, 10^9/l	5.98	4.82	7.13	5.77	3.9	7.49	0.071
Lymphocytes, %	26.4	2.83	36.1	29.96	24.3	36	0.042
Monocytes, %	6.5	5.1	6.9	10.31	6.7	10.2	0.040
ESR, mm/hr	16	5.6	36	21.42	11	28	0.021
Neutrophils, 10^9/l	48.7	46	57	51.08	45.2	55	0.971
Platelets, 10^9/l	232	119	526	253.6	198.6	286	0.672
Basophils, 10^9/l	0.4	0.1	1.9	0.28	0	0.3	0.037
Eosinophils, 10^9/l	0.51	0.1	5	0.7	0.2	3.6	0.230

Note. ALT – alanine aminotransferase, AST – aspartate aminotransferase, LDL – low-density lipoproteins, HDL – high-density lipoproteins, GFR – glomerular filtration rate, CRP – C-reactive protein, ESR – erythrocyte sedimentation rate.

Table 3

Comparative analysis of echocardiography parameters

CHF				CHF with cancer			p
Параметр	Median	Q1	Q3	Median	Q1	Q3	
ФВЛЖ	46.7	45.0	48.6	44.03	40.4	46.2	0.241
КДР	5.09	4.8	5.4	5.02	4.6	5.2	0.671
КСР	3.3	3	3.6	3.37	3.2	3.7	0.907
ТМЖП	1.25	1.1	1.4	1.21	1.1	1.3	0.461
Объем ЛП	14.79	11.2	16.8	12.6	10.56	14.43	0.232
Объем ПП	14.4	11.5	14.06	11.8	10.2	13.2	0.270
ЧСС	67.91	62	73	69.08	65	75	0.719

Note. LVEF - left ventricular ejection fraction, CDR - final diastolic size, DAC - final systolic size, LVEF - thickness of the interventricular septum, LP - left atrium, PP - right atrium, HR - heart rate.

transthoracic echocardiography was performed.

Statistical processing of the material was performed taking into account modern SAMPLE criteria. The correspondence of the data to the Gaussian distribution was evaluated using the Kolmogorov–Smirnov criterion. The values were presented in medians indicating the upper and lower quartiles (25th and 75th percentiles). The statistical significance of the differences between the averages was assessed using the Mann–Whitney criterion (U). The associations of the studied features and their characteristics were evaluated using logistic regression analysis. The statistical hypothesis was tested and the level of statistical significance was determined at a value of $p < 0.05$ [3].

Results and discussion. A comparative analysis of laboratory parameters revealed statistically significant differences in creatinine, urea, lipidogram and some indicators of the general blood test (Table 3).

Probably, the differences obtained are due to the presence of an oncological process and side effects caused by chemotherapy. There was also a significantly increased level of CRP in the group of patients with CHF and oncopathology. The echocardiography parameters were evaluated (Table 4).

Statistically significant differences in blood flow velocity during late diastole caused by atrial contraction were obtained between the studied groups (Fig. 3) and the level of systolic pressure in the pulmonary artery (Fig. 4).

Multivariate regression analysis revealed statistically significant associations between CRP levels and chemotherapy with echocardiography. The results of the analysis in the group of patients with CHF and oncology are presented in Table 5.

Conclusion. The study of the features of the course of CHF against the background of oncological pathologies, as well as the effects of chemotherapy, is an urgent task of modern cardiology. To date, the identification of signs of decompensation of heart failure in the pre-symptomatic stages is a primary task. In the conducted study, statistically significant differences in CRP levels were obtained with a significantly higher marker level in the group of patients with oncological diseases. It is worth noting that the results obtained are not a new scientific finding, since it is already known that this marker increases in patients with

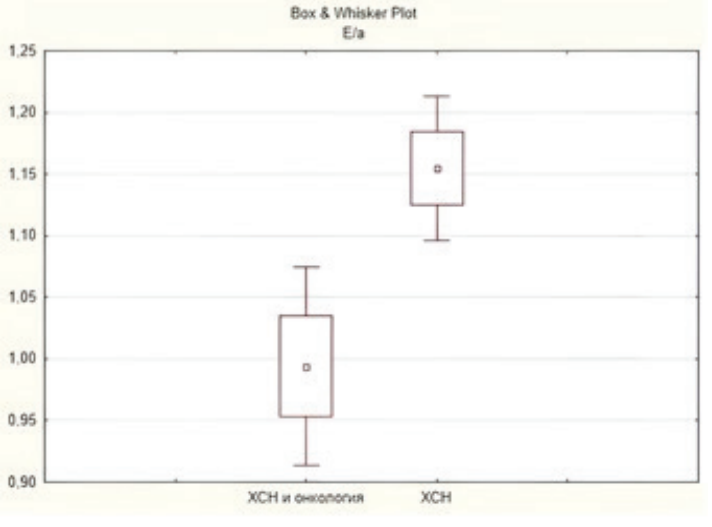

Fig. 3. Indices of blood flow velocity during late diastole induced by atrial contraction

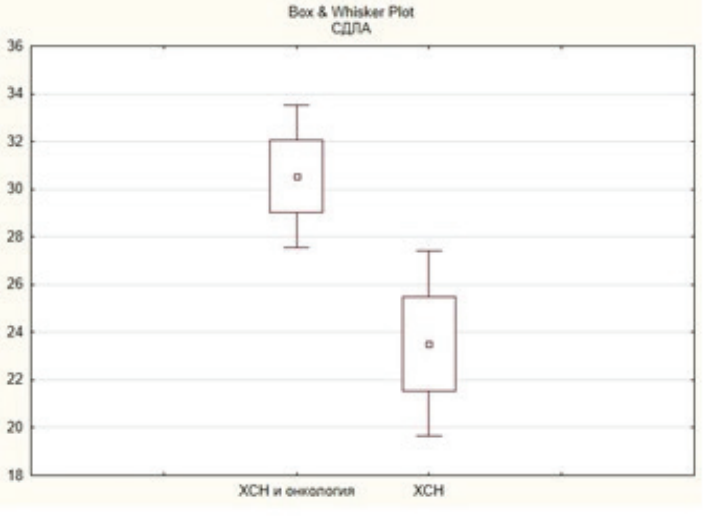

Fig. 4. Comparative analysis of systolic pressure in the pulmonary artery

Table 4

Multifactorial regression analysis with CRP levels and chemotherapy with echocardiography indicators

	R	R^2	beta	f	p
ФВЛЖ	0.129	0.016756	-0.034993	0.32380	0.576000
КДР	0.310	0.096409	0.048852	2.02721	0.170719
КСР	0.027	0.000760	-0.051832	0.01445	0.905583
ТМЖП	0.182	0.033386	-0.017488	0.65625	0.427918
Объем ЛП	0.414	0.171935	0.128353	3.94507	0.061627
Объем ПП	0.303	0.092075	0.044289	1.92683	0.181169
E/A	0.184	0.034022	-0.016819	0.66918	0.423478
СДЛА	0.535	0.286771	0.249232	7.63939	0.012355
ЧСС	0.689	0.475763	0.448171	17.24312	0.000541

malignant neoplasms [14]. It is also worth noting that CRP is associated with both the onset and course of heart failure and has a prognostic role in its development, which subsequently increases the risk of sudden cardiac death [10].

According to literature sources, patients receiving chemotherapeutic treatment in the presence of CHF, as a rule, have pronounced clinical symptoms of cardiotoxicity and morphofunctional changes in the myocardium [1]. However, our study revealed statistically significant differences only in such indicators as the blood flow rate in the late diastole caused by atrial contraction and the level of systolic pressure in the pulmonary artery, with poorer values in the group of patients with CHF and cancer. At the same time, the LVEF indicators did not differ between the groups. Thus, it should be noted that such patients, given the absence of pronounced differences in CHF symptoms and LVEF parameters, may not come under the close attention of a cardiologist. However, the association of CRP with echocardiography parameters and the differences in the above indicators probably indicate an increased risk of heart failure progression. This conclusion is consistent with the opinion of experts dealing with this problem [13]. The data obtained may indicate more pronounced changes in indicators of diastolic myocardial dysfunction and pulmonary hypertension, which may potentially indicate an increased risk of heart failure progression during treatment of malignant neoplasms.

Thus, against the background of chemotherapy for breast cancer, patients with CHF experience some significant changes reflecting a deterioration in diastolic dysfunction. It should be noted that in the regression analysis, due to the small size of the study group, it was not possible to study the effect of individual drugs on the course of heart failure, which probably requires additional research.

The authors declare that there is no conflict of interest.

References

1. Krylov A.V., et al. Poisk faktorov, povyshayushchih risk raz vitiya trevozhnyh i depressivnyh rasstrojstv v ya kutskoj populyacii [Search for factors increasing the risk of developing anxiety and depressive disorders in the Yakut population]. Yakutskij medicinskij zhurnal [Yakut Medical Journal. 2024. T. 88, No. 4. P.16-20. DOI 10.25789/YMJ.2024.88.04 (In Russ.).]

2. Krylov A.V., et al. Epigenetika rasprostranennyh nejrode generativnyh zabolevanij v yakutskoj populya cii [Epigenetics of common neurodegenerative diseases in the Yakut population]. Sovremennye problemy nauki i obrazo vaniya [Modern problems of science and education. 2023. No. 4. DOI 10.17513/spno.32745 (In Russ.).]

3. Collier D, et al. A novel functional polymorphism within the promoter of the serotonin transporter gene: possible role in susceptibility to affective disorders. Mol Psychiatry. 1996;1(6):453-60.

4. Khronicheskaya serdechnaya nedostatochnost' [Chronic heart failure] Clinical recommendations [Klinicheskiye rekomendatsii] / A.S. Galyavich, S.N. Tereshchenko, T.M. Uskach [i dr.] // Rossiyskiy kardiologicheskiy zhurnal [Russian Journal of Cardiology. 2024. No. 29: 251-349. doi:10.15829/1560-4071-2024-6162.

5. Attanasio U, Di Sarro E, Tricarico L. Cardiovascular biomarkers in cardio-oncology: antineoplastic drug cardiotoxicity and beyond // Biomolecules. 2024; N 14 (2): 199-215. doi: 10.3390/biom14020199.

6. Avagimyan A, Mkrtchyan L, Abrahomovich O. AC-mode of chemotherapy as a trigger of cardiac syndrome X: a case study. Current Problems in Cardiology // 2022. N 47(9):100994 doi: 10.1016/j.cpcardiol.2021.100994.

7. Edimiris-Herrmann A, Kolberg-Liedtke C, Bittner AK, Hoffmann O, Wetzig S, Shaheen M, Stephanou M, Kolberg HC. The role of C-reactive protein as a prognostic biomarker in patients with early breast cancer treated with neoadjuvant chemotherapy. Breast Care (Basel). 2022; 17(4): 371-376. doi: 10.1159/000522606.

8. Jain D, Aronow W. Cardiotoxicity of cancer chemotherapy in clinical practice // Hosp Pract. (1995). 2019. N 47(1): 6-15. doi:10.1080/21548331.2018.1530831.

9. Hart PC, Rajab IM, Alebraheem M, Potempa LA, et al. C-reactive protein and cancer-diagnostic and therapeutic insights. Front Immunol. 2020. N 11: 595835. doi: 10.3389/fimmu.2020.595835.

10. Maio R, Perticone M, Suraci E, Sciacqua A, Sesti G, Perticone F. Endothelial dysfunction and C-reactive protein predict the incidence of heart failure in hypertensive patients. ESC Heart Fail. 2021; 8(1): 399-407. doi: 10.1002/ehf2.13088.

11. Ribeiro ÉCT, Sangali TD, Clausell NO, Perry IS, Souza GC. C-reactive protein and frailty in heart failure. Am J Cardiol. 2022. N (66): 65-71. doi: 10.1016/j.amjcard.2021.11.018.

12. Osataphan N, Phrommintikul A, Chattipakorn, S. Effects of doxorubicin-induced cardiotoxicity on cardiac mitochondrial dynamics and mitochondrial function: insights for future interventions // Journal of Cellular and Molecular Medicine 2020. N 24: 6534–6557.

13. Suter TM, Ewer MS. Cancer drugs and the heart: importance and management // Eur. Heart J. 2013. N 34 (15): 1102-1111.

14. Wu L, Wang L, Du Y, Zhang Y, Ren J. Mitochondrial quality control mechanisms as therapeutic targets in doxorubicin-induced cardiotoxicity. Trends Pharmacol Sci. 2023; 44(1): 34-49. doi: 10.1016/j.tips.2022.10.003.

15. Zhang Y. Diagnostic value of echocardiography combined with serum C-reactive protein level in chronic heart failure. J Cardiothorac Surg. 2023; 18(1): 94-115. doi: 10.1186/s13019-023-02176-7.

16. Zhou K, Li C, Chen T, Zhang X, Ma B. C-reactive protein levels could be a prognosis predictor of prostate cancer: a meta-analysis. Front Endocrinol (Lausanne). 2023. N 14 (3): 1111277. doi: 10.3389/fendo.2023.1111277.