

Original article

Factors Associated with Mortality in Patients with Chronic Heart Failure During an 18-Month Follow-up Period

Olesya A. Rubanenko, Anatoly O. Rubanenko, Dmitry V. Duplyakov

Samara State Medical University, Samara, Russia

Received 9 June 2025, Revised 20 August 2025, Accepted 6 September 2025

© 2025, Russian Open Medical Journal

Abstract: *Background* — Chronic heart failure (CHF) is one of the leading causes of mortality. Many factors can influence the risk of mortality in patients with CHF. Therefore, it is necessary to clarify the predictors of mortality in patients with CHF.

The goal of our study was to identify predictors of adverse prognosis in patients with CHF.

Methods — The study included 591 patients with CHF at 60 medical facilities registered in Samara Region CHF Registry during one month in 2022. Their median age was 71.0 (64.0-80.0) years, and 339 (57.4%) of them were men. The follow-up period lasted 18 months, during which 198 (33.5%) patients died.

Results — According to the results of multivariate analysis, prognostic factors associated with mortality in patients with CHF were age (OR 1.024, 95% confidence interval [CI] 1.007-1.042, $p=0.006$), NYHA functional class IV (OR 2.226, 95% CI 1.358-3.649, $p=0.002$), pleural effusion (OR 1.423, 95% CI 0.973-2.083, $p=0.069$), oxygen therapy in outpatient settings (2.401, 95% CI 0.963-5.988, $p=0.06$), inotropic therapy in a hospital settings (OR 1.559, 95% CI 0.924-2.630, $p=0.096$), and left ventricular ejection fraction (LVEF) $< 40\%$ (OR 1.580, 95% CI 1.066-2.342, $p=0.023$). Previous cardiac surgery was inversely associated with the probability of death (OR 0.476, 95% CI 0.3-0.755, $p=0.002$). The area under the ROC curve, corresponding to the relationship between mortality and the value of the logistic regression function, was 0.691 ($p=0.023$) (95% CI 0.645-0.736).

Conclusion — Predictors of mortality in patients with CHF over an 18-month follow-up period include age, NYHA functional class IV CHF, pleural effusion, oxygen therapy in outpatient settings, inotropic therapy in a hospital setting, and LVEF $< 40\%$. Previous cardiovascular surgeries had a favorable effect on mortality in these patients.

Keywords: chronic heart failure, mortality, predictors, prognosis.

Cite as Rubanenko OA, Rubanenko AO, Duplyakov DV. Factors associated with mortality in patients with chronic heart failure during an 18-month follow-up period. *Russian Open Medical Journal* 2025; 14: e0409.

Correspondence to Anatoly O. Rubanenko. E-mail: a.o.rubanenko@samsmu.ru.

Introduction

The importance of accurately assessing the severity of chronic heart failure (CHF) is increasing due to the ongoing aging of the population, numerous comorbidities in elderly people, and the risk of inadequate treatment. The aforementioned factors contribute to an increase in the prevalence of CHF [1]. According to epidemiological studies, the most common diseases leading to heart failure in Russia, Europe, and the USA are hypertension in 95.5% of cases and coronary artery disease (CAD) in 69.7% of cases. Patients with CHF usually have an adverse prognosis: 1-year and 5-year mortality rates after diagnosis of all types of heart failure were 20% and 53%, respectively, in the Olmsted County cohort [2]. 1-year mortality in patients with severe heart failure ranges from 25% to 75% [3]. The prognosis of patients with CHF can be influenced by various risk factors, mainly left ventricular ejection fraction (LVEF), gender, and significant comorbidities [3]. Currently, many studies are being conducted to assess predictors of adverse prognosis in patients with heart failure [4, 5]. Nevertheless, the existing data are contradictory, which may limit their application in actual clinical practice. Additional studies

aimed at assessing predictors of adverse outcomes in patients with CHF are of paramount importance. Special attention should be paid to the assessment of leading clinical markers associated with the risk of mortality within 1 year after hospital discharge, which can improve specialized palliative care programs.

The goal of our study was to identify predictors of adverse prognosis in patients with NYHA functional classes III and IV CHF within 18 months after hospital discharge.

Material and Methods

We conducted a prospective multicenter observational study (registry) with an 18-month follow-up period ([Figure 1](#)). The study included 591 patients with CHF at 60 medical facilities registered in Samara Region CHF Registry over a one-month period in 2022. Their mean age was 71.0 (64.0-80.0) years, 339 (57.4%) of them were men. The study included patients with CHF caused by CAD, previous myocardial infarction, valvular heart disease, cardiomyopathies, and other heart diseases. All patients included in the study had signs and symptoms of NYHA functional classes III and IV CHF and at least one additional feature as follows:

Design: prospective multicenter observational study (registry) (2022)

Data collected on:

1. Cases of hospitalization for CHF in the previous 365 days;
2. Inotropic therapy in the anamnesis or currently (dobutamine, dopamine, norepinephrine);
3. Left ventricle ejection fraction < 40%;
4. Systolic blood pressure <100 mmHg;
5. Dialysis, including CKD stages 4 and 5, GFR < 30 mL/min/1.73m²;
6. Implantable cardioverter-defibrillator (ICD)/ cardiac resynchronization therapy (CRT)/ pacemaker;

Follow-up over 18 months: collecting death certificates (2024)

Figure 1. Study design.

Table 1. Baseline characteristics of patients with CHF

Parameter	n=591
Men, n (%)	339 (57.4)
Age, years	71.0 (64.0-80.0)
NYHA class	
II, n (%)	8 (1.3)
III, n (%)	491 (79.4)
IV, n (%)	84 (13.6)
CAD, including previous MI, n (%)	381 (64.5)
Cardiomyopathy, n (%)	53 (9.0)
Valvular pathology, n (%)	19 (3.2)
Hypertension, n (%)	9 (1.5)
Other, n (%)	111 (18.8)
Hospitalization within 1 year prior, n (%)	513 (86.8)
LVEF < 40%, n (%)	229 (37.1)
LBBB, n (%)	108 (17.5)
VT, n (%)	55 (8.9)
AF, n (%)	125 (21.2)
SpO ₂ , %	97(96;97)
Cancer, n (%)	46 (7.4)
Previous heart surgery, n (%)	160 (25.9)

AF, atrial fibrillation; CAD, coronary artery disease; LVEF, left ventricle ejection fraction; LBBB, left bundle branch block; MI, myocardial infarction; VT, ventricular tachycardia.

Table 2. Complications in patients with CHF

Parameter	n=591
Pleural effusion, n (%)	270 (43.7)
Ascites, n (%)	67 (10.8)
SBP < 100 mmHg, n (%)	160 (27.1)
Inotropic therapy in a hospital setting, n (%)	84 (13.6)
Heart transplant waiting list, n (%)	12 (1.9)
Inotropic therapy in outpatient settings, n (%)	54 (8.7)
Oxygen therapy in outpatient settings, n (%)	25 (4.0)
Opioid analgesics therapy in outpatient settings, n (%)	5 (0.8)
Predialysis or dialysis (CKD stages 4 and 5, GFR less than 30 mL/min/m ²), n (%)	23 (3.7)

1. More than 1 hospitalization for HF in the previous 365 days;
2. Inotropic therapy in the anamnesis or currently (dobutamine, dopamine, norepinephrine);
3. LVEF < 40%;
4. Systolic blood pressure < 100 mm Hg;
5. Dialysis, including CKD stages 4 and 5, GFR < 30 mL/min/1.73 m²;

6. Implantable cardioverter-defibrillator (ICD)/cardiac resynchronization therapy (CRT)/pacemaker;
7. Fluid retention and/or increasing need for diuretics;
8. Need for opioid analgesics after discharge;
9. Being on the waiting list for a heart transplant;
10. Need for oxygen therapy after discharge;
11. Need for inotropic agents after discharge.

Death certificates were obtained from the Samara Region Death Certificate Database.

Exclusion criteria included decompensation of liver and kidney diseases, diabetes mellitus, and severe coagulopathy. The diagnosis of CHF was established in accordance with the Russian Society of Cardiology (RSC) 2020 Clinical Practice Guidelines for Chronic Heart Failure [1].

The baseline characteristics of the patients are presented in [Table 1](#). Only 49 (24.1%) patients with CHF were younger than 65 years old. Elderly men predominated among patients with CHF. Interestingly, more than 25% of patients had undergone cardiac surgery. Atrial fibrillation, as one of the most common arrhythmias, was observed in more than 20% of patients. Most patients with severe CHF had CAD, including a history of myocardial infarction.

More than 40% of patients had pleural effusion, over 25% had low systolic blood pressure (SBP), and >10% of patients had ascites ([Table 2](#)). More than 10% of patients required inotropic therapy, oxygen, or opioids in an outpatient setting. A permanent pacemaker was implanted in 58 (9.8%) patients, an ICD was implanted in 8 (1.3%), and a CRT defibrillator in 12 (2.2%) patients. The developed questionnaire with the above parameters was distributed by the Ministry of Healthcare of Samara Region to each medical institution (outpatient or inpatient), where doctors included the eligible patients in the study. After collecting information on all patients, a dataset was formed. The proportion of missing data was less than 10%.

Statistical analysis was performed using the SPSS Statistics 26.0 software (USA). Quantitative variables are presented as the median, and 25th and 75th percentiles (due to the non-normal distribution of continuous variables). Differences between groups for continuous variables with a non-normal distribution were assessed using the Wilcoxon-Mann-Whitney rank-sum test. Qualitative variables are presented as counts and percentages of

the total number of patients with available data for each group. Univariate and multivariate logistic regression analysis was employed to identify factors associated with fatal outcome after 1.5 years of follow-up. Nagelkerke coefficient of determination (R^2) was calculated to assess the predictive ability of the model. Model validation was performed on both the training and test samples. We calculated accuracy, sensitivity, specificity, and positive and negative predictive values. ROC analysis was also performed with calculation of the AUC value. Values of $p < 0.05$ were considered statistically significant.

Results

During the 18-month observation period, 198 (33.5%) patients died from various causes (Figure 2). To determine predictors of adverse prognosis, all patients were divided into two groups. Group 1 included deceased patients ($n=198$), while Group 2 included surviving patients ($n=393$). The clinical characteristics of the patients are presented in Table 3.

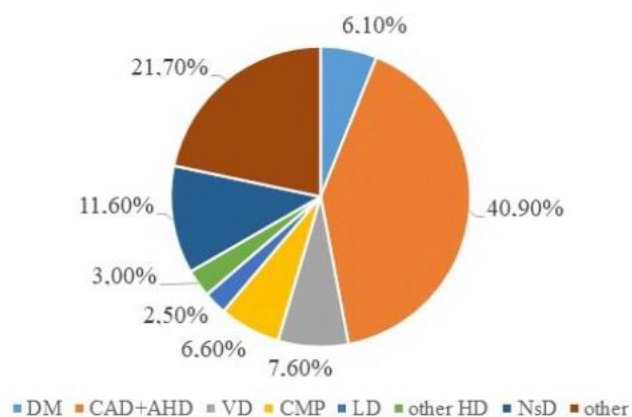


Figure 2. Main causes of mortality in patients with CHF.

DM, diabetes mellitus; CAD, coronary artery disease; AHD, atherosclerotic disease; other HD, other heart diseases; VD, other vascular diseases; CMP, cardiomyopathy; LD, lung diseases; NsD, nervous system diseases.

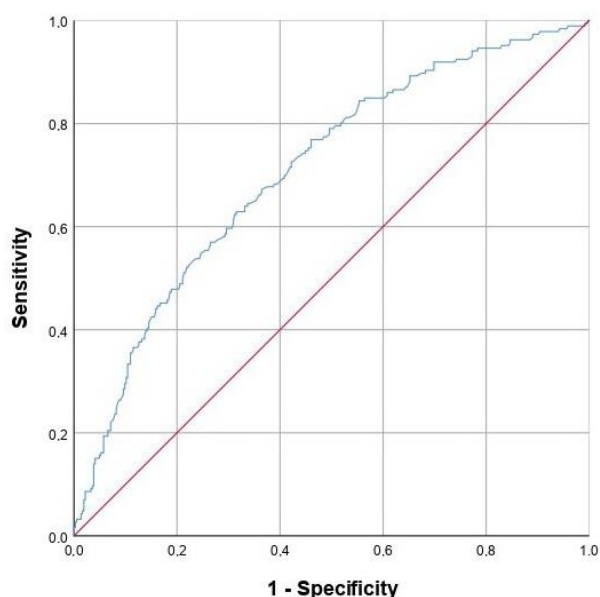


Figure 3. ROC curve demonstrating the quality of binary classification.

We observed significant differences between the two groups in age, NYHA class of CHF, presence of pleural effusion, history of cardiovascular surgery, inotropic therapy during hospitalization, and oxygen therapy in outpatient settings.

Subsequently, predictors of adverse prognosis were identified using binary logistic regression. The regression model was statistically significant ($p < 0.001$). Based on the value of the Nagelkerke coefficient of determination, 12.9% of the variance in the probability of mortality was determined by the factors included in the model. Prognostic indicators associated with the risk of death were age, presence of NYHA class IV CHF, pleural effusion, oxygen therapy in outpatient settings, inotropic therapy in the hospital, and $LVEF < 40\%$. Previously performed heart surgeries were inversely associated with the probability of death. The relationship of predictors with the probability of death in patients with CHF is presented in Table 4.

The regression equation was constructed using the following coefficients:

$$R = -5.964 + 0.031 \cdot A + 0.896 \cdot B + 0.262 \cdot C + 1.084 \cdot D - 0.713 \cdot E + 0.499 \cdot F + 0.488 \cdot G$$

where: R is the standard regression equation;

-5.694 is the constant;

A is age, years;

B is NYHA class (0 – III, 1 – IV);

C is pleural effusion (0 – absence, 1 – presence);

D is oxygen therapy (0 – absence, 1 – presence);

E is previous cardiovascular surgeries (0 – absence, 1 – presence);

F is $LVEF < 40\%$ (0 – absence, 1 – presence);

G is inotropic therapy in a hospital setting (0 – absence, 1 – presence).

$$R = \frac{1}{1 + e^{-R}}$$

where: R is the standard regression equation;

e is the base of the natural logarithm approximately equal to 2.72.

If R is less than 0.323, the risk of death is not predicted; if R exceeds or equals to 0.323, the risk of death in the patient is predicted.

The area under the ROC curve, corresponding to the relationship between mortality and the value of the logistic regression function, was 0.691 ($p=0.023$) (95% confidence interval [CI] 0.645-0.736), which indicates the average quality of the developed model and the need for further evaluation of the parameters of each patient included in the study to re-evaluate the developed model (Figure 3). The threshold value of the P function at the cutoff point was 0.31986. Values of the function equal to or exceeding this value corresponded to a prediction of a fatal outcome. The sensitivity and specificity of the model were 68.7% and 60.6%, respectively. Positive predictive value was 46.3%, negative predictive value was 79.4%, and diagnostic significance was 63.3%.

Discussion

CHF is the terminal stage of almost all cardiovascular diseases. The 5-year mortality rate in patients with CHF is 53-67% [1, 6]. The prognosis in patients with CHF depends on various clinical, laboratory, and other factors. One of the most important factors associated with an adverse long-term prognosis in patients with CHF is the LVEF. The prognosis in patients with CHF and moderately reduced ejection fraction is significantly better vs. patients with reduced LVEF [7, 8]. Our results are consistent with the aforementioned studies: in our study, LVEF <40% is statistically significantly associated with an adverse prognosis in patients with CHF in univariate and multivariate analysis and, therefore, serves as an independent predictor of mortality.

The overall incidence of heart failure is increasing due to the aging population [3]. The prevalence of heart failure is 1-2% in adults, significantly increasing with age [3]. According to previous studies, older age is a predictor of mortality in acute and chronic heart failure [9, 10]. Based on multivariate analysis, our study showed that age is an independent predictor of mortality in patients with CHF. Therefore, our study also confirms that age is associated with higher mortality in patients with heart failure.

NYHA class is an important predictor of mortality in patients with acute heart failure [11, 12]. The role of NYHA class assessment in the prognosis of patients with CHF cannot be

underestimated. NYHA class assessment in patients with CHF is very useful for diagnosis, treatment, and even for making decisions about device implantation. In our study, NYHA functional class IV CHF is associated with mortality in patients with CHF.

Interestingly, our results demonstrate that previous cardiovascular surgeries are associated with reduced mortality in patients with CHF. In this regard, our findings differ from those of Nader et al. (2023), who included only patients with acute coronary syndrome with a follow-up period of 2.5 years and did not confirm a significant effect of coronary revascularization on short-term outcomes in these patients [13]. In our study, only 64.5% of patients had a history of CAD, which may explain this difference. On the other hand, our results are consistent with the meta-analysis by Iaconelli et al. (2023), who also demonstrated a positive effect of coronary revascularization on mortality in patients with heart failure [14]. However, this effect was not statistically significant and consistent and was observed for overall and cardiovascular mortality, but not for the composite endpoint including hospitalization for heart failure plus all-cause mortality [14]. The association of previous cardiovascular surgeries with mortality in patients with CHF in our study is stronger than in the study by Iaconelli et al., but, in contrast, we did not specify the type of cardiovascular surgery and included only patients with CHF.

Table 3. Characteristics of surviving and deceased patients with CHF

Indicator	Group 1 (n=198)	Group 2 (n=393)	p-value
Males, n (%)	110 (55.6%)	229 (58.3%)	0.529
Age, years	75.0 (66.0;83.0)	71.0 (64.0;78.0)	0.001
NYHA class, n (%)			
II, n (%)	1 (0.5%)	1 (1.8%)	
III, n (%)	150 (76.5%)	341 (88.1%)	<0.001
IV, n (%)	45 (23.0%)	39 (10.1%)	
LVEF <40%, n (%)	87 (44.4%)	142 (36.4%)	0.062
LBBS, n (%)	43 (21.8%)	65 (16.5%)	0.117
VT, n (%)	17 (8.6%)	38 (9.7%)	0.669
SpO ₂ , %	96.5(96.0;98.0)	97.0(96.0;98.0)	0.338
Implantable devices, n (%)	19 (9.6%)	39 (10.1%)	0.869
Pleural effusion, n (%)	108 (54.8%)	162 (41.3%)	0.002
Ascites, n (%)	28 (14.1%)	39 (9.9%)	0.130
SP < 120 mm Hg	59 (29.8%)	101 (25.8%)	0.298
Previous cardiovascular surgery, n (%)	37 (18.8%)	122 (31.7%)	0.001
Inotropic therapy in a hospital setting, n (%)	38 (19.2%)	46 (11.7%)	0.014
Heart transplant waiting list, n (%)	3 (1.5%)	9 (2.3%)	0.759
Inotropic therapy in outpatient settings, n (%)	24 (12.2%)	30 (7.7%)	0.072
Oxygen therapy in outpatient settings, n (%)	15 (7.6%)	10 (2.6%)	0.008
Opioid analgesics therapy in outpatient settings, n (%)	3 (1.5%)	2 (0.5%)	0.340
Predialysis or dialysis (CKD stages 4 and 5, GFR < 30 mL/min/m ²), n (%)	6 (3.0%)	17 (4.3%)	0.506
Cancer, n (%)	19 (9.6%)	27 (6.9%)	0.250

Table 4. Characteristics of the relationship between independent prognostic factors and the probability of death in patients with CHF

Predictor	Univariate analysis		Multivariate analysis	
	COR; 95% CI	p-value	AOR; 95% CI	p-value
Age, years	1.026; 1.010-1.042	0.001	1.024; 1.007-1.042	0.006
NYHA class IV	2.647; 1.683-4.165	<0.001	2.226; 1.358-3.649	0.002
Pleural effusion	1.723; 1.220-2.433	0.002	1.423; 0.973-2.083	0.069
Oxygen therapy	3.148; 1.387-7.144	0.006	2.401; 0.963-5.988	0.060
Previous cardiovascular surgery	0.499; 0.329-0.756	0.001	0.476; 0.300-0.755	0.002
LVEF < 40%	1.394; 0.983-1.977	0.062	1.580; 1.066-2.342	0.023
Inotropic therapy in a hospital setting	1.792; 1.121-2.863	0.015	1.559; 0.924-2.630	0.096

Pleural effusion is a common feature in patients with CHF. We found that the presence of pleural effusion is associated with increased mortality in patients with CHF. Our results differ from those by Morales-Rull et al. (2018) and Davutoglu et al. (2010), who showed that pleural effusion in patients with acute decompensated heart failure was not an independent predictor of 1-year and 6-month mortality, respectively [15, 16]. Importantly, in our study, the presence of pleural effusion is associated with mortality in patients with CHF according to the results of univariate, but not multivariate analysis. Nevertheless, we decided to include it in the final model since the p-value was less than 0.1. Ultimately, we can interpret pleural effusion as a dependent predictor of mortality in patients with CHF.

Oxygen therapy should be used in patients with acute heart failure or acute decompensation of CHF if oxygen saturation is less than 90%. At the same time, it is unclear whether this therapy can lead to a reduction in mortality in patients with heart failure. In the study by Alasdair Gray et al. (2008), there was no significant difference in short-term (7-day) mortality between patients with acute cardiogenic pulmonary edema receiving standard oxygen therapy and non-invasive ventilation [17]. According to the results of Nicolas Berbenetz et al. (2019), non-invasive mechanical ventilation significantly reduced in-hospital mortality in patients with cardiogenic pulmonary edema compared with oxygen therapy [18]. We can assume that oxygen therapy in patients with heart failure is stronger associated with alleviating symptoms of heart failure than with improving outcomes. On the other hand, patients with CHF who have indications for oxygen therapy are considered to have more severe decompensation of heart failure vs. patients who do not require oxygen therapy. In our study, patients with CHF receiving oxygen therapy in an outpatient setting had higher long-term mortality compared with patients who did not have indications for this therapy. Our study supports the idea that patients with CHF requiring oxygen therapy have a worse prognosis than patients without indications for oxygen therapy. Our study differs from the aforementioned studies in the way long-term mortality was assessed in patients with CHF – specifically, in our study, we observed a statistically significant association between oxygen therapy and mortality was observed only based on univariate analysis. However, we did not exclude this factor from the model for the same reasons as pleural effusion.

Inotropic agents may be used in patients with heart failure accompanied by low cardiac output and hypotension [3] to alleviate the symptoms of heart failure. Patients requiring inotropic drugs in clinical practice have severe heart failure, and are expected to have higher mortality vs. patients who do not require this therapy. Our study confirms this point: we found that inotropic therapy in the hospital is associated with increased long-term mortality in patients with CHF. In any case, this indicator can be considered dependent, since we revealed a significant association between inotropic therapy and mortality only based on univariate analysis, while multivariate analysis yielded the p-value of 0.096. Still, we did not exclude this indicator from the final model, since the p-value was less than 0.1.

Limitations of the study

The presented study is a registry-based one; therefore, we cannot exclude all associated systematic errors. We did not assess the levels of some laboratory parameters, e.g. NT-proBNP, which

could have influenced mortality in patients with heart failure. We also did not analyze the treatment strategy.

Conclusion

Predictors of mortality in patients with heart failure over an 18-month follow-up period are age, NYHA functional class IV CHF, pleural effusion, oxygen therapy in outpatient settings, inotropic therapy in inpatient settings, and LVEF < 40%. Previous cardiovascular surgery had a favorable effect on mortality in these patients.

Conflict of interest

The authors declare no conflicts of interest.

AI statement

The authors did not use artificial intelligence (AI) or AI-assisted technologies to write this article.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

References

1. Russian Society of Cardiology (RSC). 2020 Clinical Practice Guidelines for Chronic Heart Failure. *Russian Journal of Cardiology*. 2020; 25(11): 4083. Russian <https://doi.org/10.15829/1560-4071-2020-4083>.
2. Gerber Y, Weston SA, Redfield MM, Chamberlain AM, Manemann SM, Jiang R, et al. A contemporary appraisal of the heart failure epidemic in Olmsted County, Minnesota, 2000 to 2010. *JAMA Intern Med* 2015; 175(6): 996-1004. <https://doi.org/10.1001/jamainternmed.2015.0924>.
3. McDonagh TA, Metra M, Adamo M, Gardner RS, Baumbach A, Böhm M, et al. ESC Scientific Document Group. 2021 ESC guidelines for the diagnosis and treatment of acute and chronic heart failure. *Eur Heart J* 2021; 42(36): 3599-3726. <https://doi.org/10.1093/eurheartj/ehab368>.
4. Szczurek-Wasilewicz W, Gąsior M, Skrzypek M, Kurkiewicz K, Szygula-Jurkiewicz B. Predictors of 1-year mortality in ambulatory patients with advanced heart failure awaiting heart transplant. *Pol Arch Intern Med* 2022; 132(2): 16151. <https://doi.org/10.20452/pamw.16151>.
5. Shahim A, Hourqueig M, Lund LH, Savarese G, Oger E, Venkateshvaran A, et al. Long-term outcomes in heart failure with preserved ejection fraction: Predictors of cardiac and non-cardiac mortality. *ESC Heart Fail* 2023; 10(3): 1835-1846. <https://doi.org/10.1002/ehf2.14302>.
6. Tsao CW, Lyass A, Enserro D, Larson MG, Ho JE, Kizer JR, et al. Temporal trends in the incidence of and mortality associated with heart failure with preserved and reduced ejection fraction. *JACC Heart Fail* 2018; 6(8): 678-685. <https://doi.org/10.1016/j.jchf.2018.03.006>.
7. Chioncel O, Lainscak M, Seferovic PM, Anker SD, Crespo-Leiro MG, Harjola VP, et al. Epidemiology and one-year outcomes in patients with chronic heart failure and preserved, midrange and reduced ejection fraction: An analysis of the ESC Heart Failure LongTerm Registry. *Eur J Heart Fail* 2017; 19(12): 1574-1585. <https://doi.org/10.1002/ehf.813>.
8. Vergaro G, Ghionzoli N, Innocenti L, Taddei C, Giannoni A, Valleggi A, et al. Noncardiac versus cardiac mortality in heart failure with preserved, midrange, and reduced ejection fraction. *J Am Heart Assoc* 2019; 8(20): e013441. <https://doi.org/10.1161/JAHA.119.013441>.
9. Pocock SJ, Ariti CA, McMurray JJ, Maggioni A, Køber L, Squire IB, et al. Meta-Analysis Global Group in Chronic Heart Failure. Predicting survival in heart failure: A risk score based on 39 372 patients from 30 studies. *Eur Heart J* 2013; 34(19): 1404-1413. <https://doi.org/10.1093/eurheartj/ehs337>.

10. Lassus JP, Siirilä-Waris K, Nieminen MS, Tolonen J, Tarvasmäki T, Peuhkurinen K, et al. FINN-AKVA study group. Long-term survival after hospitalization for acute heart failure—differences in prognosis of acutely decompensated chronic and new-onset acute heart failure. *Int J Cardiol* 2013; 168(1): 458-462; <https://doi.org/10.1016/j.ijcard.2012.09.128>.
11. Lombardi C, Peveri G, Cani D, Latta F, Bonelli A, Tomasoni D, et al. In-hospital and long-term mortality for acute heart failure: Analysis at the time of admission to the emergency department. *ESC Heart Fail* 2020; 7(5): 2650-2661. <https://doi.org/10.1002/ehf2.12847>.
12. Asano R, Kajimoto K, Oka T, Sugiura R, Okada H, Kamishima K, et al., investigators of the Acute Decompensated Heart Failure Syndromes (ATTEND) registry. Association of New York Heart Association functional class IV symptoms at admission and clinical features with outcomes in patients hospitalized for acute heart failure syndromes. *Int J Cardiol* 2017; 230: 585-591. <https://doi.org/10.1016/j.ijcard.2016.12.052>.
13. Nader V, Matta A, Kang R, Deney A, Azar R, Rouzaud-Laborde C, et al. Mortality rate after coronary revascularization in heart failure patients with coronary artery disease. *ESC Heart Fail* 2023; 10(4): 2656-2663. <https://doi.org/10.1002/ehf2.14445>.
14. Iaconelli A, Pellicori P, Dolce P, Busti M, Ruggio A, Aspromonte N, et al. Coronary revascularization for heart failure with coronary artery disease: A systematic review and meta-analysis of randomized trials. *Eur J Heart Fail* 2023; 25(7): 1094-1104. <https://doi.org/10.1002/ehf.2911>.
15. Morales-Rull JL, Bielsa S, Conde-Martel A, Aramburu-Bodas O, Llàcer P, Quesada MA, et al. RICA Investigators group. Pleural effusions in acute decompensated heart failure: Prevalence and prognostic implications. *Eur J Intern Med* 2018; 52: 49-53. <https://doi.org/10.1016/j.ejim.2018.02.004>.
16. Davutoglu V, Yildirim C, Kucukaslan H, Yuze M, Sari I, Tarakcioglu M, et al. Prognostic value of pleural effusion, CA-125 and NT-proBNP in patients with acute decompensated heart failure. *Kardiol Pol* 2010; 68(7): 771-778. <https://pubmed.ncbi.nlm.nih.gov/20648434>.
17. Gray A, Goodacre S, Newby DE, Masson M, Sampson F, Nicholl J; 3CPO Trialists. Noninvasive ventilation in acute cardiogenic pulmonary edema. *N Engl J Med* 2008; 359(2): 142-151. <https://doi.org/10.1056/NEJMoa0707992>.
18. Berbenetz N, Wang Y, Brown J, Godfrey C, Ahmad M, Vital FMR, et al. Non-invasive positive pressure ventilation (CPAP or bilevel NPPV) for cardiogenic pulmonary oedema. *Cochrane Database Syst Rev* 2019; 4(4): CD005351. <https://doi.org/10.1002/14651858.CD005351.pub4>.

Authors:

Olesya A. Rubanenکو – MD, Professor, Department of Hospital Therapy with Courses on Transfusiology and Polyclinic Therapy, Samara State Medical University, Samara, Russia. <https://orcid.org/0000-0001-9351-6177>.

Anatoly O. Rubanenکو – PhD, Associate Professor, Department of Propedeutics with the Course in Cardiology, Samara State Medical University, Samara, Russia, <https://orcid.org/0000-0002-3996-4689>.

Dmitry V. Duplyakov – MD, Professor, Department of Propedeutics with the Course in Cardiology, Samara State Medical University, Samara, Russia, <https://orcid.org/0000-0002-6453-2976>.