The aim of the study was to evaluate clinical and functional parameters, markers of myocardial and renal dysfunction, and the potential of multimarker models for predicting adverse outcomes in patients with chronic heart failure with preserved left ventricular ejection fraction (HFpEF) with type 2 diabetes mellitus (T2DM) and chronic kidney disease (CKD).
Methods. The study included 246 patients with HFpEF and T2DM, including 122 males and 124 females. The study participants were divided into two groups. The first group included 168 patients with HFpEF with T2DM and CKD, and the second group included 78 patients with HFpEF with T2DM without CKD. Follow-up period was 18 months. The combined endpoint of the study was patients' death from cardiovascular causes, hospitalization due to decompensation of chronic heart failure, or outpatient visits due to worsening heart failure symptoms. Clinical and functional parameters, quality of life, echocardiographic parameters, renal function, NT-proBNP, sST2, galectin-3, cystatin C concentrations were evaluated in all patients.

Statistical data processing was performed using the Python programming language (version 3.10, sklearn, scipy, statmodels libraries) and R (version 4.2.2).
Results. Patients in group 1 had a longer course of DM ($p<0.001$) and chronic heart failure (CHF) ($p=0.01$), higher body mass index, waist circumference ($p<0.001$), lower indices of exercise tolerance ($p<0.001$) and quality of life ($p<0.001$) compared to patients in group 2. Patients with CKD had multivessel coronary artery disease ($p<0.001$) more frequently and a more severe course of DM. More patients in this group had a history of myocardial infarction ($p<0.001$), stroke ($p<0.001$) and aortocoronary bypass surgery ($p=0.04$). More severe haemodynamic disturbances, severity of left ventricle remodeling in patients with renal impairment corresponded to higher levels of the biomarkers studied. Different correlations between the parameters of renal dysfunction and indicators of the structural and functional state of the heart, cardiac biomarkers, were found. A higher degree of correlation from moderate to high was found with the calculated glomerular filtration rate than with the degree of albuminuria. The predictive models for the decompensation of heart failure using the markers of cardiac and renal dysfunction obtained by multivariate analysis were of high quality. The area under the curve (AUC) in the ROC analysis in model 1 with NT-proBNP concentration was 0.822 (95 % CI: 0.677-0.967; $p<0.001$). In model 2 with NT-proBNP and sST2 — AUC = 0.942 (95 % CI: 0. 876-1.0; $p<0.001$); in model 3 with NT-proBNP and galectin-3 — AUC = 0.869 (95 % CI: 0.738-0.982; $p<0.001$); in model 4 with NT-proBNP and cystatin C — AUC=0.862 (95 % CI: 0.736-0.992; $p<0.001$);
Conclusion. Patients with HFpEF, T2DM and CKD have more severe clinical and functional disorders of the cardiovascular system and carbohydrate metabolism than HFpEF patients without CKD. Evaluation of NT-proBNP, sST2, galectin-3, cystatin C levels allows the differentiation of stable patients with HFpEF with T2DM and CKD and those with the high risk of heart failure decompensation. The model including NT-proBNP and sST2 levels had the best prognostic value.