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## **Instrumental Methods of Diagnostics of Early Stages of Cardiomyopathies in Young People**

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### **ABSTRACT**

Cardiomyopathies (CMP) are a heterogeneous group of myocardial diseases characterized by structural and functional changes in the heart muscle, often with a high risk of developing heart failure, arrhythmias and sudden cardiac death [1, 3, 4]. Due to the frequent subclinical course in the early stages, timely diagnosis of CMP remains one of the most important tasks of modern cardiology and laboratory medicine.

According to international and domestic epidemiological studies, the prevalence of CMP varies from 1:500 to 1:250 among the adult population, while a significant number of cases remain undiagnosed. Diagnostic errors at the preclinical stage lead to the loss of opportunities for timely prevention of disease progression [5]. Among young patients, cardiomyopathy is one of the leading causes of sudden cardiac death, especially in hypertrophic and arrhythmogenic forms.

**KEYWORDS:** кардиомиопатия, молодые пациенты, NT-проBNP, МРТ сердца, ранняя диагностика, биомаркеры.

**Purpose and objectives of the study** Conducting a prospective cohort (observational) study with elements of the case-control design, aimed at assessing the effectiveness of laboratory and instrumental methods for diagnosing early stages of cardiomyopathy in young people.

### **MATERIALS AND METHODS**

A prospective cohort observational study with elements of a case-control design. Inclusion criteria: age 18–35 years, symptoms consistent with myocardial functional disorders (shortness of breath, syncope, fatigue), no organic heart disease according to echocardiography at inclusion. Examination methods: Electrocardiography (ECG); transthoracic echocardiography (EchoCG); magnetic resonance imaging (MRI) of the heart with contrast enhancement; biochemical markers: BNP, NT-proBNP, troponin I/T; genetic testing in the presence of a family history of cardiomyopathy. Statistical analysis: assessment of sensitivity, specificity, prognostic significance of tests; construction of ROC curves; logistic regression.

## RESULTS AND DISCUSSION

As part of the prospective cohort study, the diagnostic efficiency of four key methods was assessed: magnetic resonance imaging (MRI), NT-proBNP level, electrocardiography (ECG), transthoracic echocardiography (EchoCG). Each method was assessed for sensitivity, specificity, and area under the ROC curve (AUC) based on data from the main group (n=80) with early signs of cardiomyopathy and the control group (n=40).

**Table 1. Evaluation of the effectiveness of laboratory and instrumental methods for diagnosing early stages of cardiomyopathy in young people**

Method	Sensitivity (%)	Specificity (%)	AUC
<b>MRI</b>	91	85	0.91
NT-proBNP	86	80	0.86
<b>(ECG</b>	77	75	0.77
<b>EchoCG</b>	72	89	0.74

Magnetic resonance imaging (MRI) of the heart demonstrated the highest sensitivity among the studied methods — 91%. Characteristic changes were detected in 73 out of 80 patients with confirmed cardiomyopathy: areas of myocardial fibrosis, signs of remodeling and impaired perfusion. Specificity was 85%, false-positive results were noted in 6 out of 40 people in the control group. The high value of the area under the ROC curve (AUC = 0.91) confirms the high diagnostic accuracy of the method. Determination of the NT-proBNP level turned out to be sensitive in 86% of cases: an increase in concentration was recorded in 69 out of 80 patients with cardiomyopathy. Specificity of the method was 80%. False-positive results were observed in 8 people from the control group, which is probably associated with functional overload or irregular physical activity. NT-proBNP confirmed its high prognostic value in non-invasive screening. Electrocardiography (ECG) revealed pathological changes in 62 of 80 patients (sensitivity 77%), including repolarization disorders, bundle branch block, and signs of ventricular overload. The specificity of the method was 75%. Despite its relatively low accuracy (AUC = 0.77), ECG remains an important component of primary diagnostics due to its high availability, noninvasiveness, and speed of implementation. Transthoracic echocardiography (EchoCG) showed the lowest sensitivity among the methods — 72%, but had high specificity (89%) due to its accuracy in detecting pronounced morphological changes: hypertrophy, dilation of the heart cavities, and reduced ejection fraction. Echocardiographic signs corresponding to the early stages of cardiomyopathy were registered in 58 of 80 patients. Thus, the obtained data indicate the high efficiency of the combined use of laboratory and instrumental diagnostic methods. Cardiac MRI and NT-proBNP were found to be the most sensitive to subclinical forms of CMP. At the same time, ECG and EchoCG retain their importance as basic methods of primary screening and diagnosis confirmation. Integration of these methods allows to significantly increase the accuracy of detection of cardiomyopathies at the preclinical stage, as well as to determine the strategy of subsequent observation and treatment of young patients with an increased risk of developing cardiac pathology.

## CONCLUSION

Diagnostics of early stages of cardiomyopathy in young people requires a multidisciplinary approach, including a combination of laboratory and imaging methods. Based on the results of the study, it is recommended to use NT-proBNP and cardiac MRI as the main screening tools, especially in the presence of clinical suspicions and a burdened family history. Inclusion of ECG and EchoCG in the examination algorithm provides a comprehensive assessment of the functional and morphological state

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