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Impact of Scar Localization on the Clinical Course of the Disease and Functional State of the Heart in Patients with Myocardial Infarction

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Abstract **The aim** of the study was to evaluate the impact of scar localization on the clinical course of the disease and functional state of the heart in patients with myocardial infarction. **Background.** Cicatricial changes inevitably lead to myocardial remodeling, a decrease in its contractile function and the development of chronic left ventricular dysfunction. Myocardial infarction of anterior localization has more severe manifestations than myocardial infarction of posterior localization, clinical complications are observed more often. At myocardial infarction of anterior localization of LV, a wider zone of necrosis was accompanied by a significant decrease in myocardial deformation properties and their rate in comparison with posterior infarction. **Material and methods.** 150 patients who underwent myocardial infarction and were under observation in the cardiology department (mean age was 51±8 years) were included in the study. Patients were divided into two groups depending on scar localization: group 1 (anterior wall myocardial scar (n=78)), group 2 (posterior wall myocardial scar (n=72)). **Results.** The most significant left ventricular dysfunction was revealed in patients with anterior wall scar. The most severe clinical course of heart failure was observed in patients with the presence of an anterior wall scar. Functional class III-IV according to NYHA was noted in 33% of patients. In the group with scars on the posterior walls, these figures were 24.9%, respectively. **Conclusion.** Patients with anterior myocardial wall scar are characterized by more severe course of the disease, including high functional classes according to NYHA, frequency of hospital admissions, increased NTproBNP level and high risk of lethal outcome. At the same time, patients with posterior myocardial scarring have a less severe course of chronic heart failure.

Keywords Myocardial infarction, Chronic heart failure, Anterior wall myocardial scar, Posterior wall myocardial scar

1. Introduction

Chronic heart failure (CHF) after infarction remains one of the main problems of modern cardiology and ranks among the leading causes of death, disability of patients with cardiovascular diseases [1]. The importance of studying postinfarction CHF is associated with a high morbidity rate: in 20-40% of patients after myocardial infarction (MI), CHF is developed within the first year, which significantly worsens their quality of life and prognosis. One of the main factors determining the clinical course and outcome of postinfarction CHF is scar localization in the myocardium [2]. Scarring changes inevitably lead to myocardial remodeling, reduction of its contractile function and development of chronic left ventricular dysfunction. However, in spite of clear differences in pathophysiological processes depending on the zone of myocardial lesion, the impact of scar localization on the course of CHF is still insufficiently studied [3].

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According to the results of previous experimental and clinical studies it was noted that MI of anterior localization has more severe manifestations than MI of posterior localization, clinical complications are more often observed [4]. In the research of Golubeva A. V. V. et al. (2020) the heart biomechanics at different localizations of myocardial infarction was studied. Patients were performed speckle-tracking echocardiography. In myocardial infarction of anterior localization of LV, a wider zone of necrosis was accompanied by a significant decrease in myocardial deformation properties and their rate compared to posterior infarction [5]. These differences indicate the need to study scar localization as an independent prognostic factor that can be taken into account when planning an individual treatment. Modern diagnostic methods, including echocardiography, allow to assess the localization, volume and characteristics of scar tissue with high accuracy [6]. As a result, it will create additional opportunities to develop more accurate predictive models that can help clinicians to choose optimal treatment tactics. Besides, the use of these methods contributes to the early identification of patients with high risk of complications

and improves their management [7].

The relevance of the study is also determined by the need to improve treatment methods of post-infarction CHF. Considering the importance of scar localization, there is a prospect of developing new approaches to rehabilitation and drug therapy for preventing the development of CHF in patients with scars of different localization [8]. Thus, studying the impact of post-infarction scar localization on the clinical course of heart failure is important for improving the life quality of patients, as well as optimizing treatment and improving prognosis in patients with coronary heart disease [9].

The aim of the study was to evaluate the impact of scar localization on the clinical course of the disease and functional state of the heart in patients with myocardial infarction.

2. Material and Methods

The study included 150 patients who underwent myocardial infarction and were under observation in the cardiology department (mean age was 51±8 year). Inclusion criteria were the presence of post-infarction heart failure (PAHF) confirmed by clinical data, echocardiography and NYHA classification, and patient consent to participate in the study. Exclusion criteria were as follows: patients with comorbidities impacting prognosis (oncology, severe liver and kidney disease). Patients were divided into two groups depending on scar localization: Group 1 (anterior wall myocardial scar (n=78)), Group 2 (posterior wall myocardial scar (n=72)). Echocardiographic parameters were used to evaluate the functional state of the heart: left ventricular ejection fraction, myocardial mass index and the degree of remodeling. Clinical evaluation included determination of the functional class of CHF according to NYHA, hospitalization and frequency of complications (arrhythmias, recurrent infarctions). Additionally, blood tests were performed to determine the level of biomarkers: NTproBNP (sodium uretic peptide type B). Data were collected during the hospitalization phases, after 6 months of follow-up. The obtained data were subjected to statistical processing using Windows XP (Excel) statistical programs by determining Student's criterion.

3. Results

The performed analyses revealed significant differences between the groups in echocardiographic parameters, clinical manifestations, and disease outcome. The most pronounced left ventricular dysfunction was found in patients with anterior wall scar. The mean ejection fraction was 49%, which was significantly lower than in patients with posterior wall scar (53%). Left ventricular myocardial mass index was significantly higher in the group with previous scarring (132 g/m^2 versus 150), indicating significant myocardial remodeling. The index of impaired regional left ventricular contractility was 1.2 versus 1.5, indicating severe myocardial lesion with previous localization. When analyzing the diastolic function of the left ventricle, the average E/A values for the anterior and posterior wall localization groups were 0.83±0.2 and 0.78±0.32, respectively. When comparing the initial E/A values, no significant intergroup differences were found (p>0.05). The values of tissue Doppler velocity (e' lat and e' med) were also significantly lower in the group of patients with previous MI (p>0.05). Grade 1 left ventricular diastolic dysfunction was more frequently recorded in Group 2 (73% versus 81%). Grade 2 left ventricular diastolic dysfunction was more frequently recorded in Group 1 (19% versus 27%) (Tab. 1).

Table 1. Left ventricular functional state indices

Indices	Group 1 n=78	Group 2 n=72
LAVI (мл/м2)	34.2±0.36	32.3±0.44*
TRV, м/сек	2.7±0.05	2.4±0.02*
e' lat, см/сек	8.3±0.3	8.68±0.2
e' med, см/сек	6.1±0.1	6.36±0.1
E/e'	14.7±0.14	13.6±0.12*
E/A	0.83±0.2	0.78±0.32
Left ventricular diastolic dysfunction grade 1, n (%)	33 (73)	43 (81)
Left ventricular diastolic dysfunction grade 2, n (%)	11 (27)	7 (19)
Left ventricular diastolic dysfunction grade 3, n (%)	0	0
Left Ventricular End-Diastolic Volume, мл	148±3.0	124±3.0*
LVEF, %	49±1.3	53±1.7*
LV MI, гр/м^2	147±3.1	131±2.7*
Index of Regional Contractility Impairment (IRCI)	1,5±0.03	1,2±0.02*
Average heart rate, per minute	89±4.5	63±4.2
Mean systolic blood pressure, mmHg	118±5.4	115±6.3
Mean diastolic blood pressure, mmHg	82±3.2	78±2.3

Note: *- p<0.05 – reliability of statistical differences between groups

The most severe clinical course of heart failure was observed in patients with scarring of the anterior wall. Functional class III-IV according to NYHA was noted in 33% of patients. These figures made 24.9% in the group with posterior wall scars, respectively.

After 6 months, mortality in the anterior wall scar group was 3.84% and it was 2.78 times higher than in the posterior wall scar group (1.38%). The frequency of re-hospitalization within one year was highest in the anterior wall scar group 7 (8.97%) and in the posterior wall scar groups this rate was 3 (4.16%) cases respectively. The results confirm that the localization of post-infarction scar has a significant impact on the clinical course and outcome of heart failure.

Patients with anterior wall scar have a higher risk of the most severe disease manifestations and adverse outcomes. These data emphasize the need for intensive monitoring and

individual approach to treatment of this type of patients.

As patients with anterior wall scar were more likely to have sinus tachycardia arrhythmias, up to 92% of patients had to use beta-blockers. Thirty-five percent of these patients had a decrease in left ventricular ejection fraction below 40%. In the remaining cases, other factors of sinus tachycardia had to be corrected and beta-blockers had to be recommended due to its persistence. Most patients with posterior wall scar had no indication for beta-blockers due to sinus bradycardia.

Life-threatening ventricular arrhythmias during 6 months of follow-up occurred in 7 (8.97%) patients of Group 1 and in 2 (2.77%) patients of Group 2. The incidence of left ventricular thrombus was also statistically significantly more frequent in patients with cicatricial localization of the anterior wall (2.56% versus 0%) ($p<0.05$). There were no significant statistical differences in the incidence of myocardial infarction and repeat revascularization between two groups ($p>0.05$) (Tab. 2).

Table 2. Clinical results depending on scar localization

Parameters	Group 1 n=78	Group 2 n=72	P
NYHA functional class I	20 (25.6%)	26 (36.1%)	p<0.05
NYHA functional class II	32 (41.0%)	28 (38.9%)	p>0.05
NYHA functional class III	20 (25.6%)	16 (22.2%)	p>0.05
NYHA functional class IV	6 (7.7%)	2 (2.77%)	p<0.05
Life-threatening ventricular arrhythmias	7 (8.97%)	2 (2.77%)	p<0.05
Left ventricular thrombus	2 (2.56%)	0	p<0.05
Recurrent infarctions (%)	1 (1.28%)	1 (1.38%)	p>0.05
BNP level (pg/ml)	879±112	437±112	p<0.05
Rehospitalization	7 (8.97%)	3 (4.16%)	p<0.05
Revascularization	3 (3.84%)	3 (4.16%)	p>0.05
Mortality rate for 12 months	3 (3.84%)	1 (1.38%)	p<0.05

The localization of the post-infarction scar significantly affects the course of heart failure and the prognosis of patients. Anterior wall scar: CHF was most severe in patients with anterior wall scar.

High BNP levels (437±112 pg/ml compared with the average of 879±112) indicate significant cardiac stress and an unfavorable prognosis. Posterior wall scar: patients with posterior wall scar had mild CHF. In this group, hospitalizations were rare, and the BNP level (43.7±1.12 pg/ml) was also statistically significantly low.

According to the results of the study, anterior wall scars are associated with more pronounced remodeling, severe CHF and a high risk of complications, including arrhythmia and recurrent infarction. In this case, scars of the lower and lateral walls of the myocardium are often accompanied by less pronounced symptoms and a more favorable prognosis.

4. Conclusions

The results of the study showed that the localization of post-infarction scar has a significant impact on the clinical course and prognosis of heart failure in patients who underwent myocardial infarction.

Patients with anterior myocardial wall scarring are characterized by a more severe course of the disease, including high NYHA functional classes, frequency of hospitalizations, elevated NT proBNP levels, and a high risk of death.

At the same time, patients with posterior myocardial wall scars have a relatively mild course of CHF.

Conflict of Interests' Statement

The authors declare no conflict of interest.

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The article is published for the first time and is part of a scientific work.

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Ethical Approval and Consent to Participate

The Research Ethics Board of our institution does not require review or approval of case reports. Our research was carried out in accordance with the World Medical Association Code of Ethics (Declaration of Helsinki).

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