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Left Ventricular Remodeling in Patients with Chronic Heart Failure

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Original Research Article

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Abstract: The aim of the study was to of ventricular remodeling in patients with chronic heart failure (CHF) I-III functional class (FC). In patients with CHF left ventricular remodeling leads not only to re-structure of left ventricular (LV) which accompanied by dilatation and thinning of the cavity, reducing myocardial contractility, but also to changes of geometric shapes of left ventricular and to diastolic dysfunction of LV with domination of the disturbance of relaxation.
Keywords: Chronic heart failure, ventricular remodeling, diastolic dysfunction left ventricular.

INTRODUCTION

The chronic heart failure (CHF) remains to be one of the most important problems of a modern cardiology owing to a wide circulation and the adverse forecast, despite the significant progress in optimization of its treatment. The urgency of the studied problem is caused by CHF wide incidence universally and among cardiovascular diseases (CVD). The disease sharply worsens the life quality of patients, increases the risk of lethality by 4 times, and death rate of patients within a year makes 15-50% [1, 2]. About 50% of patients with CHF, despite the use of combination therapy, die within 5 years after the onset of clinical symptoms [3, 4]. A five-year mortality of 50% was observed in those with diastolic heart failure, which is similar to that of primary systolic heart failure. The epidemiology of diastolic heart failure differs somewhat from systolic heart failure 5 [5]. In various retrospective studies, the reported incidence of diastolic heart failure varies between 20-40% [6, 7].

The cause of this complication is that the remodeling process becomes maladaptive in character with progressive dilatation of the LV, an alteration of its geometry, and final fall of the pumping function. Every time patients with either systolic or diastolic heart failure are re-hospitalized, they have a 20-22% increase in their mortality [8-10].

PURPOSE OF THE STUDY

To study left ventricular (LV) remodeling and diastolic function (DF) of in the patients with I-III functional class (FC) with CHF.

MATERIALS AND METHODS

There were studied 80 patients with CHF. Control group included 20 healthy subjects. The clinical condition of the patients was assessed by 6MWT, the scale of assessment of the clinical state (SACS) modified by V.Y. Mareev [11]. The processes of cardiac remodeling and vessels were studied by echocardiography (EchoCG). Analysis DF was made on the basis of measurement of maximal velocity of LV early filling (E), maximal velocity of the late filling of the atrium (A), the ratio E/A, increase of LV isovolumetric relaxation time (IVRT).All patients underwent an electrocardiogram, the full range of clinical, functional and biochemical examinations. The structure of the basic therapy was as follows: ACE inhibitors have taken 92% of the patients, an ARB - 8%, BAB – 99,4%, diuretics - 36%, spironolactone - 68%, aspirin - 94%, nitrates - 28%, statins 98,2 % of patients. Statistical analysis of the data obtained. Obtained in the study data were subjected to statistical analysis on a personal Pentium-IV computer using the software Microsoft Office Excel-2012 package, including the use of built-in statistical processing functions. We used the methods of variational parametric and non-parametric statistics with calculation of the arithmetic mean of the studied index (M), standard deviation (σ), standard error of the mean (m), relative values (frequency,%), the statistical significance of the measurements by comparing mean values was determined by the Student criterion (t) with the calculation of error probability (P) in checking normal distribution (kurtosis criterion) and the equality of general variances (Fisher's exact test). For statistically significant changes was taken the confidence level of $P<0,05$. Statistical significance was calculated for qualitative variables using the $\chi 2$ test (chi-square) and z-test (Glantz). To analyze the dependences features steam Pearson correlation coefficient (r) was calculated.

RESULTS

Study of tolerance to physical exercise as a result of 6MWT in examined patients with chronic heart failure showed that initially patients with CHF FC I passed distance of 461,5 ± 14,21 meters. In CHF FC II and III this distance was 332,4 ± 16,47 and 228,3 ±10,13 m respectively. The clinical condition of patients by SACS was characterized by increasing indicators of SACS with disease progression: in patients with CHF FC I this index was 3,6 ± 0,76 points, in FC II patients – 5,7 ± 0,90 points (i.e., 57% higher than FC I), in FC III it was 8,8 ± 0,81 points (i.e., 142,8% higher on FC I), respectively.

The study of left ventricular remodeling processes revealed that the patients examined in the initial stages of CHF as a result of the adaptation process remained normal levels EF and Fs with unreliable rise ESV, EDV, EDD and ESD versus the normal values. By increasing the degree of heart failure progressively decreased LV ejection fraction and Fs, as basic indexes of systolic function. In patients with CHF FC II heart failure there was EF decrease in 17,4% (P<0,05) versus the indicators of EF in patients with CHF FC I, which was also followed by the fraction decrease in anteroinferior LV in systole (Fs) in 21,4% (P<0.05), respectively, versus the indicators Fs in patients with CHF FC I. In patients with CHF FC III the disease progression was followed by the reliable decrease: EF in 30,3% (P<0.001) and Fs in 31,5% (P<0.01), respectively, versus the indicators of the patients with CHF FC I.

Indicators of EDD and EDV in patients with CHF FC II were some higher than the indicators in patients with CHF FC I. The indicators of ESV in patients with CHF FC II were authentically higher at 30,1% (P<0,001) and 16,2% ESD (P<0,01), respectively, versus the ESV and ESD indicators in patients with CHF FC I. The increase in LV EDV in patient at the initial stage of remodeling is the early compensatory response to reduction of contractility and kinetics of walls and allows supporting the stroke volume (SV) and LV EF. The indicators of the meridional systolic myocardial stress (MS) characterizing the load on LV walls in patients with CHF FC II were higher at 23,5% (P<0,01), probably, due to increase of intra-myocardial tension of LV. Despite the increase in intra-myocardial tension of ventricles, dilatation of chambers of heart the stroke volume indexes remained within normal range, there was only a trend towards a decrease in the stroke volume.

In patients with CHF FC III was followed by more expressed LV restructuring, the degree of LV dilatation increased and it characterized by the increase: EDD in 15,2% (P <0,001)versus the indicators of patients with CHF FC I and EDV in 31,4% (P<0,001). Indicators of ESD were authentically higher at patients with CHF FC III at 35,4% (P<0,001), respectively versus the indicators of patients with CHF FC I, and the indicators of ESV increased more in 67,1% versus the indicators of patients with CHF FC I. Increase of intra-myocardial pressure in the end and systolic period was characterized by reliable increase of MS –in 35,4% (P <0,02) versus the indicators of patients with CHF FC I.

Study of structural and geometrical parameters of the left ventricle in investigated patients depending on the indicators of EV revealed that in patients with EF> 50% reliable changes of indicators of geometrical parameters were not marked, whereas in patients with EF < 50% the reliable decrease SV, increase LV EDV and ESV, which confirmed the marked lesions of LV myocardial contractility.

Analysis of diastolic function showed reliable decrease in the maximum rate of early left ventricular filling (E) versus the control (P <0,05), increase of the maximum rate of late atrial filling (A) (P <0,05), decrease the ratio of E/A (P <0,01), the degree of reduction of indicators E и E/A, which were more pronounced in patients with CHF FC III (P <0,05, P <0,01).

Analysis of the results revealed the CHF patients types of diastolic dysfunction were distributed as follows: in patients with disturbances of relaxation (I type) were determined in 38 patients (47,5% I type) of cases, pseudonormalization – in 19 patients (24,3% II type), restrictive changes (III type) - in 14 patients (18% of cases, normal diastolic function were identified in 9 patients (11,5%) of patients. Patients with CHF were divided into 2 groups to assess the interrelation of violations of left ventricular function and left ventricular diastolic dysfunction: group with preserved left ventricular systolic function (EF ≥50%) and a group with a reduced EF<40%. Analysis of the prevalence of left ventricular diastolic dysfunction of various types showed that severe violations of left ventricular diastolic function - pseudonormal and restrictive types - were significantly more frequent in patients with reduced left ventricular systolic function.

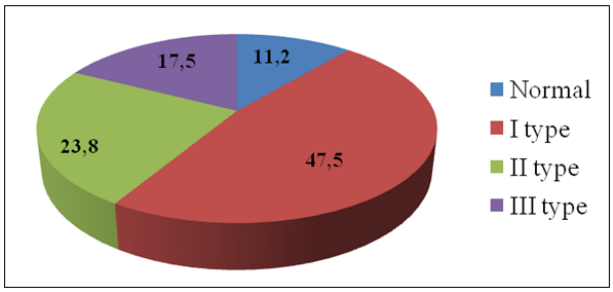

Fig-1: Diastolic function of the left ventricle in patients with CHF

CONCLUSION

Analysis of the prevalence of left ventricular diastolic dysfunction of various types showed that severe violations of left ventricular diastolic function - pseudonormal and restrictive type - were significantly more frequent in patients with reduced left ventricular systolic function.

Thus, in patients with CHF left ventricular remodeling leads not only to re-structure of LV which accompanied by dilatation and thinning of the cavity, reducing myocardial contractility, but also to changes of geometric shapes of left ventricular and to diastolic dysfunction of LV with domination of the disturbance of relaxation.

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