ORIGINAL ARTICLES

The features of structural and morphometric
parameters of the left ventricle in female chronic heart failure patients

Dadashova G.M.*

Autor:

Gulnaz M. Dadashova, PhD, senior researcher, Department of Heart Failure, Azerbaijan ScientificResearch Institute of Cardiology named after J. Abdullayev, Baku, Azerbaijan.

Summary

Object

Explore the structural-functional state of the left ventricle (LV) in female patients with post-infarction chronic heart failure (CHF) II–III functional class (FC) (NYHA).

Materials and methods

The study included 105 female patients with CHF II–III FC of non-valvular etiology; all of the patients were post-menopausal. The median age was 59 ± 6.7 years. All patients, included in the study, were performed echocardiography on ultrasound scanners «Vivid-7, Dimension» (USA).

Results

Analysis of the ECG results showed, that CHF occurs predominantly in women with preserved LV systolic function. Restrictive type of the diastolic LV relaxation was defined only in 6 patients (6.2 %), abnormal type of diastolic relaxation was observed in 32 patients (31.3 %) and in 63 (61.7 %) patients the type of violation of diastolic relaxation could not be determined. It should also be noted, that 8 patients (8.16 %) had a combination of LV systolic dysfunction, defined in terms of LVEF, and signs of violation of diastolic relaxation, i.e. mixed LV dysfunction. In 23.5 % cases concentric LV hypertrophy was defined, in 48 % cases — eccentric hypertrophy without dilatation, in 15.7 % cases — eccentric LV hypertrophy with dilatation and in 9.8 % cases — mixed hypertrophy of LV.

Conclusion

Post-infarction CHF in women is combined with the preserved LV systolic function. In cases with post-infarction CHF II–III FC, the most common type of LV remodeling is eccentric hypertrophy without dilatation.

* Corresponding author. Tel.: +994 50 599 21 03; +994 55 480 67 28; E-mail: gulnazdadashova@mail.ru

Introduction

Over the past decades, despite of the obvious achievements in the study of pathogenesis, clinic and treatment, chronic heart failure (CHF) still remains the most difficult and unfavorable prognostic complication of cardiovascular diseases. A significant number of clinical and epidemiological studies in Russia and abroad evidences this [1–6].

Over the past 20 years, the prevalence of CHF increased by more than 150 %. The incidence of CHF in the United States was about 2.5 % [7, 8], in the European population it ranged from 0.4 % to 2 % [9], in developing countries, this information is sparse. [10] The annual spread rate of CHF amounted 10 per 1 thousand people. Approximately 300 thousand people died from CHF, and treatment costs reached 1–2 % of total expenditure on health [11–13].

According to current literature data, significant demographic changes in the population over the past decade are considered as the main cause of increase in the prevalence of CHF: the decrease in the proportion of young people and a significant increase in the number of elderly and centenarians, who are at risk for development of CHF. Currently, researchers are talking about the process of global "aging" of the population in the developed world [14–17]. In the UK over the past 40 years, the proportion of persons > 65 years old increased by 50 %, and a 3-fold increase in the number of persons, who are 85 years old [18].

According to a recent registry of clinical entities, CHF is not the independent disease in the Republic of Azerbaijan, it is not included in statistical reports, but it is seen as a complication or outcome of major cardiovascular diseases. We know that as well as in Russia (before the study "Era" — epidemiological studies of patients in the European part of Russia), similar systematic data were not available [19].

This is due to the fact that CHF was not fixed both in the Russian and the national health statistics as a distinct disease, but it was dissolved in other diagnoses: coronary heart disease, rheumatic heart disease, myocarditis, cardiomyopathy, etc.

For decades, it was believed that the basis for the development of CHF was a violation of the LV contractile ability, which was revealed in the determination of its ejection fraction (EF). In the late 90s, there were reports that the clinical manifestations of CHF are observed in 20–30 % of patients with the preserved LV systolic function. This led to the assumption, that the cause of CHF could be extremely diastolic dysfunction with the preserved LV systolic function. Confirmation of this assumption has been possible thanks to the appearance of the Doppler method (Doppler-ECG) and its wider introduction into clinical practice. Essential significance of this method lies in the fact, that with its help there is a real opportunity to assess the global (systolic and diastolic) LV function in patients with CHF [20].

Most epidemiological studies indicate the predominance of men among patients with CHF [21]. A more serious epidemiological situation in terms of cardiovascular morbidity and mortality in men has led to an underestimation of the importance of this problem in women [22].

Therefore, the problem of the CHF treatment in women comes to the fore. It is necessary to define the peculiarities of CHF and its treatment in the female population, to communicate clinical manifestations with a hormonal status of women in different age periods. There is a need for a new epidemiological study, the results of which will be of great practical importance for the health system, in the development of guidelines and principles of CHF treatment in women.

Thus, considering the above definitions, the gender differences of CHF in women are interesting, which is reasonable and relevant to modern health care.

The object of research is to determine the characteristics of structural-functional state of LV in women with the post-infarction CHF II–III functional class (FC).

Materials and methods

The study included 105 women suffering from CHF II–III FC of non-valvular etiology, which are postmenopausal. Average age is 59 ± 6.7 years. All patients (n = 105), included in the study, was performed echocardiography (ECG) on the ultrasonic scanner «Vivid-7, Dimension» (USA). In the present study, this survey was not carried out in 3 women, for various reasons, so in the final data analysis, 102 patients suffering from the post-infarction CHF II–III FC were included.

The Ethics Committee of the Institute of Cardiology of Azerbaijan approved the study protocol. Work carried

out in accordance with the requirements of Good Clinical Practice (GCP), Good Epidemiology Practice (GEP) and the Helsinki Declaration of Human Rights. All patients signed the informed consent to the data analysis of records contained in their medical documentation.

The structure of complications is represented by a post-infarction stenocardia (71%), heart rhythm disorders (18%), the formation of a heart aneurysm (5%), blood clot in LV (2%) or ischemic cardiomyopathy (4%). Background increased BP was recorded in the whole group in 82% of patients, which is consistent with population-based studies on the higher frequency of arterial hypertension (AH) among women [23].

Patients, included in the study, were treated with antiplatelet agents (90%), ß-blockers (85%), angiotensin-converting enzyme (95%), diuretics (68%), nitrate (41%), statin (22%).

Statistical analysis of the material was held by software packages the Microsoft Excel. The text, the data is presented as arithmetic mean and standard error of the mean (M ± m).

Results and discussion

Analysis of the ECG study showed that CHF occurs in women predominantly with the preserved LV systolic function. Table 1 summarizes the main indicators characterizing the LV systolic function in women suffering from CHF II–III FC.

Numerous studies have shown that diastolic dysfunction developed more often in women than in men, and LVEF remained unchanged [24–29]. The prevalence of CHF in more elderly patients should be also considered. With an age increasing, the percentage of patients with the preserved LV systolic function increases [29, 30]. Thus, the prevalence of the LV diastolic dysfunction in women is associated with both the feature of a woman's heart reaction to damaging factors and gender characteristics of the CHF spread depending on age.

Table 1. **Indicators of the LV systolic function in women with post-infarction CHF II–III FC**

Indicator	Value (n=102)
ESD, mm	40.1±4.9
EDD, mm	57.0±5.2
ESV, ml	54.4±6.8
EDV, ml	109.1±11.2
LVEF, %	56.3±4.9
SV, ml	89.1±9.7

Features of cardiovascular continuum lie in the fact that at a certain stage of heart disease, progression of CHF occurs on general regularity, practically independent of etiologic factor. Perhaps this is the key to explaining the search of criteria of early diagnosis and prognosis of CHF [31–34].

Thus, when analyzing the results of ECG study of the heart, the LV systolic dysfunction is defined only in every fourth patient, whereas it is intact in other cases. To identify the etiologic and clinical-demographic indicators, which may be associated with the occurrence of LV systolic dysfunction, all the patients were divided into subgroups according to certain clinical-demographic characteristics (Table 2).

Table 2. **The incidence of the LV diastolic dysfunction, depending on the original characteristics of patients with CHF**

Subgroups of patients with CHF	The incidence of the LV diastolic dysfunction in subgroup, %
AMI in medical history	71
Age > 75 years old	53.4
Atrial fibrillation	33.2
AH as a cause of CHF	59.5
Diabetes mellitus as a cause of CHF	25.7

Thus, it was possible to determine the patient's premorbid background with CHF, in which systolic CHF is determined most likely. This form of CHF is specific in women after acute myocardial infarction (AMI), AH and in elderly patients aged ≥ 75 years.

The next logical step of the work was to determine the parameters of LV diastolic function. Table 3 summarizes the main indicators, characterizing the LV diastolic function in women with the post-infarction CHF II–III FC.

Table 3. **Indicators of the LV diastolic function in women with the post-infarction CHF II–III FC**

Indicator	Value (n = 102)
The rate of early rapid filling of LV (peak E), m/s	0,89±0,17
The rate of late atrial filling of LV (peak A), m/s	0,71±0,02
The ratio E/A	1,49±0,21
Isovolumic relaxation time, ms	85±13
The deceleration time of early diastolic filling, ms	174±33

In the study sample, based on the method of determining the arithmetic mean of each specific indicator, it can come to the mistaken belief that the LV diastolic function is not impaired. However, although the restrictive type of the LV diastolic relaxation was defined only in 6 (6.2%) patients, abnormal type of diastolic relaxation was observed in 32 (31.3%) patients, and in 63 (61.7%) patients the violation type of diastolic

relaxation could not be determined. It should also be noted, that in 8 (8.16%) patients there was a combination of the LV systolic dysfunction, defined in terms of LVEF, and violation signs of diastolic relaxation, i.e. mixed LV dysfunction.

The analysis of remodeling features of LV based on the definition of indicators, such as LV myocardial mass index (LVMMI), relative wall thickness (RWT), shown that a change in the spatial architecture of LV is specific for women suffering from the post-infarction CHF II–III FC (Table 4).

Table 4. **The incidence of various types of LV remodeling, characterized by different ratios of wall thickness and size of its cavity**

Types of LV remodeling	Frequency, abs / %
Normal LV	1/0.98
Concentric hypertrophy of LV	26/23.5
Eccentric hypertrophy of LV without dilatation	49/48.0
Eccentric hypertrophy of LV with dilatation	16/15.7
Mixed hypertrophy of LV	10/9.8

Thus, we can conclude, that the presence of the post-infarction CHF II–III FC in women indicates the presence of some form of LV remodeling with approximately 100% probability. In 23.5% cases, the LV concentric hypertrophy is defined in patients (LVH), in 48% cases — the LV eccentric hypertrophy without dilatation, in 15.7% patients — the LV eccentric hypertrophy with dilatation, and in 9.8% patients — mixed LV hypertrophy.

In recent years, the gender characteristics of cardiac remodeling after myocardial infarction (MI) are discussed actively, despite the fact that the development of CHF after MI occurs on general mechanisms [33, 34]. In particular, the experiments show that fibroblasts of woman's hearts are more resistant to ischemia than men's, which determines their lower rate of the apoptosis of heart cells after MI [35]. This was confirmed in the clinic: in women, having MI, the degree of apoptosis of cardiomyocytes was 10 times lower than in men [36]. Consequently, the post-infarction remodeling occurs in women more favorably than in men. The thinning of the myocardium walls and enlargement of the heart chambers in women is less pronounced. As we age, women saved the total amount of heart muscle cells and muscle mass, but there is their steady loss in men. Often after MI, pressure overload develops. In this case, the majority of the women LV remodeling is on relatively favorable adaptive type of the heart remodeling, whereas there is dilation of the LV chamber in men, which often leads to a decrease in systolic function.

Conclusions

Post-infarction CHF occurs predominantly with the preserved LV systolic function in women.

The presence in females of the post-infarction CHF II–III FC usually indicates the presence of some form of LV remodeling. At the same time, in 23.5% patients concentric LVH is defined, in 48% patients — eccentric LVH without dilatation, in 15.7% patients — eccentric LVH with dilatation, and in 9.8% patients — mixed LVH.

Conflict of interest: None declared.

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