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The Role of Metabolic Syndrome in The Nature of Postinfarction Remodeling of The Heart in Patients with Chronic Heart Failure

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Abstract: The aim is to study of heart's structure and hemodynamic indicators according to composition of metabolic syndrome components in the patient with chronic heart failure (CHF)functional class (FC) II-III. 62 men-patient with cardiosclerosis after heart attack were examined by the way of echocardiography on CHF FC II-III (NYHA). According to metabolic syndrome components they are devided into 3 groups: 1st group (n=20), patients without signs of metabolic syndrome; 2nd group (n=21) patients with combination of dyslipidemia (DLP), abdominal obesity (AO), arterial hypertenion (AG) and hypertriglyceridemia; 3rd group (n=21) with different combination of dyslipoproteinemia, diabetes and obesity also AG and hypertriglyceridemia. in CHF passed with metabolic syndrome is seen a clear sign of heart's systolic and diastolic.the presence of metabolic syndrome in CHF also its progressing is the subject to be hypertrophy of left ventricle, breaking the transmitral blood flow, also thickening of barier between ventricles and left ventricle back thickness.

Keywords: chronic heart failure, metabolic syndrome, echocardiography, hemodynamics.

Metabolic syndrome (MS) is currently one of the actual medical and social problems throughout the world. MS, which is characterized by a combination of insulin resistance (IR) / hyperinsulinemia, hypertriglyceridemia, gipoalfaholesterinemia, infraction of glucose tolerance and other metabolic inflaction, and also arterial hypertension is a risk factor of cardiovascular disease [1]. By the opinoin of many experts on MS characteristic is the formation of a specific kind of hemodynamics and specific damage of organ-target, which further acts as an independent risk factor for cardiovascular complications [2,3]. As shown in researches conducted in recent years, the peculiarities of heart disorders in MS is the development of hypertrophy of the left ventricle (LV), inadequate blood pressure levels [4]. MHLV viewed as an independent marker of high risk of cardiovascular disease [5], including sudden death [6] and significantly affect the mechanism of formation of diastolic dysfunction (DD), left ventricular heart [7], which is important in the formation of heart failure (HF). Currently, there are few data on the nature of the development of heart failure in combination with various MS cardiovascular disease that poses the need for further research in this direction. For this reason in this study we set the goal to explore the nature of cardiac remodeling, promoting the development of heart failure in patients with myocardial infarction (MI) due to MS.

Material and Methods

The study involved 76 male patients with chronic heart failure (CHF) II-III functional class (FC), with postinfarction cardiosclerosis. Prescription of myocardial infarction from 6 months to 5 years. Verification of

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the diagnosis carried out on the basis of the classification of the New York Heart Association (NYHA), six-minute walk test and due scale assessment scale of the clinical state. The average index six minute walk testing was detected as 304.7±19,3m (274-338m). Depending on the components of MS the patients were divided into 3 groups: Ist group (n=27), patients without MS; Group II (n=24), patients with a combination of dyslipidemia (DLP) with abdominal obesity (AO) and hypertension (AH); Group III (n=25), patients with a combination of AD, AH and DLP with diabetes of 2 types.

While diagnosing the MS, the diagnostic criteria of MS International Diabetes Federation (IDF, 2009) was used. Abdominal obesity (AO) (>94 cm for men); level of triglycerides (TG >1.7 mmol/l); the level of lipoprotein cholesterol with high density (HSLPVP <1.03 for men); blood pressure level (systolic blood pressure >130 mm Hg, diastolic blood pressure >85 mm Hg), glucose level on an empty stomach (>5.6 mmol/l) or the presence of diabetes mellitus of type 2 were considered as the main components of the syndrome.

The patients under survey were hospitalized in the cardiology department of the city hospital number 7 in Tashkent. Patients were examined on the basis of the contract with medical diagnostic centre of the Ministry of Health of the Republic of Uzbekistan. All examined patients underwent clinical, laboratory and instrumental methods of research. Echocardiography (EchoCG) was carried out on the machine Mindray (China) by method of lying in prone position and the left side of M and B modes in accordance with the requirements of the American Association of Echocardiography (ASE). Wherein the followings were evaluated: the ultimate-diastolic dimension (UDD), the ultimate-systolic dimension (USD), the thickness of the posterior wall of the left ventricle (TPW), the width of the ventricular septal (TVS), the size of the left atrium (LA), ultimate-systolic volume, ultimate-diastolic volume. Concerning the left ventricular (LV) systolic function, the data was assessed due to the level of ejection fraction (EF), which was calculated by the formula Teicholz et al. [8], stroke volume (SV), which was defined as the difference between the UDV-USV, as well as by the degree of shortening of the anterior-posterior size of the left ventricle into systole (% ΔS). Concerning the left ventricular diastolic function, the data was assessed due to the maximum speed of the early peak of diastolic filling (V_{max}Peak E, 0,62 m/s), the maximum speed of transmitral flow during systole of the left atrium (V_{max}Peak A, 0,35 m/s) and the ratio of E/A (1.5-1.6), isovolemic LV relaxation time (IVRT), deceleration time of early diastolic filling (DT). The mass of the myocardium left ventricular (LVMM) was calculated by the formula Devereux RB [9]; index mass of the myocardium left ventricular (LVMMI) as a ratio to the area of the body; the left ventricular hypertrophy criteria was accepted as LVMMI >125 g/m^2 in men and >110 g/m^2 in women. The relative width of walls (RWW) was also calculated.

MMLV calculated by Devereux RB formula [9]; LVMMI - LVMM to the area of the body; criteria for left ventricular hypertrophy received LVMI> 125 g / m2 in men and> 110 g / m2 in women. Calculated relative to the wall thickness (UTS).

$LVMM=1,04* [(UDD_{lv}+TPW+TVS)^3-UDD_{lv}^3] – 13,6$ g;

$LVIMM= LVMM/S_{body}$ g/sm^2;

$S_{body}=M^{0,425} * P^{0,725} * 0,007284$ g/sm^2;

%ΔS=UDD-USD/UDD %.

Statistical analysis of the data was performed on a personal computer type IBM PC / AT using standard electronic package program «biostatic for Windows, version 6.0." The parameters are described in the form of M ± δ. If the distribution of values group comparisons of quantitative variables was performed according to using Student's t test statistical variations (t).

Studies rtesults

Patients with CHF II-III FC, who had similar results of the study with six minute testing, have significant differences according to echocardiography and Doppler echocardiography (Table №1), depending on the existence and nature of their representation of the metabolic syndrome (MS). Indicate the presence of features of structural and functional changes in the myocardium in patients with MS. The comparative analysis established that the TPW and TVS were more increased in patients with MS rather than in patients without MS. Whereas the differences according to these indicators between 1st and 2nd groups were not significant, in the third group TVS was greater by 11.9% ($p<0.05$), and TPW by 7.7% ($p<0.05$). It is associated with an

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increase in ultimate-systolic and ultimate-diastolic size and volume of the left ventricle, which causes an increase in MMLV and IMMLV.

The patients in group II compared to patients of group I, have a significant increase in the USD and USV ($p<0.05$), with little difference in the UDD and UDV. 3rd groups differ with a considerable increase in both ultimate-systolic and ultimate-diastolic volumes and sizes. The UDD amount in these patients was greater by 8.9% ($p<0.01$), the USD by 17.6% ($p<0.01$), UDV by 20.6% ($p<0.01$) and USV by 47% ($p<0.01$). As a consequence of the above mentioned changes, the LVMM in patients with MS was greater by 10.8% ($p<0.05$) and 33.3% ($p<0.01$) in the second and third groups respectively. However, the index points to a significant increase of the current indicator only in the third group.

Table № 1.
Echocardiography and Doppler echocardiography parameters of structural and functional changes in the left ventricle of the heart in patients with heart failure and metabolic syndrome.

Indicators	1st group(n=27)	2nd group (n=24)	3rd group (n=25)
LA, cm	3,71±0,086	3,94±0,083*	4,16±0,09**
LVMM, g	212,78±6,08	235,88±9,58*	283,66±11,58**
LVMMI, g/m²	128,58±4,57	130,93±6,23	163,0±6,67**
TVS, cm	1,09±0,028	1,14±0,027	1,22±0,03*
TPW, cm	1,04±0,021	1,08±0,022	1,12±0,025*
UDD, cm	4,73±0,071	4,82±0,068	5,15±0,083**
USD, cm	2,95±0,056	3,11±0,057*	3,47±0,085**
UDV, ml	132,15±3,62	138,42±3,57	159,48±4,39**
USV, ml	61,78±2,28	68,5±2,22*	91,16±2,91**
SV, ml	70,37±3,89	69,92±3,28	68,32±2,71
EF, %	52,56±2,02	50,2±1,53	42,72±1,11**
Dt, mc	189,67±8,5	215,08±8,91*	230,83±9,52**
IVRT, mc	85,2±2,05	89,28±2,81*	95,29±2,75**
%ΔS,%	37,16±1,73	35,19±1,34	32,47±1,53*
PE, м/с	0,59±0,018	0,57±0,019	0,54±0,021
PA, м/с	0,50±0,016	0,53±0,018*	0,58±0,017**
E/A	1,18±0,042	1,08±0,054*	0,93±0,027**
Heart rate, bpm	75,37±1,72	76,92±1,96	77,4±2,36

Note: * - p< 0,05; ** - p< 0,01; *** - p< 0,001 compared to 1 group.

Along with the structural changes in patients with heart failure, there were identified the left ventricular dysfunctions as well, which is most determined in patients with MS. In particular, in the third group the EF was lower by 18.8% ($p<0.01$), which particular is due to the decrease in the shortening degree of the anterior-posterior size of the left ventricle into systole by 19.2% ($p<0.01$). Patients with MS differ by more severe manifestations of diastolic dysfunction as well, which as evident by the significant increase of RA in 2nd group ($p<0.05$) and the third group ($p<0.01$) patients within the slight decrease in PE, as well as a decrease in E/A ratio by 7.6% ($p<0.05$) and 19.5% ($p<0.01$), respectively. The disturbance of transmitral blood flow is associated with the increasing of left ventricular isovolemic relaxation time by 8.6% ($p<0.05$); 15.9% ($p<0.01$), as well as the deceleration time of early diastolic filling by13.4% ($p<0.05$) and 21.7% ($p<0.01$) in the 2nd and 3rd groups, respectively. The disorder of systolic and diastolic function of LV leads to strained work of the LA. The received data indicates that the changes revealed by the LV in patients without MS are not reflected on LA condition, while in patients with MS has an increase in its size. Herewith, if this figure in the second group is increased by 6.2% ($p<0.05$) in the third group the difference reached by 12.1% ($p<0.01$), which is out of range.

Thus, all patients with heart failure show the signs of structural and functional changes in the left ventricle and left atrium of the heart, the severity of which depends on the presence and severity of MS. The

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next stage of this work was to study the anti-remodeling efficiency of complex pharmacotherapy using the main set of preparations for the treatment of heart failure.

Conclusions:

1. The presence of metabolic syndrome in patients with chronic heart failure is an important factor reinforcing the pathological cardiac remodeling of LV.
2. The presence of metabolic syndrome in patients with chronic heart failure is an important factor progression of systolic and diastolic dysfunction of LV,
3. More pronounced changes in echocardiographic parameters are most manifested within the combination of DLP, AO and diabetes of 2 types.

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