LEFT VENTRICULAR HYPERTROPHY IN PERSONS WITHOUT ARTERIAL HYPERTENSION: PSYCHOSOMATIC APPROACH TO THE STUDY OF THIS PHENOMENON

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Received:	11th November 2022	**Objective:** to evaluate the role of psychological and somatic factors in the development of left ventricular hypertrophy in a cohort of people without hypertension and to quantify their impact on the specified phenomenon.
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Material and methods. The study included 107 practically healthy people of working age from an organized population, 46 of them men (average age 43.7 ± 11.5 years; M ± s) and 61 women (average age 43.1 ± 10.1 years; M ± s). Blood pressure was measured for all subjects according to the standard procedure, a questionnaire using standardized psychological questionnaires, study of structural changes of the myocardium using echocardiography, as well as determination of the level of metabolic (hormonal, immunological, biochemical) indicators of venous blood on an empty stomach.

Results. Individuals with left ventricular hypertrophy were characterized by significantly higher levels of depression, accumulated stress, social frustration, and reduced self-esteem of health and resilience. In the group with left ventricular hypertrophy, an avoidance strategy is significantly more often used, with less frequent use of strategies for planning problem solving and seeking social support. Positive the correlation with the left ventricular myocardial mass index was shown by: height (r = 0.56), body surface area (r = 0.54), waist circumference/hip circumference ratio (r = 0.62), triglyceride concentration (r = 0.58), very low density lipoprotein cholesterol concentration (r = 0.58) (n = 41; p ≤ 0.001). The value of the left ventricular myocardial mass index in practically healthy individuals without hypertension is determined by four factors: the level of apolipoproteins B; the ratio of waist circumference / hip circumference; the level of end products of free radical oxidation of lipids; smoking experience.

Conclusion. Features of personal response that cause increased susceptibility to stress effects, determine the nature and severity of stress reactions, their metabolic and hormonal accompaniment. Hypertrophy of the left ventricle in persons without arterial hypertension it is associated with personality traits that determine the nature of a multi-level response (somatic, hormonal, biochemical).

INTRODUCTION

Traditionally, left ventricular hypertrophy (LVH) is considered as a consequence of myocardial overload by volume and/or resistance. LVH is an obligatory stage in the treatment of arterial hypertension (AH), a number of other cardiovascular diseases (CVD), leading to the development of chronic heart failure, which is based on neurohumoral hyperactivation. However, an explanation of the pronounced variability of myocardial mass from the standpoint of only increased hemodynamic load would be incomplete. In a number of epidemiological studies, LVH was established

in 10-15% of cases among an unorganized population without hypertension and other CVD. Many authors associate this phenomenon with increased neurohormonal stimulation of cardiomyocytes as a manifestation of a stress reaction. About 70% of the population of Uzbekistan are exposed to stressors at work and at home, while there is a tendency to increase the level of stress. Lack of motor activity aggravates the effect of stressors. The question of the pathogenetic role of stress in the development of LVH before an increase in blood pressure is discussed. Psychological features of personality, features of psychoemotional response to stressors, behavioral stereotypes, conventional risk factors and their association with metabolic parameters, structural changes of the heart in a cohort of people with LVH without hypertension require in-depth study.

THE PURPOSE OF THE STUDY

To assess the role of psychological and somatic factors in the development of LVH in a cohort of people without hypertension and to quantify their impact on this phenomenon.

MATERIALS AND METHODS

A one - stage study of employees of an industrial enterprise was conducted as part of the medical examination of certain groups of the adult population . The studied sample consisted of 107 practically healthy individuals according to the results of medical examination corresponding to the I and II health groups. Of these, 46 men aged 23-60 years (43%) (average age 43.7 ± 11.5 years; M ± s) and 61 women aged 25-60 years (57%) (average age 43.1 ± 10.1 years; M ± s). Exclusion criteria from the study: essential arterial hypertension; symptomatic arterial hypertension; comorbid somatic diseases; refusal of the patient from the examination. The assessment of behavioral and biological risk factors was carried out in accordance with the national recommendations for cardiovascular prevention of HCOC (2011). The range of laboratory studies included the study of indicators of endothelial function, lipoprotein metabolism, products of oxidative modification of proteins and lipids, hormonal and immunological parameters. The fact of the normal level of arterial pressure was established according to the outpatient chart (a retrospective assessment of long-term dispensary examinations), measurements of office arterial pressure (the blood pressure level < 140/90 mm Hg was taken as a criterion), as well as according to self-monitoring data (the blood pressure level < 130-135/85 mm Hg was taken as a criterion).. In practically healthy individuals with newly diagnosed left ventricular hypertrophy, daily blood pressure monitoring was additionally performed on a BPLab device to exclude arterial hypertension. The method of measuring office blood pressure was carried out according to the standard procedure. The analysis included the value of the arithmetic mean blood pressure of the results of three measurements. Two-dimensional echocardiography and Doppler echocardiography were performed on a Philips iE 33 ultrasound scanner with an X5-1 matrix sensor in the patient's supine position and on the left side at an angle of 45° according to standard methods. A standard criterion was taken as a sign of hypertrophy of the left ventricle of the heart – the left ventricular mass index (LVMI) > 115 g/m2 for men and > 95 g/m2 for women. Psychological diagnostics was carried out using standardized scales: the Spielberger–Khanin scale of reactive and personal anxiety (licensed computer program); the depression assessment scale of the Center for Epidemiological Studies of the USA (CES – D) adapted by M.Y. Drobizhev; the method "Level of social frustration" (USF), developed by L.I. Wasserman et al.; the Holmes scale – Rhea; visual-analog scale (YOUR) self-assessment of health, everyday stress, resilience (modified version of the Dembo – Rubinstein technique); standardized questionnaire "Coping behavior strategies" for psychological diagnostics of coping strategies with stress. Statistical processing of the material was carried out using the licensed software package IBM SPSS Statistics 17.0 (USA). Nonparametric quantitative features are given in the form of the median and the boundaries of the interquartile interval (in parentheses). To check the coincidence of the distribution of the studied quantitative indicators with the normal one in the groups, the Kol-Mogorov – Smirnov agreement criterion was used. Since the distribution law of the studied numerical indicators differed from the normal one, the statistical significance of the differences was checked using the Mann-Whitney U–test. Nominal (categorical) variables were compared using Pearson's criterion χ2. To assess the conjugacy of processes, a correlation analysis was used with the determination of Spearman's rank correlation coefficients (r). To judge which of the independent predictors have the greatest influence on dependent variables, a multiple regression analysis was performed. In all statistical analysis procedures, the significance level of p was assumed to be less than or equal to 0.05.

RESEARCH RESULTS AND THEIR DISCUSSION

The results presented in Table 1 indicate that the level of self-esteem in all parameters in the group without LVH exceeds the corresponding level in the main group, and this superiority in two cases reaches the level of statistical significance. A group of people with LVH assess their level of health and resilience significantly lower compared to a group without LVH. The average indicators of reactive and situational anxiety did not reach significant intergroup differences, however, in the group with LVH, persons with a clinically significant level of personal anxiety (≥ 45 points) were relatively more common – 23 (56.1%) people. There were significant differences in the severity of depression, which amounted to 16.4 (14.9; 17.9) points in the group with LVH, and 13.0 (11.3; 14.6) points in the control group. The number of stressful events on the Holmes–Ray scale was significantly higher in the group with LVH – 179.2 (158.7; 199.8) points/year. The results of the study of ways of coping with stress indicate a significant predominance of the "Escape – avoidance" strategy in the main group with relatively rare use of coping strategies "Problem solving planning" and "Search for social support".

The results of measuring the relationship between the presence of LVH and the level of psychological indicators are given in Tables 2-4. As can be seen from Table 2, LVH shows a significant relationship with the level of depression. At the same time, the chance of a patient with depression to have an increased left ventricular mass index is 6 times higher than in people without LVH.

Based on the data presented in Table 3, personal anxiety has a statistically significant relationship with LVH. At the same time, in patients with an increased level of personal anxiety, the chance of left ventricular remodeling is 4 times higher than in the control group.

The data in Table 4 demonstrate a significant association with the level of accumulated stress. A high level of accumulated stressful events significantly increases the chance of developing left ventricular hypertrophy.

It should be concluded that clinically significant levels of anxiety, depression, accumulated stress on the Holmes–Ray scale demonstrate a statistically significant association with LVH. Taking into account the limitations of the cross-sectional study, causal relationships require confirmation in further prospective observations.

Table 1
Psychological indicators in practically healthy individuals, depending on the presence of left ventricular hypertrophy

Indicators	Group with GLJ (n = 41)	Group without LVH (n = 66)	p
VAS (health)	57.5 (50,9; 64,0)	68,5 (63,0; 73,9)	0,02
VAS (stress)	46.2 (39.1; 53.3)	44.7 (37,5; 51,9)	0,95
VAS(resilience)	52.4 (43,7; 61,1)	65,1 (58,7; 71,6)	0,02
USF	2.5 (2,4; 2,6)	1,8 (1,5; 2,0)	0,000
Depression	16.4 (14,9; 17,9)	13,0 (11,3; 14,6)	0,01
RT	36.7 (32,7; 40,6)	36,1 (32,8; 39,4)	0,80
LT	42,4 (39,3; 45,6)	41,0 (38,7; 43,4)	0,32
Accumulated stress	179,2 (158,7; 199,8)	134,7 (110,5; 158,8)	0,00
Strategies for coping with stress			
Confrontation	43.6 (40,5; 46,7)	46,5 (43,4; 49,6)	0,26
Distancing	48.2 (44,7; 51,8)	48,5 (45,7; 51,2)	0,82
Self-control	42.7 (38.8; 46.6)	44.6 (41,1; 48,1)	0,41
Search for social support	44.6 (41,3; 47,9)	48,6 (44,6; 52,5)	0,05
Taking responsibility	46.8 (43,7; 50,0)	43,8 (41,1; 46,5)	0,09
Escape – avoidance	51.6 (48.3; 55.0)	45.5 (42,2; 48,9)	0,01
Problem solving planning	43,2 (39,0; 47,4)	49,5 (46,1; 52,8)	0,03
Positive revaluation	42,9 (39,5; 46,2)	46,0 (43,1; 48,8)	0,13

Note. VAS − visual-analog scale; USF − the level of social frustration; RT − reactive anxiety; LT − personal anxiety

Table 2
The relationship of left ventricular hypertrophy with the level of depression

	Group with GLJ	Group without GLJ	Everything
Depression ≥ 18 b.	19 (46,3 %)	8 (12,1 %)	27
Depression < 18 b.	22	58	80

	(53,7 %)	(87,9 %)	
	41	66	107

Table 3
The relationship of left ventricular hypertrophy with the level of personal anxiety

	Group with GLJ	Group without GLJ	Everything
LT ≥ 45 B.	23 (56,1 %)	14 (21,2 %)	37
LT < 45 b.	18 (43,9 %)	52 (78,8 %)	70.
	41	66	107

Table 4
The relationship of left ventricular hypertrophy with the level of accumulated stress

	Group with GLJ	Group without GLJ	Everything
accumulated stress ≥ 150 b.	19 (46,3 %)	18 (27,3 %)	37
Accumulated stress < 150 b.	22 (53,7 %)	48 (72,7 %)	70LT ≥ 45
	41	66	107

It should be concluded that clinically significant levels of anxiety, depression, accumulated stress on the Holmes–Ray scale demonstrate a statistically significant association with LVH. Taking into account the limitations of the cross-sectional study, causal relationships require confirmation in further prospective observations. The structure of correlations between psychological and somatic (metabolic) indicators demonstrates significant differences in the groups identified by the presence of LVH. In individuals with LVH, almost all indicators of lipoprotein metabolism have significant correlations with behavioral response patterns that are stressful. It is also important to note that coping strategies closely correlate with the concentration of cortisol, and personal anxiety - with the level of catecholamines, and in particular adrenaline. It is known that cortisol and catecholamines determine the remodeling of the heart, while hormonal factors are closely related to personality traits. It can be assumed that the somatic manifestation of the stress reaction is shifts in neurohormonal, lipid metabolism, and the system of growth factors. At the same time, it seems that it is not so much the strength and exposure of stress that matter, as the features of personal response to psychoemotional experiences, behavioral risks, individual stress tolerance that determine the nature and severity of humoral and related structural and functional changes of the vulnerable organ. A number of researchers indicate the influence of hormonal, immunological, lipid parameters, growth factors on myocardial remodeling. Thus, a positive correlation at the highest level of significance ($n = 41$; $p ≤ 0.001$) was shown by: height ($r = 0.56$); body surface area ($r = 0.54$); waist circumference/hip circumference ratio ($r = 0.62$); triglyceride concentration ($r = 0.58$); cholesterol concentration very low density lipoproteins ($r = 0.58$); the index of the bundle / years ($r = 0.95$).The revealed direct dependences of the left ventricular myocardial mass index on psychological factors (depression, personal anxiety, the level of accumulated stress), behavioral factors suggest that the heart remodeling processes are realized through a stress reaction, one of the metabolic manifestations of which is hyperlipidemia. According to L.E. Panin, stress can increase and contribute to the formation of atherosclerosis due to stress hyperlipidemia and especially hypercholesterolemia, as well as due to damage to cell membranes by lipid peroxides. In order to identify the most significant factors affecting the left ventricular mass index in practically healthy individuals and quantify them, a step-by-step regression analysis was performed. As shown in Table 5, the value of LVL in practically healthy individuals with left ventricular remodeling is determined by four factors that have shown a direct relationship with the above indicator: the level of apolipoproteins B; the waist circumference/hip circumference ratio; the level of end products of free radical lipid oxidation (TBK products); smoking experience.

Table 6
The results of a step-by-step regression analysis of the influence of the studied variables on the value of the left ventricular mass index in a group of patients with LVH

№	Independent variables	B	p
1	Smoking experience	1.02	0.001
2	Apo At	46.97	0.002
3	WC/HC	27.97	0.006
4	TBK-products	0.19	0.040
R2 for the model = 0.79; F = 4.82; p = 0.001			

Note. The final regression equation has the form: IMLJ = 22.7 + 1.0 × smoking experience + 46.9 × Apo In + 27.9 × WC/HC + 0.2 × TBK; Apo B – apolipoproteins B; WC /HC – waist circumference/hip circumference ratio; TBK-products – end products of lipid peroxidation according to the test with thiobarbituric acid.

As the results of our study show, the system–forming feature of the correlation structure of the psychosomatic pattern of LVH, on the one hand, is mainly a group of lipid risk factors, on the other - a group of psychological indicators. Regression analysis showed a significant relationship between LVH and four indicators, of which the greatest contribution was shown by the level of apo B-containing lipoproteins (B-coefficient 46.97) and the waist circumference/hip circumference ratio (B-coefficient 27.97). It should be summarized that the vast majority of significant associations with LVMI are demonstrated by two factors, of which the first is associated with adipose tissue, the second with lipoprotein metabolism indicators that are in close interaction. The results of the analysis of the frequency of occurrence of factors, correlations with LVMH showed that stress and features of personal response to long-term psychoemotional experiences are most strongly associated with the processes of remodeling of the left ventricle. The psychophysiological mechanisms of the pathogenesis of left ventricular hypertrophy can hypothetically be presented in the following form. Intense negative emotional reaction is a link in the activity of the psychological and somatic spheres. As a consequence, the formed focus of mental pathological impulses in a stress-dependent personality becomes overgrown with systemic cyclic stress reactions at the level of systems, organs and cells. The latter determine a wide mosaic of neurohumoral accompaniment, leading to metabolic disorders (dyslipidemia and activation of oxidative stress), disorders of endothelial function, hemorheology, myocardial perfusion, while the energy and plastic supply of cardiomyocytes suffers (dystrophy, apoptosis, excessive collagen deposition, activation of the system of growth factors, pro-inflammatory cytokines).

CONCLUSIONS

1. Significant differences in psychological status in the groups were revealed depending on the presence of left ventricular hypertrophy.

2. A significant relationship has been established between the identified personality traits and left ventricular hypertrophy. Depression, personal anxiety, accumulated stress increase the chance (2-6 times) of developing left ventricular hypertrophy.

3. Coping strategies demonstrate the greatest number of significant connections with plasma lipids, cortisol levels, and personal anxiety is associated with adrenaline levels.

4. The greatest contribution to the development of left ventricular hypertrophy in people without hypertension is made by Apo B-containing lipoproteins and the waist circumference/hip circumference ratio.

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