Biological Markers and Guided Therapy, Vol. 4, 2017, no. 1, 63 - 69
HIKARI Ltd, www.m-hikari.com
https://doi.org/10.12988/bmgt.2017.734

Peculiarities of Hemodynamic Parameters and Structural-Functional Remodeling of the Left Ventricle in Patients with Hypertension and Obesity

Ganna Kozhemiaka, Olga Kovalyova, Tetyana Ashcheulova and Oleksii Honchar

Department of PIM No.1, BBB of Kharkiv National Medical University
Kharkiv, Ukraine

Abstract

The article presents the results of ultrasound dopplerographic survey of the left ventricle of the heart in patients with hypertension and with obesity. Body mass index and the grade of obesity of observed patients have been defined, the analysis between BMI and ultrasound parameters of the left ventricle has been conducted. Different types of left ventricle myocardial remodeling have been identified, their relation to the presence and grade of obesity is shown.

Keywords: hypertension, obesity, myocardial left ventricular remodeling

Introduction

Cardiovascular diseases keep the first place among the causes of mortality of middle-aged and elderly patients in most countries of the world [3]. Every year, according to WHO, they cause about 17.5 million deaths [2]. Considering, in particular, hypertension (HT), in 2015, 788214 patients were registered in Ukraine [3]. In this case, the presence of obesity is a prerequisite for the rapid development of target organ damage in HT, which significantly worsens the prognosis of the disease.

One of the earliest systemic manifestations of HT is the structural and functional alteration (remodeling) of the myocardium of the left ventricle (LV) of the heart, including a change in the geometric shape and structure of the heart muscle [7]. Remodeling of the myocardium is an invariable attribute of arterial hypertension, which, on the one hand, is a complication of it, and on the other hand it is a factor of progression and unfavorable course [10]. There are 4 types of myocardial geometry: normal geometry (NG), concentric remodeling (CR), concentric hypertrophy (CH), eccentric hypertrophy (EH), which differ in the prognostic significance and features of the concomitant functional restructuring of the myocardium [7]. Obesity is a factor that worsens the course of hypertension and speeds up the development of changes in the structure of the heart muscle [5, 9]. Excess body weight in a certain way also affects the development of geometric remodeling and the emergence of myocardial dysfunction in patients with HT [4,6,8].

The aim of the research is to study the relationship between the body mass index (BMI), different types of myocardial remodeling and features of the left ventricular functional state in patients with HT and obesity.

Materials and Methods

The study included 81 hypertensive patients, among them – 63 with obesity, who gave informed consent for the use of survey data in the publication. The first clinical group consisted of 24 patients with overweight and HT (BMI = 25-30 kg / m^2), the second – 26 patients with concomitant class I obesity (BMI = 30-34.9 kg / m^2), the third – 13 patients with HD with concomitant class II-III obesity (BMI > 35 kg / m^2). The comparison group consisted of 18 patients with normal body weight (BMI < 25 kg / m^2).

Methods of research included the collection of complaints and anamnesis, anthropometry (BMI, waist circumference, hip circumference, growth).

Ultrasound survey of the heart was performed using ultrasound scanner RADMIR Ultima PA (Ukraine, Kharkiv) according to the generally accepted method in M-, B- and D-modes of echolocation, according to the recommendations of the American Society of Echocardiography (ASE).

Verification of the diagnosis, determination of the stage and degree of HT was performed according to the criteria recommended in 2013 by the European Society for Hypertension (ESH) and the European Society for Cardiology (ESC).

Statistical processing of the obtained results was carried out by standard methods of nonparametric statistics using Statsoft STATISTICA statistical software package v. 10.0 on a personal computer. As parameters of the descriptive statistics, the median (Me), the lower (LQ), and the upper (UQ) quartiles of the sample were used. The reliability of the differences between the indicators that were studied was determined using the Mann-Whitney test. To determine interconnections between the studied parameters, a correlation analysis was performed with the calculation of Pearson correlation coefficients.

Results and discussion

In order to study the features of LV functional remodeling, additional EchoCG study of the transmitral blood flow as well as the mitral fibrous annulus motion parameters in the tissue doppler mode has been performed.

Table 1.
Functional features of the left ventricle in patients with HT depending on BMI

Index	**Clinical groups of patients with HT**			
	Normal body weight BMI<25 kg/m^2 (n=18)	**Overweight BMI=25-29,9 kg/m^2 (n=24)**	**Class I obesity BMI=30-34,9 kg/m^2 (n=26)**	**Class II-III obesity BMI>30 kg/m^2 (n=13)**
1	2	3	4	5
EF, %	70,85 (68,6; 76,2)	69,7 (61,6; 73,9) p > 0,1	68,8 (63,0; 76,8) p > 0,1 p*> 0,1	64,13 (62,0; 72,2) p = 0,049 p*> 0,1 p# > 0,1
Peak E, cm/s	67,1 (60,2; 87,2)	58,6 (48,6; 69,4) p = 0,057	67,1 (56,7; 75,3) p > 0,1 p*> 0,1	62,1 (57,0; 67,8) p > 0,1 p*> 0,1 p# > 0,1
Peak A, cm/s	78,5 (67,0; 82,6)	66,7 (58,6; 74,8) p = 0,051	68,6 (63,3; 78,3) p > 0,1 p*> 0,1	64,1 (61,42; 74,8) p > 0,1 p*> 0,1 p# > 0,1
E/A	0,94 (0,84; 1,0)	0,86 (0,73; 1,15) p > 0,1	0,99 (0,75; 1,12) p > 0,1 p*> 0,1	0,88 (0,76; 1,04) p > 0,1 p*> 0,1 p# > 0,1
1	2	3	4	5

Table 1. (Continued): Functional features of the left ventricle in patients with HT depending on BMI

Peak E', cm/s	9,7 (5,7; 10,6)	10,4 (7,7; 12,2) p > 0,1	7,75 (5,7; 9,45) p > 0,1 p*= 0,078	9,30 (6,70; 10,5) p > 0,1 p*> 0,1 p# > 0,1
E/E'	7,61 (6,51; 8,53)	5,83 (4,52; 9,62) p > 0,1	7,77 (6,66; 9,28) p > 0,1 p*> 0,1	7,67 (6,09; 9,48) p > 0,1 p*> 0,1 p# > 0,1

Notes: p – vs patients with HT without obesity; p* – vs patients with HT and overweight; p# – vs patients with HT and class I obesity; EF – ejection fraction.

According to data presented in Table 1, it can be seen that for patients with HT with class II-III obesity, the relative decrease in EF of LV was typical compared to other groups. Such Doppler parameters as peaks E and A velocities of the transmitral flow tended to decrease in all groups of patients with BMI > 25 kg / m^2. Peak E', reflecting the rate of active relaxation of the myocardium of the LV, had lower values in patients with concomitant obesity. The ratio E / E', reflecting myocardial compliance in late diastole, was greater in patients with HT and normal BMI than in patients with HT in combination with obesity / overweight. Thus, it was revealed that excessive body weight affects the formation of myocardial dysfunction.

At the next stage, the types of myocardial remodeling were determined.

Table 2
Types of LV myocardial remodeling depending on BMI

Index	**Clinical groups of patients with HT**			
	Normal body weight BMI<25 kg/m² (n=18)	**Overweight BMI=25-29,9 kg/m² (n=24)**	**Class I obesity BMI=30-34,9 kg/m² (n=26)**	**Class II-III obesity BMI>30 kg/m² (n=13)**
1	2	3	4	5
Normal geometry of LV	5,56%	25% p=0,094	3,85% p>0,1 p*=0,031	7,69% p>0,1 p*>0,1 p#>0,1
Concentric remodeling of LV	38,89%	20,83% p>0,1	19,23% p>0,1 p*>0,1	0% p=0,016 p*=0,086 p#=0,099

Table 2 (Continued): Types of LV myocardial remodeling depending on BMI

Concentric hypertrophy of LV	55,56%	33,33% p>0,1	57,69% p>0,1 p*=0,084	69,23% p>0,1 p*=0,011 p#>0,1
Eccentric hypertrophy of LV	0%	20,83% p=0,039	19,23% p=0,048 p*>0,1	23,08% p=0,032 p*>0,1 p#>0,1

Notes: p – vs patients with HT without obesity; p* – vs patients with HT and overweight; p# – vs patients with HT and class I obesity.

Analysis of the data given in Table 2 allows one to note that the increase in BMI is associated with an increase in the proportion of patients with LV hypertrophy, with changes in the structure of LV geometry (appearance of patients with eccentric type). Subsequent development of obesity was associated with a significantly more frequent occurrence of LV CH compared to other types of geometry within the group ($p < 0.05$), due to a decrease in the proportion of patients with CR and normal geometry with increasing BMI.

Concerning patients with LV EH, it is especially important to note that according to the Gottdiener classification [1] they belonged to a subtype of non-dilated hypertrophy, hence in this case it could be considered adaptive on the background of an increase in the circulating blood volume in patients with overweight and obesity.

Conclusions

1. EF and dopplerographic indices (E / E' ratio, peak E') was characterized by unfavorable dynamics with an increase in BMI in patients with HT.

2. In presence of overweight and obesity in patients with HT, the structure of types of myocardial geometry changed with an increase in the proportion of concentric and, in some cases, eccentric non-dilated LV hypertrophy.

3. Thus, it was found that an increase in BMI has a negative effect on the course of HT, which is manifested by deterioration of the morphofunctional characteristics of the myocardium of the LV with the appearance of more unfavorable types of its remodeling.

References

[1] T.V. Ashcheulova, O.V. Honchar, S.V. Ivanchenko, Ye.V. Ivanova, Klinicheskoye znacheniye variantov ekstsentricheskogo remodelirovaniya levogo zheludochka serdtsa u bol'nykh arterial'noy gipertenziyey. Clinical significance of left ventricular eccentric remodeling types in hypertensive patients, *Proccedings*

of the *Shchoríchní Terapevtichní Chitannya: víd Doslídzhen' do Realíy Klíníchnoí Praktiki XXI Stolíttya: Naukovo-Praktichna Konferentsíya z Mízhnarodnoyu Uchastyu, Prisvyachena Pam'yatí Akademíka L.T. Maloyi* (Ukraine, Kharkiv, April 23-24, 2015) (eds. NAMN Ukrayiny, MOZ Ukrayiny, DU «Natsíonal'niy ínstitut terapíyi ímení L.T. Maloyi NAMN Ukrayiny»), Kharkív, 2015, 20.

[2] A.V. Ípatov, O.M. Moroz, V.A. Golik, Osnovní pokazniki ínvalídností ta díyal'ností mediko-sotsíal'nikh yekspertnikh komísíy Ukrayiny za 2015 rík. Analítichno-ínformatsíyniy dovídnik [Main indices of disability and medical-social expert boards of Ukraine in 2015. Analytical and informational directory], Dnípropetrovs'k: «Royal-Print» (in Ukrainian), 2016.

[3] D.M. Moroz, T.S. Manoylenko, A.P. Dorogoy, Problemi zdorov'ya i medichnoi' dopomogi ta model' pokrashchannya v suchasnikh umovakh, Problems of health and medical care and model of improvement in modern situation, Kii'v (in Ukrainian), 2016.

[4] S.A. Abbasi, W.G. Hundley, D.A. Bluemke, M. Jerosch-Herold, R. Blankstein, S.E. Petersen, O.J. Rider, J.A. Lima, M.A. Allison, V.L. Murthy, R.V. Shah, Visceral adiposity and left ventricular remodeling: The Multi-Ethnic Study of Atherosclerosis, *Nutr Metab. Cardiovasc Dis.*, **7** (2015), 667-676. https://doi.org/10.1016/j.numecd.2015.03.016

[5] M. Fedecostante, F. Spannella, F. Giulietti, E. Espinosa, P. Dessì-Fulgheri, R. Sarzani, Associations between body mass index, ambulatory blood pressure findings, and changes in cardiacstructure: relevance of pulse and nighttime pressures, *J. Clin. Hypertens*, (Greenwich), **17** (2015), 147-153. https://doi.org/10.1111/jch.12463

[6] F. Martins, D.H. Campos, L.U. Pagan, P.F. Martinez, K. Okoshi., M.P. Okoshi, C.R. Padovani, A.S. Souza, A.C. Cicogna, S.A. Oliveira-Junior, High-fat Diet Promotes Cardiac Remodeling in an Experimental Model of Obesity, *Arq. Bras. Cardiol.*, **5** (2015), 479-486. https://doi.org/10.5935/abc.20150095

[7] F. Pieruzzi, L. Antolini, F.R. Salerno, M. Giussani, P. Brambilla, S. Galbiati, S. Mastriani, P. Rebora, A. Stella, M.G. Valsecchi, S. Genovesi, The role of blood pressure, body weight and fat distribution on left ventricular mass, diastolic function and cardiac geometry in children, *J. Hypertension*, **33** (2015), 1182-1192. https://doi.org/10.1097/hjh.0000000000000552

[8] N.P. Potekhin, Iu.A. Rozhnov, F.A. Orlov, A.R. Karanik, Peculiarities of myocardium remodeling in patients with ischemic heart disease and arterial hypertension, *Voen. Med. Zh.*, **2** (2011), 30-37.

[9] K.A. Sarkisov, F.A. Orlov, I.A. Alatortseva, L.M. Starovoitova, I.N. Drozdova, The influence of abdominal obesity on left ventricular myocardial remodeling in patients with arterial hypertension, *Klin. Med. (Mosk)*, **7** (2015), 67-70.

[10] M. Tadic, C. Cuspidi, Childhood obesity and cardiac remodeling: from cardiac structure to myocardial mechanics, *J. Cardiovasc. Med. (Hagerstown)*, **16** (2015), 538-546. https://doi.org/10.2459/jcm.0000000000000261

Received: April 7, 2017; Published: May 17, 2017