https://doi.org/10.30702/ujcvs/22.30(02)/MR023-2733
UDC 616.12-005.4-073.7

Oksana Yu. Marchenko[1, 2], postgraduate student at the department of children`s cardiology and cardiac surgery, cardiologist, https://orcid.org/0000-0003-4909-8347

Nadiya M. Rudenko[1, 2], Doctor of Medical Sciences, Full Professor, Head of the department of children`s cardiology and cardiac surgery, Deputy director, https://orcid.org/0000-0002-1681-598X

Vladyslav Kavalerchyk[3], Senior physician in the department of cardiology and angiology, https://orcid.org/0000-0001-7450-8593

[1]Shupyk National Healthcare University of Ukraine, Kyiv, Ukraine

[2]Ukrainian Children's Cardiac Center, Clinic for Adults, Kyiv, Ukraine

[3]Helios Kliniken Schwerin, Schwerin, Germany

Left Ventricular Global Function Index and Myocardial Contraction Fraction on 2D Echocardiography as Integral Parameters in Patients with Coronary Artery Disease

Abstract. Patients with coronary artery disease (CAD) form a large group among all patients with cardiovascular diseases. Atherosclerosis, as one of the main pathogenetic mechanisms in adverse cardiovascular events development, is one of the leading causes of disability and mortality.

Echocardiography is one of the main imaging techniques in managing cardiovascular patients. In search of a new parameter that would reflect both the morphological and functional LV changes, more and more attention has recently been paid to integrated indicators such as the left ventricular global function index (LVGFI) and myocardial contraction fraction (MCF). These parameters are independent predictors of heart failure and cardiovascular diseases.

The aim. To evaluate the prognostic value of left ventricular global index and myocardial contraction fraction based on 2D echocardiography results in patients with CAD.

Materials and methods. Patients with CAD confirmed by coronary angiography were included in the prospective clinical study. Thirty patients without CAD were a control group, 35 patients had single vessel lesion, 66 had multivessel CAD. LVGFI and MCF were calculated using 2D echocardiography technique.

Results. The groups were comparable with respect to age, body mass index (BMI) and comorbidities. The mean age of the patients in group I was 60.53±1.77 years. In group II, the mean age was the highest, 64.31±1.62 years, and in group III the participants were 63.0±1.14 years old. The data indicate the absence of a significant difference ($p = 0.39$) in the age structure of the patients. In the control group, women predominated (70%), compared to groups II and III, where the proportion of women was 31.2% and 21.2%, respectively ($p = 0.0001$). The highest BMI classified as obesity class 1 was observed in the first group: 31.74 ± 1.09 kg/m^2. Group III had BMI of 30.71 ± 0.62 kg/m^2, which also indicates obesity class 1. Group II had the lowest BMI: 29.76 ± 0.77 kg/m^2, but the difference between the groups was insignificant ($p = 0.432$).

LVGFI and MCF differed significantly among groups ($p=0.003$ and $p=0.004$, respectively). MCF was the highest in patients with multivessel disease – 35.0% (27.71; 42.0), and the lowest in the group with no vascular lesions – 42.29% (36.35; 52.21). LVGFI also was different among the groups. It was the lowest in group III (24.91% [19.22; 30.48]), and the highest in group I (30.85% [25.46; 37.13]).

Conclusions. MCF and LVGFI are closely related to the degree of coronary artery involvement. These integral parameters may be used as non-invasive markers of more significant coronary arteries involvement.

Keywords*: atherosclerosis, multivessel coronary artery disease, left ventricle remodeling, cardiovascular outcomes, SYNTAX score I, imaging techniques.*

Introduction. Patients with coronary artery disease (CAD) form a large group among all patients with cardiovascular diseases. Atherosclerosis, as one of the main pathogenetic mechanisms in adverse cardiovascular events development, is one of the leading causes of disability, although currently, mortality in the European Union has stopped growing as steadily.

Echocardiography is one of the main imaging techniques in managing cardiovascular patients. It allows physicians to obtain a set of parameters that might be predictors of more adverse events in patients with remodeling after myocardial infarction (MI) and due to changes in the left ventricle (LV) geometry [1, 2].

LV systolic dysfunction is a strong predictor for adverse events in post-MI patients, as well as in asymptomatic individuals [3]. On the other hand, this parameter does not always reflect the severity of patient symptoms. According to the European Society of Cardiology guidelines, patients with heart failure (HF) are divided into three groups according to the LV systolic function: HF with preserved left ventricular ejection fraction (EF) (LVEF>50%), HF with mid-range EF (LVEF from 40 to 49%) and HF with reduced EF (LVEF<40%) [4]. Thus, the sole EF percentage is not enough to fully estimate heart pumping ability, since it does not reflect the structural remodeling in the LV.

In search of a new parameter that would reflect both the morphological and functional LV changes, various authors have studied the left ventricular global function index (LVGFI), which integrates the volumetric and structural LV features assessment. Magnetic resonance imaging (MRI) was used in most studies to evaluate this parameter [5], but in the CARDIA study, the authors have used echocardiography [6] and established that LVGFI is an independent predictor of incident HF and cardiovascular disease that provides additional prognostic value compared with LVEF.

Myocardial contraction fraction (MCF) is another indicator that was studied as a cardiovascular event predictor. Maurer et al. have demonstrated that 2D-echo-guided MCF correlated with a lower risk of adverse cardiovascular outcomes in 2147 patients with preserved LVEF [7].

The aim. To evaluate echocardiographic LV parameters and determine their correlation with the degree of coronary arteries involvement.

Materials and methods. One hundred and thirty-one in-patients of the Ukrainian Children's Cardiac Center, Clinic for Adults (Kyiv, Ukraine) were included in the prospective clinical study over the period from January to September 2019. All the participants were evaluated using clinical, laboratory and imaging techniques, and divided into groups based on results of coronary angiography. Depending on the degree of coronary arteries involvement, 3 groups of patients were formed. The first group included 30 patients with no coronary artery involvement, the second group included 35 patients with one-vessel lesion, and the third group consisted of 66 patients with multivessel CAD. All the patients had preserved LV systolic function.

The groups were comparable with respect to age, body mass index (BMI) and comorbidities. The data are demonstrated in Fig. 1. A significant difference was identified in the history of MI (p=0.0001). In group III, 33 patients (50%) reported history of MI, whereas 10 patients (28.6%) and none of the patients had had MI in groups II and I, respectively. All the patients in all three groups had some stage of hypertension (p=1.0).

The mean age of patients in group I was 60.53±1.77 years. In group II, the mean age was the highest (64.31±1.62 years), and in group III the participants were 63.0±1.14 years old. The data indicate the absence of a significant difference (p = 0.39) in the age structure of the patients. In the control group, women predominated (70%), compared to groups II and III, where the proportion of women was 31.2% and 21.2%, respectively (p = 0.0001). The highest BMI, classified as obesity class 1, was observed in the first group: 31.74 ± 1.09 kg/m^2. Group III had a BMI of 30.71 ± 0.62 kg/m^2, which also indicates obesity class 1. Group II had the lowest BMI, 29.76 ± 0.77 kg/m^2, but the difference between the groups was insignificant (p = 0.432). None of the patients in group I reported alcohol abuse; 1 patient (2.9%) in group II and 5 (7.6%) in group III abused alcohol.

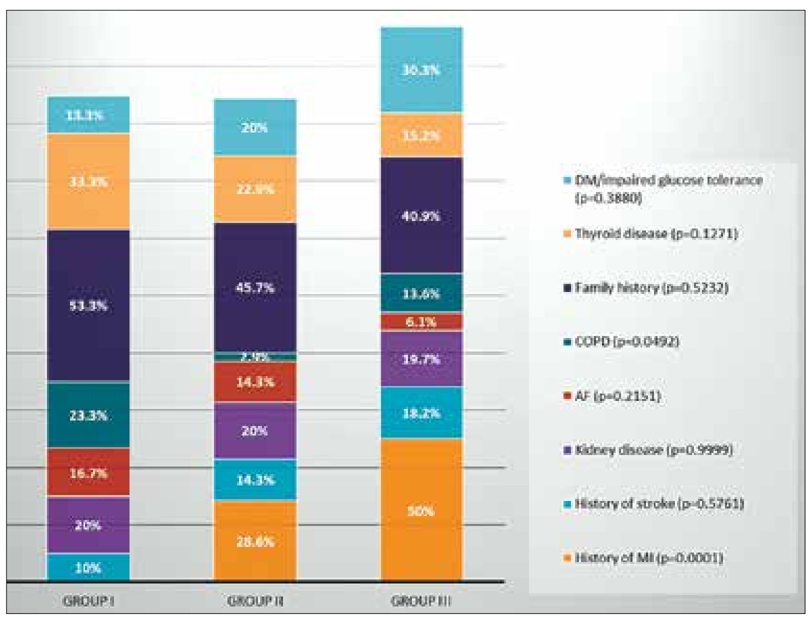

Fig. 1. *Comparison of all three groups by comorbidities*
DM, diabetes mellitus; AF, atrial fibrillation; COPD, chronic obstructive pulmonary disease

Tobacco smoking rates were similar in all three groups: 7 (23.3%) patients in group I, 11 (31.4%) in group II and 23 (34.8%) in group III. The data indicate the homogeneity of the studied groups (p=0.529).

Fig. 2 demonstrates medications the different patient groups were taking: statins, beta-blockers, renin-angiotensin-aldosterone system inhibitors and calcium channel blockers. With the exception of calcium channel blockers, the groups differed in the use of medications.

According to the New York Heart Association (NYHA) criteria, in group II the following distribution of functional classes (FC) was observed: FC I in 9 (25.7%), FC II in 18 (51.4%), and FC III in 8 (22.9%) patients. A similar distribution of NYHA classes was observed in group III: FC I in 13 (19.7%), FC II in 37 (56.1%), and FC III in 16 (24.2%) patients. None of the patients had either class 0 or IV.

The groups with atherosclerosis differed by SYNTAX score I assessment. In group II, the median result was 5 (0; 10) points indicating low risk, and in group III, the median result of 27.75 (18; 38) points indicated intermediate risk.

Echocardiography was performed on Vivid iq diagnostic ultrasound system (GE Healthcare, USA) with electrocardiography synchronization phased array transducer with 2-4 MHz frequency according to the standard protocol. The following parameters were evaluated in 2D-echo: end-diastolic diameter (EDD), end-systolic diameter (ESD), interventricular septum (IVS) thickness, posterior wall thickness (PWT), end-diastolic volume (EDV), end-systolic volume (ESV), left ventricular mass (LVM), EF, fractional shortening (FS), cardiac output (CO), stroke volume (SV), E-point septal separation (EPSS), pulmonary artery systolic pressure (PASP), peak tricuspid regurgitation velocity (TRV), left atrial volume index (LAVi), global longitudinal strain (GLS), LVGFI, MCF.

LVGFI was defined for each participant according to the following formula: LVGFI = (LV EDV – LV ESV) / myocardial volume (MV) x 100. MV (mL) = 0.8 x ([LV EDD + IVS + PWT]^3 – LV EDD3) + 0.6.

MCF was calculated using the following formula: MCF = (SV / global LV volume) x 100, where global LV volume was defined as a sum of mean LV cavity volume [LV EDV + LV ESV] / 2] and MV.

Since LV mass is calculated as the product of LV MV and myocardial tissue density (1.05 g/mL), MV was defined before calculating the mass. Thus, LVGFI was expressed as a percentage.

Coronary angiography and ventriculography were performed on Artis Zee biplane imaging system (Siemens, Germany).

The obtained data were processed using Excel and SPSS Statistics 20.0 statistical software. The tests used were both parametric and non-parametric (Shapiro-Wilk test), so the mean values with standard error (M ± m) and the median with 25 and 75 quartiles (Me [25–75%]) were used for presentation. Mann-Whitney U test for independent samples was used to compare the groups by quantitative characteristics. The Pearson χ^2 and Kruskal-Wallis test were used to assess significance between two independent samples. The differences were considered statistically significant at p<0.05.

Results and discussion. Comparison of the groups by LV diastolic dysfunction (DD) identified on echo is demonstrated in Fig. 3. The number of patients without DD was the largest in the first group (n = 13 [43.3%]) and the smallest in the group with multivessel disease (n = 2 [3%]) (p=0.001).

The most numerous patient cohort had impaired LV relaxation, with a significantly lower rate observed in group I (p=0.0001). Sixteen (53.3%) patients in group I, 28 (80%) patients in group II, and 50 (75.8%) patients in group III had the condition.

Pseudonormalization was observed in 1 (3.3%) patient from group I, 4 (11.4%) patients from group II, and 12 (18.2%) patients from group III (p=0.003).

Grade III DD (restrictive filling), as the most severe type, was not observed in any of the group I patients and did not differ significantly (p=0.564) between groups II and III (1 [2.9%] and 2 [3%] patients, respectively).

No significant difference between the groups was observed in the following parameters: end-diastolic diameter index (EDDi), end-diastolic volume index (EDVi), PWT, IVS, CO, SV, cardiac output index (COi), stroke volume index (SVi), PASP, TRV peak, LAVi. A comparison of echocardiographic parameters in different groups is represented in Table 1.

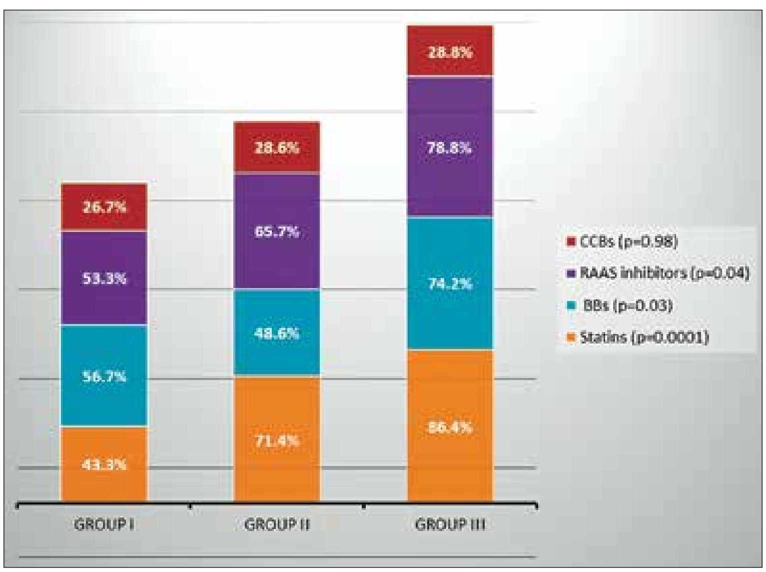

Fig. 2. *Groups comparison by prescribed medications*
RAAS, renin-angiotensin-aldosterone system; BBs, beta-blockers, CCBs, calcium channel blockers.

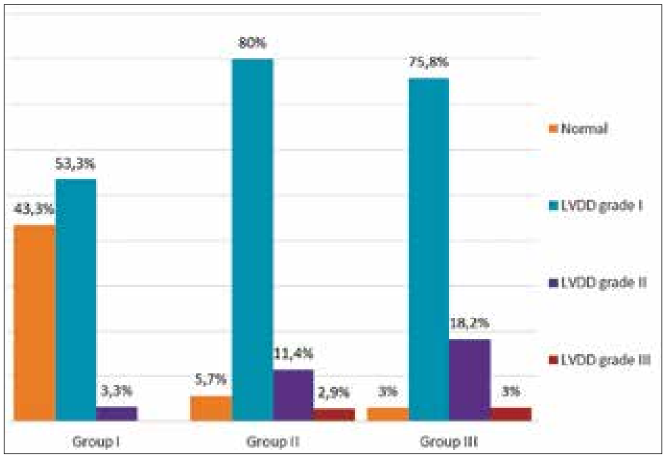

Fig. 3. *LV diastolic dysfunction in different patient groups*

A difference was observed in linear (EDD, ESD, end-systolic diameter index [ESDi], EPSS) and volumetric (EDV, ESV, end-systolic volume index [ESVi]) parameters, as well as in LVM, left ventricular mass index (LVMi), EF, FS, GLS, MCF, LVGFI.

Parameters in group III were significantly higher compared to those in group I, however, the absolute values did not exceed normal ranges. Mean EDD was 5.1 (4.7; 5.5) cm in group III and 4.75 (4.5; 5.0) cm in group I (p=0.015); mean ESD was 3.2 (2.9; 3.4) cm in group I and 3.5 (3.2; 4.1) cm in group III (p=0.0001); ESDi was 1.61(1.45; 1.78) cm in group I and 1.73 (1.6; 1.98) cm in group III (p=0.022); EPSS was 0.4 (0.3; 0.6) cm in group I and 0.6 (0.4; 0.8) cm in group III (p = 0.032). These data may suggest the similarity among the groups in linear dimensions.

The volumetric parameters in group I: EDV 107.5 (92.0; 119.0) mL, ESV 40.5 (33.0; 46.0) mL, ESVi 20.61 (18.42; 23.98) mL/m^2; in group III: EDV 118.5 (102.0; 145.0) mL, ESV 50.5 (41.0; 71.0) mL, ESVi 24.72 (20.53; 32.86) mL/m^2. Normal volumetric and linear parameters do not reflect LV remodeling and, accordingly, changes in hemodynamics. Integrated indicators may be more useful in this case.

Given the discrepancies in standard parameters, LVM was additionally calculated for males and females in

Table 1

Echocardiographic LV parameters

Parameter	Group I	Group II	Group III	p-value
EDD, cm	4.75 (4.5; 5.0)	5.0 (4.7; 5.3)	5.1 (4.7; 5.5)	**0.0151**
EDDi, cm/m^2	2.49 (2.26; 2.65)	2.55 (2.31; 2.72)	2.53 (2.38; 2.74)	0.5210
ESD, cm	3.2 (2.9; 3.4)	3.3 (3.1; 3.75)	3.5 (3.2; 4.1)	0.0001
ESDi, cm/m^2	1.61 (1.45; 1.78)	1.72 (1.55; 1.91)	1.73 (1.6; 1.98)	**0.0222**
EDV, mL	107.5 (92.0; 119.0)	114.0 (90.0; 129.5)	118.5 (102.0; 145.0)	**0.0243**
EDVi, mL/m^2	55.41 (47.78; 62.23)	55.56 (48.48; 66.23)	57.11 (51.98; 71.64)	0.2822
ESV, mL	40.5 (33.0; 46.0)	45.0 (39.0; 59.0)	50.5 (41.0; 71.0)	0.0001
ESVi, mL/m^2	20.61 (18.42; 23.98)	22.5 (19.21; 28.69)	24.72 (20.53; 32.86)	**0.0021**
PWT, cm	1.0 (0.9; 1.1)	1.0 (0.9; 1.1)	1.1 (1.0; 1.2)	0.2513
IVS, cm	1.1 (1.0; 1.3)	1.1 (1.0; 1.3)	1.2 (1.1; 1.4)	0.1631
EPSS, mm	0.4 (0.3; 0.6)	0.4 (0.3; 0.7)	0.6 (0.4; 0.8)	0.0322
LVM, g	184.0 (148.0; 212.0)	201.0 (167.0; 241.0)	224.0 (193.0; 276.0)	**0.0011**
LVMi, g/m^2	94.0 (77.0; 119.0)	101.0 (88.5; 116.0)	117.0 (101.0; 137.0)	**0.0012**
EF, %	60.0 (59.0; 65.0)	58.0 (51.5; 62.0)	54.0 (47.0; 59.0)	**0.0001**
FS, %	34.0 (32.0; 36.0)	32.0 (30.0; 34.5)	29.0 (24.0; 32.0)	0.0001
CO, L/min	5.18 (4.4; 6.2)	4.77 (4.19; 5.43)	4.94 (4.19; 5.79)	0.3943
SV, mL	77.0 (65.0; 87.0)	71.0 (63.5; 87.0)	77.0 (61.0; 88.0)	0.8224
COi, L/min/m^2	2.72 (2.34; 3.04)	2.48 (2.17; 2.82)	2.48 (2.18; 3.02)	0.1582
SVi, mL/m^2	40.06 (36.01; 45.23)	38.88 (33.16; 44.15)	38.07 (33.36; 43.60)	0.5971
PASP, mmHg	21.5 (19.4; 26.0)	24.0 (20.0; 26.0)	23.76 (20.0; 27.49)	0.3153
TRV peak, m/s	2.06 (1.9; 2.35)	2.22 (2.0; 2.32)	2.1 (1.98; 2.37)	0.5124
LAVi, mL/m^2	28.7 (26.66; 33.13)	30.2 (22.9; 33.41)	29.61 (25.41; 33.76)	0.8423
GLS, %	-19.35 (-18.4; -20.7)	-18.3 (-15.4; -19.7)	-14.1 (-12.2; -16.2)	**0.0001**
MCF, %	42.29 (36.35; 52.21)	39.53 (33.06; 45.61)	35.0 (27.71; 42.0)	**0.0033**
LVGFI, %	30.85 (25.46; 37.13)	28.09 (24.0; 32.29)	24.91 (19.22; 30.48)	0.0042

Data are represented by medians with 25 and 75 quartiles (Me [25–75%]); i, parameter index versus body surface area.

each group. In group I, the median LVM in females was 164 (132.5; 194.5) g, which may be classified as a slight increase. In male group I participants, LVM was 210.0 (194.0; 249.5) g, not exceeding the normal range. In group II, LVM was 181.0 (147.0; 207.0) g in females and 234.0 (186.0; 270.0) g in males. These values in both groups may be classified as slightly increased, according to the recommendations [16]. In group III, LVM was 222.0 (181.0; 240.0) g in females, which is classified as severely increased; and 233.0 (194.0; 282.5) g in males, that is, slightly increased.

In group I, LVMi was within normal range for both subgroups: 85 (72.0; 106.0) g/m^2 in females and 101.5 (97.5; 121.0) g/m^2 in males. In group II, LVMi was 91 (77.0; 98.0) g/m^2 in females, which falls into the normal range. In males of group II, however, LVMi was slightly increased up to 116.0 (103.0; 121.0) g/m^2. In group III, the LVMi was moderately increased in females (116.5 [106.0; 127.0] g/m^2) and slightly increased in males (117.0 [100.5; 137.5] g/m^2).

EF in all three groups was within normal limits [8]. The lowest EF was observed in group III (54.0% [47.0; 59.0]); groups I and II had similar values, with EF of 60.0% (59.0; 65.0) and 58.0% (51.5; 62.0), respectively.

FS in all groups was within normal range: 34.0% (32.0; 36.0) in group I, 32.0% (30.0; 34.5) in group II and 29.0% (24.0; 32.0) in group III.

MCF and LVGFI are relatively new indicators, but their value has been demonstrated in many works by various authors [5, 6, 7]. Both indicators differed significantly among the groups. MCF was the highest in patients with multivessel disease (35.0% [27.71; 42.0]) and the lowest in the group without vascular lesions (42.29% [36.35; 52.21]). A similar difference was observed for LVGFI, which was the lowest in group III (24.91% [19.22; 30.48]) and the highest in group I (30.85% [25.46; 37.13]). The results are demonstrated in Fig. 4 and 5.

In this study, we obtained both linear and volumetric parameters that did not exceed recommended normal ranges [8]. However, patients with multivessel disease had a higher grade of DD with preserved LV systolic function.

LV DD is extremely common and tends to worsen with age. DD remains a valuable indicator of LV remodeling. It correlates with HF symptoms occurrence in elderly patients both with preserved and reduced EF [9].

EPSS, described by Massie et al. back in 1977 [10] as a new echocardiographic index for evaluating LV function, has remained valuable ever since. It is significantly higher in patients with multivessel CAD compared to no coronary involvement group (p=0.0322).

Evaluation of LVM and LVMi revealed discrepancies in hypertrophy degree in females. Thus, in groups I and II, median LVM was slightly increased, while the LVM index versus body area fell into the normal range. Females in group III had pronounced hypertrophy according to the median LVM (which was severely increased) [15], however, LVMi in the same subgroup was only moderately elevated. The identified discrepancies suggest that using absolute LVM values is impractical. Thus, British Association of Echocardiography guidelines classify LV hypertrophy stages based solely on the LVMi, not the absolute LVM value [11].

MCF is a volumetric measure of myocardial shortening and is a simple, clinically useful indicator that reflects the overall efficiency of LV myocardial activity. This parameter has been widely studied in patients with myocardial hypertrophy, cardiac amyloidosis [12, 13] and as a prognostic marker for cardiovascular events [14]. In our study, we found a significant difference between the three groups (p=0.0033). The lowest median value 35.0% (27.71; 42.0) was observed in patients with multivessel disease, compared to the group with no coronary involvement, which had MCF of 42.29% (36.35; 52.21). This demonstrates the importance of further studies to evaluate this parameter in patients with cardiovascular disease.

LVGFI is a combined parameter for both the structural and functional LV characteristics. Mewton et al. [5] have proved in their study that it is a powerful predictor of HF and severe cardiovascular events in a multiethnic cohort. The authors used MRI. However, in the CARDIA study [6], researchers have obtained similar results using

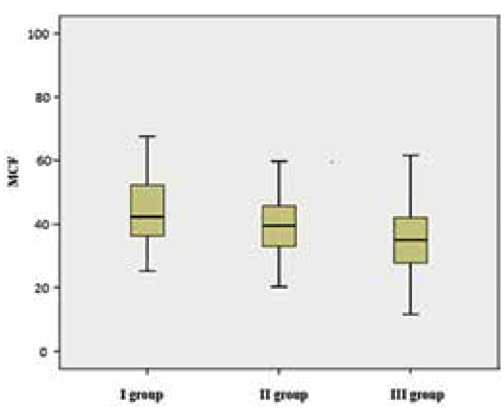

Fig. 4. *MCF in groups*

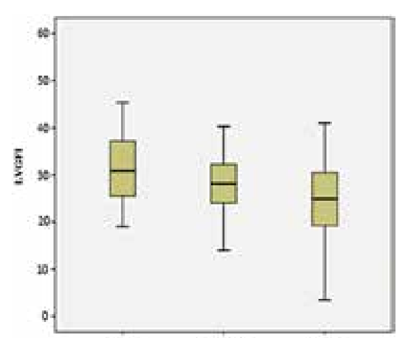

Fig. 5. *LVGFI in groups*

echocardiography. Although the absolute values were different in different study endpoints, there remains a clear trend in the fact that higher values were observed in participants with no history of cardiovascular events. We obtained similar results. Patients without CAD had higher LVGFI (30.85% [25.46; 37.13]), while patients with multivessel disease had the lowest value among all groups (24.91% [19.22; 30.48]).

Given the small sample size, these parameters need to be further studied in order to become standardized and implemented into clinical practice.

Conclusion. As a result of the study, an association was identified between integral parameters – MCF and LVGFI – and coronary involvement degree, evaluated using SYNTAX score I. Patients with multivessel CAD had significantly lower MCF and LVGFI (p=0.0033 and p=0.0042, respectively). Integral parameters that reflect both volumetric and linear characteristics are a more wholesome way to evaluate LV remodeling and predict the potential unfavorable course.

MCF and LVGFI prognostic value may further be used to classify high-risk patients; however, more studies need to be performed to standardize these parameters.

Conflict of interests

Authors declare no conflict of interests.

Authors' contributions: Marchenko O. Yu.: research concept, design collection and assembly of data; Marchenko O. Yu., Kavalerchyk V.: data analysis and interpretation; Marchenko O. Yu.: writing the article; Rudenko N. M.: critical revision of the article; Marchenko O. Yu., Rudenko N. M.: final approval of the article.

References

1. Lam CS, Lyass A, Kraigher-Krainer E, Massaro JM, Lee DS, Ho JE, et al. Cardiac dysfunction and noncardiac dysfunction as precursors of heart failure with reduced and preserved ejection fraction in the community. Circulation. 2011;124(1):24-30. https://doi.org/10.1161/CIRCULATIONAHA.110.979203. Erratum in: Circulation. 2011;124(17): e458.
2. Ambale-Venkatesh B, Yoneyama K, Sharma RK, Ohyama Y, Wu CO, Burke GL, et al. Left ventricular shape predicts different types of cardiovascular events in the general population. Heart. 2017;103(7):499-507. https://doi.org/10.1136/heartjnl-2016-310052
3. Yeboah J, Rodriguez CJ, Stacey B, Lima JA, Liu S, Carr JJ, et al. Prognosis of individuals with asymptomatic left ventricular systolic dysfunction in the multi-ethnic study of atherosclerosis (MESA). Circulation. 2012;126(23):2713-9. https://doi.org/10.1161/CIRCULATIONAHA.112.112201
4. Delepaul B, Robin G, Delmas C, Moine T, Blanc A, Fournier P, et al. Who are patients classified within the new terminology of heart failure from the 2016 ESC guidelines? ESC Heart Fail. 2017;4(2):99-104. https://doi.org/10.1002/ehf2.12131
5. Mewton N, Opdahl A, Choi EY, Almeida AL, Kawel N, Wu CO, et al. Left ventricular global function index by magnetic resonance imaging--a novel marker for assessment of cardiac performance for the prediction of cardiovascular events: the multi-ethnic study of atherosclerosis. Hypertension. 2013;61(4):770-8. https://doi.org/10.1161/HYPERTENSIONAHA.111.198028
6. Nwabuo CC, Moreira HT, Vasconcellos HD, Mewton N, Opdahl A, Ogunyankin KO, et al. Left ventricular global function index predicts incident heart failure and cardiovascular disease in young adults: the coronary artery risk development in young adults (CARDIA) study. Eur Heart J Cardiovasc Imaging. 2019;20(5):533-40. https://doi.org/10.1093/ehjci/jey123
7. Maurer MS, Koh WJ, Bartz TM, Vullaganti S, Barasch E, Gardin JM, et al. Relation of the Myocardial Contraction Fraction, as Calculated from M-Mode Echocardiography, With Incident Heart Failure, Atherosclerotic Cardiovascular Disease and Mortality (Results from the Cardiovascular Health Study). Am J Cardiol. 2017;119(6):923-8. https://doi.org/10.1016/j.amjcard.2016.11.048
8. Lang RM, Badano LP, Mor-Avi V, Afilalo J, Armstrong A, Ernande L, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. J Am Soc Echocardiogr. 2015;28(1):1-39.e14. https://doi.org/10.1016/j.echo.2014.10.003
9. Kane GC, Karon BL, Mahoney DW, Redfield MM, Roger VL, Burnett JC Jr, et al. Progression of Left Ventricular Diastolic Dysfunction and Risk of Heart Failure. JAMA. 2011;306(8):856-63. https://doi.org/10.1001/jama.2011.1201
10. Massie BM, Schiller NB, Ratshin RA, Parmley WW. Mitral-septal separation: new echocardiographic index of left ventricular function. Am J Cardiol. 1977;39(7):1008-16. https://doi.org/10.1016/S0002-9149(77)80215-4
11. Harkness A, Ring L, Augustine DX, Oxborough D, Robinson S, Sharma V; Education Committee of the British Society of Echocardiography. Normal reference intervals for cardiac dimensions and function for use in echocardiographic practice: a guideline from the British Society of Echocardiography. Echo Res Pract. 2020;7(1):G1-G18. https://doi.org/10.1530/ERP-19-0050. Erratum in: Echo Res Pract. 2020;7(1):X1.
12. Bansal M, Cho GY, Chan J, Leano R, Haluska BA, Marwick TH. Feasibility and accuracy of different techniques of two-dimensional speckle based strain and validation with harmonic phase magnetic resonance imaging. J Am Soc Echocardiogr. 2008;21(12):1318-25. https://doi.org/10.1016/j.echo.2008.09.021
13. Arenja N, Fritz T, Andre F, Riffel JH, Aus dem Siepen F, Ochs M, et al. Myocardial contraction fraction derived from cardiovascular magnetic resonance cine images—reference values and performance in patients with heart failure and left ventricular hypertrophy. Eur Heart J Cardiovasc Imaging. 2017;18(12):1414-22. https://doi.org/10.1093/ehjci/jew324

14. Abdalla M, Akwo EA, Bluemke DA, Lima JAC, Shimbo D, Maurer MS, et al. Association between reduced myocardial contraction fraction and cardiovascular disease outcomes: The Multi-Ethnic Study of Atherosclerosis. Int J Cardiol. 2019;293:10-16. https://doi.org/10.1016/j.ijcard.2019.07.040
15. Lazoryshynets VV, Kovalenko VM, Potashev SV, Fedkiv SV, Rudenko AV, Vitovskiy RM, et al. [Cardiac Chamber Quantification by Echocardiography in Adults: Recommendations from the Association of Cardiovascular Surgeons of Ukraine and Ukrainian Society of Cardiology]. Ukrainian Journal of Cardiovascular Surgery. 2020;(4 (41):96-117. Ukrainian. https://doi.org/10.30702/ujcvs/20.4112/096-117.16.12.22020

Глобальний індекс лівого шлуночка та фракція вкорочення міокарда на основі 2D-ехокардіографії як інтегральні параметри у пацієнтів з ішемічною хворобою серця

Марченко О. Ю.[1, 2]**,** аспірант кафедри дитячої кардіології та кардіохірургії, лікар-кардіолог консультативної поліклініки, https://orcid.org/0000-0003-4909-8347

Руденко Н. М.[1, 2]**,** д-р мед. наук, професор, завідувач кафедри дитячої кардіології та кардіохірургії, заступник директора з наукової роботи кардіологічного профілю, https://orcid.org/0000-0002-1681-598X

Кавалерчик В.[3], завідувач відділення кардіології та ангіології, керівник лабораторії ехокардіографії, https://orcid.org/0000-0001-7450-8593

[1]Національний університет охорони здоров'я України імені П. Л. Шупика, м. Київ, Україна
[2]ДУ «Науково-практичний медичний центр дитячої кардіології та кардіохірургії МОЗ України», м. Київ, Україна
[3]Клініка Шверін, Університетський кампус медичної школи MSH Гамбург, м. Шверін, Німеччина

Резюме. Пацієнти з ішемічною хворобою серця (ІХС) становлять численну групу серед усіх пацієнтів із серцево-судинними захворюваннями. Атеросклероз, як один з основних патогенетичних механізмів розвитку несприятливих серцево-судинних подій, є однією з головних причин інвалідності та смертності.

Ехокардіографія є одним з основних методів візуалізації в лікуванні пацієнтів із серцево-судинною патологією. У пошуках нового параметра, який би відображав як морфологічні, так і функціональні зміни лівого шлуночка, останнім часом все більше уваги приділяється інтегральним показникам, таким як глобальний індекс лівого шлуночка та фракція вкорочення міокарда. Ці параметри є незалежними предикторами серцевої недостатності та серцево-судинних захворювань.

Мета дослідження – оцінити прогностичне значення глобального індексу лівого шлуночка та фракції вкорочення міокарда за результатами 2D-ехокардіографії у хворих з ІХС.

Матеріали та методи. У проспективне клінічне дослідження були включені пацієнти з ІХС, яка підтверджена даними коронароангіографії. Тридцять пацієнтів не мали ІХС та становили групу І (контрольну), 35 пацієнтів мали односудинне ураження (група ІІ), 66 – багатосудинне ураження вінцевих артерій (група ІІІ). Глобальний індекс лівого шлуночка та фракцію вкорочення міокарда розраховували за допомогою методики 2D-ехокардіографії.

Результати та їх обговорення. Групи були зіставні за віком, індексом маси тіла та супутніми захворюваннями. Середній вік пацієнтів групи І становив 60,53 ± 1,77 року. У групі ІІ середній вік був найвищим – 64,31 ± 1,62 року, у групі ІІІ – 63,0 ± 1,14 року. Дані свідчать про відсутність достовірної різниці (p = 0,39) у віковій структурі хворих. У контрольній групі переважали жінки (70 %), порівняно з групами ІІ та ІІІ, де частка жінок становила 31,2 % та 21,2 % відповідно (p = 0,0001). Найвищий індекс маси тіла, віднесений до І ступеня ожиріння, спостерігався у групі І – 31,74 ± 1,09 кг/м^2. Третя група мала індекс маси тіла 30,71 ± 0,62 кг/м^2, що також свідчить про І ступінь ожиріння. У групі ІІ був найнижчий індекс маси тіла – 29,76 ± 0,77 кг/м^2, але різниця між групами була недостовірною (p = 0,432).

Глобальний індекс лівого шлуночка та фракція вкорочення міокарда суттєво відрізнялися між групами (p = 0,0033 та p = 0,0042 відповідно). Фракція вкорочення міокарда була найнижчою у пацієнтів із багатосудинним ураженням – 35,0 (27,71; 42,0) %, а найвищою у групі без ураження вінцевих судин – 42,29 (36,35; 52,21) %. Глобальний індекс лівого шлуночка також відрізнявся між групами. Найнижчим він був у групі ІІІ – 24,91(19,22; 30,48) %, а найвищим у групі І – 30,85 (25,46; 37,13) %.

Висновок. Фракція вкорочення міокарда та глобальний індекс лівого шлуночка тісно пов'язані зі ступенем ураження вінцевих артерій. Ці інтегральні показники можуть використовуватися як неінвазивні маркери більш значущого ураження судинного русла серця.

Ключові слова: *атеросклероз, багатосудинне ураження вінцевих артерій, ремоделювання лівого шлуночка, серцево-судинні наслідки, SYNTAX Score I, методи візуалізації.*

Стаття надійшла в редакцію / Received: 03.05.2022
Після доопрацювання / Revised: 20.05.2022
Прийнято до друку / Accepted: 17.06.2022