

## Echocardiographic parameters of left ventricular systolic and diastolic functions in patients with ischemic cardiomyopathy

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### ABSTRACT

The aim of the study was to determine the peculiarities of left ventricular systolic and diastolic function in patients with ischemic cardiomyopathy. In our study have been involved 20 practically healthy and 62 affected with ischemic cardiomyopathy. Has been performed overall Echocardiographic study of characteristics of structural-functional index at Ischemic Cardiomyopathy of different severity. The patients were randomized in to 3 groups: patients with moderately expressed reduction of left ventricle ejection fraction ( $EF > 40\%$ ), patients with systolic dysfunction of average severity ( $EF 30-40\%$ ), and expressed reduction ejection fraction of LV ( $EF < 30\%$ ). Have been established the following echocardiographic criteria of ischemic cardiomyopathy: end diastolic size of LV – more than 52 mm, end diastolic volume of LV – more than 133 ml, index of LV myocard mass – more than  $140 \text{ g/m}^2$ ,  $EF$  – less than 50%, shortening fraction – less than 23%, index of local contractility – more than 1.3. In patients with Heart ischemic disease at prevalence of at least three components, Echo-index of formation is considered as of high probability.

**KEYWORDS:** *ischemic cardiomyopathy, left ventricle function, left ventricle remodeling, ejection fraction, heart echocardiography*

Ischemic Cardiomyopathy (ICM) is a typical manifestation of Left Ventricle (LV) remodeling in consequence of replacement dead cardiomyocytes by fibrous tissue and disposition of the intact myocytes. LV remodeling is a slow process, which includes a lot of long-term compensation mechanisms - sizes of the heart elevate, their geometrical forms change as well [1,2,5]. Due to LV remodeling progress Cardiac Failure (CF) becomes resistant. Patients with ICM have local hypo- or akinetic zones with lines of demarcation, thick coronary artery walls and atherogenic plaques in them. 50% of patients with ICM and 10% of patients with Dilated Cardiomyopathy have LV diskiness of two or more segments [3]. Correct evaluation of LV systolic and diastolic parameters allow us to choose optimal treatment.

Studies of ICM are not numerous, but at the diseases with LV dilatation and Congestive Heart Failure. Echocardiographic and angiographic parameters are in tight correlation [4].

**Goals of Study:** The aim of our study was showing up the features of structural and functional parameters of heart in ICM of different severity.

### MATERIALS AND METHODS

The study included 62 ICM patients – man 9 (15%), woman 51 (85%), the average age  $62,63 \pm 13,11$  yr old. Patients had Myocardial Infarction (MI) and Heart failure (NYHA II-III). Patients with chronic aneurysm of LV were excluded from the study.

Patients were randomized into 3 groups according to LV systolic dysfunction: the group I - patients with expressed reduction of LV ejection fraction ( $EF < 30\%$ ); the group II - patients with systolic dysfunction of average severity ( $EF 30-40\%$ ); the group III - patients with moderate reduction of LV ejection fraction ( $EF > 40\%$ ).

In a two-dimensional regime have been defined the end-diastolic (EDV) and end-systolic (ESV) volumes of LV, index of end-diastolic (IEDV) and end-systolic (IESV) volume of LV, ejection fraction of LV ( $EF\%$ ), Shortening Fraction (SF%), LV myocardium mass (LV MM), index of LV myocardium mass (LV IMM), highest local contractility

index (ILC). The end-diastolic (EDD) and end-systolic (ESD) diameter of LV were measured in M-regime. The thickness of interventricular septum (TIS) and posterior wall (RTPW) of LV; the systolic myocardial stress (MS,  $\text{din/cm}^2$ ). RTPW of LV was measured by the formula:  $RTPW = 2 \times TPW / EDS$

Diastolic features of LV were studied using transmitral diastolic flow. Have been evaluated maximal speed of transmitral diastolic flow at early filling of LV (E), maximal speed of transmitral diastolic flow at late filling of LV (A) and correlation of max speeds of flow during early and late fulling of LV (E/A). Time of the early diastolic filling (TEDF) and time of the isovolume relaxation (TIR) were evaluated.

**Statistical** elaboration of obtained results has been carried out by using the packet applied program "Statistica" – 5.0. for Windows. All the data have been presented as  $\bar{x} \pm s$  (average  $\pm$  standard deviation). The reliability of difference between the obtained data has been evaluated by using criteria -  $t$  Student. The difference  $p < 0,05$  has been considered as a statistically reliable value. The parallel correlative analysis was also conducted (Person coefficient of correlation; if  $t \geq t_{\alpha, \nu}$ , then the hypothesis  $H_0$  is turned down and the correlation between the parameters is considered as a confidence).

### RESULTS AND DISCUSSION

Patients with ICM had significantly increased end-diastolic size, end-systolic size, end-diastolic volume, end-systolic volume of LV than healthy individuals (Tab.1).  $EF$  and  $SF$  were statistically low in patients than in control group ( $p < 0,001$ ). Patients from the group I have maximal values of EDS, ESS, EDV and ESV of LV ( $64,5 \pm 6,8$  mm;  $51,64 \pm 8,71$  mm;  $218,4 \pm 48,17$  ml;  $125,7 \pm 52,8$  ml) and minimal values of  $EF$  ( $22,41 \pm 3,32\%$ ) and Shortening Fraction ( $19,6 \pm 7,9\%$ ), there was trustworthy difference within the group. LV Myocardial Mass and LV Myocardial Mass Index of all patients ( $351,3 \pm 75,66$  g;  $304,6 \pm 70,04$  g;  $244 \pm 42,81$  g and  $190,8 \pm 48,28$   $\text{g/m}^2$ ;  $161,6 \pm 32,6728$   $\text{g/m}^2$ ;  $140,4 \pm 30,3728$   $\text{g/m}^2$ ) reliably differed ( $p < 0,001$ ) from healthy individuals ( $208 \pm 6$  g and  $118 \pm 9,4$   $\text{g/m}^2$ ), also there were trustworthy differences within the groups ( $p < 0,05$ ). Posterior Wall Thickness ( $0,33 \pm 0,07$

mm,  $0,37\pm 0,07$  mm and  $0,41\pm 0,09$  mm) was significantly lower than in control group.

At the time of study of LV diastolic parameters was found that the patients with  $EF > 40\%$  have significant reduction of ratio E/A ( $0,95\pm 0,06$ ;  $p < 0,001$ ) than healthy individuals have ( $1,29\pm 0,07$ , the 1st type of diastolic dysfunction). Also the members of the groups have significant differences (Tab.2). Patients with  $EF < 30\%$  have considerable ( $p < 0,001$ ) increase of early diastolic filling ( $110\pm 11$  cm/c) and reduction of late diastolic filling; it means that transmitral flow appears to be pseudo normal

and therefore the second - restrictive type of LV diastolic dysfunction has been developed ( $E/A > 2,7$ ).

For determination Echocardiographic criteria for ICM we used Echo-index of Kerene offered for evaluating of LV late remodeling. Adding  $EF < 50\%$  we established oriental Echocardiographic criteria for ICM: LV EDS less than 52 mm, EF less than 50% and SF less than 19%. Patients, with Ischemic Heart Disease and having no less than 3 Echo-index components, are at high risk of ICM formation.

Haemodynamic parameters	Size of Haemodynamic parameters (a±s)			
	Control group (n=20)	Patients with ICM (n=62)		
		I group EF<30% (n=22)	II group EF 30-40% (n=30)	III group EF>40% (n=10)
LA (mm)	31,4±1,5	49,23±6,54*	45,77±7,35 *#	44,6±6,43 *##
EDS LV (mm)	47,8±1,7	64,5±6,8 *	58,1±7,5*°	52±6,77 *°□
IEDS LV (sm/m <sup>2</sup> )	2,72±0,05	3,46±0,48 *	3,08±0,38 *°	2,87±0,44 *°#
ESS LV (mm)	33,4±1,4	51,64±8,71 *	43,6±7,9 *°	40±7,78 *°#
IESS LV (sm/m <sup>2</sup> )	1,9±0,6	2,69±0,56 *	2,25±0,6 *°	2,21±0,4 *°□
EDV LV (ml)	129,5±5,15	218,4±48,17*	169,7±49,64 *°	132,6±36 *°□
IEDV LV (ml/m <sup>2</sup> )	73,6±4,4	117±24,4 *	88,47±22,58 *°	72,4±21 *°#
ESV LV (ml)	55,3±4,02	125,7±52,8 *	87,8±35,94 *°	74,3±29,93 *°#
IESV LV (ml/m <sup>2</sup> )	31,4±2,5	66,64±27,5 *	45,8±17,67 *°	42±15,97 *°#
RTPW	<0,45	0,33±0,07	0,37±0,07	0,41±0,09
MM LV (g)	208±6	351,3±75,66 *	304,6±70,04 *°	244±42,81 *°□
IMM LV (g /m <sup>2</sup> )	118±9,4	190,8±48,28 *	161,6±32,67 *°	140,4±30,37 *°#
EF (%)	62,2±3,9	22,41±3,32 *	34,2±3,38*°	50,3±5,25*°□
FS (%)	32,4±1,26	19,6±7,9 *	22,3±9,03 *#	23,32±9,43*##

Note: \* - significant difference from the control group, ° - significant difference from the group I, □ - significant differences between the groups II and III, # - not significant difference.

**Tab.1** Haemodynamic parameters of left Ventricel in Patients with ICM.

Doppler echocardiographic parameter	Size of Doppler echocardiographic parameter (a±s)			
	Control group (n=20)	Patients with ICM (n=62)		
		I group EF <30% (n=22)	II group EF 30-40% (n=30)	III group EF >40% (n=10)
ILC	1,0	1,6±0,06	1,5±0,04	1,3±0,03
E	80±5	110±11*	94±7,2*°	63±4,02*°□
A	65±4	40±5*	67±6 *°	66±5 *°#
E/A	1,29±0,07	2,69±0,38 *	1,49±0,12 *°	0,95±0,06*°□
TEDF	180±6	119±5*	125±4 *°	142±4*°□
TIR	79±4	61±6 *	67±5*°	95±5 *° □

Note: \* - significant difference from the control group, ° - significant difference from the group I, □ - significant differences between the groups II and III, # - not significant difference.

**Tab.2** Doppler echocardiographic parameter of left Ventricel in Patients with ICM.

**CONCLUSION**

- Patients with ICM have LV eccentric hypertrophy i. e. the second type of LV remodeling - elevated LV MM and LV Posterior Wall Thickness less than 0,45 mm.
- Echocardiographic parameters of ICM are LV EDS more than 52 mm, LV EDV more than 133 ml, LV IMM more than 140 g/m<sup>2</sup>, EF less than 50%, SF less than 23% and Index of Local Contractility more than 1,3.
- Echocardiographic parameters of severe form of ICM are LV EDS more than 64 mm, LV EDV more than 218 ml, LV IMM more than 190 g/m<sup>2</sup>, EF less than 22%, SF less than 19%, ILC more than 1,6 and E/A more than 2,7.
- Patients, with Heart Failure and Ischemic Heart Disease, having LV diastolic dysfunction, EF less than 50% and high ILC (>1) have been diagnosed as ICM patients.

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## Эхокардиографические показатели систолической и диастолической функций левого желудочка при ишемической кардиомиопатии

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### Р Е З Ю М Е

Целью исследования являлось изучение характеристики систоло-диастолической функции левого желудочка (ЛЖ) при ишемической кардиомиопатии различной степени тяжести. Под наблюдением находились 62 больных ишемической кардиомиопатией. В зависимости от тяжести систолической дисфункции левого желудочка больные были подразделены на 3 группы: в I группу составили больные с резко выраженным снижением сократительной функции ЛЖ, в II группу – с систолической дисфункцией ЛЖ средней тяжести, в III группу – с умеренно сниженной сократительной функцией ЛЖ (ФВ>40). Для раннего диагностирования ишемической кардиомиопатии выявлены следующие эхокардиографические критерии: КДР ЛЖ – более 52 мм, КДО ЛЖ - более 133 мл, ИММ ЛЖ – более 140 гр/м<sup>2</sup>, ФВ – менее 50%, FS - менее 23%, ИЛС - более 1,3, наличие диастолической дисфункции ЛЖ.

**Ключевые слова:** сердечная недостаточность, ишемическая кардиомиопатия, функция левого желудочка, ремоделирование левого желудочка, эхо-кардиография сердца

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□ **International committee of medical journal editors. Uniform requirements for manuscripts submitted to biomedical journals.** Ann Intern Med 1997;126:36–47.

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