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LEFT VENTRICULTURAL FUNCTION ON ECHOCARDIOGRAPHY AND PERFUSION SCINTIGRAPHY OF MYOCARDIUM

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Abstract

They performed the comparative analysis of evaluation results concerning regional and integral left ventricular myocardial contractility according to echocardiography and myocardial perfusion scintigraphy (without load) among the patients with painless myocardial ischemia, regardless of the experienced myocardial infarction. The following parameters were determined: the volumes and integral contractility of the left ventricle by the disc method, the regional contractility in scores according to the scheme of seventeen segments, a number of indices of central hemodynamics. In terms of regional contractility scores, they calculated left ventricular contractility index, which can be considered as an indirect characteristic of its integral contractility.

Both methods demonstrated a high value coincidence degree of the left ventricle main functional parameters. At the same time, the assessment of regional contractility had a number of discrepancies: the index of contractility by scintigraphy was higher than the same index for echocardiography. The evaluation of regional contractility differed almost for half of the segments by the results of two methods. In most cases, the discrepancies in the assessment of regional contractility were determined by a higher degree of dysfunction according to scintigraphy results.

It can be assumed that the differences identified are related to the methodology of diagnostic studies and to the features of heart disease. The final judgment on such a complex functional indicator as regional contractility should be taken considering the results of all available methods.

Key words: *ejection fraction, regional contractility, echocardiography, perfusion scintigraphy.*

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1. INTRODUCTION:

One of the main functional characteristics of the heart is left ventricular (LV) contractility, it is divided into integral and regional one. Integral contractility is the total contractility of the whole LV without taking into account the disturbance of its individual segment functions, the main indicator of LV contractility is the ejection fraction (EF), as the proportion of stroke volume from diastolic LV volume. Regional contractility is the estimate of each segment contractility of the myocardium separately. It is usually determined by the nature of LV wall systolic movement in a separate area. It is described as normo-, hypo-, a-, or dyskinesia, which corresponds to the normal, decreased, absent or reverse systolic movement of the myocardium [1,2]. The normal functioning of all LV segments is also the confirmation of its integral contractility integrity. The LVEF index correlates with the prognosis and risk of complications [3].

There are various ways to assess LV regional contractility, characterizing an endocardial excursion (M-mode of echocardiography (ECHO-CG)), the movement of individual parts of myocardium (2D ECHO-CG mode, tissue dopplerography, magnetic resonance imaging), or internal myocardial tension (speckle -tracking). The differences in the physical principles of individual methods may cause a possible discrepancy between their results in clinic and during an experiment [4].

Nowadays the available and informative methods are ECHO-CG and perfusion scintigraphy of myocardium (PSM). Both methods allow to evaluate as integral so as regional LV contractility, and are widely used in IHD diagnosis [5-8]. A parallel evaluation of LV contractility and some indices of central hemodynamics via ECHO-CG and PSM is of practical interest, since the same indicators are calculated on the basis of the methods with a different physical basis. The comparative evaluation of two methods will help to determine the comparability of the data obtained with their help.

2. METHODS:

The results of ECHO-CG and PSM were analyzed among the patients who underwent examination at the cardiological department with the diagnosis of chronic IHD (the form of a painless myocardial ischemia), regardless of myocardial infarction presence and coronary interventions [9]. There were the following exclusion criteria: heart defects, pericardial pathology and severe concomitant diseases. The study involved fifteen patients, 11 of them were men, their average age was 58 years. They analyzed the results of planned studies: PSM without load and ECHO-CG according to the standard protocol. The volumes and integral contractility of the LV were determined by the disc method. Regional contractility was assessed in points: 1 (normokinesia), 2 (hypokinesia), 3 (akinesia), 4 (dyskinesia) [10, 11]. In terms of regional contractility scores, LV contractility index (CI) was also calculated as the average score of seventeen segments. The index of contractility is the generalizing indicator of LV regional contractility, and can be considered as an indirect characteristic of its integral contractility. The following LV functional parameters were also calculated: end-diastolic volume (EDV), stroke volume (SV), ejection fraction (EF), the index of contractility (IC) and minute volume (MV). Statistical processing was carried out using software tools, the significance level made 0.05.

3. RESULTS AND DISCUSSION:

The calculated functional parameters of the patients examined did not differ significantly by the results of ECHO-CG and PSM (Table 1), although the calculated LV EDV was 8% higher on average according to PSM.

Table 1. Calculated parameters of the left ventricle according to the results of Echocardiography and perfusion scintigraphy of the myocardium

Indicators	Echocardiography			Perfusion scintigraphy of the myocardium			p
	M	CI	SD	M	CI	SD	
Finite-diastolic volume, ml	130,31	102,60 - 158,01	45,85	140,21	106,86 - 173,57	57,77	> 0,05
Ejection fraction, %	49,00	41,49 - 56,52	13,01	48,36	39,39 - 57,32	15,53	> 0,05
Impact volume, ml	60,14	52,78 - 67,50	12,18	60,71	54,47 - 66,96	10,82	> 0,05
Minute volume, l /min	4,10	3,50 - 4,71	0,95	3,89	2,93 - 4,84	1,66	> 0,05
Contractility index	1,38	1,15 - 1,61	0,39	1,52	1,29 - 1,76	0,40	< 0,05

M – mean, CI – 95% confidence interval, SD – standard deviation.

At the same time, assessment of LV regional contractility using the contractility index had significant differences in the results of two methods: according to ECHO-CG data, the CI was 1.38 +/- 0.39 (1.00 - 2.00) on the average, and according to PSM data - 1.52 +/- 0.40 (1.00 - 2.27), $p < 0.05$. The maximum values of IC among individual patients according to ECHO-CG data did not exceed 2.00, whereas according to PSM data in they were from 2.00 to 2.27 points in the same cases. The difference in the obtained data is related to the differences in the character of the systolic movement of individual myocardium segments, determined by all methods.

The proportion of myocardial segments, for which there was the discrepancy in the estimates of contractility, calculated by different methods, varied from 0% to 83% among individual patients, and made 44.64% +/- 28.23% on the average. The average discrepancy in contractility quantitative estimates for individual segments in points varied from 0.50 in the basal sections of the LV anterior wall to 1.00 points in the middle sections of LV anterior wall. In general, for the studied group, the discrepancies in the estimates were 0.69 +/- 0.27 points per segment on the average, indicating moderate differences within adjacent levels of contractility gradation.

The increased variability in the estimates of two methods for individual segments among some patients may be associated with a certain dependence of diagnostic accuracy on the individual features of the heart structure and the nature of its dysfunction. In particular, the discrepancy in the estimates for the largest number of segments (83%) was observed among the patients with diffuse myocardial disease, reduced LVEF (34% on the average) and a large proportion of dysfunctional segments. On the average, the discrepancies in the quantitative estimation of individual segment contractility were small.

The most common discrepancies in the estimation of regional contractility by two methods were observed in the following localizations: the apical parts of LV lateral wall (75%), the middle parts of LV lateral wall (67%), and the basal parts of the interventricular septum (IVS) (67%). The most common discrepancies were found in the following localizations: basal parts of LV anterior wall (41%), middle sections of LV anterior wall (33%), basal sections of the lateral wall (41%), the basal sections of LV wall (41%) and the apical sections of LV lower wall (41%). The higher frequency of contractility divergence estimates in these localizations can be related to the structural features and the technique of myocardium individual part visualization on the ECHO-CG: in particular, the often encountered S-shaped bending of the IVS, accompanied by moderate hypertrophy with local hypo- or hyperkinesia.

If estimates are differed by two methods, PSM data showed more pronounced dysfunction as compared with the ECHO-CG data (73% of discrepancies), whereas the more severe dysfunction was observed almost three times less frequently in 27% of the cases according to ECHO-CG data. The higher degree of myocardial dysfunction according to PSM data as compared with ECHO-CG was detected most often in the following localizations: the apical sections of the lateral wall (58%), the middle parts of the lateral wall (50%), and the middle sections of LV lower wall (50%). A frequent underestimation of contractile dysfunction by ECHO-CG can be associated with the superposition of the acoustic shadow from the rib on the studied segment (the middle sections of the LV bottom wall), since the location plane in this case is almost perpendicular to the space between ribs.

On the contrary, according to PSGM data the prevalence of myocardial dysfunction was least observed in the following localizations: the apical parts of IVS, the apical sections of the lower wall, and the basal parts of LV lower wall (25% in each case). According to ECHO-CG the lower frequency of contractile dysfunction underestimation at these sites is probably associated with a good accessibility for the location from the apex of myocardium apical parts both in IVS and in the lower wall. The basal parts of the lower wall are accessible both from the apex and from the parasternal access, which increases the accuracy of its contractility evaluation.

According to ECHO-CG data, the prevalence of contractile dysfunction as compared to PSM was more often detected in the apical department of IVS (33%), and least of all in the basal and middle sections of the anterior wall, in the basal sections of the lateral wall, and also in the middle sections of the lower wall (no more than 8 % in each case). The practice of heart ultrasound examination shows that focal lesions in the upper part of LV are usually associated with the dysfunction of IVS adjacent apical segment, which can cause overdiagnosis of such dysfunction according to ECHO-CG data. A low (no more than 8% of cases) frequency of myocardial dysfunction echographic hyperdiagnosis in other segments may be the result of their visualization

higher quality and a lower frequency of their lesion (lower wall, high sections of the lateral wall).

4. CONCLUSIONS:

Both methods demonstrated a high coincidence degree left ventricle main functional parameters, including LVEF, as the leading indicator of its integral contractility. At the same time, the assessment of regional contractility demonstrated a number of discrepancies. LV contractility index based on PSM results was significantly higher than that for ECHO-CG (1.52 and 1.38). On the average, the assessment of regional contractility differed almost for half of the segments by the results of the two methods (44.64%). In the overwhelming number of cases (73%), the discrepancies in the assessment of regional contractility were determined by a higher degree of dysfunction according to PSM results and only in 27% of cases with a more severe dysfunction according to ECHO-CG data.

The average difference in the estimates was about 0.7 points, which indicates the difference only within the adjacent gradations of dysfunction. The largest share of segments with the discrepancies in estimates (83%) was found among the patients with diffuse myocardial disease, a larger number of dysfunctional segments and a reduced LVEF (34% on the average).

The greatest frequency of discrepancies between the results of both methods was observed along the lateral wall (middle and apical divisions) and in the basal sections of IVS. The lowest frequency of discrepancies was observed in the anterior wall (basal and middle sections), as well as in the basal parts of the lateral and lower LV wall. In most cases, the method of PSM showed a greater degree of regional contractile dysfunction as compared with ECHO-CG. A higher frequency of dysfunction according to ECHO-CG data was detected in the apical department of IVS. It can be assumed that the revealed differences in the estimates of regional contractility are related both to ECHO-CG methodology according to two methods and to the features of heart disease. It should be remembered that no instrumental method has an absolute diagnostic accuracy.

5. SUMMARY:

Thus, the final judgment on the status and clinical significance of such a comprehensive functional indicator as LV regional contractility should be taken in consideration of all available method results and in their application to the patient's condition.

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