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METHODS AND SIGNIFICANCE BEFORE AND AFTER REVASCULARIZATION OF LEFT GENDURY DEFORMATION IN PATIENTS WITH ISCHEMIC

Summary. The study of averages S and SR showed the low S longitudinal fibers, low S and SR circular fibers and normal S and high SR radial fibers, no changes in these parameters after revascularization. A detailanalysis the segments showed a decrease S and SR in 46,8% segments of longitudinal, 51,5% circular and 25,7% of the radial fibers of the LV. The same53,2% segments of longitudinal, 48,5% and circular 72,8% segments of the radial fibers had normal and increased values of S and SR as well as with different options to change S or SR. After revascularization improved deformation properties of longitudinal and circular fibers of the left ventricle in the group with low values of S and SR. The increased number of segments with high or normal value of SR. Normal values of S and SR radial fibers observed in most segments (56,7%).

Key words: coronary heart disease, left ventricular function, strain, strain rate.

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МЕТОДЫ И ЗНАЧЕНИЕ ДО И ПОСЛЕ РЕВАСКУЛЯРИЗАЦИИ ЛЕВОЙ ЖЕНДУРНОЙ ДЕФОРМАЦИИ У БОЛЬНЫХ ИШЕМИЧЕСКОЙ

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Резюме. Изучение средних показателей S и SR показало низкие значения S продольных волокон, снижение S и SR циркулярных волокон, нормальный показатель S и высокий SR радиальных волокон, а также отсутствие изменений деформационных свойств после реваскуляризации. Анализ сегментов выявил снижение показателей S и SR у пациентов в ответ на ИБС в 46,8% продольных сегментах, в 51,5% циркулярных и в 25,7% радиальных волокнах ЛЖ.При этом 53,2% продольных сегментов, 48,5% циркулярных и 72,8% сегментов радиальных волокон имели нормальные и повышенные значения S и SR. После реваскуляризации деформационные свойства продольных и циркулярных волокон ЛЖ в группе с низкими значениями S и SR улучшились, а также увеличилось количество сегментов с высоким или нормальным значением SR. Нормальные значения S и SR радиальных волокон отмечаются в большинстве сегментов (56,7%).

Ключевые слова: ишемическая болезнь сердца, функция левого желудочка, деформация, скорость деформации.

Introduction. In recent years, it has become possible to obtain a holistic view of the mechanics of contraction and relaxation of various myocardial zones using methods for assessing myocardial deformation. Echocardiographic (EchoCG) examination of patients with coronary heart disease (CHD) is an important diagnostic method that allows monitoring the patient before and after revascularization. IHD can manifest itself in the form of angina attacks, varying in duration and severity. It should be noted that with angina pectoris, standard echocardiography may not show changes in the contractile function of the left ventricle (LV), while with unstable angina, zones of hypo- or akinesis may be

detected [1]. The study of the effect of CAD on the LV myocardium and the function of its fibers can be carried out using the Velocity Vector Imaging (VVI) technology [2–4]. In domestic literature, this technology is defined by the term "visualization of the velocity vector of myocardial movement" [5]. The contractile function of the left ventricle is the result of the interaction of longitudinal, radial and circular fibers. During systole, there is a shortening of the longitudinal and circular fibers, as well as a transverse thickening of the radial fibers [6]. Indicators reflecting the function of LV fibers are strain (S) and strain rate (SR) [2]. It is known that in coronary artery disease, the deformation parameters of the longitudinal fibers primarily change, since the blood supply to the subendocardial layers suffers to a greater extent [7]. Dysfunction of radial and circular fibers is observed mainly in transmural lesions [6, 8, 9].

Purpose of the study: To evaluate the effect of coronary artery disease and surgical revascularization on the deformity parameters and strain rate of the longitudinal, circular and radial fibers of the LV myocardium.

Patients and Methods: 450 LV segments were analyzed in 24 people with coronary artery disease without prior myocardial infarction with coronary anamnesis 5.7 ± 4.4 years before and on the 12th day after coronary bypass surgery (CABG). The mean age was 60.0 ± 8.12 years (from 46 to 75 years). According to PCI data, three-vessel coronary lesions dominated in 19 (76%) patients, two-vessel lesions were noted in 6 (24%) patients. Damage to the trunk of the left coronary artery was detected in 7 (28%) patients.

When analyzing the nature of the lesion of the coronary bed in all examined patients, the predominance of stenoses from 71 to 99% was noted.

Echocardiography was performed on an AcusonX 300 ultrasound scanner (Siemens) with a 1–5 MHz transducer in B-mode, in duplex scanning mode (color Doppler mapping and pulsed Doppler sonography). The deformation properties of the LV myocardium were assessed in the post-processing mode using the Syngo VVI system, Siemens Medical Solutions USA Inc.

Results and discussion: Standard EchoCG at rest did not reveal any dynamics of LV systolic and contractile function.

The study of LV myocardial fiber function using VVI technology began with an analysis of the average S and SR values of longitudinal, circular and radial LV fibers. The data obtained showed a decrease in S and a normal SR in the study of longitudinal fibers.

Analysis of longitudinal fiber function was performed in 450 LV segments before and after revascularization. Normal S (−19.3 ± 1.19%) and SR (−1.01 ± 0.07 s) LV segments (group 1) and remained without significant changes after revascularization (S −16.25 ± 6.4% (p = 0.09); SR −1.08 ± 0.5 (p = 0.56)) .

In group 2 (n = 211 (46.8%)), low rates S (−9.7 ± 4.0%) and SR (−0.59 ± 0.2 s–1) increased (S −12.4 ± 5.6 (p = 0.000001), SR −0.89 ± 0.4 s–1 (p = 0.000001)), but did not reach the norm. High S (−25.4 ± 4.03%) and SR (−1.91 ± 0.8 s–1) in group 3 (n = 56 (12.4%)) decreased so that S reached the norm (S −17.6 ± 6.6 (p = 0.000001)), while SR remained high (−1.31 ± 0.7 (p = 0.0001)).

In groups 4 (n = 9 (2%)) and 5 (n = 37 (8.2%)), normal S values (−20.6 ± 3.0% and −19.5 ± 1.1%) were combined with a decrease (−0.81 ± 0.05 s–1) and an increase (−1.44 ± 0.25 s–1) in SR. After revascularization, no significant changes were detected in group 4 (S -17.3 ± 8.0% (p = 0.28); SR -1.22 ± 0.58 s–1), and in group 5, a decrease in S(−15.8 ± 5.37 (p = 0.0002)) and normalization SR(−1.14 ± 0.4 s–1 (p = 0.0006)). In groups 6 (n = 70 (15.5%)) and 7 (n = 39 (8.6%)) with low S (−12.8 ± 3.2% and −14.3 ± 3.1 %) observed normal (−0.97 ± 0.25 s–1) and increased (−1.42 ± 0.36 s–1) SR values. After surgical treatment in group 6, S significantly increased (−14.5 ± 5.4 (p = 0.03)), but did not reach the norm, while the dynamics of SR (−1.03 ± 0.5 s–1 (p = 0.4)) is not noted.

In group 7, the indicators remained without significant changes (S −15.2 ± 6.9% (p = 0.37); SR −1.2 ± 0.1 s–1 (p = 0.14)). The S score in groups 8 (n = 7 (1.5%)) and 9 (n = 2 (0.8%)) was increased (−23.3 ± 1.3% and −22.1 ± 0.04 %, respectively), while SR in group 8 was within the normal range (−1.97 ± 0.06 s–1), and in group 9 it was reduced (−0.82 ± 0.04 s–1). After revascularization, there

were no changes in S and SR in groups 8 (S −17.21 ± 8.8%, p = 0.12; SR −1.24 ± 0.6 s–1, p = 0.27) and 9 (S −14.18 ± 9.07%, p = 0.43; SR −0.89 ± 0.63 s–1, p = 0.89). Segments with a change in the direction of movement (group 10) were not detected in the analysis of longitudinal fibers.

Thus, in IHD, most segments (232 (51.5%)) of LV circular fibers have low deformation properties. However, 218 (48.5%) include segments with normal and elevated S and SR values (72 (16.0%) and 7 (1.5%), respectively), as well as with different variants of changes in either S or SR (139 (30.8%)). After CABG, there is an increase in the number of segments with low S and SR values, which may indicate a negative effect of surgical treatment on circular fibers. Nevertheless, in group 2 (low S and SR), there is a significant positive dynamics of deformation properties. The number of segments with a normal SR value (128 (28.5%)) increases, the normal direction of fiber movement is restored. When analyzing radial fibers, 10 groups were identified before revascularization. Before (S 28.0 ± 4.08%; SR 1.36 ± 0.1 s–1) and after surgical treatment in group 1 (n = 44 (9.7%)) SR remained without significant changes (1.46 ± 0.5 s–1 (p = 0.24)) , while S decreased (19.6 ± 13.6% (p = 0.0001)). Indicators S (12.5 ± 5.1%) and SR (0.63 ± 0.2 s–1) in group 2 (n = 75 (16.6%)) normalized (S 26.3 ± 22, 6% (p = 0.000002); SR 1.59 ± 1.18 s–1 (p = 0.000001)). Increased S and SR (S 58.6 ± 21.5%; SR 2.8 ± 1.03 s–1) in group 3 (n = 116 (25.7%)) decreased after revascularization (S 26.9 ± 23.4 (p = 0.000001); SR 1.67 ± 1.4 s –1 (p = 0.000001)) however, the SR value is slightly higher than normal.

Our study showed that the analysis of only the average values of the deformation properties of the LV myocardial fibers does not provide detailed information about the effect of CAD and CABG on the function of the LV segments. Thus, the generalized data showed a decrease in S with normal SR of longitudinal fibers, a decrease in S and SR of circular fibers, as well as a normal value of S and an increase in SR of radial fibers before revascularization. A similar analysis of the function of fibers after CABG showed the absence of dynamics in the deformation properties of the left ventricle. Thus, surgical revascularization

does not affect LV fiber function. In contrast to the literature data [10–12], a more detailed analysis of the S and SR function of each segment was undertaken. This led to the fact that in addition to segments with a decrease in deformation properties in IHD, there is a significant number of segments with different variants of changes in S or SR indicators, which, in our opinion, may indicate a compensatory-adaptive function of LV myocardial fibers.

Conclusions: The effect of coronary artery disease on the LV segments is expressed not only in a combined decrease or compensatory increase in S and SR (groups 2, 3), but is also characterized by a variety of options associated with a change mainly in the S or SR indicator (groups 4–9). Along with this, there is a change in the direction of movement of LV myocardial fibers (group 10). A decrease in deformation parameters (S and SR) in patients in response to IHD was noted in 211 (46.8%) longitudinal segments, in 232 (51.5%) circular and 116 (25.7%) radial LV fibers, while 239 (53.2%) segments of the longitudinal, 218 (48.5%) circular and 328 (72.8%) segments of the radial fibers are represented by normal and increased values of S and SR, as well as different variants of changes in S or SR.

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