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DEFORMATION OF THE LEFT VENTRICULAR MYOCARDIUM IN PATIENTS ISCHEMIC HEART DISEASE BEFORE AND AFTER REVASCULARIZATION

Summary. In recent years, it has become possible to obtain a holistic view of the mechanics of contraction and relaxation of various zones of the myocardium 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, differing in duration and severity. It should be noted that in case of exertional angina during standard echocardiography, changes in the contractile function of the left ventricle (LV) may not be observed, while in unstable angina, it is possible to identify zones of hypo- or akinesis.

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

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ДЕФОРМАЦИЯМИОКАРДА ЛЕВОГО ЖЕЛУДОЧКА У БОЛЬНЫХ ИШЕМИЧЕСКОЙ БОЛЕЗНЬЮ СЕРДЦА ДО И ПОСЛЕ РЕВАСКУЛЯРИЗАЦИИ

Резюме. В последние годы появилась возможность получения целостного представления механики сокращения и расслабления различных зон миокарда при помощи методов оценки деформации миокарда. Эхокардиографическое (ЭхоКГ) исследование пациентов с ишемической болезнью сердца (ИБС) является важным диагностическим методом, позволяющим проводить наблюдение за пациентом до и после реваскуляризации. ИБС может проявляться в виде приступов стенокардии, различающихся по продолжительности и тяжести. Следует отметить, что при стенокардии напряжения при стандартном ЭхоКГ-исследовании может не наблюдаться изменений сократительной функции левого желудочка (ЛЖ), тогда как при нестабильной стенокардии возможно выявление зон гипо-или акинеза.

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

Introduction. In the domestic literature, this technology is defined by the term “visualization of the myocardial velocity vector” [5]. LV contractile function is the result of the interaction of longitudinal, radial and circular fibers. During

systole, there is a shortening of longitudinal and circular fibers, as well as transverse thickening of the radial fibers [6]. Deformation (S) and strain rate (SR) are indicators reflecting the function of LV fibers [2]. It is known that in ischemic heart disease, the deformation indices 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 assess the effect of coronary artery disease and surgical revascularization on the deformity and strain rate of longitudinal, circular and radial fibers of the LV myocardium.

Material and Methods: We analyzed 450 LV segments in 24 patients with coronary artery disease without a history of myocardial infarction with a coronary history of 5.7 ± 4.4 years before and on the 12th day of postoperative coronary artery bypass grafting (CABG). The average age was 60.0 ± 8.12 years (from 46 to 75 years). According to PCI, three-vascular lesions of the coronary bed were dominant - 19 (76%), two-vascular lesions were observed in 6 (24%) patients. Damage to the left trunk of the coronary artery was detected in 7 (28%) patients. When analyzing the nature of the lesion of the coronary bed in all examined patients, the prevalence of stenoses from 71 to 99% was noted. In each position, 6 segments were analyzed. The study of circular and radial fibers was performed from the parasternal approach in the LV cross section at the level of the mitral valve, papillary muscles and at the level of the apex. It should be noted that 6 segments were evaluated in each LV cross section. Thus, when using VVI technology, the LV is divided into 18 segments [13]. The study of the function of longitudinal, circular and radial fibers before and after revascularization was carried out on the basis of changes in systolic S and SR values.

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

The study of the function of LV myocardial fibers using VVI technology began with an analysis of the average S and SR values of longitudinal, circular and radial LV fibers.

Analysis of longitudinal fiber function was performed in 450 LV segments before and after revascularization. Normal indicators S (−19.3 ± 1.19%) and SR (−1.01 ± 0.07 s − 1) were detected in 19 (4.2%) 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 indicators 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 in such a way that S reached the norm (S −17.6 ± 6.6 (p = 0.000001)), and 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) 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 %), normal (-0.97 ± 0.25 s – 1) and increased (–1.42 ± 0.36 s – 1) SR values were observed. After operative 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 marked.

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 index 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 was no change in S and SR indices 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). No segments with a change in the direction of movement (group 10) were found in the analysis of longitudinal fibers.

In group 6 (n = 47 (10.4%)) S remained unchanged (below normal) (S −13.8 ± 6.8% (p = 0.15)), SR significantly decreased from −1.54 ± 0.1 s – 1 to −1.20 ± 0.5 s – 1 (p = 0.0002). In group 7 (n = 15 (3.3%)), the SRc indicator normalized −2.34 ± 0.3 s – 1 to −1.33 ± 0.4 s – 1 (p = 0.000006), then there was no increase in S (S - 14.9 ± 5.9% (p = 0.86)). In group 10 (n = 10 (2.5%)) (S 18.5 ± 9.2%; SR 1.18 ± 7.02 s – 1) after revascularization, the correct nature of fiber movement is noted, although the deformation properties of the segments remain low (S −16.9 ± 7.8% (p = 0.000001); SR −1.21 ± 0.5 s – 1 (p = 0.000002)).

A detailed study of the postoperative segments showed a significant positive dynamics in the function of segments with low S and SR values of all LV fibers, as well as an increase in the number of segments with normal or increased SR values. Thus, a detailed analysis of the segments shows a positive effect of revascularization on LV fiber function in the early stages.

Conclusions: 1. The influence of coronary artery disease on LV segments is expressed not only in a combined decrease or compensatory increase in S and SR (groups 2, 3), but also characterized by various options associated with a change mainly in the indicator S or SR (groups 4–9). Along with this, there is a change in the direction of movement of LV myocardial fibers (group 10).

2. Decrease in deformation indices (S and SR) in patients in response to coronary artery disease was noted in 211 (46.8%) longitudinal segments, in 232 (51.5%) circular and 116 (25.7%) radial LV fibers, then as 239 (53.2%) segments of longitudinal, 218 (48.5%) circular and 328 (72.8%) segments of radial fibers are represented by normal and increased values of S and SR, as well as different variants of changes in S or SR.

3. The influence of surgical revascularization is carried out in the form of a significant positive dynamics of the deformation properties of longitudinal and

circular LV fibers in the group with low S and SR values (group 2), as well as an increase in the number of segments with high or normal SR values.

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