# DIAGNOSTIC SIGNIFICANCE OF SPECKLE TRACKING IN PATIENTS WITH MYOCARDIAL INFARCTION

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**Abstract.** *Echocardiography is a useful technique for risk stratification and prognosis assessment after acute myocardial infarction. Currently, researchers and clinicians are showing the greatest interest in the problem of determining the viable myocardium zone. First of all, this is due to the fact that such information is necessary for preoperative patient selection and predicting the effectiveness of cardiac surgery Also, the area of the viable myocardium zone changes significantly during treatment, which allows us to evaluate the effectiveness of drug therapy and surgical interventions over time.*

**Key words:** *myocardial infarction, echocardiography, speckle tracking echocardiography.*

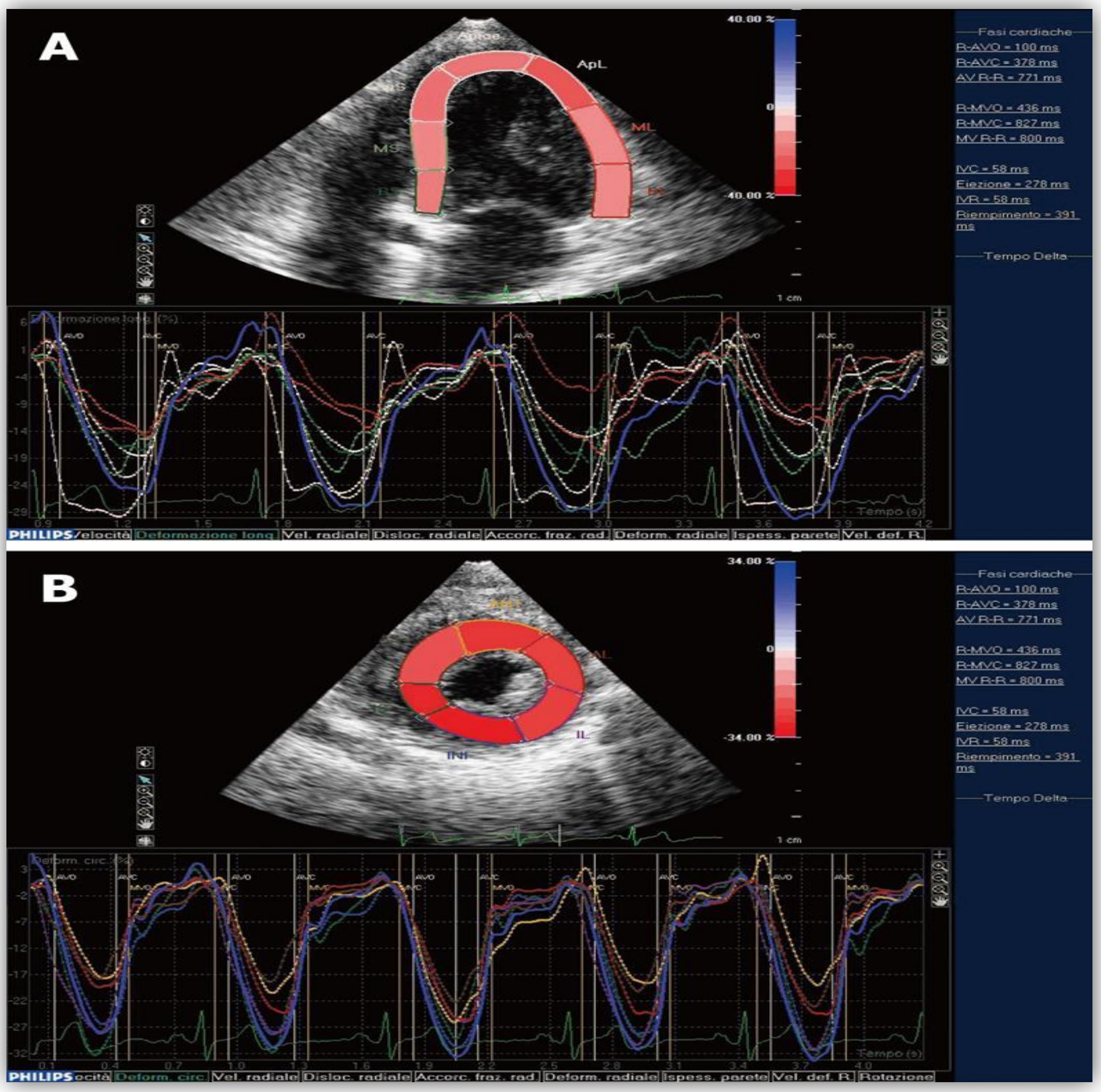
An accurate quantitative assessment of the area of necrosis and the zone of viable (stunned and hibernating) myocardium in patients with myocardial infarction (MI) is of fundamental importance for making a number of decisions that determine the fate of the patient. Myocardial necrosis is an irreversible change in the heart muscle. Despite the fact that the post-infarction scar, in addition to connective tissue components, contains myofibroblasts that receive blood supply from neovessels and maintain cellular metabolism, this zone does not contract and does not affect the global contractile function of the heart.

It was previously believed that the most powerful prognostic factors in MI were ejection fraction and left ventricular (LV) end-systolic volume. According to modern concepts, depth and area myocardial necrosis during MI determine the functional restorative ability of the myocardium and are more stronger predictors of adverse cardiovascular events than LV systolic activity.

When performing EchoCG, movement is assessed and LV wall thickness, which provides indirect information about the presence or absence of necrosis in a particular segment [8]. It should be remembered that the resolution of 2D echocardiography is allows you to identify damage zones that affect more 20% of the myocardial wall thickness [9]. Thus, a violation of segmental contractility of the LV in the infarcted zone is assessed qualitatively, according to the “all or nothing” principle, i.e. it is impossible to visualize the depth of damage in one or another another segment, since areas of akinesis can be observed, even if only the inner layers of the myocardium are ischemic. Despite the fact that 2D echocardiography can assess the degree of impairment of regional myocardial contractility, differential diagnostics between cicatricial changes and new foci of necrosis is not always feasible due to the fact that, due to the stunning effect of wall motion, wall motion can persist for a long time after reperfusion.

To more accurately determine areas of necrosis and ischemia myocardium, an assessment of LV strain (Strain) and strain rate (Strain rate) has been proposed. In a one-dimensional object, the only possible deformation of the object is lengthening or shortening. The myocardium can be deformed in the longitudinal, transverse and radial directions. In addition, the analysis of myocardial deformation is complicated by shear deformations. Myocardial deformity can be evaluated using transtissue Dopplerography and the most promising and accurate speckle tracking technique, which, unlike transtissue Dopplerography, does not depends on the scanning angle, since it is not based on Doppler technology and makes it possible to distinguish between active and passive contraction of the myocardium. O. Gjesdal et al. showed that using speckle tracking Strain at a longitudinal strain level of -15% it is possible to assess impaired segmental contractility with a sensitivity of 76% and a specificity of 95% [7].

Fig.1 Systolic myocardial deformation after electro-mechanical activation. A: LV longitudinal strain from the apical four-chamber view: time-strain curves show a negative end-systolic strain representing myocardial shortening during systole; B: LV circumferential strain from the short axis view: time-strain curves show a negative end-systolic strain representing myocardial shortening during systole. End-systole has been identified by the AVC. At this point, we could observe the negative peak of the time-strain curves corresponding to each myocardial segment.



ST allows you to obtain additional information about the heart that traditional echocardiography methods cannot provide. It can be used to diagnose various heart conditions, such as:

- Coronary artery disease: ST helps to assess the presence of cardiac ischemia - a disruption of the blood supply to the heart muscle. This is achieved by measuring changes in myocardial deformation in response to physical activity. If a section of the myocardium does not receive enough oxygen and nutrients, then the deformation changes will differ from other areas of the heart.
- Arrhythmias: ST can be used to diagnose various types of arrhythmias: such as atrial fibrillation, atrial fibrillation, extrasystole, etc. Myocardial deformation analysis can help identify areas of the heart that are most susceptible to arrhythmias.
- Valvular diseases: ST can help determine the presence of stenosis or insufficiency of the heart valves. Changes in deformation may indicate the presence of problems with the valves.
- Hypertrophic cardiomyopathy: ST can be used to determine changes in the structure of the myocardium, which may indicate the development of hypertrophy of the heart muscle.

**Strain**: The severity of deformation of the analyzed area in relation to its normal value can be assessed using such a parameter as strain. The results obtained are expressed as a percentage.

**Strain Rate**: The unit of measurement is a second. Based on experimental data, it has been proven that the strain rate does not have a pronounced dependence on the change in load occurring in the left ventricle. However, it should be noted that the warning indicating deformation has a clear noise, so many studies still use measurements of this parameter.

**Longitudinal Strain:** The deformation of the heart muscle from the very base of the heart to the top is called longitudinal. Through the analysis, it is possible to obtain regional as well as global indicators. The latter was recently approved for assessing the functioning of the left sections of the heart - the ventricle and atrium.

**Radial Strain:** A change in the myocardial structure in the radial direction (closer to the center) is called radical. The indicator allows you to find out the presence of thickening or thinning of the left ventricle during its contraction, relaxation. Values

\u200b\u200bfor this type of study are obtained in various planes (basal, apical) and the short axis of the left ventricle.

**Circumferential strain:** This is the contraction of individual muscles of the left ventricular cardiac muscle along the circular perimeter. Measurements resemble negative curves.

**Twisting and Torsion:**This parameter was recently assessed using MRI. Now it has become possible using speckle tracking technology. Twisting is a physiological process that occurs during compression of the heart. This indicator is calculated as the difference in average rotation between two levels.

**Untwisting:** The speed of this process is considered to be the initial manifestation of cardiac relaxation. Therefore, the results of the study refer to diastole.

In order to predict the recovery of myocardial function, the coronary reserve is also determined - an indicator reflecting the state of blood flow in the affected segments. This is a rather complex invasive method. The coronary reserve correlates with the segmental longitudinal systolic strain at rest [8, 2], an increase in systolic strain and systolic strain velocity in stress echocardiography.

Circular strain parameters also carry important information. The study by Liszka et al. showed that low values of longitudinal, transverse and circular strain, as well as left ventricular torsion, are associated with the development of its dilation, while the circular apical strain has the greatest accuracy as a prognostic factor, the critical value was -15.92% [5].

Several studies have documented a correlation between global longitudinal

left ventricular systolic strain and development of remodeling [5, 8, 9, 14, 16]. It is noteworthy that these studies obtained similar critical values of the overall longitudinal systolic strain, being a predictor remodeling. Thus, D'Andrea et al. found that strain ≤ -12% predicts an increase in LV EDV ≥ 15% within 6 months after non-ST-elevation myocardial infarction [9], Bochenek et al. defined the value of -12.5% as a criterion for the development of remodeling after ST-elevation infarction [5], Lacalzada et al. defined the value of -12.46% as a criterion.

**Conclution:** Literature data suggest that speckle tracking echocardiography is a promising method that allows for the most accurate detection of regional and global myocardial contractility disorders, determination of the degree of future myocardial remodeling, identification of myocardial segments that can potentially restore their function after revascularization, and assessment of the risk of developing cardiovascular events in patients with acute myocardial infarction.

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