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Limitations of Diagnosis of Ischemic Left Ventricular Dysfunction Using The Values of Strain, Twist and Untwist in Patients With Myocardial Infarction of Various Localization

Aim To compare capabilities for diagnosing regional and global myocardial dysfunction using The values of longitudinal and circular strain, left ventricular (LV) torsion and untwisting in patients with myocardial infarction (MI) of various locations.

Material and methods Patients included in The study (n=121) were divided into three groups: patients with unstable angina (n=30), patients with anterior MI (n=45), and patients with inferior MI (n=46). Clinical, laboratory and instrumental test were performed, including echocardiography. For a quantitative analysis of LV contractility, The maximum systolic peaks of regional and global longitudinal and circular strain, systolic and diastolic rotation, LV torsion and untwisting were measured.

Results Anterior MI was characterized by injury of The LV apical segments, while inferior MI was characterized by injury of The basal segments. In anterior MI, The longitudinal strain was reduced less than 14.5% and circular strain less than 19.3% in The apical segment of The LV anteroseptal wall (ASW). In akinesia of The LV ASW apical segment, longitudinal and circular strains were reduced less than 10%. The magnitude of The circular strain of The LV ASW apical segment (diagnostic threshold 19.3%, sensitivity (Se) 87%, specificity (Sp) 90%) was superior to that of The longitudinal strain as a diagnostic marker for regional ischemic dysfunction in anterior MI. The magnitude of The circular strain of The basal segment of The LV inferior wall in inferior MI has a greater diagnostic value for identifying regional systolic dysfunction than The value of The longitudinal strain of this LV segment. The diagnostic threshold was 17.3%, Se 79%, Sp 80%.

Conclusion A decrease in The circular strain of The LV ASW less than 19.3% in The LV apical segment is more specific (Sp 90%) for diagnosing regional systolic dysfunction in anterior MI than a decrease in longitudinal strain. A circular strain value of less than 17.3% in The basal segment of The LV inferior wall is more specific (Sp 80%) than The longitudinal strain of this segment for diagnosing regional systolic dysfunction in inferior MI. Predominant injury to The LV apex in anterior MI can cause systolic and diastolic myocardial dysfunction, which is manifested by a decrease in LV circular deformation, torsion and untwisting.

Keywords Strain; torsion; left ventricular untwisting; myocardial infarction

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Introduction

Data obtained from conventional echocardiography is subjective and depends on individual expertise. Speckle tracking echocardiography (STE) is a more reproducible and objective method for quantifying early abnormalities in global and regional left ventricular (LV) systolic and diastolic function. STE has advantages over previous techniques for measuring myocardial strain: less angular dependence, measurement of longitudinal, circumferential, and radial strain, ability to assess myocardial rotation, torsion, and untwisting [1–5]. Quantitative assessment of myocardial contractility is not limitɛd to the diagnosis of post-infarction fibrotic changes in the LV; STE is increasingly used to assess myocardial viability, in stress echocardiography, to study myocardial function after revascularization, and to assess prognosis after myocardial infarction (MI) [1, 2, 6–8]. According to the results of the VALIANT study, it is acceptable to use the values of longitudinal and circumferential LV strain to assess long-term outcomes after MI [9]. According to these studies, a reduced longitudinal strain is an early sign of myocardial damage, not only in ischemic LV dysfunction. Reduced LV circumferential strain and torsion are predictors of more severe LV dysfunction and remodeling, which are more common in transmural LV lesions [10–14]. LV dysfunction is a key prognostic factor in post-MI patients [15]. STE, which more accurately diagnoses regional or global LV dysfunction in MI, may have the greatest prognostic potential.

Objective

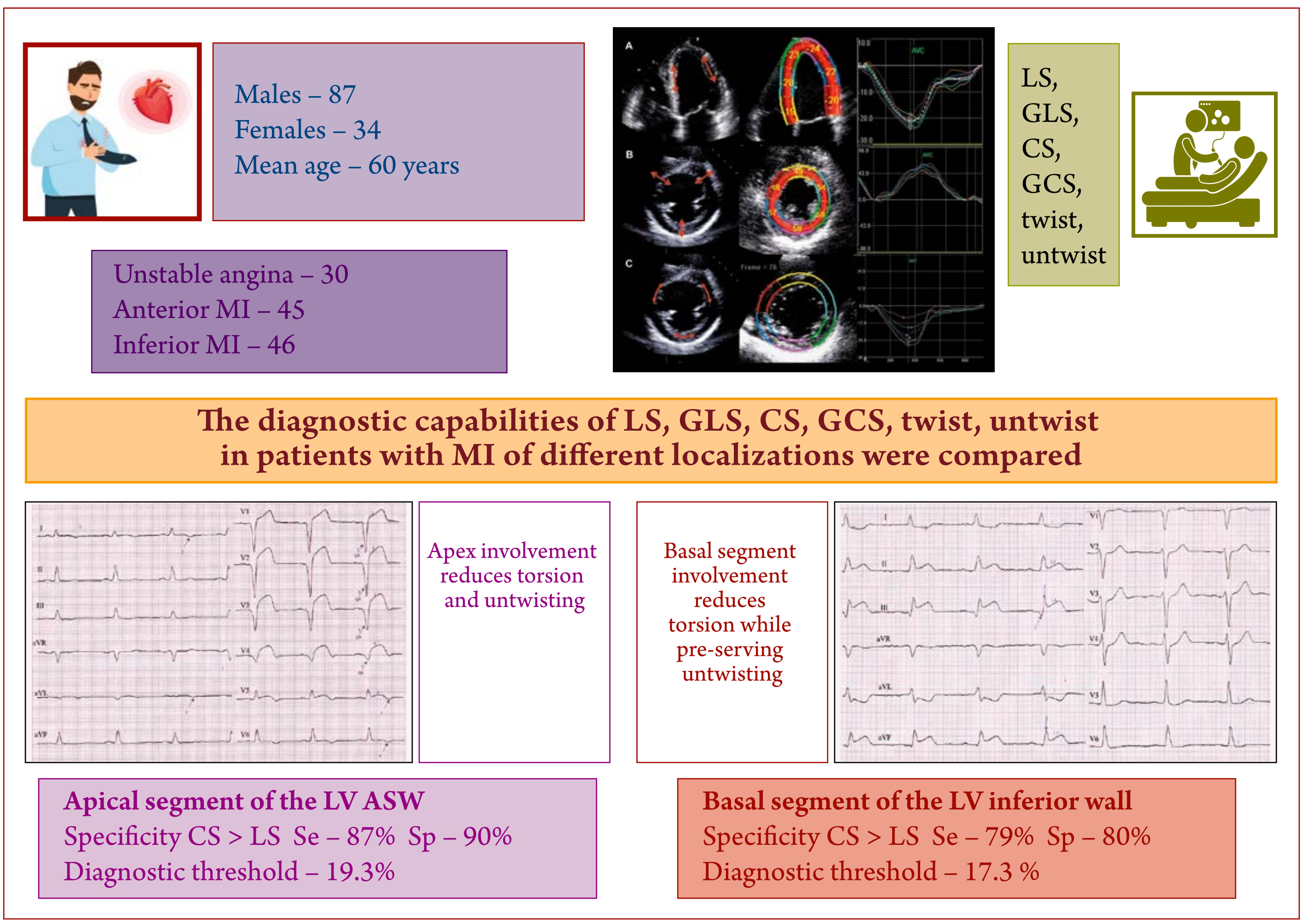
Compare the ability to diagnose regional and global myocardial dysfunction using LV longitudinal and circumferential strain, torsion, and untwisting in patients with MI of different locations.

Material and Methods

A total of 121 patients with unstable angina (UA) and MI were included in the study. The study was conducted in accordance with Good Clinical Practice and the tenets of the Declaration of Helsinki. The study protocol was approved by the Ethics Committee of Kursk State Medical University. All subjects signed a written informed consent prior to inclusion in the study.

According to the recommendations [15], medical history was obtained from all patients, who also underwent clinical and laboratory examinations. Patients were divided into 3 groups: Group 1 – patients with UA (n=30), Group 2 – patients with anterior MI (n = 45), Group 3 – patients with inferior MI (n = 46). Criteria for anterior MI: electrocardiographic evidence of myocardial damage in the anterior leads (I, aVL, V1-V4) and echocardiographic evidence of zones of local abnormalities in the LV anteroseptal wall motion. Criteria for inferior MI: electrocardiographic evidence of myocardial damage in the inferior leads (II, III, aVF) and detection of zones of local abnormalities in the LV inferior wall motion. There were 30 (66.7%) patients with Q-IM and 15 (33.3%) patients with non-Q-IM in the anterior MI group. The inferior MI group included 25 (54.3%) patients with Q-IM and 21 (45.7%) patients with non-

Central Illustration. Limitations of Diagnosis of Ischemic Left Ventricular Dysfunction Using The Values of Strain, Twist and Untwist in Patients With Myocardial Infarction of Various Localization



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Q-IM. Any focal electrocardiographic abnormalities and local wall motion abnormalities demonstrated by echocardiography were excluded in the UA group. Patients with MI were included in the study only if 3 criteria were met: clinical and laboratory signs [15], mandatory simultaneous presence of electrocardiographic evidence of myocardial damage, and local wall motion abnormalities on echocardiography. Patients were excluded from the study if any of the 3 criteria were not met. In addition, patients with a combination of anterior and inferior wall motion abnormalities were excluded. Other exclusion criteria: suboptimal ultrasound image quality, arrhythmias, bundle branch blocks.

Echocardiography was performed 6.5 ± 2.7 days after admission using an Affiniti 70 scanner with an S5–1 probe (1.7–3.5 MHz). The main parameters were scanned and measured from the apical and short axis LV views. Apical images were made from 2-, 5- (+LV outflow tract) and 4-chamber views. Short-axis views were acquired at the basal, middle, and apical levels. Measurements of (left atrial and LV) volumes, assessment of LV systolic and diastolic function, and LV wall motion abnormalities were performed according to the recommendations of the American Society of Echocardiography and the European Association of Cardiovascular Imaging [1].

Qualitative two-dimensional echocardiographic images were used to analyze myocardial strain. Frame rates ranged from 60 to 80 frames per second. The following parameters were determined in STE mode (aCMQ software suite): maximum systolic peaks of longitudinal (LS) and circumferential (CS) strain of LV segments (%), global longitudinal strain (GLS), and global circumferential strain (GCS). In the short-axis views, the peaks of systolic and diastolic rotation were determined from the rotation curve. Torsion was calculated as the difference between apical and basal rotation in degrees. Torsion and untwisting indices are the ratio of torsion to the size of the LV longitudinal axis in the apical four-chamber view (°/cm). Moduli of negative strain values (except tabulated values) are shown in the text. All patients included in the study underwent coronary angiography according to M.P. Judkins. The Gensini score was calculated [15, 16].

Statistical processing of the obtained data was carried out in Statistica v.13 and SPSS v.23 using the methods of parametric and non-parametric statistics. In the case of normal distribution (Kolmogorov-Smirnov test was used), the significance of differences between means was estimated using Bonferroni t-test for multiple comparisons. The significance of the difference between the categorical characteristics and their frequencies was compared using the chi-squared test. In the case of non-normal distribution, comparisons were made using the Mann-Whitney U test. The tabulated data are expressed as the means and the standard deviations (M±SD) or the medians and the interquartile ranges (Me [25th percentile; 75th percentile]). ROC curves were constructed to evaluate the quality of binary classification of the studied characteristic. The differences were statistically significant at $p<0.05$.

Results

The main characteristics of the subjects are shown in Table 1.

It is shown in Table 1 that MI patients are characterized by male predominance (inferior MI), smoking (anterior and inferior MI), less frequent use of antiplatelet agents (inferior MI), beta-blockers (anterior MI), and revascularization procedures (anterior MI) according to medical history. Patients with MI (especially anterior MI) had, on average, more significant left heart dilation and LV systolic and diastolic dysfunction [1]. This is likely due to more severe coronary artery lesions in anterior MI. It was found that in anterior MI, wall motion abnormalities were predominant in the apical segment of the LV anteroseptal wall: predominantly akinesia – in 28 (62.2%) patients and less frequently hypokinesia – in 17 (37.8%; $p<0.05$). At the same time, there were significantly fewer cases of akinesia in the basal segment of the LV anteroseptal wall (4 patients, 8.9%) than in the apical segment ($p<0.001$). In the inferior IM, akinesia was more frequently observed in the basal segment of the inferior LV wall (17 patients, 36.9%) and less frequently in the apical segment (4 patients, 8.7%; $p<0.05$). Furthermore, the detection rate of akinesia of the apical segment of the LV anteroseptal wall in anterior MI was significantly higher than that of akinesia of the basal segment of the LV inferior wall in inferior MI ($p < 0.001$). Table 2 shows the myocardial segment strain values of the subjects.

The magnitude of systolic longitudinal and circumferential strain decreases to a greater extent in anterior MI according to the data presented. In apical segments of all LV walls, both longitudinal and circumferential strain values are reduced, a consequence of the preferential apical involvement in anterior MI [17, 18]. In inferior MI, circumferential and, less frequently, longitudinal strain of the basal and middle segments of the inferior, inferoseptal, and inferolateral LV walls are more frequently reduced.

The sensitivity and specificity of the diagnosis of LV systolic dysfunction in anterior and inferior MI using regional longitudinal and circumferential strain values are demonstrated by ROC curves (Figures 1, 2).

Table 1. Characteristics of the CAD patient groups studied

Parameter		Group 1, IW (n = 30)	Group 2, anterior MI (n = 45)	Group 3, inferior MI (n = 46)
Sex, n (%)	Male	17 (56.7)	30 (66.7)	40 (87.0)
	Female	13 (43,3 %)	15 (33.3)	6 (13.0)**
Age, years		61.1 ± 9.0	59.9 ± 11.1	60.8 ± 7.7
History of CVDs, n (%)		11 (36.7)	20 (44.4)	18 (39.1)
Hypertension, n (%)		23 (76.7)	36 (80)	31 (67.4)
DLD, n (%)		11 (36.7)	12 (26.7)	14 (30.4)
Smoking, n (%)		7 (23.3)	24 (53.3)**	23 (50)**
DM type 2, n (%)		3 (10)	10 (22.2)	6 (13.0)
History of MI, n (%)		3 (10)	10 (22.2)	7 (15.2)
Revascularization, n (%)		9 (30)	4 (8.9)*	7 (15.2)
Previous therapy, n (%)	AP	14 (46.7)	14 (31.1)	12 (26.1)*
	ACE in-hibi-tors/ ARBs	14 (46.7)	16 (35.5)	16 (34.8)
	BBs	14 (46.7)	12 (26.7)*	15 (32.6)
	Statins	10 (33.3)	8 (17.8)	9 (19.6)
BMI, kg/m^2		28.0 [25.1; 31.2]	27.2 [25.2; 30.5]	26.9 [25.4; 29.4]
SBP, mm Hg		120 [120; 140]	110 [100; 130]	120 [110; 130]
DBP, mm Hg		80 [70; 80]	70 [60; 80]	80 [70; 80]
CHF class (NYHA), n (%)	Class I	9 (30)	13 (28.9)	11 (23.9)
	Class II	12 (40)	19 (42.2)	25 (54.3)
	Class III	9 (30)	13 (28.9)	10 (21.8)
HR, bpm		67.3 ± 10.8	74.2 ± 13.8	69.2 ± 13.1
LAVI, mL/m^2		28.5 ± 8.0	35.2 ± 11.7*	29.9 ± 8.1
LVEDVI, mL/m^2		42.9 ± 9.5	55.9 ± 17.7**	50.1 ± 14.9
LVESVI, mL/m^2		15.4 ± 4.4	24.5 ± 9.9***	20.7 ± 8.8*
LVEF, %		64.7 ± 6.5	55.8 ± 8.3***	58.8 ± 7.5**
LVMI, g/m^2		74.6 ± 15.1	91.1 ± 20.9***	84.9 ± 17.2
DD, n (%)		1 (3.3)	12 (26.7)*	8 (17.3)
Gensini score		26.4 [0; 47.0]	83 [51.0; 94.0]***	62 [38.0; 86.0]***,#
PCI, n (%)		16 (53.3)	43 (95.5)	37 (80.4)

UA, unstable angina; DLD, dyslipidemia; AP, antiplatelet agents; ACE inhibitors/ARBs, angiotensin-converting enzyme inhibi-tors/ angiotensin III receptor blockers; BBs, beta-blockers; BMI, body mass index; LAVI, left atrial volume index; LVEDVI, left ventricular end-diastolic volume index; LVESVI, left ventricular end-systolic volume index; LVMI, left ventricular mass index; DD, diastolic dysfunction.
Differences between the Group 1 and Group 2, and Group 1 and Group 3: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Differences between Group 2 and Group 3: # $p < 0.05$.

As shown in Figure 1, the circumferential strain of apical segment has the greatest diagnostic value for regional LV systolic dysfunction in anterior MI.

Figure 2 shows that the diagnostic value of circumferential strain is higher than that of longitudinal

Table 2. Systolic longitudinal and circumferential strain in the CAD patient groups under study

Parameter			Group 1, IW (n = 30)	Group 2, anterior MI (n = 45)	Group 3, inferior MI (n = 46)
ASW	LS	BS	-8.2 ± 6.3	-6.8 ± 4.5	-8.4 ± 4.5
		MS	-9.6 ± 5.0	-3.2 ± 4.9***	-9.6 ± 4.4
		AS	-18.3 ± 5.7	-9.0 ± 5.8***	-16.4 ± 6.0
	CS	BS	-17.8 ± 9.1	-14.3 ± 6.9	-16.3 ± 6.8
		MS	-20.9 ± 5.7	-11.2 ± 7.7***	-18.0 ± 5.6
		AS	-29.9 ± 8.8	-8.8 ± 10.4***	-25.4 ± 7.8
ILW	LS	BS	-10.5 ± 5.8	-10.5 ± 5.1	-10.6 ± 5.3
		MS	-10.7 ± 4.9	-10.0 ± 4.1	-9.9 ± 5.3
		AS	-17.6 ± 5.1	-10.2 ± 8.3***,#	-15.1 ± 5.5
	CS	BS	-20.5 ± 7.3	-19.8 ± 6.5	-15.8 ± 6.6**
		MS	-22.9 ± 7.7	-19.9 ± 7.1	-15.9 ± 10.0**
		AS	-32.3 ± 8.2	-20.2 ± 12.6***	-27.7 ± 10.1
ISW	LS	BS	-9.8 ± 6.9	-7.2 ± 3.8*	-8.2 ± 4.3
		MS	-11.6 ± 3.5	-7.6 ± 3.9***	-11.3 ± 4.1
		AS	-18.9 ± 5.8	-11.8 ± 7.9***	-17.8 ± 5.2
	CS	BS	-20.9 ± 5.9	-16.7 ± 5.7*	-16.4 ± 6.2*
		MS	-23.1 ± 4.9	-16.2 ± 7.3***	-18.3 ± 5.1***
		AS	-30.8 ± 8.3	-15.7 ± 12.9***	-28.0 ± 8.1
ALW	LS	BS	-11.7 ± 5.8	-10.2 ± 4.9	-9.9 ± 5.5
		MS	-10.2 ± 5.9	-9.4 ± 4.0	-9.5 ± 5.7
		AS	-19.1 ± 6.6	-12.0 ± 7.2***	-18.7 ± 5.5
	CS	BS	-19.2 ± 6.7	-16.9 ± 7.4	-16.9 ± 6.2
		MS	-23.1 ± 7.7	-18.5 ± 6.7*	-18.2 ± 6.8*
		AS	-30.2 ± 8.5	-19.8 ± 11.8***	-26.4 ± 10.1
UA	LS	BS	-10.4 ± 6.5	-10.2 ± 4.8	-4.8 ± 6.1***
		MS	-12.8 ± 4.3	-8.9 ± 5.3*	-11.4 ± 4.9
		AS	-18.6 ± 6.1	-10.8 ± 7.4***	-18.9 ± 5.5
	CS	BS	-22.1 ± 5.4	-20.3 ± 5.5	-14.1 ± 6.9***
		MS	-24.9 ± 5.9	-19.6 ± 5.9***	-17.5 ± 6.9***
		AS	-31.7 ± 9.2	-20.3 ± 11.1***	-27.3 ± 9.7
AW	LS	BS	-12.6 ± 4.7	-8.6 ± 5.1**	-9.8 ± 5.2
		MS	-10.9 ± 5.2	-9.1 ± 4.7	-11.9 ± 3.9
		AS	-18.4 ± 6.4	-13.6 ± 7.9*	-18.2 ± 6.7
	CS	BS	-16.8 ± 5.3	-12.2 ± 6.7**	-13.8 ± 7.3
		MS	-18.0 ± 7.5	-13.9 ± 7.7*	-16.8 ± 6.9
		AS	-30.9 ± 8.4	-17.2 ± 12.4***	-27.0 ± 8.7

AU, unstable angina; ASW, anteroseptal wall; ILW, inferolateral wall; ISW, inferoseptal wall; ALW, anterolateral wall; IW, inferior wall; AW, anterior wall; BS, basal segment; MS, middle segment; AS, apical segment.
Differences between Group 1 and Group 2 and between Group 1 and Group 3: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Differences between Group 2 and Group 3: # $p < 0.01$.

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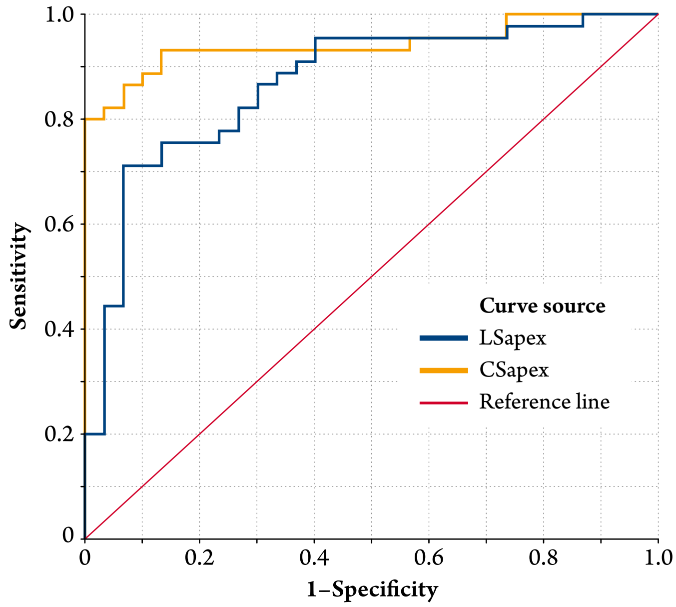
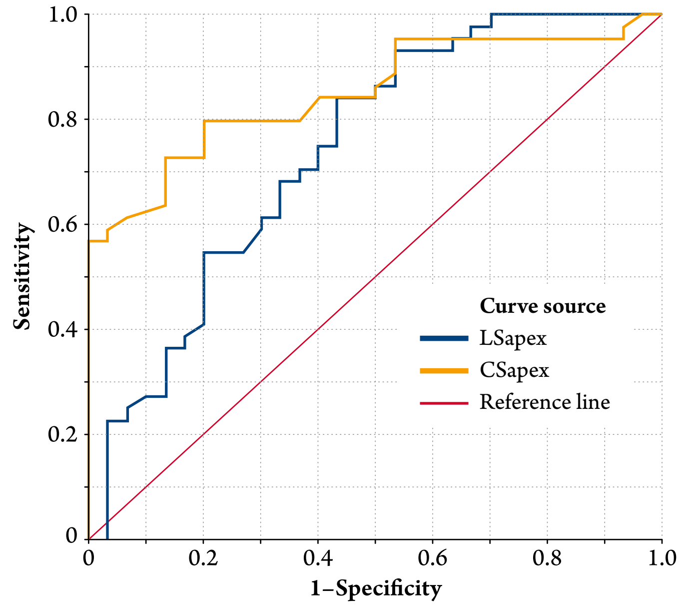
Figure 1. ROC curves for diagnosis of regional systolic dysfunction in anterior myocardial infarction based on longitudinal and circumferential strain of the apical segment of the left ventricular anteroseptal wall



ROC curves characterizing the dependence of the presence of regional systolic dysfunction in anterior myocardial infarction on longitudinal and circumferential strain of the apical segment of the left ventricular anteroseptal wall LSapex and CSapex are the values of systolic longitudinal and circumferential strain of the apical segment of the left ventricular anteroseptal wall AUC LS 0.869 [0.785; 0.983]; p<0,001; diagnosis threshold 14.5 %, sensitivity 82 %, specificity 73 %. AUC CS 0.943 [0.890; 0.996]; p<0,001; diagnosis threshold 19.3 %, sensitivity 87 %, specificity 90 %.

Figure 2. ROC curves for diagnosis of regional systolic dysfunction in inferior myocardial infarction based on longitudinal and circumferential strain of the basal segment of the left ventricular inferior wall



ROC curves characterizing the dependence of the presence of regional systolic dysfunction in inferior myocardial infarction on longitudinal and circumferential strain of the basal segment of the left ventricular inferior wall LSbasal and CSbasal are the values of systolic longitudinal and circumferential strain of the basal segment of the left ventricular inferior wall. AUC LS 0.740 [0.621; 0.859]; p<0,01; diagnosis threshold 8.6%, sensitivity 70 %, specificity 63 %. AUC CS 0.850 [0.764; 0.936]; p<0,001; diagnosis threshold 17.3 %, sensitivity 79 %, specificity 80 %.

Table 3. Global longitudinal and circumferential strain and LV rotation and torsion indices in the CAD patient groups under study

Parameter		Group 1, IW (n = 30)	Group 2, anterior MI (n = 45)	Group 3, inferior MI (n = 46)
GLS, %		-18.5 ± 4.1	-7.7 ± 2.9***	-12.1 ± 2.7***
GCS, %		-24.2 ± 4.9	-14.9 ± 5.3****	-19.4 ± 4.7****,#
Basal rotation, °	S	-4.7 ± 2.6	-3.6 ± 1.9	-3.3 ± 1.9*
	D	-2.3 ± 1.3	-2.0 ± 1.3	-1.8 ± 1.4
Apical rotation, °	S	5.3 ± 2.7	3.0 ± 3.3**	4.5 ± 2.9
	D	1.5 ± 1.8	0.25 ± 2.1*	1.1 ± 1.5
Torsion, °		10.0 ± 3.7	6.6 ± 3.4***	7.9 ± 3.3*
Torsion index, °/cm		1.2 ± 0.53	0.75 ± 0.41***	0.92 ± 0.42*
Untwisting, °		3.8 ± 2.5	2.2 ± 2.6*	3.0 ± 1.5
Untwisting index, °/cm		0.46 ± 0.27	0.24 ± 0.29***	0.35 ± 0.22

UA, unstable angina; S, systolic rotation; D, diastolic rotation.
Differences between Group 1 and Group 2 and between Group 1 and Group 3: * p < 0.05; ** p < 0.01; *** p < 0.001; ****p < 0.0001
Differences between Group 2 and Group 3: # p < 0.0001.

strain for detecting regional systolic dysfunction in the inferior IM.

According to some studies, global longitudinal and circumferential strain are superior to regional strain as diagnostic criteria for myocardial ischemia (Table 3) [2, 19].

The torsion index is reduced in anterior MI due to decreased apical systolic rotation and in inferior MI due to decreased basal systolic rotation. Reduced apical diastolic rotation in anterior MI leads to reduced LV untwisting.

Discussion

The results of the study showed that anterior MI is characterized by involvement of the apical segments of the LV, whereas inferior MI is characterized by involvement of the basal segments, which is consistent with the nature of myocardial blood supply [17, 18]. Therefore, the most appropriate segments for diagnosing regional systolic dysfunction are the apical anteroposterior segment in anterior MI and the basal segment of the inferior LV wall in inferior MI. In the absence of MI, the uniform decrease in longitudinal strain in both the apical and basal segments of the LV is attributed to causes unrelated to LV ischemia [12, 13]. However, reduced LV myocardial strain in MI is explained to a greater extent by the presence of wall motion abnormalities [1–3, 10, 11, 20]. The more pronounced decrease in global LV strain (GLS and GCS) in anterior IM compared to inferior IM is explained by the predominance of myocardial akinesia. For the same reason, regional circumferential strain is reduced to a greater extent in anterior IM than in inferior IM. The observed reduction in longitudinal strain of less than 14.5% and circumferential strain of less than 19.3% in the apical segment of the LV anteroseptal wall in anterior MI is consistent with literature data [1, 2, 13, 21]. The circumferential strain of the apical segment of the LV anteroseptal wall decreases less than 10% due to the predominance of akinesia in this segment [10, 11, 22]. Circumferential strain of the apical segment of the LV anteroseptal wall (diagnostic threshold 19.3%, sensitivity 87%, specificity 90%) is superior to longitudinal strain in diagnosing regional ischemic dysfunction in anterior MI.

The predominantly basal segment involvement in inferior MI determines the difficulty of echocardiographic diagnosis of regional LV systolic dysfunction. Circumferential strain of the basal segment of the LV inferior wall in inferior MI is not as significantly reduced as circumferential strain of the apical segment of the LV anteroseptal wall in anterior MI, which may be related to a smaller number of patients with akinesia of the basal segment of the LV inferior wall. In addition to underdiagnosis and overdiagnosis of lesion size, the reason for the observed differences may be due to less damage to subepicardial fibers in inferior IM. According to the data obtained, circumferential strain of the basal segment of the inferior LV wall in inferior MI has a greater diagnostic value for the detection of regional systolic dysfunction compared to longitudinal strain of this LV segment. The diagnostic threshold was 17.3%. Sensitivity was 79% and specificity was 80%.

The differences in the specificity of longitudinal and circular strain in the diagnosis of wall motion abnormalities may be due to the acoustic pattern of combinations of bright and dark spots of different myocardial segments. This pattern is formed by the reflection of the ultrasound beam from multidirectional myocardial fibers. At the same time, the formation of a characteristic ultrasound pattern represented by a combination of dark and bright spots is crucial for the analysis of ventricular wall motion using the speckle tracking method [2, 23–25]. Furthermore, the magnitude of backscatter from the inferior wall in the short-axis view is more homogeneous from epicardium to endocardium, in contrast to the anterior LV wall [25]. Another reason for the different diagnostic capabilities of longitudinal and circumferential strain in anterior and inferior MI is the predominance of the ascending band in the endocardium of the LV inferior wall, where, unlike the interventricular septum, there is no spiral fiber overlap [26, 27].

Apical segment rotation is a major contributing factor to LV torsion and untwisting [26]. Therefore, torsion and untwisting indices are reduced to a greater extent in anterior IM due to LV apex involvement. This may be the reason for the negative prognosis of anterior IM compared to inferior IM [15, 18]. Inferior MI showed a decrease in torsion index due to a decrease in basal systolic rotation. Untwisting index decreases slightly in inferior MI, which is associated with preservation of apical diastolic rotation. A more pronounced decrease in untwisting in anterior MI may be related to the involvement of the ascending segment of the myocardial band, which plays an important role in LV diastolic untwisting [27, 28].

In contrast to previous studies, it has been shown how regional and global LV strain, torsion and untwisting change depending on the localization of MI, not only on the severity of LV lesions and remodeling [10–14]. This allowed us to identify the predominant role of circumferential strain in the diagnosis of regional systolic dysfunction in MI and to determine the significance of torsion and untwisting in anterior MI.

Limitations

Gadolinium magnetic resonance imaging of the myocardium is the most appropriate technique for the diagnosis of local wall motion abnormalities, especially in inferior myocardial infarction, because detection of local wall motion abnormalities based on systolic left ventricular wall thickening may lead to underdiagnosis and overdiagnosis of myocardial lesion size.

Conclusion

A decrease in circumferential strain of less than 19.3% in the apical segment of the left ventricular anterior septal wall is more specific (90%) for the diagnosis of regional systolic dysfunction in anterior myocardial infarction than a decrease in longitudinal strain. Circumferential strain of less than 17.3% in the basal segment of the inferior left ventricular wall is more specific (80%) than longitudinal strain of this segment for diagnosing regional systolic dysfunction in inferior myocardial infarction.

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Predominant left ventricular apical involvement in anterior myocardial infarction may lead to systolic and diastolic myocardial dysfunction, manifested by decreased circumferential strain, left ventricular torsion and untwisting.

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