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Value of Longitudinal Strain in Assessment of Patients with Suspected Acute Coronary Syndrome and No Wall Motion Abnormalities

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ABSTRACT

Background: Echocardiography is a first simple technique for the evaluation of coronary artery disease (CAD), which is useful in the diagnostic and prognostic workup of these syndromes. The clinical work-up of patients presenting with chest pain is a diagnostic challenge.

Objective: We inspected the diagnostic performance of global (GLS) and territorial (TLS) longitudinal strain to predict CAD in patients presenting with suspected non-ST-segment elevation acute coronary syndrome (NSTE-ACS) but apparent normal global and regional systolic function.

Patients And Method: A cross sectional study included 90 patients with suspected NSTE-ACS with normal left ventricular ejection fraction (LVEF) (≥50%) and wall motion score index (WMSI) (=1). Speckle-tracking echocardiography was performed to all patients on admission then patients underwent coronary angiography or noninvasive test according to their risk stratification. Patients were classified to 2 groups (CAD and No CAD).

Results: There was significant sensitivity and specificity of cardiac enzymes, GRACE score, Global longitudinal strain and territorial longitudinal strain in identifying CAD. However there was no statistically significant difference in conventional echocardiographic data between both studied groups. A cutoff value of GLS -17.1, TLS-LAD cutoff level >-17.15, TLS-LCX cutoff level >-16.9 and TLS-RCA cutoff level >-16.3. GLS as a predictor for the number of affected vessels, cutoff point of ≥ -15.4 can be used. A predictor for the presence of proximal lesions, cutoff point of TLS LAD ≥ -15.1 and TLS LCX ≥-15.3 can be used.

Conclusions: Global longitudinal strain and territorial longitudinal strain can be used for early detection of the presence of coronary artery occlusion to identify patients who may benefit from early reperfusion. GLS also can predict multivessel disease and TLS can be used as a predictor for the presence of proximal lesions.

Keywords: Acute Coronary Syndrome; Global and Territorial strain; Speckle-tracking Echocardiography.

INTRODUCTION

There is a challenge to make a positive diagnosis of acute coronary syndrome (ACS), especially in patients who have an equivocal initial clinical and paraclinical assessment [(1)]. By allowing evaluation of global and segmental systolic function and avoiding differential diagnoses, echocardiography plays an important role in the clinical work-up of patients with chest discomfort [(2,3)].

Echocardiography is a first simple technique for the evaluation of coronary artery disease (CAD), which is useful in the diagnostic and prognostic workup of these syndromes [(4)]. Visual estimation of wall motion abnormalities may fails in detecting less clear or transient myocardial ischemia and in providing accurate differential diagnosis [(5)].

Speckle tracking echocardiography (STE) is a quick, easy and available noninvasive tool that provides additive information over basic echocardiography. It is able to identify subtle myocardial damage and to localize ischemic territories in accordance to the coronary lesions. A clear "polar map" is useful for differential diagnosis and management [(1)]. However, the diagnostic value of 2D strain in suspected ACS patients without global or regional wall motion abnormality has not yet been reported [(6)].

The latest European Society of Cardiology (ESC) guidelines for the diagnosis and management of non-ST-elevation ACS (NSTE-ACS) suggest the use of speckle tracking to support diagnosis in patients referred to echocardiography for clinical suspicion of ischemic disease and absence of visual wall motion abnormalities. High sensitivity and specificity (86% and 73%, respectively) were reported for cutoff values of LV GLS > −18,8% to detect significant coronary stenosis in patients with chest pain and inconclusive electrocardiographic (ECG) and blood test results, providing an additive value to the wall motion score index (WMSI) [(7,8)].

The present study aimed to find a better characterization and management of patient with suspected NSTE-ACS with apparent normal LV global and regional function and to determine the role of longitudinal strain as assessed by speckle-tracking in those patients, also to correlate the results of longitudinal strain with the results of coronary angiography.

MATERIALS and METHOD

This is a single center, cross sectional study, conducted in Cardiology Department, Zagazig University Hospitals, Egypt. We enrolled 90 patients who had suspected NSTE-ACS and apparent normal LV global and regional function.

Inclusion and exclusion criteria:

The study included all patients with suspected NSTE-ACS but apparent normal left ventricular

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systolic function as assessed by LVEF and WMSI (=1.0). The patients were divided into two groups according to the presence (group 1) or absence (group 2) of significant CAD.

We excluded patients with ST segment elevation acute coronary syndrome, previous history of myocardial infarction, previous history of coronary artery intervention either percutaneous coronary intervention (PCI)or coronary artery bypass graft (CABG), severe primary valvular dysfunction, hypertrophic obstructive cardiomyopathy (HOCM), patients with chronic kidney disease CKD, patients with poor echocardiographic window and ECG findings consistent with AF or LBBB or other arrhythmias.

Clinical assessment:

Twelve leads ECG to was performed to exclude presence of acute ST segment elevation, arrhythmias, LBBB, Pathological Q wave as an indicator of old myocardial infarction, and acute pericarditis.

High-sensitivity troponin (hsTnT) levels were detected via serial hsTnT assessment, cardiac enzymes (CK total and CKMB), CBC, kidney function tests, liver function tests and electrolytes were assessed.

Risk stratification of patients was calculated according to GRACE score.

A standard transthoracic echocardiography (TTE) was performed using VIVID GE. 2 dimensional (2D), M-Mode, color flow assessment, continuous and pulsed wave Doppler were done. Images were acquired in the standard parasternal and apical views with data acquisition according to recommendations from the American Society of Echocardiography [(2)]. Images were taken while the patient was in the supine and the left lateral positions.

Echocardiography was performed for all the 90 patients. From the parasternal long-axis view of the left ventricular (LV) end-diastolic and end-systolic diameters, LV end-systolic volume (ESV) and end-diastolic volumes (EDV) were measured from the apical 4-chamber view. Left ventricular ejection fraction (LVEF) was calculated using the modified Simpson biplane method. LV filling pressure was obtained by pulsed-wave Doppler from apical 4-chamber view with the sample volume positioned at the tips of the mitral valve, and by dividing the early (E) transmitral velocity wave by early annular diastolic velocity using TDI imaging to compute the E/E′ ratio. Velocities in early (E) and late (A) diastole were recorded, in addition to the calculation of the E/A ratio.

Resting segmental wall motion was assessed in a 17-segment model by two observers (each segment was assigned a score of 1 for normal wall motion, 2 for hypokinetic motion, 3 for akinetic motion or 4 for dyskinetic motion) and the wall motion score index (WMSI) was calculated by averaging the segmental values.

Global longitudinal strain (GLS) using the speckle tracking technique was performed only at admission time using Echo Pac (Version E95Vivid) by automated function imaging. Longitudinal strain was measured for each LV segment using the apical three, four and two chamber views with frame rate of 60 to 90 frames/sec. The LV endocardial border was traced using the optimal frame for endocardial identification in all three apical views, and the automatically created region of interest was manually adjusted to the thickness of the myocardium. Aortic valve closure was defined in the apical long-axis view, and the interval between the R wave and this time point was then automatically measured to serve as a reference for identification of end-systole. The average value of global longitudinal strain “GLS” obtained from averaging the strain values of whole LV segments at rest was calculated automatically, where values less than (-20%) were considered abnormal.

The territorial longitudinal strain (TLS): was calculated based on perfusion territories of the three major coronary arteries in a 17-segment LV model by averaging all segmental peak systolic strain values within each territory[(4)]. For comparison with the angiographic findings, segments were correlated with the arterial supply as followed: basal anterior and anteroseptal, mid-anterior and anteroseptal, apical anterior, septal and apex were assigned to the left anterior descending (LAD) coronary artery distribution; basal inferoseptal and inferior, mid-inferoseptal and inferior, and apical inferior were assigned to the right coronary artery (RCA); and basal inferolateral and anterolateral, mid-inferolateral and anterolateral, and apical lateral were assigned to the left circumflex artery (LCX).

Non-invasive tests were recommended as an alternative to ICA to exclude ACS when there was a low-to-intermediate likelihood of CAD and when cardiac troponin and/or ECG were normal or inconclusive for patients who were free from chest pain, stress imaging was performed during hospitalization or shortly after discharge.

I. *Exercise ECG*: Symptom-limited exercise ECG was performed involved graded exercise.
II. *Stress imaging*: was preferred over exercise ECG due to its greater diagnostic accuracy [(5)]**.** Either (DSE) Dobutamine Stress Echocardiography or (MPI) Myocardial Perfusion Imaging.
III. *CT Coronary Angiography* was performed to visualize the extent and severity of non-obstructive and obstructive CAD, as well as atherosclerotic plaque composition and high risk features (e.g., positive remodeling, low attenuation plaque) [(6)].

Coronary Angiography:

Invasive intervention was done for a) patients diagnosed as NSTEMI and high likelihood of CAD, b) patients with positive non-invasive tests by professional team using an automated edge detection system. Where the coronary artery narrowing was visually estimated and expressed as percentage of luminal diameter stenosis. Patients with ≥ 70% narrowing in LAD, circumflex artery or right coronary artery or their major branches and ≥50% in left main coronary were classified as having significant angiographic coronary artery disease [7]. *Proximal LAD* was defined from the origin to the first diagonal branch (D1) (although some authors use the first septal perforator (S1) as the landmark), *RCA proximal* from the ostium to one half the distance to the acute margin of the heart and *Proximal circumflex* artery from its origin of left main and including origin of first obtuse marginal branch. Then revascularization was done to candidate patients according to current guidelines.

Ethical consent:

An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis

The collected data were analyzed using SPSS program (Statistical Package for the Social Sciences) version 24.0. Qualitative data were represented as frequencies and percentages. Quantitative data were expressed as mean ± SD (Standard deviation), median, and range. Chi square test was used to calculate difference between qualitative variables. Student T test was used to compare between means of 2 groups and Mann-Whitney test was calculated for non-parametric data. Receiver Operating Characteristic (ROC) curve also was done and the true positive rate (Sensitivity) was plotted in function of the false positive rate (100-Specificity) for different cutoff points. The significance level for all above mentioned statistical tests was calculated. P value of <0.05 was considered significant.

RESULTS

In the current study the demographic data and risk factors were insignificantly different between the 2 studied groups **(Table 1).**

Table (1): Relation between demographic data, risk factors and CAD among the studied patients

Variable	CAD				p-value
	No (N=18)		Yes (N=72)		
	No	%	No	%	
Age (years)					
Mean ± SD	54.8 ± 9.77		53.22 ± 13.8		**0.557**
(Range)	30-69		28- 74		
Sex					
Male	13	72.2	47	65.3	**0.238**
Female	5	27.8	25	34.7	
BMI (kg\m2)					
Mean ± SD	26.1 ± 2.7		26.6 ±2.58		**0.364**
(Range)	20-31		22-31		
Risk factors					
HTN	16	45.7	33	60.0	**0.185**
DM	16	45.7	22	40.0	**0.593**
Hyperlipidemia	6	17.1	15	27.3	**0.268**
Smoking	17	48.6	24	43.6	**0.647**
Positive family history	9	25.7	20	36.4	**0.292**

Regarding cardiac enzymes (hs cTnT and CKMB) and GRACE score there was statistically significant difference in cardiac enzymes in relation to CAD where troponin (hs cTnT) and CKMB were statistically higher among patients with CAD than patients without CAD **(Table 2).**

Table (2): Cardiac enzymes and GRACE score in relation to CAD among the studied patients

Variable	CAD		p-value
	No (N=18)	Yes (N=72)	
Troponin			
Mean ± SD	45 ± 22.8	2703.9 ± 2260.7	**0.023***
Median (Range)	20 (10-160)	2600 (14-7200)	
CKMB			
Mean ± SD	40.49 ± 36.56	63.73 ± 47.18	**0.042***
Median (Range)	20 (8-160)	64 (7-180)	
GRACE score			
Mean ± SD	88.83± 11.02	97.45± 14.34	**0.002***
Median (Range)	90 (64-108)	96 (70-122)	

***: p-value is significant**

Regarding conventional echocardiographic data there was no statistically difference in LVED volume, LVES volume, LVEF, WMSI, E\A ratio and E\e` in CAD among the studied patients **(Table 3).**

Table (3): Echocardiographic data and CAD among the studied patients

Item		CAD		p-value
		No (N=18)	Yes (N=72)	
LVED Vol	Mean ± SD	89.8 ±7.2	87.13 ± 4.4	**0.112**
	Median (Range)	87 (83-110)	86 (80-105)	
LVES Vol	Mean ± SD	34.06 ±4.35	35.16± 4.6	**0.226**
	Median (Range)	35 (26-41)	36 (26-43)	
LVEF%	Mean ± SD	61.6 ± 5.2	59.36± 5.43	**0.059**
	Median (Range)	61 (52-69)	58 (50-68)	
E/A ratio	Mean ± SD	0.78 ± 0.18	0.85 ± 0.21	**0.068**
	Median (Range)	0.7 (0.5-1.3)	0.8 (0.5-1.3)	
E/e` ratio	Mean ± SD	9.54 ± 1.06	9.84 ± 1.5	**0.272**
	Median (Range)	9 (8-13)	10 (7-14)	

Global longitudinal strain was highly statistically lower in CAD group than in subjects with no CAD. Territorial longitudinal strain in LAD, LCX and RCA there was highly statistical significant difference in relation to CAD **(Table 4)**.

Table (4): Global longitudinal strain and territorial longitudinal strain in relation to CAD among the studied patients

Item		CAD		p-value
		No (N=18)	Yes (N=72)	
GLS	Mean ± SD	-17.74 ± 3.31	-15.48 ± 1.90	**0.007***
	Median (Range)	-16.8 (-25 to -13)	-15.8 (-18.9 to -12.4)	
TLS -LAD	Mean ± SD	-18.16 ± 2.7	-16.16 ± 2.77	**0.001***
	Median (Range)	-18 (-23 to -13.2)	-15.2 (-22.8 to -12.5)	
TLS-LCX	Mean ± SD	-18.02 ± 2.13	-16.9 ± 1.86	**0.031***
	Median (Range)	-18.2 (-22.2 to -14.2)	-17.4 (-20.2 to -12.3)	
TLS-RCA	Mean ± SD	-18.27 ±2.35	-17.18 ± 1.76	**0.032***
	Median (Range)	-18.2 (-22.8 to -14)	-17.6 (-21.8 to -12.5)	

***p-value is significant**

TLS-LAD had statistically significant excellent diagnostic potentials for LAD occlusion where AUC = 0.936, p-value <0.001 and 95% CI (0.874-0.998), cutoff level > -17.15, and had sensitivity of 97.8% and specificity of 83.3% in diagnosis of LAD occlusion **(Figure 1)**.

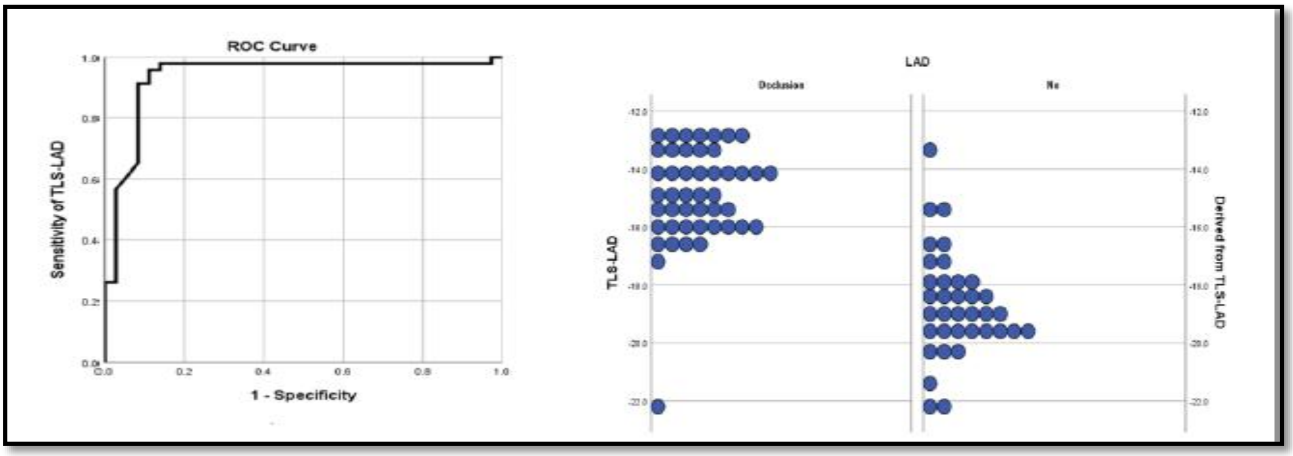

Figure (1): ROC curve and dot plot of TLS-LAD for diagnosis of LAD occlusion

TLS-LCX had statistically significant excellent diagnostic potentials for LCX occlusion where AUC = 0.912, p-value <0.001 and 95% CI (0.828-0.997), cutoff level > -16.9, and had sensitivity of 96.3% and specificity of 87.3% in diagnosis of LCX occlusion **(Figure 2)**.

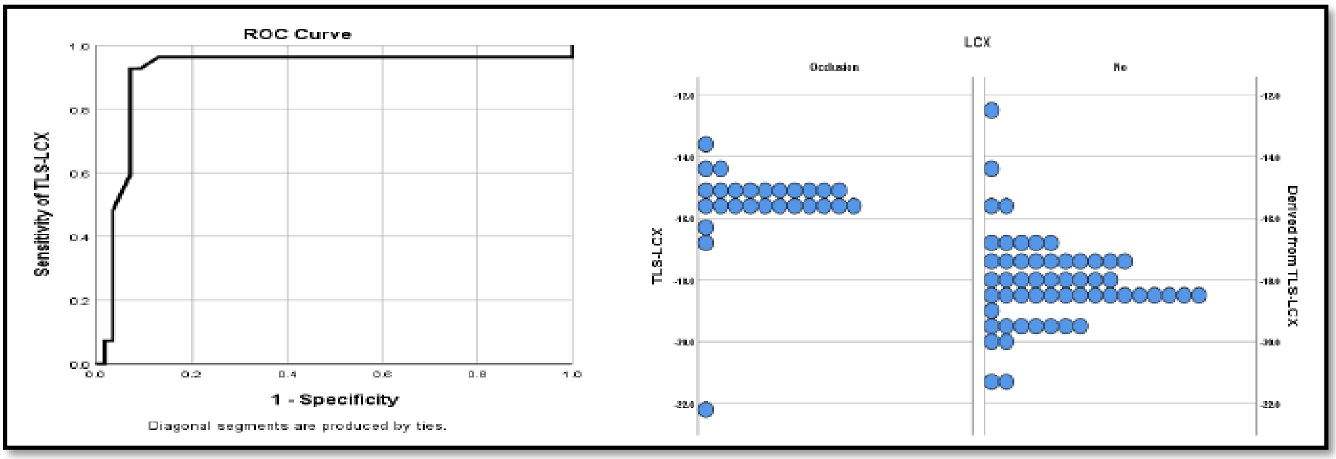

Figure (2): ROC curve and dot plot of TLS-LCX for diagnosis of LCX occlusion

TLS-RCA had statistically significant excellent diagnostic potentials for RCA occlusion where AUC = 0.936, p-value <0.001 and 95% CI (0.870-1.000), cutoff level > -16.3, and had sensitivity of 94.1% and specificity of 87.7% in diagnosis of RCA occlusion **(Figure 3)**.

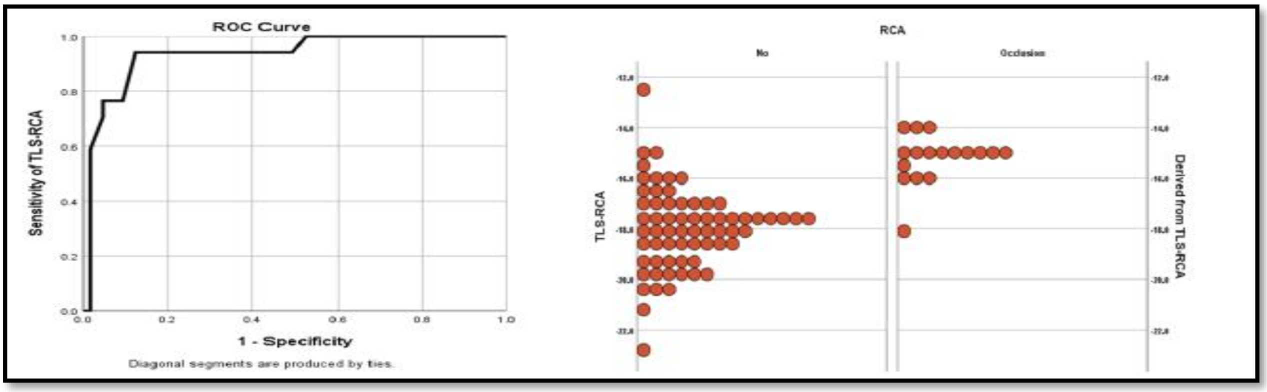

Figure (3): ROC curve and dot plot of TLS-RCA for diagnosis of RCA occlusion

There was a highly statistically significant difference between the different groups as regard TLS LAD and TLS LCX, which all were found to be significantly higher among patients with proximal lesions compared to those without lesions and those with non-proximal lesions and there was no significant difference between the different groups as regarding TLS RCA **(Table 5)**.

Table (5): Diagnostic performance of TLS in RCA, LCX and LAD among the studied groups

Variable	Patients without Lesions (n=56)	Patients with proximal lesion(n=7)	Patients with non-proximal lesion (n=9)	p-value	Post-hoc test
TLSRCA: Median Range	-18.3 (-21.1) – (18.4)	-15 (-15.2) – (-14)	-15.2 (-16.2) – (14)	**<0.001***	**<0.0011 <0.0012 0.2523**
Variable	**Patients without Lesions (n=45)**	**Patients with proximal Lesion (n=11)**	**Patients with non-proximal lesion (n=16)**	**p-value**	**Post-hoc test**
TLSLCX: Median Range	-18.5 (-22.5) – (17.8)	-15.2 (-15.6) – (-13.6)	-15.4 (-16.8) – (16.4)	**<0.001***	**<0.0011 <0.0012 0.013***
Variable	**Patients without Lesions (n=26)**	**Patients with proximal Lesion (n=26)**	**Patients with non-proximal lesion (n=20)**	**p-value**	**Post-hoc test**
TLSLAD: Median Range	-19.4 (-22) – (-18)	-14 (-16) - (-13)	-16 (-14) – (-17)	**<0.001***	**<0.0011 <0.0012 <0.0013***

***p-value is significant**
1: patients without lesion versus patients with proximal lesions; 2: patients without lesion versus patients with non-proximal lesions, 3: patients with proximal lesions versus patients with non-proximal lesions.

Table 6 displays that male sex, systolic hypertension, GRACE score, and GLS were statistically significant independent predictors of CAD. The logistic regression model was highly statistically significant, χ^2= 43.97, p <0.001. The model explained 52.4 % (Nagelkerke R2) of the variance in ischemic changes and correctly classified 78.9% of cases. Hypertensive patients were 7.5 times more likely to exhibit ischemic changes than non-hypertensive and patients with GLS were 1.6 times more likely to exhibit ischemic changes **(Table 6)**.

Table (6): Multivariate analysis of clinical data, cardiac enzymes and echo finding in diagnosis of CAD

Variables	B	Sig.	Exp (B)	95% C.I. for EXP(B)	
				Lower	Upper
Age	-0.080	0.052	0.923	0.851	1.001
Male	-2.252	**0.044***	0.105	0.012	0.937
DM(+)	0.795	0.277	2.215	0.528	9.289
HTN(+)	2.027	0.070	7.589	0.848	67.936
smoker(+)	0.195	0.830	1.215	0.205	7.198
Dyslipidemia(+)	0.192	0.821	1.211	0.231	6.364
Family history(+)	0.686	0.373	1.986	0.438	8.996
BMI (Kg/m²)	0.000	0.998	1.000	0.769	1.301
Troponin	0.000	0.121	1.000	0.999	1.000
CKMB	0.017	0.287	1.017	0.986	1.049
SBP(mmHg)	0.041	**0.034***	1.042	1.003	1.083
GRACE SCORE	0.089	**0.017***	1.094	1.016	1.177
LVEF%	-0.047	0.588	0.954	0.805	1.130
GLS	0.508	**0.023***	1.661	1.072	2.574
TLS-LAD	0.251	0.111	1.285	0.944	1.750
TLS-LCX	-0.118	0.558	0.888	0.598	1.321
TLS-RCA	0.218	0.232	1.244	0.870	1.779
Constant	7.952	0.431	2840.81		

R2= 0.52, Chi-square test for model coefficient =43.97, ***p-value is significant**

DISCUSSION

Speckle tracking echocardiography (STE) is a widely available noninvasive tool that could easily and quickly provide additive information over basic echocardiography, since it is able to identify subtle myocardial damage and to localize ischemic territories in accordance to the coronary lesions [3].

The study population was 90 consecutive patients with suspected NSTE-ACS with apparent normal LV global and regional functions. Included patients were divided into two groups according to angiographic data; Group (A) 72 patients with significant CAD and group (B) 18 patients with no significant CAD. This study aimed to discover a better management of patient with suspected NSTE-ACS and to determine the role of longitudinal strain as assessed by speckle -tracking, and also to correlate the results of longitudinal strain with the results of coronary angiography.

In our study, there was no statistically significant difference between both studied groups as regard age, sex, hypertension, current smoking, dyslipidemia, DM and family history. Our study shows that there was statistically significant difference in cardiac enzymes in relation to CAD where troponin and CKMB were statistically higher among patients with CAD than patients without CAD. This disagrees with **Keddeas *et al.***[9] who revealed no significant difference regarding CK-MB level in patients with NSTEMI, which may be due to the relatively small sample size in their study**.**

Our study shows that there was highly statistically significant difference in GRACE score where it was statistically higher among patients with CAD than patients without CAD, In concordance with **Chen *et al.***[10] who found that in patients with NSTEMI, the GRACE risk model was still robust in predicting all-cause mortality and was performed reasonably well in predicting triple endpoints. Also our results agreed by **Atici *et al.***[11] who revealed hsTnT median (range) values for the CAD and control groups were 850 (303–2820) pq/mL and 215 (70–982) pq/mL (P = 0.001), respectively, and GRACE risk mean ± SD scores were 107.00 ± 11.99 and 100.33 ± 11.92 (P = 0.005), respectively; these values were significantly higher in the CAD patients group than control group.

In our study, regarding conventional echocardiographic data, there was no statistically different difference in LVED volume, LVES volume, LVEF, WMSI, E\A ratio and E\e` among the studied patients. This agrees with **Atici *et al.***[11] who reported no statistical difference between groups with regard to conventional echocardiographic parameters, such as LV mass, EDD (end-diastolic diameter), ESD (end-systolic diameter), EF, and EDV, as well as SV (stroke volume), E-wave, A-wave, and E/A ratio.

In our study there was highly statistically difference regarding Global longitudinal strain. In concordance with **Keddeas *et al.***[9] who found that NSTEMI patients with acute occlusion had significantly lower global longitudinal strain (p value < 0.007), 60% of them had reduced GLS (less negative than 16%) and number of LV segments with reduced strain (functional risk area by strain) was significantly higher in these patients compared to those who didn't have acute coronary occlusion.

The present study shows that there was highly statistically difference regarding territorial longitudinal strain in LAD, LCX and RCA in relation to CAD. This is in concordance with **Atici *et al.***[11] who revealed that GLS and TLS assessments demonstrated a statistically significant difference between CAD and control groups, with GLS values of 16.27 ± 1.91 and −18.74 ± 1.93 (P < 0.001), TLS-LAD values of −15.67 ± 1.83 and −18.54 ± 1.97 (P < 0.001), TLS-RCA values of −17.04 ± 1.81 and −19.20 ± 1.86 (P < 0.001), and TLS-Cx values of −17.40 ± 2.08 and −18.34 ± 2.18 (P = 0.028), respectively.

In our study there was a highly statistically significant difference between the different groups as regard TLS LCX and TLS LAD, which all were found to be significantly higher among patients with proximal lesions compared to those without lesions and those with non-proximal lesions and there was no significant difference between the different groups as regarding TLS RCA. **Magdy *et al.*** [12] studied the relationship of PSLS (Peak systolic longitudinal strain) and PSSR (Post systolic strain rate) and the site of stenosis in LAD, and found that patient with proximal LAD stenosis had a significantly lower PSLS and PSSR when compared to those with mid and distal LAD lesions, however there was no significant difference in PSLS and PSSR when patients with mid lesions compared to distal LAD lesions. ROC curve of PSLS and PSSR demonstrated a high diagnostic accuracy (AUC of 0.88 and 0.83 respectively) to detect resting regional ischemia using a cutoff value of −13.69% for PSLS with a high sensitivity 93.3% and a specificity of 80%.

Regarding multivariate analysis of our clinical data, cardiac enzymes and echo finding in diagnosis of CAD, the best fitting logistic regression model displayed that male sex, systolic hypertension, GRACE score, and GLS were statistically significant independent predictors of CAD. A logistic regression was performed to ascertain the effects of HTN, DM, obesity, smoking, male gender, age, family history, GRACE score and longitudinal strain on the likelihood that participants have CAD. This is in concordance with **Atici *et al.***[11] who found that their best logistic regression model displays GLS that detected subtle changes in LV myocardial function, was better than a conventional echocardiography and GRACE score.

Regarding the limitations of this study, many individuals were excluded owing to logistical issues such as unwillingness to undergo CA or invasive procedures, and many people refused to attend hospitals because of the COVID epidemic. The results were obtained from a single medical center. Also, the number of patients was relatively small. Like all echocardiographic methods, myocardial deformation imaging is dependent on image quality. As all patients were in sinus rhythm, no conclusion could be drawn on patients with atrial fibrillation or other arrhythmias. The aim of our study was not to compare between stress imaging modalities and strain echocardiography but to determine the impact of strain analysis in patient with suspected NSTE-ACS. Further studies may pick up this topic and compare strain parameter against stress echocardiography, MRI, SPECT or CT. Moreover, we did not study strain rate, post systolic strain or post systolic strain index in our patients, which need further studies as they may help in detection of coronary artery occlusion. Also we didn`t study circumferential strain, which help in detection of total coronary occlusion. The use of angiographic data alone as the guidance value may disregard coronary events in patients without significant stenosis. Microvascular maintenance between coronary arteries may result in inaccurate strict regional analysis due to this dual perfusion. Myocardial strain often remain depressed in patients with former myocardial infarctions, even after successful revascularization, so ruling out new coronary artery stenosis may be more challenging in this population.

CONCLUSIONS

2D GLS and TLS can be considered as a part of routine echocardiography in evaluation of NSTEMI patients, and it is a promising, easy to perform, quick imaging and noninvasive method to predict CAD in patients with NSTE-ACS for early detection of the presence of coronary artery occlusion to identify patients who may benefit from early reperfusion. According to our findings, A cutoff value of GLS -17.1, TLS-LAD cutoff level >-17.15, TLS-LCX cutoff level >-16.9 and TLS-RCA cutoff level >-16.3. GLS as a predictor for the number of affected vessels, cutoff point of ≥ -15.4 can be used. A predictor for the presence of proximal lesion, cutoff point of TLS LAD ≥ -15.1 and TLS LCX ≥-15.3 can be used.

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