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Value of Two-Dimensional Strain Imaging in Prediction of Myocardial Function Recovery After Percutaneous Revascularization of Infarct-Related Artery

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ABSTRACT

Background: Acute myocardial infarction (MI) is often accompanied by impaired regional myocardial systolic function. A novel approach known as two-dimensional speckle tracking echocardiography was used to quantify regional LV function.

Objective: The aim of the current study was to evaluate of the role of Speckle Tracking Echocardiography in prediction of left ventricular function recovery after percutaneous coronary intervention to left anterior descending coronary artery in patients with anterior ST segment elevation myocardial infarction with impaired left ventricular ejection fraction.

Patients and methods: This study included 50 patients and 15 normal control adult persons. Patients had suffered from first attack of anterior STEMI. They were admitted at the CCU units of Al-Azhar University Hospitals from September 2016 to September 2018 and treated with thrombolytic therapy. Each patient was subjected to conventional transthoracic echocardiography before hospital discharge and before reperfusion. Speckle tracking echocardiography and resting SPECT were done one week after MI. Percutaneous coronary intervention to LAD within one week after MI for patients with demonstrated myocardial viability by resting SPECT. Three months after percutaneous revascularization to LAD, all patients were reevaluated using conventional TTE and strain imaging. The studied population were divided into 2 Groups; group A: 24 patients who showed post-PCI LV function recovery and Group B: 26 patients who did not showed post-PCI LV function recovery.

Results: There was statistically significant increase in the prevalence of diabetes mellitus, smoking and dyslipidemia in group B. There was high statistically significant difference between the two groups as regard baseline LVEF (%), baseline wall motion score index (WMSI), mean baseline and follow up WMSI values, baseline number of affected left anterior descending (LAD) segments as assessed by WMSI, baseline and 90 days follow up mean number of affected LAD segments, baseline strain values at both global LV and territorial LAD segments. Control group showed mean territorial LAD strain was - 20.41± 0.61, mean baseline territorial LAD strain of group (A) - 13.20 ± 2.05 and mean baseline territorial LAD strain of group (B) - 8.47 ± 2.12. Regarding mean baseline territorial LAD strain and mean GLS of the LV, Receiver Operating Characteristic curve was done between group A and B for obtaining a cut off value of – 11.3 % and – 11.8 % respectively.

Conclusion: LV global and territorial strain measured by 2D STE is a good predictor of LV function recovery in STEMI patients after percutaneous revascularization of infarct–related artery.

Keyword: Acute myocardial infarction, percutaneous revascularization, Speckle tracking echocardiography

INTRODUCTION

There are currently two ways to assess myocardial deformation by echocardiography: tissue Doppler imaging (TDI) and speckle-tracking Echocardiography (STE). The latter is not based on Doppler analysis but on the following of bright points via gray scale analysis [1]**.** Speckle-tracking echocardiography is a noninvasive ultrasound imaging technique that allows for an objective and quantitative evaluation of global and regional myocardial function independently from the angle of insonation and from cardiac translational movements [2]. Two-dimensional speckle tracking can also be used for the assessment of coronary artery disease during dobutamine stress echo [3]. Automated function imaging (AFI) is clinically applicable and an effective means of assessing LV function due to its short acquisition time, feasibility and accuracy, whatever the experience of the operator [4]**.** By measuring deformation derived from tissue Doppler velocity, strain imaging had largely overcome these limitations. However, the routine clinical use of these measurements is constrained by problems that are inherent in the use of Doppler, that relate to signal noise and angle dependency [5]**.** Speckle-tracking analysis with automated function imaging (AFI) has been introduced as a reliable echocardiographic technique to assess global LV longitudinal strain [4]**.** Angle dependency is not a problem with 2- dimensional speckle tracking echocardiography (STE), but this technique is dependent on image quality and operates at limited frame rate [6]. Single photon emission computed tomography myocardial perfusion imaging is a powerful modality for the assessment of coronary artery disease, prognostication of CAD and the determination of viability. It acts as a guide for

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therapy and has the ability to assess effectiveness of therapy. The use of SPECT myocardial perfusion imaging has also been shown to be cost-effective compared to other modalities in cardiology [7].

The aim of the current study was to evaluate of the role of Speckle Tracking Echocardiography in prediction of left ventricular function recovery after percutaneous coronary intervention to left anterior descending coronary artery in patients with anterior ST segment elevation myocardial infarction with impaired left ventricular ejection fraction.

PATIENTS AND METHODS

This study included a total of 50 patients suffering from first attack of anterior STEMI and 15 normal volunteers served as controls, attending at CCU unit, Al-Azhar University Hospitals.

Approval of the ethical committee and a written informed consent from all the subjects were obtained. This study was conducted between September 2016 to September 2018.

The patients were treated with thrombolytic therapy after exclusion of the contraindications for its use.

Inclusion criteria: Patients with anterior STEMI, treated with thrombolytic therapy and with impaired LV ejection fraction (45% or less).

All patients showed single vessel disease i.e. left anterior descending (LAD) artery; amenable for percutaneous coronary intervention (PCI). Demonstrated myocardial viability using myocardial perfusion scan and single-photon emission computed tomography Gated - SPECT studies.

Exclusion criteria: Refusal of the patient to participate in the study. Patients with bad echo window or when complete echo study could not be completed. Patients who could not be followed for recommended period. Patients with significant arrhythmias as atrial fibrillation (AF) or frequent PVCs interfere with STE analysis. Patients with significant valvular disease. Patients with significant lesions in coronary vessels other than LAD. Patients developed acute coronary syndrome after PCI. Each patient underwent the following: Complete history taking: as regard risk factors, previous MI, Heart failure symptoms and Drug history**.** Clinical examination: General examination: Pulse, Blood pressure, Neck veins, Lower limb edema, and abdominal examination. Cardiac examination for: Signs of cardiac decompensation. Presence of any complications of MI. Abdominal pulsations. laboratory investigations: Serum cholesterol, triglycerides, LDL and HDL. Fasting and post prandial blood glucose levels. Renal functions. Resting 12- lead ECG was done to all patients for: ST – T segment changes and significant arrhythmias. Conventional Transthoracic Echocardiography (TTE): A Philips IE 33 phased array system equipped with STE technology was used . All the patients were examined in the left lateral decubitus position. Echocardiographic images were acquired from the standard views (parasternal long-axis, apical four – chamber, apical long axis and apical two- chamber views). Recordings and different measurements were obtained according to the guidelines of ASE [8]. and include the following: recordings and calculations of different cardiac chambers dimensions. LV systolic function: by calculating ejection fraction (EF) using: A) - M-mode method B) 2-D Simpson biplane method. Color flow Doppler was recorded from parasternal, apical four chambers and apical long axis views for assessment of valvular heart disease. Regional wall motion was assessed according to the standard 17-segment model. Wall motion score (WMS) had been evaluated by two independent operators. Visual analysis of the contractile function of all the 17 segments was interpreted according to the American Society of Echocardiography criteria using a four-point score: (1) normal; (2) hypokinetic; (3) akinetic; or (4) dyskinetic. Wall motion score index was calculated as WMS/ 17 [9]. LAD territory included seven segments; basal anterior, basal anteroseptal, mid-anterior, mid-anteroseptal, apical anterior, apical septal, and apex (apical cap) [10]. (Figure 1)

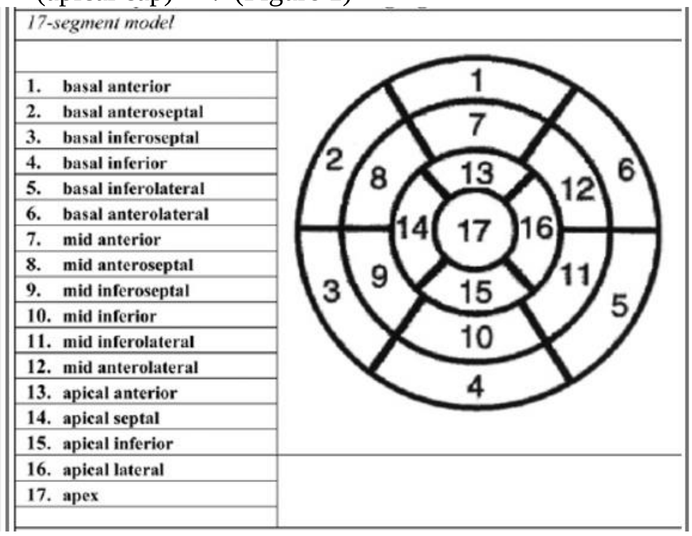

Figure (1): Standard segmental myocardial display for semi quantitative visual) analysis in a 17-segment model [11]**.**

Conventional Echocardiographic study was done during admission before reperfusion and also 3 months after PCI [12]. Speckle Tracking Echocardiography (STE): Two dimensional global and segmental strain and strain rate according to recommendations of ASE using automated function imaging (AFI) was used to assess segmental and global LV [4]. This was done with conventional Echocardiography and 3 months after PCI [13]. The following steps were followed: Acquiring APLAX, A4-C, and A2-C views. Marking the aortic valve closure timing, and then anchors 3 points inside the myocardial tissue. Offline processing using the three-click method that minimizes variability potentially created in a manual tracing process. Two points placed at the base along the mitral valve annulus, and one at the apex, trigger the automated process. Mean frame rate of the obtained images was 70 (40–100) frames/second. The AFI algorithm tracks the percent of wall lengthening and shortening in a set of three longitudinal 2D image planes (apical long, two chambers and four chambers) and displays the results for each plane. It then combines the results of all three planes in a single bull's-eye summary (agreeing with the standard 17-segment model), which presents the analysis for each segment along with a global peak systolic value for the LV [4] (Figure 2).

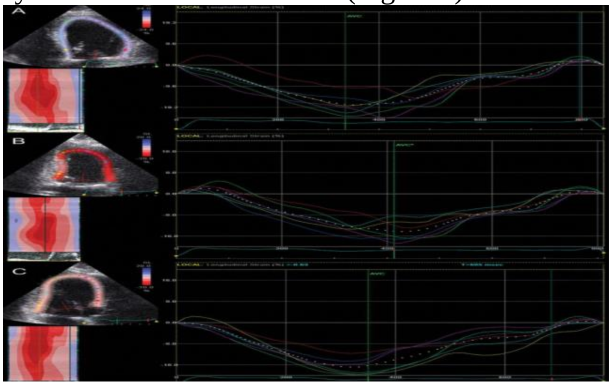

Figure (2): Assessment of LV global and segmental longitudinal strain by 2D speckle-tracking analysis in apical 4 (A), apical 2 (B) and apical 3 (C) chamber views [14]

Myocardial perfusion scan: Resting myocardial SPECT imaging with technetium-99m tetrofosmin (500 MBq, injected at rest) was performed using a triple-head SPECT camera system (GCA 9300/HG, Toshiba Corp) equipped with low-energy– high resolution collimators. Around the 140-KeV energy peak of technetium-99m tetrofosmin, a 20% window was used. A total of 90 projections (step and shoot mode, 35 seconds per projection; imaging time, 23 minutes) were obtained over a 360° circular orbit. Data were stored in 64x64 matrix. This was performed one week after MI to detect viability on **LAD** territories [15]. Revascularization: All patients underwent percutaneous coronary intervention to LAD within one week after MI for patients with demonstrated myocardial viability [16]. Follow-up: All the patients during the 90 days follow-up period were on optimal medical treatment in the form of double antiplatelets, statins, B-blockers and ACEI . Three months after percutaneous revascularization to LAD , all patients were re-evaluated for clinical findings, MACE and assessment of global and segmental functions using conventional TTE and strain imaging [13]. Post-PCI LV functional recovery is defined as: improvement of LVEF % by ≥ 5% [17].

According to the occurrence of LV functional recovery, the studied population were divided in to 2 groups; Group A: included 24 patients who showed post-PCI LV function recovery, while Group B: included 26 patients who did not show post-PCI LV function recovery. Control group: included 15 normal adult persons that were studied to get also their mean LAD segmental strain by STE, to determine the difference of the mean LAD segmental strain from the baseline mean LAD segmental strain of group A and group B. Subjects were accepted as normal if they did not have a history of cardiac or pulmonary disease and if they had a normal physical examination, electrocardiogram, and echocardiography.

Statistical analysis*:* Statistical presentation and analysis of the present study was conducted, using the mean, standard Deviation, unpaired student t-test, paired t-test, analysis of variance [ANOVA] test, chi-square, Tukey test and ROC-curve tests by Statistical Package For The Social Sciences (SPSS V20). The data had been expressed as mean ± SD, and categorical variables as percentages. The optimal cutoff points were determined by receiver operating characteristic (ROC) curves, and the sensitivity and specificity was determined according to: **Sensitivity** = true positives/ (true positives + false negatives) x 100%**.** **Specificity** = true negatives/ (true negatives + false positives) x 100%**. Positive predictive value** (PPV) = true positives/(true positives + false positives) x 100%, **Negative predictive value** (NPV) = true negatives/(true negatives + false negatives) x 100%. **Accuracy**: the ratio of the true positive and true negative on all patients. Continuous variables was compared by using unpaired t-test For numerical data between both groups , paired t-test for the same group and Chi – square test was used for categorical data . **Analysis of variance [ANOVA] tests**: According to the computer program SPSS for Windows. ANOVA test was used for comparison among different times in the same group in quantitative data**. The Tukey Test (or Tukey procedure),** also called Tukey's Honest Significant Difference test, is a post-hoc test based on the student zed range distribution. An ANOVA test can tell you if your results are significant overall, but it will not tell you exactly where those differences lie. After you have run an ANOVA and found significant results, then you can run Tukey's HSD to find out which specific group's means (compared with each other) are different. The test compares all possible pairs of means. **Significant statistical results** was considered if P value <0.05. **Highly significant results** were considered if P value < 0.01**.**

RESULT

Demographic characteristics and risk factors in the control and patients groups: In group A: the mean age was 51.62 ± 5.55 years ranging from 42 to 61 years. In group B: the mean age was 52.92 ± 5.42 years ranging from 43 to 62 years. The mean age for the whole study patients (group A and B) was 52.3 ± 5.47 years. In the control group: the mean age = 49.06 ± 7.015 years, ranging from 41–62 years . As regard the demographic criteria and the risk factors, there was statistically significant difference between group A and B as regard DM, dyslipidemia and smoking, but no statistically significant difference as regard age, gender, hypertension and family history of CAD (table 1).

Table (1): Comparison between group A and B as regard demographic criteria and risk factors

Variants		Group A (24 patients)	Group B (26 patients)	P value
Age (years)	Mean	51.62	52.92	0.729
	SD	5.55	5.42	
Gender	Male	15 (62.5 %)	19 (73.1 %)	0.423
	Female	9 (37.5 %)	7 (26.9 %)	
DM	Diabetic	5 (20.8 %)	13 (50 %)	0.032
	Not diabetic	19 (79.2 %)	13 (50 %)	
HTN	Hypertensive	10 (41.7 %)	12 (46.2 %)	0.749
	Not hypertensive	14 (58.3 %)	14 (53 .8 %)	
Dyslipidemia	Dyslipidemic	5 (20.8 %)	13 (50 %)	0.032
	Not dyslipidemic	19 (79.2 %)	13 (50 %)	
Smoking	Smoker	6 (25 %)	15 (57.7 %)	0.019
	Not smoker	18 (75 %)	11 (42.3 %)	
FH of CAD	Positive	8 (33.3 %)	8 (30.8 %)	0.846
	Negative	16 (66.7 %)	18 (69.2 %)	

SD: standard deviation, **DM** : diabetes mellitus, **HTN** : hypertension, **FH** : family history, **CAD** : coronary artery disease.

Echocardiographic characteristics: There was statistically significant difference between group A and B as regarding LVEF% (pre and post), WMSI (pre and post), Number of affected LAD segments (pre and post), LAD strain by STE (pre and post) and GLS of LV by STE (pre and post), but no statistically significant difference concerning LVEDD (pre and post) and LVESD (pre and post) (table 2).

Table (2) *: showing comparison between group A and B regarding the Echocardiographic characteristics*

Variable	***Group A***	***Group B***	***P value***
LVEDD (pre)	*55.04 ± 2.65*	*56.31 ± 2.93*	*0.115*
LVEDD (post)	*54.75 ± 3.31*	*56.42 ± 2.82*	*0.083*
LVESD (pre)	*43.73 ± 1.81*	*44.37 ± 2.25*	*0.275*
LVESD (post)	*42.47 ± 2.86*	*44.21 ± 3.32*	*0.056*
LVEF % (pre)	*41.21 ± 1.32*	*32.12 ± 2.52*	*< 0.001*
LVEF % (post)	*49.08 ± 1.06*	*33.92 ± 2.26*	*< 0.001*
WMSI (pre)	*1.65 ± 0.15*	*1.9 ± 0.14*	*< 0.001*
WMSI (post)	*1.32 ± 0.11*	*1.87 ±0.12*	*< 0.001*
Number of affected LAD segments (pre)	*4.21 ± 0.51*	*6.12 ± 0.50*	*< 0.001*
Number of affected LAD segments (post)	*2.38 ± 0.49*	*5.97 ± 0.51*	*< 0.001*
LAD strain by STE (pre)	*- 13.20 ± 2.05*	*8.47 ± 2.12-*	*< 0.001*
LAD strain by STE (post)	*14.61 ± 2.41-*	*- 8.61 ± 2.12*	*< 0.001*
GLS of LV by STE (pre)	*13.19 ± 2.18*	*8.80 ± 1.96*	*< 0.001*
GLS of LV by STE (post)	*14.59 ± 2.56*	*8 .97 ± 1.99*	*< 0.001*

LVEDD : left ventricular end-diastolic diameter, **LVESD** : left ventricular end-systolic diameter, **LVEF** : left ventricular ejection fraction, **WMSI** : wall motion score index, **LAD** : left anterior descending artery, **STE** : speckle tracking Echocardiography, **Pre** : baseline assessment during admission, **Post** : follow up assessment after 90 days.

Comparison between the mean territorial LAD strain measured by 2D STE for the control group and baseline mean territorial LAD strain measured by 2D STE for group A and B : The mean territorial LAD strain measured by 2 D STE for the control group was - 20.4 ± 0.62. The mean baseline territorial LAD strain measured by 2 D STE for the group A was - 13.20 ± 2.05 . The mean baseline territorial LAD strain measured by 2 D STE for the group B was - 8.47 ± 2.12 and the difference between the control group and group A was 35.29 % but the difference between the control group and group B was 58.48 %. So, the more shift from the normal values of the mean territorial LAD strain measured by 2 D STE , the less likely for LVEF to recover after revascularization (table 3).

Table (3) : showing Comparison between the mean territorial LAD strain measured by 2 D STE for the control group and baseline mean territorial LAD strain measured by 2 D STE for group A and B

	LAD pre			**ANOVA**	
	Range	Mean ± SD	%	f	P-value
Control	-19.5 - -21.5	- 20.4 ± 0.62		196.430	<0.001**
Group A	-8.9 - -15.4	-13.20 ± 2.05	35.29		
Group B	-5.5 - -13.5	- 8.47 ± 2.12	58.48		

Tukey's test		
Group A and Group B	Group A and Control	Group B and Control
<0.001**	<0.001**	<0.001**

Receiver Operating Characteristic (ROC) curve between group A and group B concerning mean territorial LAD strain measured by 2 D STE : Regarding mean baseline territorial LAD strain measured by 2 D STE , Receiver Operating Characteristic (ROC) curve was used for obtaining a cut off value of – 11.3 % (with sensitivity = 84.6 % , specificity = 83.3 % , PPV = 84.6 % and NPV = 83.3 and accuracy = 85.0) for prediction of LV function recovery after revascularization (table 4) and (figures 3 and 4).

Table (4): showing the cutoff value of mean territorial LAD strain measured by 2 D STE, predicting post- PCI LV function recovery, obtained by the Receiver Operating Characteristic (ROC) curve

ROC curve between group A and group B as regard LAD					
Cut off	**Sens.**	**Spec.**	**PPV**	**NPV**	**Accuracy**
< - 11.3 %	**84.6**	**83.3**	**84.6**	**83.3**	**85.0**

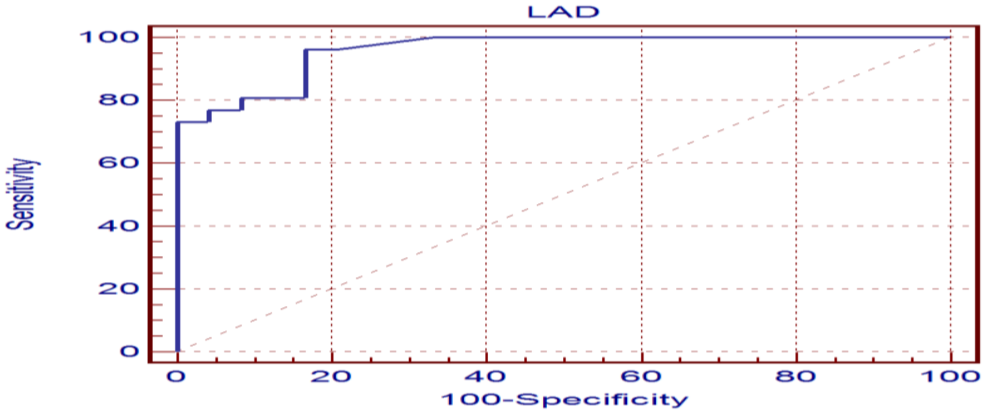

Figure (3): diagram showing the Receiver Operating Characteristic (ROC) curve plotted for obtaining the cutoff value of mean territorial LAD strain measured by 2 D STE ,predictin0g post- PCI LV function recovery.

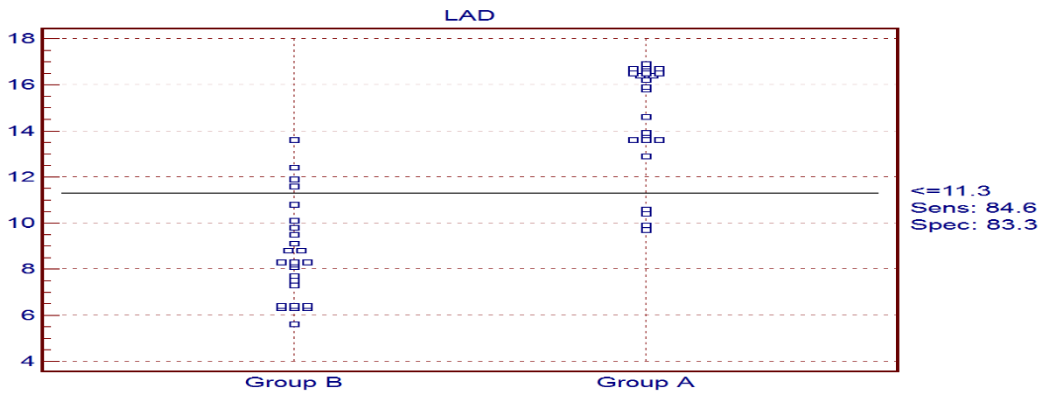

Figure (4): diagram showing the cutoff value of mean territorial LAD strain measured by 2 D STE, predicting post- PCI LV function recovery with its sensitivity and specificity, obtained by the Receiver Operating Characteristic (ROC) curve.

Receiver Operating Characteristic(ROC) curve between group A and group B as regards mean GLS of the LV measured by 2 D STE: Regarding mean GLS of the LV measured by 2 D STE , Receiver Operating Characteristic (ROC) curve was used for obtaining a cut off value of – 11.8 % (with sensitivity = 88.5 % , specificity = 83.3 % , PPV = 85.2 % and NPV = 87.0 and accuracy = 86.0) for prediction of LV function recovery after revascularization (table 5) and (figures 5 and 6).

Table (5): showing the cutoff value of mean GLS of the LV measured by 2 D STE, predicting post- PCI LV function recovery, obtained by the Receiver Operating Characteristic (ROC) curve.

ROC curve between group A and group B as regard LV					
Cut off	**Sens.**	**Spec.**	**PPV**	**NPV**	**Accuracy**
<- 11.8	**88.5**	**83.3**	**85.2**	**87.0**	**86.0**

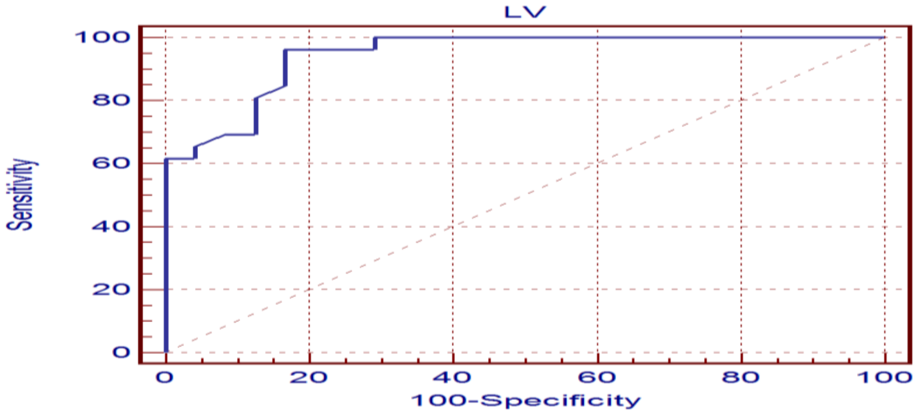

Figure (5): diagram showing the Receiver Operating Characteristic (ROC) curve plotted for obtaining the cutoff value of mean GLS of the LV measured by 2 D STE ,predicting post- PCI LV function recovery.

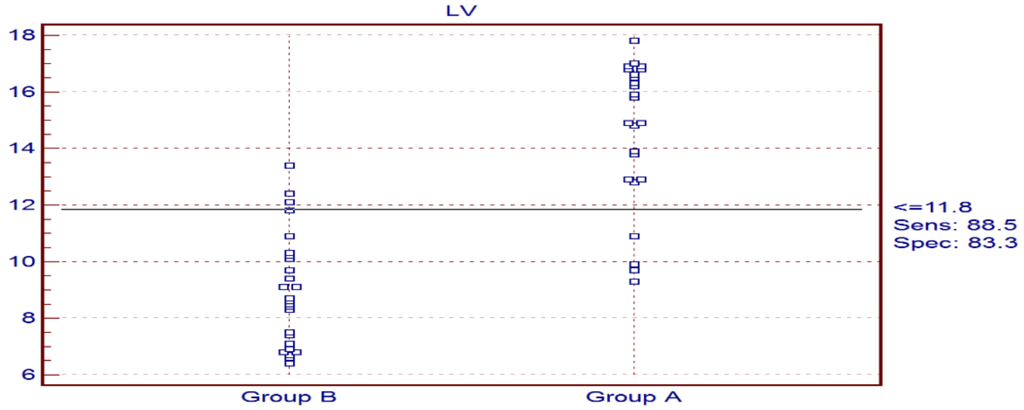

Figure (6) : diagram showing the cutoff value of mean GLS of the LV measured by 2 D STE, predicting post- PCI LV function recovery with its sensitivity and specificity, obtained by the Receiver Operating Characteristic (ROC) curve.

DISCUSSION

Speckle-tracking echocardiography is a reliable approach to quantify regional LV function from routine gray-scale 2D echocardiographic images, calculate myocardial strain, using an Automated Function Imaging (AFI), independent of angle of incidence[4]. There are currently 2 ways to assess myocardial deformation: tissue Doppler (TD) and a new method known as speckle-tracking (ST). The latter is not based on Doppler analysis but on the following of bright points via gray scale analysis [1].

Since the presence of substantially viable myocardium which is an important determinant of recovery of LV function after acute infarction. Quantitative assessment of LV myocardial viability after acute infarction may provide a valuable tool for prediction of functional recovery with improved clinical outcome. Echocardiographic analysis of myocardial deformation by speckle tracking has additional value in the assessment of myocardial viability [18]. The studied population were divided into 2 groups; Group A: (24 patients) included patients who showed post-PCI LV function recovery, while Group B: (26 patients) included patients who did not show post-PCI LV function recovery. Post-PCI LV functional recovery is defined as: improvement of LVEF % by ≥ 5% [17]. Control group included 15 normal adult persons was studied to get their mean LAD segmental strain by STE.

In the present study, we have found that the two groups were matched concerning age, gender, hypertension, and family history of ischemic heart disease and this was in accordance with **Andrea *et al.***[19] ,who studied 70 patients with non ST-segment elevation myocardial infarction underwent percutaneous coronary intervention and divided after 6 months into two groups according two LV remodeling.

In the present study, we have found that the prevalence of diabetes mellitus was significantly higher in the group II, which showed no recovery than group A and that was compatible with the findings of **Bochenek *et al.***[20], who studied 66 patients with first STEMI by TTE, STE, 3 D Echocardiography , followed them 3 months after primary PCI to detect myocardial recovery and LV remodeling. They found that the absence of diabetes was a predictor of myocardial recovery and that the presence of diabetes makes the prognosis worsen. Also this is in agreement with **Andrea *et al.*** [19] .

In the present study we found that there was no significant difference between group A and B concerning baseline LVEDD and LVESD. This is in agreement with **Shehata** [21], who studied 50 patients with anterior STEMI treated by thrombolytic then PCI to LAD. They divided the patients into 2 groups according to LV function recovery as in our study (≥ 5%) and reported that there was no statistically significant difference between the 2 groups as regards baseline LVEDD and LVESD. However, he used Dobutamine Echocardiography for assessment of viability and followed the patients for 4 months. In the present study : we found that there was significant difference between group A and B as regards baseline LVEF, LV global strain and territorial LAD strain. This also is in agreement with **Shehata** [21] **,** who reported that baseline LVEF, LV global strain and territorial LAD strain were significantly higher in group A than in group B.

In the present study we found that assessment of global and territorial LV strains using STE at baseline and after PCI to LAD in anterior STEMI patients was of a good value in prediction of LV function recovery . In group A: there was significantly higher baseline LVEF% and strain values at both global LV and territorial levels. So higher strain values recorded basically before PCI could help predict post-PCI LV function recovery. Although higher baseline LVEF%, was still a powerful predictor but STE was more accurate because LVEF is influenced by loading conditions, does not correlate well with symptom status and the ability of LVEF to detect subtle changes in myocardial function is low. In patients with extensive myocardial infarction, the presence of regional hyperkinesis may result in almost normal LVEF, thereby affecting the prognostic value of this parameter. The relatively small number of patients studied did not hinder obtaining significant differences concerning strain values. Also analyzed data from the current study aided extraction of informative cutoff values for AFI -based strain, to predict post-PCI LV function recovery.

Our finding were compatible with the findings of **Aniyathodiyil *et al.*** [22] **,** who studied 50 patients with STEMI with conventional echocardiography and STE early during admission and at one month follow up after primary PCI. They concluded that in STEMI patients , STE-based GLS could be used to assess global and regional LV function, and it can be used in addition to the routinely used echocardiographic parameters such as LVEF, MPI, and WMSI.

It can also be used to predict short-term outcomes in patients with acute MI undergoing primary PCI and is a robust parameter to assess regional and global LV function and has shown to be better than LVEF and as good as WMSI and

MPI. These findings are similar to our study, but in our study we concluded a cutoff value for prediction of LV function recovery and we used longer follow up periods for more accurate results. Longer follow-up period in our study aimed at achieving more tissue recovery after possible stunning or hibernation for proper assessment of LV function recovery **Mollema *et al.*** [17]**,** also studied 147 patients with acute myocardial infarction, who underwent primary PCI and global LV strain using AFI technique. They were assessed within 48 hours of admission (at baseline). Viability index was assessed with SPECT study within two months of acute myocardial infarction. At 1-year follow-up, echocardiography was repeated.

This study reported that higher baseline global longitudinal LV strain after acute MI, was significantly associated with LV function recovery after 1-year follow up period. **Szymczyk *et al.*** *using* a longer period of follow up and only global LV strain**,** found that longitudinal strain can predict long term myocardial recovery [18] and this was compatible to our findings. Moreover, our findings were correlated with the findings of **Sodiqur *et al.*** [23], who studied patients with CAD, who underwent elective PCI . Echocardiographic measurements of LV function by EF as well as by 2D speckle tracking to assess global longitudinal strain were performed in all patients within 24 hours pre- and post-PCI procedure.

The LV global longitudinal peak strain was calculated from 18 segments measurement. It was concluded that recovery of left ventricular function could be detected early post-revascularization of coronary artery disease by either ejection fraction or global longitudinal strain measurements. However, the latter is more accurate but no follow up in this study. In addition, our findings were compatible with the findings of **Shehata** [21]**,** who reported that higher baseline LVEF and strain values were associated with post PCI LV function recovery.

As regards the ability of baseline LVEF for prediction of LV function recovery after revascularization : our findings were correlated with the findings of **Bochenek *et al.*** [20] , who found that the lower the EF, the worse was the outcome in a study included 66 patients with STEMI and were followed for 3 months period. As regards the cutoff value for prediction of LV function recovery after revascularization, in the present study we concluded the cutoff value for both global LV strain and segmental LAD territories strain for prediction of LV function recovery after revascularization was - 11.8 % For LV GLS with sensitivity of 88% and specificity of 83 % and - 11.3 % for LAD with sensitivity of 84 % and specificity of 83.3 % . This is in agreement with [17]**,** who used LV GLS for prediction of LV function recovery after revascularization and reported a cutoff value for only LV GLS (- 13.7 %) which is higher than that in our study but with slightly lower sensitivity (86 %) and specificity (74%) values among a larger number of STEMI patients (147) and for a longer follow up period (one year). Moreover **Andrea *et al.*** [19] **,** concluded that longitudinal LV global and regional speckle-tracking strain measurements were powerful independent predictors of LV remodeling and LV function recovery after reperfusion therapy. However, they studied NSTEMI patients not anterior STEMI patients as in our study.

As regards territorial LAD strain : in our study we concluded that territorial LAD strain was a powerful independent predictors of LV function recovery after reperfusion therapy and higher baseline LAD strain values were significantly associated with LV function recovery after 90 days follow up period besides we concluded a cutoff value for territorial LAD strain that can predict LV function recovery after revascuarization (-11.3 %) with sensitivity = 84 % and specificity = 83.3 %). This was in agreement with **Shehata** [21], who also reported a cutoff value for territorial LAD strain that was - 6.5 % at peak dose of dobutamine with sensitivity = 84 % and specificity = 75 %) for prediction of LV function recovery after revascularization. But he used dobutamine Echocardiography instead of SPECT study for assessment of viability before PCI to LAD.

Regarding prediction of viability by strain imaging **Bansal *et al.***[24] , reported that strain imaging by Color-coded Doppler tissue imaging could predict viability in both anterior and posterior circulations, while speckle tracking-based 2D strain measurements could predict viability only in the anterior circulation. However, strain imaging by Color-coded Doppler tissue imaging has many limitation as angle dependency and cannot differentiate between active and passive segmental contractility.

In our study, we used only 2 D STE for strain measurement, which was more accurate and for only anterior STEMI patients. Also **Park *et al.*** [25] **,** pionted to the value of strain imaging in predicting LV function recovery after acute MI . He studied 24 acute anterior STEMI patients with Colour- coded Doppler tissue imaging one day after PCI and after 6 weeks. They concluded that strain imaging has a good value in predicting myocardial viability. This is in agreement with our study, but in our study, we used STE which is more accurate than TDI that had many limitations.

In addition, we used longer follow up period for more accurate results. In our study, we found that both LVEF and LV GLS were strong predictors of LV function recovery in anterior STEMI patients but **Delgado *et al.*** [26]**,** showed the relation between LV GLS by AFI and LVEF by Simpson method in acute STEMI. They studied 222 patients with CAD including 99 acute STEMI patients and reported that global left ventricular longitudinal strain assessed with AFI is linearly related to biplane LVEF. But in acute STEMI patients , a less strong correlation between them was observed, suggesting that these 2 parameters reflect different aspects of left ventricular systolic function that GLS is more accurate than LVEF by Simpson method because in patients with extensive myocardial infarction, the presence of regional hyperkinesis may result in almost normal LVEF. Thereby affecting the prognostic value of this parameter. A follow-up period was not also included in this study protocol.

CONCLUSION

It could be concluded that LV global and territorial strain measured by 2D STE has a good value in prediction of LV function recovery Therefore, baseline global and territorial LV strains, measured using STE, might serve as a marker of residual myocardial viability after infarction.

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