Role of 2d Speckled Tracking Echocardiography in Assessment of in Hospital and One Year Outcome of Patients with Acute Myocardial Infarction Versus Chronic Coronary Artery Disease

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Abstract

Two-dimensional speckle strain (2D STE) echocardiography can aid in the prognosis of acute myocardial infarction (AMI) and chronic coronary artery disease (CAD). the aim of the present study was to determine the possibility of using of two-dimensional speckle tracking echocardiography to predict cardiac events comparing of patients with acute myocardial infarction versus chronic coronary artery disease. this was a prospective study includes two hundred patients (20-70 years old) in two groups were selected from national heart institute and El Sahel hospitals first group one hundred of patients with a diagnosis of first attack of acute myocardial infarction (STEMI or NSTEMI) and the other group one hundred of patients with known chronic CAD who presented for clinical checkup at the outpatient department . The duration of the study ranged from 6-12 months. as regard strain parameters in patients with first acute MI; there was high significant difference between cases with cardiac event and those without as regard GLS epi %, GLS total wall, % and GCS endo,%, also there was significant difference between cases with cardiac event and those without as regard GLS endo, (%),GCS epi,% and GCS total wall,%., and there was highly statistical difference between chronic coronary heart diseases cases with cardiac event and those without as regard conventional echocardiography and strain parameters. Global strain parameters by 2D STE may be useful for the prediction of cardiac events in patients with CAD but add no supplemental information to baseline characteristic and ejection fraction in patients with AMI.

Keywords: Acute Myocardial Infarction, Cardiac Event, Coronary Artery Disease, Echocardiography.

1. Introduction

Myocardial remodeling occurs prior to the development of cardiac disease; consequently, international guidelines have underlined the importance of detecting subclinical left ventricular (LV) dysfunction [1].

Furthermore, LV systolic function is recognized as a major predictor of outcome after acute myocardial infarction (AMI).2 As a result, echocardiography following AMI is implemented as a routine procedure for risk stratification. Frequently used measurements for echocardiographic quantification of global and regional LV systolic function include LV ejection fraction (LVEF) and wall motion score index (WMSI) [2] .

However, in recent years, more novel echocardiographic techniques, such as tissue Doppler imaging and 2-dimensional strain echocardiography (2D STE), have been shown to be superior to prognostic measures compared to the LVEF and WMSI [3] 2D STE has been recognized in a range of studies to provide important prognostic information in patients with coronary artery disease (CAD) 6,7 and AMI [4].

However, the majority of studies that have evaluated the usefulness of novel myocardial deformation measures in patients with CAD and AMI have mainly focused on the prognostic use of only global longitudinal deformation parameters and rarely evaluated layer specific data (endocardial and epicardial myocardium) [5] To date, it is still unclear whether there is a difference in the sensitivity or characteristics of 2D STE parameters for the prediction of prognosis in patients with AMI or CAD.

2. Subjects and methods

This prospective study includes two hundred patients (20-70 years old) in two groups had been selected from national heart institute and El Sahel hospitals first group one hundred of patients with a diagnosis of first attack of acute myocardial infarction (STEMI or NSTEMI) and the other group one hundred of patients with known chronic CAD who presented for clinical checkup at the outpatient department.

Inclusion criteria
First group

A diagnosis of acute myocardial infarction had been made on the basis of: Persistent chest discomfort or other symptoms suggestive of ischaemia. ST segment elevation in at least two contiguous leads as STEMI, in contrast patients without ST segment elevation may have ST or T wave changes. Elevation of creatine Kinase enzyme and its myocardial band (MB) fraction to more than twice the upper limit of normal and elevation of cardiac troponin values with at least one value above the 99th percentile upper reference limit with necrosis in a clinical setting consistent with myocardial ischaemia. AMI patients must be successfully revascularized in all perfusion beds.

Second group

Patients with known CAD who presented for clinical checkup at the outpatient department and underwent echocardiography during the same period and they were on optimal medical treatment for at least 3 months and coronary revascularized according to current guidelines [6] prior to being included in the study.

Exclusion criteria

In both groups, patients with relevant valvular heart disease were excluded. Because of the emergency valuation of the AMI group, we choose the following procedure: after providing information about the study process to the patient by the study physician, an

independent physician was asked to assess the patient by checking all inclusion and exclusion criteria. Only upon acceptance of the patient by the independent physician is the patient included in the study. After the procedure, the patient will be questioned again as to whether he or she is still willing to participate in the study after 48 hours and is able to revoke his or her consent indefinitely. All included patients provided written informed consent.

Method

All the patients will be subjected to:

1- **History taking:** A careful history had been taken from the patient especially the chest pain analysis and the associated symptoms, past history of any chronic diseases, ex: diabetes & hypertension any treatments the patient receive and whether the patient smokes or not.

2- **General examination:** Including the examination of head and face, skin, extremities, chest and abdominal examination, JVP, BP, Arterial pulse and temp.

3- **Local examination:** Including Inspection, palpation, percussion and auscultation **.**

4- **ECG:** The ECG had been done on admission and will be studied as follows: ST segment deviation from isoelectric line which had been defined as the level of the proceeding TP segment had been measured 80 ms after the J point to the nearest 0.5 mm.

5- **Lab findings:** Plasma levels of creatine kinase & creatine kinase –MB fraction will be assessed every 8 hours in the first 24 hours. -Troponin had been done on admission [1].

6- **Echocardiography:** Left ventricular parasternal short-axis views at basal, midventricular, and apical levels were acquired, as well as 2-, 3- and 4-chamber views. A 18-segment model with 6 segments at the basal, midventricular, and apical short-axis level was used to divide the LV. Wall motion was assessed by visual interpretation for each LV segment as normokinetic, mildly hypokinetic, severely hypokinetic, akinetic, or dyskinetic. WMSI was calculated for each patient as the average of the analyzed segmental values. LVEF and end-systolic and end-diastolic volumes were assessed by biplane Simpson's method using manual tracing of digital images. All measurements were performed in 3 consecutive heart beats and were averaged. In the AMI group, echocardiographic examinations were performed within 48 hours of coronary angiography. All segmental values were averaged to global data. All echocardiographic data were analyzed by 2 blinded experienced cardiologists. To avoid confusion, we expressed all strain data as absolute values

7- **Coronary angiography:** Using standard techniques, x-ray coronary angiography was performed. The severity of coronary stenosis was determined quantitatively using Philips softwere. All decisions on coronary interventions and subsequent clinical care were based on the discretion of the treating cardiologist. Finally coronary angiographic findings will be correlated with the ECG findings in both groups.

8- **Clinical follow-up:** Clinical follow-up was performed every 3 months for one year based on telephone contact.

Statistical analysis

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) **(Statistical Package for the Social Sciences)** software for analysis.

3. Results

Conventional echocardiographic parameters: -

There is no significant difference between the studied groups as regard LVESV; also there is no significant difference between the studied groups as regard LVEDV and EF. LVEDV: The Mean LVEDV was [110.7±11] lv for the CAD group and [109.4±24.04] lv for the AMI group, (P value =0.134). LVESV: The Mean LVESV was [41.8±5.6] lv for the CAD group and [40.3±9.6] lv for the AMI, (P value =0.314). EF (%): The Mean EF (%): was [67.56 ± 3.77] cm for the CAD group and [67.3 ± 3.34] cm for the AMI, (P value =0.801).

Strain parameters

There was no statistical significant difference between the two studied groups as regard strain parameters Table [1].

This table shows that there is high significant difference between cases with cardiac event and those without as regard LVEDV (lv) and EF%, also there is significant difference between cases with cardiac event and those without as regard LVESV (lv) Table [2].

This table shows that there is high significant difference between cases with cardiac event and those without as regard GLS epi,%, GLS total wall, % and GCS endo,%, also there is significant difference between cases with cardiac event and those without as regard GLS endo, (%),GCS epi,% and GCS total wall,%. Table [3].

This table shows that there is significant difference between cases with cardiac event and those without as regard LVEDV (lv), EF%, and LVESV (lv) Table [4].

Table (1) Comparison between the two studied groups as regard conventional echocardiography parameters.

Variable	AMI N=100	CAD N=100	T test	P value
LVEDV(lv)				
Mean ± SD	109.4±24.04	110.7±11	1.51	0.134
Range	35-159	60-130		

Table (1) Continue

LVESV(lv)				
Mean ± SD	40.3±9.6	41.8±5.6	1.15	0.314
Range	17.9-53	18-55		
EF (%)				
Mean ± SD	67.3 ± 3.34	67.56 ± 3.77	0.25	0.801
Range	60 – 73	59 – 73		

Table (2) Comparison between the two studied groups as regard tissue strain parameters.

Variable	**AMI** **N=100**	**CAD** **N=100**	**T test**	**P value**
GLS endo, (%)				
Mean ± SD	18 ± 6	17 ± 6	1.06	0.491
Range	5 – 30	4 –30		
GLS epi,%				
Mean ± SD	13 ± 4	12 ± 4	0.96	0.446
Range	4 – 24	4 – 25		
GLS total wall, %				
Mean ± SD	15 ± 4	14 ± 4	0.234	0.376
Range	6 –25	5 – 25		
GCS endo,%				
Mean ± SD	27 ± 7	25 ± 8	0.436	0.664
Range	12 – 42	8 – 42		
GCS epi,%				
Mean ± SD	15 ± 5	15 ± 4	1.39	0.167
Range	4 – 27	4 – 26		
GCS total wall,%				
Mean ± SD	20 ± 6	20 ± 5	1.16	0.245
Range	7-33	8-33		

Table (3) Conventional echocardiography parameters with and without cardiac event in patients with first acute myocardial infarction.

Variable	**No cardiac event** **N=75**	**Cardiac event** **N=25**	**T test**	**P value**
LVEDV(lv)				
Mean ± SD	115.4±22.04	110.7±11	4.51	<0.001
Range	65-159	35-133		(HS)
LVESV(lv)				
Mean ± SD	44.3±5.9	39.8±5.4	3.25	<0.041
Range	24-53	17.9-50		(S)
EF (%)				
Mean ± SD	69.3 ±4.39	64.51 ± 4.17	6.25	<0.001
Range	63 – 73	60 – 73		(HS)

Table (4) Strain parameters with and without cardiac event in patients with first acute myocardial infarction.

Variable	**No cardiac event** **N=75**	**Cardiac event** **N=25**	**T test**	**P value**
GLS endo, (%)				
Mean ± SD	19 ± 5	16 ± 4	3.06	0.031
Range	6 – 30	5 –30		(S)
GLS epi,%				
Mean ± SD	15 ± 3	11 ± 3	6.1	<0.001
Range	7 – 24	4 – 24		(HS)
GLS total wall, %				
Mean ± SD	16 ± 4	13 ± 3	0.234	<0.001
Range	8–25	6– 20		(HS)
GCS endo,%				

Table (4) Continue

Mean ± SD	28 ± 7	24 ± 7	0.436	<0.001
Range	16 – 42	12 – 40		(HS)
GCS epi,%:				
Mean ± SD	16 ± 3	14 ± 3	3.39	0.008
Range	7 – 27	4 – 25		(S)
GCS total wall,%				
Mean ± SD	21 ± 4	19 ± 4	2.11	0.021
Range	8-33	7-30		(S)

Table (5) Conventional echocardiography parameters with and without cardiac event in patients with Coronary artery disease.

Variable	No cardiac event N=60	Cardiac event N=40	T test	P value
LVEDV(lv)				
Mean ± SD	111.4±10.14	109.7±10	4.59	0.041
Range	70-130	60-120		(S)
LVESV(lv)				
Mean ± SD	42.3±5.1	39.8±5.6	3.15	0.046
Range	20-53	18-55		(S)
EF (%)				
Mean ± SD	69.3 ± 3.31	64.56 ± 3.71	5.15	0.009
Range	61 – 73	59 – 70		(S)

Table (6) Strain parameters with and without cardiac event in patients with Coronary artery disease.

Variable	No cardiac event N=60	Cardiac event N=40	T test	P value
GLS endo, (%)				
Mean ± SD	18 ± 4	15 ± 3	3.06	0.021
Range	6 – 30	4 –27		(S)
GLS epi,%				
Mean ± SD	13 ± 3	11 ± 3	2.96	0.046
Range	5 – 25	4 – 23		(S)
GLS total wall, %				
Mean ± SD	16 ± 3	11 ± 3	5.23	<0.001
Range	6 –24	5 – 22		(HS)
GCS endo,%				
Mean ± SD	27 ± 4	24 ± 4	3.43	0.041
Range	14 – 42	8 – 40		(S)
GCS epi,%				
Mean ± SD	17 ± 3	12 ± 2	4.49	<0.001
Range	7 – 26	4 – 22		(HS)
GCS total wall,%				
Mean ± SD	22 ± 4	18 ± 4	3.16	0.035
Range	12-33	8-30		(S)

4. Discussion

Recently, clinical studies have investigated the diagnostic value of 2D strain during DSE for inducible ischemia detection in patients with suspected CAD, with special emphasis on the myocardial longitudinal strain reserve (LSR) with speckle-tracking echo, defined as the reserve between peak stress and rest during DSE, which reflects the ability of the myocardium to improve its function during stress testing [7].

In the current study there is no significant difference between the studied groups as regard LVESV, also there is no significant difference between the studied groups as regard LVEDV and EF.

Our results were in agreement with study of [8] as they reported that there was no significant difference between the studied groups as regard EF.

However, J.Liszka [9] reported that there was significant difference between the studied groups as regard LVEDV, LVESV and EF.

The two dimensional-speckle tracking echocardiography (2D-STE) has been used to assess the global and regional myocardial functions of the left ventricle (LV), since it automatically recognizes two dimensional myocardial speckles to track the myocardial trajectory and quantitatively analyzes the longitudinal,

radial and circumferential myocardial strains of the left ventricle [10].

The present study showed that there was no statistically significant difference between the two studied groups as regard strain parameters (GCS & GLS).

Our results were supported by study of [11] as they reported that there was no statistically significant difference between the two studied groups as regard strain parameters GCS.

However, [12] revealed that there was a statistically significant difference between the study groups regarding stress GLS.

The current study showed that as regard patients with acute myocardial infarction, there is high significant difference between cases with cardiac event and those without as regard LVEDV (lv) and EF%, also there is significant difference between cases with cardiac event and those without as regard LVESV (lv). There is high significant difference between cases with cardiac event and those without as regard GLS epi,%, GLS total wall, % and GCS endo,%, also there is significant difference between cases with cardiac event and those without as regard GLS endo, (%),GCS epi,% and GCS total wall,%.

Our results were supported by study of [13] as they revealed that among the strain variables examined, GLS (P = 0.045) and GCS (P = 0.004) endocardial strain parameters showed the greatest differences in those with and without cardiac event AMI group.

Many domestic and international studies conducted by [14,15] have found that GLS could accurately detect the MIS (Myocardial infarction size) and had a higher diagnostic value than LVEF and WMSI [16] applied 3D-STE to evaluate the MIS and found that patients with a bigger MIS had lower values of 3D strain parameters. These studies also showed that GCS, GLS, GRS, WMSI (wall motion score index), and LVEF were all well correlated with the MIS detected by the magnetic resonance imaging (MRI).

In patients after AMI, the majority of studies have examined the prognostic value of GLS as a parameter of longitudinal deformation performance [3]. Similar to the AMI setting, 2D STE has also been recently utilized to provide prognostic information in CAD patients [17]. These studies never directly compared these 2 patient types.

[18] observed that after adjusting for potential confounders, midwall, endocardial, and epicardial GLS were significant predictors of fatal and nonfatal cardiovascular events.

[19] found that the averaged strain obtained in all LV segments (global longitudinal strain) is a reliable predictor of LVR (≥ 15% increase in LV EDV at 6 months after AMI) with a sensitivity of 84.8% and specificity of 87.8%. [20] related 4-chamber and 2-chamber global peak longitudinal strain and parasternal short-axis global circumferential strain to the LVR at 20-month follow-up. Although both types of strain were associated with clinical outcomes, only circumferential analysis was found to be predictive of LVR (≥ 15% increase in LV ESV assessed at 20-month follow-up)..

[21] reported that impaired LV torsion may help predict LVR assessed 6 months after the AMI and defined as ≥ 15% or ≥ 20% increase in LV EDV.

In the study in our hands, as regard patients with coronary artery disease, there is significant difference between cases with cardiac event and those without as regard LVEDV (lv), EF%, and LVESV (lv). There is high significant difference between cases with cardiac event and those without as regard GLS epi, % and GLS total wall, also there is significant difference between cases with cardiac event and those without as regard GLS endo, (%), GLS epi, %, GCS endo and GCS total wall, %.

Our results were supported by study of [13] as they reported that a more pronounced separation between patients with and without a cardiac event was observed in CAD patients. GCS & GLS parameters attained statistical significance in patients with and without a cardiac event (P < 0.001 and P = 0.011, respectively).

In recent studies carried out by [22] reported that longitudinal strain has been recognized as a sensitive parameter in the detecting CAD at rest even in the presence of normal LV wall motion in patients with severe CAD.

[23] who found a significant negative correlation between longitudinal strain and severity of CAD as assessed by coronary angiography. This agrees with the fact that longitudinal mechanics predominate in the ischemia-vulnerable subendocardium as subendocardial myocardial fibers are mainly longitudinal oriented and abnormalities of myocardial deformation in the longitudinal axis are seen in the development of many pathophysiologic states, including CAD and myocardial infarction [24].

5. Conclusion

Results from the present study demonstrate that layer-specific 2D STE may be considered as a sensitive tool that is capable of predicting cardiac events in CAD patients, which may not be detected using conventional echocardiographic parameters. In contrast, 2D STE fails to increase the predictive power in patients with AMI, probably due to acute myocardial edema and myocardial stunning. On this basis, we believe that extensive echocardiography does not offer any significant benefit for AMI patients in the acute setting.

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