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Accuracy of Two-Dimensional Speckle Tracking Echocardiography in Detection of Myocardial viability in Patients with Ischaemic Cardiomyopathy

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Abstract*:*

Background*:* ischaemic cardiomyopathy is one of the common causes of high mortality and increasing prevalence of heart failure. Because of the need to treat the cause of ischemic cardiomyopathy, testing of patients and detection of myocardial viability is much important and can help to identify viable segments of myocardium that have great chance of improving after revascularization. Noninvasive imaging are used for detection of viability and 2 dimensional speckle tracking echocardiography is under research for this.

Aim of the work: Detection of myocardial viability in ischemic cardiomyopathy using 2D speckle tracking Echocardiography versus myocardial perfusion imaging.

Patients and Methods: The ethical approval was obtained from the hospital ethical research committee and each patient entering the study signed an informed consent. Fifty patients included in this study with known ischemic cardiomyopathy. They were recruited from outpatient clinic at Al-Hussien Hospital during the period from October 2017 to July 2018. Myocardial perfusion imaging and 2D speckle tracking echocardiography with segmental longitudinal strain and global longitudinal strain were done to the fifty patients.

Results: 2D speckle tracking echocardiography with segmental longitudinal strain and global longitudinal strain when compared with myocardial perfusion imaging predicted cutoff point for viable segment from nonviable with detected sensitivity and specificity.

Conclusion: The new echocardiographically-derived myocardial deformation indices, which reflect structural changes assessed by transthoracic echocardiography can be used to detect myocardial viability.

Keywords: echocardiography, myocardial viability, myocardial perfusion imaging, ischemic cardiomyopathy, speckle tracking.

Introduction

Because of increased mortality and increased incidence of heart failure and the great need to treat the etiology, testing of patients with heart failure will increase obviously[1]**.** SPECT is one of the non-invasive nuclear imaging techniques, which is frequently used to detect viable myocardium. Viable myocardium can be elicited by detecting the myocyte membrane integrity through the amount of myocardial uptake of the radioactive tracers. The radioactive tracers used in daily practice included Thallium-201 or Technetium (Tc)-99 m or Tc-99 m tetrofosmin, with Tc-99 m sestamibi being the most available and used tracer in daily **practice [2].**

Aim of the study:

The aim of this work is to identify viable segments from non-viable segments in patients with ischemic cardiomyopathy using two dimensional (2D) speckle tracking echocardiography in comparison with myocardial perfusion imaging and detection of cutoff point for myocardial viability.

Patients and Methods

Patients

We included 50 patients with diagnosis of ischemic cardiomyopathy who came to cardiology outpatient clinic at Al-Hussin Hospital from October 2017 to July 2018. **The study was approved by the Ethics Board of Al-Azhar University.**

***Inclusion criteria*:**

- Patients with cardiomyopathy due to ischaemic origin who have EF<40%.

Exclusion criteria:

- Patients with cardiomyopathy due to non-ischaemic cause.
- Patients with AF.
- Patients with poor echo window.

Methods

1. Informed consent was taken from all patients for the study participation.

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2. History was taking from all patients for assessment of chest pain, other cardiac symptoms and previous tests for diagnosis of ischemia.
3. General and local cardiac examination was done for all patients including (vital signs, head and neck examination, upper and lower limb examination, abdominal examination and local chest and cardiac examinations).
4. Resting 12 leads ECG was done for all patients.
5. Echocardiography:

- All patients were examined at rest in the left lateral decubitus position to obtain adequate images in different standard views.
- LV volumes and LVEF were assessed with Simpson's method in apical four chamber (4CH) and two-chamber (2CH) views.

6. ***Myocardial deformation imaging :***

- The 2D STE analysis was performed using commercially available software on standard 2D grayscale images from apical 4CH, 3CH, and 2CH views for LV longitudinal strain [3].
- Each strain was measured at end-systole at the moment of aortic valve closure.

7. ***Myocardial perfusion imaging :***

- MPI was performed using injection of technicium 99 and patients were imaged using Gamma camera

Then the raw data was analyzed using the available software. (Software: Evolution™ for cardiac)

Statistics

Descriptive:

Statistical analysis: Data were tabulated and analyzed using the computer program SPSS (Statistical package for social science) version 20. Quantitative date was expressed as mean standard deviation (SD). Qualitative data were expressed as frequency and parentage.

The following tests were done: Independent-samples t-test of significance: was used when comparing between two means. Chi-square test was used when comparing between non-parametric data.

Receiver operating characteristics (ROC) curves: was used to detect sensitivity, specificity, cut-off point, positive predictive value (PPV) and negative predictive value (NPV). Probability (P-value) P-value <0.05 was considered significant. P-value <0.001 was considered as highly significant. P-value >0.05 was considered insignificant. Diagnostic sensitivity: It measures the incidence of true positive results in patients group. Diagnostic specificity: It measures the incidence of true negative results in a non-diseased group. Positive predictive value: It is the percent of true positive results among all positive results. Negative predictive value: It is the percent of true negative results among all negative results.

Results

We have tested the 50 patients:

Table (1): descriptives and frequencies of 2D echocardiographic data:

Descriptives	Number	Mean	Std. Deviation
age	50	52.30	5.471
EF	50	30.8000	6.26295
LVEDV	50	193.6000	82.30258
LVESV	50	139.9800	75.26456

Std. deviation=standard deviation.

Statistics for MPI and speckle tracking echocardiograph

Segments tested:

We have tested the 17 segments of the left ventricle in the 50 patients and shown as 850 tested segments:

MPI

We have tested the 17 segments of the left ventricle of the 50 patients using myocardial perfusion imaging (MPI) and the segments are grouped into 3 groups according to viability: viable, nonviable, and mixed scar and ischaemia as table (2)

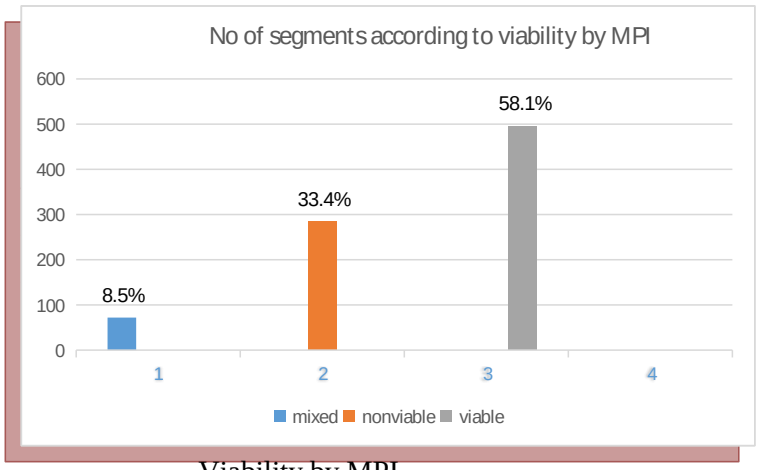
Table (2): distribution of viability using Myocardial perfusion imaging:

Distribution of viability	Frequency	Percent	Valid Percent	Cumulative Percent
Non-viable	284	33.4	33.4	33.4
Mixed scar and ischaemia	72	8.5	8.5	41.9
viable	494	58.1	58.1	100.0

In this table the segments are classified as viable, nonviable, and mixed scar and ischaemia according to percent of each as detected by Myocardial perfusion imaging.

Diagram 1: distribution of viability using Myocardial perfusion imaging:

Number of segments



P <0.001

Viability by MPI

The diagram showing the percent of each class as detected by Myocardial perfusion imaging.

SLS *(segmental longitudinal strain):*

The 17 segments of LV of the 50 patients are tested using longitudinal strain of the 2D speckle tracking echocardiography and the 850 segments were grouped in to 3 groups according to viability; viable, nonviable, and mixed viable and scar as shown in table (3):

Table (3): distribution of viability using segmental and global longitudinal strains of 2D speckle tracking echocardiography and its statistical significance:

Distribution of viability	No of segments	Mean	Std. Deviation	P value
Non-viable	284	-6.5000	2.96495	0.001
Mixed scar and viable	72	-9.2222	1.89307	
Viable	494	-15.9352	3.57644	

No= number, std. Deviation=standard deviation.

Diagram 2: box-plot curve for distribution of viability using segmental and global longitudinal strains speckle tracking echocardiography:

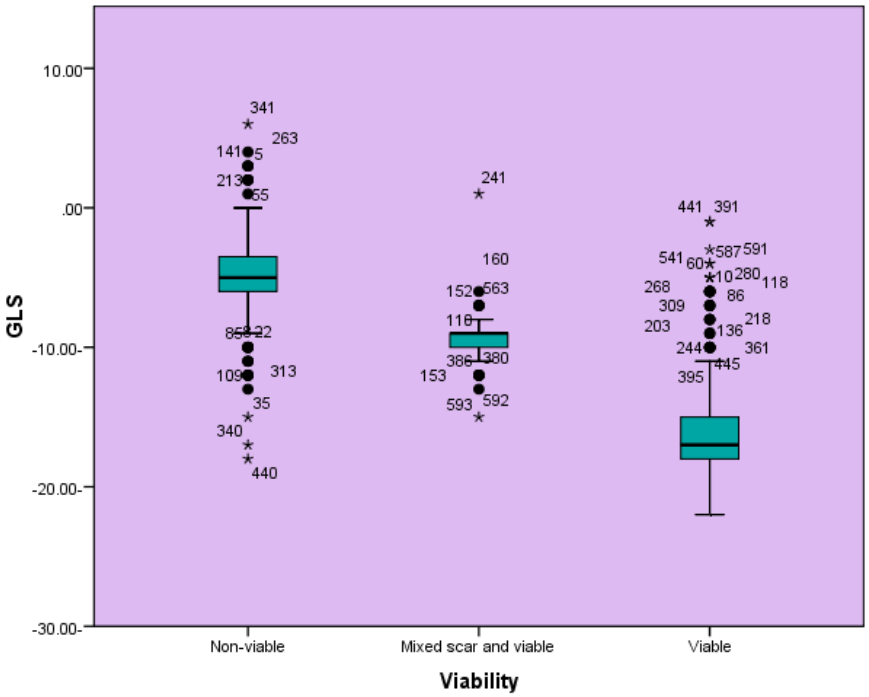
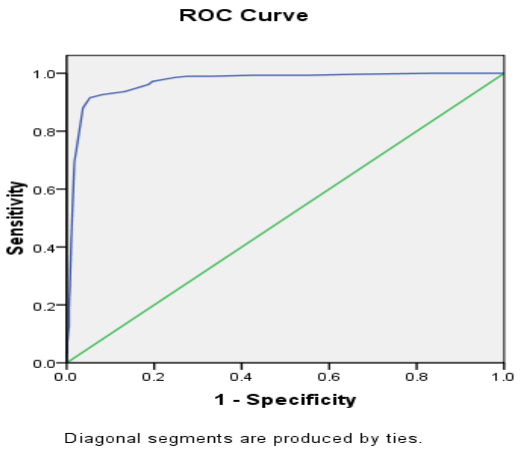


Diagram 3: ROC curve for sensitivity and specificity of segmental and global longitudinal strains of 2D speckle tracking echocardiography in detection of myocardial viability:



2D speckle tracking echocardiography can detect nonviable myocardium at cutoff point -8.5 with standard deviation (2.9) at sensitivity 88% and specificity 92%.

Discussion

Speckle-tracking echocardiography was used to assess LV function using gray-scale 2D echocardiography, myocardial strain is calculated, using an automated function imaging (AFI) [4].

As viable myocardium is important to determine recovery of LV function after acute infarction, quantitatively assessed LV myocardial viability after acute infarction can provide reliable predictor of functional recovery with improving clinical outcome. Myocardial deformation analysis by 2D speckle tracking has additive value in the detection of viable myocardium [5].

Then the raw data were analyzed using the available software (Evolution™ for cardiac). According to segmental analysis of LV, the 17 segments were studied in the 50 patients and the resulted 850 segments were divided according to MPI in to:

- ✓ Viable: 494 Segments.
- ✓ Non-viable: 284 segments.
- ✓ Mixed viable and scar: 72 segments.

Then, the 50 patients were tested using the 2D STE and software was used on standard 2D grayscale imaging from apical 4CH, 3CH, and 2CH views for LV longitudinal strain (LS)[6].

The results of SLS of LV were displayed as values and compared with the MPI results of each segment to detect cutoff value of myocardial viability.

In our study:

- ➢ The mean LVEF was 30.8% (±6.2).
- ➢ there was statistical significance indicating the following : The peak longitudinal systolic strain can detect myocardial viability at cutoff point -6.5(±2.9) for non-viable myocardium at sensitivity of 88% and specificity of 92% with P value <0.001 and these results are compatible with the results achieved by Martin Hutyra et al.[6], which concluded that the SLS can detect non-viable myocardium but at different cutoff point (-5.3) and the difference between cutoff values may be related to number of patients and different reference imaging as they compared to SPECT which carry higher sensitivity and specificity to MPI.

❖ We **concluded** that 2D STE with SLS and GLS can detect myocardial viability at cutoff point with considerable specificity and sensitivity.

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