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Original article

Rest 2D speckle tracking echocardiography may be a sensitive but nonspecific test for detection of significant coronary artery disease

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Summary. *Aims:* To detect the significance of coronary artery disease in the patients, who are suspected, was assumed to be one of the advantages of 2D STE, as a novel non-invasive imaging modality with acceptable accuracy. *Methods:* In this study, 216 patients who were suspected to have coronary artery disease and candidate for coronary angiography, underwent rest two-dimensional speckle tracking echocardiography (2D STE) and negative global systolic longitudinal strain was evaluated. Results: Negative global systolic left ventricular longitudinal strain under 18% in rest 2D-STE was significantly prevalent in patients with significant CAD in coronary angiography (P value<0.0001).Our results revealed sensitivity of 91.1%, specificity of 63.0%, positive predictive value of 80.4%, negative predictive value of 81.0% and accuracy of 80.5% for rest 2D-STE in detection of significant CAD. *Conclusion:* Here in we showed that rest Two-dimensional speckle tracking echocardiography could be a sensitive but nonspecific imaging modality to determine significant coronary artery disease. Future studies with large size will reveal more detailed findings. (www.actabiomedica.it)

Key words: 2D speckle tracking echocardiography, coronary artery disease, coronary angiography

Introduction

Two-dimensional speckle tracking echocardiography (2D STE) is a novel technique of cardiac imaging for assessment of cardiac movement based on frame-to-frame tracking of ultrasonic speckles in gray level 2D images. It is known as a relatively angle independent technology that can determine global and regional strain (1, 2). Two-dimensional STE has been showed clinically helpful in the evaluation of cardiac systolic and diastolic function as well as providing novel insights in interpreting a variety of pathologies. A large number of studies have appraised the role of 2D STE in different cardiac conditions. However, the clinical value of 2D STE remains controversial because of inconsistent reports from different studies (3-5).

Detection of significant coronary artery disease in the patients who are suspected, was supposed to be one of the advantages of 2DSTE, as a noninvasive approach with acceptable accuracy, before referring them for coronary angiography. Moreover, predicting at risk territory of the coronary vessel could be useful by the means of this approach (1, 6).

In this study, we evaluated the sensitivity and specificity of rest 2D STE for detecting of significant coronary artery disease (≥50%) in the patients who were candidate for coronary angiography.

Material and methods

In this study, which was done from January 2013 to April 2014, among patients who were referred to our cardiology clinic in Modarres hospital, patients who were candidate for coronary angiography were selected. Our exclusion criteria were: documented CAD, PCI or CABG in previous, history of anti-ischemic drugs like nitrates, beta blocker or calcium channel blocker, significant valvular disease and arrhythmia. The indication for coronary angiography in this study was decided by the clinical evaluation of experienced cardiologist.

Rest 2DSTE was performed by one experienced echocardiogragher for the selected patients before they underwent coronary angiography. We used intraobserver variability to determine the interclass coefficient.

Echocardiographic images were attained at rest using VividE9 ultrasound scanner (GE Ultrasound, USA) prior to coronary angiography. Three uninterrupted cardiac cycles were applied for each of three standard apical (two-, three-, and four-chamber) views and were kept for off-line longitudinal strain analysis, using EchoPAC software (GE Ultrasound). For assessment of longitudinal strain, we recorded standard 2D ultrasound images with a frame rate between 60 and 70 frames per second (fps) from the standard views. The endocardium was manually marked out from selected cineloops of apical view images. Visual confirmation of tracking was executed and segments with insufficient tracking were eliminated. Speckle tracking was carried out on all three apical views of rest images and negative global systolic longitudinal strain was estimated.

The cut off point for normal negative global systolic left ventricular longitudinal strain assessed by speckle tracking technique was considered 18% (6, 12).

An interventional cardiologist, blinded to patient clinical status and echocardiography results, assessed the angiograms regarding to the severity and location of stenosis of the major epicardial coronary arteries. Stenosis ≥50% was considered as significant coronary artery stenosis which was interpreted by visual (eyeball) estimation. To assess intraobserver variability, one experienced echocardiogragher measured the global systolic left ventricular longitudinal strain, with the second set of measurements performed 2 weeks later.

Statistical analyses were performed by SPSS statistical software (version 16). Independent T-test was used for quantitative studies. A level of P value <0.05 was considered statistically significant.

Results

216 patients including 132 males and 84 females finally enrolled in our study. Mean age of the patients was 61.1±9.9.153 patients had positive rest 2D-STE and 63 patients had negative rest 2D-STE. Demographic, clinical and angiographic characteristics of the patients are showed in Table 1.

Our results showed sensitivity of 91.1%, specificity of 63.0%, positive predictive value of 80.4%, negative predictive value of 81.0% and accuracy of 80.5% for rest 2D-STE in detection of significant CAD (Table 2).

Negative global systolic left ventricular longitudinal strain under 18% in rest 2D-STE was considerably prevalent patients in with significant CAD in coronary angiography (P value<0.0001).

Table 1. Demographic, clinical and angiographic characteristics of the patients

	n 216
Age, (years)	61.1±9.9
Sex (male), [n (%)]	132 (61.1%)
Major cardiovascular Risk factors	
Hypertension	36 (16.7%)
Diabetes	45 (20.8%)
Smoking	30 (13.8%)
Hyperlipidemia	51 (23.6%)
Family history of CAD	24 (11.1%)
Distribution of significant CAD (≥50%) in coronary angiography	
LAD	108 (16.7%)
LCX	45 (6.9%)
RCA	9 (1.4%)
LAD+LCX	72 (11.1%)
LAD+RCA	99 (15.3%)
LCX+RCA	9 (1.4%)
LAD+LCX+RCA	63 (9.7%)

Table 2. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of rest 2D-STE for detection of significant CAD

Sensitivity	Specificity	PPV	NPV	Accuracy
91.1%	63.0%	80.4%	81.0%	80.5%

Also, negative global systolic left ventricular longitudinal strain was inversely correlated with increased age (P value=0.003).In addition, according to this point that all 2D-STE was performed by one experienced echocardiogragher, the intraoserver variability for global systolic left ventricular longitudinal strain was 0.91 (0.78-0.97)

Discussion

Early detection of the coronary artery disease by the means of noninvasive, safe and highly accurate imaging modality is an inevitable desire in cardiovascular medicine. 2D STE has recently opened new windows in this era.

To our knowledge, this study was the first study in Iran which assessed the power of rest 2D STE for detection of significant CAD. Our results demonstrated that rest 2D STE is a sensitive but nonspecific test for detection of significant CAD.

It was reported that diminution in strain by 2D STE is more objective and precise than the traditional visual technique of evaluating wall motion abnormality (3). Also, it was determined that longitudinal, radial and circumferential strains were decreased in ischemic areas in coronary artery disease (7, 8, 17).

In our study, negative global systolic left ventricular longitudinal strain was used. It is suggested for the future studies to include radial and circumferential strains to enhance the accuracy of the 2D STE.

Lower longitudinal strain value in asymptomatic patients without wall motion abnormalities was showed to be a helpful predictor of stable ischemic cardiomyopathy (9). Moreover, studies in patients with acute myocardial infarction revealed that longitudinal strain is correlated with the LV infarct size and peak levels of cardiac troponin T (10, 11).

Our findings similarly showed that negative global systolic left ventricular longitudinal strain under 18% in rest 2D-STE was noticeably related with significant CAD in coronary angiography.

Reduced global longitudinal strain determined by 2D STE in rest images for recognition of non-obstructive CAD had comparable accuracy to the traditional wall motion score index (WMSI) measured in stress echocardiography (12).

As compared with stress echocardiography, our study consequences illustrated that rest 2D STE was more sensitive test for detection of significant CAD. In addition, sensitivity of rest 2D STE is comparable with adenosine SPECT (14).

Current meat-analysis demonstrated that sensitivity and specificity of 2D STE for prediction of coronary artery diseases were about 85% and 84%, respectively (14). Our study results revealed higher sensitivity and lower specificity in comparison with current meat –analysis .In another study, the best accuracy for detecting CAD was achieved by integrating wall motion abnormality analysis and longitudinal strain during dobutamine stress. Possibly, strain should be used along a stress test, instead of at rest, at least for most of the patients with suspected CAD (18).

It has showed that 2D STE is more available and less time-consuming modality in comparison with MRI (15). As our findings showed, negative results of rest 2D STE had acceptable negative predictive value for CAD; this could be helpful in emergency department and cardiology clinic for discharging suspected patients for CAD with a negative rest 2D STE test.

It should be mention that microvascular dysfunction without significant stenosis of coronary artery disease can reduce strain in speckle tracking and make the specificity of 2D STE to be low (1-3, 6).

2D STE presents new insights into the left ventricle dysfunction and emerges likely to improve detection of coronary artery disease and viable myocardium.

It should not be forgotten that there are some controversies about the sensitivity and specificity of 2D STE (10, 14, and 16) and one of the major reasons of the design of this study, which is the first study in Iran and also in Middle East, to assess this point.

This study can serve as a trigger for future researches evaluating 2D STE in detail, in ischemic and non-ischemic heart disease and thus developing new diagnostic approaches.

Limitations

First, it is undeniable that the number of the patients that enrolled in our study was relatively small. Future studies with large sample size are recommended for revealing new outcomes about 2D STE. Second, we had limited financial resources for expanding our study to a large population. Third, exclusion criteria in our study eliminated significant number of the patients because most of them had documented history of CAD; in addition, these criteria may be inadequate and restricted criteria for better selection of the patients may be needed in future studies. Another limitation that should be mentioned is that cut off strain values currently may differ according to the different vendors. .Finally, in this study, we only focused on the presence or absence of morphologic coronary stenosis of ≥50%,which is the most common way of interpretation; in spite of this, detailed coronary assessment with fractional flow rate (FFR) is absolutely valuable and suggested for the future investigation.

Conclusion

Our study showed that rest Two-dimensional speckle tracking echocardiography could be a sensitive but nonspecific imaging modality with relatively acceptable negative predictive value to determine significant coronary artery disease. Nevertheless, detailed data about 2D STE is to somehow controversial, and this study with such a small size cannot answer all the remaining questions.

Ethical approval

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

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