Accuracy of Speckle Tracking Echocardiography in Detection of Coronary Artery Disease Severity

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ABSTRACT

Objectives: The purpose of the present study was to assess the accuracy of Speckle Tracking Echocardiography (STE) to detect the disease severity of coronary arteries. Design: This study is a prospective study.

Settings: This study enrolled 143 patients with symptoms suggesting ischemic heart disease consulting Ibn Al-Baitar Center for Cardiology and Cardiac Surgery from September 2019 to March 2021.

Methods: Examinations involved assessment of the abnormality of regional wall motion and left ventricular function and speckle tracking strain by obtaining 2D grey scale harmonic images in the apical long - axis three chamber, four-chamber, and two-chamber views for the global and segmental analysis of global longitudinal strain (GLS).

Results: The results revealed that 46 patients (32.2%) had no significant coronary lesion and 97 patients (67.7%) had significant coronary artery disease (CAD). Furthermore, the results of GLS were abnormal and statistically significant in patients with one and two-vessel disease (p-value = 0.02 and 0.001 respectively) and more significant in patients with three vessels disease (p-value = 0.0001), all patients with left main stem disease have abnormal GLS.

Conclusion: The STE could be considered one of the most accurate methods used for the uncovering of coronary disease severity.

Keywords: Cardiac diseases, Coronary artery disease, Echocardiography, Speckle tracking echocardiography.

INTRODUCTION

Coronary artery disease (CAD) is a common health problem, and a main etiology related to increased morbidity as well as mortality throughout the world[1-3]. Non-invasive patient recognition who are suffering from CAD is clinically challenging despite the prevalent use of imaging techniques[4]. Echocardiography can be considered the most widely used cardiac imaging for the diagnosis of CAD and assessment of the function of the left ventricle[5]. However, resting regional wall motion is normal at rest except when a history of previous myocardial infarction or myocardial stunning is reported[6]. Furthermore, conventional echocardiography might not always detect the motion abnormalities of the regional wall at rest so more advanced echocardiography techniques may be used for better detection of CAD, the measured longitudinal motion and deformation using speckle tracking can be considered as the most sensitive biomarkers of CAD particularly in patients suffering from coronary stenosis where recurrent myocardial stunning could be caused by intermittent ischemia[7]. Unlike basic echocardiography, Speckle tracking echocardiography (STE) is a non-invasive tool by which additive information can be easily and quickly provided as it is capable of identifying subtle damage of myocardium and localizing ischemic territories relying on the coronary lesions[8]. In patients who were suspected to have stable angina pectoris, the assessment of global longitudinal peak systolic strain Global longitudinal strain (GLS) at rest is considered an autonomous predictor of significant CAD and there is significant improvement in diagnostic implementation for the exercise test. In addition, the 2-dimensional strain echocardiography can identify the patient with high risk[9]. There is support for the clinical application of 2D-STE to detect suspected myocardial ischemia in patients as a result of CAD. Therefore, a combination of 2D-STE and ECG monitoring may be used for early screening of patients with CAD in the future[10]. Assessment of the accuracy of STE to detect the disease severity of the coronary artery was the aim of this experiment.

PATIENTS AND METHODS

This study was prospective and involved 143 patients with symptoms suggesting ischemic heart disease consulting Ibn Al-Baitar Center for Cardiology and Cardiac Surgery from September 2019 to March 2021. Exclusion criteria included:

- Patients with atrial fibrillation
- Patients with multiple ventricular ectopic beats,
- Patients with significant valvular heart disease
- Patients with LV systolic dysfunction
- Patients with a poor acoustic window or poor image acquisition.

Conventional 2D echocardiographic examinations were performed using a Philips iE33 system (Bothell WA, USA). Examinations involved assessment of regional wall motion abnormality left ventricular (LV) function and speckle tracking strain by obtaining 2D grey scale harmonic images in the apical long-axis three-chamber, four-chamber and two-chamber views for both global and segmental analysis of GLS. The results of GLS and segmental longitudinal strain were considered abnormal as they were higher than the normal range which was also reported in the HUNT experiment (-17.4 % and -15.9 % for women and men respectively)[11].

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Coronary angiography: The evaluation of angiographic outcomes was performed by a sophisticated cardiologist regarded as incognizant of patient clinical and echocardiographic findings. The cutoff percentage of the stenosis in diameter was ≥ 70% and ≥ 50% for the three pericardial vessels and the left main (LM) coronary artery respectively which was used to assess the number of the affected vessels[12].

Statistical analysis: Data expressed as descriptive statistics. SPSS software (version 19) was used to perform statistical analysis. The chi-square test or Fisher's exact test and p-value < 0.05 was regarded as a significant value.

RESULTS

Demographic and angiographic: In total, 143 participants were enrolled in the present research, 103 participants were male and 40 were female. The characteristics of demography and angiography of different groups are outlined in Table 1. This table demonstrated that after coronary angiography: 46 patients (32.2%) were discovered to have no significant coronary lesion and 97 patients (67.7%) had significant CAD.

Table 1. The demographic and angiographic baseline characteristics

Parameters	
Age (years)	55.7±9.7
Gender, n(%)	
Male	103 (71.9%)
Female	40 (28.1%)
Hypertension	103 (71.9%)
Diabetes mellitus	51 (35.4%)
Smoking	64 (44.8%)
Presentation	
Stable angina	85 (59.4%)
Acute coronary syndrome	58 (40.6%)
LV ejection fraction, %	61.7 ± 8.09
Coronary angiography:	
No Significant CAD:	46 (32.3%)
Significant CAD:	97 (67.7%)
Single Vessel disease	33 (22.9%)
Double Vessel disease	34 (24%)
Triple Vessel disease	30 (20.8%)
LM stenosis	7 (5.2%)

The results confirmed that the accuracy of the GLS for detection of CAD was relatively high indicated by up to 80% specificity and 67% sensitivity (Table 2).

Table 2. Sensitivity specificity of the GLS for detection of CAD

Global longitudinal Strain	**Coronary angiography**		**Sensitivity**	**Specificity**	**p-value**
	No CAD	**CAD**			
Normal	37	31	67.7%	80.6%	0.0001
Abnormal	9	66			
Total	46	97			
p-value < 0.05 was regarded significant					

The strain of echocardiography was more representative for GLS used for detection of CAD and significantly higher with triple vessels than two vessels or one vessel involvement (Table 3).

Table 3. shows the relation between strain echocardiography results and the number of vessels involved

Number of vessels involvement	GLS		Total	p-value
	Normal	Abnormal		
One vessel disease	24	9	33	0.02
Two vessel disease	7	27	34	0.001
Three vessel disease	2	28	30	0.0001
LMS lesion	0	7		0.028

This table revealed that the results of GLS were abnormal and statistically significant in patients with single and double vessel disease (p-value = 0.02 and 0.001 respectively) and more significant in patients with triple vessel disease (p-value = 0.0001), all patients suffering from left main stem disease had abnormal GLS.

DISCUSSION

Using echocardiography for the assessment of regional myocardial function by echocardiography gives insight into diagnosing and managing CAD. The standard 2DE is extensively used to assess regional wall motion abnormalities which depends on the evaluation of myocardial hypertrophy and excursion of the endocardium. This is a skewed method where the investigation encompasses a complete visualisation of the endocardium[13]. This research aimed to check the accuracy of STE to detect the severity of CAD. In the current experiment, the prediction of present and severe CAD was performed by assessment of the GLS value, we found that lower GLS value was related to the high percentage of CAD on coronary angiography which was represented by highly sensitive, specific and significant p-value, this was in congruent with Anwar et al (2013),[14] who enrolled 25 participants suspected to have clinical CAD after coronary angiography: 15 of them have significant CAD and 10 have insignificant CAD. The diagnosis accuracy (sensitivity and specificity) of STE in comparison with regional wall motion abnormalities were 68.6% and 77.0% respectively. Choi et al. (2008)[15] checked up two hundred seventy-three patients and reported that diagnosis accuracy (sensitivity and specificity) of the peak systolic strain (the outcome lower than the cutoff) were approximately 71% and 93%, respectively and mentioned that Ultrasound-dependent strain imaging correlated strongly with coronary angiography confirming its importance as a non-invasive diagnostic device to detect the stenosis of coronary artery in patients suffering from pain in the chest with unapparent wall motion abnormalities using standard echocardiography. Our study found that the significance of GLS increases with an increase in the severity of CAD, the p-value was 0.02 in patients with single-vessel disease versus 0.001 in patients suffering from double-vessel disease and 0.0001 in patients who had triple-vessel disease. These results are consistent with Choi et al. (2009)[16] who evaluated 96 patients, who have no RWMA at rest, with coronary angiography and 2D strain and classified patients as 38 patients have 3 vessel disease, 28 participants with single or double vessel disease and 30 patients without CAD and found that the global and the segmental LS were found to be minor in lofty threat group in comparison to another two groups of this study despite the detection of normal resting wall motion and LV ejection fraction. Moustafa et al (2018),[17] evaluated 200 subjects with assumed CAD where normal resting echocardiography was undergone to both STE and coronary artery angiography and revealed that there was highly significant variation in GLS subjects with significant CAD versus patients with normal coronaries, and there were highly significant variations in GLS patients regional longitudinal strain when the results of patients with a

single vessel, double vessels and triple vessels disease were compared (p-value=0.001, 0.001, and 0.041 respectively). The assessment of patients suffering from acute and chronic CAD using STE improves the prognostic evaluation of suffering from preserved ejection fraction since STE is capable of predicting cardiac dysfunction before ejection fraction reduction. The developed heart deficit and cardiac death as a result of myocardial infarctions are highly dependent on the extent of the damaged myocardium[18]. The future directions could harness artificial intelligence for betterment of diagnosis and direction of therapy for these cardiovascular diseases[19].

CONCLUSION

According to the findings of this study, speckle tracking echocardiography was an accurate method which can be used to detect the severity of coronary disease.

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