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Original Article

The correlation between speckle tracking echocardiography and coronary artery disease in patients with suspected stable angina pectoris

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ABSTRACT

Background: To examine the value of speckle tracking echocardiography to detect the presence, extent and severity of coronary artery affection in patients with suspected stable angina pectoris.

Methods: Two hundred candidates with suspected stable angina pectoris and normal resting conventional echocardiography were subjected to speckle tracking echocardiography and coronary angiography. Global and segmental longitudinal peak systolic strain were assessed and were correlated to the results of coronary angiography for each patient.

Results: There was a statistically significant difference in the mean of global longitudinal peak systolic strain between normal coronaries and different degrees of coronary artery disease (CAD) (-20.11 ± 0.8 for normal, -18.34 ± 2.52 for single vessel, -16.14 ± 2.85 for two vessels, -14.81 ± 2.12 for three vessels, -13.01 ± 2.92 for left main disease). GLPSS showed high sensitivity for the diagnosis of single vessel CAD (90%, specificity 95.1%, cutoff value: -18.44 , AUC: 0.954); two vessels disease (90%, sensitivity 88.9%, cutoff value -17.35 , AUC: 0.906) and for three vessels CAD (cutoff value -15.33 , sensitivity 63% and specificity 72.2% AUC 0.681) segmental LPSS also showed statistical significance for localization of the affected vessel for left anterior descending, left circumflex and right coronary artery ($p=0.001$) and inverse correlation with syntax score that was significant with high and intermediate score ($p=0.001$) and insignificant for low syntax score (p value 0.05).

Conclusion: Two-dimensional speckle tracking echocardiography has good sensitivity and specificity to predict the presence, extent and severity of CAD.

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1. Introduction

Noninvasive identification of patients with coronary artery disease (CAD) remains a clinical challenge despite the widespread use of imaging and provocative testing; more than 50% of patients currently referred to coronary angiography show normal or non-obstructive CAD.¹

In stable CAD, coronary computed tomography angiography (CTA) is a non-invasive alternative to assess coronary anatomy, but according to expert consensus only selected patients should be considered for CTA.²

Exercise testing is widely used for selecting patients for coronary angiography, but has its clear limitations as emphasized in the European guidelines for stable CAD.³

Measurements of longitudinal motion and deformation are most sensitive markers of coronary artery disease especially in patients with coronary stenosis, where intermittent ischemia may result in subtle forms of stunning that may be detectable with strain measurements.⁴

Thus we are in need of a simple, non-invasive method to improve the selection of patients who are referred for coronary angiography.

The aim of the study was to evaluate the value of global longitudinal peak systolic strain (GLPSS) performed at rest to predict the presence, extent and severity of CAD in patients with suspected stable angina pectoris.

2. Methods

2.1. Study design

Single center, prospective study enrolled 200 consecutive patients with suspected stable angina pectoris from January

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2014 to April 2016. All patients signed an informed consent and the study was approved by the local ethics committee.

Inclusion criteria included: adult patients (age ≥ 18 y) who presented to outpatient clinic by clinically suspected stable CAD a condition which encompasses several groups of patients: (i) those having symptoms felt to be related to coronary artery disease (CAD) such as dyspnea; (ii) those previously symptomatic with known obstructive or non-obstructive CAD, who have become asymptomatic with treatment and need regular follow-up; (iii) those who report symptoms for the first time and are judged to already be in a chronic stable condition (for instance because history-taking reveals that similar symptoms were already present for several months). All patients were without regional wall motion abnormality on two-dimensional echocardiography (2D) and with preserved systolic function.⁵

Exclusion criteria included: patients with left ventricular ejection fraction $< 50\%$ by 2D echocardiography, prior history of percutaneous coronary intervention (PCI) or coronary artery bypass graft (CABG), patients presented with acute coronary syndrome confirmed by positive cardiac enzymes (serum troponin), congestive heart failure, more than trivial valvular heart disease, intra-ventricular conduction disturbances, pathological Q-waves in the resting electrocardiography (ECG), atrial fibrillation, failure to assess all segments by speckle tracking or patients who refused coronary angiography.

2.2. Baseline evaluation

- On admission all patients had a review of their medical history, included demographic data (age, gender, body mass index [BMI]), presence of risk factors for coronary atherosclerosis (smoking, diabetes, hypertension, dyslipidemia, family history of premature CAD) and associated co-morbidities in addition to general and cardiac examination.
- 12 leads surface electrocardiography to exclude any arrhythmia or the presence of Q waves or ST-T wave changes at rest.
- Laboratory investigations beside routine evaluation in the form of complete blood count (CBC), liver function and kidney function, cardiac biomarkers (troponin I and CK-MB) to exclude acute event.
- A complete conventional echocardiographic examination was performed for all patients using Vivid 7 Vingmed-General Electric, Horton, NORWAY apparatus to assess left ventricular wall thickness, internal dimensions, wall motion abnormality, systolic and diastolic function by 2D, M-Mode and Doppler echocardiography.
- Speckle tracking was evaluated by recording three consecutive end-expiratory cardiac cycles using high frame rate (80–100 frames/s) and harmonic imaging was acquired in the apical four-, two-chamber views as well as long axis views for quantification of peak systolic strain by automated function imaging speckle tracking analysis. GLPSS for the complete LV was provided by the software using a 17-segment model in a 'bull's eye' plot calculated as the average of a longitudinal peak systolic strain

of each view and the mean of the three views the normal value of longitudinal peak systolic strain is -20% .⁶

- Coronary angiography was performed in less than 1 month from performing echo study by the percutaneous femoral approach. Angiograms were obtained for each coronary vessel in at least 2 projections. A reduction in arterial lumen area of $\geq 50\%$ of any coronary vessel, including left main coronary vessel and $> 70\%$ for left anterior descending (LAD), left circumflex (LCX) and right coronary artery (RCA) were considered significant. The analysis of the coronary angiograms was performed visually by an experienced operator who was blinded to the results of the echocardiographic examinations then syntax score was calculated.

All echo reports were read in a blinded manner by three cardiologists; Intra and inter observer agreement were done using (ICC) with values of Intra Class correlation of 0.875 and value of Inter class correlation 0.825.

2.3. Statistical analysis

Statistical analysis was performed using SPSS software (IBM SPSS Statistics for Windows, Version 20.0, IBM Corp., Armonk, NY, USA). Continuous variables were presented as means \pm standard deviation and categorical variables as numbers or frequencies. The Chi-square test was used to compare frequencies. One-way analysis of variance was used to compare descriptive parameters after confirming normal distributions. Kappa test was used for categorical data with good agreement; Pearson's correlation coefficients were used to assess the strength of relationship between continuous variables. Receiver operating characteristic (ROC) curve analysis was used to identify parameters that best predicted the presence of CAD and regional assessment of CAD. The level of evidence was detected in significant (p value < 0.05).

3. Results

3.1. Study population

The study included 270 patients only 200 fulfilled the criteria of inclusion and exclusion as shown in the flow chart Fig. 1.

Mean age of the studied population was 53.86 ± 8.99 and mean body mass index was 28.67 ± 6.28 as shown in Table 1. As regards to risk factors of the studied patients; 125 patients (62.5%) were diabetic, 128 patients (64%) were hypertensive, 114 patients (57%) were dyslipidemic, 79 patients (39.5%) were smoker, 27 patients (13.5%) had a family history as shown in Table 1.

3.2. Coronary angiography results

According to the results of coronary angiography patients were classified into those with normal coronary angiography, which included 50 patients (25%) and patients with CAD which included 150 patients (75%). Table 1

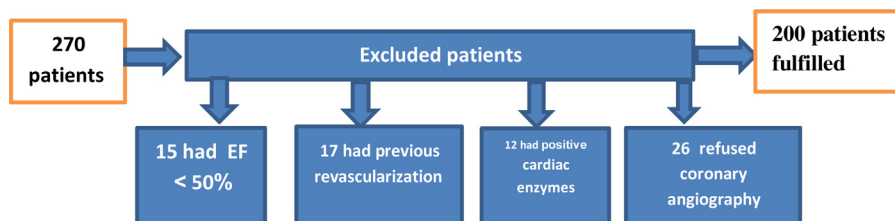


Fig. 1. Flow chart of included and excluded patients.

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