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ORIGINAL ARTICLE

Assessment of left atrium mechanical function by deformation imaging in atrial fibrillation and its correlation with CHA_2DS_2-VASc risk score

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Abstract *Objectives:* Evaluation of left atrium (LA) mechanical function by speckle tracking based strain (SPTS) in patients with chronic non-valvular atrial fibrillation (AF) and its correlation with CHA_2DS_2-VASc risk score.

Background: AF is a progressive condition that begins with increased hemodynamic load or structural remodeling of the atria, understanding atrial function could lead to better ability to predict the risk of developing stroke and the response to treatment. SPTS is a recently emerged modality that accurately estimates myocardial function.

Methods: Sixty patients with chronic AF and 20 age and sex matched normal control individuals underwent conventional echo where LV dimensions, wall thickness, EF, LA diameter and volumes were measured. Peak left atrial longitudinal strain (PALS) was measured in apical four (AP4) and two chamber view (AP2) and its correlation with CHA_2DS_2-VASc risk score in the AF group was evaluated.

Results: LA diameter and volumes were greater in AF patients (P-value < 0.001). PALS in each LA wall and in both AP4 and AP2 views were highly significantly lower in AF patients in comparison with control but did not reach a statistically significant correlation with CHA_2DS_2-VASc score. Also, there was no significant difference between PALS in patients with CHA_2DS_2-VASc score less than and more than two points.

Conclusion: AF leads to impairment of LA mechanical function as evidenced by low PALS but PALS was not significantly correlated with CHA_2DS_2-VASc score. Also, there was no significantly statistical difference between PALS in patients with low and high CHA_2DS_2-VASc scores.

1. Introduction

Atrial fibrillation (AF) is the most commonly sustained arrhythmia in the general population; its prevalence increases with age and is associated generally with increased mortality.[1]

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Patients with atrial fibrillation have a substantial risk of stroke, which is modified by the presence or absence of several risk factors.[2]

Since 2006, stronger evidence has accumulated that there are additional risk factors that should be considered in assessing thromboembolic risk and would be of value in identifying those patients at truly low risk.[3] The additional risk factors have been expressed in the CHA_2DS_2-VASc (congestive heart failure, hypertension, age $\geqslant$75 years, diabetes mellitus, previous stroke/transient ischemic attack, vascular disease, age 65–74 years, sex category; age $\geqslant$75 years and previous stroke carry doubled risk weight) score, which has been proposed to complement the $CHADS_2$ score.[3]

During the past several years, strain and strain rate imaging have emerged as a quantitative technique to estimate accurately myocardial function and contractility. Non-Doppler, Speckle Tracking Strain Imaging (SPTS) is a new echocardiographic technique for obtaining strain and strain rate measurements. It analyzes motion by tracking speckles in the ultrasonic image in two dimensions.[4]

The analysis of left atrial by SPTS is a new tool that can be used to evaluate left atrial mechanical function.[5]

We aim in this study to assess LA mechanical function using SPTS and to study the correlation between SPTS and CHA_2DS_2 VASc score.

2. Patients and methods

Sixty patients with persistent non-valvular AF for at least one month were referred for cardiac assessment in cardiology department, Menoufiya University hospital and were compared with 20 apparently healthy individuals with age and sex matched to the patient group (control group). All participants provided an informed consent and the study protocol was approved by the institutional ethics committee. Comorbid conditions such as diabetes, hypertension, heart failure, history of stroke and vascular diseases, including coronary artery disease (CAD), heart attack (myocardial infarction), peripheral artery disease (PAD), and complex aortic plaque were taken into account to risk-stratify the subjects according to CHA_2DS_2-VAS criteria.

Patients with primary valvular heart disease, congenital heart diseases, pericardial diseases, resting heart rate greater than 100 beats per minute and any arrhythmia other than AF, poor echogenic patients, and patients who refuse to participate in the study were excluded.

All patients underwent physical examination, 12- lead ECG, Echocardiographic examination was done using commercially available Vivid 9 Ultrasound Machine (GE Vingmed, Horton, Norway) with a multi-frequency 1.7–4 MHz transducer "M S5 probe" conducted to a single lead ECG, Echocardiographic imaging was obtained in the parasternal long, short-axis views, apical two and four-chamber views using standard transducer positions. LV end-diastolic and systolic diameters, septum and posterior wall thickness, ejection fraction (EF%) by M, Mode, and LA Antero-posterior diameter by M, Mode in Para-sternal long axis view and the average of maximum LA volume in A4C and A2C views were measured.

Speckle tracking echocardiography: Apical four and two chamber views were obtained, using a conventional 2-D gray scale echocardiography, during breath hold with a stable ECG recording. 2-D sector width is adjusted to include LA. Three consecutive cardiac cycles are recorded and the frame rate is set between 60 and 80 frames per second or at least 40% of HR. Recordings are processed using an acoustic-tracking software incorporated in the Vivid Nine system (Echo Pac, GE Vingmed, Horton, Norway), allowing off-line semi-automated analysis of speckle-based strain.

To calculate left atrial strain, the atrial endocardium is first traced manually then epicardial surface is traced automatically, and after manually reducing the region of interest to the atrial thickness, the software automatically divides each wall into 3 segments apical, mid and basal segments and we take average of this wall and then the average of the view, once the longitudinal atrial strain curves have been obtained, measurement of peak atrial strain was taken as the peak of the positive curve occurring at the end of LV systole (peak atrial longitudinal strain, PALS). Because there is no software available to calculate atrial strain until now, we employ the same software that is used for the analysis of ventricular myocardium.

2.1. Intra-observer and inter-observer variability

Intra-observer variability was determined by repeating the off-line measurement of LA speckle tracking measurement in 10 patients one week apart. Inter-observer variability was determined by comparison of all offline speckle tracking measurements in 10 patients by two cardiologists who were blinded to each other's interpretations. Variability values were calculated as the absolute difference between the corresponding measurements in terms of the mean percentage.

2.2. Statistical analysis

Using statistical package for the social science software (SPSS) version 16, data from the patients and controls were collected and were subjected to statistical analysis.

Two types of statistics were done: (1) Descriptive: e.g. mean and standard deviation SD. (2) Analytical: – (A) Student's *t*-test: It is a single test used to indicate collectively the presence of any significant difference between two groups for a normally distributed quantitative variable. (B) Mann–Whitney test: It is a nonparametric test of Student's *t*-test. It is used to indicate collectively the presence of any significant difference between two groups for non normally distributed quantitative variables. (C) Pearson's Correlation analysis (r): It is used to show strength and direction of association between two quantitative variables. (D) Spearman correlation analysis (r): It is used to show strength and direction of association between a quantitative variable and an ordinal qualitative variable. (E) P value (the probability of error) was considered significant as the following: significant difference if $P < 0.05$, non-significant difference if $P > 0.05$, and highly significant difference if $P < 0.001$.[6]

3. Results

The study includes sixty AF patients (29 males and 31 females) with mean age of 65.03 $\pm$ 8.53 y and 20 healthy individuals as