RESEARCH ARTICLE

Left atrial function assessment by speckle tracking echocardiography in low-risk atrial fibrillation patients

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Abstract

Objective: To compare the left atrial function utilising speckle tracking echocardiography in patients with low-risk and high-risk non-valvular atrial fibrillation.

Methods: The descriptive, cross-sectional study was conducted at the cardiology department of Kafrelsheikh University Hospital, Egypt, from January 2021 to January 2022, and comprised low-risk atrial fibrillatin participants in group I, high-risk atrial fibrillatin patients in group II, and healthy controls in group III. After detailed medical history, the subjects underwent 12-lead electrocardigram, and echocardiographic assessment, including two dimensional, M-mode, tissue doppler, and speckle tracking of the left atrium. The association of left atrial strain with Congestive heart failure, hypertension, age ≥75 (doubled), diabetes, stroke (doubled), vascular disease sex category (female) score was explored. Data was analysed using SPSS 28.

Results: Of the 90 subjects, there were 30(33.3%) in each of the 3 groups. The mean age among the groups was significantly different among the groups (p=0.014). Left atrial ejection fraction and left atrial strain had an overall significant difference among the groups (p<0.001). Congestive heart failure, hypertension, age ≥75 (doubled), diabetes, stroke (doubled), vascular disease sex category (female) score was negatively correlated with Left atrial ejection fraction and (p<0.001) and left atrial strain (p<0.001).

Conclusion: In individuals with atrial fibrillatin, there was a significant decrease in left atrial strain and left atrial function. The use of speckle tracking echocardiography allowed for a more detailed analysis of left atrial mechanics. The correlation of left atrial strain and left atrial ejection fraction with Congestive heart failure, hypertension, age ≥75 (doubled), diabetes, stroke (doubled), vascular disease sex category (female) score was significantly negative.

Keywords: Atrial fibrillation, Electrocardiography, Echocardiography, Speckle. **DOI: 10.47391/JPMA.EGY-S4-29**

Introduction

Approximately 1% of strokes and other thromboembolic events are caused by atrial fibrillation (AF), which is the most prevalent cardiac arrhythmia.[1] Patients with AF have a high risk of stroke which is affected by several risk factors.[2] Since 2006, several studies have demonstrated the need to identify actually low-risk AF individuals when assessing thromboembolic risk by using additional risk indicators to complement the CHA2DS2 score system.[3] (CHA2DS2-VASc) score reveals additional risk factors, such as age ≥75 years, diabetes mellitus (DM), hypertension (HTN), past history of stroke/transient ischaemic attack (TIA), vascular disease, congestive heart failure (CHF), age 65-74 years , and gender category female, with age ≥75 years and past history of stroke.TIA carrying double the risk. It was proposed as an addition to the (CHADS2) scoring system.[4] Strain and strain rate can be measured using non-doppler speckle tracking strain imaging. Recently, speckle tracking analysis modality has been used to measure the left atrial mechanical function.[4]

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The current study was planned to compare the left atrial (LA) function utilising speckle tracking echocardiography (STE) in patients with low-risk, high-risk non-valvular AF and normal subjects as a control group, and to identify the connection between LA strain and CHA2DS2-VASc score.

Patients and methods

The descriptive, cross-sectional study was conducted at the cardiology department of Kafrelsheikh University Hospital, Egypt, from January 2021 to January 2022, The patients were selected from those who had been referred to the hospital for echocardiographic evaluation in this period Those included were non-valvular AF patients who have low risk defined as CHA2DS2-VASc score 0 for males and 1 for females, high-risk AF patients, and healthy subjects as controls**.** Those excluded were patients with primary valvular disease or artificial heart valves, coronary artery disease (CAD), congenital heart disease (CHD) and those who refused to participate.

After taking informed consent, the patients were subjected to clinical evaluations and detailed history after which they were categorised into three group 1 having low-risk non-valvular AF individuals, group 2 having high-risk non-valvular AF individuals, and group 3 having healthy controls.

For the purpose of risk assessment, factors such as peripheral arterial disease (PAD), CAD, DM, smoking, HTN, stroke and heart failure were looked at.

The CHA2DS2-VASc scoring system comprises of the following variables: high blood pressure (BP), heart failure (HF), age ≥75 years with prior stroke, DM, stroke or TIA, vascular disease, age 65-74 years , and gender category (female). Age ≥75 years and prior stroke/TIA were each given 2 points, and the other clinically relevant non-major risk factors were each given one point, with total scores ranging 0-9. This score can identify the low risk group.[5]

A 12-lead surface electrocardigram (ECG) was done with a voltage of 10mm/mv and a velocity of 25mm/s for every patient for the affirmation of AF presence. Two-dimensional (2D) echocardiography and Doppler examination were done (Philips EPIQ 7C; S5-2 probe) with a single-lead ECG in a typical LA posture. Echocardiographic images were obtained in long-axis parasternal view, apical 4- and 2-chamber views using standard transducer positions. LA anteo-posterior (AP) diameter was assesed in M-mode,[6] maximal LA volume and LA volume index (LAVI),[7] left ventricle (LV) volume and LV ejection fraction (LV EF) using biplane Simpson's method.[8] Pulsed Doppler trans-mitral flow in apical 4-chamber view was used to detect passive ventricular filling (E wave) and tissue Doppler imaging was done to detect early diastolic (E□)[4] assessment. Echocardiographic images of the apical 4- and 2-chamber views of the LA chamber were acquired while the patients held their breath and maintained a stable ECG. Three cardiac cycles were collected to calculate the average heart rate. These settings helped frame-to-frame tracking, and 60-80fps or 40% of heart rate was selected as the standard setting. The recordings were finalised using an acoustic tracking software (Philips EPIQ 7C), which allowed offline automated strain analysis. The endocardial boundary of LA was traced to measure the strain. After checking each segment's tracking, longitudinal strain curves were generated.

Data Was analysed using SPSS 28. Numeric data was expressed as means and standard deviations, while categorical data was expressed as frequencies and percentages. One-way analysis of variance (ANOVA) was used to compare quantitative data among the groups. If the total impact was large, post-hoc analysis was done. All analyses were Bonferroni-corrected. Chi-square or Fisher's exact test was used to compare categorical data, as appropriate. Correlation analysis utilised Spearman's. CHA2DS2-VASc score was predicted using multivariate linear regression. Confidence intervals (CIs) and regression coefficients were computed. P<0.05 was considered statistically significant.

Approval code: MKSU 50- 6- 10

Results

Of the 90 subjects, there were 30(33.3%) in each of the 3 groups. The mean age in group I was 58±4 years, in group 2 it was 64±9 years and in group III it was 60±9 years (p=0.014). Group II had a stronger association with DM, HTN, HF, stroke and vascular disease than the other 2 groups (p<0.001). Pulse rate in group I was 79±10b/m, in group II it was 80±10b/m and in group III it was 73±9b/m (p=0.011). The groups were not different in terms of gender (p=0.051), systolic blood pressure (SBP) (p=0.994), diastolic blood pressure (DBP) (p=0.458), weight (p=0.097), height (p-=0.164) and body surface area (BSA) (p=0.062) (Table 1). Conventional echocardiographic measurements and speckle tracking parametres showed signficant differences except for left ventricular end systolic volume (LVESV)

Table-1: General characteristics in the studied groups

		Group I (n = 30)	Group II (n = 30)	Group III (n = 30)	*p-value*
Age (years)	Mean ±SD	58 ±4 a	64 ±9 b	60 ±9 a,b	0.014
Gender	Males n (%)	16 (53.3)	9 (30.0)	18 (60.0)	0.051
	Females n (%)	14 (46.7)	21 (70.0)	12 (40.0)	
Diabetes mellitus	n (%)	0 (0.0)	18 (60.0)	0 (0.0)	<0.001
Hypertension	n (%)	0 (0.0)	22 (73.3)	0 (0.0)	<0.001
Heart failure	n (%)	0 (0.0)	9 (30.0)	0 (0.0)	<0.001
Stroke	n (%)	0 (0.0)	11 (36.7)	0 (0.0)	<0.001
Vascular disease	n (%)	0 (0.0)	16 (53.3)	0 (0.0)	<0.001
Systolic blood pressure	Mean ±SD	116 ±12	116 ±11	117 ±11	0.994
Diastolic blood pressure	Mean ±SD	73 ±8	72 ±8	75 ±10	0.458
Weight (kg)	Mean ±SD	76 ±10	71 ±11	76 ±11	0.097
Height (cm)	Mean ±SD	169 ±11	165 ±12	171 ±12	0.164
BSA	Mean ±SD	1.88 ±0.16	1.8 ±0.18	1.9 ±0.19	0.062
Pulse	Mean ±SD	79 ±10 a	80 ±10 a	73 ±9 b	0.011

BMI: Body mass index, CAD: Coronary artery disease, SD: Standard deviation.

Table-2: Echo and speckle tracking characteristics among the study groups.

		Group I (n = 30)	Group II (n = 30)	Group III (n = 30)	*p-value*
LAAP diameter	Mean±SD	4 ±0.2 a	4.6 ±0.3 b	3.1 ±0.2 c	<0.001
LAVI	Mean±SD	37.05 ±5.69 a	58.17 ±10.55 b	24.24 ±6.4 c	<0.001
LAEF	Mean±SD	33 ±2.82 a	22.67 ±1.92 b	58.13 ±6.67 c	< 0.001
Peak E	Mean±SD	61 ±6 a	56 ±8 a	72 ±14 b	< 0.001
Septal e`	Mean±SD	6.33 ±0.76 a	3.93 ±0.78 b	12.3 ±3.61 c	< 0.001
E/e`	Mean±SD	9.78 ±0.87 a	14.92 ±1.23 b	6.31 ±1.67 c	<0.001
LA strain	Mean±SD	19.8 ±1.5 a	11.8 ±1.6 b	47.0 ±8.2 c	<0.001
LVESV	Mean±SD	26.97 ±7.45	27.7 ±7.16	28.07 ±7.18	0.838
LVEDV	Mean±SD	60.9 ±13.5 a,b	59.3 ±11.1 a	69.1 ±15.8 b	0.015
LVEF	Mean±SD	56 ±4 a	55 ±4 a	64 ±5 b	<0.001

One-way analysis of variance (ANOVA) was employed. In the event of a significant overall impact, post hoc analysis was undertaken. Various letters imply different pairs of significance. All post hoc analyses were Bonferroni optimised.

LA AP: Left atrial antero-posterior, LAVI: Left atrial volume index, LA EF: Left atrial ejection fraction, LVESV: Left ventricular end systolic volume, LVEDV: Left ventricular end diastolic volume, LVEF: Left ventricular ejection fraction, SD: Standard deviation.

Table-3: Multivariate linear regression analysis for predicting CHA2DS2-VASc score in AF cases.

	Unstandardized B (95% CI)*	*p-value*
LA AP diameter	3.630 (3.074 - 4.186)	< 0.001
LAVI	0.099 (0.065 - 0.133)	< 0.001
LAEF	-0.178 (-0.269 - -0.087)	< 0.001
Peak E	-0.083 (-0.118 - -0.048)	< 0.001
Septal e'	-0.959 (-1.208 - -0.710)	< 0.001
E/e'	0.537 (0.396 - 0.678)	< 0.001
LA strain	-0.327 (-0.443 - -0.212)	< 0.001

*Controlled for age, gender, diabetes mellitus (DM) and hypertension (HTN).
B: Regression coefficient 95% confidence interval (CI).
CHA2DS2-VASc: Congestive heart failure, hypertension, age ≥75 (doubled), diabetes, stroke (doubled), vascular disease sex category (female), AF: Atrial fibrillation, LA AP: Left atrial antero-posterior, LAVI: Left atrial volume index, LA EF: Left atrial ejection fraction.

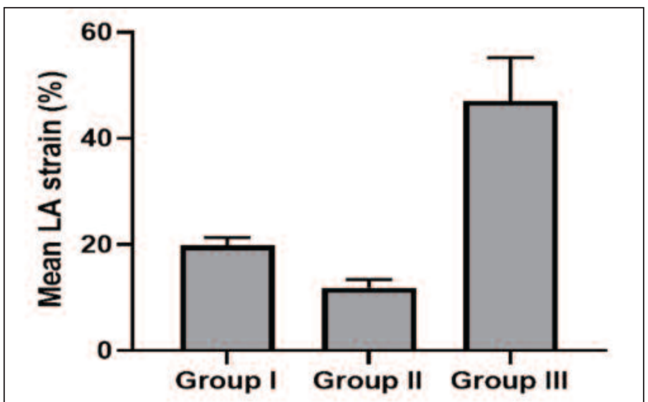

Figure: Mean left atrial (LA) strain among the studied groups.

(Table 2). Mean LA strain among the groups was also significantly different (Figure).

Multivariate linear regression analysis showed CHA2DS2-VASc score was positively correlated with 7 paramteres while controlling for the effect of age, gender, DM and HTN (Table 3).

Discussion

In the current study, AF patients showed substantially lower peak LA strain than the control group, and peak LA strain was much lower in group II than in group I. Shaikh et al.[6] reported that peak LA strain was lower in AF patients than controls. Mochizuki et al.[7] confirmed a reduction in 2D STE peak LA strain in paroxysmal and chronic AF patients.

AF patients had an impairment of LA function due to atrial ultrastructure abnormalities, including increased cell size, myolysis and perinuclear glycogen accumulation. As demonstrated by Tsai et al,[8] 6 weeks of 400 bpm atrial pacing results in isolated atrial cardiomyopathy with diminished reservoir and booster pump functions as well as higher relative conduit function and chamber stiffness. Di Salvo et al.[9] observed that myocardial atrial deformations were severely impaired throughout recent-onset AF. During ventricular ejection the lengthening of the atrium was greatly declined and so the atrial shortening in ventricular early filling. These results confirm an increase of atrial stiffness during AF, which reduced conduit and reservoir performance. The correlation of the CHA2DS2-VASc score with peak LA strain was accomplished in our study , with a significantly lesser LA strain in the high risk group in comparison with low risk one. Islas et al.[10] discovered a correlation between LA longitudinal strain and CHA2DS2-VASc. Kurosawa et al.[11] showed significant and independent connection between LA strain and CHA2DS2-VASc score. This is in contrast with the current findings. One of the disadvantages of the CHADS2 and CHA2DS2-VASc risk scores is the suboptimal weight of anticoagulation risk/benefits .[12] Also these risk scores preclude assessing LA contractility. Speckle monitoring is a new way to measure LA mechanical function. LA dysfunction may occur even with lone AF (LAF) which is verified by Hong et al.[13] who compared 40 paroxysmal LAF patients with 30 healthy controls in sinus rhythm in accordance with the longitudinal LA strain/strain rate for reservoir, booster and conduit function . Despite of lower LA strain and strain rate for all three phasic activities, LA volume did not differ between the patient and control groups in a study.[14] The LA mean strain was reduced even if CHADS2 was 0 as confirmed by Yihui Li et al .[15] LA strain in AF patients is reduced, with large score-related changes in another study.[16]

The current study has its limitations as the sample size was not calculated, which could have had an adverse effect on the power of the study.

Conclusion

AF lowered LA mechanical function. LA strain, LA EF and CHA2DS2-VASc score were correlated statistically.

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Conflict of Interest: None.

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