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Assessment of Left Ventricular Function in Patient with Atrial Fibrillation Uses Real-Time Triplain Speckle Tracking Incomparison with 2D Speckle Tracking.

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Abstract: Background: The Yellow Emperor's Classic of Internal Medicine by Huang Ti NeiChing SuWen contains the earliest historical account of what could be atrial fibrillation (AF), dating back some 4000 years. AF is now considered to be the most common arrhythmia of clinical significance.
Aim: This paper focused on the assessment of left ventricular systolic function using (triplane speckle tracking strain) and compare with two-dimensional speckle tracking to identify its role as a predictor of subclinical left ventricular systolic dysfunction in AF patients with normal ejection fraction.
Patients and methods: Our study was interested to study patients with normal ejection fraction by assessing left ventricular systolic function by sing (triplane speckle tracking strain) as well as compare with two-dimensional speckle tracking to identify its role as a predictor of subclinical left ventricular systolic dysfunction in AF. Our study was based on databases collected from hospitals in Baghdad-Iraq between 16th July 2021 and 18th September 2022. The paper also used quantitative data, including percentages, means, standard deviations, and ranges, to analyze various variables.
Results and discussion: As many of our patients have atrial fibrillation, we expect the presence of subtle LV systolic dysfunction despite a normal left ventricular ejection fraction (LV EF). This condition is known as heart failure with preserved left ventricular ejection fraction (HFPEF). In addition, GLS in AF patients was significantly influenced by LVEF, E, and E'. AF involves a reduction in atrial mechanical contraction, resulting in impaired LV filling, which can adversely affect haemodynamic performance and cause LV systolic dysfunction.
Conclusion: Triplane echocardiography allows for the assessment of LV GLS in a single beat, making Real-Time triplane a simple tool to use for AF patients. Triplane echocardiography allows for the assessment of LV GLS in a single beat, making Real-Time triplane a simple tool to use for

AF patients. In addition, this study presents evidence that GLS is more impaired in AF patients than in those without AF.

Key words: Atrial Fibrillation (AF); Left Ventricular Function; Triplain Speckle Tracking; 2D Speckle Tracking.

Introduction

The Yellow Emperor's Classic of Internal Medicine by Huang Ti NeiChing SuWen contains the earliest historical account of what could possibly be atrial fibrillation (AF) approximately 4000 years ago. Einthoven made the first electrocardiographic recording of atrial fibrillation in 1906, while Adams documented the association of mitral stenosis and irregular pulses using Laennec´s newly invented stethoscope [1]. AF is presently considered the most prevalent arrhythmia with clinical significance. The incidence of AF rises significantly as individuals age. Roughly 33% of all hospitalizations associated with arrhythmias are due to AF. Atrial fibrillation is the prevalent arrhythmia that practitioners encounter and the frequent cause of hospitalization with regards to arrhythmias [2-6]. AF is linked to an approximate five-fold rise in the risk of stroke and a two-fold rise in the risk of all-cause mortality. AF is also connected to the emergence of heart failure. While the risk of developing AF tends to increase in cases of heart failure in both men and women, AF is also recognized as a source of heart failure symptoms. Congenital heart disease, perimyocarditis, and hypertrophic cardiomyopathy are all recognised to be linked with AF [3,4], alongside non-cardiac factors such as hyperthyroidism, alcohol abuse, diabetes mellitus, electrolyte imbalances, and chronic obstructive pulmonary disease. Atrial fibrillation (AF) is a prevalent arrhythmia that presents a significant independent risk factor for stroke and has a notable impact on lifespan, increasing all-cause and cardiovascular mortality rates by approximately double. Chronic AF results in a marginally elevated risk of mortality [5-8]. Risk factors for stroke in non-valvular AF include advanced age (over 65 years), diabetes, hypertension, heart failure, previous stroke, or transient ischaemic attack, as well as echocardiographic atrial enlargement or ventricular systolic dysfunction. AF is the most common sustained arrhythmia and is characterised by disorganised, rapid, and irregular atrial activation. AF is the most common sustained arrhythmia and is characterised by disorganised, rapid, and irregular atrial activation. It is necessary to explain technical term abbreviations when first used. The ventricular response to the rapid atrial activation is also irregular. In the untreated patient, the ventricular rate also tends to be rapid and is entirely dependent on the conduction properties of the AV junction. Although typically, the rate will vary between 120 and 160 beats/min, in some patients, it can be >200 beats/min [9-12]. In other patients, because of heightened vagal tone or intrinsic AV nodal conduction properties, the ventricular response is <100 beats/min and occasionally even profoundly slow. The mechanism for AF initiation and maintenance, although still debated, appears to represent a complex interaction between drivers responsible for the initiation and the complex anatomic atrial substrate that promotes the maintenance of multiple wavelets of (micro) reentry [13,14]. This paper was focused on the assessment of the left ventriclar systolic function using (triplane speckle tracking strain) and compare it with two-dimension speckle tracking to identify its role as a predictor of subclinical Left ventriclar systolic dysfunction in atrial fibrillation patients with normal ejection fraction.

Patients and methods

Our study was interested to study patients with normal ejection fraction by assessing left ventricular systolic function by sing (triplane speckle tracking strain) as well as compare with two-dimensional speckle tracking to identify its role as a predictor of subclinical left ventricular systolic

dysfunction in AF. Our study was based on databases collected from hospitals in Baghdad-Iraq between 16th July 2021 and 18th September 2022.

To construct the results methodology, left ventricular ejection fraction (LVEF) was assessed using several methods, including ocular assessment and the biplane Simpson method. The eyeball method relies on operator experience and is subjective, leading to potential missed findings and underestimation of LVEF, particularly in patients with near-normal EF.

To progress with outcomes methodology, triplane echocardiography can assess a single beat of Left Ventricular Global Longitudinal Strain (LV GLS), which allows it easier to measure accurately for AF patients. The use of real-time triplane imaging in AF patients can avoid beat-to-beat variability in the cardiac cycle, resulting with more accurate measurements of LV GLS.

The paper calculated Pearson correlation coefficients to assess the correlation between quantitative variables, with associated t-tests to test the significance of the correlation. The coefficient of determination (r2) was also calculated to determine the proportion of variation in one variable that can be explained by knowing the values of another variable. In addition, specific variables such as mitral annular plane systolic excursion (MAPSE), EF, FS, S', Ee,' LVIDD, LVIDS, LVEDV, LVESV, and left atrial dimension (LA) were measured and compared between the AF and control groups.

Results

Table 1: Initial clinical characteristics of the Study Group.

		AF (Group I)		Control Group II		P-value
		No	%	No	%	
Age (years)	Mean±SD (Range)	48.2±12.2 (25-81)		46.4±13.1 (20-84)		0.203
Gender	Male	48	48.0	58	58.0	0.157
	Female	52	52.0	42	42.0	
IHD & MI	Yes	29	29.0	1	1.0	0.001*
	No	71	71.0	99	99.0	
Valvular Heart Disease	Yes	6	6.0	2	2.0	0.149
	No	94	94.0	98	98.0	
Hypertension	Yes	50	50.0	41	41.0	0.201
	No	50	50.0	59	59.0	
Heart failure	Yes	15	15.0	-	-	-
	No	85	85.0	100	100	
Congenital Heart Disease	Yes	3	3.0	-	-	-
	No	97	97.0	100	100	

Pericardial disease	Yes	1	1.0	-	-	-
	No	99	99.0	100	100	
Alcohol	Yes	8	8.0	7	7.0	0.854
	No	92	92.0	93	93.0	
Smoking	Yes	26	26.0	26	26.0	-
	No	74	74.0	74	74.0	
Chest infection	Yes	12	12.0	15	15.0	0.535
	No	88	88.0	85	85.0	
Idiopathic	Yes	21	21.0	-	-	-
	No	79	79.0	100	100	
Drugs	Yes	3	3.0	2	2.0	0.732
	No	97	97.0	98	98.0	
Thyroid disease	Yes	2	2.0	-	-	-
	No	98	98.0	100	100	
***Significant difference between proportions using Pearson Chi-square test at 0.05 level**						

Table 2: Distribution of echo data accoding to AF (Group I) and control (Group II).

	(Group I) AF	(Group II) Control	P-value
LVIDD	52.57±6.71 (26.0-71.0)	50.37±3.91 (41.0-65.0)	0.005*
LVIDS	32.76±6.25 (20.0-59.0)	29.27±3.63 (22.0-40.0)	0.0001*
LVEDV	115.79±30.44 (18-200)	101.05±20.57 (56-214)	0.0001*
LVESV	48.92±14.41 (13.0-95.0)	42.74±8.17 (20.0-71.0)	0.0001*
IVSD	10.05±1.98 (6.0-17.0)	9.26±1.32 (6.0-13.0)	0.001*
IVSS	14.03±2.52 (9.0-22.0)	13.88±1.97 (9.0-21.0)	0.639
LA	40.02±6.29 (10.0-59.0)	35.34±2.32 (30.0-39.0)	0.0001*
EF%	56.11±9.28 (29.0-74.0)	63.95±5.30 (47.0-80.0)	0.0001*
FS%	34.75±6.68 (17.0-50.0)	37.63±5.04 (25.0-49.0)	0.001*
Mapse	10.38±1.81 (7.0-15.0)	12.83±1.44 (11.0-20.0)	0.0001*
s'cm\s	8.78±1.38 (6.0-15.0)	10.64±1.06 (6.0-13.0)	0.0001*
E\e'	**12.87±1.24 (11.0-16.0)**	**8.94±2.01 (5.0-13.0)**	**0.0001***

Table 3: Assessment of LV function in both studied Groups using 2D and 3P (triplane).

		(Group I) AF		Group II		P-value
		No	%	No	%	
EF%	Abnormal <52%	29	29.0	2	2.0	0.0001*

	Normal (EF=>54)	71	71.0	98	98.0	
Diastolic function	Abnormal	86	86.0	-	-	-
	Normal	14	14.0	100	100	
GLS BY 2D 3CH%	abnormal	95	95.0	5	5.0	0.0001*
	Normal	5	5.0	95	95.0	
GLS BY 3P 3CH%	abnormal	96	96.0	13	13.0	0.0001*
	Normal	4	4.0	87	87.0	
GLS BY 2D 4CH%	abnormal	98	98.0	20	20.0	0.0001*
	Normal	2	2.0	80	80.0	
GLS BY 3P 4CH%	abnormal	99	99.0	33	33.0	0.0001*
	Normal	1	1.0	67	67.0	
GLS BY 2D 2CH%	abnormal	92	92.0	3	3.0	0.0001*
	Normal	8	8.0	97	97.0	
GLS BY 3P 2CH%	abnormal	98	98.0	8	8.0	0.0001*
	Normal	2	2.0	92	92.0	
Average GLS BY 2D%	abnormal	99	99.0	3	3.0	0.0001*
	Normal	1	1.0	97	97.0	
Average GLS BY 3P%	abnormal	99	99.0	16	16.0	0.0001*
	Normal	1	1.0	84	84.0	
***Significant difference between proportions using Pearson Chi-square test at 0.05 level**						

Table 4: Assessment of LV systolic function by GLS in two studied Groups using modes 2D and 3P, as shown below.

	AF	**Control**	**P-value**
GLS BY 2D 3CH%	-13.82±3.38 (-19.7--3.3)	-20.48±2.22 (-31.6--15.3)	0.0001*
GLS BY 3P 3CH%	-12.81±3.44	-19.29±2.37	0.0001*

	(-19.5--3.1)	(-24.0--9.4)	
GLS BY 2D 4CH%	-13.08±3.32 (-19.7--3.9)	-19.27±2.06 (-26.2--12.0)	0.0001*
GLS BY 3P 4CH%	-12.18±3.21 (-21.9--3.5)	-18.73±1.78 (-27.0--15.5)	0.0001*
GLS BY 2D 2CH%	-13.97±3.37 (-20.8--4.3)	-19.88±1.80 (-25.0--16.3)	0.0001*
GLS BY 3P 2CH%	-13.09±3.16 (-18.4--3.3)	-19.56±1.79 (-25.9--16.8)	0.0001*
Average GLS BY 2D%	-13.57±3.17 (-18.1--4.3)	-19.91±1.66 (-24.4--16.4)	0.0001*
Average GLS BY 3P%	**-12.70±3.13 (-18.0--4.0)**	**-19.19±1.57 (-24.3--15.7)**	**0.0001***

Table 5: (A) Comparison between 3p and 2D in AF (Group I) and control (Group II).

	Average GLS BY 3P%		**Average GLS BY 2D%**		**P-value**
	No	Mean ± SD	No	Mean ± SD	
AF Group					
EF Dysfunction (EF<52)	29	-11.23±3.89	29	-12.05±3.84	0.017*
Normal (EF=>54)	71	-13.30±2.55	71	-14.20±2.64	0.0001*
Control Group					
EF Dysfunction (EF<52)	2	-21.15±4.45	2	-20.20±1.84	0.698
Normal (EF=>54)	**98**	**-19.14±1.49**	**98**	**-19.91±1.66**	**0.0001***

Table 5: (B) Relation between global longitudinal strain by 2d and GLS by 3p.

		GLS BY 3P 3CH%	**GLS BY 3P 4CH%**	**GLS BY 3P 2CH%**	**Average GLS BY 3P%**
GLS BY 2D 3CH%	**r**	0.794**			
	P	0.0001			
GLS BY 2D 4CH%	**r**		0.697**		
	P		0.0001		
GLS BY 2D 2CH%	**r**			0.849**	
	P			0.0001	
Average GLS BY 2D%	**r**				0.870**
	P				**0.0001**

Table 6: Correlation between lv GLS by two modes, 2d, 3p, and echo data in a patient.

AF		**EF%**	**FS%**	**Mapse**	**s'cm\s**	**E\e'**
GLS BY 2D 3CH%	r	-0.479**	-0.369**	-0.202*	-0.444**	0.163
	P	0.0001	0.0001	0.044	0.0001	0.106
GLS BY 3P 3CH%	r	-0.390**	-0.464**	-0.239*	-0.333**	0.126
	P	0.0001	0.0001	0.017	0.001	0.212
GLS BY 2D 4CH%	r	-0.411**	-0.439**	-0.173	-0.360**	0.179

	P	0.0001	0.0001	0.085	0.0001	0.075
GLS BY 3P 4CH%	r	-0.397**	-0.372**	-0.265**	-0.391**	0.276**
	P	0.0001	0.0001	0.008	0.0001	0.006
GLS BY 2D 2CH%	r	-0.349**	-0.402**	-0.145	-0.255*	0.208*
	P	0.0001	0.0001	0.149	0.010	0.038
GLS BY 3P 2CH%	r	-0.358**	-0.407**	-0.208*	-0.348**	0.124
	P	0.0001	0.0001	0.038	0.0001	0.219
Average GLS BY 2D%	r	-0.444**	-0.443**	-0.194	-0.386**	0.228*
	P	0.0001	0.0001	0.053	0.0001	0.022
Average GLS BY 3P%	r	-0.399**	-0.435**	-0.251*	-0.382**	0.179
	P	**0.0001**	**0.0001**	**0.012**	**0.0001**	**0.075**

Table 7: Correlation of multivariate with conventional echo data in AF patients.

AF		**EF%**	**FS%**	**Mapse**	**s'cm\s**	**E\e'**
LVIDD	r	-0.257**	-0.141	-0.219*	-0.306**	-0.045
	P	0.010	0.161	0.029	0.002	0.656
LVIDS	r	-0.403**	-0.409**	-0.268**	-0.367**	0.043
	P	0.0001	0.0001	0.007	0.0001	0.670
LVEDV	r	-0.029	0.036	0.034	-0.080	0.213*
	P	0.774	0.725	0.741	0.426	0.033
LVESV	r	-0.204*	-0.022	-0.149	-0.218*	0.120
	P	0.042	0.831	0.140	0.029	0.233
IVSD	r	-0.155	-0.030	0.138	-0.036	0.162
	P	0.124	0.764	0.172	0.722	0.108
IVSS	r	-0.119	0.185	0.154	0.037	-0.082
	P	0.239	0.066	0.126	0.718	0.417
La	r	-0.396**	-0.294**	-0.146	-0.184	0.072
	P	0.0001	0.003	0.148	0.067	0.475
EF%	r	1	0.563**	0.256*	0.251*	-0.041
	P		0.0001	0.010	0.012	0.683
FS%	r	0.563**	1	0.274**	0.269**	-0.130
	P	0.0001		0.006	0.007	0.196
Mapse	r	0.256*	0.274**	1	0.534**	-0.101
	P	0.010	0.006		0.0001	0.319

s'cm\s	r	0.251*	0.269**	0.534**	1	-0.246*
	P	0.012	0.007	0.0001		0.014
E\e'	r	-0.041	-0.130	-0.101	-0.246*	1
	P	**0.683**	**0.196**	**0.319**	**0.014**	

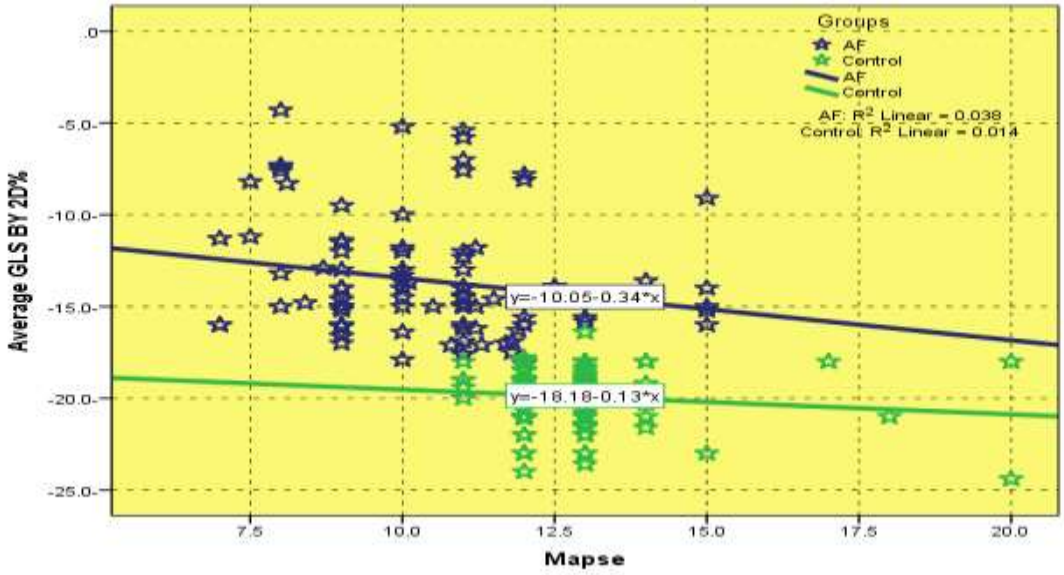

Figure 1: Shows linear correlation between MAPSE and average GLS by 2d indirect correlation between two measurements.

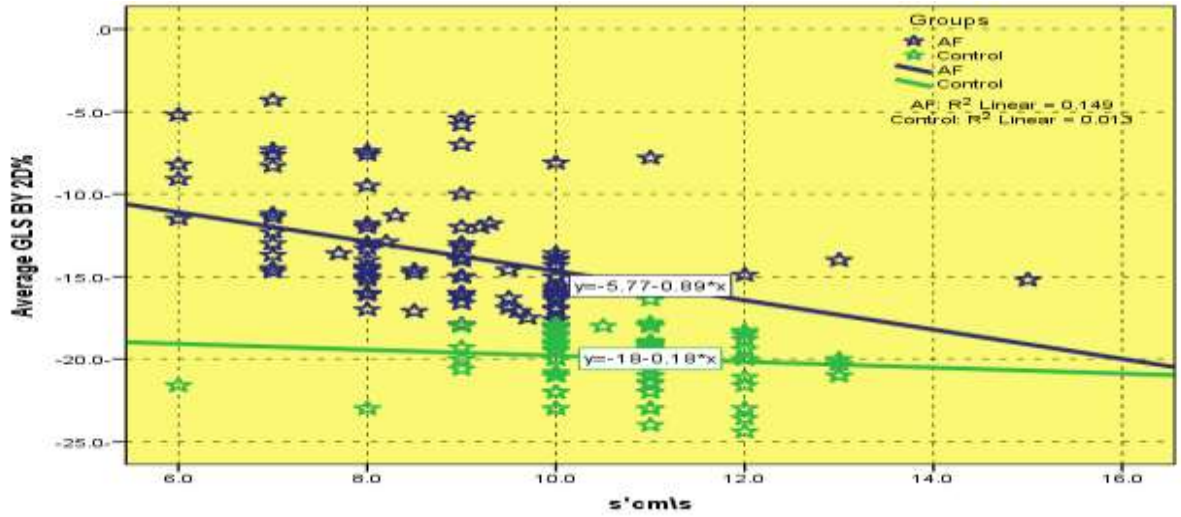

Figure 2 shows a linear correlation between average GLS AND S'.

Discussion

The early identification of subclinical systolic dysfunction provides valuable information for implementing prevention and control interventions against heart failure. As many of our patients have atrial fibrillation, we anticipate the presence of subtle LV systolic dysfunction despite a normal left ventricular ejection fraction (LV EF). This medical condition is referred to as heart failure with

preserved left ventricular ejection fraction (HFPEF) [15]. It is now possible to identify this condition by examining the LV strain and rotation (twist and torsion) in order to determine the severity of LV systolic dysfunction. LV mechanics help to differentiate between patients with HFpEF and heart failure with reduced EF (HFrEF). In this study, we compared clinical and echocardiographic parameters between patients with and without AF, as well as determinants of GLS in all patients and those with AF. When compared to age, gender, and LVEF-matched non-AF patients, those with AF exhibited significantly impaired GLS. As a result, AF per se was found to be a major determinant of GLS, even after adjusting for baseline and echocardiographic characteristics. [16]

Furthermore, the GLS in AF patients was significantly influenced by LVEF, E, and E'. AF involves a reduction in atrial mechanical contraction, resulting in impaired LV filling, which can negatively impact hemodynamic performance and cause LV systolic dysfunction. Technical abbreviations will be explained upon their first usage. In addition, paroxysmal tachycardia - often present in AF patients - may result in cardiomyopathy and consequent systolic dysfunction. Although good rate control can significantly improve insufficient ventricular filling in AF patients, the lack of atrial booster pump function can still hinder LV systolic function [17]. Hence, AF ought to be considered a crucial factor in LV systolic function. Browen and colleagues indicated that GLS is a reliable method for measuring global LV function and has a strong correlation with LVEF. Our study similarly found a substantial correlation between GLS and LVEF. Galderisi and colleagues also reported a significant correlation between GLS and LV diastolic function. The usefulness of E' as a parameter for assessing LV diastolic function has been previously reported. Specifically, impaired GLS by 3P 4CH and by 2D 2CH and AVG GLS by 2D were observed. It is well-established that AF can lead to impaired LV diastolic function due to the absence of active atrial contraction. However, to date, no research has assessed the impact of AF on GLS, which has recently become acknowledged as a more sensitive index of early systolic dysfunction and a superior predictor of cardiovascular prognosis. [18]

Global longitudinal strain (GLS) is a contemporary clinical tool with excellent sensitivity in identifying early cardiac dysfunction prior to clinical manifestations. For instance, the strain was able to detect impeded ventricular function in patients experiencing initial septic shock despite preserving ejection fractions. GLS can also predict outcomes in patients with heart failure and myocardial infarction. However, transthoracic echocardiographic (TTE) images often produce suboptimal results when measuring strain in critically ill patients. In order to be a useful marker for left ventricular (LV) systolic function in a critical care setting, the marker should be easily obtained, even if the image quality is suboptimal [19,20].

Conclusions

To be concluded, our study found that triplane echocardiography can assess of LV GLS in a single beat, which results in real-time triplane being a simple tool to test for AF patients. This study avoids changes in cardiac cycle beats that cause high-accuracy measurements. Triplane speckle tracking is also more accurate to discover subtle LV dysfunction for AF patients when compared to two-dimensional imaging. In addition, our outcomes show that GLS is more impaired in AF patients to compare with patients without AF. Furthermore, the outcomes study was related to patients with atrial fibrillation who have normal ejection fraction on conventional echocardiography.

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