Assessment of Left Atrial Longitudinal Strain in Patients with Dilated Cardiomyopathy and Its Correlation with Occurrence of Atrial Fibrillation

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Abstract:

The study aimed to asses left atrial longitudinal strain (PALS)furthermore, its job in anticipating atrial fibrillation (AF) event in patients with expanded cardiomyopathy (DCM) with LVEF under 40% by utilizing dot following echocardiography (STE). in this examination we arbitrarily doled out 100 Egyptian patients with enlarged cardiomyopathy who were additionally ordered into two gatherings: SR gathering, 50 patients with sinus cadence and AF gathering, 50 patients with constant AF. Left atrial longitudinal strain (PALS) was estimated utilizing 2D STE. Left atrial longitudinal strain (PALS) values were altogether lower in AF bunch than in SR gathering (7.44 ±1.49% versus 15.82 ±3.15%; p <0.001). ROC examination showed that PALS under 11.1% (AUC 0.981; 95% CI 0.958–1.000; p < 0.0001) recognize SR from AF patients with DCM. End: In patients with DCM and atrial fibrillation the left atrial longitudinal strain (PALS) values are altogether lower than in patients with AF than the individuals who had saved sinus cadence, PALS cut-off worth <11.1% was appeared to have the best demonstrative exactness in foreseeing event atrial fibrillation in DCM patients and LVEF < 40%.

Keywords: Left atrium, Left atrial longitudinal strain, Speckle tracking echocardiography, Dilated cardiomyopathy, Atrial fibrillation.

1. Introduction

Atrial fibrillation (AF) and Dilated cardiomyopathy (DCM) are firmly connected. Atrial fibrillation is the most well-known supported arrhythmia in patients with DCM and Patients with DCM have a five to ten times more prominent likelihood of building up this arrhythmia than those without cardiovascular breakdown [1].

There is rising worry about contemplating and seeing left atrial structure and capacity in AF and DCM, because of their distinctive clinical ramifications in cardiovascular breakdown as decay of LA work during AF lessens LV stroke volume that may bring about creating of HF side effects. Thusly, the consequence of unusual LV work is expanded filling pressure, contrarily influencing the boundaries of LA capacity and volume [2]. Crumbling of LA work in patients with AF and DCM is related with more serious hazard for cardiovascular occasions particularly thromboembolic occasions, thus evaluation of LA structure and capacity is critical to foresee both hazard for these occasions and the achievement of forestalling them [3].

Investigation of left atrial capacity in AF and DCM with the promising instrument dot following echocardiography (STE) can clarify its job in the pathogenesis, determination, guess and the executives of this ailment and its sorts [4].

2. Patients and methods

The examination was directed on one hundred patients with DCM was led at the cardiology branch of Benha University Hospitals during the period from Jan 2019 to Dec 2019. who were additionally arranged into two gatherings: SR gathering, 50 patients with sinus mood and AF gathering, 50 patients with tireless AF.

Patients with left ventricular launch division under 40% dependent on echocardiography and the span of AF surpassed a year in AF gathering (Persistent AF) base on resting ECG. were qualified for consideration.

Avoidance measures included past history of natural valvular ailment, prosthetic valves, intra-cardiovascular shunts, embedded clinical gadgets, atrioventricular conduction aggravations, cadence other than SR or AF or powerlessness to assent for the examination.

An educated assent was acquired from the patients or their legitimate watchmen after endorsement of the Ethical Committee of Benha University of Medical Science. Segment factors and hazard factors are introduced in Table (1).

Table (1) Risk factors and demographic variables of study groups.

		SR Group		AF Group		P value
		N (50)	%	N (50)	%	
HTN		14	28%	16	32%	0.656
DM		23	46%	22	44%	0.840
Smoking		24	48%	26	52%	0.584
Family history		8	16%	5	10.0%	0.452
Gender	F	8	18%	10	20%	0.603
	M	42	84%	40	80%	
Age	Mean± SD	58.3±7.60		62.3±7.13		0.076
	Range	47-73		40-74		

All study population underwent the following diagnosticwork up
1. Full medical history including (Age, sex, symptoms suggestive of cardiac disease and current medications.
2. Twelve lead electrocardiogram (ECG) to confirm the rhythm and exclude rhythm other than SR or AF.
3. 3.Echocardiography data:Two-dimensional (2D) echocardiography and Doppler examination was performed with a 1.7 – 4 MHz transducer (Epic 7 Philips Ultrasound Machine) with simultaneous ECG signal recorded. All examinations were performed with the patients in the standard left lateral position. 2D images were acquired with a frame rate >60/s, obtained during breath hold and saved in cine-loop format from three consecutive beats.

A - Conventional two-dimensional

A comprehensive echocardiographic study to all patients including:

LV global function (Volumes and ejection fraction):

2D-mode in apical four-chamber see (A4C) and apical two-chamber see (A4C) are acquired to evaluate LV volumes and worldwide systolic capacity. Biplane Simpson's technique is the main strategy at present suggested for the estimation of LV volumes and EF utilizing 2D echocardiography. This utilizes the guideline of summation of twenty tube shaped plates of equivalent stature. Distance across of the chamber shifted relying upon the state of the LV depression. This requires the LV hole to picture in long pivot (LAX) remembering the base and peak for two symmetrical planes. The endocardial outskirt must be drawn and associated at the mitral valve level by a straight line [5]. Inbuilt programming in all the echocardiography machines would consequently partition this LV zone into twenty equivalent divisions once the LV LAX has been set apart from the summit to the center of the line joining the mitral annulus. Volume of every one of these twenty circles is summated independently in the two symmetrical planes and arrived at the midpoint of to give the LV volume. LV volumes are estimated at end diastole and end systole in both the planes and utilized in the condition for figuring the EF [5]. The quantitative assurance of EF was determined utilizing LV end-diastolic volume (LVEDV) and left ventricular end-systolic volume (LVESV) assesses as follows: (LVEF = (LVEDV − LVESV)/LVEDV X 100) [6].

LA measurements

Left atrial estimations were acquired utilizing M-Mode and 2D. LA anteroposterior distance across was estimated in parasternal long hub see (PLAX) opposite to the aortic root long pivot, at the degree of the aortic sinuses by utilizing the main edge to driving edge show at end systole, not long before mitral valve opening speaking to the maximal LA volume. LA transverse and longitudinal distances across were estimated in apical four-chamber see [7].

LA volumes and capacity

2D echocardiography was performed to survey LA volumes toward the finish of systole (LAVmax) and toward the finish of diastole (LAVmin), in both apical four-chamber and apical two-chamber sees. The technique for plates (biplane altered Simpson strategy) is the favored technique for computing LA volume as indicated by the ASE rules. Most extreme LA volume (LAV max, estimated on the 2D outline not long before mitral valves opening) and least LA volume (LAV min, the littlest LA volume estimated on the edge at end-diastole touching to mitral valve conclusion) were figured independently [6]. 2D LA pictures were autonomously gotten and advanced in anticipation of volume measurement. Initially, most extreme volume at end-systole was distinguished. LA endocardial outskirts in the A4C and A2C sees were followed. The following of the left chamber was finished by drawing a line from one part of the annulus to the contrary side. The atrial member and pneumonic veins were avoided in this following. The length of the left chamber was estimated in both the A4C and A2C sees. This length was estimated from the focal point of the mitral annulus to the inward edge of the farthest degree of the followed predominant LA divider, at the inexact midpoint. Ultrasound framework naturally determined LA biplane volume utilizing biplane plate summation. With the strategy for circles, the more drawn out of the two lengths estimated ought to be utilized. The accompanying list of LA work were determined: LA discharging portion (LAEF) = (LAVmax – LAVmin)/LAVmax ×100% [8].

B-2D spot following echocardiography

Apical four-chamber see were gotten utilizing customary 2D dark scale echocardiography, with stable ECG recording. In SR Patients, three back to back cardiovascular cycles were recorded and found the middle value of, however in AF patients an arrived at the midpoint of estimation of practically five successive beats is required. The edge rate was set between 60 – 80 edge for every second (FPS). Chronicles were prepared utilizing explicit acoustic-following programming normally accessible on devoted workstation, taking into consideration a disconnected semi-mechanized examination of dot based strain [9].

The endocardial surface of every LA divider (septal, parallel) is physically followed in apical four view by an and click approach. Following of LA endocardial surface was done in brokenness with its intersection with the pneumonic veins and LA extremity. An epicardial surface following is then naturally produced by the framework [10]. After manual following, the product naturally isolated each divider into three (apical, mid, basal) fragments. The subsequent following quality for each fragment is consequently scored as either worthy or non-satisfactory, with the chance of further manual amendment. Sections in which no sufficient picture quality can be gotten are dismissed by the product and rejected

from the examination. In subjects with satisfactory picture quality, the three fragments of each divider are totally broke down and LA strain bend naturally acquired. In conclusion the product created the longitudinal strain bends for each fragment and a mean bend of all portions that mirror the pathophysiology of atrial capacity [11]. Setting zero endure LV end-diastole, the LA strain design is described by an overwhelming positive wave that tops toward the finish of ventricular systole, trailed by two unmistakable sliding stages in early diastole and late diastole [12]. The systolic segment of LA strain generally reflects LA supply work, though the early diastolic and late diastolic parts for the most part reflect LA channel capacity and LA contractile capacity, individually. Pinnacle atrial longitudinal strain (PALS) which is the most powerful proportion of LA work (for the most part the repository work), was then dictated by ascertaining the normal of the all LA divider fragments toward the finish of LV systole [12].

2.1 Statistical analysis

Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 25 (IBM Corp., Armonk, NY, USA). Data was summarized using mean and standard deviation for quantitative variables. Qualitative data were expressed as frequency and percentage. Comparisons between groups were done using unpaired t test. Multivariant Logistic regression was done to detect independent predictors of AF. Receiver operating characteristic (ROC) curve analysis was used to identify optimal cut-off values of PALS for prediction of AF. Area Under Curve (AUC) was also calculated. Criteria to qualify for AUC were as follows: 0.90 – 1 = excellent,

0.80-0.90 = good, 0.70-0.80 = fair; 0.60-0.70 = poor; and 0.50-0.6 = fail. The optimal cutoff point was established at point of maximum accuracy. p-value <0.05 was considered significant, p-value <0.001.

3. Results

There was no significant statistical difference between the 2 groups as regarding the age (p = 0.076) and Gender (p = 0.603). In patients of SR group, 42 patients (84%) were males and 8 patients (16%) were females and their age ranged from 47-73 years, with mean age of 58.3±7.60. In patients of AF group, 40 patients (80%) were males and 10 patients (20%) were females and their age ranged from 40-74 years, with mean age of 62.3±7.13 Table (1).

There was no significant statistical difference between the 2 groups as regarding risk factors; 14 patients (28%) were hypertensive in SR group vs. 16 patients (32%) in AF group (p = 0.656). In addition, 23 patients (46%) were diabetic in SR group vs. 22 patients (44%) in AF group (p = 0.840). Also 24 patients (48%) were smokers in SR group vs. 26 patients (52%) in AF group (p = 0.584) and 8 patients (16%) had positive family history for DCM an CAD in SR group vs. 5 patients (10%) in AF group (p = 0.452) Table (1).

At presentation, patients of AF group had significantly greater heart rate 80.38±5.13 vs. 79.14±6.31 bpm for SR group; P <0.001. while there was no significant statistical differences were found in both systolic, diastolic and mean blood pressure (SBP, DBP and MAP respectively) between SR and AF group: (108.32± 11.37 vs. 105.38 ± 8.33 mmHg; P= 0.140, 68.48±2.83 vs. 65.38±2.87 mmHg; P =0.057 and 89.88± 6.61 vs. 87.24± 3.84 mmHg; P =0.493 respectively Table (2).

Table (2) General Clinical Signs in the two groups.

	SR Group			AF Group			P value
	Mean	SD	Range	Mean	SD	Range	
HR	79.14	6.31	69.0- 87.0	89.38	5.23	81.0 -98.0	< 0.001
SBP	108.32	11.37	92.0 -125.0	105.38	8.33	95.00 -120.0	0.140
DBP	68.48	2.83	65.0- 71.0	65.38	2.87	65.00 -73.0	0.057
MAP	89.88	6.61	79.0 -99.0	87.24	3.84	83.00 -96.0	0.493

Echocardiographic parameters in the two studied groups

- On comparing conventional echocardiographic measurements in the studied groups, the anteroposterior LA diameter was significantly greater in AF group: (5.47±0.28 vs. 4.63±0.28 cm in SR group; p < 0.001.
- Also, the longitudinal and transverse LA diameter were significantly greater in AF Group: (6.89±0.41 vs. 6.13±0.31 cm in SR group; p < 0.001 and 5.7±0.39 vs. 4.82±0.31 cm in SR group; p< 0.001, respectively.
- Also, the LA volumes (maximal and minimal) were significantly greater in AF Group: (129.2±23.43 vs. 96.24±21.35; P < 0.001 and 84±19.11 vs. 68.52±23.54; p <0.001); respectively.

- LA emptying fraction was significantly reduced in patients of AF Group: (28.66±4.34 % vs. 35.34 ±3.57 % in SR group; P < 0.001).
- Peak atrial longitudinal strain (PALS) was significantly reduced in patients of AF Group compared with patients of SR Group (7.44 ±1.49 vs 15.82 ±3.15; p<0.001).
- There was no significant statistical differences between AF and SR group as regarding left ventricular end systolic volume (LVESV), left ventricular end diastolic volume (LVEDV) and left ventricular ejection fraction (LVEF): (131.7±11.17 vs 129.76±19.11 ml; p =0.730, 159.8±12.33 vs 166.98±25.46 ml; p=0.051) and (31.70±3.63 vs 29.84±4.18 %; p=0.229) ; respectively Table (3).

Table (3) 2D echocardiography and STE results among study groups.

	SR Group			AF Group			P value
	Mean	SD	Range	Mean	SD	Range	
LAD AP, cm	4.63	0.28	4.0 - 5.0	5.47	0.28	4.80-6.00	< 0.001
LAD, cm Longitudinal	6.13	0.31	5.70- 6.80	6.89	0.41	6.00-7.60	<0.001
LAD, cm Transverse	4.82	0.31	4.20-5.30	5.70	0.39	4.90-6.30	<0.001
LAVmax, ml	96.44	21.35	66-142	129.2	23.43	87-167	< 0.001
LAVmin, ml	68.62	23.54	36-106	85.32	19.11	55-115	< 0.001
LAEF, %	35.34	3.57	29-42	28.66	4.34	23.9-32	< 0.001
PALS, %	15.82	3.15	7.40-20.6	7.44	1.49	5.40-11.40	< 0.001
LVESV, ml	129.76	19.11	98-158	131.7	11.17	110-150	0.730
LVEDV, ml	166.98	25.46	136-212	159.8	12.33	132-188	0.051
LVEF, %	29.84	4.18	23-37	31.70	3.63	25.-37	0.229

Regression analysis

Left Atrial diameters, volumes and function indexes showed significant differences between AF and SR group, as anteroposterior, longitudinal, transverse LA diameters, LAVmax and LAVmin were significantly greater in the AF group, whereas LAEF and PALS were significantly lower in AF group.

Multivariate logistic regression was done using the above 7 parameters showed that LAVmin and PALS were independent predictors for AF occurrence in DCM patients where the PALS is the most significant independent predictor of AF Table (4).

Table (4) Multivariate logistic regression analysis for prediction of AF in DCM patients.

		P value	OR	95% C.I.	
				Lower	Upper
AF	LAVmin	0.033	0.920	0.853	0.992
	PALS	<0.001	0.320	0.206	0.502

ROC curve

The receiver-operator characteristic (ROC) curve was used to test diagnostic value of PALS in predicting occurrence of atrial fibrillation in patients with DCM.

PALS cut-off value <11.1% was shown to have the best diagnostic accuracy (sensitivity = 96%; specificity = 96%) in predicting occurrence atrial fibrillation in DCM patients Table (5), Fig (1).

Table (5) ROC analysis for prediction of AF using PALS.

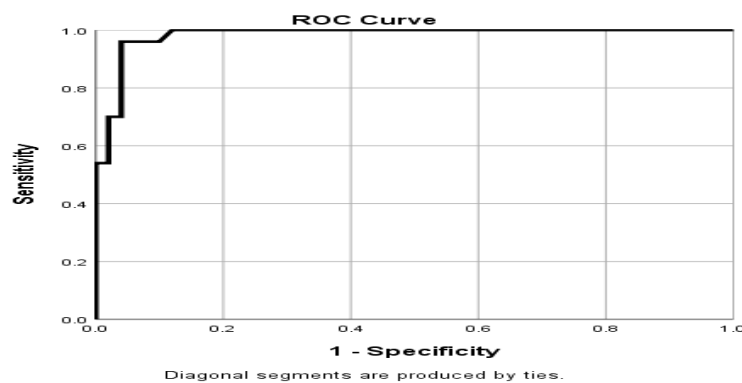| AUC	P value	95% Confidence Interval		Cut-off value	Sensitivity (%)	Specificity (%)
		Lower Bound	Upper Bound			
0.981	<0.001	0.958	1.000	11.1	96	96

Fig (1) ROC curve for prediction of AF using PALS.

4. Discussion

Atrial fibrillation and cardiovascular breakdown are two of the most common cardiovascular malady conditions. They frequently exist together and lead to noteworthy bleakness and mortality. Sufficient administration methodologies for this double scourge keep on being the subject of many exploration contemplates. The evaluation of left atrial (LA) work is utilized in different cardiovascular ailments as LA assumes a correlative job in heart execution by balancing left ventricular (LV) work [3].

Transthoracic two-dimensional and Doppler echocardiography can gauge LA work non-intrusively. Be that as it may, assessment of left atrial capacity in AF and DCM with the promising instrument dot following echocardiography (STE) can clarify its job in the pathogenesis, analysis, anticipation and the executives of this ailment and its sorts. Ordinary reaches for LA distortion and slice off qualities to determine LA brokenness to have various illnesses have been accounted for, however information are as yet clashing [4].

The point of this examination was to evaluate the auxiliary and useful cardiovascular contrasts in 100 DCM patients. Patients were characterized into two gatherings; SR gathering, 50 patients with sinus mood and AF gathering, 50 patients with atrial fibrillation. In this examination, we utilized 2D STE to asses top atrial longitudinal strain (PALS) by 2D STE in DCM patients and recognize its job in foreseeing event of atrial fibrillation in those patients.

In our examination, there was no huge factual contrast between the two gatherings as with respect to quiet socioeconomics (age and sex). In consent to our examination, Parthenakis et al. [13] in a gathering of 147 patients with non-ischemic widened cardiomyopathy (NIDC), 40 patients with AF and 107 with SR exhibited that age and sex didn't contrast between the two gatherings. Correspondingly, Budeus et al. [14] in a gathering of 94 patients with sinus musicality were followed follow-up for a mean of 40 months for recognition of AF event in patients with heart dysfunctions found that there were no critical contrasts concerning age and sex among AF and SR patients.

What's more, in our investigation, there was no huge measurable distinction between the two gatherings as with respect to hazard factors (hypertension, Diabetes Mellitus, smoking and family). Like our investigation, Mornos et al. [15] in a gathering of 113 patients with cardiovascular breakdown for forecast of new-beginning AF, exhibited that there was no distinction as to the in regards to hazard variables and comorbidities among SR and AF patients.

At introduction, patients of AF bunch in our investigation had essentially more noteworthy pulse (HR), while there were no critical measurable contrasts found in both systolic, diastolic and mean circulatory strain (SBP, DBP and MAP separately) between the two gatherings. In concurrence with our investigation, Tuomainen et al. [16] in a gathering of 87 patients with DCM, 19 patients with AF and 68 others with SR experienced broad non-obtrusive and intrusive assessment during a hospitalization period indicated more prominent pulse in resting ECG in AF patients contrasted and those with SR. Tuomainen et al. (16) additionally found no huge factual contrasts in both systolic, diastolic and mean pulse (SBP, DBP and MAP separately) between the two gatherings.

In our investigation, we found that there were no significant contrasts in LV essential echocardiographic highlights; Left ventricular end diastolic volume (LVEDV), left ventricular end systolic volume (LVESV) and left ventricular discharge division (LVEF) between the two gatherings. In concurrence with our examination, Aleksova et al. [1] in a gathering of 539 patients, 52 of them had AF analyzed the prognostic ramifications of AF in a subset of patients with IDCM found no significant contrasts in left ventricular launch portion between the two gatherings at standard. Rather than our investigation, Aleksova et al. [1] in a similar report found that patients with AF at gauge had less expanded left ventricle with littler left ventricular end diastolic volume (LVEDV), left ventricular end systolic volume (LVESV). This complexity might be because of huge number of patients and diminished proportion of AF patients to add up to patients (10% of absolute examination patients), the vast majority of AF patients was guys and marginally more seasoned in the creator's investigation.

What's more, we found that left atrial measurements indicated huge contrasts among AF and SR bunch as anteroposterior, longitudinal, transverse LA breadths were more prominent in AF than SR gathering. Matei et al. [17] in a gathering 348 patients determined to have DCM with sinus musicality were followed clinically, ECG and echocardiography for a mean of 60 months found that broadening of LA distance across end up being acceptable prescient components for the nearness of changeless atrial fibrillation. In concurrence with our investigation, Tuomainen et al. [16] in a gathering of 87 patients with DCM, 19 patients with AF and 68 others with SR indicated critical increment in LA anteroposterior width in AF patients contrasted and those with SR.

We found that LAVmax and LAVmin were significantly more prominent in the AF than SR gathering, while LAEF (LA complete exhausting portion) were significantly lower in AF than in the SR gathering. Also, Cho et al. [18] in a gathering of 150 patients evaluated by strain imaging in anticipating future improvement of atrial fibrillation in patients with cardiovascular breakdown demonstrated patients who grew new AF had a bigger LA measurement and volume and lower LAEF. Additionally, Sade et al. [19] in a gathering of 106 patients in patients with LVEF < 35% Receiving CRT saw over a 5-year follow-up that diminished LAEF and increment LA volumes were related with higher hazard for creating.

We found that the PALS which speak to the dynamic repository capacity of LA was undermined in DCM patients. What's more, these capacities are more undermined if DCM is related with AF. Left atrial longitudinal strain (PALS) was significantly lower in AF than in SR gathering. Multivariate calculated relapse was done demonstrated that LAVmin and PALS were autonomous indicators for AF event in DCM patients

where the PALS is the most critical free indicator of AF. Buddies was appeared to have the best symptomatic precision in anticipating event of atrial fibrillation in DCM patients with a cut-off worth (11.1%) to separate among SR and AF gathering.

In concurrence with our examination, Motoki et al. [20] In 256 patients with AF (paroxysmal, 204; diligent, 52), After a middle of 8.0 long periods of follow-up showed the prognostic hugeness of LA strain for foreseeing sinus mood support in patients with AF after catheter removal. Motoki et al. demonstrated that LA strain was a free indicator of beat result after AF removal. Also, they saw that LA strain < 23.2% demonstrated a higher rate of AF repeat contrasted and patients with > 23.2%. Be that as it may, difference happens as PALS cut-off qualities for forecast of AF is a lot of lower in our examination since it was done on DCM patients with EF<40% yet Schneider et al. study was done on patients with typical launch part.

Likewise, Sade et al. [19] in a gathering of 106 patients in patients with LVEF < 35% Receiving CRT saw over a 5-year follow-up that diminished left atrial strain esteems was related with higher hazard for creating AF and left atrial strain saw as autonomous indicators of new AF improvement.

Schneider et al. [21] in a gathering of 118 patients with AF (74 paroxysmal AF, 44 determined AF) when removal just as during 3 months of follow-up found that PALS after catheter removal varied significantly in patients with AF and controls and found that the best individual indicators of sinus mood upkeep were cut-off estimations of 19.5% for PALS. Rather than our investigation, PALS cut-off qualities for forecast of AF is a lot of lower in our examination since it was done on DCM patients with EF<40% yet Schneider et al. study was done on patients with ordinary launch part.

Thus, Cho et al. [18] in a gathering of 150 patients evaluated by strain imaging in anticipating future advancement of atrial fibrillation in patients with cardiovascular breakdown exhibited that atrial dyssynchrony dependent on strain during the supply time frame is the most grounded indicator for new beginning AF in CHF.

Başaran et al. [22] in a gathering of 90 patients created postoperative atrial fibrillation (POAF) with protected LVEF, showed that PALS was impeded in postoperative atrial fibrillation patients and diminished PALS was a free indicator of POAF event.

5. Limitations

Our examination had a few constraints. To start with, the size of the populace test was moderately little. Bigger, multi-driven examinations ought to be finished to confirm our outcomes. Besides, we just examined a piece of LA divider in apical four perspectives, however in certain examinations, different fragments from two-chamber sees were likewise included. Thirdly, the absence of normalization in the left atrial strain estimation along with contrasts in programming between produces make our outcomes hard to contrast and others. Fourthly, the

heftiness, for example, lung weight may obstruct picture quality and the muddled endocardium may likewise influence the outcome. In addition, there is no devoted programming for atrial strain and all estimations were acted in the application at first concocted for the left ventricle.

5. Conclusion

In patients with DCM and LVEF < 40%, most of left atrial diameters, volumes and function indexes showed significant differences between AF and SR group, as anteroposterior, longitudinal, transverse LA diameters, LAVmax and LAVmin were significantly greater in the AF group, whereas LAEF and PALS were significantly lower in AF group. PALS is the most significant independent predictor of AF and PALS below (11.1%) distinguish AF from SR patients.

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