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EVALUATION OF LEFT ATRIAL FUNCTIONAL INDEX (LAFI) IN PATIENTS WITH ATRIAL FIBRILLATION AND DIASTOLIC DYSFUNCTION

Cardiology

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ABSTRACT

BACKGROUND : Left atrium is not a simple passive transport chamber that transfers blood from the pulmonary circulation to the left ventricle. Various echocardiographic parameters were available for the evaluation of LA function.
AIMS OF STUDY: Evaluation of echocardiographic rhythm independent marker of LA function Left Atrial Functional Index (LAFI) using TTE in patients with AF and diastolic dysfunction and the comparison of this LAFI to traditional parameters of LA function.
METHODS: Study was conducted in 60 persons who attended the cardiology OPD for cardiac evaluation.
RESULTS: The LAFI as measured by Echo, is decreased in patients with diastolic dysfunction and also in persons with chronic AF.
CONCLUSION: The LAFI accentuates differences between groups as compared to traditional echo parameters of LA function. In the future, the LAFI may be used as a potential target for therapeutic maneuvers.

KEYWORDS

Echo, LA function, Left Atrial Functional Index (LAFI), Atrial fibrillation. HFpEF.

AIMS AND OBJECTIVES OF THE STUDY

This study evaluates echocardiographic rhythm independent marker of left atrial (LA) function Left Atrial Functional Index (LAFI) using Transthoracic Echocardiogram in patients with atrial fibrillation and diastolic dysfunction and the comparison of this left atrial functional index to traditional parameters of left atrial function.

BACKGROUND

In the past left atrium was thought of as a simple passive transport chamber. But it is not so. During the early 1980s multiple studies were conducted to obtain normal values for left atrium. Left atrium is not a simple passive transport chamber that transfers blood from the pulmonary circulation to the left ventricle. It is a highly dynamic chamber that responds to distension by secretion of atrial natriuretic peptides. The delicate interplay between natriuresis, vasodilatation, and inhibition of the sympathetic and renin–angiotensin–aldosterone systems helps in the partial restoration of fluid and haemodynamic balance.

LA function[1] has been conventionally described in three separate phases :

First, during left ventricular (LV) contraction and isovolumetric relaxation, left atrium receives the pulmonary venous return and stores energy in the form of pressure, and thus the left atrium acts as a reservoir.

Secondly, after the opening of mitral valve, the Left Atrium transfers blood passively into the Left Ventricle during the phase of rapid filling, and during the phase of diastasis as a result of pressure gradient, and thus acting as a conduit, Thirdly, during the final phase of diastole, the Left Atrium actively contracts (booster bump) and contributes between 15 and 30% of LV stroke volume. This booster function of left atrium is important during left ventricular dysfunction.

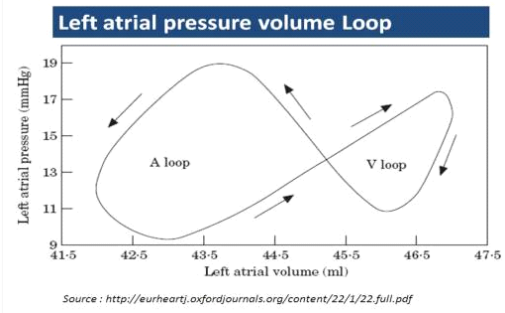


FIGURE:1

Left atrial functional index[4]

It is an echocardiographic parameter. Left atrial funtional index[4] is a ratio that involves the analogues of left ventricular stroke volume, reservoir function of left atrium and the size of the left atrium.

Left Atrial Functional Index

LAFI = LAEF X LVOT-VTI / LAESVI
(LAEF (LA emptying fraction) = ((LAESV - LAEDV)/LAESV) X100, LVOT-VTI = velocity time integral across the left ventricular outflow tract in cm LAESVI is the largest LA volume measure in ventricular systole (LAESV) in ml indexed to body surface area or ml/m2.

This means left atrial functional index is directly proportional to reservoir function of left atrium and left ventricular stroke volume, inversely proportional to the size of the left atrium.

The physiological basis[4] for the above ratio is that in normal persons the left atrium maintains its normal size (when indexed to body surface area) during normal left ventricular stroke volume, and the capability of the left atrium to contribute to the left ventricular stroke volume by tranferring most of the contents of the left atrium during every cardiac cycle.

Combination of all the above parameters leads to the development of a healthy index that is called left atrial functional index. LAFI adjusts for extremes of body weight and extremes of heart rate. In otherwords it is rhythm independent. Even though atrial contraction is important in left ventricular filling, this index is not dependent on this single variable.

In patients with atrial fibrillation and normal sized left atrium (good emptying during diastole) the LAFI should be normal.

Studies conducted in patients with atrial fibrillation[5] before and after reversion to sinus rhytm proved that left atrial functional index is a useful echocardiographic tool.

MATERIALS AND METHODS

Study was conducted in 60 persons who attend our cardiology Outpatient department for cardiac evaluation.

Echocardiography imaging was done by using PHILIPS HD 7 echo machine.

Inclusion criteria

1) Persons with chronic atrial fibrillation of any cause
2) persons with diastolic dysfunction of various grades.

Exclusion criteria

1) critically ill patients
2) pregnant and breast feeding women.
3) persons in their extremes of age.

Control

Persons who attend cardiology OPD for cardiac evaluation without history of ischemic heart disease, significant valvular heart disease, peripheral vascular disease or cerebrovascular disease, hypertension, diabetes, and without on cardioactive medications.

Study procedure

M mode, 2 D, Doppler and tissue Doppler recordings were done by transthoracic echocardiogram using PHILIPS HD 7 mechine.

In the parasternal long axis view left atrial anteroposterior diameter was obtained by M mode.

Mitral inflow velocity in cm/s was obtained by pulsed wave Doppler examination at a sweep speed of 100 mm/s from the apical 4-chamber view by placing the sample volume at the tips of the mitral leaflets.

Peak velocity of atrial contraction in diastole (A wave velocity cm/s) was measured as an average of 3 beats.

A wave TIME VELOCITY INTEGRAL was measured.

Doppler tissue imaging was obtained by placing the sample volume over the basal atrial septum with the mitral annulus and the recording was done at a sweep speed of 100cm/sec. By this e' (the peak velocity in early diastole) and a' (active atrial contraction in late diastole were recorded.

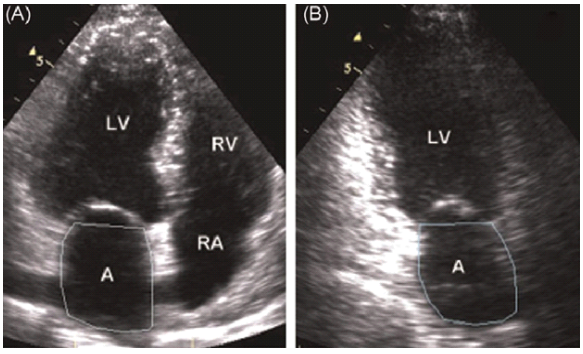
Left Atrial volumes were measured at two time points:

a) just before opening of mitral valve (maximal LA volume or LAESV);
b) at the time of mitral valve closure (minimal LA volume or LAEDV).

All volumes were calculated from apical 4- and 2-chamber views using the biplane method of discs.

The following LA emptying function parameters were derived: Left Atrial reservoir volume ml = (LAESV - LAEDV); LA emptying fraction %, LAEF = [((LAESV2 - LAEDV)/LAESV) X 100].

The maximal left atrial volume was indexed to body surface area (LAESVI ml/m2).



RESULTS

TABLE -1

AGE

	Group						P value
	Control		Diastolic Dysfunction		Atrial Fibrillation		
	Mean	SD	Mean	SD	Mean	SD	
AGE	55.16	3.45	53.56	3.88	54.80	4.73	0.344

Mean age of the patients in this study group was 53 YEARS.

TABLE-2: ANTHROPHOMETRIC PARAMETERS

	Group						
	Control		Diastolic Dys		Atrial fibrillation		P value
	Mean	SD	Mean	SD	Mean	SD	
WEIGHT Kg	60.56	6.89	61.12	7.38	57.25	7.94	0.185
HEIGHT cms	159.72	7.55	157.84	7.26	158.80	7.90	0.680
BMI	23.64	2.17	24.55	2.75	22.74	3.19	0.089
B S A	1.65	.12	1.65	.13	1.59	.14	0.284

TABLE-3: ECHOCARDIOGRAPHIC PARAMETERS ACROSS DIFFERENT GROUPS.

	Group						P value
	Control		Diastolic Dysfunction		Atrial Fibrillation		
	Mean	SD	Mean	SD	Mean	SD	
LA M MODE (mm)	34.64	4.37	44.64	6.30	48.10	7.60	0.000
LA ESV (ml)	41.00	2.66	51.60	5.46	56.20	9.76	0.000
LA EDV (ml)	22.60	3.81	38.16	6.23	43.95	9.15	0.000
LA EMPTYING FRACTION	44.52	7.41	26.00	5.08	21.65	3.54	0.000
LA STROKE VOLUME	18.40	3.06	13.40	2.04	12.25	1.48	0.000
LVEDD (mm)	46.56	3.70	50.44	4.83	50.55	6.00	0.007
LVESD (mm)	27.68	3.78	33.92	7.27	33.65	7.43	0.001
LV EJECTION FRACTION	62.44	3.07	57.08	9.87	55.30	8.70	0.007
LVOT VTI (cm)	22.68	2.78	21.48	3.55	21.90	2.38	0.360

TABLE-4: Left atrial functional index (LAFI)in patients with Diastolic dysfunction and atrial fibrillation.

	Group						P value
	Control		Diastolic Dysfunction		Atrial Fibrillation		
	Mean	SD	Mean	SD	Mean	SD	
E/e'	7.37	1.08	14.69	4.85	9.06	2.11	0.000
LAVI	24.91	2.57	31.56	4.88	35.60	6.50	0.000
LAFI	42.29	10.69	18.51	7.60	13.77	3.70	0.000

DISCUSSION

Because of the individual components used in the LAFI[4] calculation formula, which associate LA function and morphology with LV systolic function, LAFI is dependent on LA reservoir function and is adjusted for cardiac output and indexed atrial volume[6]. All these parameters are rhythm independent. Thus, LAFI can be calculated in patients with chronic and paroxysmal atrial fibrillation and in those receiving ablation for atrial fibrillation.

In this study we found that various left atrial echocardiographic parameters were affected in patients with Atrial fibrillation and also in patients with diastolic dysfunction. The main parameter Left Atrial Functional Index is very much reduced in the study group. Patients with atrial fibrillation had a mean LAFI of 13.7 compared to value of 42.2 in normal individuals. The mean LAFI was 18.5 in individuals with diastolic dysfunction. Compared to the left atrial volumic index, the variation in LAFI is much better in patients with atrial fibrillation and diastolic dysfunction.

LIMITATIONS

There are several potential limitations to our study. This was a single-centre study with a small sample size. This limits the generalizability of our findings but allows better control and compliance with the study protocol. Transthoracic 2D echo has got its own limitations like inter and intraobserver variability.

CONCLUSION

There is no single measure to evaluate atrial function and several traditional parameters are rhythm dependent. The LAFI is a rhythm independent measure of atrial function that additionally incorporates an analogue of cardiac output and BSA. The LAFI accentuates differences between groups as compared to traditional parameters of atrial function. The LAFI may be a more sensitive marker of changes in atrial function over time including in persons in whom atrial function deteriorates such as those in AF, and in whom atrial function would be expected to improve, such as after successful Cardioversion. . We found that the Left Atrial Functional Index as measured by echocardiogram, is decreased in patients with abnormal myocardial relaxation and also in persons with chronic atrial fibrillation. LAFI is a strong and independent predictor of long-term survival in stable outpatients with HFpEF[7]. LAFI provided incremental prognostic value over other clinical risk factors, heart rhythm, NT-proBNP, and echocardiographic covariates. LAFI can be used as a prognostic indicator in patients with HFpEF[3], Heart Failure with reduced ejection

fraction. (HFrEF). In the future, the LAFI may be used as a potential target for therapeutic maneuvers.

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