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GLOBAL LONGITUDINAL STRAIN EVALUATION IN HYPERTENSION WITH AND WITHOUT LEFT VENTRICULAR HYPERTROPHY BY SPECKLE TRACKING ECHOCARDIOGRAPHY

Cardiology

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ABSTRACT

Aim: Assessment of Left ventricular (LV) function in hypertensive patients with left ventricular hypertrophy (LVH) and in those without LVH using two dimensional speckle tracking echocardiography (2D-STE).

Materials and Methods: Hundred hypertensive patients were included in the study. Of these 50 patients with LVH and 50 patients with non LVH and all had normal left ventricular ejection fraction (LVEF). Two-dimensional conventional and speckle tracking echocardiography was done to all patients to assess left ventricle systolic function and global longitudinal strain.

Results: There was no significant difference between hypertensive patients with LVH and without LVH regarding age and sex distribution. There was significantly higher septal wall thickness (1.2±0.3cm p= <0.001), Posterior wall thickness (1.3±0.4cm p=<0.001), and left atrium size (3.9±0.5) in hypertensive patients with LVH (P < 0.001) compared to non LVH patients. GLS (Global Longitudinal Strain) was significantly decreased in patients with systemic hypertension with LVH (−17.4 ± 3.03) compared to no LVH (-19.6±4.6) patients (P value =0.005).

Conclusion: This study concluded that there is impairment of left ventricular (LV) systolic function detected by two-dimensional speckle tracking echocardiography in hypertensive patients, especially if associated with LVH with apparently preserved LV systolic function.

KEYWORDS

INTRODUCTION:

Hypertension is the leading risk factor for cardiovascular disease. LV hypertrophy is an independent predictor of morbidity and mortality and LV mass reduction induced by anti-hypertensive therapy improves the prognosis (1). LV dysfunction in hypertensive patients is associated increased morbidity and mortality and it has to be considered in the assessment of global cardiovascular risk (2).

While conventional echocardiography can detect changes in LV diastolic function associated with left ventricular hypertrophy (LVH), global LV systolic function often remains preserved until late in the course of the disease, making subtle changes in LV contractile function difficult to interpret in the early stages.

Analysis of myocardial strain by speckle tracking enables quantitative and detailed assessment of LV function with high level of diagnostic accuracy [3]. In contrast to Tissue Doppler imaging (TDI), speckle-tracking echocardiography (STE) is an angle-independent technique that may allow an accurate assessment of segmental myocardial deformation by grey-scale-based imaging analysis frame by frame [4].

MATERIALS AND METHODS:

Hypertensive patients were selected from the cardiology outpatient clinic. Full history taking and general and cardiac clinical examinations were done before selection. Written informed consent was obtained from all patients. This is a prospective study that was carried from Aug 2017 to March 2018 on 100 hypertensive patients.

Diagnosis of hypertension was based on ESH/ESC guidelines for management of hypertension if SBP ≥140mmHg and/or DBP ≥90mmHg on two or more hospital visits at one week interval.

Inclusion and exclusion criteria:

Inclusion criteria were any patient with chronic hypertension with or without electrocardiographic (ECG) criteria of LVH in sinus rhythm and normal ejection fraction (EF).

Exclusion criteria were any rhythm other than sinus rhythm, depressed left ventricular (LV) systolic function, significant valvular heart disease, diabetes mellitus, ischemic heart disease, cardiomyopathies and significant renal and hepatic disease.

METHODS:

All patients were subjected to proper history taking including clinical examination, measurements of heart rate, weight, and height. Body surface area and body mass index were calculated. Transthoracic echocardiography - Conventional echocardiographic Doppler study, tissue Doppler imaging, and 2D speckle tracking imaging were performed using Vivid 9 (General Electric Healthcare), equipped with harmonic M4S variable frequency phased-array transducer.

Images were obtained with patients in the left lateral decubitus position at end-expiration. All standard measurements were obtained in the parasternal long-and short-axis views, apical four-chamber view, two-chamber view, and apical long-axis view.

Quantification of the LV dimensions was done using M-mode echocardiography, and for ejection fraction using the modified Simpson's method. LV mass in grams was calculated according to area-length method and then, LV mass was normalized for body surface area to obtain LV mass index (LVMI in g/m^2). Relative wall thickness (RWT) was calculated as 2PWTd/LVEDd (where PWT is the posterior wall thickness in end diastole and LVEDD is the left ventricle end diastolic diameter).

LVH was defined by an LVM index >115 g/m2 for men or >95 g/m2 for women.

Diastolic function was assessed by recording mitral flow with standard pulsed Doppler technique and also by tissue Doppler imaging in the apical four-chamber view by placing the sample volume over the septal and lateral mitral annuli.

2D speckle tracking echocardiography:

Longitudinal strain imaging by 2D-speckle tracking echocardiography (2D-STE) was done with high-quality ECG-gated images from the apical four-chamber, two-chamber, and three-chamber views; all were obtained at nearly identical heart rates. The gain settings were optimized. The depth was reduced so that the LV occupied most of the image sector. Care was taken to avoid foreshortening of the LV, the gray-scale frame rate was kept between 50 and 90 frames/s; minimum three cardiac cycles were obtained for each loop. All the images were obtained in breath-hold to avoid any breathing artifacts. The strain values for all the segments were recorded and averaged to obtain the Global Longitudinal Strain (GLS). Lower level of normal GLS is −19.1%.(5)

RESULTS:

Clinical and demographic data of patients with systemic hypertension with and without LVH are listed in Table 1

Table1:

	Hypertensive With Lvh(n=50)	Hypertensive With No Lvh(n=50)	P value
age	54±12	55.2±10.4	0.59
male	36(72%)	38(76%)	
female	14(28%)	12(24%)	
BSA	1.68±0.3	1.69±0.2	0.8

BSA-body surface area

There was no significant difference between hypertensive patients with LVH and without LVH regarding age and sex distribution.

Conventional echocardiographic data of patients with systemic hypertension with and without LVH are listed in Table 2

Table 2:

	Hypertensive With Lvh(n=50)	Hypertensive With No Lvh(n=50)	P value
FS%	34.6±8.4	36.6±5.6	0.16
EF%	62.1±8.2	65.8±10.2	0.04
LVEDD(cm)	4.4±0.9	4.3±1.0	0.61
LVESD(cm)	3.0±0.9	3.1±1.0	0.60
IVSd(cm)	1.2±0.3	0.9±0.4	0.0001
PWTd(cm)	1.3±0.4	0.9±0.3	<0.0001
AO(cm)	3.7±0.6	3.4±0.8	0.03
LA(cm)	3.9±0.5	3.3±0.9	0.0001

AO, Aorta; EF, ejection fraction; FS, Fractional shortening; IVSd, interventricular septum in diastole; LA, left atrium; LVEDD, left ventricle end diastolic dimension; LVESD, left ventricle end-systolic dimension; PWTd, posterior wall thickness in diastole;

Table 2 revealed significantly higher septal wall thickness, Posterior wall thickness, and left atrium size in hypertensive patients with LVH ($P < 0.001$) compared to non LVH patients.

2D speckle tracking echocardiography:

Table 3:

	Hypertensive With Lvh(n=50)	Hypertensive With No Lvh(n=50)	P value
GLS	-17.4±3.03	-19.6±4.6	0.005

As shown in Figure 1, GLS (Global Longitudinal Strain) was significantly decreased in patients with systemic hypertension with LVH (−17.4 ± 3.03) compared to no LVH (-19.6±4.6) patients (P value =0.005).

Figure 1:

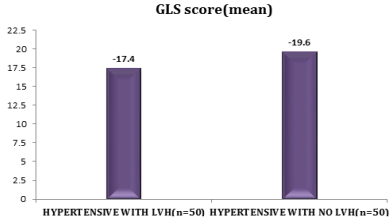
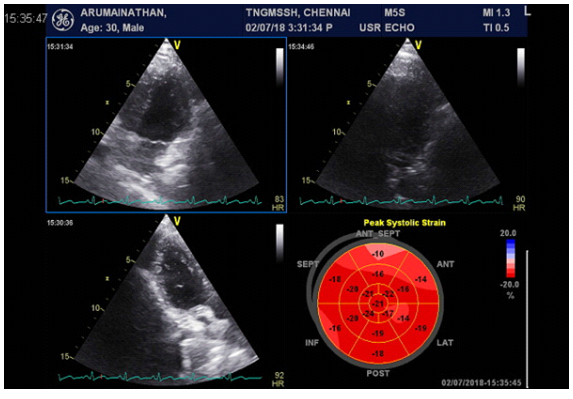


Figure 2, revealing recording of a speckle tracking imaging of a patient.



DISCUSSION:

We studied 100 hypertensive patients. Patients with hypertension has increased wall thickness and left atrium size. our findings consistent with Możdżan et al, found that hypertensive patients compared with controls presented larger dimensions of both ventricles and left atrium, thicker left ventricular walls, and higher mass index (6).

The above results show that speckle tracking echocardiogram is able to detect subclinical myocardial dysfunction in hypertensive patients with left ventricular hypertrophy despite normal global systolic parameters by conventional 2D echocardiography. Tulika et al postulated that the early features of LV systolic dysfunction in hypertension with apparently normal LV systolic function was in the axial axis, while systolic shortening in circumferential and radial axes was preserved (7).

Our results are in concordance with the findings of Kouzu et al.who found that longitudinal strain was significantly reduced in those with LV hypertrophy (8) and Saghir et al. revealed that hypertensive individuals with LVH had significantly decreased systolic longitudinal strain and strain rate values(9).

Limitations:

We included patients with different onset, severity and treatment modalities of hypertension and the small number of the study population may have influenced the result.

CONCLUSION:

This study concluded that there is impairment of LV systolic function detected by two-dimensional speckle tracking echocardiography in hypertensive patients, especially if associated with LVH with apparently preserved LV systolic function. These changes may be potential cardiovascular risk markers in such patients and enable identification of higher risk subgroups in whom more aggressive treatment could have a significant impact on prognosis.

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