

Assessment of Left Ventricular Longitudinal Function in Hypertensive Patients with Left Ventricular Hypertrophy by MAPSE

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ABSTRACT:

BACKGROUND:

Hypertension is an important risk factor for many cardiovascular diseases worldwide. The use of MAPSE in the assessment of LV systolic dysfunction is helpful especially in cases of poor imaging quality, since good imaging quality is needed for the modern echocardiographic techniques.

OBJECTIVE:

Detection of early subclinical LV systolic dysfunction in hypertensive patients with left ventricular hypertrophy (LVH) with preserved ejection fraction by MAPSE.

PATIENTS AND METHODS:

A comparative case-control study which took place at Al-Yarmouk Teaching Hospital in Baghdad/Iraq from October 2018 to October 2019. The study population consisted of 60 hypertensive patients with left ventricular hypertrophy (LVH) and 60 healthy subjects enrolled as controls.

RESULTS:

There was a high significant reduction in mean MAPSE for hypertensive patients with LVH compared with controls (P value = 0.0001). There was a significant reduction in mean S' for hypertensive patients with LVH when compared with mean S' for controls (P = 0.0001). There was a positive linear correlations between MAPSE and S' for hypertensive patients with LVH (r = 0.572, P = 0.001).

CONCLUSION:

MAPSE can be used on daily practice for assessment of subclinical LV systolic function in hypertensive patients with left ventricular hypertrophy and select them for preventive treatment.

KEYWORDS: Left ventricular hypertrophy, Mitral annular plane systolic excursion, Hypertension

INTRODUCTION:

Hypertension is one of the most common diseases all over the world. While conventional echocardiographic techniques can recognize "changes in LV diastolic function associated with left ventricular hypertrophy (LVH), global LV systolic function usually remains preserved until late in the course of the disease, making subtle changes in contractile function of the left ventricle difficult to interpret in the early stages⁽¹⁾.

MAPSE (Mitral Annular Plane Systolic Excursion) has been considered as a well-recognized clinically useful echocardiographic

parameter for the estimation of LV longitudinal function and correspond with global systolic function of left ventricle⁽²⁾.

Previous clinical studies reviewed that MAPSE is a sensitive parameter to determine slight abnormalities in many patients with cardiovascular diseases at the early stages where longitudinal function is damaged before other components (which can even be increased by compensation)⁽³⁾.

PATIENTS AND METHODS:

2.1. Study Design: This cross sectional study was carried from the time period in October 2018 to October 2019 at Al-yarmouk Teaching Hospital. Patients and controls were selected from subjects attending Echo department at the same hospital. A total number of hypertensive patients and apparently healthy subjects was (120). (60) hypertensive patients having left ventricular hypertrophy (LVH) within normal ejection fraction ,and (60) healthy persons were enrolled as controls.

2.1.1. The patients: Blood pressure of this group $\geq 140/90$ mmHg with normal EF ($EF \geq 54\%$ in females and $\geq 52\%$ in males). Patients in this study were selected from those attending the echocardiography unit whom fulfill the inclusion and exclusion criteria for this study.

2.1.2. Control subjects: All subjects in this group were normotensive with blood pressure less than $140/90$ mm Hg, and fulfill the inclusion and exclusion criteria for this study except they were normotensive.

2.2.1. Inclusion criteria:

All individuals (Patients and control) with the following criteria were included in this study:

1. A known case of hypertension with LVH (for patients); with septal wall thickness in male ≥ 11 mm, and in females ≥ 10 mm, Normotensive (for control)
2. Normal sinus rhythm

2.2.2. Exclusion criteria: All subjects (Patients and controls) with this criteria were kept out from this study:

1. Patients with reduced EF $< 54\%$ in females and $< 52\%$ in males.
2. Pregnant women.
3. Athletic subjects
4. Previous ischemic heart diseases and heart failure.
5. Structural heart disease
6. Valvular heart disease.
7. Congenital heart diseases.
8. Patients having atrial fibrillation (AF) or any rhythm disturbances.
9. Patients diagnosed with Diabetes Mellitus.
10. Thyroid problems or dysfunctions.
11. Renal problems or dysfunctions.

12. Malignant diseases or those with immunosuppressive therapy, chemotherapy and radiotherapy.

13. Subjects with poor echogenicity.

2.3. Echocardiography

Echocardiography was performed for all subjects using a Vivid E9® system (GE Vingmed; Hortoen, Norway) with 5 MHz transducer by specialist echo cardiographer. All subjects were examined on his/her left lateral side, to make the heart lateral to sternum and forward to chest, as required by the American society of echocardiography with dimmed light room.⁽⁴⁾

RESULTS:**3.1. Distribution of general characteristics according to HT patients with LVH and controls:**

Considering distribution of general characteristics according HT patients with LVH and controls: There was a high significant increase in mean age, BMI, SBP, DBP, and mean BP in patients with HT with LVH and controls (P value = 0.0001) No significant difference was observed between HT patients with LVH and controls regarding Gender (**Table 1**)

Table 1 : Distribution of general characteristics according to HT patients with LVH and controls .

	HT with LVH Mean \pm SD Range	Control Mean \pm SD Range	P value
Age (years)	56.1 \pm 12.6 (17-88)	41.4 \pm 12.1 (21-73)	0.0001 *S
Gender (M/F)	20/40	19/41	0.8
BMI (Kg/m ²)	34.06 \pm 5.71 (21.49-48.09)	29.52 \pm 5.60 (18.58-45.03)	0.0001 *S
SBP(mmHg)	155.89 \pm 23.59 (110-213)	120.33 \pm 9.44 (100-140)	0.0001 *S
DBP(mmHg)	94.97 \pm 13.36 (68-140)	76.83 \pm 7.18 (60-90)	0.0001 *S
Mean BP(mmHg)	115.28 \pm 15.16 (83-161.67)	91.33 \pm 7.25 (76.7-106.7)	0.0001 *S

*Significant difference between two independent means using Students-t-test at 0.05 level.

3.2. Distribution of echocardiographic measures according to HT patients with LVH and controls:

Mean septal wall thickness for HT patients with LVH was significantly higher than mean of controls ($P < 0.001$). Means of MAPSE and S' for HT patients

with LVH were significantly lower than means of MAPSE and S' for controls ($P = 0.0001$). No significant differences were observed between HT patients with LVH and controls regarding means of EF (by M-mode or Simpson's methods). (Table 2)

Table 2: Distribution of echocardiographic measures according to HT patients with LVH and controls

Variable	HT with LVH	Controls	P value
	Mean \pm SD	Mean \pm SD	
Septal wall thickness (in diastole) (mm):	12.3 \pm 2.1	7.7 \pm 1.2	<0.001 *S
MAPSE (mm):	13.4 \pm 3.4	15.9 \pm 2.2	0.0001 *S
EF by (M-mode) %	74 \pm 8.5	73.6 \pm 7.2	0.7
EF by (Simpson's) %	62.2 \pm 12.7	61.6 \pm 9.2	0.7
S' (cm/s):	0.09 \pm 0.02	0.11 \pm 0.02	0.0001 *S

*Independent sample t-test, S=Significant.

3.3. Cutoff point and test validity of MAPSE for HT patients with LVH:

The acceptable cut off points and the corresponding validity values for MAPSE level in prediction of HT with LVH was shown in

table 3 and figure 5, cutoff MAPSE level of 14 had acceptable validity results (80% sensitivity, 51.7% specificity, 50% PPV, 80% NPV and accuracy 78%).

Table 3: ROC coordinates for prediction of HT with LVH by MAPSE.

Cutoff point	Sensitivity	Specificity	PPV	NPV	Accuracy
13.1	90%	43.3%	42.8%	87.6%	77%
14	80%	51.7%	50%	80%	78%
14.9	66.7%	66.7%	64%	66.7%	68%

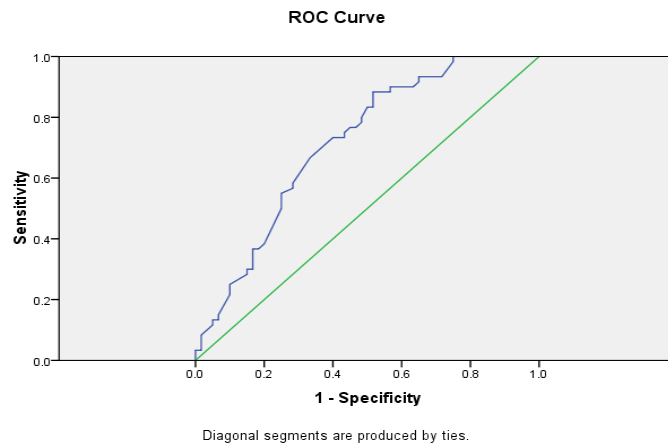


Figure 5: ROC for MAPSE prediction of HT with LVH (AUC=0.7)

3.5. Pearson's correlations: Regarding Pearson's linear correlations with MAPSE, the following relationships have been noticed: A significant negative correlation was observed between MAPSE and BMI for hypertensive (HT) patients with LVH ($r = -0.290$, $P = 0.015$).

A positive significant correlation was observed between MAPSE and S' for HT patients with LVH ($r = 0.572$, $P = 0.001$). NO significant correlations were observed between MAPSE and EF (by M-mode or by Simpson's methods) for the hypertensive groups (**Table 4**)

Table 4: Pearson's correlations and linear regression between MAPSE and different correlated parameters for the two HT subgroups.

Correlations		Hypertension with LVH
BMI (Kg/m ²)	r	-0.290*
	P	0.015
EF by M-mode %:	r	0.200
	P	0.098
EF by (Simpson's)%:	r	0.198
	P	0.100
S' (cm/s):	r	0.572**
	P	0.001

*Significant correlation at 0.05 level. **Highly significant correlation at 0.01 level.

DISCUSSION:

In the current study, the age group "was significantly higher in hypertensive groups than the" age of healthy controls (P value was <0.0001). Our "study was in agreement with" Parikh et al study⁽⁵⁾ who stated that Normal aging was associated with significant increases in systolic blood pressure (P value was < 0.05) Parikh and his co workers studied 48 normal subjects and 40 hypertensive patients (though no other cardiovascular disease or diabetes) their ages ranged from 50–79 years.

Regarding gender, in our study no significant differences were observed between all study groups," this finding was in agreement with Ayoub et al⁽⁶⁾ study and Natori et al⁽⁷⁾ study who studied eight hundred participants (400 men, 400 women) their SBP > 140 mmHg and DBP > 90 mmHg and their ages ranged from 45 to 84 years. The two studies reviewed in their articles that there were no significant differences in gender between hypertensive patients and controls.

In this study, high significant differences were observed between hypertensive patients and controls regarding **mean BMI** (P value was 0.0001). This finding agreed with Ayoub et al study⁽⁶⁾ who showed that there was a significant differences in their mean BMI between hypertensive patients and controls (P value = 0.03).

In the current study, hypertensive group had significantly higher mean **septal wall thickness** over healthy control (P value < 0.001 in HT patients with LVH). The fact of left ventricular hypertrophy in hypertensive patients had been well established in" Cuspidi et al study⁽⁸⁾ , "the result concerning left ventricular hypertrophy in hypertensive patients was in agreement with the result of Cuspidi and his coworkers, in which they made analysis for 30 studies and demonstrate one of the largest database on echocardiographic LVH prevalence in hypertensive population of 37,700 patients from different studies. The main finding of their work was that 36 – 41 % of both treated and untreated hypertensive patients had alterations in cardiac structure"⁽⁸⁾. In the current study, **ejection fraction (EF)** is considered as the usual and conventional echocardiographic parameter that is currently recommended for the assessment of LV systolic function. Mean EF measured by (M-mode) in hypertensive groups was not significantly differed from controls. This result was in agreement with those of Narayanan et al⁽⁹⁾ who studied 52 hypertensive patients with preserved EF and 52 normal subjects, they found that ejection fraction (EF) was similar in both groups and no significant difference was noticed between them. In this study, no significant difference was observed in mean EF by simpson's method for hypertensive group and controls (P = 0.7).

Our result was in agreement with Ayoub et al⁽⁶⁾ who studied 60 hypertensive patients and 30 healthy controls, all with preserved EF, and reviewed that there was no significant difference in mean EF by simpson's between hypertensive patients and controls. In this study, there was a high significant reduction in mean **MAPSE** of hypertensive patients with LVH when compared

with mean MAPSE of control group (P value was 0.0001), this result was in agreement with Qureshi et al⁽¹⁰⁾ study who studied 43 HT patients without LVH with preserved EF and compared them with 22 HT patients with LVH with preserved EF ,their result stated that a significant reduction in mean MAPSE was observed in LVH group comparing with the mean MAPSE of those without LVH group (P value < 0.001). Regarding **S'**, in the present "study, there was a high significant reduction in mean S' of HT patients with LVH and mean S' of controls (P value was 0.0001), this result was in acceptance with Ayoub et al⁽⁶⁾ who showed that a high significant reduction was observed in mean S' of hypertensive patients when compared with mean S' of control group (P value = 0.01). **MAPSE and S'** are surrogates for the LV longitudinal function⁽¹¹⁾ ,⁽¹²⁾,⁽¹³⁾. In the present study we found that there was a significant linear correlation between MAPSE and S' in hypertensive groups (P value was 0.001, r = 0.572) ,this finding agreed with Khorshid et al⁽¹⁴⁾ who studied "200 patients divided into two groups ; group A included 100 patients with normal EF and group B included 100 patients with reduced EF, they found that when combing the measurement of both parameters MAPSE and S' this could increase their sensitivity and specificity for predicting normal or subnormal EF". There was a close correlation between MAPSE and S'.

CONCLUSIONS:

MAPSE can predict the early reduction of LV longitudinal systolic function despite preserved EF especially in hypertensive patients with LVH. "This suggests earlier intervention in these patients may be" of good benefit for them. It helps in identifying the patients at high risk subgroups and can made a preventive measure for them, and that could have a significant impact on prognosis.

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