Correlation between the Posterior Left Ventricular Wall Thickness and Relative Wall Thickness with Global Longitudinal Strain (GLS) In Hypertension

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Abstract

Background:Hypertension also known as raised blood pressure, is a state when blood vessels have permanently high. Primary hypertension is the most common one range about 90-95% of cases and may exist due to environmental and genetic factors, whilst secondary hypertension forms about 2-10% of cases and has many etiological factors such as vascular, endocrine or renal causes. Hypertensive heart disease is one of complications of hypertension which means a group of changes in theleft atrium (LA), left ventricle (LV), and coronary arteries as due to high blood pressure.

Aim of study: This study is targeted to evaluate the correlation between posterior wall thickness (PWT) of LV and relative wall thickness (RWT) with global longitudinal strain (GLS%) in hypertension by conventional and advanced echocardiographic modalities.

Method:A cross sectional study of total number 50 individuals (female: 29 and male: 21) who have primary hypertension on antihypertensive medications. Our study reported from December 2021 to April 2022 in Merjan Teaching City at Babylon province, Iraq. Two-D conventional echocardiography, Tissue Doppler Imaging and Global longitudinal strain (GLS %) by speckle-tracking echocardiography had been performed. Statistical data analysis of correlation was done and the significance value was <0.05).

Results: There is a significant correlation between the GLS% and diameter (mm) among hypertensive patients. (N=50, r = 0.292, P= 0.04) as well as between the GLS % and RWT among hypertensive patients. (N=50, r = 0.293, P value = 0.039).

Conclusion: the study concluded a significant correlation between GLS% with increasing in both PWT and RWT in hypertensive patients.

Keywords: Hypertension, echocardiography, global longitudinal strain, posterior wall thickness and relative wall thickness.

1. INTRODUCTION

Hypertension or raised blood pressure, is a state when blood vessels have permanently high pressure. The latest AHA/ACC guidelines define hypertension as systemic blood pressure $\geq 130/80$ mmHg, while the ESC guidelines, use a little different approach to risk and defined high blood pressurewhen the pressure $\geq 140/90$ mmHg (1-3). Primary hypertension is the most common type of hypertension affects about 90-95% of cases and may exist due to environmental and genetic factors. Whilst secondary hypertension forms about 2-10% of cases and has many etiological factors such as vascular, endocrine or renal causes (4).

Hypertensive heart disease occurs when the LV wall thickness rises to decrease the wall stress to normal. Initially, the increasing wall tension happens with increase thickness of the left ventricular walls within the "normal" domain. So, prolonged exposure will lead to progression of a strange increase in wall thickness of left ventricle (5).

Hypertrophy of the left ventricular (LVH) is an aberrant increased LV mass. Echocardiography plays an important role to measure LV mass and function. The conventional echocardiography (2D-echocardiography) permit the calculations of LV internal dimension, posterior wall diameters at the end diastole, and interventricular septal, allow direct measurements of LV mass, and relative wall thickness (RWT) (6). These measurements were obtained by the next formulas and accordingly we detect the concentric changes in LV geometry (7)

$$\label{eq:LV mass} \begin{split} LV \ mass = 0.8 \times [(LVEDD + IVSd + PWTd)^3 - (LVEDD)^3] + 0.6 \\ RWT = (2PWd)/\ LVEDd \end{split}$$

Concentric hypertrophyreferred to increase LV mass and RWT (8) and incidence of LVH in hypertensivepatients is an alarm sign of subtle LV dysfunction and consequently heart failure (9). Myocardial strain is a unitless measurement of myocardial deformational changes, used in clinical practice by applying imaging-based techniques (10-12). The most common technique is Speckle-tracking echocardiography (STE), which have clinical advantages in a variable settings (13-14). Anobserved functional changes of LV could be distinguish when quantify myocardial strain (15). The subtle variations in LV contractility is hard to explain in the initial stage of hypertension because of the global LVsystolic function usually stays normal till the latest stage of the disease(16). Early LV dysfunction that detect earlier than the progression of LVH possibly have a clinical significance that will warrant invasive management aimed at decreasing the cardiac mortality and/or morbidity.Therefore, myocardial strain applied assuitable in the cardiovascular risk estimation (17).

Global Longitudinal Strain (GLS) is the more reliable for evaluating the systolic function in heart failure patients (HFpEF or HFrEF) as in normal individuals (41). Global longitudinal strain is classified into mildly decreased [(-15%)–(-12.5%)], moderately decreased [(-8.1%)–(-12.5%)], and severe decrease if < - 8.0%(17).

2. METHODOLOGY

This cross-sectional researchincluded total number of 50 individuals (female: 29 and male: 21), with mean age of 51.28 ± 7.27 and range of 30-60 years old, who have primary hypertension on treatments. Our study was reported from December 2021 to April 2022 in Merjan Teaching City at Babylon province, Iraq. Athletes, smoker, diabetes mellitus, chronic kidney diseases, cardiomyopathy, valvular heart disease, aortic coarctation, congenital heart diseases and respiratory diseases were all excluded from the study.

Questionnaires

The study questionnaire included past medical history, personal habits like drugs and alcohol intake, and BSA was measured by

Mosteller method formula = [height (m) \times weight (kg) \times 3600]/2

Blood pressure and heart rate had been taken at time of examination.

Echocardiographic modalities

Conventional 2D echocardiography had been done to measure the RWT by measuring the PWT and LVEDD to apply the following formula

$RWT = 2 \times PWT / LVEDD$

As well, 2D-ECG guided STE images had been taken from the A4C, A2C, suprasternal and apical long-axis views at end of exhalation when the breath hold to put off breathing artifacts and at nearly same heart rates to calculate the LV longitudinal strain imaging. The LV had entire image sector with caution to put off foreshortening of the LV and three cardiac cycles had been recorded for every cine loop.

The depth was reduced, gain was optimized and the frame rate had been preserved from 50 to 90 frames/s. The images had been stored then transmitted to a workstation and analysis was done subsequently.

Statistical scrutiny

The data analysis were completed by means of SPSS version 20, correlational analysis were tested and statistical p-value was taken and when reached 0.05% was considered as significant.

Ethical issue

The study design was approved and authorized by institutional committee of research ethics at the College of Medicine and Merjan hospital ethical board. An informed written consents was taken from all the applicants before being involved in this study.

3. **RESULTS**

The study results revealed a significant correlation between global longitudinal strain percentwith increasing PWT diameter (mm) among the hypertensive patients. (N=50, r = 0.292, P value= 0.04). Also, significant correlation between the GLS % with the increasing RWT among the hypertensive patients. (N=50, r = 0.293, P value = 0.039), Figures 1, 2.



Figure 1: The correlation between GLS (%) and Posterior wall thickness diameter (mm) among hypertensive patients. (N=50, r=0.292, P= 0.04)



Figure 2: The correlation between GLS (%) and Relative wall thickness among hypertensive patients. (N=50, r = 0.293, P= 0.039*)

4. **DISCUSSION**

The study intended to assess the correlation between left ventricular PWT and RWT with GLS in hypertension using the conventional and advanced echocardiographic modalities. Asignificant relation was found between the RWT and increased PWT with altered GLS% in patients with hypertension.

In hypertensivepatients, the systolic function of LV is generally remain normal as far as the global ejection fraction (EF) and fractional shortening (FS) remain withinusual ranges. Nevertheless, both the FS and EF replicate the universal myocardial contractility and do not keep abnormalregional systolic functions into consideration (23).Further evidence supporting may lie in the findings of Ayoub AM et al., whorecently found increasedLV mass index in hypertension with reduced GLS%compared to hypertension with normal GLS%, even though being insignificant. The study also revealed a significant correlation between the GLS%and LV (24).A study published earlier, exposed that hypertensive persons with LV hypertrophy had considerably reduced systolic GLS%than in controls (20).

The increasing workload on the heart as a result of hypertension will leading to mechanical and functional variations in the myocardium and theLV hypertrophy is one of those changes. Also, prolong exposure to pressure overload will increase dramatically relative wall thickness that may indicate LV remodeling which is an early feature of hypertensive heart disease. Li L et al, 2001 (18) supported this outcome, and revealed that the evaluation of LV geometry by RWT provide an additional predictor of diastolic dysfunction among hypertensive patients.

A new Chinese studycategorized applicants into normotensive, prehypertensive and hypertensive. During the next 10 years' follow up, the study found that the prevalence of LV massenlarged gradually from the normotensive to prehypertension and hypertension patients(19). The current studyresults were consistent with the study findings that were described by Saghir et al. (20), which also show that hypertensive patients with LVH have significantly depressed GLS% values in comparison to normal people that attributed to pressure overload cardiomyopathy that occurs in association with sub-endocardial fibrosis due to chronically elevated afterload in hypertensive patients will affect the global longitudinal strain of myocardium inversely. Also, some studies tell us the LV longitudinal cardiac function is significantly decreased at the hypertrophiedregion when connective tissue contents increased by pressure over load and lead to more sub-endocardial fibrosis(21) while other study revealed that reduced Global longitudinal strain is independently related to both magnitude of the LV mass and pressure overload (22).

5. CONCLUSION

The study concluded a significant correlation between GLS% with increasing in both PWT and RWT in hypertensive patients. Early detection of prehypertension will aid to take crucial precautionary measures to decrease the future cardiovascular events.

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