



ORIGINAL ARTICLE

Evaluation of left ventricular performance in hypertensive patients by speckle tracking echocardiography: Correlation with brain natriuretic peptide



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KEYWORDS

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Abstract *Background:* Hypertension results in hemodynamic changes ranging from maladaptive left ventricular hypertrophy (LVH) to heart failure. Two-dimensional speckle tracking echocardiography (2D-STE) allows rapid and accurate analysis of regional and global left ventricular (LV) systolic and diastolic functions.

Objective: Assessments of LV function in hypertensive patients with apparently preserved LV systolic function using 2D-STE in correlation with plasma brain natriuretic peptide (BNP) levels.

Patients and Methods: Eighty hypertensive patients were enrolled, they were classified into LVH group (group III) and non-LVH group (group II). Twenty sex and age-matched healthy individuals were recruited as controls (group I). 2D-STE was done to all subjects to assess LV longitudinal strain, and strain rate (SR). Plasma BNP levels were measured in all subjects.

Abbreviations: BNP, brain natriuretic peptide; BSA, body surface area; DBP, diastolic blood pressure; DTI, Doppler tissue imaging; EF, ejection fraction; ESH/ESC, European society of hypertension/European society of cardiology; Esys%, peak longitudinal systolic strain; LV, left ventricular; LVH, left ventricular hypertrophy; LVM, left ventricular mass; LVMI, left ventricular mass index; NT-proBNP, N-terminal pro-brain natriuretic peptide; SBP, systolic blood pressure; SRa s⁻¹, peak late diastolic strain rate; SRe s⁻¹, peak early diastolic strain rate; SRs s⁻¹, peak systolic strain rate; 2D-STE, two dimensional speckle tracking echocardiography

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Results: Global longitudinal systolic strain was significantly reduced in group III compared with group II ($P = 0.037$) and group I ($P = 0.000$). Furthermore, group III showed significantly reduced global LV longitudinal systolic SR and early diastolic strain rate compared with group II ($P = 0.023$ and 0.008 respectively), and group I ($P = 0.01$ and 0.0001 respectively). On the other hand, the mean values of global SRa s^{-1} were significantly higher in both group II and group III compared to group I ($P = 0.0001$). A negative correlation was found between BNP level and global peak systolic strain, global systolic strain rate, early diastolic strain rate and late diastolic strain rate in hypertensive patients (groups II & III) in whom BNP level was significantly higher than controls (group I) ($P = 0.000$).

Conclusion: A substantial impairment of LV systolic and diastolic functions is detected in hypertensive patients with apparently preserved LV systolic function, especially if associated with LVH, as evidenced by two-dimensional speckle tracking echocardiography. Plasma BNP level is elevated in hypertensive patients and shows a significant negative correlation with strain and strain rate values.

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1. Introduction

Hypertension is a well-recognized risk factor for cardiovascular diseases, it causes left ventricular (LV) pressure overload which results in various geometric changes that progress to diastolic heart failure and/or heart failure with LV systolic dysfunction.¹

Left ventricular hypertrophy (LVH) is both a major maladaptive response to chronic pressure overload and an important risk factor in patients with hypertension. In the Framingham Heart Study, even borderline isolated systolic hypertension at an elderly age was associated with increased left ventricular wall thickness and impaired diastolic filling.²

In response to increased LV pressure load, ventricular myocytes release B-type natriuretic peptide (BNP), together with its N-terminal fragment (NT-Pro BNP), they produce diuresis, natriuresis and vasodilatation, which reduce the load on the heart.³

Early detection of LV dysfunction before the development of LVH may represent a clinical finding that would justify aggressive treatment aimed at reducing cardiovascular morbidity and mortality, therefore it has to be considered in the assessment of global cardiovascular risk.⁴

Several studies revealed that patients with LVH have greater plasma levels of BNP than other patients.³ Furthermore, an increase in plasma BNP has been shown to reflect the prolongation in LV relaxation time, increase in LV end-diastolic pressure and the LV mass index (LVMI) in patients with hypertension.⁵ Based on these findings, BNP levels could be related to cardiac remodeling and diastolic dysfunction in hypertensive patients.⁵

Echocardiographic strain imaging is an innovative approach recently developed for the assessment of left ventricular myocardial mechanics.⁶ Myocardial strain can be determined using a tissue Doppler imaging or two-dimensional speckle tracking echocardiography (2D-STE). Doppler-based techniques are limited by the angle-dependence of the signal, precluding the assessment of apical left ventricular function. In contrast, two-dimensional speckle tracking studies orthogonal components of strain independent of the insonation angle because it tracks deformation between acoustic markers in the ultrasonic image in two dimensions.⁶

The aim of this study was to evaluate the LV performance in patients with hypertension using speckle tracking echocardiography and correlate the findings with BNP levels.

2. Subjects and methods

Hypertensive patients were selected from cardiology outpatient clinic of the Menoufiya University Hospital. Full history, general and cardiac clinical examination were done before selection. Written informed consent was taken from all patients and the study protocol was approved from the Ethics Committee of the Menoufiya University.

This study was carried out on 80 hypertensive patients and twenty age and sex matched healthy subjects as a control group. Control subjects had no detectable cardiovascular risk factors and not receiving any medications, they were volunteers recruited from among the hospital staff, medical and nursing students, and members of the local community. Hypertension was diagnosed based on ESH/ESC guidelines for management of hypertension if SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg on two or more hospital visits at one week interval.⁷ All patients had a complete physical examination, including body surface area (BSA) calculation.⁸

2.1. Exclusion criteria

It included patients with ejection fraction $< 50\%$ or with symptoms or sign of heart failure, diabetes mellitus, patients with known coronary artery disease, patients with significant valvular disease and patients with atrial fibrillation or other rhythm disturbances.

2.2. Study population grouping

Group I (control group) included twenty sex and age-matched healthy individuals (mean age 50.5 ± 6.0 years; 8 males and 12 females), group II included 40 hypertensive patients without echocardiographic criteria of LVH (mean age 51.6 ± 5.1 years; 16 males and 24 females) and group III included 40 hypertensive patients with echocardiographic criteria of LVH (mean age 52.2 ± 6.0 years, including 21 males and 19 females).

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