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Could early septal involvement in the remodeling process be related to the advance hypertensive heart disease?

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ABSTRACT

Background: Quantitative imaging analyses showed an earlier septal wall involvement in hypertension. We planned to determine the effect of hypertension on regional myocardial performance index (MPI) in a hypertensive patient population.
Methods: We evaluated 119 hypertensive patients who were divided into gr. I: 57 patients without left ventricular hypertrophy (LVH), (53.1 ± 10 years), and gr. II: 62 patients with LVH (55.1 ± 9 years) using conventional and tissue doppler imaging. They were compared with gr. III, a sex-age-matched normal control group (37 subjects, 53.0 ± 10 years).
Results: We detected basal septal and basal lateral contraction time (CT), isovolumetric CT and relaxation time (IVRT) and MPI. EF was 68 ± 5 % in gr. I, 69 ± 5 % in gr. II, 69 ± 4 % in gr. III. LV mass index was 122 ± 11 g/m2 in gr. I, 148 ± 13 g/m2 in gr. II and 118 ± 13 g/m2 in gr. III. Concentric LVH was detected in gr. II (relative wall thickness = 0.49 ± 0.8). LV septal and lateral MPI were abnormal in both hypertensive groups ($p < 0.0001$). Septal MPI was correlated moderately with septal wall thickness ($r = 0.447$, $p < 0.001$).
Conclusions: LV diastolic dysfunction becomes more severe in septal wall than lateral wall in hypertensive LVH. Septal myocardial performance is more dominantly affected by hypertension possibly due to earlier septal involvement in disease course. Septal MPI is correlated moderately with septal wall thickness.

1. Introduction

Hypertension is one of the major risk factors for cardiovascular and cerebrovascular disease. Optimal antihypertensive medication is well described in the management of patients with cardiovascular complications due to chronic hypertension [1]. Hypertension leads to hypertensive LV hypertrophy (LVH) and ultimately results in overt heart failure [2]. Mid-basal segmental myocardial involvement as the early response was noted in the volume overload-mediated LVH in experimental studies [3]. It was suggested that the septal wall is first involved in hypertension and becomes hypertrophic in a clinical setting [4]. We and the others confirmed the old findings and described the diminished segmental cavity and dominant hypertrophy of LV base, respectively in hypertensive LVH which is different from cardiomyopathy using real-time 3 dimensional echocardiography [5,6]. The early documentation of the disease process in hypertension recently has gained more importance [7]. The precise analysis by novel tissue imaging has documented earlier involvement of LV septal base even in mild hypertension despite preserved global LV contractility [8]. We aimed to detect the severity of segmental functional involvement in a population of patients with hypertension and hypertensive LVH, relatively advance stage of the hypertensive heart disease. We performed systolic and diastolic functional analysis of regional myocardial tissue and determined regional myocardial performance of the different cardiac walls in these patient groups.

2. Materials and methods

Total 150 consecutive patients with hypertension were evaluated. Blood pressure measurement was taken from both arms twice after the patients rested, and the patients whose blood pressure value was >140/90 mm Hg or those who were on antihypertensive medication were included. Patients with sinus rhythm and optimal acoustic window by two-dimensional echocardiography were selected. 119 patients were eligible for inclusion and were on antihypertensive medication (Table 1). Patients with coronary artery disease were excluded using exercise stress test. Patients with secondary hypertension, valvular heart disease, left ventricular dysfunction, diabetes mellitus, liver disease, renal disease, malignancy, recent (<3 months) arterial or venous thromboembolic disease, active infections and/or a history of inflammatory or connective tissue disorders were also excluded. The selected patients were divided into two groups according to LV mass index. We

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Table 1
Demographic features and antihypertensive treatments of the patient groups.

	Group I (n = 57)	Group II (n = 62)	Group III (n = 37)
Age (years)	53.1 ± 10	55.1 ± 9	53.0 ± 10
Male sex (n (%))	23 (40)	25 (40)	15 (40)
BMI (kg/m^2)	27.9 ± 5.1	28.4 ± 4.7	26.5 ± 4.2
DHT (>10 years), (n (%))	32 (56)	62 (100)	–
ACE i./ARB, (n (%))	54 (95)	58 (94)	–
CCB, (n (%))	43 (75)	49 (79)	–
Diuretics, (n (%))	32 (56)	38 (61)	–
Beta blockers, (n (%))	19 (33)	25 (40)	–

BMI: body mass index, DHT: duration of hypertension, ACE i.: angiotensin converting enzyme inhibitors ARB: angiotensin receptor blockers, CCB: calcium channel blockers.

studied 57 hypertensive patients without LVH (group 1) and 62 hypertensive LVH patients (group 2) and compared them with 37 age-sex matched normal controls. We obtained approval from local ethics committee of Mustafa Kemal University and all findings were evaluated in close collaboration with Johns Hopkins Medicine. The study was supported by institutional facilities without any specific fund and all patients gave written consent to the study and the protocol was consistent with the Declaration of Helsinki.

2.1. Echocardiographic protocol

Patients were studied in the left lateral decubitus position (Vingmed System 5, 1.5–2.5 MHz transducer; GE Vingmed, Horten, Norway). The ECG was recorded simultaneously. Digital data were acquired during passively held end-expiration and transferred to a Macintosh computer for off-line measurement. All authors had full access to all the data in the present study and take responsibility for the integrity of the data and accuracy of the data analysis.

Standard resting echocardiographic studies consisted of M-mode, cross-sectional, and transmitral Doppler blood flow velocity measurements (mean of three consecutive beats). M-mode tracings from the parasternal long-axis view were used to measure the diameter of septal thickness, LV intracavitary diameter, and posterior wall thickness in systole and diastole. LV volumes and ejection fraction were calculated by the modified biplane Simpson's method. LV mass was estimated by the method of Devereux and patients with greater LV mass index than 134 g/m^2 in men and 110 g/m^2 in women were accepted as LVH. Relative wall thickness (RWT) was calculated by the formula (2*PWT)/LVEDD, where PWT is posterior wall thickness and LVEDD is LV end-diastolic diameter; LVH was classified accordingly as either concentric (RWT > 0.42) or eccentric (RWT ≤ 0.42), [9].

2.2. Pulsed tissue doppler imaging

Tissue Doppler Imaging (TDI) permits a quantitative assessment of both global and regional function and timing of myocardial velocities. Pulsed TDI was performed at transducer frequencies of 3.5-4.0 MHz, adjusting spectral Doppler filters until a Nyquist limit of 15-20 cm/s was reached, and using minimal adequate gain. TDI was performed using LV apical 4-chamber imaging and sample volume was subsequently placed on the basal septal (Fig. 1) and basal lateral segment walls in the apical four-chamber view. It is documented that the basal region is associated with the greatest and the most reliable tissue velocity compared with other regions [10]. The imaging angle was adjusted to ensure a parallel alignment of the sampling window with the myocardial segment of interest. Color noise reduction was adjusted, and a color Doppler scanning frame rate of 100 to 140 Hz was used. Myocardial E' and A' waves were obtained from LV septal wall, than E/E' was calculated. Isovolumetric contraction time (IVCT), contraction time (CT), and isovolumetric relaxation time (IVRT) were measured and myocardial performance index (MPI) calculated from the base of septal and lateral walls using the Tei Index which was shown to be valuable in hypertensives [11].

3. Statistical analysis

Measurement results are presented as mean and standard deviation. Data comparison of both groups was performed with ANOVA and independent t-test using SPSS software 16.0 (SPSS, Inc). Correlation between variables was determined using the Pearson correlation test. A value of $p < 0.05$ was considered statistically significant.

4. Results

Demographic features of 3 groups were pointed out in Table 1. Two dimensional echocardiography was performed in all groups and

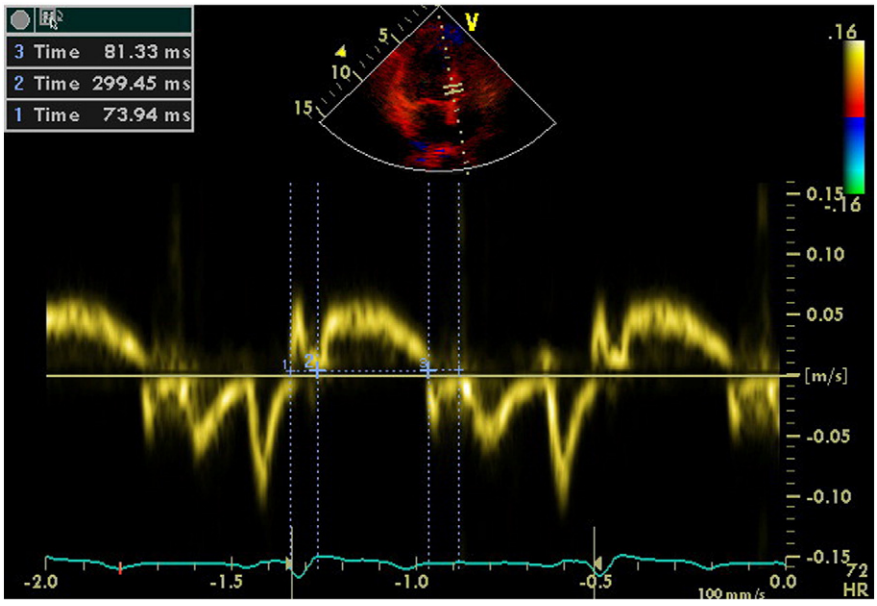

Fig. 1. Evaluation of isovolumetric contraction time, contraction time and isovolumetric relaxation time of the LV septal base by tissue Doppler imaging in a hypertensive patient (MPI = 51).