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Assessment of left atrial and left ventricular functions in hypertensive patients with sinus rhythm and atrial fibrillation using tissue Doppler imaging

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Abstract

If treated, hypertension (HTN) may reduce the risk of cardiovascular disease (CVD) and overall mortality (1). Life expectancy in adults is reduced by five years due to HTN, which is commonly misdiagnosed or improperly treated despite the widespread availability of effective pharmacological medicines and updated clinical recommendations (2). Hypertensive heart disease is a cardiovascular sequela of hypertension and is characterised by left ventricular hypertrophy (LVH), left atrial enlargement, left ventricular diastolic dysfunction, functional mitral regurgitation, and neuro-hormonal alterations (3). Doppler tissue imaging has paved the way for novel echocardiography modalities like as tissue tracking and strain rate imaging, which may be utilized to evaluate regional LV systolic shortening. Myocardial stretching or shortening may be determined using strain rate analysis (4).

Keywords: Hypertension, Echocardiography, AF, Strain, Tissue Doppler imaging.

1.Introduction

Office blood pressure measurements that are more than or equal to 140/90 indicate hypertension. Treatment of patients with these BP levels has been shown to be effective in several randomised controlled trials [5].

Several lifestyle and pharmacological therapy techniques have been shown to be extremely successful and well-tolerated, allowing for adequate BP reduction. Despite this, hypertension continues to be the leading avoidable cause of CVD and overall mortality worldwide [6]. LVH, HF, coronary artery diseases, ischemic heart disease, arrhythmias, sudden cardiac death, and stroke are all consequences of hypertensive heart disease (HHD) [7]. Appropriateness is a key problem in lowering the expense of improper use of echocardiography, which is significant since echocardiogram is the most prevalent and first-line imaging technique in many clinical circumstances [8]. Noninvasive evaluation of myocardial mechanics and heart function has made great strides because to the development of tissue Doppler imaging and speckle-tracking imaging during the last decade [9].

2.Patients and methods

Study design:

It is a single center; observational study that was conducted at cardiology department at "Benha University hospital".

Patients:

Two hundred patients with hypertension were enrolled in this study.

They have been classified into two groups:

- Group (I): 100 hypertensive patients with normal sinus rhythm.
- Group (II): 100 hypertensive patients with atrial fibrillation.

Inclusion criteria:

Consecutive adult male and female patients with systemic hypertension. Hypertension was diagnosed as a blood pressure of ≥140/90mmHg or as the current use of antihypertensive drugs.

Exclusion criteria:

- Patients with ischemic heart disease
- Patients with rheumatic heart disease.
- Patients with degenerative valvular heart disease.
- Patients with Ejection Fraction (EF) < 50%.

All patients will undergo:

a- History taking: Age, Sex, Body mass index BMI= Weight (Kg) / (Height in meters)^2

- HTN details: Type, Onset, Drugs used, Associated risk factors

b- Conventional transthoracic 2D Echocardiography:

- Patients will be examined in the left lateral decubitus with a commercially available ultrasound system (Philips, Epic 7, equipped with a 5.5 X transducer).
- Volumetric Measurements of LA:
- LA maximal volume (Vmax) at end-systole, just before the mitral valve opening; LA minimal volume (Vmin) at end-diastole, after mitral valve closure (10)
- The LA size will be represented by LA maximal volume measured at end-systole and indexed by body surface area (LA volume index).
- Measurements were repeated 3 times in each individual, and the average was used for analysis.
- We defined LA enlargement as a LA volume index of ≥ 28mL/m2 (11).

e- Tissue Doppler imaging:

- Tissue Doppler imaging (frame rate range: 75-150/s) was obtained in apical 4- and 2-chamber views and in the apical long-axis view during end-expiration. The Doppler tissue signal angle was less than 20 degrees. Digitally stored loops of Doppler tissue imaging were used for offline derivation of tissue tracking images and strain rate recordings (12).
- The strain rate is calculated as the difference between myocardial velocities from 2 points divided by the distance separating the points.

- The Doppler tissue technique in this study allowed processing of simultaneous tissue tracking and strain rate in different myocardial segments in the same cine-loop.

Results and discussion

3. Results

It was a single center; observational study that was conducted at cardiology department at "Benha University hospital".

A total of 200 patients with hypertension were enrolled in the study, and they were divided into two groups according to cardiac rhythm:

• Group (I): 100 hypertensive patients with normal sinus rhythm.

• Group (II): 100 hypertensive patients with atrial fibrillation.

General characteristics:

Of the 200 patients enrolled in the study the mean age was 57.7 ±13.6 years and mean BMI 25.21 ±4.12 kg/m^2. 88 patients (44%) were males & 112 patients (56%) were females (table 1).

Dyslipidemia was the most common comorbidity reported in the current study accounting for 114 patients (57%), followed Diabetes reported in 96 patients (48%). 39 patients (19.5%) were smokers while 81 patients (40.5%) were ex-smokers, 43 patients (21.5%) had positive family history for cardiac diseases (table 1)

Table (1): Baseline clinical and demographics characteristics of the included patients (n=200).

Demographics &risk factors		*Mean± SD / Count*	*Range / %*
Age	**Years**	57.7 ±13.6	26 -94
BMI	**Kg/m2**	25.21 ±4.12	16.5 -35.7
Sex	**Male**	88	44%
	Female	112	56%
Diabetes	**Yes**	96	48%
Dyslipidemia	**Yes**	114	57%
Smoking	**Smoker**	39	19.5%
	Ex-smoker	81	40.5%
Family History	**Positive**	43	21.5%

Echocardiographic data of the study population indicated a mean ejection fraction of 64.8%, a mean LVEDV of 80 mL, a mean LVESV of 31 mL, a mean LV mass index of 115.3 g/m2, a mean LA Vmax of 79 mL, a mean LA Vmin of 48 mL, and a mean LA volume index of 36.1 mL/m2. Tissue doppler imaging revealed average speeds of 5.2 cm/sec for S, 9.9 cm/sec for e', 88.2 cm/sec for E, 13.4 for E/e', and 178.2 msec for deceleration.

General features and differences in demographics between the two groups:

Age, sex, body mass index, and risk factors such diabetes, dyslipidemia, smoking, and family history were all comparable across the two research groups (P > 0.05).

Patients in Group II had a reduced ejection fraction (P = 0.04) and a larger left ventricular ejection fraction (LVEF), left ventricular systolic volume (LVSV), left atrial volume (LAV), and left atrial volume index (LVVI), but no change in LV mass was found between the two groups.

Patients in group I have a greater S wave velocity than those in group II (P = 0.04), whereas patients in group II have a higher E wave velocity and E/e' (both P = 0.04). Group I patients also had a longer duration of E wave deceleration (P 0.01). The e' wave velocity did not vary significantly across the groups, though (P value 0.676)

Techniques for Statistics

Quantitative variables were summarised with means and standard deviations and compared between groups using the Mann Whitney U test, all of which were calculated using SPSS 22. The Chi2 test was used to make comparisons between categorical data provided in frequency and percentages. Predicting the prevalence of AF in hypertensive individuals required a sensitivity analysis to determine the best threshold for doing so. In order to illustrate the projected area under the curve, a receiver curve of characteristic curve was built. The P-values were all two-tailed. Results with probability percentages (P%) lower than 0.05 were deemed significant (13).

4. Discussion

Consistent with Slee (14), who compared patients with preserved and reduced left ventricular ejection fraction in a study of heart failure progression and mortality in atrial fibrillation, we found that patients in group II had significantly lower LVEF than those in group I and also had significantly higher LVEDV, LVESV (P values 0.0001 for both). Additionally, Petre (15) found that the LVESV of patients with HTN and AF was significantly greater than that of patients with HTN but without AF.

While Wang (16) found that LV mass index was greater in hypertensive patients with paroxysmal AF than patients without AF (P value 0.05), we found no such difference between study groups with (P value 0.094), which may be attributable to Wang's (16) very small sample size of 90 patients.

Both Kagawa (17) and Mancusi (18) found that LA dilatation is a robust, independent predictor of poor

outcome in middle-aged individuals with arterial hypertension.

5. Conclusion

- Since hypertension is the most frequent, independent, and theoretically modifiable risk of atrial fibrillation, it is one of the common sequelae of hypertensive heart disease.
- Among patients with hypertension, tissue doppler imaging, which is included in most commercially available echocardiographic systems, showed a lot of promise for predicting incident AF.
- Among hypertensive patients, AF was associated with lower LVEF, LVEDV, LVESV, LA Vmax, LA Vmin, and LA Volume index compared to sinus rhythm.

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