SUBCLINICAL LEFT VENTRICULAR DIASTOLIC DYSFUNCTION IN HYPERTENSIVE PATIENTS IN SLEMANI CITY USING 2D ECHOCARDIOGRAPHY

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Submitted: 28/5/2018; Accepted: 12/8/2018; Published 15/10/2018

ABSTRACT

Background

Diastolic dysfunction refers to when the diastole part is abnormal. The ventricles do not properly relax and become stiff meaning they cannot fill with blood properly. This causes blood to "dam up" in other parts of the body. The pressure in the ventricles then increases as blood from the next heartbeat tries to enter. Diastolic dysfunction is a common problem, with many people aged older than 70 years having the condition

Objectives

To detect subclinical left ventricular diastolic dysfunction in hypertensive patients with preserved ejection fraction using 2D echocardiography.

Methods

This is a cross-sectional study that was carried on 80 hypertensive patients referred to slemani cardiac hospital and medical emergency outpatient clinic for evaluation and treatment of hypertension and 80 age and sex-matched healthy volunteers as a control group. All subjects underwent conventional echocardiographic examination and assessment of diastolic dysfunction by 2D echocardiography according to updated Europian guidelines for diastolic dysfunction

Results

A total of one hundred sixty (160) individuals were included in the final analysis. Mean age was 55.03±7.67SD years. Males accounted for 51.9% (n=83) of the studied sample and 48.1% (n=77) were females. Fifty percent (n=80) were hypertensive (cases) and the other 50% (n=80) were non-hypertensive (controls).hypertensive patients have significantly higher rates of diastolic dysfunction (22 cases vs 12) and LVH (19 vs 5) than non-hypertensives, they also have higher mean lateral annulus velocity (8.83±2.41vs10.21±2.62) and TR velocity(2.28±0.37vs2.11±0.11) but smaller mean LA volume.

Conclusion

Impairment of diastolic function detected by 2D echocardiography was significantly higher in hypertensive patients (with and without LVH) compared to nonhypertensive patients. Early detection of diastolic dysfunction in hypertensive patients is necessary to prevent diastolic heart failure which is the major type of heart failure in hypertensive patients.

Keywords: *Hypertension, 2D echocardiography, Diastolic dysfunction, Heart failure.*

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https://doi.org/10.17656/jsmc.10170

INTRODUCTION

The global prevalence of hypertension defined as an average systolic BP of 140 mmHg or greater, a diastolic BP of 90mmHg or greater, or the use of antihypertensive medication was estimated to increase by 60% to a total of 1.56 billion by 2025, which is 29% of the worldwide adult population [1]. During the same period, 75% of the world's hypertensive population will be residing in the third world countries[1, 2]. According to the Framingham Study, hypertension accounts for about a quarter of heart failure cases [3].

Diastolic heart failure (HF) is a progressive disorder characterized by impaired left ventricular (LV) relaxation, increased LV stiffness, increased interstitial deposition of collagen, and modified extracellular matrix proteins. Diastolic HF, also referred to as HF with normal ejection fraction currently accounts for 40% to 50% of all HF cases and has a prognosis, which is as ominous as that of systolic HF [4]. With life expectancy increasing, HF is growing into a major health problem. Because the process of myocardial remodeling starts before the onset of symptoms, recent HF guidelines [5].

Doppler echocardiography is the most practical method for assessing filling patterns and myocardial relaxation and for estimating LV filling pressures at rest and with exertion by recording flow velocities from the atrioventricular valves, central veins, and myocardial tissue. [6, 7, 8].Diastolic dysfunction and diastolic heart failure are not synonymous terms[9].

In the last 10 years or so, it has become apparent that approximately half of the patients who present with classic signs and symptoms of heart failure appear to have a normal ventricular function, typically defined by the finding of an ejection fraction of >50% on echocardiography. This group has been variously described as having diastolic dysfunction, diastolic heart failure, or "heart failure with a normal ejection fraction (HFNEF)[9].

A major reason for the paucity of randomized controlled trials in heart failure patients is the difficulty in defining and measuring diastolic function. Although hemodynamic data obtained by heart catheterization can be used to measure diastolic function, the invasive nature of this assessment limits its applicability to most patients. Therefore, Doppler echocardiography is the method of choice in routine clinical practice to asses for diastolic dysfunction[10].

LV diastolic dysfunction is a progressive condition and is characterized by an increased resistance dependence on ventricular preload [11]. Diastolic HF is thought to be responsible for as many as 74% of cases of HF in hypertensive patients[12]. Echocardiography is an alternative technique to cardiac catheterization in the evaluation of patients with diastolic dysfunction which include M-mode, 2-D, and Doppler echocardiography studies [13].

The aim of the study is to detect the prevalence of subclinical left ventricular diastolic dysfunction in hypertensive patients with preserved ejection fraction using 2D echocardiography.

PATIENTS AND METHODS

This is a cross-sectional study that was carried from January 2017 to January 2018 on 80 hypertensive patients referred to slemani cardiac hospital and medical emergency outpatient clinic for evaluation and treatment of hypertension and 80 age and sex-matched healthy volunteers as a control group. They were enrolled in the study after obtaining their written informed consent. our cases were all known cases of hypertension. Control subjects had no detectable cardiovascular risk factors and not receiving any medications.

Exclusion criteria included patients with ejection fraction <50% or sign and symptoms of heart failure, known case of diabetes mellitus, valvular lesions, atrial fibrillation, any rhythm disturbance, known case of thyrotoxicosis, COPD , morbid obesity, age>80, <40 and ischemic heart disease.

The following data were collected:

• Complete and detailed medical history: With attention to Hypertension, thyrotoxicosis, COPD, DM and family history of premature coronary artery disease.

• Full clinical examination including body surface area [14], heart rate, rhythm)., heart, and chest auscultation, systolic and diastolic blood pressure. Hypertension was classified based on JACC(Journal of the American college of cardiology) guidelines for classification of hypertension[15].

• Assessment of LV diastolic functions with conventional echocardiography.

For diastolic function assessment, Echocardiography

was done by a single operator using the GE Vivid 7 echocardiography machine. Four variables were evaluated when determining whether LV diastolic function is normal or abnormal [16]. LV diastolic function is normal if more than half of the available variables do not meet the cutoff values for identifying abnormal function. LV diastolic dysfunction is present if more than half of the available parameters meet these cutoff values. The study is inconclusive if half of the parameters do not meet the cutoff values [16]. The presence of several abnormal findings, as well as cutoff values with high specificity for the myocardial disease, is recommended to decrease false positive diagnoses of diastolic dysfunction.

The four recommended variables and their abnormal cutoff values are annular e0 velocity (septal e0 < 7 cm/sec, lateral e0 < 10 cm/sec), average E/e0 ratio > 14, LA maximum volume index > 34 mL/m2 , and peak TR velocity > 2.8 m/sec. On the basis of the writing group's collective expert opinion, average E/e0 ratio is recommended for simplification. Although E/e0 ratio may be obtained at septal or lateral annulus, and different values exist because of the normally higher lateral annular velocities, an average E/e0 ratio > 14 is used throughout this document and is consistent with recent studies in normal subjects. [16]

Data analysis was done by computerized statistical software; Statistical Package for Social Sciences (SPSS) version 24. Descriptive statistics presented as (mean ± standard deviation) and frequencies as percentages. Multiple contingency tables conducted and appropriate statistical tests performed, Chi-square used for categorical variables and independent t-test was used to compare between means. In all statistical analysis level of significance (p-value) set at =< 0.05 and the result presented as tables and/or graphs.

RESULTS

A total of one hundred sixty (160) individuals were included in the final analysis. Mean age was 55.03±7.67SD years. Males were accounted for 51.9% (n=83)of studied sample and 48.1% (n=77) were females. Fifty percent (n=80) were hypertensive (cases) and the other 50% (n=80) were non-hypertensive (controls). These values along with other socio-demographic features are shown in table 1

Both cases and controls are relatively well-matched in terms of numbers, ages (the hypertensive group is older by a mean of 3.59 years) and gender as shown in table 2 below.

Regarding hemodynamic measures of both groups, hypertensive patients have significantly higher rates of diastolic dysfunction (22 cases vs 12) and LVH (19 vs 5) than non-hypertensives, they also have higher mean lateral annulus velocity (8.83±2.41vs10.21±2.62) and TR velocity(2.28±0.37vs2.11±0.11) but smaller mean LA volume as shown in table 3.

The rate of Diastolic dysfunction and its parameters are significantly related to the grades of HT as illustrated in table 4.

Again hemodynamic measures and hence diastolic dysfunction are significantly related to the BMI as shown in table 5.

Regarding the relation of age to E/E' ratio in both groups, increasing age causes increase in E/E' ratio, (Moderate Positive correlation) and P values are significant (less than 0.05), interestingly, correlation coefficient (R) in non-hypertensive patients is greater than correlation coefficient in hypertensive patients, this means that age has lesser effect on E/E' when a patient has hypertension and vice-versa!. See figure 1 and 2.

Table 1. Socio-demographic and clinical characteristics of the participants.

Variable	N (%)
Age (mean ± SD) years	55.03±7.67
Sex	
Female	77 (48.1)
Male	83 (51.9)
BMI	
18.50 – 24.90	103 (64.4)
25.0 – 29.90	51 (31.9)
30.0 – 34.90	6 (3.8)
Smoker	
No	111 (69.4)
Yes	49 (30.6)
Alcoholic	
No	148 (92.5)
Yes	12 (7.5)
Hypertension	
No	80 (50)
Yes	80 (50)

Table 2. Basic characteristics of hypertensive and non-hypertensive patients with comparison

Variable	HTN N	Non-HTN N	P Value
Age (mean ± SD)	56.82±8.88	53.23±5.72	0.003
Sex			
Female	41	36	0.429
Male	39	44	
BMI			
18.50 – 24.90	57	46	
25.0 – 29.90	23	28	
30.0 – 34.90	0	6	0.022
Smoke			
No	56	55	0.864
Yes	24	25	
Alcoholic			
No	74	74	1.000
Yes	6	6	

Table 3. Comparison of cardiac hemodynamic measures in both groups.

Variable	HTN N	NO HTN N	P Value
Diastolic dysfunction			
No	58	68	0.053
yes	22	12	
Left ventricular hypertrophy			
No	61	75	0.002
Yes	19	5	
E/E' (mean ± SD)	11.05±3.13	11.07±2.39	0.959
LA volume(mean ± SD)	29.16±5.27	31.41±1.65	0.000
E' lateral (mean ± SD)	8.83±2.41	10.21±2.62	0.001
E'septal (mean ± SD)	7.71±2.81	7.92±1.23	0.533
TR Velosity (mean ± SD)	2.28±0.37	2.11±0.11	0.0001

Table 4. Cardiac hemodynamic measures according to the grades of hypertension.

HT Grades	Diastolic dysfunction N No/Yes	LVH N No/Yes	E/E' (mean ± SD)	E' Lateral (mean ± SD)	E' septal (mean ± SD)	LA volume (mean ± SD)	TR Velocity (mean ± SD)	P-value
Grade 0	9/0	9/0	9±1.93	11.44±0.52	8.88±2.31	28.38±3.02	2.13±0.17	
Grade 1	39/10	41/8	10.64±2.54	8.59±2.28	7.52±2.66	28.22±5.22	2.22±0.35	0.000
Grade 2	10/12	11/11	11.17±3.84	9.35±2.61	8.64±3.41	28.82±4.72	2.39±0.51	

Table 5. Cardiac hemodynamic measures according to Body mass index.

BMI	Diastolic dysfunction No/Yes	LVH* No/Yes	E/E' (mean ± SD)	E' Lateral (mean ± SD)	E' septal (mean ± SD)	LA volume (mean ± SD)	TR Velocity (mean ± SD)	P-value
18.5–24.9	90/13	91/12	10.67±2.44	9.57±2.27	7.9±2.14	29.13±4.07	2.18±0.27	
25–29.9	36/15	39/12	11.38±3.17	10.07±2.65	7.86±2.27	32.06±3.12	2.210.32	0.000
30–35	0/6	6/0	14.96±0.25	4.0±0.0	6.0±0.0	35.1±0.0	2.3±0.0	

***LVH: left ventricular hypertrophy**

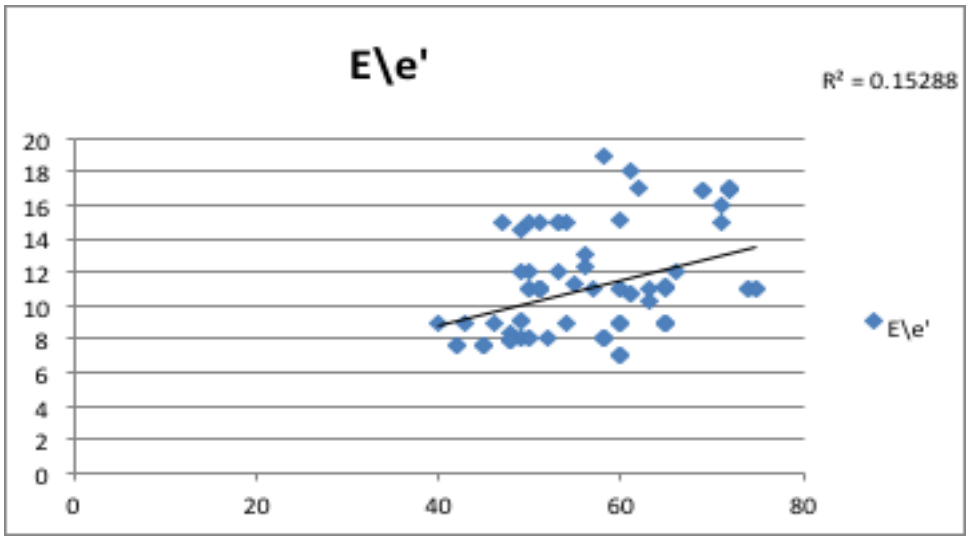

Figure 1. Correlation between E/E' with age in hypertensive patients.

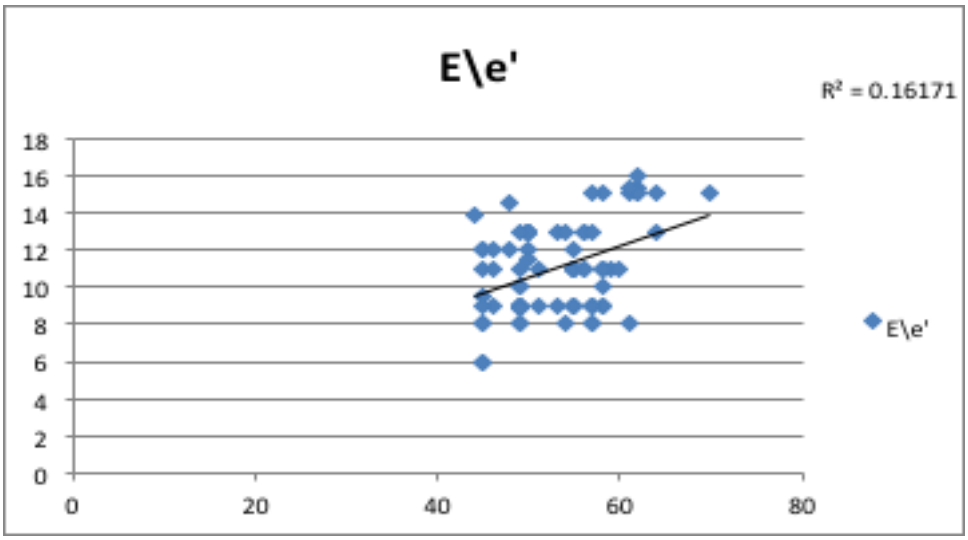

Figure 2. Correlation between E/E' with age in non-hypertensive patients.

DISCUSSION

Abnormalities of LV diastolic function are common in cases of systemic hypertension in whom the left ventricular systolic performance is still normal.

In this study hypertensive patients have significantly higher rates of diastolic dysfunction (22 cases vs 12) and LVH (19 vs 5) than non-hypertensives, they also have higher mean lateral annulus velocity (8.83±2.41vs10.21±2.62) and TR velocity(2.28±0.37vs2.11±0.11) but smaller mean LA volume. The rate of Diastolic dysfunction and its parameters are significantly related to the grades of HT.

The prevalence of LV diastolic dysfunction in hypertensives in this study was 27.5% (22 out of the 80). However, the prevalence in the normotensive controls was 15% (12 out of 80). A recent study in Asia on the prevalence of DD by Masliza et al [17] found a lower incidence of 18.6% (32 out of 198) in their newly diagnosed with systemic hypertensives and 6 (3.4%) among the controls. another study Kingue et al [18] in Black African untreated hypertensive population in Cameroon (67%). Balogun et al [19] reported a prevalence of 46% in their study on hypertensives. The selection, inclusion criteria and the characteristics of those patients might have accounted for the higher prevalence in their study. The reported prevalence

of LVDD depends on several factors, such as the characteristics of the population under study, imaging techniques, and the criteria applied to diagnose or to grade LVDD.

Relationships between LV diastolic function and overweight and obesity as classified by the WHO expert consultation definition for Asians were analyzed. this study suggests that BMI has an independent correlation with parameters of LV diastolic function. In our study population, the overweight and obese groups had more impaired diastolic function compared with the normal-weight group, and both of these weight groups were independent predictors of LV diastolic dysfunction.

Many studies have demonstrated that overweight and obesity are important risk factors for the development of heart failure [20-,23]. Most studies use the most popular WHO BMI criteria of $\geq$ 25 kg/m^2 for overweight and $\geq$ 30 kg/m^2 for obesity [24], which were both calculated based on Western populations. However, Asian populations have a lower mean BMI than Western populations, in addition to a higher percentage of body fat and a greater risk for cardiovascular disease at a given BMI [25, 26].

In the I-PRESERVE echocardiographic substudy, LV mass and LA size remained independently associated with an increased risk of morbidity and mortality [27]. In other study LV hypertrophy, septal E/e· ratio, and TR peak velocity were predictive of outcome beyond clinical and laboratory characteristics. Because LV hypertrophy, elevated filling pressures, and elevated PASP frequently coexist, a greater number of these abnormalities is associated with a higher risk for incident hospitalization for heart failure [28]. LVDD develops early in most cardiac diseases and leads to the elevation of LV filling pressures. Therefore, echocardiographic measurements of diastolic function provide important prognostic information.

In this study Regarding the relation of age to E/E' ratio in both groups, increasing age causes increase in E/E' ratio, (Moderate Positive correlation) and P values are significant (less than 0.05), interestingly, correlation coefficient (R) in non-hypertensive patients is greater than correlation coefficient in hypertensive patients, this means that age has lesser effect on E/E' when a patient has hypertension and vice-versa! Whether this difference is important or not is not well known. This finding needs further studies.

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