

Original Research Article

Study of diastolic dysfunction in essential hypertension patients in relation to age and duration of treatment

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ABSTRACT

Background: Hypertension is a major health problem worldwide and its complications have significant socioeconomic impact. The objective of this study was to evaluate diastolic dysfunction (DD) in essential hypertension patients and the influence of age and duration of hypertension on this parameter.

Methods: One hundred essential hypertensive patients (HT) underwent Doppler echocardiography to obtain E/A wave ratio (E/A), atrial deceleration time (ADT), isovolumetric relaxation time (IRT) and Tissue Doppler early diastolic mitral annular velocity (E). All patients were grouped according to age at diagnosis of hypertension and duration of the disease.

Results: A higher prevalence of DD occurred parallel to age and duration of the disease.

Conclusions: DD was prevalent in this hypertensive population, being highly affected by age and DD is observed in incipient stages of hypertensive heart disease, and thus its early detection may help in the risk stratification of hypertensive patients.

Keywords: Age, Diastolic function, Essential hypertension

INTRODUCTION

Hypertension is a major health problem worldwide and its complications have significant socioeconomic impact. Hypertension is well known to be one of the major risk factors for stroke, coronary heart disease and renal failure. Therefore, prevention and treatment of hypertension and the associated target organ damage remains important public health challenges.¹ Diastolic dysfunction is now well established as a cause of left sided heart failure and as a powerful predictor of cardiovascular events. Diastolic dysfunction is present in over 25% of adults over 40 years of age and accounts for approximately 50% of heart failure cases. Systemic hypertension (HTN) is the most commonly associated condition in patients with left ventricular diastolic dysfunction (LVDD).²

The traditional definition of diastole (διαστολε = "expansion"), includes the part of the cardiac cycle starting at the aortic valve closure when LV pressure falls below aortic pressure and finishing at the mitral valve closure. A normal diastolic function is clinically defined as the capacity of the left ventricle to receive a filling volume and its ability to guarantee an adequate stroke volume, operating at a low-pressure regimen. In descriptive terms, diastole can be divided in four phases:

Isovolumetric relaxation

This is the period occurring between the end of systolic ejection (aortic valve closure) and the opening of the mitral valve, when LV pressure continues its rapid fall, while LV volume remains constant.

LV rapid filling

This begins when LV pressure falls below left atrial (LA) pressure and the mitral valve opens. During this period, the blood has an acceleration which achieves a maximal extent, directly related to the magnitude of atrio-ventricular pressure, and stops when these gradient ends. This period represents a complex interaction between LV suction (active relaxation) and viscoelastic properties of the myocardium (compliance).

Diastasis

This occurs when LA and LV pressures are almost equal and LV filling is essentially maintained by the flow coming from pulmonary veins with left atrium representing a passive conduit with an amount depending on LV pressure, function of LV “compliance”.

Atrial systole

This corresponds to LA contraction and ends at the mitral valve closure. This period depends on LV compliance and, to a lower extent, on pericardial resistance, atrial force, and atrio-ventricular synchronicity (Electrocardiogram-derived PR interval).³

METHODS

100 consecutive patients of essential hypertension referred for transthoracic echocardiogram at department

of internal medicine of our teaching hospital were included in the study.

Inclusion criteria

- Diagnosed cases of essential hypertension on treatment

Exclusion criteria

Patients of secondary hypertension, systolic dysfunction, ischemic heart disease, valvular heart disease which could have potential impact over the measured echocardiographic parameters of diastolic dysfunction were excluded from study.

Demographic data of patients (age, sex, age at diagnosis, target organ damage) was recorded in prescribed proforma.

The echocardiography was done using a Esaote (Model 2014) machine by experienced physician trained in the field. The inbuilt software in the machine was used to calculate LV ejection fraction (EF). Pulse wave doppler derived mitral inflow velocities (E and A) were obtained by putting sample volume at the tip of mitral leaflets. E wave deceleration time (DT), isovolumic relaxation time (IVRT) was also obtained at the same time. DD was diagnosed and graded according to the values mentioned in the table below. Additionally, TDI was used to assess DD by putting the sample volume at septal and lateral mitral annulus.⁴

Table 1: Echo based diastolic dysfunction was graded as follows.

Parameter	Normal	Gr I DD Impaired myocardial relaxation	Gr II DD pseudo normal pattern	Gr III DD restrictive filling reversible	Gr IV DD restrictive filling irreversible
E/A	1.0-1.5	<1.0	1.0-1.5	>1.5	>1.5
IVRT	70-90 ms	>90 ms	<90 ms	<70 ms	<70 ms
DT	160-240 ms	>240	160-200	<160	<160
E/E'' (TDI)	<8	>15	>15	>15	>15

E and A Peak velocity of blood during early diastolic filling (E) and atrial contraction (A); IVRT Isovolumetric relaxation time; DT Deceleration time; E'' septal early diastolic mitral annular motion as measured by doppler tissue imaging.

Tissue Doppler early diastolic mitral annular velocity (E''), which is relatively non-load dependent in patients with cardiac disease, is generally thought to be the best non-invasive estimate of LV relaxation. The longer it takes for the LV to relax, the lower is the E'' velocity. The resulting E/E'' ratio, has been validated as a reasonably reliable non-invasive indicator of LV filling pressure in patients with preserved LVEF.⁵

RESULTS

The major results are presented in the Tables below.

A total of 100 patients were identified (mean age, 67.9 years; mean LVEF 59%; and 58% male).

From above table, it can be inferred that, in essential hypertension patients, prevalence of diastolic dysfunction increases parallel with age.

Out of 100 hypertensive patients with diastolic dysfunction 14 were below 30 years of age. The number increased to 57 for patients above 50 years of age.

Table 2: Age distribution.

Age in years	No. of patients with diastolic dysfunction (N)	Percentage (%)
<30	14	14
31-50	29	29
>50	57	57
Total	100	100

Table 3: Sex distribution.

Gender	No. of patients with diastolic dysfunction (N)	Percentage (%)
Male	58	58
Female	42	42

Table 3: Grades of diastolic dysfunction in 100 patients of hypertension.

Grade of DD	No. of patients (N)	Percentage (%)
Gr 1	58	58
Gr 2	24	24
Gr 3	10	10
Gr 4	8	8
Total	100	100

Table 4: Relation between age at diagnosis of hypertension and diastolic dysfunction.

Duration of hypertension (Years)	No. of patients (N)
Less than 10	9
10/30/17	21
More than 30	70
Total	100

As depicted in Table 5, duration of disease has direct correlation with the left ventricular diastolic dysfunction in essential hypertension patients. Only 9 patients out of 100 showed some degree of diastolic dysfunction if the duration for which they were on anti-hypertensive therapy was less than 10 years. The number increased to 70 when the patients were on anti-hypertensive therapy for more than 30 years.

DISCUSSION

Relaxation of the heart is a major determinant of early diastolic filling and atrial blood rushes into the ventricle during the terminal stage of relaxation.

Diastolic dysfunction is a complex process that arises from numerous interrelated contributing factors such as pressure variations in the ventricle, Cardiac preload, afterload, ventricular relaxation and compliance. Diastolic dysfunction is an abnormality of relaxation, filling, or distensibility of the left ventricle that is associated with augmented cardiovascular mortality.⁶

Our study confirms the well-established independent correlations of DD with both aging and essential hypertension. Moreover, Systolic BP also appears to play a crucial and independent role in the presence of DD, as a recent study has also shown.⁷

The epidemiological relationship between hypertension and diastolic dysfunction has been well established in a number of recent studies. Up to 50% of patients with hypertension have evidence of diastolic dysfunction, which has been associated with an 8- to 10-fold increased risk of mortality. Hypertension has been associated with increased collagen deposition and cross-linking, increased interstitial fibrosis, and disturbance of calcium homeostasis in the myocardium, 19, 20 all of which may contribute to worsening diastolic function. Similar mechanisms likely contribute to increased vascular stiffness and worsening of vascular function in patients with hypertension. Both diastolic dysfunction and abnormalities of vascular function likely play a role in the pathogenesis of heart failure with preserved ejection fraction, and abnormalities of both have been observed in these patients, although diastolic dysfunction likely precedes the overt manifestations of heart failure by many years.⁸

The present study has confirmed in a larger number of patients the first reports of early impairment of left ventricular filling in hypertension, an impairment often found before any evidence of reduced cardiac output or ejection fraction. In addition, the concomitant determination of ventricular volume curves and of echocardiographic left ventricular indexes has allowed an examination of the correlates of that impairment. The reduction in peak rate of early left ventricular filling was related to left ventricular mass and left ventricular end-systolic diameter, not to arterial pressure levels themselves.

Although the degree of systolic performance and the rate of early left ventricular filling correlated significantly with each other, ejection fraction and left ventricular fractional shortening remained within normal limits in most patients, whereas the rate of left ventricular filling was significantly reduced. Thus, we could again determine that cardiac abnormalities in patients with hypertension had their first measurable expression in abnormalities of left ventricular filling rather than in systolic performance. These findings further underline the early cardiac involvement in hypertension recently described in experimental models of hypertensive subjects.

Evaluation of alterations in diastolic function in the hypertensive population showed that alterations are prevalent and changed in regard to normotensive patients and, as found in other studies, were influenced mainly by age.⁹

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Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

1. Dwivedi S, Singh G. Profile of hypertension in elderly subjects. *JAPI.* 2000;48.
2. Armstrong WF, Ryan T. Evaluation of left ventricular diastolic function. In: Feigenbaum's *Echocardiography*, 7th edition, Philadelphia, Lippincott Williams and Wilkins. 2005;7:159-83.
3. Zile M, Brutsaert D. New concepts in diastolic dysfunction and diastolic heart failure: Part I. Diagnosis, prognosis, and measurements of diastolic function. *Circulation.* 2002;105:1387-93.
4. Oh JK, Seward JB, Tajik AJ. Assessment of diastolic function and diastolic heart failure. *The Echo Manual.* 3rd edition, New Delhi: Wolters Kluwer Health (India) Pvt. Ltd; 2006:120-142.
5. Sohn D, Chai L, Lee D, Kim HC, Kim HS, Oh BH, et al. Assessment of mitral annulus velocity by Doppler tissue imaging in the evaluation of left ventricular diastolic function. *J Am Coll Cardiol.* 1997;30:474-80.
6. Nikitin N, Witte KK, Clark AL, Cleland JG. Color tissue Doppler-derived long-axis left ventricular function in heart failure with preserved global systolic function. *Am J Cardiol.* 2002;90:1174-7.
7. Henein M, Lindqvist P, Francis D, Morner S, Waldenstrom A, Kazzam E. Tissue Doppler analysis of age-dependency in diastolic ventricular behaviour and filling. *Eur Heart J.* 2002;23:162-71.
8. Redfield MM, Jacobsen SJ, Burnett JC, Mahoney DW, Bailey KR, Rodeheffer RJ. Burden of systolic and diastolic ventricular dysfunction in the community: appreciating the scope of the heart failure epidemic. *JAMA.* 2003;289:194-202.
9. White WB, Schulman P, Dey HM. Effects of age and 24-hour ambulatory blood pressure on rapid left ventricular filling. *Am J Cardiol.* 1989;63:1343-7.

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