



PREVALENCE OF DIASTOLIC DYSFUNCTION IN HYPERTENSIVE PATIENTS

**Dr P
Krishnarajan ***

MD, Assistant professor Department of General medicine Govt Sivagangai medical college. *Corresponding Author

Dr. D.Girubaharan

MD, Assistant professor, Department of General medicine, Government Sivagangai medical college.

ABSTRACT

INTRODUCTION: Hypertension is one among the forerunners of major macro vascular complications like cerebrovascular accident, coronary artery disease, chronic kidney disease and peripheral vascular disease. Hypertension is prevalent cause of diastolic dysfunction with normal EF evident from various studies. Although the presence of sub-clinical left ventricular diastolic dysfunction (LVDD) increases cardiovascular risk, the current ESH/ESC guidelines do not include the presence of this condition in the list of target organ damage or cardiovascular risk charts dedicated to the hypertensive population. The current study was designed to determine diastolic dysfunction in patients with hypertensive with preserved left ventricular systolic function.

Methods: This was a prospective and retrospective study conducted on hypertensive patients attending the out-patient department of Government Sivagangai Medical College, Sivagangai. A total of 160 patients diagnosed to have hypertension with preserved systolic function (EF > 50%) were studied. Ten patients were excluded for not getting adequate window to examine the cardia through echocardiography. Finally, 150 patients were included in the study.

Results: In our study, out of 150 patients, 62% of patients had LV diastolic dysfunction, in our study there was a significant correlation between age and diastolic dysfunction which was statistically significant. In our study, a significant correlation was observed between sex and diastolic dysfunction which was statistically significant. In our study, there was a significant correlation between duration of hypertension and diastolic dysfunction. Prevalence of diastolic dysfunction is higher in patients with long duration of hypertension. Prevalence of diastolic dysfunction is more with higher grade of diastolic BP. Both were statistically significant. In our study, there was no significant correlation between LVH and Diastolic dysfunction. **Conclusions:** There is an unexpectedly high prevalence of different forms of diastolic dysfunction in treated hypertensive patients who are free of overt cardiovascular disease. The current findings have potential relevance in clinical practice for evaluation of hypertensive patients as diastolic dysfunction may be an early manifestation of cardiac involvement in hypertension.

KEYWORDS : Hypertension. Diastolic dysfunction

INTRODUCTION

Hypertension has been a problem that has attracted scientific mind from time immemorial. Hypertension is the most prevalent non communicable disease affecting the people across throughout the world. Hypertension is one among the forerunners of major macro vascular complications like cerebrovascular accident, coronary artery disease, chronic kidney disease and peripheral vascular disease. Various data from clinical studies reveals 30-50% of patients with congestive cardiac failure have normal ejection fraction with impaired diastolic function (diastolic HF)¹. Hypertension is prevalent cause of diastolic dysfunction with normal EF evident from various studies.

Patients with Hypertension develops inadequate relaxation LV even in without affecting ejection fraction and many previous research reports showed specific changes in LV. Like hemodynamics as² decreased peak mitral early diastolic filling wave (E) velocity, increased peak mitral atrial contraction wave (A) velocity, and a decreased ratio of peak mitral E to A velocities (E/A). This altered flow velocity curve is associated with the presence of impaired LV relaxation³, and the decreased E/A is called an "abnormal relaxation" pattern and has been used as an indicator of diastolic dysfunction in patients with hypertension. This pattern has been described in 30 % to 50 % of patients with hypertension with or without preserved systolic function. More advanced hypertensive heart disease is likely to be associated with reduced LV compliance as well as impaired relaxation, resulting in raising LV filling pressure and an increase in E/A. If diastolic function of LV is assessed with trans mitral flow velocity curve alone, both patients with truly normal pattern and those with pseudonormal pattern are recognized to have normal diastolic function, and the presence of diastolic dysfunction among many patients will remain unrecognized⁴.

The current study was designed to determine diastolic dysfunction in patients with hypertensive with preserved left ventricular systolic function by combined transmitral flow velocity curve and pulmonary venous Doppler analysis, specifically highlighting the limitation of the transmitral flow velocity curve alone to detect diastolic dysfunction.

Materials And Methods

This was a prospective and retrospective study conducted on hypertensive patients attending the out-patient department of

Government Sivagangai Medical College, Sivagangai. They were selected randomly for enrollment into the study, after consideration of inclusion and exclusion criteria. A detailed history had taken, thorough clinical examination and investigations performed as per proforma in all cases. Ethical clearance for the study was obtained from Ethical committee.

A total of 160 patients diagnosed to have hypertension with preserved systolic function (EF > 50%) were studied. Ten patients were excluded for not getting adequate window to examine the cardia through echocardiography. Finally, 150 patients were included in the study.

Informed consent was taken from all the study subjects. Echocardiographic studies were performed by a cardiologist. Ambulatory asymptomatic patients diagnosed to have hypertension (grade I & II) for minimum period of 6 months on any class of antihypertensives were included in the study. Patients with congestive cardiac failure, Coronary heart disease, Valvular heart disease, Cardiomyopathy, Diabetes mellitus, Alcoholism, Cirrhosis, Chronic kidney disease and EF<50% were excluded.

A detailed clinical history of subjects was taken as per proforma. Each subject underwent a detailed physical examination & systemic examination. A standard 12 lead ECG was recorded in all subjects to look for any abnormalities. Routine hematological and biochemical investigations including, hemoglobin concentration, blood sugars, blood urea and serum creatinine were done. Two-dimensional and M-mode Echocardiography was performed. Left ventricular diastolic dysfunction was determined by decreased E/A ratio (transmitral flow velocity curve). Normal E/A ratio was defined as E/A ratio \geq age and sex adjusted mean value -2SD. Abnormal E/A ratio was defined as E/A ratio < age and sex adjusted mean value -2SD.

Data's were analyzed using the SPSS software. Statistical significance was indicated by the Chi-square test. Variables were considered to be significant if $p < 0.05$

Observation & Results

A prospective and retrospective study consisting of 150 hypertensive cases attending the outpatient departments of Government Sivagangai Medical College. The number of males was 85(57%) and that of

females was 65 (43%). The patient's age ranged from 31 to 64 years. Most cases (54%) were between 41-60 years of age.

In our study, duration of hypertension in most of the patients was above 4 years in 81 patients (54%) and 2-4 years in 50 patients and rest had hypertension for less than 2 years. Coming the levels of systolic BP, In our study most of the patients (45%) had Systolic BP between 140 and 159, 57 patients had Systolic BP more than 160 and rest had Systolic BP less than 140. Coming to Diastolic BP in our study group was more than 90 in 67 patients, 80-90 in 42 patients, less than 80 in 41 patients. Hence mean systolic BP in our study group was 154.34 and mean diastolic BP in our study group was 86.76. In our study, 83 patients (55.3%) were on single drug (mostly amlodipine), 44 patients (29.3%) were on two drugs and 23 patients (15.4%) were on three drugs Moving on to ECG changes in our study, left atrial enlargement was the most common ECG change present in 38% of patients, followed by left ventricular hypertrophy (33%) and left axis deviation (24%)

Table 1: Diastolic Dysfunction

Diastolic dysfunction defined by E/A	Number	%
Normal diastolic function (E/A- normal, Δd- normal)	57	38
Pseudo normal (E/A –Normal, Δd=abnormal)	27	18
Abnormal diastolic function (E/A abnormal, Δd- normal)	66	44
Total	150	100

In our study, E/A ratio cut off value for LV dysfunction was set as 1.0. Out of 150 patients, 43% had abnormal E/A ratio (<1) and remaining 57% had E/A ratio >1. Patients said to be normal by E/A ratio, were further distinguished by Δd fraction into true normal and pseudo normal. Patients with pseudo normal E/A ratio would have been characterized as having normal diastolic function if E/A ratio was used alone. Thus estimation of Δd resulted in detection of 27 more cases of diastolic dysfunction. This group of cases with normal E/A ratio but abnormal Δd was considered to be having "pseudonormal pattern" of diastolic dysfunction. In our study, out of 150 patients, 62% of patients had LV diastolic dysfunction.

In our study there was a significant correlation between age and diastolic dysfunction which was statistically significant (p value – 0.0008). This showed that with advancing age there was impairment of LV relaxation and filling independent of other co-morbid illness and risk factors. In our study, a significant correlation was observed between sex and diastolic dysfunction which was statistically significant (p value – 0.013). Diastolic dysfunction was more common in males compared to females.

In our study, there was a significant correlation between duration of hypertension and diastolic dysfunction. Prevalence of diastolic dysfunction is higher in patients with long duration of hypertension. In our study, significant correlation was observed between grade of SBP and diastolic dysfunction and was statistically significant. (p value – 0.012). There was a significant correlation between diastolic BP and diastolic dysfunction. Prevalence of diastolic dysfunction is more with higher grade of diastolic BP. Both were statistically significant, In our study, there was no significant correlation between LVH and Diastolic dysfunction.

Among all the cases E/A ratio was normal in 57 cases. Sixty six cases had E/A ratio less than age adjusted normal range indicating abnormal diastolic function. Twenty seven cases had pseudonormal pattern (E/A normal, Δd abnormal).

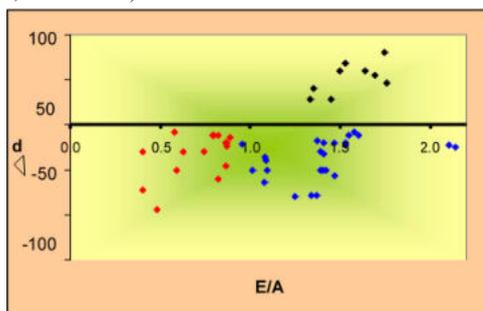


Chart 1: Relation Between E/a Ratio And Δd In Cases With Normal Diastolic Function (blue), Cases With Pseudonormal Pattern (black) And Cases With Abnormal Diastolic Function (red)

Table 2: Echo Parameters In Cases With Diastolic Dysfunction

Echo parameters Mean ± SD (Min-Max)	Normal diastolic function (n=57)	Diastolic dysfunction		p value
		Pseudo normal (n=27)	Abnormal (n=66)	
Ejection Fraction (%)	63.26±4.47	61.33±1.58	65.09±4.63	0.075
LVIDS	2.44±0.30	2.05±0.51	2.84±0.47	0.000
LVIDD	4.13±0.38	3.61±0.74	4.47±0.47	0.000

Ejection fraction was normal among all groups of cases. Both LVIDS and LVIDD were maximum in the group with abnormal diastolic function and minimum in the group with pseudonormal pattern. Both values were statistically significant (p=0.000 for each). This was indicative of restrictive filling pattern of LV due to decreased compliance.

DISCUSSION

Hypertension is one of the most common diseases afflicting humans throughout the world.5 The prevalence of hypertension in Indian population is 3 to 15% in male and 2 to 15%

in female in urban population and 1.6 to 6.9% in male and 2.4 to 8.8% in female in rural population⁶.

The aim of the study was to determine the dysfunction in hypertensive patients with normal EF by both transmitral pressure gradients and doppler study of pulmonary vein specifically observing only the transmitral flow velocity curves itself gives clue to diastolic dysfunction. This study was done on a relatively uniform & ambulant hypertensive population.

Diastolic function is affected by modifiable and non modifiable risk factors. Sex, Age, duration, and hypertrophy of LV affects after load. There has been changes as age advances in the form of limitations of transmitral flow velocity curves without any other pathology So Age related control subjects to verify the age- adjusted control values done in our study.

Subjects in our study underwent echocardiographic examination where diastolic function evaluated and graded by transmitral flow velocity curves and E/A ratio [ratio of mitral early diastolic filling wave (E) velocity to mitral atrial contraction wave (A) velocity]. Data regarding normal E/A ratio are lacking in Indian population and hence an age and sex matched control group was recruited to determine the E/A ratio in different age groups.

For determination of impairment of relaxation, E/Aratio was set as previous studies proves that as the age advances E/A ratio will decrease⁷. However, the values for the E/A ratio observed in hypertensive group (abnormal E/A ratio; 0.80 ± 0.22) were significantly lower than the controls. The control subjects E/A ratio mean - 2SD in these age-groups varied from 1.15 to 0.95, which was 0.15 more and 0.05 less than 1, Therefore age was taken into consideration while interpreting E/A ratio value in cases. Control E/A values were very useful in this regard Majority of cases in our study were males (58%). A similar male preponderance was noted in several earlier studies⁸. The mean age of cases in our study was 45.70±11.12 years. This was comparable to mean age of cases in the earlier Asian studies. (Masliza et al⁹, mean age 43.1±5.7years), whereas other western studies had enrolled older cases (Mottram et al¹⁰).

Diastolic dysfunction as defined by E/A ratio was found to be abnormal in 44% of cases in our study. Mottram et al¹⁰, had found abnormal E/A ratio in 40% of their patients which is comparable to our finding. Other investigators have found a lower proportion of cases with abnormal E/A ratio in their study group.

Although the sex ratio in abnormal E/A ratio group was equal (50% v/s 50%), more females tended to have normal E/A ratio (62% v/s 48%) in our study. Mottram et al¹⁰ had found that female sex was an independent predictor of diastolic dysfunction. In our study there was diastolic dysfunction preponderantly observed in male.

Abnormal E/A ratio correlated with DBP ≥ 90mm Hg in our study. There was also correlation between normal diastolic function defined by E/A ratio and DBP < 80 mmHg (p=0.004). Mottram et al¹⁰ had also found DBP to be significantly associated with diastolic dysfunction a finding similar to our study.

Our study found out the association between abnormal E/A ratio and duration of hypertension and systolic & diastolic blood pressure. No other study except Masliza⁹ study had found an association between systolic BP, duration of hypertension and diastolic dysfunction.

Cases with normal E/A ratio were further evaluated for pseudonormal pattern of diastolic function defined by Δd , an indicator of LV filling and diastolic function. Eighteen percent of cases in our study with normal E/A ratio were found to have pseudonormal pattern of diastolic function i.e. normal E/A ratio but abnormal Δd . Other studies which have looked for diastolic function by Δd have found results similar to ours. Pseudonormal pattern was found 23% in Yamamoto¹¹ study and 13% in Mottram's¹⁰ study.

Both LVIDD and LVIDS were significantly higher in abnormal diastolic function group and significantly lesser in patients with pseudonormal pattern of diastolic function. Although both group of cases had diastolic dysfunction of varying degree, increased LVIDD and LVIDS signify dilatation of LV and decreased LVIDD and LVIDS signify reduced compliance of LV. Mottram et al¹⁰. have also found, elevation in diastolic blood pressure to be significantly associated with diastolic dysfunction.

Diastolic blood pressure is dependent on peripheral resistance and increases afterload of the heart. Our study also found correlation between DBP < 80 mmHg and normal diastolic function (p=0.001). This has not been shown by previous studies.

Although earlier studies had found correlation between left ventricular hypertrophy and diastolic dysfunction, recent studies including our study have not confirmed the association. Masliza et al⁹ also did not find correlation between LVH and diastolic dysfunction and have suggested that a compensatory physiological mechanism in response to pressure load during early hypertension even before onset of demonstrable LVH may be the cause for diastolic dysfunction.

The cardinal impression of our study was that LV diastolic dysfunction is more common than as we suspected (62% of the hypertensive population studied), in subjects with hypertension devoid clinically detectable heart disease. In addition to revealing a prevalence of LVDD of 62%, this study also unveiled a significant number of subjects (18%) with a pseudonormal pattern by use of Δd for evaluation of diastolic dysfunction similar to previous studies. Mottram¹⁰ and Yamamoto¹¹ have found abnormal diastolic function to be present in 53% and 55% of cases respectively comparable to our study.

CONCLUSION

The current study demonstrated that the presence of LV diastolic dysfunction in hypertensive patients is actually greater than previously reported by studies that analyzed transmitral flow velocity curves alone. Pseudonormal pattern of LV dysfunction can be missed by routine ECHO which is an intermediate stage of LV Dysfunction. So further studies needed to evaluate isolated diastolic dysfunction in hypertensive patients for early diagnosis, treatment to prevent morbidity and mortality.

REFERENCES:

1. Libby: Braunwald's Heart Disease: A Textbook of Cardiovascular Medicine, 8th Chap. 26,pg 641
2. Cooper RS et al. Hypertension treatment and control in sub-Saharan Africa: the epidemiological basis for policy. *British Medical Journal*, 1998, 316, 614-617.
3. Adebayo AK, Adebisi AA, Oladapo OO, Ogah OS, Aje A, Ojji DB, Falase AO. Characterisation of heart failure with normal ejection fraction in a tertiary hospital in Nigeria.
4. Zile M, Brutsaert D. New concepts in diastolic dysfunction and diastolic heart failure: part 1. Diagnosis, prognosis and measurements of diastolic function. *Circulation*, 2002;105:1387-1393.
5. European study Group on Diastolic heart Failure. How to diagnose diastolic heart failure. *European Heart journal*, 2008; 19:990-1003.
6. Brilla CG, Weber KT. Mineralocorticoid excess, dietary sodium and myocardial fibrosis. *J Lab Clin Med* 1992; 120:893-901
7. Troughton RW, Prior DL, Frampton CM, et al: Usefulness of tissue Doppler and color M-mode indexes of left ventricular diastolic function in predicting outcomes in systolic left ventricular heart failure (from the ADEPT study). *Am J Cardiol* 2005; 96:257.
8. Yamamoto K, Redfield MM, Nishimura RA. Analysis of left ventricular diastolic function. *Heart* 1996; 75:27-35
9. Masliza M, Daud SM, Khalid Y. Assessment of Diastolic function in Newly Diagnosed Hypertensives. *Ann Acad Med Singapore*. 2005; 34:684-688.
10. Mottram PM, Haluska BA, Leano R, Carlier S, Case C, Marwick TH. Relation of arterial stiffness to diastolic dysfunction in hypertensive heart disease. *Heart*. 2005 Dec;91(12):1551-6.
11. Yamamoto K, Wilson DJ, Canzanello VJ, Redfield MM. Left ventricular diastolic dysfunction in patients with hypertension and preserved systolic function. *Mayo Clin Proc*. 2000 Feb;75(2):148-55.