Original Research Paper Medicine

# A study of prevalence of left ventricular diastolic dysfunction and its correlation with left ventricular hypertrophy in patients with newly diagnosed hypertension by Doppler echocardiography


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**ABSTRACT** ***Introduction:*** *Hypertension leads to structural and functional adaptation leading to left ventricular hypertrophy and impaired diastolic function are common effects on heart. Doppler echocardiography is an important and non invasive method of evaluating hypertensive patients for diastolic dysfunction. Aim of study was to find out the prevalence of left ventricular diastolic dysfunction in newly diagnosed hypertensive patients and to find correlation of left ventricular hypertrophy with diastolic dysfunction.* ***Materials and methods:*** *The study was conducted at M.M. Institute of Medical Sciences and Research, Mullana, Ambala India. Fifty newly diagnosed asymptomatic hypertensive with age <55 years were taken from OPD and indoor wards of medicine department. According to JNC-8 criteria stage 1 and stage 2 were considered for this study. Blood pressure monitoring was done in all selected patients by using sphygmomanometer. Two readings were taken at the same visit in sitting position after a gap of 10-15 minutes. ECG (electrocardiogram) was done to exclude any major coronary artery disease. 2-D Echocardiography was done in all selected patients using M mode, two-dimensional and Doppler.* ***Observations-*** *58% (29) patients had left ventricular hypertrophy (LVH). 42%(21) patients had no left ventricular hypertrophy (LVH). In our study the prevalence of diastolic dysfunction in newly diagnosed hypertensive patient was 86%. The commonest type of diastolic dysfunction was impaired relaxation 86%, pseudonormal pattern in 10.34% and restrictive pattern of LV diastolic dysfunction in 3.4% of hypertensives with LVH.* ***Conclusion:*** *The conclusion of present study is stronger association of blood pressure with LVH, very high prevalence of diastolic dysfunction in hypertensive population and significant correlation of diastolic dysfunction with LVH.*


**KEYWORDS** :

**Introduction:**

Hypertension is a disease that affects whole body more or less. Cardiac complications are major cause of morbidity and mortality in essential hypertension[1] including congestive heart failure, ventricular arrhythmias, myocardial ischemia and sudden death. Hypertension leads to structural and functional adaptation leading to left ventricular hypertrophy. Along with genetic component, hemodynamic component contribute in left ventricular hypertrophy. In early natural history of hypertension, increased LV mass and impaired diastolic function are common effects on heart [2,3,4]. It is well established that LV relaxation is often abnormal in hypertension with or without LVH suggesting that abnormal relaxation may be early response to cardiac overload caused by hypertension[5,6]. Diastolic dysfunction can be assessed by several methods. Doppler echocardiography is an important and non invasive method of evaluating hypertensive patients for diastolic dysfunction[7]. Early recognition of diastolic dysfunction may help in additional risk stratification and subsequently guide for appropriate pharmacological management.

Literature showed few studies from north Indian population on left ventricular diastolic dysfunction with LVH in newly diagnosed hypertensive patients. So, this study has planned at our institute to find out prevalence of left ventricular diastolic dysfunction and correlation with LVH.

**Aim of study:**

- To find out the prevalence of left ventricular diastolic dysfunction in newly diagnosed hypertensive patients.
- To find correlation of left ventricular hypertrophy with diastolic dysfunction.

**Material and methods:** The study was conducted at M.M. Institute of Medical Sciences and Research, Mullana, Ambala India. Fifty newly diagnosed asymptomatic hypertensives with age <55 years were taken from OPD and indoor wards of medicine department. According to JNC-7[8] criteria stage 1 and stage 2 were considered for this study. All patients were subjected to detailed history after informed written consent and detailed systemic examination was done. Patients were excluded from study were Diabetes mellitus, protinuria> 500 mg/dl, Chronic kidney disease, Coronary artery diseas, valvular heart disease, cardiomyopathy .Secondary hypertension, LV ejection fraction < 50%,

Blood pressure monitoring was done in all selected patients by using sphygmomanometer. Two readings were taken at the same visit in sitting position after a gap of 10-15 minutes. Biochemical investigations: RFT, FBS, Postprandial blood glucose, complete urine albumin were done in all patients. ECG (electrocardiogram) was done to exclude any major coronary artery disease. 2-D Echocardiography was done in all selected patients using M mode, two-dimensional and Doppler. Examinations of the left ventricle was performed in the left decubitus position using an ultrasound system (model VIVID-E) with a 3.5 MHz transducer frequency for M-Mode and 2.5 MHz for Doppler recording. M-Mode tracings was quantified according to the recommendation of the American Society of Echocardiography. Left ventricular diastolic indices were assessed by echo-pulsed Doppler analysis. Only frames with optimal

visualization of interfaces and simultaneously showing septum, LV internal diameter and posterior wall was measured in diastole.

The left ventricular mass was calculated by using the cube formula proposed by devereux[9];

LV Mass = Myocardial volume x 1.05 g /$cm^3$
= [(IVS+LVIDd +PW)] 3-(LVIDd) 3 x 1.05 g /$cm^3$

LV mass was corrected for height and body surface area and were taken as LV mass index (gm x $m^2$). It was normalised for height 2.7 to correct the effect of overweight. Left ventricular hypertrophy was defined as left ventricular mass index >51g/$m^{2.7}$[10]

Criteria for left ventricular hypertrophy was taken as:

- Left ventricular relative wall thickness >0.45. Relative wall thickness was defined as posterior wall thickness + interventricular septal thickness / left ventricular interior dimensions
- Wall thickness of interventricular septum or posterior wall>13 mm in diastole.
- Left ventricular mass index >51gm/$m^{2.7.}$

Left ventricular diastolic filling was assessed by echo-pulse Doppler analysis. The diastolic mitral flow was assessed by early diastolic peak flow velocity (E), late diastolic peak flow velocity (A), the ratio of E to A (E/A) and the deceleration time of the early mitral velocity was recorded with the sample volume at the mitral leaflet tips. Deceleration time (EDT) was measured as the time from peak E velocity to the time when the E wave descent intercepted the zero line. Isovolumetric relaxation time (IVRT) was measured with a continuous wave Doppler beam intersecting LV outflow and inflow tract. Pulsed Doppler recordings of trans-mitral flow velocities was obtained between the tips of the mitral leaflets for measuring peak early LV filling velocity/peck atrial filling velocity (E/A) and deceleration time (EDT). Pulsed Doppler recording from LV outflow tract was used to measure Isovolumetric relaxation time (IVRT) from the closure spike of the aortic valve to the onset of mitral flow. Measurements up to three cycles was averaged .The diastolic dysfunction was categorized as Normal

EDT=160-220ms,IVRT=70-90ms,E/A=1-2, GradeIEDT>240ms,IVRT> 90mGradeIIEDT>160200ms,IVRT>90ms,E/A=1,Grade III E DT<160,IVRT<70,E/A>2

The data obtained was subjected to appropriate statistical analysis for assuring the results of the study.

**Observations-**

Fifty newly diagnosed hypertensive patients were taken for the study. Out of these, 50%(25) were females and 50%(25) were males. 40%(20) patients were of stage I HTN and 60%(30) patients were of stage II HTN. 58% (29) patients had left ventricular hypertrophy (LVH). 42%(21) patients had no left ventricular hypertrophy (LVH).

**Table-I** Correlation of demographic and echocardiographic variables in two groups: Hypertensives with LVH and hypertensives without LVH.

| Variables | Hypertensives with LVH (n= 29) | Hypertensives without LVH (n= 21) | p value |
|---|---|---|---|
| Age( Years) | 50.96±6.02 | 45.23±5.24 | <0.001 |
| Sex Male | 16(64%) | 9(36%) | |
| Female | 13(52%) | 12(48%) | |
| BMI ( Kg/$m^2$) | 24.6±4.18 | 24.14±3.70 | >0.001 |
| SBP | 172.75±17.30 | 151.52±10.42 | <0.001 |
| DBP | 104.27±7.28 | 92.95±4.40 | <0.001 |
| IVSd (cm) | 1.35±0.22 | 0.91±O.20 | <0.001 |
| LVIDd(cm) | 4.26±0.62 | 3.68±0.73 | <0.001 |
| LVEF(%) | 62%±4.25 | 61%±3.21 | >0.001 |
| LVMI(gm/$h^{2.7}$) | 73.74±17.48 | 38.0±9.44 | <0.001 |
| LVPWd(cm) | 1.44±0.266 | 1.02±0.25 | <0.001 |
| A/E | 0.80±0.22 | 0.93±0.26 | >0.001 |
| IVRT(ms) | 122.66±17.52 | 104.75±22.97 | <0.001 |
| EDT(ms) | 295.86±47.46 | 234.27±74.94 | <0.001 |
| RWT | 0.71±0.21 | 0.54±0.61 | >0.001 |

Table 1, showed that there was statistically significantly higher age in group of hypertensives with LVH as compared to hypertensives without LVH. However, there was no statistically significant difference between two groups in BMI ( p= 0.6890). The systolic blood pressure (SBP) and diastolic blood pressure (DBP) values were significantly higher in hypertensives with LVH as compared to hypertensives without LVH (p< 0.0001). IVSd, LVIDd, LVMI, LVPWd were significantly higher in hypertensive patients with LVH as compared to hypertensives without LVH. There was no significant change in LVEF in two groups, as patients who had LVEF < 50 were excluded from the study, A/E ratio was < 1 in both groups. It was more decreased in patients of hypertension with LVH as compared to without LVH but not statistically significant. EDT and IVRT was statistically higher in hypertension with LVH as compared to hypertension without LVH (p< 0.001). RWT was higher 0.71± 0.21 in hypertension with LVH as compared to hypertension without LVH (0.51±0.61) but not statistically significant. All patients of hypertension with LVH had concentric LVH and 76% (16 /21) of hypertensives without LVH had eccentric remodelling.

**Table 2:** Pattern of left ventricular diastolic dysfunction in two groups: hypertension with LVH and hypertension without LVH

| Group | Hypertension with LVH ( n =29) | Hypertension without LVH (n=21) |
|---|---|---|
| Normal | 0% | 33.3% |
| I Impaired relaxation | 86% | 57% |
| II Pseudonormal | 10.34% | 9.5% |
| III Restrictive | 3.4% | 0% |

In our study the prevalence of diastolic dysfunction in newly diagnosed hypertensive patient was 86%. Table 2 showed that commonest type of diastolic dysfunction was impaired relaxation 86% in hypertension with LVH group and 57% in hypertension without LVH. Pseudonormal pattern was found in 10.34% of hypertensive patients with LVH group and 9.5% of hypertensive patients without LVH. Restrictive pattern of LV diastolic dysfunction was found in 3.4% of hypertensives with LVH, none in hypertensives without LVH.

**Discussion:**

The present study showed that prevalence of hypertension was equal in both sex 25 males and 25 females. Maximum patients belonged to age group 45-55 years. These findings were consistent with other studies Das S et al [11].60% of patients were in stage II of hypertension while 40% in stage I . Gupta R et al [12]also reported similar results.

Present study showed 58% of patients had left ventricular hypertrophy according to echocardiography criteria. Study conducted by Conrady Ao et al [13] showed prevalence of LVH in hypertensive patients ranges from 52.2% to 72.2%. Another study done by Richard B Devereux et al[14]showed prevalence of LVH was 42%. Dunn et al[15] had reported black patients with essential hypertension have greater degree of LVH than white patients.

Devereux et al[14] showed a number of factors like age, race, adrenergic overactivity and renin angiotensin system overactivity determines LV mass. In our study mean systolic and diastolic pressures were significantly higher in patients of LVH as compared to patients without LVH. So, left ventricular hypertrophy represents a response to chronically increased afterload. Our study showed 86% of prevalence of diastolic dysfunction in hypertensive population that agrees with study done by GU Adamu et al[16], Salama M[17] etr al, Nishimura R et al[18]. In our study abnormal relaxation

pattern was present in 74%, pseudonormal pattern was present in 10% and restrictive pattern was seen in 2% of patients. These findings are similar to GU Adamu et al[16] and Varshashinde et al[19] study, Wachtell K[20] et al showed restrictive LV filling pattern is very uncommon finding (< 4%) in hypertensive patients without heart disease. It was observed that all (100%) hypertensives with left ventricular hypertrophy had diastolic dysfunction, while 57% being hypertensives without LVH. Snider et all[21] study in children with systemic hypertension emphasized the presence of diastolic dysfunction even in the absence of LVH. As 57% of our patient with LVH had showed diastolic dysfunction, which indicates that increased tension on myocardium by systemic hypertension lead to abnormal relaxation before development of LVH. However, further longitudinal studies are needed to confirm this. Giuseppe Schillachi et al [22] study showed that LV mass index was greater in patients with low adjusted E/A ratio, but they showed that adverse prognostic value of E/A ratio was consistently independent of LV mass. In our study E/A ratio is less (0.80 ± 0.22) in hypertensive with LVH as compared to hypertensive patients without LVH (0.93±0.21). EDT, IVRT was significantly higher in hypertensive patients with LVH as compared to those without LVH. Presence of diastolic dysfunction with LVH may imply higher mortality and higher morbidity.[23,24]

So, to conclude, the present study showed stronger association of blood pressure with LVH, very high prevalence of diastolic dysfunction in hypertensive population and significant correlation of diastolic dysfunction with LVH. Left ventricular diastolic dysfunction starts before development of LVH. Hence, further longitudinal studies are needed to confirm this. Presence of diastolic dysfunction with LVH may imply higher mortality and higher morbidity.[23,24]. So, Doppler echocardiographic evaluation should be recommended to all hypertensive patients for early diagnosis and therapeutic intervention that may improve diastolic function and can prevent development of left ventricular hypertrophy

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