



ASSOCIATION OF LEFT VENTRICLE DIASTOLIC DYSFUNCTION (LVDD) WITH UNCONTROLLED HYPERTENSION

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ABSTRACT:

BACKGROUND: Hypertension is a chronic medical condition with multisystem involvement. It usually remains asymptomatic for long time and can have sudden catastrophic consequences. Cardiac involvement in hypertension is a well known phenomenon resulting in a wide range of cardiac pathologies that varies from left ventricular hypertrophy to diastolic heart failure. Left ventricular diastolic dysfunction (LVDD) is usually the earliest cardiac manifestation of hypertension which can be detected by echocardiogram.

OBJECTIVE: To determine the association between LVDD and uncontrolled hypertension.

MATERIAL & METHODS: This case control study was conducted at department of cardiology, Punjab Institute of Cardiology, Lahore from 24 Nov 2016 to 23 May 2017. One hundred and sixty patients fulfilling the inclusion criteria were enrolled. The respondents were divided into two groups; cases with uncontrolled hypertension and control with controlled hypertension. Blood pressure was noted and Echocardiography was done. LVDD was measured using the standard parameters.

RESULTS: The mean age of cases group was 44.71 ± 13.68 years and in control group it was 47 ± 13.68 years. Out of 160 patients, LVDD was found in 71 (44.38%) patients : 57 in uncontrolled hypertension group and 14 in controlled hypertension group $p < 0.0001$. Age (> 50 years) and duration of hypertension (> 12 months) were other predictors of LVDD.

CONCLUSION: LVDD is more common in patients with uncontrolled hypertension then in patients with well controlled hypertension.

KEYWORDS: Left ventricular diastolic dysfunction, uncontrolled hypertension

INTRODUCTION:

Left ventricle diastolic dysfunction (LVDD) is usually the earliest cardiac manifestation of hypertension which can be diagnosed by echocardiogram.¹ Even in patients with normal LV systolic function LVDD can be present which is related to increased incidence of morbidity and mortality.² Early detection of LVDD and treatment prevents hypertensive cardiovascular diseases like heart failure.³

Hypertension is related to many cardiovascular pathologies.⁴ Reduction of BP in hypertensive patients is associated with improvement in the diastolic function and reduction of symptoms like shortness of breath, weakness and palpitations in nearly 20–30 % of patients with hypertension.⁵

Wide range of cardiovascular diseases are related to hypertension, and congestive cardiac failure is mostly the final outcome. But most of

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the time the hypertensive heart diseases are under recognized in absence of symptoms. Early detection of hypertensive changes in heart allows us prevent more serious complications. Diastolic dysfunction is one of the early and easily detectable functional and hemodynamic change. Up to 33% of patients with hypertension can have diastolic dysfunction.⁶

Uncontrolled Blood Pressure (BP) causes morphologic alterations in the myocardium.⁷ LV Diastolic dysfunction is one of the commonest alteration in myocardial function.⁸ Heart failure with preserved Ejection Fraction is a well-recognized condition due to Left Ventricular Diastolic Dysfunction (LVDD) in patients with HTN.⁹

In a study, LVDD was present in 62% of patients with uncontrolled hypertension and 11.3% patients with well controlled hypertension. Impaired relaxation was the most common finding (84.9%) in diastolic dysfunction.¹⁰ In another study, the value of E/e' was higher in Uncontrolled Hypertension (8.3 ± 2.7) group than in the Controlled hypertension group (7.3 ± 2.3 ; $p = 0.02$).¹¹

The aim of this study by Doppler echocardiography is to investigate the association of LV diastolic dysfunction with uncontrolled hypertension subjects in the local population. It provides valuable infor-

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mation which might be useful to prevent or delay the progression of symptomatic heart failure and other consequences of hypertension. Few studies, related to this topic have been conducted so far in local population.¹² By knowing the exact magnitude of this association we will be able to make better plan for the management of such patients.

OBJECTIVE:

To determine the association of Left ventricular diastolic dysfunction (LVDD) with uncontrolled hypertension

OPERATIONAL DEFINITIONS:

LEFT VENTRICULAR DIASTOLIC DYSFUNCTION:

LVDD was assessed by pulse wave Doppler technique measuring transmitral E wave and A wave velocities. Isovolumic relaxation time (IVRT) and Deceleration time (DT) were also recorded. Criteria for LVDD:DT > 240ms IVRT > 90ms E/A < 1.0

IVRT:

The interval between mitral valve opening and aortic valve closure, during which LV volume remains same but myocardial muscle tension decreases.

DT:

The time taken from the peak E velocity to baseline.

CONTROLLED HYPERTENSION:

It was considered, if BP was less than 140/90 mmHg with antihypertensive therapy. Mean of 3 readings 15 minutes apart was taken.

UNCONTROLLED HYPERTENSION:

It was considered, if BP was greater than or equal to 140/90 mmHg with antihypertensive therapy. Mean of 3 readings 15 minutes apart was taken.

MATERIALS AND METHODS:

This case control study was conducted at department of cardiology, Punjab Institute of Cardiology, Lahore from 24 Nov 2016 to 23 May 2017 (6 months). 160 patients fulfilling the inclusion criteria were enrolled.

The sample size of 160 (80 in each group) was estimated by 95% confidence level and 9% margin of error with an expected percentage 62% of uncontrolled hypertension and 11.3% of controlled hypertension in Left Ventricular Diastolic dysfunction patients.¹⁰

INCLUSION CRITERIA:

- Cases: Patients with uncontrolled hypertension
- Control: patients with controlled hypertension
- Patients ages between 20-70
- Patients of both gender

•Patients coming for echocardiography

EXCLUSION CRITERIA:

- Known patients of cardiovascular disease (coronary artery disease, congestive heart failure, valvular pathology)
- Patients with other systemic diseases like renal impairment (urea > 200, creatinine > 1.3), deranged liver function tests (AST or ALT > 40iu/l), thyroid dysfunction, rheumatic heart disease.
- History of diabetes(Fasting plasma glucose >=126 mg/dl) and atrial fibrillation

After approval from Hospital Ethical committee and the higher Board of studies PIC, 160 patients (cases=60, control=60) were enrolled and informed consent was taken from the patients. Blood pressure was recorded using Accuson mercury sphygmomanometer after five minutes of rest while patient remained seated. Average of 3 blood pressure readings was taken. Echocardiography was done by a single operator. The following parameters were noted: E/A ratio using pulsed wave Doppler technique at the level of the mitral valve leaflets' tip, E wave deceleration time (DT), isovolumic relaxation time (IVRT). LVDD was diagnosed in the presence of E/A <1.0, DT > 240ms and IVRT > 90ms.

DATA ANALYSIS:

All the data was entered in statistical package for social sciences (SPSS) v22.0. The quantitative data like age, BP, DT, IVRT and E/A were presented as mean \pm S.D. The qualitative data like sex, LVDD and group were presented in pie charts, bar charts, frequency and percentages. Odds ratio was used to compare the Categorical variables (LVDD and Both groups). Data was stratified for age, gender, duration of hypertension and BMI to deal with effect modifier. Post stratification OR was calculated. OR > 1 was consider significant. p value \leq 0.05 was consider significant.

RESULTS:

In this study, total 160 respondents participated. The mean age of the cases group patients was 44.71 ± 13.68 years and that of control group subjects was 47 ± 13.68 years. (Table-1)

In this study, 75(46.88%) subjects were male and 85(53.13%) subjects were females. The male to female ratio of the subjects were 0.8:1. (Fig-1)

In our study, the male respondents were 75 in which 40 were from cases group and 35 were from control group, similarly the female respondents were 85 in which 40 were from cases group and 45 were from control group. (Table-1)

Table-1: Comparison of baseline characteristics in two study groups.

| Characteristics | | Study Groups | | p value |
|--|-----------|----------------|------------------|---------|
| | | Cases N=80 | Controls N=80 | |
| Age(years ± SD) | Mean | 44.71 ± 13.68 | 47.00 ± 13.86 | 0.295 |
| Sex | Male | 40 | 35 | 0.526 |
| | Female | 40 | 45 | |
| BMI(Kg/m ² ± SD) | Mean | 25.88 ± 5.061 | 26.42 ± 4.86 | 0.492 |
| Duration of hypertension (months ± SD) | Mean | 11.06 ± 7.03 | 11.53 ± 7.15 | 0.676 |
| * Blood Pressure in mmHg (Mean ± SD) | Systolic | 183.58 ± 27.74 | 123.57 ± 7.13 | 0.0001 |
| | Diastolic | 103.27 ± 7.75 | 77.11 ± 4.85 | 0.0001 |

*Grouping variable

Table-2: LVDD in two groups compared with respect to age, gender, BMI and duration of HTN.

| Comparing parameters | | No. of patients having LVDD n=71 | | P-value |
|-----------------------------------|-----------------|----------------------------------|------------------|---------|
| | | Cases n=57 | Controls n=14 | |
| Age | ≤ 50 (n=56) | 42 | 14 | 0.0313 |
| | > 50 (n=15) | 15 | 0 | |
| Gender | Male (n=34) | 27 | 7 | 0.8598 |
| | Female (n=37) | 30 | 7 | |
| BMI | Normal (n=33) | 25 | 8 | 0.3719 |
| | Abnormal (n=38) | 32 | 6 | |
| Duration of hypertension (months) | ≤ 12 (n=55) | 41 | 14 | 0.0295 |
| | > 12 (n=16) | 16 | 0 | |

The study results showed that the mean value of Body Mass Index (BMI) of case group patients was 25.88±5.061 kg/m² and its mean value in control respondents was 26.42±4.86 kg/m² (Table-1). BMI > 25 was consider abnormal.

The study results showed that the mean value of duration of hypertension of case group patients was 11.06±7.03 months and its mean value in control respondents was 11.53±7.15 months. (Table-1)

In this study, the mean value of Systolic blood pressure of case group patients was 183.58±27.74 mmHg and its mean value in control respondents was 123.57±7.13 mmHg. The mean value of diastolic blood pressure of case group patients was 103.27±7.75 mmHg and its mean value in control respondents was 77.11±4.85 mmHg. (Table-1)

Out of 160 patients the LVDD was found in 71(44.38%) patients. (Fig-2)

Out of 71 patients with LVDD, 57 were from case group and 14 were from control group. OR = 11.68 (CI = 5.502-24.808). Table-2

The study results showed that in ≤ 50 years old

respondents the LVDD was found in 56 subjects in which 42 were from case group and 14 were from control group, similarly in >50 years old respondents the LVDD was found in 15 subjects and all were from case group: p=0.0313 (Table-2).

The study results showed that in male respondents the LVDD was found in 34 subjects in which 27 were from case group and 7 were from control group, similarly in female respondents the LVDD was found in 37 subjects in which 30 were from case group and 7 were from control group. p= 0.8598 (Table-2).

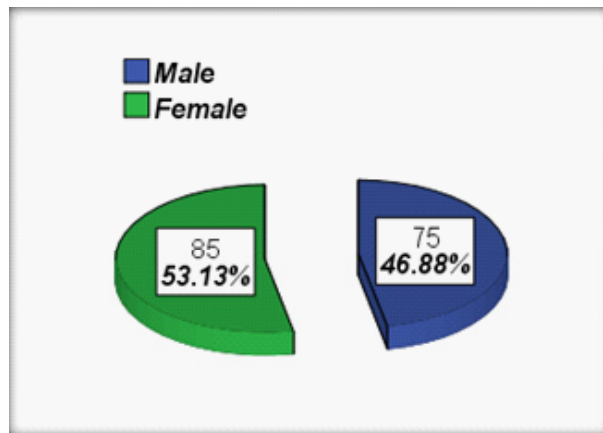


Fig-1: Frequency distribution of gender

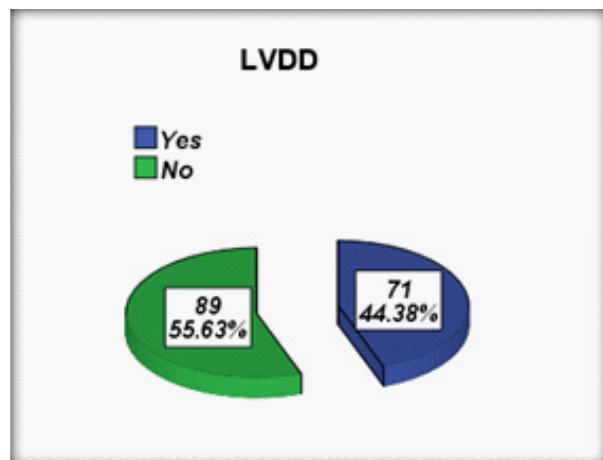


Fig-2 : Frequency distribution of LVDD

The study results showed that in normal BMI (value < 25) respondents the LVDD was found in 33 subjects in which 25 were from case group and 8 were from control group, similarly in abnormal BMI respondents the LVDD was found in 38 subjects in which 32 were from case group and 6 were from control group: p=0.3719 (Table-2).

The study results showed that in respondents with duration of hypertension ≤ 12 months the



LVDD was found in 55 subjects in which 41 were from case group and 14 were from control group, similarly in respondents with duration of hypertension >12 months the LVDD was found in 16 subjects and all were from case group: $p=0.0295$ (Table-2).

DISCUSSION:

This case control study was carried out at Department of Cardiology, Punjab Institute of Cardiology, Lahore to determine the association of LVDD with uncontrolled hypertension.

Heart failure is a complex cardiac pathology caused by any alteration in structural, morphological or functional condition of heart that disturbs LV relaxation or contraction. Uncontrolled Blood Pressure is the major cause of such changes in heart leading to LVDD. Diastolic dysfunction is the commonest of these functional alterations. LVDD is found more in Black population than Whites, and is more common in elderly ladies than men. Systemic hypertension is well known cause for LVDD that leads to heart failure with preserved ejection fraction.¹⁰

In our study the LVDD was found in 71 (44.38%) patients; 57 were from case group and 14 were from control group $p<0.0001$ indicating that patients with uncontrolled hypertension are at a significantly higher risk of developing LVDD. It was further observed that patients with LVDD were more likely to be older than 50 years ($p=0.0313$) and with longer (> 12 months) duration of hypertension ($p=0.0295$).

In a study by Adamu G et al, LVDD was present in 63% of patients with uncontrolled hypertension and in 11.5% of patients with controlled Blood Pressure. Abnormal relaxation pattern was the commonest type (85.9%) of diastolic dysfunction.¹⁰

In another study by Komori et al¹¹, the value of E/e' was higher in uncontrolled hypertension (8.3 ± 2.7) group than in the controlled hypertension group (7.3 ± 2.3 ; $p=0.02$).

The Latest Research in Asian countries about

the prevalence of diastolic dysfunction by Masliza et al¹² concluded that incidence of diastolic dysfunction was 18.6% (32 out of 198) in patients recently diagnosed with hypertension and 6 (3.4%) in normal individuals.

Hypertension is the major cause of heart failure. Hypertensive males have two fold and females have three folds increased risk of developing heart failure as compared to normotensive people.¹³

A study by Katholi et al¹⁴ reported that left ventricular hypertrophy is a pathophysiological response to hypertension causing diastolic dysfunction and reduced coronary flow reserve. LV hypertrophy enhances the incidence of atrial fibrillation, heart failure with preserved Ejection Fraction, systolic heart failure, and sudden cardiac death in hypertensive patients.

A study by Leiria et al¹⁵ reported that the incidences of controlled hypertension, white-coat effect, masked uncontrolled hypertension and sustained hypertension were 27%, 17%, 18%, and 36%. Masked uncontrolled hypertension incidence was higher than previously reported. There was a significant increasing trend among the 4 groups in variables related to LVH ($P < 0.001$ for trend). There was not a clear "dose-response" association of the 4 hypertensive phenotypes with nephropathy and diastolic function.

Different studies showed a strong correlation between hypertension and LVDD. In Sub-Saharan Africa, hypertension and hypertensive heart disease places themselves in a higher rank in the overall burden of non-communicable diseases.¹⁶⁻¹⁹ This study also showed that LVDD is more common in patients with uncontrolled hypertension as compared to patients with well controlled hypertension.

CONCLUSION:

We conclude that patients with uncontrolled hypertension are much more likely to develop left ventricular diastolic dysfunction as compared to those with controlled hypertension.

Author's Contribution

SMAN: Consultant incharge of the study. AS: Conducted the study. SAA: Data analysis. MAI: Data collection. MS: Proof reading



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