PREVALENCE OF LEFT VENTRICULAR DIASTOLIC DYSFUNCTION IN PATIENTS WITH LEFT VENTRICULAR HYPERTROPHY

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ABSTRACT

Background: Abnormalities in left ventricular relaxation are indicators of left ventricular (LV) diastolic dysfunction. LV diastolic dysfunction may occur in patients with LV hypertrophy in the absence of systolic dysfunction.

Objective: The purpose of this study is to assess the prevalence of LV diastolic dysfunction in patients with left ventricular hypertrophy in Pakistani population.

Methods: 200 consecutive patients age 20 years and above and of either sex with left ventricular hypertrophy were included in this study. LV diastolic function was assessed by pulsed wave Doppler studies measuring transmitted E and A-wave velocities, E/A ratio, deceleration time and Isovolumic relaxation time intervals. LV diastolic dysfunction was diagnosed.

Results: Out of 200 patients, 106 (53%) were male and 94 (47%) were female. The average age was 53.66 + 11.07 years. The average body surface area of male patients was 1.79 + 0.19 and female patients was 1.59 + 0.16 m2. The average LV mass of male patients was 290.09 + 68.29 and of female patients was 242.23 + 54.34 grams. 92 (46%) patients had LV diastolic dysfunction. 58 (61.70%) of female patients and 50 (47.17%) of male patients had LV diastolic dysfunction (P=0.04). The average age of patients with LVDD was 55.55 + 10.86 years as compared to 50.27 + 10.38 years in patients without LVDD (P=0.001). The mean body surface area of patients with LVDD was 1.667+0.202 as compared to 1.738+0.199 of patients without LVDD (P=0.014). Ejection fraction and LV mass were not different statistically in patients with or without LVDD.

Conclusion: LVDD is a frequent finding in patients with left ventricular hypertrophy. It is more frequent in female patients with advancing age & smaller body surface area.

Key Words: Left ventricular diastolic dysfunction, left ventricular hypertrophy, Doppler echocardiograph.

INTRODUCTION

Left ventricular hypertrophy is an independent risk factor for major cardiovascular events including myocardial infarction and sudden death[1-4]. It is also one of the leading causes of congestive heart failure[5]. However many patients with congestive heart failure have preserved LV systolic function. Left ventricular diastolic dysfunction (LVDD) resulting in diastolic heart failure has been proposed as the mechanism of congestive symptoms that accounts for approximately one third of all cases with congestive heart failure[6,7].

Diastolic heart failure is a clinical syndrome characterized by signs and symptoms of heart failure, preserved systolic function and abnormal diastolic function. These abnormalities are caused by a decrease in ventricular relaxation and/or an increase in ventricular stiffness[8]. With advent of recent

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echocardiographic techniques incorporated with conventional Doppler studies like tissue Doppler imaging and color M-mode, the ability to accurately diagnose diastolic dysfunction has significantly improved[9].

LVH and LVDD are the early manifestation of cardiovascular target organ damage in patients with arterial hypertension and signify hypertensive heart disease[16]. Identification of LVH and LVDD in hypertensive heart disease is critical, as these individuals are more prone to develop congestive heart failure, arrhythmia, myocardial infarction and sudden cardiac death.

In the clinical setting the coexistence of systolic and diastolic dysfunction in patients with symptomatic heart failure occurs very often. The diagnosis of heart failure can be make by simple clinical examination but the identification of diastolic dysfunction needs instrumental assessment ECG can show signs of LVH, due to hypertensive cardiomyopathy or other causes. Diastolic dysfunction may be asymptomatic and therefore identified incidentally during a Doppler echocardiographic examination. The diagnostic importance of this tool rises from the high feasibility of transmitral Doppler indexes of diastolic function, shown even in studies on general population[17]. To date, standard Doppler indexes may be effectively supported by the evaluation of pulmonary venous flow[18] and tissue Doppler[19,20] and color M-mode derived flow propagation rate[21].

Few studies have been done in Pakistani population assessing LVDD in various clinical entities[10-14]. However data is not available regarding the prevalence of LVDD in patients with LVH. We have conducted this study at our Institute to find out the prevalence of LVDD in patients with LVH and also the factors affecting the development of LVDD in Pakistani population.

METHODS

This was a descriptive, cross sectional, prospective study conducted from July to December 2006 at the department of echocardiography, Karachi Institute of Heart Diseases. 200 consecutive patients with LVH fulfilling the inclusion criteria were included in the study.

Inclusion criteria:

- Patients above 20 years of age and of either sex.
- Patients with symmetrical LVH on echocardiography.
- Patients with normal LV systolic function.
- Patients without segmental wall motion abnormalities.
- Patients without valvular or congenital heart disease.
- Patients without other systemic diseases.

The demographic characteristics of all patients were recorded. Echocardiographic studies of these patients were performed in our echo lab. equipped with Toshiba Nemio 35 machines with M-mode, 2-D, color flow, pulse wave and continuous wave Doppler modalities. These echo studies were performed by trained technicians under the supervision of consultant cardiologists.

LVH was determined by thickness of interventricular septum and LV posterior wall, left ventricular mass and LV mass index. LV mass was calculated by Devouroux formula. LV mass index was calculated by LV mass divided by body surface area. LV mass index greater than 99 grams/m2 for male and 88 grams/m2 for female patients was taken as significant for LVH[15].

Diastolic function was assessed by pulse wave Doppler technique measuring transmitral E wave and A wave velocities and pulmonary venous flow. Isovolumic relaxation (IVRT) time and deceleration time (DT) were also recorded. Criteria for LV diastolic dysfunction.

Normal Filling

- DT – 160-220 ms
- IVRT – 70-90 ms
- E/A – 1-2

Diastolic dysfunction Grade I

- DT > 240 ms
- IVRT > 90 ms
- E/A < 1.0

Diastolic dysfunction Grade II

- DT 160-200 ms
- IVRT > 90 ms
- E/A > 1.0
- E'/A' < 1.0

Diastolic dysfunction Grade III, IV

- DT < 160 ms
- IVRT < 70 ms
- E/A < 1.0

Statistical analysis: the data were tabulated and analyzed by using Statistical Package for Social Sciences (SPSS) version 13. Data are presented as mean ± standard deviation for continuous variables and as proportions for categorical variable. Student's 't' test and chi-square test were used where appropriate. All p values are 2-sided and an α level was set at 0.05.

RESULTS

200 consecutive patients with LVH were included in the final analysis. There were 94 (47.1%) female patients and 106 (52.9%) male patients. The mean age of the patients was 53.66+11.07 years (Range 28-81 years) (Table-I). The mean of height, weight and body surface area of these patients are given in Table-II. Table-III shows the echocardiographic values. The mean interventricular septum was 12.81+1.43mm in female patients and 13.36+2.45 mm in male patients, and posterior wall thickness was 12.29+1.02mm and 12.55+1.21 mm in female patents and male patients respectively. LV dimension during diastole was 41.99+6.08 in female patients and 45.84+5.29 mm in male patients and during systole was 28.68+4.18 mm in female patients and 31.47+4.80 mm in male patients. The mean ejection fraction was 68.95+5.90 in female patients and 67.91+6.01 in male patients. The mean LV mass index for female patients was 152.44 gm/m2 and for male patients was 161.43 gm/m2.

The mean IVRT in patients with E/A <1 was 107 ms DT was. In patients with normal E/A ratio mean IVRT was 83 ms and DC was 245 ms.

108 (54%) patients had LVDD. 50 (47.17%) were male and 58 (61.70%) were female (P=0.04). Table-IV shows the effect of different variable on LVDD.

When different variables were analyzed to find out any

Table-I : Number and Age of Patients

Sex	Age (Mean Years)	No. of cases	Std. Deviation	Minimum Age (Years)	Maximum Age (Years)	% of Total Sum
Female	53.79	94	11.35	32	81	47.1%
Male	53.55	106	10.87	28	75	52.9%
Total	53.66	200	11.07	28	81	100.0%

Table-II : Height, Weight and BSA of Patients

Sex		Height (Meters)	Weight (Kg)	BSA
Female	Mean	1.4970	61.4894	1.5899
	Std. Deviation	5.949	12.0837	.1579
Male	Mean	1.6179	71.3396	1.7973
	Std. Deviation	8.621	13.5168	.1900
Total	Mean	1.5611	66.7100	1.6998
	Std. Deviation	9.610	13.7452	.2036

BSA = Body surface area

Table-III : Echocardiographic parameters

Report

Sex		IVS±D	PW±D	LVD±D	LVD±S	E.F.	LV Mass	LVMI
Female	Mean	12.80	12.29	41.98	28.67	68.94	242.23	153.56
	Std. Deviation	1.42	1.02	6.08	4.18	5.90	54.33	35.08
Male	Mean	13.36	12.55	45.84	31.47	67.90	290.08	161.99
	Std. Deviation	2.45	1.21	5.29	4.80	6.01	68.29	36.26
Total	Mean	13.10	12.43	44.03	30.16	68.39	267.59	158.03
	Std. Deviation	2.05	1.13	5.98	4.72	5.96	66.43	35.87

IVS_D: Interventricular septum (diastolic), PW_D (Posterior wall thickness (diastolic), LVD_D = Left ventricular dimension (diastolic), LVD_S = Left ventricular dimension (systolic), E.F. = Ejection fraction, LVMI = LV mass index

correlation with LVDD, gender of the patients increasing age and body surface area have found to be positively correlated with the development of LVDD. 61.7% females has LVDD as compared to 47.17% male patients in the study population (P=0.04). The mean age of patents with LVDD was 55.55 + 10.86 years as compared to 50.27 + 10.38 years of patients without LVDD (P=0.001). The mean body surface area of patients with LVDD was 1.667+0.202 and of patients without LVDD was 1.738 + 0.199 (P=0.014). However the body surface area was not different statistically when further analyzed in subgroup of male and female patients. Other variables i.e. LV systolic function, LV mass and LV mass index were not different significantly in the two groups (Table-IV).

We further analyzed the data to see the effect of these variables in male and female patients (Tables V and VI). In male patients the mean age of patients with LVDD become more significantly higher than the age of patients without LVDD (p=0.001). The other variables remain insignificant. However in female patients, in addition to age, LV mass index was also significantly higher in patients with LVDD as compared to patients with out LVDD (p=0.041).

DISCUSSION

The result of our study showed the number of male and female patients in almost comparable (53% vs. 47%). The mean age of these patients are also similar. The echocardiographic parameters are also comparable in both male and female patients.

The main objective of this study was to assess the prevalence of LVDD in patients with LVH and the factors effecting the development of LVDD in these patients. Out of 200 patients with LVH and normal systolic function, 108 (54%) had LVDD. These findings are comparable to those reported in other studies[18, 19]. Studies conducted to assess the prevalence of LVDD in patients with diabetes mellitus have also shown similar findings[20, 21].

LVDD was found to be more frequent in female patients (61.70%) as compared to male patients (47.17%) in our study (P=0.04).

Our study also shows that patients with LVDD were of older age as compared to those without LVDD (P=0.001). This difference persisted when the data was analyzed for male (P=0.001) and female patients (P=0.042), and more marked for male patients.

Table-IV : Effect of different variables on LVDD

	LVDD	No LVDD	P Value
No. of Patients			
Males	50 (47.17%)	56 (52.83%)	0.04
Females	58 (61.70%)	36 (38.30%)	
AGE			
Males	57.58 ± 10.40	49.95 ± 10.06	0.001
Females	55.66 ± 11.26	50.78 ± 10.98	0.042
Mean	55.55 ± 10.86	50.27 ± 10.38	0.001
Ejection Fraction +SD %			
Males	68.18 ± 5.63	67.66 ± 6.37	0.659
Females	69.46 ± 5.71	68.11 ± 6.19	0.282
Mean	68.87 ± 5.68	67.84 ± 6.27	0.223
LV Mass (gm) ± SD			
Males	286.89 ± 65.85	292.92 ± 70.87	0.652
Females	250.13 ± 50.48	292.49 ± 58.51	0.073
Mean	267.16 ± 60.69	67.84 ± 72.95	0.920
LV Mass Index ± SD (Gm/m^2)			
Males	162.71 ± 34.68	161.35 ± 37.92	0.848
Females	159.35 ± 32.61	144.22 ± 37.32	0.041
Mean	160.91 ± 33.47	154.65 ± 38.41	0.223
Body Surface Area			
Males	1.771 ± 0.202	1.821 ± 0.177	0.180
Females	1.578 ± 0.155	1.609 ± 0.163	0.361
Mean	1.667 ± 0.202	1.738 ± 0.199	0.014

Another important finding in this study was the relationship of body surface are (BSA) with LVDD. Patients with LVDD have smaller body surface area as compared to those without LVDD (P=0.014). However this difference was not significant statistically when the data was further analyzed for male and female patients.

The echocardiographic features i.e. ejection fraction and LV mass were similar in both the groups. Only LV mass index shows significant difference in female patients with LVDD (P=0.041).

It is controversial whether LVDD is necessarily accompanied on the development of LVH or rises up independently of it[22-23]. It is true that diastolic dysfunction is a direct sequel of pressure overload associated to elevated 24-hour blood pressure[24].

This study was conducted to assess the prevalence of LVDD in patients with LVH and the factors influencing the development of LVDD in these patients. Out of 200 patients with LVH and normal LV systolic function 108 (54%) had LVDD. These findings are comparable to those reported in other studies[18, 19]. Studies conducted to assess the prevalence of LVDD in patients with diabetes mellitus have also shown similar findings[20, 21].

CONCLUSION

Our study has shown that LVDD is a frequent finding in patients with LVH and normal systolic function. It is more frequent in female patients, with advancing age and patients with smaller body surface area. In female patients LV mass index also effects the development of LVDD.

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