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A STUDY OF LEFT VENTRICULAR DIASTOLIC DYSFUNCTION IN HYPERTENSIVE PATIENTS AND ITS RELATION TO LEFT VENTRICULAR MASS

Cardiology

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ABSTRACT

Aim and Objective: The study was conducted with an aim to evaluate hypertensive patients with diastolic dysfunction and its correlation with left ventricular mass by echocardiography and electrocardiography.

Materials and Methods: This study was conducted in NRI Institute of Medical Sciences, Visakhapatnam, India. All 50 subjects for the study were inpatients, with hypertension of less than 5years duration. Each subject was evaluated with echocardiography , pulse Doppler study and ECG for evidence of diastolic dysfunction and LVH.

Results: The mean age of the subjects was found to be 66.88 (SD± 11.286). There was no significant correlation found between left ventricular hypertrophy and gender in our study(56% males, 44% females). All of the 50 (100%) patients had grade 1 LV diastolic dysfunction, which was statistically significant (p=0.00001). Grade 1 LV diastolic dysfunction was observed as a reversal of the ratio of early mitral inflow velocity-E-wave to the late inflow velocity A- wave. Of the 50 patients, 10(20%) patients showed evidence of left ventricular hypertrophy on ECG, while 40 (80%, p=0.00001) did not have the findings. 10(20%) of the patients with diastolic dysfunction showed evidence of left ventricular hypertrophy on 2D echocardiography as opposed to 40 (80% p=0.00001) who did not. 2(4%) of the 50 patients were type 2 diabetes mellitus and 3 (6%) out of the 50 subjects were patients of chronic kidney disease, both of which were not statistically significant (p>0.005) and did not influence the outcome of the study.

Conclusion: We concluded that diastolic dysfunction was an early pathological consequence in hypertensive disease and its occurrence preceded that of left ventricular remodeling or hypertrophy as evidenced by ECG and echocardiography.

KEYWORDS

Diastolic Dysfunction-, left ventricular mass.

INTRODUCTION:

Hypertension constitutes one of the most common causes of diastolic dysfunction and is a major contributor to the pathogenesis of a large proportion of heart failure cases.[1,2]

Hypertension is classified based on the average of two or more properly measured seated, blood pressure readings on each of two or more hospital visits. According to JNC 7 guidelines hypertension is classified into

Normal	<120 systolic BP	<80 diastolic BP
Prehypertension	120-139 SBP or	80-89 DBP
Stage I Hypertension	140-159 SBP or	90-99 DBP
Stage 2 Hypertension	>160 SBP or	>100 DBP

Diastolic dysfunction is defined as an impaired relaxation and filling of the ventricle leading to an elevation of ventricular end diastolic pressure at any given diastolic volume. The most common cause of Diastolic dysfunction is hypertension related changes, mainly left ventricular hypertrophy, also to some extent, fibrosis.[3]

Initial studies of diastolic cardiac function in hypertension demonstrated that slowing of the maximal rate of left ventricular filling occurred before alterations in either ejection fraction or cardiac output. Non-invasive techniques allow the evaluation of the diastolic function of the heart in asymptomatic patients.[4] Diastolic dysfunction is a risk factor for the development of congestive heart failure and has prognostic value in population settings[5]. The present study was undertaken to determine the relationship between diastolic dysfunction and left ventricular mass in essential hypertension.

MATERIALS AND METHODS:

Method of collection of data: A minimum of 50 patients with hypertension of less than 5 years duration were taken into the study.

All 50 patients had a 12-lead ECG taken using 'BPL Cardiart 61 08 T' machine with the patient supine using standard calibration.

The ECG was analyzed for evidence of left ventricular hypertrophy using the Sokolow-Lyon criteria for LVH - S V1+ R V5 or V6 > 35 mm 2D echo with pulse Doppler was done on all patients.

2D Echo using the 3S probe of the GE LOGIQ F8 EXPERT machine recorded by the same professional. Dimensions were recorded to visualize the heart in all views. Mid- cavity dimensions were measured, and LV mass was calculated and indexed to body surface area according to formulae by the ASE. LVH was diagnosed if the LV mass was 116g/m^2 or more for males and 104g/m^2 or more for females.

Pulsed-wave Doppler transmitral velocities were recorded from the apical 4-chamber view by placing the sample volume between the leaflet tips in the center of the flow stream. Early diastolic mitral flow velocity (E), late diastolic mitral flow velocity (A),the ratio of early to late diastolic mitral flow velocity (E/A), and the deceleration time were measured. From the apical 4-chamber view, the pulmonary venous flow velocities were recorded by placing the sample volume approximately 1cm into the right upper pulmonary vein. The pulmonary venous peak systolic (PVs) and peak diastolic (PVd) flow velocities, the ratio of peak systolic-to-diastolic flow velocities (PVs/PVd), and peak reversal flow velocity due to left atrial contraction (PVa) were recorded.

LV Diastolic dysfunction was graded from I to IV based on established criteria.

SELECTION CRITERIA

Patients with documented hypertension with diastolic dysfunction on echocardiographic Doppler evaluation were selected for the study.

STUDY TYPE: Purposive, cross sectional study.

INCLUSION CRITERIA:

Documented hypertension of less than 5 years duration.

EXCLUSION CRITERIA:

Documented Ischemic heart disease.
Congenital heart disease.
Valvular heart disease.
Patients with established heart failure.
Presence of systolic dysfunction.

DATAANALYSIS:

Data collected was analyzed by frequency, percentage and chi-square test.

ETHICAL COMMITTEE CERTIFICATE:

Ethical committee clearance was obtained to conduct the study from the Institutional Ethical committee. As it is a non-interventional study, oral consent was given by ethical committee. Informed consent was obtained from all patients included in the study group.

RESULTS:

The mean age of the subjects presenting with the disease was found to be 66.88 (SD ± 11.286), number of years of hypertension 3.36 (SD ±1.411) and BMI 21.62 (SD ±2.828) [FIGURE1,TABLE1]

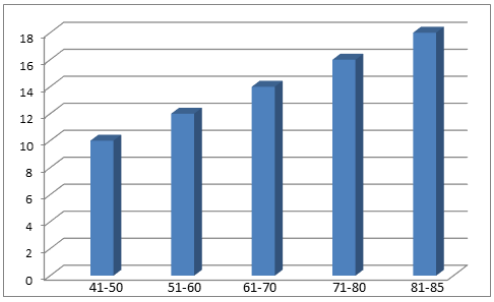

Figure 1: Age distribution

Table 1: Age distribution- Mean and standard deviation

	Minimum	Maximum	Mean	Std. Deviation
AGE	42	85	66.88	11.286
NO OF YEARS OF HYPERTENSION	0	5	3.36	1.411
BODY MASS INDEX	17	28	21.62	2.828

8(16%) were categorized as overweight TABLE 2 .

Table 2: Body Mass Index

BMI	FREQUENCY	PERCENT
NORMAL	42	84.0
OVER WEIGHT	8	16.0
TOTAL	50	100.0

Of the 50 patients studied, 22(44%) were females and 28(56%) were males. [TABLE3,FIGURE2.]

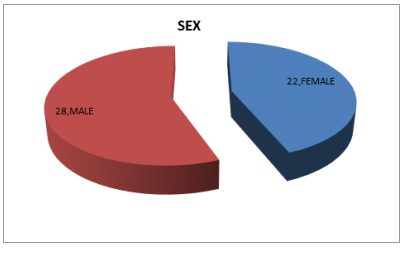

Figure 2: Sex Distribution of cases

Table 3: Sex distribution of cases

	FREQUENCY	PERCENT
FEMALE	22	44.0
MALE	28	56.0
TOTAL	50	100.0

Diastolic dysfunction

All of the 50 (100%) patients had grade I diastolic dysfunction, which was statistically significant (p=0.00001). Grade I LV diastolic dysfunction was observed as a reversal of the ratio of early mitral inflow velocity-E-wave to the late inflow velocity A-wave. [TABLE4,FIGURE3.]

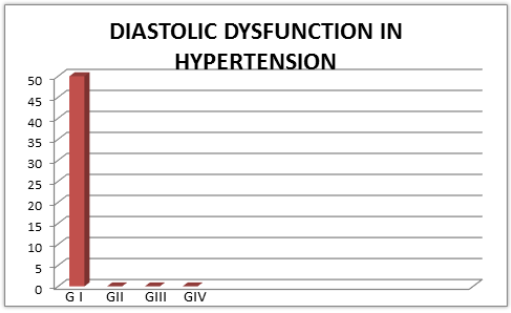

Figure.3: Doppler study-LV diastolic dysfunction (E/A ratio)

Table 4: Doppler study- diastolic dysfunction (E/A ratio)

	FREQUENCY	PERCENT
GRADE I	50	100
GRADE II	0	0
GRADE III	0	0
GRADE IV	0	0

Electrocardiogram

ECG was done on all 50 subjects, of which 10(20%) patients showed evidence of left ventricular hypertrophy, while 40 (80%, p=0.0001 HS) did not. The chart shows the distribution of patients based on the presence or absence of left ventricular hypertrophy in patients with diastolic dysfunction. [TABLE5,FIGURE4.]

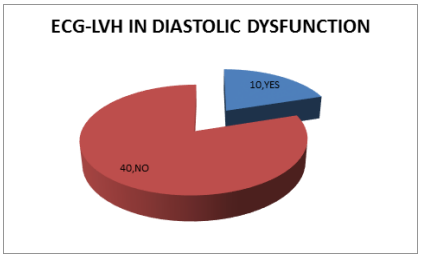

Figure 4: ECG criteria for LVH

Table 5: ECG criteria for LVH

	FREQUENCY	PERCENT
NO	40	80.0
YES	10	20.0
TOTAL	50	100.0

Two Dimensional echocardiography:

10(20%) of the patients with diastolic dysfunction showed evidence of left ventricular hypertrophy as opposed to 40 (80% p=0.00001) statistically significant) who did not. [TABLE6,FIGURE5,TABLE7.]

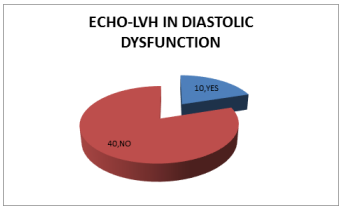

Figure 5: LVH by Echo in diastolic dysfunction

Table 6: Echo criteria for LVH

	FREQUENCY	PERCENT
NO	40	80.0
YES	10	20.0
TOTAL	50	100.0

Table 7: Left ventricular mass index of patients with left ventricular hypertrophy

	AGE IN YEARS	SEX	ECG-LVH	LV MASS INDEX-gm/m^2 OF BODY SURFACE AREA.
1.	59	F	NO	120
2.	49	M	NO	138
3.	85	F	NO	132
4.	82	M	YES	140
5.	83	F	YES	133
6.	84	M	YES	138
7.	70	F	NO	122
8.	70	F	YES	130
9.	48	M	YES	128
10.	60	M	YES	130

Of the 50 patients in our study, 2(4%) were type 2 diabetes mellitus, which was not statistically significant (p>0.005)[TABLE8,FIGURE6.]

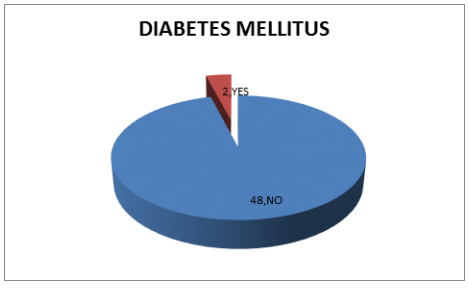

Figure 6: Diabetes mellitus

Table 8: Daibetes mellitus

	FREQUENCY	PERCENT
NO	48	96.0
YES	2	4.0
TOTAL	50	100.0

3(6%) out of the 50 subjects in our study were patients of chronic kidney disease, which was not statistically significant (p>0.005).[TABLE9,FIGURE7].

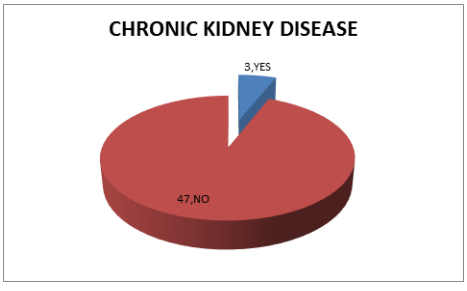

Figure 7: Chronic kidney disease

Table 9: Chronic kidney disease

	FREQUENCY	PERCENT
NO	47	94.0
YES	3	6.0
TOTAL	50	100.0

DISCUSSION

The mean age of the subjects was found to be 66.88 (SD±11.286). This finding confirms the major influence of the aging process on left ventricular diastolic function. Klein AL et al observed the previously described association between Lvdiastolic dysfunction and age.[6]These data are consistent with age-associated increases in CVD and with studies suggesting that senescence itself may be associated with impairment in diastolic function.[7]

There was no significant correlation found between left ventricular hypertrophy and gender in our study (56% males, 44% females). But Verdacchia et al found that, compared to men, hypertensive women require longer duration of exposure to high blood pressure levels to develop left ventricular hypertrophy.[8]

On studying the 12 lead ECG of all subjects, 40(80%) failed to meet the Sokolow-Lyon (SV_1+$RV_{5/6}$ >35mm) criteria for left ventricular hypertrophy. This is consistent with the observation made by Devereux RB et al in their study that in hypertensive patients the incidence of morbid events is poorly correlated with the ECG as cardiac changes manifest late on ECG.[9]

It was found that 40(80%) of the patients did not show evidence of left ventricular hypertrophy on 2D echocardiography. Impaired left ventricular early diastolic relaxation detected by Doppler echocardiography identifies hypertensive patients at increased cardiovascular risks, independent of left ventricular mass.[10]

Simone GD et al conducted a study on cohort of outpatients. They concluded that left ventricular mass was the most potent bioassay of cardiovascular abnormality, in arterial hypertension, incorporating the harmful effect of systolic and diastolic dysfunction.[11]

Zile MR et al prospectively studied 47 patients who met the diagnostic criteria for definitive diastolic heart failure. They concluded that patients with heart failure and normal a ejection fraction have significant abnormalities in active relaxation and passive stiffness and that the pathological cause of elevated diastolic pressures and heart failure is a abnormal diastolic function.[12]

Brucks S et al studied the contribution of left ventricular diastolic dysfunction to heart failure regardless of ejection fraction in 206 patients who were found to have clinical evidence of heart failure (New York Heart association class II or more) when evaluated by a faculty cardiologist Wake Forest university school of medicine.[13]

Grigorian-Shamagian L et al analyzed over 600 deaths in a community long term study. They concluded that the spectrum of causes of death in patients with heart failure were independent of left ventricular ejection fraction in the long term.[14]

Bhatia RS et al found that among the patients who presented with new onset heart failure, a substantial proportion had an ejection fraction of more than 50 percent and that the survival of these patients were similar to that with a reduced ejection fraction.[15]

Kang S et al conducted a study in 2095 patients. The study concluded that arterial stiffness is associated with early mid diastolic heart failure in the general middle and aged population independent of age, gender, BMI, PVWT, IVST, E/E ratio and high blood pressure.[16]

In this study, 4% of the patients had diabetes mellitus and 6% were patients of chronic kidney disease and 16% were categorized as overweight. Russo C et al in their study concluded that hypertension as well as diabetes have an independent negative impact on LV diastolic function that goes beyond the effect of an increased body size and is independent of other co variants possibly affecting LV diastolic function. The combination of hypertension and diabetes exerts a synergistic effect on the parameters of LV diastolic function, and results in higher LV filling pressure than either condition alone.[17]

Study Limitations:

- The relatively small sample size.
- The coexistence of chronic kidney disease and diabetes mellitus were not excluded from the study group.
- The effect of anti-hypertensive medications could not be predicted with accuracy as some patients were on combination of drugs. However, some medications directly or indirectly, especially the calcium channel blockers and ACE inhibitors, may have had a beneficial effect on diastolic function and left ventricular remodeling.

CONCLUSION

LV Diastolic dysfunction is seen early in hypertensive patients, even before the onset of abnormal remodelling or any evidence of structural alteration in the left ventricular (hypertrophy) mass. Also, as evidenced by the studies conducted thus far, diastolic dysfunction is an early predictor of congestive heart disease even without the evidence of impaired systolic function and hence becomes imperative to have an adequate control of hypertension, as it, by itself is one the leading causes of diastolic dysfunction.

·The present study was undertaken to determine the relationship

between diastolic dysfunction and left ventricular mass in essential hypertension.

·We studied a total of 50 patients with essential hypertension of less than 5years duration.

- All 50 patients had a 12-lead ECG taken using 'BPL Cardiart 6108T' machine with the patient supine using standard calibration. 2D Echo was done using the 3S probe of the GE LOGIQ F8 machine recorded by the same professional. Pulsed-wave Doppler transmitral velocities were recorded from the apical 4-camber view by placing the sample volume between the leaflet tips in the center of the flow stream. Early diastolic mitral flow velocity (E), late diastolic mitral flow velocity (A), the ratio of early to late diastolic mitral flow velocity (E/A), and deceleration time were measured.[18]
- It was observed that the mean age of the subjects presenting with the disease was 66.88 (SD ±11.286), number of years of hypertension 3.36 (SD ±1.411) and BMI 21.62(SD ±2.828). Of the 50 patients, 22 were females and 28 were males.
- All of the 50 patients had a grade I diastolic dysfunction, which was statistically significant.
- 10 out of the 50 patients with diastolic dysfunction showed evidence of left ventricular hypertrophy on ECG. Also, 10 patients were seen to have left ventricular hypertrophy by echocardio graphy.
- In summary, slowing of maximal left ventricular filling rate was found to be common in hypertensive patients even before evidence of left ventricular hypertrophy on ECG and 2D echocardiography.
- There was no correlation found between LV diastolic dysfunction and age, gender, body mass index.

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