

Original Research Article

Left ventricular diastolic dysfunction in primary hypertension and ischemic heart disease-evaluation by doppler echocardiography

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ABSTRACT

Background: Congestive heart failure caused by a predominant abnormality in diastolic function is both common and causes significant morbidity and mortality. The objective of the study was to evaluate application of doppler echocardiography in determining left ventricular diastolic dysfunction in ischemic heart disease and essential hypertension.

Methods: Present study is based on analysis of 75 patients of hypertension and 60 patients of IHD (UA, AMI, IMI) admitted to Bapuji and Chigateri general hospital during December 2019 to November 2020. Detailed history and physical examination were done. Every patient was subjected to ECG, CXR, routine investigations and Doppler Echo cardiography.

Results: A total of 75 patients of primary hypertension were studied. 37 patients showed diastolic dysfunction with E/A ratio <1, with increased atrial filling fraction. Out of 37 patients, 24 showed LVH and 13 cases did not have LVH. A total of 60 patients of ischemic heart disease were studied. 23 patients showed diastolic dysfunction with E/A ratio <1, with increased atrial filling fraction and prolonged isovolumetric relaxation time.

Conclusions: Our findings suggest that myocardial damage in patients with HTN and IHD affects diastolic dysfunction before systolic dysfunction. Doppler echocardiography is a valuable non-invasive method to detect left ventricular diastolic impairment and the intentional assessment of diastolic function is advisable for early detection of LV dysfunction before clinical symptoms appear.

Keywords: Doppler echocardiography, Primary hypertension, Ischemic heart disease, Diastolic dysfunction

INTRODUCTION

Cardiovascular diseases (CVDs) are the most prevalent cause of death and disability worldwide. This is true for developed countries as well as developing countries like India which are expected to face a phenomenal increase in the burden of chronic diseases in the near future.¹

While CVDs are currently a dominant cause of death in India, they are likely to be the overwhelming cause of mortality and morbidity in the future of all CVDs, the predominant cause of mortality and morbidity is CHD.

The likely cause of this epidemic a part of the surge in chronic diseases lies in the country's epidemiologic transition. This transition is characterized by rapid urbanization and its accompanying adverse lifestyle changes (eg, drug and alcohol addictions, unhealthy diet, physical inactivity, and increasing psychosocial ailments) and by increasing longevity.^{2,3}

Hypertension is highly prevalent in India. Recent studies give an idea about its increasing prevalence attributable to rapid alteration of lifestyle in developing countries like India and Nepal. Studies showed that more than a quarter

of world's population had hypertension in 2000, and this proportion would increase to 29% by 2025. Men and women had similar overall prevalence of hypertension, and the prevalence increased with age consistently all over the world. Studies also negate the impact of affluence and family size and suggest that hypertension is equally prevalent in rich and poor.^{4,5}

Till the recent past, all the importance was being given to the systolic function of the heart even in the genesis of congestive heart failure, the role of systolic ventricular has been well recognized and stressed upon, time and again.⁶ But it is in this last decade that clinicians and researchers have discovered that reversible and irreversible abnormalities of left ventricular diastolic function contribute significantly to symptoms in individuals with a variety of cardiac disorders, including those with normal or near normal systolic function. This has important therapeutic implications can also help physicians for planning, early intervention strategies. Thus, DD can be used as an early indicator, as it is a precursor to increased left ventricular mass, left ventricular hypertrophy and clinical left ventricular failure.^{7,8}

So, the present study was conducted to evaluate application of doppler echocardiography in determining left ventricular diastolic dysfunction in ischemic heart disease and essential hypertension.

METHODS

This prospective study was conducted in 75 patients of primary hypertension and 60 cases of ischemic heart disease (unstable angina, anterior wall infarction and inferior wall infarction) admitted to J.J.M. Medical College, Viz., Chigateri General Hospital and Bapuji Hospital during May 2006 to June 2007 were studied. Purposive sampling was used. Ethical clearance was obtained from the institutional ethical committee for the present study.

Control Groups: Patients with hypertension without DD and patients with IHD without DD were taken as controls.

Both the sets of patients were studied separately.

All patients were subjected to color Doppler echocardiographic examination.

Inclusion criteria

Patients >18 years of age. Patients with primary hypertension. Patients with IHD

Exclusion criteria

Patients with renal disease, diabetes mellitus, secondary hypertension. Patients with valvular heart disease. Patients with congenital heart disease.

All those included for study were subjected to;

M-Mode left ventricular study. Transmitral Doppler echocardiographic study of left ventricular inflow pattern. Combined study of Doppler echocardiography and phonocardiography to measure isovolumetric relaxation time. Following doppler echocardiographic indices of left ventricular function were measured.

Doppler study

Peak velocity of early mitral flow - E - velocity cm/sec. Peak velocity of late mitral flow - A - velocity cm/sec. E/A ratio. Velocity time integral of total diastolic flow (VTIM - cms). Velocity time integral of atrial wave (VITA - cms). Atrial filling fraction (VTIA/VTIM ratio). Isovolumetric relaxation time (IRT in msec).

M-Mode left ventricular study

LVIDs (mm). LVIDd (mm).

$$\begin{aligned} \text{Ejection fraction} \\ &= (LVIDd3 - LVIDs3 \div LVIDd3) \\ &\times 100 \end{aligned}$$

All the patients were subjected to detailed clinical examination routine hematological and biochemical examination, FBS, urea, creatinine, SGOT, LDH, CPK, serum cholesterol, urine examination, ECG, CXR (PA View)

Statistical methods

The information generated from the survey and observations were entered into statistical package for social sciences (SPSS) 11.5 following which various statistical analyses were performed. Continuous data are expressed as mean±SD and between groups are compared with unpaired student 't' test. P<0.05 significant, p<0.001 highly significant.

RESULTS

75 patients with primary hypertension and 60 patients with IHD admitted in Bapuji Hospital and Chigateri General Hospital, attached to J.J.M. Medical College, Davangere, during May 2006 to June 2007 were analysed. Both the groups (i.e., patients with primary hypertension and IHD) were studied separately.

In our study, patients with hypertension were in the age ranging from 30-90 years, with mean age of 60 years in control group and 63 years in study group. Age groups were comparable. There was no significant difference among the two groups (Table 1).

There were 29 (78%) males and 8 (22%) females in the study groups. Among the study group 24 patients had LVH and 13 patients did not have LVH (Table 2).

Table 1: Age distribution (HTN).

Age	Normal	%	DD	%
30-39	1	3	1	3
40-49	5	13	4	11
50-59	11	29	8	22
60-69	11	29	13	35
70-79	7	18	9	24
80-89	3	8	2	5
Total	38		37	
Mean±SD	59.76±11.74		62.86±11.56	

t*Value=1.15 P=0.25 Not Significant.

The left ventricular filling studies by Doppler echocardiography done in study and control population

were analysed and the results are (Table 3) E-velocity (cm/sec) was reduced in study group compared to control group (60.05±5.99 versus 64.53±7.59). Data was significant P<0.01. A-velocity (cms/sec) was increased in study group compared to control (73.8±6.29 versus 52.89±9.86). Data was highly significant. P<0.001. E/A ratio was reduced in study group compared to controls (0.82±0.07 versus 1.25±0.27). Data was highly significant. P<0.001. VTIA (cms) was slightly increased in study group compared to control (6.12±1.57 versus 5.06±2.11). Data was significant. P<0.05. VTIM (cms) was slightly increased in study group compared to controls (14.32±2.1 versus 13.7±3.04). Data was not significant. P>0.05. VTIA/VTIM ratio was increased in study group compared to controls (0.42±0.09).

Table 2: Doppler echocardiographic indices of the patients with primary hypertension and controls (Mean±SD).

Echo doppler index	Normal (n=38)	Present (n=37)	t* Value	P value	Significance
E-v (cm/sec)	64.53±7.59	60.05±5.99	2.82	P<0.01	S
A-v (cm/sec)	52.89±9.86	73.81±6.29	10.91	P<0.001	HS
E/A ratio	1.25±0.27	0.82±0.07	9.69	P<0.001	HS
VTIA (cm)	5.06±2.11	6.12±1.57	2.46	P<0.05	S
VTIM (cm)	13.7±3.04	14.32±2.1	1.03	P>0.05	NS
VTIA/VTIM	0.35±0.10	0.42±0.09	3.52	P<0.001	HS
LVIDd (mm)	43.16±5.95	43.03±6.26	0.09	P>0.05	NS
LVIDs (mm)	30.55±3.67	30.62±5.17	0.06	P>0.05	NS
EF%	63.39±6.01	59.81±5.73	2.64	P<0.05	S
IRT (m sec)	77.08±10.45	114.16±17.02	11.4	P<0.001	HS

*Student's Unpaired t Test. S =Significant, HS= Highly Significant, NS=Not Significant.

Table 3: Age distribution.

Age	Normal	%	Present	%
30-39	2	5	4	11
40-49	7	18	2	5
50-59	14	37	6	16
60-69	8	21	7	19
70-79	3	8	4	11
80-89	3	8	0	0
Total	37		23	
Mean±SD	57.22±11.73		55.48±13.67	

* Student's Unpaired t Test. t* Value=0.52, P=0.61 Not Significant.

Table 4: Sex distribution.

Sex	Normal	DD	X2 *Value	Significance
Male	28 (76)	18 (78)	0.007	P=0.93 Not Significant
Female	9 (24)	5 (22)		

* X2 Test chi square test

Data was highly significant. P<0.001. LVIDd (mm) did not change in the study group compared to controls.

P>0.05. Data was not significant. LVIDs (mm) did not change in the study group compared to controls.

P value was not significant. Ejection fraction percentage in study group was decreased compared to controls. (59.81±5.73 versus 63.39±6.01) Data was significant. P<0.05.

In our study patients with IHD were in the age group ranging from 30-90 years. The age group of 60-69 had maximum number of cases (19).

Out of 60 IHD cases, 46 (76%) were males and 14 (24%) were females. DD was present in 18 (78%) of males and 5 (22%) of females (Table 4).

Left ventricular filling studies by Doppler echocardiography done in IHD study and control group were analysed. The results are as E-velocity (cm/sec) was decreased in study group compared to control group (62.43± versus 67.92±7.93) P value was significant P<0.01. A-velocity (cm/sec) was increased in study group compared to controls. Data was highly significant. P<0.001 (78.83±5.5 versus 52.22±10.23). E/A Ratio – was reduced in study group compared to controls (0.79±0.0 versus 1.34±0.27). Data was highly significant, P<0.001 Table 5.

Table 5: Doppler echocardiographic indices of patients with ischemic heart disease and controls (Mean±SD).

Echo doppler index	Controls (n=37)	Present (n=23)	t* Value	P value	Significance
E-v (cm/sec)	67.92±7.93	62.43±4.10	3.06	P<0.01	S
A-v (cm/sec)	52.22±10.23	78.83±5.5	11.46	P<0.001	HS
E/A ratio	1.34±0.27	0.79±0.07	9.53	P<0.001	HS
VTIA (cm)	4.29±1.6	6.05±1.81	3.94	P<0.001	HS
VTIM (cm)	12.49±3.86	13.58±1.32	1.3	P>0.05	NS
VTIA/VTIM	0.32±0.09	0.44±0.12	4.43	P<0.001	HS
LVIDd (mm)	41.54±5.53	44.72±5.55	2.16	P>0.05	NS
LVIDs (mm)	29.27±3.91	32.52±4.83	2.85	P<0.01	S
EF%	62.05±4.66	60.17±4.48	1.54	P>0.05	NS
IRT (m sec)	81.73±8.37	120.52±11.88	14.8	P<0.001	HS

Student's Unpaired t Test. S =Significant, HS= Highly Significant, NS= Not Significant.

DISCUSSION

Primary hypertension

E/A ratio was reduced in the present study because suggesting increased late mitral flow (Table 6).

Table 6: Comparison of E/A ratio (HTN).

Echo doppler index	Present study measurements	Rovner et al ³
E-velocity	60.05±5.99	75.0±21.0
A-velocity	73.81±6.29	69.0±20.0
E/A ratio	0.82±0.07	1.1±0.5

Atrial filling fraction

Atrial filling fraction in primary hypertension is not compared with the above- mentioned study, as the authors did not elucidate the same. So atrial filling fraction measurement of present study is compared with that of the Framingham heart study (Table 7).

Table 7: Comparison of atrial filling fraction (HTN).

Echo doppler index	Present study	Framingham heart study ⁹
Atrial filling fraction	0.42±0.09	0.31±0.08

Atrial filling fraction in our study group is higher implying that atrial contribution to ventricular filling was higher which is due to decrease in the ventricular compliance.

Isovolumetric relaxation time of present study is increased and is similar to the findings of Rovner et al¹⁰ (Table 8).

Ischemic heart disease

E/A ratio is reduced in our study group because of increased late mitral flow.

Table 8: Comparison of isovolumetric relaxation time (HTN).

Echo doppler index	Present study	Rovner et al ¹⁰
Isovolumic relaxation time	114.16±17.02	112.0±29.0

Atrial filling fraction (VTIA/VTIM ratio) in present study is higher, indicating that atrial contribution to the ventricular filling was higher because of decreased ventricular compliance (Table 9).

Table 9: Comparison of Echo doppler indexes of IHD.

Echo doppler index	Present study	Stoddard et al ¹¹
E-velocity (cm/sec)	62.43±4.1	60.20±15.6
A-velocity (cm/sec)	78.83±5.5	57.1±15.6
E/A	0.79±0.07	1.21±0.71
VTIA	6.05±1.81	5.1±1.5
VTIM	13.58±1.32	14.3±3.5
VTIA/VTIM	0.44±0.12	0.37±0.13
LVIDd	44.72±5.55	51.0±7.0
LVIDs	32.52±4.83	-
EF %	60.17±4.48	63.0±15.0
IRT	120.52±11.88	70.0±21.0

Present study showed higher values of isovolumetric relaxation time which denotes that aortic relaxation during early diastolic filling is impaired. However, isovolumetric relaxation time is influenced by other variables like left atrial pressure at mitral opening and aortic pressure at aortic valve closure.

Limitations

Non-random sampling was used and small sample size was taken.

CONCLUSION

It was concluded that, in the early stages of hypertensive heart disease, before there is a detectable increase in left ventricular chamber size, sustained elevation of blood pressure is associated with abnormal left ventricular filling despite normal systolic function. Myocardial ischemia and infarction may adversely affect both relaxation and compliance. Also, patients with impaired relaxation with ischemic heart disease, increasing impairment in relaxation correlated with decreasing peak velocity of early filling and increased atrial contribution to filling. Hence, Doppler echocardiography is reliable, non-invasive investigative method of detecting left ventricular DD.

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