A STUDY OF LEFT VENTRICULAR DIASTOLIC DYSFUNCTION IN ISCHEMIC HEART DISEASE-EVALUATION BY DOPPLER ECHOCARDIOGRAPHY

General Medicine

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ABSTRACT

Background: Heart failure is a clinical syndrome characterized by symptoms and signs of increased tissue/organ water and decreased tissue/organ perfusion. Diastolic heart failure is a clinical syndrome characterized by the symptoms and signs of heart failure, a preserved ejection fraction (EF), and abnormal diastolic function Abnormalities in diastolic function can occur in the presence or absence of a clinical syndrome of heart failure and with normal or abnormal systolic function. Therefore, whereas Diastolic Dysfunction describes an abnormal mechanical property, diastolic heart failure describes a clinical syndrome.

Aims & Objectives:
1. To evaluate significance of left ventricular diastolic dysfunction in ischemic heart disease.
2. To evaluate application of Doppler echocardiography in determining left ventricular diastolic dysfunction in ischemic heart disease.
3. To find out early left ventricular diastolic dysfunction in ischemic heart disease as a marker of impending major cardiac events and to promote the quality of life.

Materials and Methods: 60 cases of ischemic heart disease (unstable angina, anterior wall infarction and inferior wall infarction) admitted to Govt. General Hospital during April 2014 to September 2015 were studied.

Results: The left ventricular filling studies by Doppler echocardiography done in study and control population were analysed and the results are as follows. In our study patients with IHD, E-velocity (cm/sec) was decreased in study group compared to control, A-velocity (cm/sec) was increased in study group compared to controls,

Conclusion: myocardial ischemia and infarction may adversely affect both relaxation and compliance.one has to use parameters not affected by heart rate, and preload may alter parameters of Doppler echocardiographic indexes. However, compared to radionuclide and catheterization studies, Doppler echocardiographic method is faster, safer, non-invasive, more economical study can be done bedside without any risks to the patient which are inherent with radionuclide and catheterization techniques.

KEYWORDS

Diastolic Dysfucntion (DD), Ischemic Heart Disease (IHD), Doppler Echocardiography ((DE), Systolic & Diastolic Heart Failure.

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. 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. 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.

On average, 40 percent of patients with heart failure have preserved systolic function.7 The incidence of diastolic heart failure increases with age, and it is more common in older women.8Hypertension and cardiac ischemia are the most common causes of diastolic heart failure .Common precipitating factors include volume overload; tachycardia; exercise; hypertension; ischemia; systemic stressors (e.g., anemia, fever, infection, thyrotoxicosis); arrhythmia (e.g., atrial fibrillation, atrioventricular nodal block); increased salt intake; and use of nonsteroidal anti-inflammatory drugs.

AIMS & OBJECTIVES
1. To evaluate application of doppler echocardiography in determining left ventricular diastolic dysfunction in ischemic heart disease
2. To evaluate significance of left ventricular diastolic dysfunction in ischemic heart disease .
3. To find out early left ventricular diastolic dysfunction in ischemic heart disease as a marker of impending major cardiac events and to promote the quality of life.

MATERIALS AND METHODS
60 cases of ischemic heart disease (unstable angina, anterior wall infarction and inferior wall infarction) admitted to Govt. General Hospital during April 2014 to September 2015 were studied.

Control Groups:
patients with IHD without DD were taken as controls.
All patients were subjected to color Doppler echocardiographic examination.

Inclusion Criteria:
* Patients >18 years of age
  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)

Ejection Fraction = (LVIDd3 – LVIDs3 / LVIDd3) x 100

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).

RESULTS

60 patients with IHD admitted to Govt. General Hospital, Kurnool, during April 2014 to September 2015 were analysed.

ISCHEMIC HEART DISEASE
AGE DISTRIBUTION

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).

TABLE-1:

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

SEX DISTRIBUTIO N

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 -2:

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

DOPPLER ECHOCARDIOGRAPHIC INDICES OF PATIENTS WITH ISCHEMIC HEART DISEASE AND CONTROLS (Mean +/- SD) :

RESUTLS ARE AS FOLLOWS:

The left ventricular filling studies by Doppler echocardiography done in study and control population were analysed and the results are as follows.

- E-velocity (cm/sec) was reduced in study group compared to control group (60.05±5.99 V/s 64.53 ± 7.59). Data was significant P<0.01.
- A-velocity (cms/sec) was increasd in study group compared to control (73.8±6.29 V/s 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 V/s 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 V/s 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 V/s 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). 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 Vs 63.39 ± 6.01) Data was significant. P<0.05.

TABLE-3:

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.

- Left ventricular filling studies by Doppler echocardiography done in IHD study and control group were analysed.

The results are as follows:

- E-velocity (cm/sec) was decreased in study group compared to control group (62.43 ± 4.1 Vs 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 Vs 52.22 ± 10.23).
- E/A Ratio – was reduced in study group compared to controls (0.79 ± 0.07 Vs 1.34 ± 0.27). Data was highly significant. P<0.001.
- VTIA (cms) was increased in our study group compared to control group (6.05 ± 1.81 Vs 4.29 ± 1.6). Data was highly significant. P<0.001.
- VTIM (cms) was slightly increased in study group compared to control group (13.58 ± 1.32 Vs 12.49 ± 3.86). P value was not significant.
- VITA / VTIM ratio was increased in study group compared to control group (0.44 ± 0.12 Vs 0.32 ± 0.09). Data was highly significant. P<0.001.
- LVIDd (mm) did not change in our study group compared to control group (44.72 ± 5.55 Vs 41.54 ± 5.53). P value was not significant.
- There was no difference in the ejection fraction percentage in both the study and control groups (60.17 ± 4.48 Vs 62.05 ± 4.66). P value was not significant.
- Analysis of Data shows that diastolic filling abnormalities are common in patients with impaired relaxation, than in patients with normal relaxation.

DISCUSSION
Systolic versus diastolic HF

Patients with chronic HF can be divided into two categories on the basis of characteristic changes in cardiovascular structure and function[44].

Systolic HF (SHF) is characterized by abnormalities in systolic function (ie, reduced left ventricular ejection fraction [LVEF]) usually with progressive chamber dilation and eccentric remodeling. Because the dominant abnormality is in systolic function, this syndrome is called SHF. This syndrome is also called HF with a reduced LVEF (HFrEF). SHF has been defined by a variety of LVEF partition values ranging from less than 35 to 50 percent. Our preference is to define SHF by an LVEF <50 percent.

Diastolic HF (DHF) is characterized by a normal LVEF, normal LV end-diastolic volume, and abnormal diastolic function, usually with

concentric remodeling or hypertrophy[45]. The dominant abnormality resides in diastole. However, in clinical practice, the diagnosis of DHF is often one of exclusion based on the finding of a normal or near normal (or "preserved") LVEF. As a result, this syndrome is also called "HF with preserved EF" (HFPEF). DHF may be best defined as HF with LVEF >50 percent and evidence of diastolic dysfunction.

ISCHEMIC HEART DISEASE
TABLE 4: COMPARISON OF ECHO DOPPLER INDEXES OF IHD WITH STODDARD M.F. ET AL

Echodoppler Index	Present study	Stoddard M.F. 60et al.,
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

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

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.

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

Table:5- Comparison of E/A Ratio in Age Groups Between Present Study and Abdul Latif Mohammed Et Al

	Abdl Latif Mohammed et al		Present study	
	decreased E/A-	Normal E/A	Decreased E/A	Normal E/A
> 50 years of age	22	21	17	28
≤ 50 years of age	0	7	6	9
Total	22	28	23	37

Table:6- Comparison of E/a Ratio in IHD/AMI Patients Groups Between Present Study and Abdul Latif Mohammed Et Al

	Abdl Latif Mohammed et al		Present study	
	decreased E/A-	Normal E/A	Decreased E/A	Normal E/A
IHD/AMI	22	28	23	37
Total	22	28	23	37

Diastolic dysfunction in DHF — In DHF, abnormalities in diastolic function form the dominant pathophysiologic basis for the development of the clinical syndrome of HF The major abnormalities in LV diastolic function are:

*   Slowed, delayed, and incomplete myocardial relaxation
*   Impaired rate and extent of LV filling
*   Shift of filling from early to late diastole
*   Increased dependence on LV filling from atrial contraction
*   Decreased early diastolic suction/recoil
*   Increased LA pressure during the early filling
*   Increased passive stiffness and decreased distensibility of the LV
*   Impaired ability to augment cardiac output during exercise
*   Reduced ability to augment relaxation during exercise
*   Limited ability to utilize the Frank-Starling mechanism during exercise

Causes of Diastolic Dysfunction and Heart Failure
Common causes
*   Cardiac ischemia, Hypertension. Aging, Obesity, Aorticstenosis
*   Uncommon causes,
*   Myocardial Infiltrative diseases (e.g., amyloidosis, sarcoidosis,

fatty infiltration), Noninfiltrative diseases (e.g., idiopathic and hypertrophic cardiomyopathy) Endomyocardial diseases

Hypereosinophilic syndrome, Storage diseases, Glycogen storage diseases, Hemochromatosis, Pericardial disorders, Constrictive pericarditis, Effusive-constrictive pericarditis, Pericardial effusion

CONCLUSION
1. To conclude myocardial ischemia and infarction may adversely affect both relaxation and compliance.
2. Neverthless, other clinical variables like heart rate, age, and preload may alter parameters of Doppler echocardiographic indexes. Hence, one has to use parameters not affected by heart rate, and preload.
3. Compared to radionuclide and catheterization studies, Doppler echocardiographic method is faster, safer, non-invasive, more economical study and can be done bedside without any risks to the patient which are inherent with radionuclide and catheterization techniques.

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