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ORIGINAL RESEARCH

Evaluation of left ventricular diastolic dysfunction in type 2 diabetic patients: A cross-sectional study

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ABSTRACT
Background: Left ventricular diastolic dysfunction (LVDD) refers to the inability of the left ventricle of the heart to relax and fill properly during the diastolic phase (when the heart relaxes between beats). The present study was conducted to evaluate left ventricular diastolic dysfunction (LVDD) in diabetic patients.
Materials and Methods: A prospective cross-sectional observational study was conducted on 96 type 2 diabetic patients of both genders. Anthropometric measurements like height, weight, and waist circumference were recorded. Blood pressure was measured and measurement of complete blood count, liver function test, renal function test, fasting and postprandial blood sugar, HbA1c, and lipid profile was done. LVDD was assessed by electrocardiographic and echocardiographic studies. Assessment of diastolic dysfunction was also calculated.
Results: Out of 96 patients, males were 50 and females were 46. Age group (years) 30-40 had 5 grade I and 2 grade II, 40-50 had 12 grade I and 6 grade II and 50-60 had 23 grade I and 7 grade II diastolic dysfunction patients. There were 22 males and 18 females with grade I and 15 males with grade II diastolic dysfunction. Duration of diabetes with 0-4 years had 6 grade I and 2 grade II, 5-10 years had 12 grade I and 5 grade II and 10-15 years had 22 grade I and 8 grade II diastolic dysfunction patients. HbA1c (%) was <7 in 8 grade I and 4 grade II and >7 in 32 grade I and 11 grade II patients. The difference was significant ($P< 0.05$).
Conclusion: LVDD was most strongly associated with type 2 diabetes. The study came to the conclusion that early detection and treatment will improve outcomes, lower morbidity, and stop heart failure in the future.
Keywords: Left ventricular diastolic dysfunction, Diabetes, Haemoglobin.

Introduction

Left ventricular diastolic dysfunction (LVDD) refers to the inability of the left ventricle of the heart to relax and fill properly during the diastolic phase (when the heart relaxes between beats).[1] This condition can lead to increased pressures in the left atrium, pulmonary veins, and pulmonary circulation, eventually causing symptoms of heart failure. Chronic high blood pressure can lead to left ventricular hypertrophy, which impairs relaxation. Diastolic dysfunction is more common in older adults due to changes in the heart muscle.[2] Reduced blood supply to the heart can affect the muscle's ability to relax. Grade I diastolic dysfunction is slightly impaired diastole and Grade II is elevated pressure in the left side of heart. Diabetes can lead to changes in the myocardial structure and function. Obesity is associated with various cardiovascular risks that can contribute to diastolic dysfunction. Narrowing of the aortic valve increases the workload on the left ventricle, leading to hypertrophy and diastolic dysfunction.[3]

According to the data, diastolic dysfunction in diabetics appears before systolic dysfunction. It is unknown what causes this LVDD in diabetics.[4]Prior to systolic damage, diastolic dysfunction is an early indicator of diabetic heart muscle disease. An independent correlation exists between diastolic

dysfunction and elevated cardiovascular and all-cause mortality in a population-based sample of middle-aged and older persons.[5]A primary indicator of the degree of diastolic dysfunction is elevated Left Atrial (LA) volume, whether or not Left Ventricular (LV) inflated pressure is present. In individuals with HFpEF, fibrosis and underlying remodelling of LA dysfunction.[6]

Aim and objective

The present study was conducted to evaluate left ventricular diastolic dysfunction (LVDD) in diabetic patients.

Materials and Methods

The present cross-sectional prospective observational study was conducted on 96 type 2 diabetic patients of both genders and no clinical evidence of cardiovascular disease in the Department of General medicine, Anugrah Narayan Magadh Medical College & Hospital, Gaya, Bihar, India.

The duration of study was from August 2021 to July 2023.The Institutional Ethics Committee gave the study its approval. All were informed regarding the study and their written consent was obtained. Data such as name, age, gender etc. was recorded.

Inclusion Criteria

- Patients to give written informed consent.
- Patients attending ANMMCH Hospital as outpatients and inpatients during the study period.
- Patients with type 2 DM.
- Patient's age between 20-60 years.
- Available for follow up.

Exclusion Criteria:

- Patients who don't gave written informed consent.
- Patients with evidence of coronary artery disease (CAD).
- MI by history and resting Electrocardiogram (ECG).
- Type 1 DM patients.
- Patients with heart diseases with normal systolic ejection fraction, hypertension, thyroid disorder, respiratory or renal diseases.
- Pregnant women.
- Those unable to attend follow-up.

Sampling Size Determination and Sampling Technique

The following simple formula would be used for calculating the adequate sample size in prevalence study

$n= Z^2 P (1-P)/d^2$

n= sample size, Z= level of confidence, P= prevalence, d= Absolute error or precision

Z = Is standard normal variate (at 5% type 1 error ($P< 0.05$) it is 1.96 and at 1% type 1 error ($P<0.01$) it is 2.58). As in majority of studies P values are considered significant below 0.05 hence 1.96 is used in formula. p = Expected proportion in population based on previous studies or pilot studies.

The sample size was calculated using a single population proportion formula, by considering, 95% confidence level, a 5% margin of error, and a 6% estimated proportion of overall prevalence

Sample size = $1.962 \times 0.06 (1-0.06)/0.052$

$=86$

Considering 10% non-response rate, the total minimum sample size for study was 95 patients. We included 96 patients in the present study.

Study Procedure

Anthropometric measurements like height, weight, and waist circumference were recorded. Blood pressure was measured, and measurements of the complete blood count, liver function test, renal function test, fasting and postprandial blood sugar, HbA1c, and lipid profile were done. Assessment of diastolic dysfunction: A transthoracic ECG was done to assess the ventricular dimensions, the presence of regional wall motion abnormalities, and the LV ejection fraction. Left Ventricular Diastolic Function (LVDD) was assessed by electrocardiographic and echocardiographic studies. Pulsed-wave Doppler with the transducer in the apical four-chamber view and the Doppler beam directed perpendicular to the plane of the mitral annulus was used to measure mitral inflow, and a colour M-mode Doppler ECG was also performed.

Statistical Analysis

The statistical analysis was conducted using SPSS version 25.0. Descriptive statistics were computed for continuous data, including frequencies, percentages, means, and standard deviations (SD). For categorical variables, ratios and proportions were calculated. The chi-square test, if appropriate, was used to evaluate differences in proportions among qualitative variables. A p-value below 0.05 was deemed to have statistical significance.

Results

Table: I Distribution of patients

Total- 96		
Gender	**Male**	**Female**
Number	50 (52.08%)	46 (47.91%)

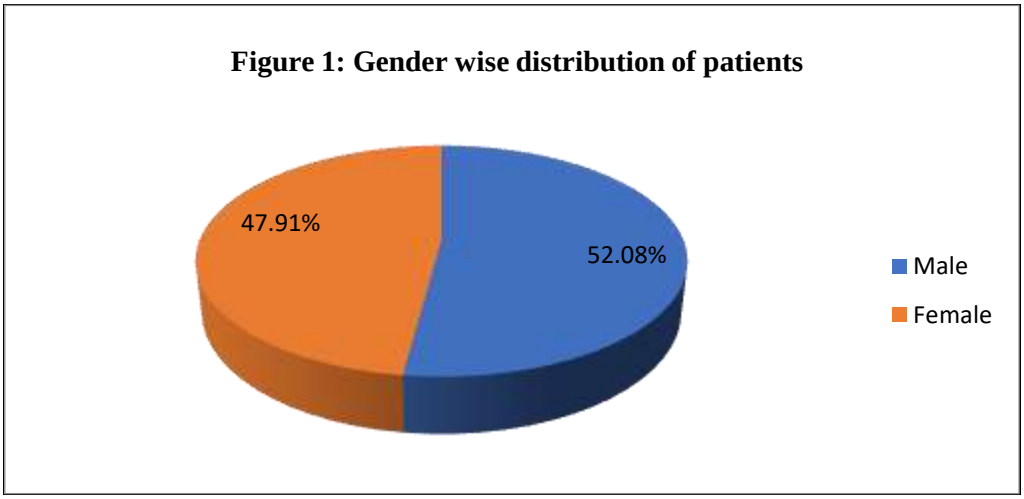

Table I, Figure 1, shows that out of 96 patients, males were 50 (52.08%) and females were 46 (47.91%).

Table: II Assessment of parameters

Parameters	**Variables**	**Patients with diastolic dysfunction (n=55)**		**P value**
		Grade I (40)	**Grade II (15)**	
Age group (years)	30-40	5	2	0.05
	40-50	12	6	
	50-60	23	7	
Gender	Male	22	15	0.04
	Female	18	0	
duration of diabetes (years)	0-4	6	2	0.05
	5-10	12	5	
	10-15	22	8	
HbA1c (%)	<7	8	4	0.01
	>7	32	11	

Table II, Figure 2, shows that age group (years) 30-40 had 5 grade I and 2 grade II, 40-50 had 12 grade I and 6 grade II and 50-60 had 23 grade I and 7 grade II diastolic dysfunction patients. There were 22 males and 18 females with grade I and 15 males with grade II diastolic dysfunction. Duration of diabetes with 0-4 years had 6 grade I and 2 grade II, 5-10 years had 12 grade I and 5 grade II and 10-15 years had 22 grade I and 8 grade II diastolic dysfunction patients. HbA1c (%) was <7 in 8 grade I and 4 grade II and >7 in 32 grade I and 11 grade II patients. The difference was significant (P< 0.05).

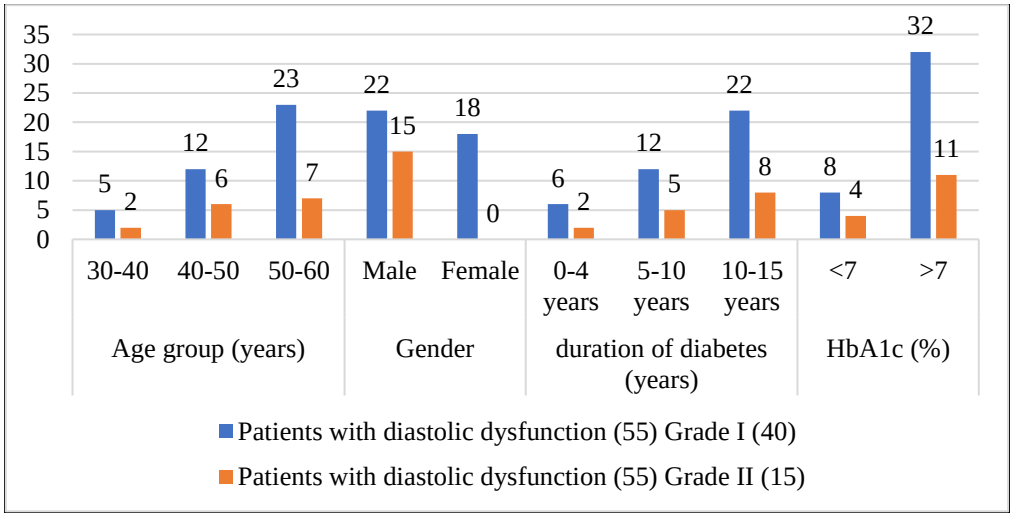

Figure 2: Assessment of patients diastolic dysfunction

Discussion

The evidence suggests that diastolic dysfunction precedes systolic dysfunction in diabetics. The pathogenesis of this LVDD in diabetics is not known.[7] Diastolic dysfunction is an early sign of diabetic heart muscle disease preceding systolic damage.[8] Diastolic dysfunction is independently associated with increased all-cause mortality as well as cardiovascular mortality in a population-based sample of middle aged and elderly adults.[9] The present study was conducted to evaluate left ventricular diastolic dysfunction (LVDD) in diabetic patients.

We found that out of 96 patients, males were 50 and females were 46. Shukla et al[10] assessed left ventricular diastolic dysfunction (LVDD) in diabetic patients and its association with age, gender, duration, and glycosylated haemoglobin (HbA1c) in 150 normotensive patients with type 2 DM. The present study showed that 85 out of 150 type 2 diabetic patients had diastolic dysfunction, out of which 80 had grade I diastolic dysfunction and, five of them had grade II diastolic dysfunction. The prevalence of diastolic dysfunction was increased with age, duration, and HbA1c (≥7%) and was not affected by gender.

We found that age group (years) 30-40 had 5 grade I and 2 grade II, 40-50 had 12 grade I and 6 grade II and 50-60 had 23 grade I and 7 grade II diastolic dysfunction patients. There were 22 males and 18 females with grade I and 15 males with grade II diastolic dysfunction. Duration of diabetes with 0-4 years had 6 grade I and 2 grade II, 5-10 years had 12 grade I and 5 grade II and 10-15 years had 22 grade I and 8 grade II diastolic dysfunction patients. HbA1c (%) was <7 in 8 grade I and 4 grade II and >7 in 32 grade I and 11 grade II patients. Sharavanan et al.[11] in their study a total of 66 diabetic patients were detected with diastolic dysfunction among the 120 subjects under study. Highest prevalence of left ventricular diastolic dysfunction was observed in the female population and in the individuals belonging to the age group of more than 45 years. Statistical analysis revealed a significant association between the glycosylated hemoglobin and diastolic dysfunction in diabetic patients. Cardio vascular disorders accounts for major morbidity and mortality in patients with diabetes mellitus, which may predispose to the development of diabetic cardiomyopathy leading to congestive cardiac failure. Prompt diagnosis and treatment prevents the progression of heart failure in insulin resistance.

Limitation(s) of the study

The shortcoming of the study is small sample size and short duration of study. Hence the resulting statistics might not accurately represent the population. Future studies incorporating larger sample sizes and multicentre collaborations could further validate and extend our results. Differentiating diastolic abnormalities across populations with and without diabetes was a major limitation of the current study's lack of a control group.

Conclusion

Authors found that Left Ventricular Diastolic dysfunction (LVDD) was most strongly associated with type 2 diabetes. The study came to the conclusion that early detection and treatment will improve outcomes, lower morbidity, and stop heart failure in the future.

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