

# Study of Left Ventricular Dysfunction in Normotensive Type 2 Diabetes Mellitus Patients

Daya Shanker<sup>1</sup>, Vinay Gupta<sup>2</sup>

## ABSTRACT

**Introduction:** Type 2 Diabetes Mellitus is characterized by variable degrees of insulin resistance, impaired insulin secretion and increased glucose production. In elderly patients, type 2 diabetes mellitus is one of the risk factors for the development of symptomatic heart failure. Type 2 diabetes causes micro and macro-vascular complications which affect all organs of body especially heart.

**Material and methods:** It is an observational, cross sectional design to study the frequency of left ventricular dysfunction in 80 normotensive type 2 diabetic patients of both genders conducted in the department of medicine, at tertiary care hospital in city of Lucknow. Patients recruited in the study were evaluated for left ventricular dysfunction.

**Results:** Out of 80 cases, 51 cases (63.75%) were male while 29 cases (36.25%) were female. Male outnumbered female cases showing male to female ratio of 1.75:1. In present study, overall mean age was 53.32±10.61. 39 patients (48.75%) were detected with Left Ventricular Diastolic Dysfunction (LVDD). Mild, moderate and severe dysfunction was found among 41.25%, 7.5% and 2.5% of the subjects respectively. 30 patients (37.50%) were detected with left Ventricular Systolic Dysfunction (LVSD). Among patients with LVDD, majority patients (48.78%) have 5-10 years duration of diabetes while among other group, majority patients (51.28%) have less than 5 years of duration of diabetes.

**Conclusion:** There was statistically significant difference among subjects with and without LVDD in relation to E/A ratio. There was statistically significant difference between both groups regarding LVEF%. It was also observed that as the duration of the diabetes increases, the incidence of LVDD was also increased. Early diagnosis and therapeutic interventions in diabetes mellitus before the deleterious cardiac sequelae become established.

**Key words:** Type 2 Diabetes Mellitus, LVSD, LVDD, Echocardiography.

complications which affect all organs of body especially heart. Left ventricular dysfunction, increased left ventricular mass, increased left ventricular wall thickness and diabetic cardiomyopathies are major cardiovascular complications associated with diabetes mellitus.<sup>4</sup> Left ventricular diastolic dysfunction has been demonstrated in normotensive and asymptomatic diabetic patients.<sup>5</sup>

An early diagnosis of cardiac complications in patients suffering from type 2 DM can be of great help to prevent or delay the development of these complications. Literatures show that very few studies have been carried out to study the relation between ventricular dysfunction and type 2 DM. Therefore aim of present study is to evaluate the frequency of left ventricular dysfunction in normotensive type 2 diabetes mellitus patients using echocardiography.

## MATERIAL AND METHODS

The present study was an observational, cross sectional study conducted in department of medicine of a tertiary care hospital, Lucknow on 80 normotensive type II diabetic patients of both genders from January 2019 to December 2019. Study subjects were recruited from both in and out patient departments. Informed consent from all participants and permission from Institutional Ethics Committee was obtained prior to study. All the patients of type 2 diabetes mellitus clinically having no symptoms of cardiovascular disease and normal blood pressure of < 130/80 mmHg, with normal ECG were included in the study. Patients with history of myocardial infarction by history and resting electrocardiogram (ECG), hypertension, angina pectoris, Type I DM, alcoholism, thyroid diseases etc were excluded from the study. Patients with regional wall motion abnormalities or not consenting to participate were also excluded.

Patients recruited in the study were evaluated for left ventricular dysfunction defined as (1) an inability to fill the left ventricle, during rest or exercise, to a normal end-diastolic volume without an abnormal increase in LV end

## INTRODUCTION

Type 2 Diabetes Mellitus is characterized by variable degrees of insulin resistance, impaired insulin secretion and increased glucose production. Worldwide, the number of adults with diagnosed type 2 diabetes would be about 300 million by year 2025.<sup>1</sup> Globally, prevalence of diabetes mellitus is increasing especially in developing countries like India. In India, there are about 69.1 million people suffering from diabetes and this number will increase in near future. In elderly patients, type 2 diabetes mellitus is one of the risk factors for the development of symptomatic heart failure.<sup>2,3</sup> Type 2 diabetes causes micro and macro-vascular

<sup>1</sup>Assistant Professor, Department of Medicine, Prasad Institute of Medical Sciences, Lucknow, UP., <sup>2</sup>Assistant Professor, Department of Medicine, Rani Durgavati Medical College Banda, UP, India

**Corresponding author:** Dr Vinay Gupta, Assistant Professor, Department of Medicine, Rani Durgavati Medical College Banda UP, India

**How to cite this article:** Daya Shanker, Vinay Gupta. Study of Left Ventricular Dysfunction in Normotensive Type 2 Diabetes Mellitus Patients. International Journal of Contemporary Medical Research 2023;10(4):D5-D8.



diastole or mean left atrial pressure; or (2) failure to increase LV end diastolic volume and therefore cardiac output during exercise. Early and late diastolic myocardial velocities were attained and the ratio (E/A) was calculated. A reduced E/A ratio of <1 and increase in the size of LA was considered to be evidence of left ventricular diastolic dysfunction.

Data was tabulated in an excel sheet and means & standard deviations of the measurements per group were used for statistical analysis. Difference between two groups was determined using student t-test as well as chi-square test and the level of significance was set at  $p < 0.05$ .

## RESULT

Table 1 shows demographic profile of cases in present study. Out of 80 cases, 51 cases (63.75%) were male while 29 cases (36.25%) were female. Male outnumbered female cases showing male to female ratio of 1.75:1. In present study, overall mean age was  $53.32 \pm 10.61$ . Majority of cases (67.5%) have normal body mass index followed by overweight (21.25%) and obese cases (11.25%). Mean BMI was  $53.32 \pm 10.61$ .

Table 2 shows laboratory parameter at baseline in present study. The mean duration of diabetes was  $7.21 \pm 6.05$  years. The mean FBS, PPBS and HbA1c values were  $161.09 \pm 15.12$ ,  $220.84 \pm 28.07$  and  $7.88 \pm 1.13$  mg/dl respectively. The mean creatinine and urea values were  $0.69 \pm 0.12$  and  $20.97 \pm 3.14$  mg/dl respectively. The mean cholesterol, Triglyceride and HDL values were  $188.29 \pm 12.74$ ,  $182.21 \pm 39.11$  and  $43.78 \pm 5.25$  mg/dl respectively.

In present study, out of 80 cases, 39 (48.75%) patients were detected with Left Ventricular Diastolic Dysfunction (LVDD). Mild, moderate and severe dysfunction was found among 41.25%, 7.5% and 2.5% of the subjects respectively. (Table 3) Table 4 shows that there was statistically significant difference among subjects with and without LVDD in relation to E/A ratio.

Table 5 shows that patients were evaluated for left ventricular systolic dysfunction. 30 patients (37.50%) were detected with left Ventricular Systolic Dysfunction (LVSD). There was statistically significant difference between both groups regarding LVEF%.

Table 6 shows correlation of diastolic dysfunction of DM with duration of diabetes. Among patients with LVDD, majority patients (48.78%) have 5-10 years duration of diabetes while among other group, majority patients (51.28%) have less than 5 years of duration of diabetes. It was also observed that as the duration of the diabetes increases, the incidence of LVDD was also increased.

### Discussion:

Globally, prevalence of diabetes mellitus is increasing. Worldwide, the number of adults with diagnosed type 2 diabetes would be about 300 million by year 2025. Studies done by various researchers <sup>6-8</sup> have well described the epidemiology and characteristics of coronary artery disease in type 2 diabetes mellitus. Along with fresh coronary events, abnormalities in the left ventricular structure and function could be important contributors to cardiac death

S. No.	Parameter	No. of Cases (%)	Mean
1	Gender		Mean Age
	Male	51 (63.75%)	51.16±11.28
	Female	29 (36.25%)	55.44±9.87
	Total	80 (100.00%)	53.32±10.61
2	Body Mass Index (Kg/M <sup>2</sup> )		Mean
	Normal	54 (67.5%)	24.12±2.74
	Overweight	17 (21.25%)	
	Obese	09 (11.25%)	

**Table-1:** Demographic Profile of Cases in Present Study

S.No.	Parameter	Mean	SD
1	Blood Sugar related		
	FBS	161.09	15.12
	PPBS	220.84	28.07
	HbA1c	7.88	1.13
2	Kidney function related		
	Creatinine (mg/dl)	0.69	0.12
	Urea (mg/dl)	20.97	3.14
3	Lipid Profile		
	Cholesterol	188.29	12.74
	Triglyceride	182.21	39.11
	VLDL	32.98	4.15
	LDL	124.88	29.54
	HDL	43.78	5.25
4	Liver related		
	Total bilirubin (mg/dl)	1.12	1.01
	SGOT (IU/L)	44.82	26.98
	SGPT (IU/L)	47.74	20.13
	Alkaline phosphatase (u/l)	109.14	50.88
	Total protein (g/dl)	6.15	0.65
	Serum albumin (mg/dl)	3.57	0.72

**Table-2:** Laboratory Parameter at Baseline in Present Study

in diabetes mellitus. Various authors like Nathem DM et al<sup>9</sup> and Davidson JA et al<sup>10</sup> have evaluated the role of diabetes mellitus in causation of various cardiovascular diseases. According to them, diabetes causes structural and functional abnormalities to heart structure that are independent of the effect of atherosclerosis and these abnormalities contribute significantly to adverse cardiovascular events. First stage of putative “diabetic cardiomyopathy” is left ventricular diastolic dysfunction.<sup>11</sup>

In present study, out of 80 cases, 39 (48.75%) patients were detected with Left Ventricular Diastolic Dysfunction (LVDD). Mild, moderate and severe dysfunction was found among 41.25%, 7.5% and 2.5% of the subjects respectively. There is statistically significant difference among subjects with and without LVDD in relation to E/A ratio. Study done by Arora M et al.<sup>3</sup>, Patil VC et al.<sup>8</sup> and Sharavanan TKV et al.<sup>12</sup> observed LVDD among 53%, 54.33% and 55% of patients which coincide with the result of present study while Vittal D et al.<sup>14</sup> and Patil MB et al.<sup>13</sup> observed diastolic dysfunction among 66% and 64.3% of patients which is quite

LVDD	Mitral E/A Ratio	Deceleration Time (m sec)	No. of cases	% of cases
Normal Function	$0.75 < E/A < 1.5$	$< 220$	39	48.75
Mild Dysfunction	$EA \leq 0.75$	$> 220$	33	41.25
Moderate Dysfunction	$0.75 < E/A < 1.5$	150-200	06	7.5
Severe Dysfunction	$E/A \geq 1.5$	$< 150$	02	2.5

Table-3: Distribution of Patient according to LVDD

Parameters	Patients with LVDD (N=41)		Patients without LVDD (N=39)		P value
	Mean	SD	Mean	SD	
E/A ratio	1.02	0.31	0.6	0.12	0.009
DT (msec)	194.11	11.19	223.9	15.24	0.068
IVRT (msec)	70.98	6.98	76.09	12.94	0.182

Table-4: Echocardiography parameters of patients in present study

LVEF	No. of Cases (%)	LV Ejection Fraction (%)		LV Ejection Fraction (%)
		Mean	SD	
Normal Range (52%-72%)	50 (62.5%)	64.87	3.02	<0.01
Mild Abnormal (41%-51%)	15 (18.75%)	42.17	5.18	
Moderate Abnormal (30%-40%)	12 (15.0%)			
Severe Abnormal (<30%)	03 (3.75%)			

Table-5: Distribution of Patient according to LVSD

Duration of diabetes	Patients with LVDD (N=41)		Patients without LVDD (N=39)		P value
	No. of cases	% of cases	No. of cases	% of cases	
<5 years	7	17.07	20	51.28	0.008
5-10 years	20	48.78	17	43.58	
>10 years	14	34.14	2	5.12	

Table-6: Correlation of diastolic dysfunction of diabetes mellitus with duration of diabetes

higher compared to result of present study. Study done by Ashraf et al<sup>15</sup> reported a lesser prevalence of 30.76% which is quite lower in comparison of present study.

In our study, statistically significant difference was found among subjects with and without LVDD in relation to E/A ratio while no significance was found in relation to DT (msec) and IVRT (msec). Similar results were observed by Arora M et al.<sup>3</sup> and Kumar VS et al<sup>16</sup> reported 66% patients have diastolic dysfunction as defined by E/A with mean E/A of 0.73 with standard deviation (SD)  $\pm$  0.01. Mean LVEF% was comparatively more among subjects with LVSD (64.87) as compared to subjects without LVSD (42.17) with statistically significant difference as  $p < 0.01$ .

30 patients (37.50%) were detected with left ventricular systolic dysfunction (LVSD) in present study. Dodiya-Manuel et al<sup>11</sup> in their study demonstrated a significant reduction in mean left ventricular ejection fraction in diabetics compared to healthy controls (62.2% versus 68.5%;  $P < 0.001$ ), which coincides with our study. This significant reduction in mean ejection fraction signifies early left ventricular systolic dysfunction in these diabetic patients despite absence of symptoms of cardiovascular disease.

Table 6 shows correlation of diastolic dysfunction of DM with duration of diabetes. Among patients with LVDD, majority patients (48.78%) have 5-10 years duration of diabetes while among other group, majority patients (51.28%) have less

than 5 years of duration of diabetes. It was also observed that as the duration of the diabetes increases, the incidence of LVDD was also increased. Similar results were observed by Senthil N et al<sup>17</sup>, Mishra TK et al<sup>18</sup> and Kumar VS et al.<sup>16</sup> Masugata et al<sup>19</sup> observed that the cardiac diastolic dysfunction without LV systolic dysfunction in patients with well-controlled Type 2 DM is related neither to hypertension nor LV hypertrophy but rather to aging and duration of Type 2 DM. Hameedullah et al<sup>20</sup> in their study found that there was a strong correlation between HbA1c level and diastolic indices. Diastolic dysfunction was more frequent in poorly controlled patients with diabetes, and its severity was correlated with glycemic control. Similar results were observed in present study. The present study had some limitations. Stress electrocardiography, stress echocardiography, myocardial perfusion imaging, and coronary angiography were not used to exclude sub clinical coronary disease.

## CONCLUSION

Present study results tell the vital role of echocardiogram to evaluate the diastolic functional parameters. Early diagnosis and therapeutic interventions in diabetes mellitus patients before the establishment of cardiac complications reduce morbidity and mortality due to cardiac disease.

## REFERENCE

1. Patil MB, Nishkal Prabhu A Burji. Echocardiographic

- Evaluation of Diastolic Dysfunction in Asymptomatic Type 2 Diabetes Mellitus. *JAPI*. 2012; 60:23-26.
2. Soares Felício J, Cavalcante Koury C, Tavares Carvalho C, et al. Present insights on cardiomyopathy in diabetic patients. *Current Diabetes Reviews*. 2016; 12:384-95.
  3. Arora M, Singh VK, Sirohi TR, Singhal S. Study the frequency of left ventricular dysfunction in normotensive type 2 diabetic patients. *International Journal of Contemporary Medical Research* 2021;8(3):C1-C5.
  4. Kumar VS, Sreelatha M, Ramesh K, Shekar GC. Study of Left Ventricular Diastolic Dysfunction in Type 2 Diabetes Mellitus Patients. *Int J Sci Stud* 2017; 5:219-224.
  5. Zimmet PZ. Diabetes and its drivers: the largest epidemic in human history? *Clin. Diabetes Endocrinol*. 2017; 3:1.
  6. Reis JP, Allen NB, Bancks MP, Carr JJ, Lewis CE, Lima JA, et al. Duration of Diabetes and Prediabetes During Adulthood and Subclinical Atherosclerosis and Cardiac Dysfunction in Middle Age: The CARDIA Study. *Diabetes Care*. 2018;41:731-8.
  7. Chaudhary AK, Aneja GK, Shukla S, Razi SM. Study on Diastolic Dysfunction in Newly Diagnosed Type 2 Diabetes Mellitus and its Correlation with Glycosylated Haemoglobin (HbA1C). *J Clin Diagn Res* 2015;9:OC20-2.
  8. Patil VC, Patil H V, Shah KB, Vasani JD, Shetty P. Diastolic dysfunction in asymptomatic type 2 diabetes mellitus with normal systolic function. *J Cardiovasc Dis Res* 2011;2:213-22.
  9. Nathan DM, Cleary PA, Backlund JY, Genuth SM, Lachin JM, Orchard TJ, Raskin P, Zinman B: Intensive diabetes treatment and cardiovascular disease in patients with type 1 diabetes. *N Engl J Med* 2005; 353: 2643- 2653.
  10. Davidson JA, Parkin CG. Is hyperglycemia a causal factor in cardiovascular disease? Does proving this relationship really matter? Yes. *Diabetes Care*. 2009;32 Suppl 2(Suppl 2):S331-S333.
  11. Dodiya-Manuel ST, Akpa MR, Odia OJ. Left ventricular dysfunction in normotensive type II diabetic patients in Port Harcourt, Nigeria. *Vasc Health Risk Manag*. 2013; 9:529-533.
  12. Sharavanan TKV, Prasanna KB, Ekanthalingam S, Sundaram A, Premalatha E, Arumugam B. A study on the prevalence of diastolic dysfunction in type 2 diabetes mellitus in a tertiary care hospital. *IAIM*. 2016; 3:216-21.
  13. Patil MB, Nishkal Prabhu A Burji. Echocardiographic Evaluation of Diastolic Dysfunction in Asymptomatic Type 2 Diabetes Mellitus. *JAPI*. 2012; 60:23-26.
  14. Vittal D, Babu M. Prevalence of left ventricular diastolic dysfunction among patients with asymptomatic diabetes mellitus type 2. *International Journal of Advances in Medicine* 2019. 10.18203/2349-3933.ijam20193103.
  15. Ashraf S, Basir F. Association of hypertension and diastolic dysfunction with type-2 diabetes mellitus. *Pakistan Journal of Medical Sciences* 2007; 23:344-348.
  16. Kumar VS, Sreelatha M, Ramesh K, Shekar GC. Study of Left Ventricular Diastolic Dysfunction in Type 2 Diabetes Mellitus Patients. *Int J Sci Stud* 2017; 5:219-224.
  17. Senthil N, Vengadkrishnan K, Vankineni SS, Sujatha S. Diastolic Dysfunction in Young Asymptomatic Diabetics Patients. *Int J Sci Stud*. 2015; 3:226-229.
  18. Mishra TK, Rath PK, Mohanty NK, Mishra SK. Left ventricular systolic and diastolic dysfunction and their relationship with microvascular complications in normotensive, asymptomatic patients with type 2 diabetes mellitus. *Indian Heart J*. 2008; 60:548-53.
  19. Masugata H, Senda S, Goda F, Yoshihara Y, Yoshikawa K, Fujita N, et al. Left ventricular diastolic dysfunction in normotensive diabetic patients in various age strata. *Diabetes Res Clin Pract*. 2008; 79:91-6.
  20. Hameedullah, Faheem M, Bahadar S, Hafizullah M, Najeeb S. Effect of glycaemic status on left ventricular diastolic function in normotensive type 2 diabetic patients. *J Ayub Med Coll Abbottabad*. 2009; 21:139-44.

**Source of Support:** Nil; **Conflict of Interest:** None

**Submitted:** 29-02-2022; **Accepted:** 28-03-2023; **Published:** 30-04-2023