

# Correlation of Left Ventricular Dysfunction and Diabetes in Normotensive Patients

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## ABSTRACT

**Introduction:** Over the last three decades, number of epidemiological, clinical and autopsy studies had proposed the presence of diabetic heart disease as a distinct clinical entity. Diastolic heart failure (HF) is also referred to as HF, with preserved left ventricular (LV) systolic function. The present study was being undertaken to determine the effect of DM on LV filling in normotensive adults and to assess the morbidity and mortality.

**Material and methods:** An observational cross-sectional study conducted in asymptomatic, normotensive type 2 diabetes mellitus patients for monitoring left ventricular function at Rohilkhand Medical College and Hospital, Bareilly. Total 49 patients were included in study and evaluated for the left ventricular function. Details of patients such as socio-demographic profile, history of habit, routine blood investigation, Echocardiographic evaluation of heart, and other medical history were collected.

**Results:** Among diastolic LV dysfunction patients, 52.1% had HbA1c between 6.5–10 and 47.9% had HbA1c >10, while Systolic LV dysfunction patients, 52.6% had HbA1c between 6.5 – 10 and 47.4% had HbA1c >10.

**Conclusion:** The relationship of LV dysfunction type with HbA1c level was statistically non-significant ( $p > 0.05$ ).

**Keywords:** Left Ventricular Dysfunction, Diabetes, Normotensive Patients

DM was one of the major risk factors for diastolic HF. The mortality rates among the patients with diastolic HF ranges from 5-8% annually as compared with 10-15% among patients with systolic HF.

Furthermore, the relationship of glucose control to LV diastolic filling in DM has not been well defined. The relationship between the clinical features of diabetes and LV function are linear. Knowledge of abnormalities of cardiac function in the preclinical phase will aid in understanding the disease and its prognosis<sup>4</sup>

The present study was undertaken to determine the effect of DM on LV filling in normotensive adults and to assess the morbidity and mortality and to correlate left ventricular dysfunction and diabetes in normotensive patients

## MATERIAL AND METHODS

The study was conducted in the department of medicine in Rohilkhand Medical College and Hospital, Bareilly

This was an observation cross sectional, non-randomized hospital based study. Conducted at Department of General Medicine RMCH, Bareilly with Convenient sampling method. 49 patients from duration of Nov 2017-Oct 2018 with DM type 2, were enrolled in this study. All patients were normotensive without evidence of heart failure, coronary artery disease, thyroid or overt renal disease and with normal ECG thoracic x-ray. All patients underwent Doppler echocardiography by a single experience cardiologist. The diagnosis of LVDD has been according to the criteria of Heart Failure and Echocardiography Associations of the

## INTRODUCTION

Over the last three decades, number of epidemiological, clinical and autopsy studies had proposed the presence of diabetic heart disease as a distinct clinical entity. Diastolic heart failure (HF) is also referred to as HF, with preserved left ventricular (LV) systolic function. Many studies had reported that the incidence of HF in diabetic subjects was high even in the absence of hypertension and coronary artery disease. Studies had reported high prevalence of pre-clinical diastolic dysfunction among subjects with DM.<sup>1</sup> Studies using Doppler echocardiography had confirmed the findings of abnormal diastolic function as an early indicator of cardiac involvement in asymptomatic patients with Type 1 or Type 2 DM.<sup>2</sup>

Diabetic subjects have been reported to develop congestive HF in the absence of coronary heart diseases, hypertension or any known structural heart disease<sup>3</sup> Patients with signs and symptoms of HF with preserved LV systolic function i.e., ejection fraction of 60% were said to have diastolic HF.

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**How to cite this article:** Anubhav Gupta, Yadav Akhilesh Jawaharlal, Rajiv Ratna Chaudhary, Sarda Mukund Shyam, Rakesh Kumar. Correlation of left ventricular dysfunction and diabetes in normotensive patients. International Journal of Contemporary Medical Research 2020;7(8):H23-H26.

**DOI:** <http://dx.doi.org/10.21276/ijcmr.2020.7.8.30>



European Society of Cardiology.

**Inclusion Criteria:** -All patients of:

1. Age more than 19 years, both males and females
2. Normotensive asymptomatic diabetic patient (diagnosed as per ADA guidelines, 2017)
  - a. HbA1C more than or equal to 6.5%
  - b. Fasting plasma glucose more than 126 mg/dl. Fasting is defined as no caloric intake for at least 8 hours.
  - c. 2 hour plasma glucose more than 200 mg/dl during Oral glucose test.
  - d. In a patient with classic symptom of hyperglycemia or hyperglycemic crisis, a random plasma glucose more than 200 mg/dl.

**Exclusion criteria:** - Patients with

1. Age less than 19 years, both males and females
2. Hypertensive patient
3. Patient with symptom of congestive heart failure & coronary artery disease
4. Patient with Chronic Kidney Disease and anemia
5. Patient on drug therapy with drugs known to cause

cardiomyopathy (e.g. Daunorubicin, Bleomycin, Adriamycin etc.)

6. Patient of autonomic neuropathy
7. Patient associated with any comorbid condition (Chronic liver disease, Malignancy, any thyroid therapy)

A comprehensive history and examination (including fundus examination) was conducted by the principal investigator and the following investigations was performed and systematically documented.

1. Hemoglobin
2. Weight
3. BMI
4. BP
5. Fasting blood sugar
6. Post prandial blood sugar
7. Echocardiography

## RESULTS

An observational cross-sectional study conducted in asymptomatic, normotensive type 2 diabetes mellitus patients for monitoring left ventricular function at Rohilkhand Medical College and Hospital, Bareilly. Total 49 patients were included in study and evaluated for the left ventricular function. Details of patients such as socio-demographic profile, history of habit, routine blood investigation, Echocardiographic evaluation of heart, and other medical history were collected. All the data were entered into Microsoft excel spreadsheet and analyzed with the help of SPSS software version 20.0. Analyzed results of the current study were mentioned below.

In current study, mean age of the patients  $54.67 \pm 11.6$  years with minimum 30 years and maximum 75 years. More than one-thirds of the patients (34.7%) were 50 – 59 years old, followed by 60 – 69 years old (26.5%), 40 – 49 years old (16.3%),  $\geq 70$  years old (14.3%) and 30 – 39 years old (8.2%). As shown in table number 1

In current study, more than half of the patients (53.1%) were females (n=26) with male – female ratio of 1: 1.13 (table no.2).

As shown in table number 3, more than three fifth of the patients (61.2%) had Left ventricular ejection fraction (LVEF) in normal range (52% to 72%). However, 16.3% patients had mild abnormal LVEF (41% - 51%), 12.2% patients had moderate abnormal LVEF (30% - 40%) and 10.2% patients had severely abnormal LVEF (<30%).

Only 2% patients (table number 4) had normal diastolic function ( $0.75 < \text{Mitral E/A ratio} < 1.5$  &  $\text{DT} < 220$  msec). However, 79.6% patients had mild diastolic dysfunction ( $\text{EA} \leq 0.75$  &  $\text{DT} > 220$  msec), 14.3% had moderate diastolic

Age group (Years)	No. of patients	Percentage
30 – 39	4	8.2
40 – 49	8	16.3
50 – 59	17	34.7
60 – 69	13	26.5
$\geq 70$	7	14.3
Total	49	100.0

Mean  $\pm$  SD:  $54.67 \pm 11.6$  years, Minimum 30 years & maximum 75 years

**Table-1:** Age wise distribution of all patients

Gender	No. of patients	Percentage
Male	23	46.9
Female	26	53.1
Total	49	100.0

**Table-2:** Gender wise distribution of all patients

Left Ventricular Ejection Fraction (LVEF)	No. of patients	Percentage
Normal range (52% - 72%)	30	61.2
Mild abnormal (41% - 51%)	8	16.3
Moderate abnormal (30% - 40%)	6	12.2
Severe abnormal (< 30%)	5	10.2
Total	49	100.0

**Table-3:** Distribution of all patients based on LVEF

Diastolic Dysfunction	Mitral E/A ratio	Deceleration time (DT) (MSEC)	No. of patients	Percent
Normal function	$0.75 < \text{E/A} < 1.5$	$< 220$	1	2.0
Mild Dysfunction	$\text{EA} \leq 0.75$	$> 220$	39	79.6
Moderate Dysfunction	$0.75 < \text{E/A} < 1.5$	150 – 200	7	14.3
Severe Dysfunction	$\text{E/A} \geq 1.5$	$< 150$	2	4.1
Total			49	100.0

**Table-4:** Distribution of all patients based on Diastolic dysfunction

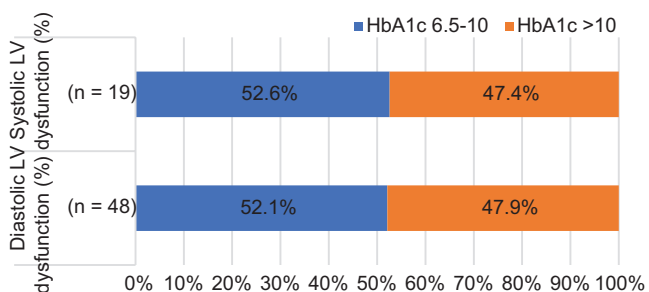
HbA1c level	LV dysfunction type	
	Diastolic (%)	Systolic (%)
6.5 – 10	25 (52.1)	10 (52.6)
> 10	23 (47.9)	9 (47.4)
Total	48 (100.0)	19 (100.0)

Chi square test = 0.002, df = 1, p value = 0.968

**Table-5:** Distribution of patients based on HbA1c level & LV dysfunction type

No	Study	Place	Year	No of patient	Mean Age (Years)	M:F ratio	LV dysfunction		Duration DM
							Sys	Dia	
1	Current study	UP, India	2019	49	54.7±11.6	1:1.13	38%	98%	6.3 y
2	Patil et al <sup>6</sup>	Maharashtra, India	2011	127	–	1.2:1	-	55.3%	>5 y
3	Chaudhary et al <sup>7</sup>	UP, India	2015	100	50.1±6.32	1.9:1	-	41%	-
4	Exiara et al <sup>8</sup>	Greece	2010	114	44 ± 8.2	1:1.4	-	63.2%	-
5	Poulsen et al <sup>9</sup>	Denmark	2010	305	58.6±11.3	1.2:1	9%	40%	4.5 y
6	Aigbe et al <sup>10</sup>	Nigeria	2012	150	55.4±11.6	1:1.3	-	72%	4.5 y
7	Dodiya-Manuel et al <sup>11</sup>	Nigeria	2013	90	50.8±9.1	1:1.3	15.6%	57.8%	3.4 y

**Table-7:** Comparison of current study with various other studies



**Chart-1:** Distribution of patients based on HbA1c level and LV dysfunction type

dysfunction ( $0.75 < E/A \text{ ratio} < 1.5$  &  $DT \text{ } 150 - 200 \text{ msec}$ ) and 4.1% patients had severe diastolic dysfunction ( $E/A \text{ ratio} \geq 1.5$  &  $DT < 150 \text{ msec}$ ).

Among patients with Diastolic LV dysfunction ( $n=48$ ), more than half of the patients (52.1%) had HbA1c level 6.5 – 10 and remaining 47.9% had HbA1c level >10. Among patients with Systolic LV dysfunction ( $n=19$ ) also, more than half of the patients (52.6%) had HbA1c level 6.5 – 10 and remaining 47.4% had HbA1c level >10. By applying chi square test the relationship of HbA1c level and type of LV dysfunction was statistically non-significant ( $p > 0.05$ ) (table-5, chart-1).

## DISCUSSION

Type 2 diabetes mellitus (T2DM) related with higher risk of heart failure (HF) and death. The risk of cardiovascular complications was 2 to 2½ times greater in people with T2DM compared with the non-diabetic population<sup>5</sup> Current observational cross-sectional study conducted on 49 asymptomatic, normotensive type 2 diabetes mellitus (T2DM) patients for monitoring left ventricular function at Rohilkhand Medical College and Hospital, Bareilly. In Maharashtra, India, Patil et al<sup>6</sup> conducted prospective case control study for monitoring the incidence of diastolic dysfunction in 127 diabetes patients and comparing its relation to age, duration of DM, Glycosylated hemoglobin (HbA1c) levels, obesity indices and diabetic microangiopathies among 100 healthy subjects. In Orissa, Mishra et al<sup>7</sup> In current study, mean age

of the patients  $54.67 \pm 11.6$  years (range 30 – 75 years). Majority of the patients were 50 – 59 years old (34.7%) and 60 – 69 years old (26.5%). Similar mean age was found in a study conducted by Aigbe et al.<sup>10</sup>

Previous studies had found higher prevalence of pre-clinical diastolic dysfunction among diabetic patients.<sup>1</sup> DM was one of the major risk factors for diastolic HF. The evidence suggests that myocardial damage in diabetic patients affects diastolic function before the systolic function. LVDD characterizes the 1<sup>st</sup> stage of diabetic cardiomyopathy and earlier changes in systolic function occurs

In this study, 61.2% patients had LVEF in normal range (52% to 72%), 16.3% had mild abnormal LVEF (41% - 51%), 12.2% patients had moderate abnormal LVEF (30% - 40%) and 10.2% patients had severely abnormal LVEF (<30%). In this study among males, majority of the patients 39.1% had abnormal LVEF, while among females, 38.5% patients had abnormal LVEF. Among <50 years old patients, 16.7% had abnormal LVEF, among 50 – 69 years old patients 46.7% had abnormal LVEF and among  $\geq 70$  years olds 42.9% had abnormal LVEF. The relationship of age group and gender with LVEF was found to be statistically non-significant ( $p > 0.05$ ).

Mishra et al<sup>12</sup> had found that T2DM patients had a lower EF ( $54 \pm 10.8\%$ ) comparing to controls ( $67 \pm 6.1\%$ ,  $p < 0.05$ ), lower E-velocity ( $50.1 \pm 10.6 \text{ cm/s}$ ) comparing to controls ( $58.4 \pm 6.3 \text{ cm/s}$ ,  $p < 0.05$ ). Dodiya-Manuel et al<sup>60</sup> had found a significant reduction in mean LVEF in diabetics (62.2%) comparing to controls (68.5%,  $p < 0.001$ ), though among patients mean EF was normal ( $62.4\% \pm 8.47\%$ ) but significantly lower comparing to controls ( $68.52\% \pm 7.94\%$ ,  $p < 0.001$ ).<sup>11</sup>

## CONCLUSION

Current observational cross-sectional study in normotensive T2DM patients had found 38.8% patients had abnormal LVEF. However, relation of age and gender with LVEF was statistically non-significant ( $p > 0.05$ ). Diastolic dysfunction

was found in 98% patients, while the relationship of age group and gender with diastolic dysfunction was statistically non-significant ( $p > 0.05$ ). LVID<sub>(s)</sub> and LVID<sub>(d)</sub> both were abnormal in 10.2%, while LVID<sub>(s)</sub> was separately abnormal in 10.2% and LVID<sub>(d)</sub> was separately abnormal in 10.2%.

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

**Submitted:** 12-06-2020; **Accepted:** 30-07-2020; **Published:** 31-08-2020