

To Evaluate Diastolic Dysfunction and Left Ventricular Mass in Asymptomatic Normotensive ATYPE 2 Diabetes Mellitus

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Received: 08-12-2025 / Revised: 07-01-2026 / Accepted: 11-02-2026

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Conflict of interest: Nil

Abstract:

Background and Objectives: The world today is witnessing an epidemic of diabetes mellitus. Globally and nationally, diabetes and its complications have become the most important contemporary and challenging health problem. It is estimated that there will be more than 200 million diabetics in the world within the next 10 years. India has already become the diabetes capital of the world with over 30 million affected patients that is alarmingly just a tip of the iceberg and is expected to touch the 69.9 million marks in 2025. To evaluate Diastolic Dysfunction in asymptomatic normotensive Type 2 Diabetes Mellitus. To study left ventricular mass in asymptomatic normotensive Type 2 Diabetes Mellitus.

Material and Methods: Study will be conducted in outpatient department of VMMC and Safdarjung Hospital. Cross sectional observational study. A total of 100 subjects, 50 Diabetic normotensive patient and 50 non-diabetic healthy individuals satisfying the inclusion and exclusion criteria were included in this study.

Conclusion: In our study diastolic dysfunction and LVM was present in 56% and 48% respectively in asymptomatic normotensive type 2 DM subjects. Asymptomatic normotensive type 2 DM had significantly high prevalence of diastolic dysfunction and left ventricular mass as compared to healthy subjects. LV diastolic dysfunction and left ventricular mass were correlated with the age, gender, HbA1c, duration of diabetes, BMI, smoking, dyslipidemia. After univariate analysis of various risk factors for diastolic dysfunction it was found that poor glycemic control (HbA1c), duration of diabetes, smoking, dyslipidemia was significantly associated with diastolic dysfunction ($P < 0.05$) whereas age, gender, BMI were not significantly associated with diastolic dysfunction ($P > 0.05$).

Keywords: HbA1c, diabetes, smoking, dyslipidemia, LVM.

DOI: 10.25258/ijcpr.18.2.66

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Introduction

The world today is witnessing an epidemic of diabetes mellitus. Globally and nationally, diabetes and its complications have become the most important contemporary and challenging health problem. It is estimated that there will be more than 200 million diabetics in the world within the next 10 years. India has already become the diabetes capital of the world with over 30 million affected patients that is alarmingly just a tip of the iceberg and is expected to touch the 69.9 million marks in 2025. It is associated with a multitude of cardiovascular complications. Clinical, epidemiological and pathological studies attribute the increased occurrence of clinical congestive heart failure in diabetic subjects to diabetic cardiomyopathy, which could take the form of diastolic and/or systolic left ventricular dysfunction. Left ventricular diastolic dysfunction may represent the reversible first stage of diabetic cardiomyopathy reinforcing the

importance of early examination of diastolic ventricular function in individuals with diabetes.

The Framingham Heart Study revealed marked increase in peripheral arterial disease, congestive heart failure, coronary artery disease, myocardial infarction and sudden death (The risk increases from 1 to 5-fold) in diabetics. The American Heart Association recently designated DM as a major risk factor for cardiovascular disease along with other major risk factors (smoking, hypertension and hyperlipidemia). Myocardial involvement in diabetes may occur relatively early in the course of the disease, initially impairing the diastolic relaxation and when more extensive resulting in decreased myocardial contraction. Prior to the development of symptomatic CHF sub-clinical LV dysfunction (systolic and diastolic) does exist for some time. Further, increased LV mass has been

documented in Type 2 Diabetes even in normotensive individuals at an early stage. LVH is an ominous prognostic sign and independent risk factor for further cardiac events and hence identification of this subset of patients would enable early interventional strategies that could decrease the incidence of cardiac events. There have been few studies that have evaluated the development of systolic and diastolic LV dysfunction and LV mass in Type 2DM patients, who are normotensive and have no cardiac symptoms.

Material and Methods

Study set up: Study will be conducted in outpatient department of VMMC and Safdarjung Hospital.

JNC 8 Recommendations Patient subgroup	Target SBP (mm Hg)	Target DBP (mm Hg)
≥60 years	<150	<90
<60 years	<140	<90
>18 years with CKD	<140	<90
>18 years with Diabetes	<140	<90
(CKD=Chronic Kidney	Disease, DBP=Diastolic	Pressure, SBP=Systolic Blood
	Blood	

Exclusion Criteria

- Coronary artery disease diagnosed by symptoms, ECG or regional wall motion abnormality on Echocardiogram.
- Congestive cardiac failure diagnosed by signs and symptoms, chest radiograph and Echocardiography.
- Heart rate <50 or >100 per minute, primary AV block, atrial fibrillation or any other cardiac arrhythmia diagnosed by clinical examination and electrocardiogram as they would interfere with doppler studies.
- Thyroid Disorder.
- This cross-sectional study was conducted in VMMC and Safdarjung Hospital New Delhi over a period of eighteen month. The study was comprised of a total of 100 subjects of which 50 are Type 2 Diabetes mellitus, normotensive and 50 Non-Diabetic individual fulfilling inclusion and exclusion criteria.
- All cases were subjected to a detailed history and physical examination after taking written consent.
 - Age and sex
 - Detailed present history and relevant past history.
 - History of smoking, any drug intake.
 - Height (in meter) and weight(kg).
 - Body mass index (BMI) in kg/.

Diabetes Mellitus: ADA criteria 2014 for diagnosis of diabetes are [12]

Study design: Cross sectional observational study. Study duration is Two years.

Sample size: A total of 100 subjects, 50 Diabetic normotensive patient and 50 Non-Diabetic healthy individual satisfying the inclusion and exclusion criteria were included in this study.

Inclusion criteria

- All patients already diagnosed as Type 2 Diabetes Mellitus.
- Normal blood pressure as per JNC 8 guidelines.

HbA1C>6.5%*FPG>126mg/dL (7.0 mmol/L)* (fasting defined as no caloric intake for 8 hrs) or 2-hr PG>200mg/dL(11.1mmol/L) during OGTT (75 gm) * Or Random PG>200mg/dL(11.1mmol/L) (in person with symptoms of hyperglycemia or hypoglycemic crisis)

- In absence of unequivocal hyperglycemia, result confirmed by repeat test.

Statistical Analysis: Categorical variables were presented in number and percentage (%) and continuous variables were presented as mean ± SD and median. Normality of data was tested by Kolmogorov- Smirnov test. If the normality was rejected then non parametric test was used.

Results

The study conducted, was a single centre case - control study. The patients were enrolled after taking informed consent from the patients or family member. 50 cases of normotensive type 2 DM with age between 40-65 years were recruited into the study after satisfying inclusion & exclusion criteria during a span of period from Nov 2014 to Apr 2016. 50 controls of age group 40-65 years fulfilling exclusion criteria were taken as control. The study sample were recruited from those patients attending Safdarjung hospital aimed at to determine the frequency of DD and LVM in asymptomatic normotensive type 2 DM.

Table 1: Mean age distribution

Age	Case(n=50)	Control(n=50)	P value
Mean ± SD	53.34 ±6.84	54.08 ±6.62	0.557
Median	52	55	
Min-Max	41-67	42-67	
Inter quartile Range	49-60	48-60	

Table 2: Age Distribution

		Group		Total	P value
		Case	Control		
Age Distribution (in year)	1) 40-49	13(26%)	15(30%)	28(100%)	0.679
	2) 50-59	23(46%)	22(44%)	45 (100%)	
	3) >=60	14(28%)	13(26%)	27 (100%)	
Total	50(100%)	50 (100%)	100 (100%)		

Age Distribution: In case group maximum patients are between age of 50-59 years (comprises 46%) followed by age group 60-69 year (comprises 28%).

In control group maximum patients are between age group 50-59 year (comprises 44%). There is no significant difference between cases and controls.

Table 3: Case

	Case	Control	Total
Female	20(40.00%)	19(38.00%)	39(39.00%)
Male	30(60.00%)	31(62.00%)	61(61.00%)
Total	50(100.00%)	50(100.00%)	(100)100.00%

Table 4: Prevalence of LVM among Cases and Controls

		Group		Total	P value
		Cases	Controls		
LVM	Absent	26(44%)	45(94%)	71(71%)	<0.001
	Present	24(56%)	5(6%)	29(29%)	
Total		50(100%)	50(100%)	100(100%)	

Table 5: Relation between DD and Dyslipidemia

		Diastolic dysfunction		Total	P value
		Absent	Present		
Dyslipidemia	Absent	13 (72.22%)	5 (27.78%)	18 (100.00%)	0.003
	Present	9 (28.13%)	23 (71.88%)	32 (100.00%)	
Total		22 (44.00%)	28 (56.00%)	50 (100.00%)	

Diastolic Dysfunction was present in 23(71.88%) out of 32 Dyslipidemic and absent in 9(28.13%) out of 32 dyslipidemic. Among cases who were not

dyslipidemic DD was present in 5(27.78%) out of 18 cases. This distribution of DD among dyslipidemic was significant (P value 0.003)

Table 6: Relation between LVM and Dyslipidemia

		LVM		Total	P value
		Absent	Present		
Dyslipidemia	Absent	16 (88.89%)	2 (11.11%)	18 (100.00%)	0.0001
	Present	10 (31.25%)	22 (68.75%)	32 (100.00%)	
Total		26 (52.00%)	24 (48.00%)	50 (100.00%)	

LVM was present in 22(68.75%) out of 32 Dyslipidemic and absent in 10(31.25%) out of 32 dyslipidemic. Among cases who were not dyslipidemic LVM was present in 2(11.11%) out of 18 cases. This distribution of abnormal LVM among dyslipidemic was significant (P value 0.001)

The incidence of diabetes mellitus DM is increasing worldwide and rapidly assuming epidemic proportions. A number of epidemiological, clinical and autopsy studies have proposed the presence of diabetic heart disease and is being proposed as a distinct clinical entity. Studies have reported a high prevalence of pre-clinical diastolic dysfunction among subjects with DM. The evidence indicates that myocardial damage in diabetic subjects affects

Discussion

diastolic function before the systolic function. So far, very few population-based studies have been carried out in India, to demonstrate the prevalence of diastolic dysfunction and left ventricular mass in diabetic subjects in the Indian patients. The objective of our study was to determine whether there is any association between diastolic dysfunction, left ventricular mass and type 2DM, even in the asymptomatic subjects.

This study was conducted to evaluate diastolic dysfunction and left ventricular mass in 50 asymptomatic normotensive type 2 diabetes mellitus. Mean age of the cases were 53.34 years and of controls were 54.08 years, median age of cases were 52 years and of controls were 55 years. In case group maximum patients were between age of 50-59 years (46%) followed by age group ≥ 60 years (28%). In control group maximum patients were between age of 50-59 years (44%) followed by age group ≥ 60 years (44%). There was no significant difference in age distribution among case and control. Out of 50 cases of type 2 diabetes mellitus, majority of the cases were males (60%). Out of 50 controls 62% were males. There was no significant difference of gender distribution among cases and controls. Our study shows that 28 (56%) subjects from the case group had diastolic dysfunction, and 3(6%) amongst control group showed the diastolic dysfunction. Diastolic dysfunction in type 2 diabetic subjects was significantly higher as compared to the control group ($P < 0.001$).

We compared our result with various studies and found to be almost similar with the studies done by Rajesh Rajput et al, Siddiq Ibrahim Khalil et al, Hamedullah et al, Virendra C Patil et al, G Anitha et al. Our study showed dissimilar result when compared with the result of Dike ojji et al who found in their case control study of 122 individuals with type 2 DM found that diastolic dysfunction was present in 71% of cases which is higher than the present study. This may be due to mean age of cases in previous study was 55.30 ± 8.53 as compared to this study having mean age of 53.34 ± 6.84 . Our study also showed dissimilar result when compared with Mamatha B Patil et al who in their study on 50 cases of normotensive type 2 DM found that 64% had diastolic dysfunction. In our study 56% had diastolic dysfunction, this is due to that 6% cases in previous study were more than 70-year-old. Our study also showed dissimilar result when compared with Abhay kumar chaudhary et al who in their study on 100 cases of newly diagnosed DM found that 41% had diastolic dysfunction which in comparison to our study had lower prevalence, this is because in previous study cases were newly diagnosed (duration of diabetes is less than 1 month). Our study also showed dissimilar result when compared with Archana Gupta et al who in their study on 100 cases of normotensive type 2 DM found that 68% had

diastolic dysfunction which in comparison to our study had higher prevalence, this is because 73% cases had their HbA1c $> 7.5\%$ in previous study as compared to this study having HbA1c $> 7.5\%$ in only 62% cases.

Total 24 (48%) subjects from the case group had abnormal LVM, and 5(10%) amongst control group had abnormal LVM. Left ventricular mass in type 2 diabetic subjects was significantly higher as compared to the control group ($P < 0.001$).

We compared our result with various studies and found almost similar with the studies done by Sukamal Santra et al and Mohamed kamal et al who found in their study the prevalence of abnormal LVM among normotensive type 2 diabetes mellitus was 53% and 50% respectively. The diastolic dysfunction and LVM is the earliest manifestation of diabetic cardiomyopathy and hence, detecting and treating it in early stages would prevent disease progression to symptomatic cardiac failure. It is therefore recommended that all patients of type 2 DM should be subjected to 2D-guided M-mode echocardiography periodically for early detection of DD and abnormal LVM in order to decrease morbidity and mortality of diabetic patients.

Conclusion

In our study diastolic dysfunction and LVM was present in 56% and 48% respectively in asymptomatic normotensive type 2 DM subjects. Asymptomatic normotensive type 2 DM had significantly high prevalence of diastolic dysfunction and left ventricular mass as compared to healthy subjects. LV diastolic dysfunction and left ventricular mass were correlated with the age, gender, HbA1c, duration of diabetes, BMI, smoking, dyslipidemia. After univariate analysis of various risk factors for diastolic dysfunction it was found that poor glycemic control (HbA1c), duration of diabetes, smoking, dyslipidemia were significantly associated with diastolic dysfunction ($P < 0.05$) whereas age, gender, BMI were not significantly associated with diastolic dysfunction ($P > 0.05$). After univariate analysis of various risk factors for left ventricular mass it was found that age, duration of diabetes, poor glycemic control (HbA1c), BMI, smoker, dyslipidemia was significantly associated with left ventricular mass ($P < 0.05$) whereas gender was not significantly associated with left ventricular mass ($P > 0.05$).

References

1. Mohan V, Sandeep S, Deepa R, Shah B, Varghese C. Epidemiology of type 2 diabetes: Indian scenario. *Indian J Med Res.* 2007 Mar;125(3):217-30.
2. Zarich SW, Nesto RW. Diabetic cardiomyopathy. *Am Heart J.* 1989 Nov;118(5 Pt 1):1000-12.

3. Raev DC. Which left ventricular function is impaired earlier in the evolution of diabetic cardiomyopathy? An echocardiographic study of young type I diabetic patients. *Diabetes Care*. 1994 Jul;17(7):633-9.
4. Cosson S, Kevorkian JP. Left ventricular diastolic dysfunction: an early sign of diabetic cardiomyopathy? *Diabetes Metab*. 2003 Nov;29(5):455-66.
5. Zarich SW, Nesto RW. Diabetic cardiomyopathy. *Am Heart J*. 2001; 35:166-8.
6. Plouin PF. The importance of diabetes as a cardiovascular risk factor. *Int J Clin Pract Suppl*. 2000 May;(110):3-8.
7. Danbauchi SS, Anumah FE, Alhassan MA, David SO, Onyemelukwe GC, Oyati IA. Left ventricular function in type 2 diabetes patients without cardiac symptoms in Zaria, Nigeria. *Ethn Dis*. 2005 Autumn;15(4):635-40.
8. Dawson A, Morris AD, Struthers AD. The epidemiology of left ventricular hypertrophy in type 2 diabetes mellitus. *Diabetologia*. 2005 Oct;48(10):1971-9.
9. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care*. 2007 Jan;30 Suppl 1:S42-7
10. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care*. 2004 May;27(5):1047-53.
11. Savage DD, Levy D, Dannenberg AL, Garrison RJ, Castelli WP. Association of echocardiographic left ventricular mass with body size, blood pressure and physical activity (the Framingham Study). *Am J Cardiol*. 1990 Feb 1;65(5):371-6.
12. Jullien V, Gosse P, Ansoborlo P, Lemetayer P, Clementy J. Relationship between left ventricular mass and serum cholesterol level in the untreated hypertensive. *J Hypertens*. 1998 Jul;16(7):1043-7.
13. Bella JN, Devereux RB, Roman MJ, O'Grady MJ, Welty TK, Lee ET, Fabsitz RR, Howard BV. Relations of left ventricular mass to fat-free and adipose body mass: the strong heart study. The Strong Heart Study Investigators. *Circulation*. 1998 Dec 8;98(23):2538-44.