Original Article

Prevalence and Correlation of Cardiomyopathy in Type 2 Diabetes Mellitus Patients in South Rajasthan: A Prospective Observational Study

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Abstract

Background: Diabetes mellitus (DM) is a leading cause of cardiovascular morbidity and mortality worldwide. Among its cardiovascular complications, diabetic cardiomyopathy (DCM) is a distinct myocardial dysfunction occurring in diabetic patients without underlying coronary artery disease or hypertension. It manifests initially as diastolic dysfunction and progresses to heart failure if left undiagnosed and untreated. However, its early-stage detection remains a challenge due to the asymptomatic nature of the disease. This study aimed to determine the prevalence of DCM in Type 2 diabetes mellitus (T2DM) patients and evaluate its correlation with diabetes duration, lipid profile, and body mass index (BMI) in a tertiary care hospital in Rajasthan, India.

Methods: A prospective observational study was conducted at Maharana Bhupal Government Hospital, Udaipur, affiliated with R.N.T. Medical College, Rajasthan, involving 75 T2DM patients who underwent echocardiographic evaluation. Inclusion criteria included diagnosed cases of T2DM per ADA (2014) guidelines. Patients with ischemic heart disease, hypertension, and valvular heart disease were excluded. Echocardiography, lipid profile, HbA1c, and BMI were analysed to assess the prevalence and risk factors associated with DCM. Statistical analysis was performed using Microsoft excel, and results were interpreted using chi-square and t-tests.

Conclusion: The prevalence of DCM was 60%, with diastolic dysfunction as the predominant finding (75.5%). Significant associations were observed with higher BMI ($p < 0.0001$), HbA1c levels ($p < 0.0001$), and dyslipidaemia ($p < 0.05$). The findings suggest that routine echocardiographic screening in asymptomatic diabetic patients is essential to identify and manage DCM early, preventing progression to heart failure and reducing mortality.

Keywords: Diabetic cardiomyopathy, Type 2 diabetes mellitus, Echocardiography, Diastolic dysfunction, Cardiovascular complications.

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Introduction

Diabetes mellitus (DM) is a rapidly growing global health concern, affecting millions worldwide. According to the International Diabetes Federation (IDF) 2021, approximately 537 million adults are living with diabetes, and this number is expected to reach 783 million by 2045. India, often referred to as the diabetes capital of the world, accounts for 77 million diabetics, placing it among the top three countries with the highest diabetes prevalence[1].

The primary cause of diabetes-related morbidity and mortality is cardiovascular disease (CVD), which accounts for nearly 50% of deaths in diabetic patients[2]. Among the various cardiac complications of diabetes, diabetic cardiomyopathy (DCM) is a unique yet frequently overlooked entity. DCM is defined as structural and functional myocardial impairment in diabetic patients in the absence of hypertension, coronary artery disease (CAD), or valvular heart disease[3]. The condition is progressive, beginning with subclinical diastolic dysfunction before advancing to systolic dysfunction and heart failure. DCM is a significant but often underdiagnosed complication of diabetes mellitus (DM). Studies estimate that approximately 12–30% of diabetic patients develop some degree of DCM, with variations depending on diagnostic criteria and population characteristics. The prevalence is higher in type 2 diabetes mellitus (T2DM) due to the combined effects of insulin resistance, hyperglycaemia, and associated metabolic derangements. Women with diabetes appear to be at a higher relative risk of developing heart failure compared to men. Additionally, DCM contributes substantially to the increased risk of heart failure in diabetic patients, with diabetics having a two- to fivefold higher risk of heart failure compared to non-diabetics. The condition is more prevalent in older adults, those with longer diabetes duration, poor glycaemic control, and coexisting obesity.

The pathogenesis of DCM is multifactorial, involving chronic hyperglycaemia, insulin resistance, oxidative stress, microvascular dysfunction, autonomic neuropathy, and metabolic disturbances[4]. Persistent hyperglycaemia leads to increased myocardial fibrosis, left ventricular hypertrophy (LVH), and reduced myocardial compliance, which impairs diastolic filling[5]. Key risk factors associated with DCM include: Poor glycaemic control (high HbA1c)[6]; Obesity (high BMI)[7]; Dyslipidaemia (elevated triglycerides and total cholesterol)[8]; Duration of diabetes (longer duration associated with increased risk)[9]

Despite increasing recognition, DCM often remains undiagnosed in its early stages because many patients are asymptomatic until they develop heart failure. Echocardiography is the gold standard for early detection, enabling clinicians to identify myocardial dysfunction before the onset of overt clinical symptoms[10].

Given the high burden of diabetes in India and the limited awareness of DCM, this study was conducted to determine the prevalence of DCM in T2DM patients in Rajasthan and analyse its correlation with BMI, lipid profile, and diabetes duration.

Materials & Methods

This prospective observational study was conducted over 12 months (January 2017 - December 2017) at Maharana Bhupal Government Hospital, Udaipur, a tertiary care centre affiliated with R.N.T. Medical College, Udaipur, Rajasthan. The sample size was calculated using power analysis to detect a significant difference in the prevalence of diabetic cardiomyopathy (DCM) between the general population (18%) and Type 2 diabetes mellitus (T2DM) patients (38%), with 90% power and a significance level (α) of 0.01. Based on these parameters, the required sample size was determined to be 73 patients which was further enhanced to 75 for present study. A total of 75 patients with Type 2 diabetes mellitus (T2DM) were enrolled, based on American Diabetes Association (ADA 2014) criteria. Patients with coronary artery disease (CAD), hypertension, valvular heart disease, chronic kidney disease, chronic liver disease, or chronic respiratory illness were excluded to maintain the specificity of diabetic cardiomyopathy (DCM). Data collection included detailed clinical history, anthropometric measurements (BMI), and laboratory investigations (HbA1c, fasting blood sugar, and lipid profile). Echocardiography was performed to assess diastolic and systolic function, using mitral inflow E/A

ratio, deceleration time, left ventricular mass index (LVMI), and left ventricular ejection fraction (LVEF). The presence of diastolic dysfunction (isolated or combined with systolic dysfunction) was used to define DCM. Statistical analysis was performed using Microsoft excel, with continuous variables expressed as mean ± standard deviation (SD) and categorical data analysed using chi-square and t-tests. A p-value < 0.05 was considered statistically significant.

Result & Discussion

Table 1: Demographic and Clinical Characteristics

Group	n (%)
Diabetic Cardiomyopathy (DCM)	45 (60%)
Non-DCM	30 (40%)

Table 2: Demographic and Clinical Characteristics

Parameter	DCM (Mean±SD)	Non-DCM (Mean±SD)	p-value
Age (years)	60.1 ± 9.4	58.8 ± 7.1	NS
Male/Female	31/14	21/9	NS
BMI (kg/m²)	27.4 ± 3.9	25.9 ± 2.5	<0.0001
HbA1c (%)	8.5 ± 1.1	7.5 ± 0.8	<0.0001
FBS (mg/dL)	187.5 ± 28.4	159.4 ± 26.7	0.0001
Total Cholesterol (mg/dL)	176.3 ± 50.5	150.8 ± 27.1	<0.05
Triglycerides (mg/dL)	128.2 ± 47.8	106.9 ± 19.4	<0.05

The prevalence of DCM in our study was 60%, which is significantly higher than previous studies, such as Zabalgoitia et al. (2001)[9], which reported a 47% prevalence among normotensive, asymptomatic type 2 diabetics. Similarly, Boyer et al. (2004)[10] observed a 40–75% prevalence using Doppler echocardiography. Diastolic dysfunction was the most common abnormality detected, with 34 patients (75.5%) exhibiting isolated diastolic dysfunction. Systolic dysfunction was observed in 4 patients (8.8%), and both systolic and diastolic dysfunction were found in 7 patients (15.5%). This aligns with studies by Fang et al. (2003)[11] and Devereux et al. (2000)[12], which emphasized that diastolic dysfunction precedes systolic dysfunction in diabetes-related cardiomyopathy.

Table 3: Echocardiographic Parameters in DCM and Non-DCM Groups

Parameter	DCM (Mean±SD)	Non-DCM (Mean±SD)	p-value
LVMI (g/m²)	108.3 ± 33.0	88.4 ± 15.3	<0.001
Ejection Fraction (%)	58.1 ± 11.0	62.9 ± 3.9	<0.05

Our study found a significant increase in left ventricular mass index (LVMI) in DCM patients, which was consistent with the Strong Heart Study (2003)[13], which reported higher LVMI in diabetics compared to non-diabetics. The slightly reduced ejection fraction (EF) in DCM patients (58.1 ± 11.0%) suggests early impairment in systolic function, aligning with Bell et al. (2003)[14], who noted that systolic dysfunction in diabetics is often under recognized until overt heart failure develops.

Table 4: Correlations between Duration of Diabetes and DCM Risk

Duration of Diabetes (Years)	No. of DCM Patients (%)
< 3 years	6 (13.3%)
3-5 years	19 (42.2%)
6-10 years	13 (28.8%)
>10 years	7 (15.5%)

A higher prevalence of DCM was observed in patients with a diabetes duration of 3–5 years (42.2%), followed by 6–10 years (28.8%). This challenges the conventional assumption that DCM only develops after 10+ years of diabetes duration, as suggested by Attali et al. (1988)[15]. However, it aligns with Kiencke et al. (2010)[16], who found significant myocardial dysfunction in T2DM patients within the first five years of diagnosis.

Table 5: Correlations between Glycaemic Control (HbA1c) and DCM Risk

HbA1c Level (%)	DCM (Mean ± SD)	Non-DCM (Mean ± SD)	p- value
HbA1c (%)	8.5 ± 1.1	7.5 ± 0.8	<0.0001

A significantly higher HbA1c level was associated with DCM ($p < 0.0001$).This supports findings by Struthers et al. (2000)[17], who reported that for every 1% increase in HbA1c, the risk of heart failure increases by 8–10%. The Finnish Diabetic Cohort

Study (Soininen et al., 2018)[18] also found that HbA1c levels >8.0% doubled the risk of developing cardiac dysfunction.

Table 6: Obesity (BMI) and DCM Risk

BMI Range (kg/m²)	DCM (%)	Non- DCM (%)
< 25	9 (20%)	21 (70%)
25-29.9	22 (48.8%)	7 (23.3%)
≥ 30	14 (31.1%)	2 (6.7%)

Higher BMI was significantly associated with DCM ($p < 0.0001$). This supports studies by Galderisi et al. (1991)[19], who found that obesity was a strong predictor of diastolic dysfunction. Our findings also correlate with Karamitsos et al. (2007)[20], who reported that a BMI >30 kg/m² increases the risk of diastolic dysfunction by 2.1-fold.

Table 7: Lipid Profile and Cardiomyopathy Risk

Lipid Parameter	DCM (Mean ± SD)	Non-DCM (Mean ± SD)	p-value
Total Cholesterol (mg/dL)	176.3 ± 50.5	150.8 ± 27.1	<0.05
Triglycerides (mg/dL)	128.2 ± 47.8	106.9 ± 19.4	<0.05

Our study found that higher total cholesterol and triglyceride levels were significantly associated with DCM. This aligns with findings from Boyer et al. (2004)[10] and the Strong Heart Study (2003)[13], which established dyslipidaemia as an independent predictor of left ventricular hypertrophy in diabetics.

Conclusion

This study highlights the high prevalence (60%) of diabetic cardiomyopathy (DCM) in asymptomatic and symptomatic T2DM patients, with diastolic dysfunction being the most common abnormality (75.5%). Significant associations were observed between DCM and poor glycaemic control (HbA1c > 8.0%, $p < 0.0001$), obesity (BMI > 27 kg/m², $p < 0.0001$), and dyslipidaemia ($p < 0.05$), indicating that metabolic abnormalities play a crucial role in its pathogenesis. The early onset of DCM (42.2% cases occurring within 3–5 years of diabetes duration) suggests that subclinical myocardial dysfunction develops sooner than traditionally expected, necessitating routine echocardiographic screening for early detection and intervention. Given that 46.6% of DCM cases were asymptomatic, this study underscores the importance of proactive cardiovascular monitoring in diabetic patients, particularly those with risk factors such as obesity, hyperglycaemia, and dyslipidaemia. Early lifestyle modifications, glycaemic control, and lipid-lowering therapies may help prevent the progression of diabetic cardiomyopathy to overt heart failure, ultimately reducing cardiovascular morbidity and mortality in T2DM patients. Future longitudinal studies with larger cohorts are needed to evaluate the long-term impact of metabolic control on DCM progression.

Clinical Implications

- Routine echocardiographic screening should be considered for all T2DM patients, especially those with poor glycaemic control, obesity, and dyslipidaemia.
- Early intervention with lifestyle modification and optimal glycaemic control may prevent progression to heart failure with preserved ejection fraction (HFpEF).
- Future research should focus on long-term follow-up studies to determine whether strict metabolic control can reverse subclinical DCM.

Limitations

- Single-centre study, requiring larger, multicentre trials for broader applicability.
- Lack of follow-up data to assess progression from diastolic dysfunction to symptomatic heart failure.

Conflict of Interest: Nil

Source of Funding: Nil

Ethical Approval: Taken from IEC of RNT Medical College Udaipur, Vide Reference Number 165/IEC/2016 - 04/12/2016.

References

1. IDF diabetes atlas 2021 [Internet]. Diabetesatlas. org. [cited 2025 Feb 8]. Available from: https:// diabetesatlas.org/atlas/tenth-edition/
2. Leon BM, Maddox TM. Diabetes and cardiovascular disease: Epidemiology, biological mechanisms,

treatment recommendations and future research. World J Diabetes. 2015 Oct 10;6(13):1246-58.

3. Zhao X, Liu S, Wang X, Chen Y, Pang P, Yang Q, Lin J, Deng S, Wu S, Fan G, Wang B. Diabetic cardiomyopathy: Clinical phenotype and practice. Front Endocrinol (Lausanne). 2022 Dec 7;13:1032268.
4. Bugger H, Abel ED. Molecular mechanisms of diabetic cardiomyopathy. Diabetologia . 2014;57(4):660–71.
5. Jia G, Hill MA, Sowers JR. Diabetic cardiomyopathy: An update of mechanisms contributing to this clinical entity: An update of mechanisms contributing to this clinical entity. Circ Res. 2018;122(4):624–38.
6. Seferović PM, Paulus WJ. Clinical diabetic cardiomyopathy: a two-faced disease with restrictive and dilated phenotypes. Eur Heart J. 2015;36(27):1718–27, 1727a–1727c.
7. American Diabetes Association. Diagnosis and classification of diabetes mellitus. Diabetes Care. 2014 Jan;37 Suppl 1:S81-90.
8. Grundy SM, Benjamin IJ, Burke GL, Chait A, Eckel RH, Howard BV, et al. Diabetes and cardiovascular disease: a statement for healthcare professionals from the American Heart Association: A statement for healthcare professionals from the American heart association. Circulation. 1999;100(10):1134–46.
9. Zabalgoitia M, Ismaeil MF, Anderson L, Maklady FA. Prevalence of diastolic dysfunction in normotensive, asymptomatic patients with well-controlled type 2 diabetes mellitus. Am J Cardiol. 2001;87(3):320–3.
10. Boyer JK, Thanigaraj S, Schechtman KB, Pérez JE. Prevalence of ventricular diastolic dysfunction in asymptomatic, normotensive patients with diabetes mellitus. Am J Cardiol. 2004;93(7):870–5.
11. Fang ZY, Prins JB, Marwick TH. Diabetic cardiomyopathy: evidence, mechanisms, and therapeutic implications. Endocr Rev. 2004;25(4):543–67.
12. Devereux RB, Roman MJ, Paranicas M, O'Grady MJ, Lee ET, Welty TK, et al. Impact of diabetes on cardiac structure and function: the strong heart study: The Strong Heart Study. Circulation. 2000;101(19):2271–6.
13. De Simone G, Devereux RB, Roman MJ, Chinali M, Okin PM, Daniels SR. Does cardiovascular risk factor burden explain the relation between diabetes and left ventricular mass? Hypertension. 2000;35(3):367–73.
14. Bell DS. Diabetic cardiomyopathy: a unique entity or a complication of coronary artery disease? Diabetes Care. 2003;26:2949–51.
15. Attali JR, Sachs RN, Valensi P, Palsky D, Tellier P, Vulpillat M, et al. Asymptomatic diabetic cardiomyopathy: a noninvasive study. Diabetes Res Clin Pract. 1988;4(3):183–90.
16. Kiencke S, Handschin R, Von Dahlen R, Muser M, Brunner-La Rocca HP, Schlapfer M. Preclinical diabetic cardiomyopathy: prevalence, screening, and outcome. Eur J Heart Fail. 2010;12(9):951–7.
17. Struthers AD, Morris AD. Screening for and treating left-ventricular abnormalities in diabetes mellitus: a new way of reducing cardiac deaths? Lancet. 2000;355(9200):29–31.
18. Soininen P, Kangas AJ, Würtz P, Suna T, Ala-Korpela M. Quantitative serum nuclear magnetic resonance metabolomics in cardiovascular epidemiology and genetics. Circ Cardiovasc Genet. 2015;8(1):192–206.
19. Galderisi M, Anderson KM, Wilson PW, Levy D. Echocardiographic evidence for the existence of a distinct diabetic cardiomyopathy (the Framingham Heart Study). Am J Cardiol [Internet]. 1991;68(1):85–9.
20. Karamitsos TD, Francis JM, Myerson S, Selvanayagam JB, Neubauer S. The role of cardiovascular magnetic resonance imaging in heart failure. J Am Coll Cardiol. 2009;54(15):1407–24.