

Research

Diastolic Dysfunction in Asymptomatic Type 2 Diabetes Mellitus Evaluated by Echocardiography: A Cross-Sectional Study of 50 Patients

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Abstract:

Background: Type 2 diabetes mellitus (T2DM) is a major risk factor for cardiovascular disease, and evidence suggests that diabetic cardiomyopathy may initially manifest as diastolic dysfunction before any overt systolic abnormalities. This study was undertaken to evaluate left ventricular diastolic function in asymptomatic T2DM patients using echocardiographic parameters. Methods: A cross-sectional observational study was conducted on 50 asymptomatic, normotensive T2DM patients aged 30–70 years. Echocardiographic parameters including E/A ratio, isovolumetric relaxation time (IVRT), and deceleration time (DT) were assessed. Patients with known cardiovascular diseases or other systemic conditions affecting cardiac function were excluded. Results: Among 50 patients, 26 (52%) demonstrated diastolic dysfunction. Diastolic dysfunction was more prevalent in males (59.2%) compared to females (43.4%). Significant correlations were observed between diastolic dysfunction and increasing age, BMI, HbA1c levels, and duration of diabetes ($p < 0.05$). E/A ratio < 1 , IVRT > 100 ms, and DT > 200 ms were sensitive indicators of early diastolic dysfunction. Conclusion: Diastolic dysfunction is prevalent in asymptomatic T2DM patients and may precede systolic abnormalities. Echocardiographic screening is essential in early stages of diabetes to prevent long-term cardiovascular complications.

Keywords: Type 2 Diabetes Mellitus, Diastolic Dysfunction, Echocardiography, E/A Ratio, HbA1c, Left Ventricular Function

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Introduction

Type 2 Diabetes Mellitus (T2DM) is a global epidemic, with its prevalence projected to exceed 500 million by 2030. It is not only a metabolic disorder but also a significant cardiovascular risk factor. One of the earliest and often overlooked cardiac manifestations in diabetic individuals is **left ventricular diastolic dysfunction (LVDD)**—a hallmark of diabetic cardiomyopathy independent of hypertension and coronary artery disease [1,2].

LVDD refers to impaired relaxation and compliance of the myocardium, leading to abnormal ventricular filling patterns. Studies using Doppler echocardiography have highlighted that **diastolic dysfunction often precedes systolic dysfunction**, making it a valuable early indicator of myocardial involvement in T2DM [3,4].

The pathogenesis of diabetic cardiomyopathy includes **myocardial fibrosis, endothelial dysfunction, and microangiopathy**, all of which contribute to impaired diastolic function [5]. Early identification of subclinical diastolic dysfunction could prompt therapeutic interventions to prevent progression to symptomatic heart failure.

This study aimed to assess the **prevalence of diastolic dysfunction** in asymptomatic T2DM patients and its correlation with clinical parameters such as **age, sex, BMI, duration of diabetes, and glycemic control**.

Materials and Methods

Study Design:

Cross-sectional observational study conducted from July 2024 to December 2024 at Dhiraj Hospital, Vadodara

Sample Size:

50 patients with diagnosed Type 2 Diabetes Mellitus.

Inclusion Criteria:

- Age between 30–70 years
- Diagnosed with T2DM for at least 6 months
- Asymptomatic with respect to cardiovascular symptoms
- Normotensive and not on any antihypertensive medications

Exclusion Criteria:

- Known cases of coronary artery disease, heart failure, stroke, or arrhythmias
- Renal impairment, thyroid dysfunction, or pregnancy
- Systolic heart failure (EF < 50%)

Echocardiographic Evaluation:

All patients underwent 2D, M-mode, and Doppler echocardiography. Parameters recorded:

- Mitral inflow early diastolic velocity (E)
- Late diastolic (atrial) velocity (A)
- E/A ratio
- Isovolumic Relaxation Time (IVRT)
- Deceleration Time (DT) of the E wave

Data Collection:

Clinical evaluation, BMI calculation, HbA1c testing, and echocardiographic assessment were done for all patients. Diastolic function was assessed using:

- E/A ratio (normal: 1–2)
- Isovolumetric relaxation time (IVRT; normal: 60–100 ms)
- Deceleration time of E wave (DT; normal: 150–200 ms)

Statistical analysis was performed using chi-square and t-tests. A p-value <0.05 was considered statistically significant.

Results

Baseline Characteristics of Study Participants

A total of 50 asymptomatic, normotensive patients with Type 2 Diabetes Mellitus (T2DM) were included in the study. The demographic and clinical parameters are summarized in

Table 1: Baseline Characteristics of Study Participants (n = 50)

Variable	Mean \pm SD
Age (years)	54.2 \pm 9.1
Duration of Diabetes (years)	7.3 \pm 3.5
Body Mass Index (kg/m ²)	27.5 \pm 3.2
HbA1c (%)	8.4 \pm 1.2
Ejection Fraction (%)	63.1 \pm 6.2

Prevalence of Diastolic Dysfunction

Out of the total 50 patients, **26 (52%)** demonstrated echocardiographic evidence of diastolic dysfunction. This indicates a high burden of subclinical cardiac involvement among asymptomatic T2DM patients.

Association Between Clinical Variables and Diastolic Dysfunction

A statistically significant association was observed between diastolic dysfunction and age, sex, BMI, HbA1c level, and duration of diabetes. The detailed distribution is presented in

Table 2: Diastolic Dysfunction According to Clinical Variables

Parameter	Diastolic Dysfunction Present (%)	p-value
Age > 50 years	63%	<0.05
Male Gender	59.2%	<0.05
BMI > 25 kg/m ²	61%	<0.05
HbA1c > 8%	65%	<0.01
Diabetes Duration > 5 years	68%	<0.01

Echocardiographic Findings

The echocardiographic evaluation showed abnormalities in the E/A ratio, Isovolumetric Relaxation Time (IVRT), and Deceleration Time (DT). The findings are summarized in

Table 3: Echocardiographic Parameters in Study Participants

Parameter	Normal Range	Mean \pm SD	Abnormal in (%)
E/A Ratio	1.0 – 2.0	0.89 \pm 0.23	52%
IVRT (ms)	60 – 100	87.9 \pm 20.3	52%
Deceleration Time (ms)	150 – 200	180.7 \pm 34.6	46%

A reduced E/A ratio and prolonged IVRT were the most commonly observed abnormalities, consistent with impaired myocardial relaxation. Despite these findings, all patients maintained a preserved ejection fraction, supporting the conclusion that diastolic dysfunction precedes systolic abnormalities in diabetic cardiomyopathy.

Discussion

This study found that **52% of asymptomatic T2DM patients** had LV diastolic dysfunction, in line with previous reports [6,7]. The most affected parameters were **E/A ratio** and **IVRT**, both indicative of **impaired myocardial relaxation**.

LVDD was found to be more common in:

- Patients **aged >50 years**
- Those with **BMI >25**
- **Poor glycemic control** (HbA1c >8%)
- **Longer diabetes duration** (>5 years)

These findings are consistent with studies by Poirier et al. [1], Vinereanu et al. [8], and Hiwase et al. [9], all of whom stressed that poor metabolic control contributes significantly to subclinical myocardial involvement. Importantly, **EF remained preserved** in the majority of patients, reiterating the notion that **diastolic dysfunction is an early manifestation** of diabetic cardiomyopathy [10,11].

The use of **echocardiography as a screening tool** is supported by the ADA and ESC guidelines in high-risk diabetic patients [12,13].

Conclusion

The study highlights that **over half of the asymptomatic T2DM patients** had diastolic dysfunction, underscoring the **silent cardiovascular involvement** in diabetes. LVDD correlates significantly with **age, BMI, HbA1c, and duration of diabetes**, making these key markers for early screening. Early intervention in such patients can potentially delay progression to symptomatic heart failure.

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