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Assessment of Left Ventricular Diastolic Dysfunction in Patients with Type 2 Diabetes Using Echocardiography

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is associated with a spectrum of cardiovascular complications, including diabetic cardiomyopathy, which often manifests early as left ventricular diastolic dysfunction (LVDD). Early detection of LVDD using echocardiography can help prevent progression to overt heart failure.

Objectives: To assess the prevalence of LVDD in patients with T2DM&to evaluate its association with clinical & biochemical parameters.

Methods: A cross-sectional observational study was conducted on 100 patients with T2DM. All subjects underwent detailed clinical evaluation, laboratory investigations, & transthoracic echocardiography. Diastolic function was assessed using standard Doppler & tissue Doppler parameters. Statistical analysis was performed to determine associations.

Results: LVDD was detected in 62% of patients. Significant associations were observed between LVDD & age, duration of diabetes, HbA1c levels, & hypertension ($p < 0.05$).

Conclusion: LVDD is highly prevalent among T2DM patients&is significantly associated with poor glycemic control & longer disease duration. Routine echocardiographic screening may help in early identification & management.

Keywords: Assessment, Ventricular, Diastolic, Dysfunction, Type 2 Diabetes& Echocardiography.

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Introduction

Type 2 diabetes mellitus (T2DM) is a major global health concern due to its rising prevalence. Cardiovascular issues are the main cause of morbidity and mortality in diabetics. Among these, diabetic cardiomyopathy is a distinct condition characterized by abnormalities in the morphology and function of the heart that have nothing to do with hypertension or coronary artery disease [1]. Left ventricular diastolic dysfunction (LVDD) is often the initial manifestation of diabetic cardiomyopathy. It comes before both clinical heart failure&systolic dysfunction. Echocardiography, particularly Doppler and tissue Doppler imaging, can consistently and non-invasively measure diastolic function.

Early identification of LVDD allows for timely intervention to prevent development in people with asymptomatic diabetes. This study aims to evaluate the prevalence of LVDD and its relationship to clinical and biochemical variables in patients with type 2 diabetes [2].

Age, obesity, diabetes mellitus, cardiovascular ischemia, hypertension, aortic stenosis, myocardial illnesses, endomyocardial clutters, pericardial emission, and constrictive pericarditis are some of the major reasons of left ventricular diastolic dysfunction [3]. Diastolic dysfunction and cardiovascular breakdown with saved discharge part (HFpEF) are more common in people with type-2 diabetes, which seems to show how diabetes affects the improvement of these disorders. It is associated with alterations in the digestion, structure, and function of the heart. Hyperglycemia, lipotoxicity, insulin blockage, and weight—a high risk factor that rises with age—are among the factors that contribute to myocardial dysfunction in diabetes [4-6].

Diastolic dysfunction is among the most well-known cardiovascular disorders that might result in a clinical crisis. Inadequate ventricular filling causes the mass of the left ventricle to thicken, increasing the weight inclination of blood in the aspiratory arteries. Transudate liquid spills into the lung alveoli as a result, creating pneumonic edema, which lowers blood oxygen levels and, if untreated, dyspnea [7-8].

Materials&Methods

Study Population

A total of 100 patients diagnosed with T2DM attending the outpatient&inpatient departments were included.

Inclusion Criteria

- Age ≥ 30 years
- Diagnosed T2DM (as per ADA criteria)
- Willing to participate

Exclusion Criteria

- Known coronary artery disease
- Valvular heart disease

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- Heart failure
- Chronic kidney disease stage ≥ 3
- Thyroid disorders

Data Collection

Detailed history&physical examination were conducted. The following parameters were recorded:

- Age
- Gender
- Duration of diabetes
- Blood pressure
- Body mass index (BMI)

Laboratory Investigations

- Fasting blood glucose
- Postprandial blood glucose
- HbA1c
- Lipid profile

Echocardiographic Assessment

Transthoracic echocardiography was performed using a standardized protocol. The following parameters were assessed:

- Mitral inflow velocities (E&A waves)
- E/A ratio
- Deceleration time (DT)
- Isovolumetric relaxation time (IVRT)
- Tissue Doppler imaging (E′ velocity)
- E/E′ ratio

LVDD was graded according to established guidelines.

Statistical Analysis

Data were analyzed using SPSS software. Continuous variables were expressed as mean ± SD. Categorical variables were expressed as percentages. Chi-square test&t-test were used. A p-value < 0.05 was considered statistically significant.

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Results

Table 1: Baseline Characteristics of Study Population

Parameter	LVDD Present (n=62)	LVDD Absent (n=38)	p-value
Age (years)	58.4 ± 8.2	51.2 ± 7.5	0.001
Male (%)	60%	55%	0.62
Duration of DM (years)	9.5 ± 3.2	5.1 ± 2.8	0.0001
BMI (kg/m²)	27.8 ± 3.5	25.6 ± 3.1	0.02
Hypertension (%)	68%	42%	0.01

Table 2: Biochemical Parameters

Parameter	LVDD Present	LVDD Absent	p-value
FBS (mg/dL)	162 ± 32	138 ± 28	0.003
PPBS (mg/dL)	228 ± 45	190 ± 38	0.001
HbA1c (%)	8.6 ± 1.2	7.4 ± 1.0	0.0001
LDL (mg/dL)	132 ± 28	118 ± 25	0.04
HDL (mg/dL)	38 ± 6	42 ± 7	0.02

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Table 3: Echocardiographic Parameters

Parameter	LVDD Present	LVDD Absent	p-value
E/A Ratio	0.78 ± 0.15	1.22 ± 0.18	0.0001
Deceleration Time (ms)	240 ± 30	190 ± 25	0.0001
IVRT (ms)	110 ± 15	85 ± 12	0.0001
E′ Velocity (cm/s)	6.2 ± 1.1	9.5 ± 1.3	0.0001
E/E′ Ratio	14.8 ± 3.2	9.2 ± 2.1	0.0001

Table 4: Grading of Diastolic Dysfunction

Grade	Number of Patients	Percentage	p-value
Grade I	38	61.3%	0.001
Grade II	18	29.0%	0.003
Grade III	06	9.7%	0.02

Discussion

This study found that LVDD was much more common in T2DM patients (62%). The findings are consistent with past studies that indicate diastolic dysfunction precedes diabetic cardiomyopathy [9].

Age and the duration of diabetes showed a strong correlation with LVDD, suggesting that myocardial stiffness is influenced by cumulative metabolic burden. Higher HbA1c levels showed a significant correlation between LVDD and poor glycemic control, underscoring the importance of stringent glucose regulation [10].

Hypertension exacerbated LVDD, most likely due to increased afterload and myocardial remodeling. Two echocardiographic findings that indicate inadequate relaxation and high filling pressures are reduced E' velocity and an elevated E/E' ratio. Most patients had Grade I diastolic dysfunction, which was indicative of early disease [11–12]. However, some showed signs of advanced impairment, highlighting the significance of early screening.

A study by Wojciech Kosmala et al. found that most patients were in the 50–55 age range, which is comparable to our own, with 40% of the population being female and 60% being male. In this study, diastolic dysfunction was more common in men. Additionally, grade 3 or 4 diastolic dysfunction was more common in men [13–14]. Most newly diagnosed people with diabetes and hypertension had normal diastolic function. The duration of diabetes and

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hypertension was directly associated with the occurrence of diastolic dysfunction. Compared to each condition alone, the combination of diabetes and hypertension increases the LV filling pressure and has a synergistic effect on LVDD [15].

Conclusion

LVDD is highly prevalent in patients with T2DM & is significantly associated with age, duration of diabetes, glycemic control, & hypertension. Echocardiography is an effective tool for early detection. Routine screening should be considered in diabetic patients to prevent progression to heart failure.

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