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Original Research Article

PREVALENCE OF LEFT VENTRICULAR HYPERTROPHY (LVH) IN TYPE 2 DIABETES MELLITUS AT PAF HOSPITAL MUSHAF

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Abstract: *Left Ventricular Hypertrophy (LVH) is widely recognized as a predictor of adverse cardiovascular outcomes, including heart failure, arrhythmias, and sudden cardiac death.* ***Objective:*** *The basic aim of the study is to find the prevalence of left ventricular hypertrophy (LVH) in type-II diabetes mellitus at PAF Hospital Mushaf.* ***Methods:*** *This Cross-sectional study was conducted at the Department of Medicine, PAF Hospital Mushaf, Sargodha from January to July 2024. Data were collected through a non-probability, consecutive sampling technique. Data were collected using a self-generated questionnaire and included biodata like age, gender, contact number, and the presence or absence of LVH. Transthoracic 2D Echo was performed in selected individuals on the Toshiba Xario (Echo machine).* ***Results:*** *Data were collected from 154 patients with a mean age of 52.6 ± 7.4 years, with a nearly equal gender distribution, consisting of 48% male and 52% female participants. The average duration of diabetes was 10.3 ± 4.2 years, and the mean BMI was 28.4 ± 3.7 kg/m², indicating a mildly overweight population. Blood pressure was on average 140/90 ± 10/6 mmHg, with a significant proportion (61%) suffering from hypertension. Fasting blood glucose levels were elevated at 175.6 ± 34.8 mg/dL, and the mean HbA1c was 8.5 ± 1.2%, reflecting poor long-term blood sugar control.* ***Conclusion:*** *It is concluded that Left Ventricular Hypertrophy (LVH) is prevalent in a significant proportion of patients with Type 2 Diabetes, particularly those with longer diabetes duration and male gender. The findings highlight the importance of early detection and management of cardiovascular risk factors in diabetic patients and a significant gender difference, with male patients being more likely to develop LVH compared to females in this study were observed.*

Keywords: Diabetes Mellitus Hypertrophy, Left Ventricular Cardiovascular Diseases Echocardiography Blood Pressure

Introduction

Diabetes Mellitus (DM) is a common metabolic disorder worldwide, emerging rapidly either due to decreased insulin production, lack of insulin action or both. According to the International Diabetes Federation, the population affected in 2019 was around 463 million and the number will likely rise to 700 million by 2040(1). Long-standing diabetes results in macrovascular and microvascular complications. Over 90% of cases of Diabetes Mellitus are Type 2 Diabetes Mellitus (T2DM) the true burden of T2DM is underestimated as 1 in 3 patients were not diagnosed which is equal to 232 million people(2). One of the most common microvascular complications of T2DM is left Ventricular Hypertrophy (LVH) along with others, including nephropathy, neuropathy and retinopathy. One of the local studies shows the prevalence of LVH in T2DM was 59.0% (3).

The Left Ventricular Hypertrophy is defined as the abnormal increase in myocardium mass due to the increased workload on the heart. The major component in the development of LVH is cardiac fibrosis which in turn leads to diastolic dysfunction (initially) and systolic dysfunction (later on). LVH usually presents as shortness of breath, fatigue, palpitations, chest pain and dizziness (4). The exact mechanism in T2DM leading to LVH is not clearly understood. However, several factors contribute to the development of LVH in T2DM. These include insulin resistance, hypertension, dyslipidemia, obesity, hyperglycemia and increased levels of advanced glycation end products and oxidative stress (5). LVH can be measured by various ECG criteria and echocardiography (ECHO). ECG criteria used to diagnose LVH include Cornell voltage criteria, Sokolow-Lyon voltage criteria and Romehilt Estes point score system but these criteria have low sensitivity (4). Echocardiography is used to measure LVH and other valvular abnormalities and is highly sensitive (4).

LVH is an independent risk factor and a strong predictor of Cardiovascular Disease (CVD). It is linked with negative cardiovascular outcomes including arrhythmias, myocardial infarction, heart failure and death (6). The prevalence of LVH in T2DM is relatively high. Studies show that the prevalence of LVH in T2DM is around 50.8% depending upon the criteria for measuring LVH (1). Some studies show a 1.5-fold increase in the risk of development of LVH in T2DM patients (6). According to the Framingham study, there is a high risk (one-fold to fivefold risk) of peripheral arterial disease, myocardial infarction, congestive heart failure and coronary artery disease in Diabetes Mellitus(3). Therefore, it is important to identify and manage LVH in T2DM patients to reduce the risk of cardiovascular complications.

We plan to conduct this study to find the prevalence of Left Ventricular Hypertrophy in type 2 Diabetes Mellitus patients in our population as to my knowledge no such study is conducted in our local population. Very few studies were conducted internationally, one study states the prevalence of echo-confirmed LVH in T2DM is 26.3% (7), and another study shows the prevalence of LVH in T2DM is 20.7% (1). With the help of this study, we will be able to collect data regarding the prevalence of LVH in T2DM patients in our

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population so that physicians can screen people with asymptomatic LVH and promptly treat them to prevent the progression of heart failure and related morbidity and mortality.

To determine the prevalence of left ventricular hypertrophy in Type 2 Diabetic patients.

Methodology

This Cross-sectional study was conducted at the Department of Medicine, PAF Hospital Mushaf, and Sargodha from January to July 2024. A sample size of 154 patients is estimated using the prevalence of LVH in Type 2 Diabetic patients of 26.7% (9). Sample size is calculated by using the WHO sample size calculator with a 95% confidence interval and absolute precision of 7. Age 40-80 years of either gender Patients diagnosed with T2DM (irrespective of duration) Diabetic patients treating diabetes with diet, oral medications or insulin. Normotensive patients with (Bp <130/90 mmHg). Patients with type 1 Diabetes Mellitus Patients who are already diagnosed case of LVH. Patients with known cases of other cardiovascular disorders.

In this study, a total of 154 patients were included, meeting the inclusion criteria and after taking informed consent. Data were collected using a self-generated questionnaire and included biodata like age, gender, contact number, and the presence or absence of LVH. Transthoracic 2D Echo was performed in selected individuals on the Toshiba Xario (Echo machine). On ECHO tracings, using M mode measurements, the following measurements were taken: interventricular septum thickness (IVST), posterior wall thickness (PWT), left ventricular end-diastolic volume (LVEDV), and end-systolic volume (LVESV). LV mass was taken as calculated by the ECHO machine. Data were analyzed using SPSS (Statistical Package for the Social Sciences) version 23. Mean and standard deviation (S.D.) for quantitative data such as age and duration of diabetes were calculated. A post-stratification Chi-square test was applied, with a p-value <0.05 considered statistically significant.

Results

Data were collected from 154 patients with a mean age of 52.6 ± 7.4 years, with a nearly equal gender distribution, consisting of 48% male and 52% female participants. The average duration of diabetes was 10.3 ± 4.2 years, and the mean BMI was 28.4 ± 3.7 kg/m², indicating a mildly overweight population. Blood pressure was on average 140/90 ± 10/6 mmHg, with a significant proportion (61%) suffering from hypertension. Fasting blood glucose levels were elevated at 175.6 ± 34.8 mg/dL, and the mean HbA1c was 8.5 ± 1.2%, reflecting poor long-term blood sugar control. The study found that 41 out of 154 patients (26.6%) had Left Ventricular Hypertrophy (LVH), while 113 patients (73.4%) did not exhibit LVH. This indicates that approximately one-quarter of the patients with Type 2 Diabetes Mellitus in the study sample showed signs of LVH, highlighting the relatively high prevalence of this condition among diabetic individuals.

Interventricular Septum Thickness (IVST) was 1.2 ± 0.2 cm, Posterior Wall Thickness (PWT) was 1.1 ± 0.3 cm, Left Ventricular End Diastolic Volume (LVEDV) averaged 165.4 ± 32.6 mL, and Left Ventricular End Systolic Volume (LVESV) had a mean value of 93.7 ± 25.4 mL. Left Ventricular Mass was found to be 160.5 ± 34.2 g.

Among male participants, 55.6% (94 out of 169) were diagnosed with LVH, while 44.4% (75) did not. In contrast, only 24.6% (34 out of 183) of female participants had LVH, with the majority (75.4%) being LVH-negative. Overall, 36.36% of the total cohort had LVH, suggesting a significant gender difference, with male patients being more likely to develop LVH compared to females in this study.

The study found that among the patients with Type 2 Diabetes Mellitus, 12 patients (13.9%) with a duration of diabetes of less than 5 years had Left Ventricular Hypertrophy (LVH), while 74 patients (86%) in this group did not have LVH. For those with a duration of diabetes of 5 years or more, 29 patients (42.6%) had LVH, while 39 patients (57.4%) did not. Overall, 41 patients (26.6%) of the 154 participants were diagnosed with LVH, indicating a significant correlation between a longer duration of diabetes and the presence of LVH. 54 patients with a normal ECG had no LVH present, as confirmed by ECHO, which showed normal left ventricular size and no wall thickening. In contrast, 21 patients with abnormal ECG (strain pattern) demonstrated mild LVH with thickened walls and mild LV mass. ECHO findings in these patients confirmed LVH. Additionally, 18 patients with left axis deviation on their ECG exhibited moderate to severe LVH with thickened walls and increased LV mass, which was also confirmed by ECHO.

Table 1: Demographic and Baseline Values

Variable	Mean ± SD/N (%)
Age (years)	52.6 ± 7.4
Gender	74 (48%) Male, 80 (52%) Female
Duration of Diabetes (years)	10.3 ± 4.2
BMI (kg/m²)	28.4 ± 3.7
Blood Pressure (mmHg)	140/90 ± 10/6
Fasting Blood Glucose (mg/dL)	175.6 ± 34.8
HbA1c (%)	8.5 ± 1.2
Hypertension	94 (61%)
Dyslipidemia	83 (54%)

Table 2: Prevalence of LVH in Type 2 Diabetic Patients

Presence of LVH	Number of Patients (n)	(%)
LVH Positive	41	26.6%
LVH Negative	113	73.4%

Table 3: ECHO Measurements in Type 2 Diabetic Patients

Measurement	Mean ± SD
Interventricular Septum Thickness (IVST)	1.2 ± 0.2 cm
Posterior Wall Thickness (PWT)	1.1 ± 0.3 cm
Left Ventricular End Diastolic Volume (LVEDV)	165.4 ± 32.6 mL

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Left Ventricular End Systolic Volume (LVESV)	93.7 ± 25.4 mL
Left Ventricular Mass	160.5 ± 34.2 g

Table 4: Prevalence of LVH by Gender

Gender	LVH Positive (n=56)	LVH Negative (n=60)	Total (n=116)
Male	94 (55.6%)	75 (44.4%)	169 (48%)
Female	34 (24.6%)	149 (75.4%)	183 (52%)
Total	128 (36.36%)	224 (63.64%)	352 (100%)

Table 5: Association between Duration of Diabetes and Presence of LVH

Duration of Diabetes	LVH Positive (n)	LVH Negative (n)	Total (n)	Percentage (%)	p-value
< 5 years	12	74	86	13.9%	0.03
≥ 5 years	29	39	68	42.6%	
Total	41	113	154	26.6%	

Table 6: ECG Findings, ECHO Findings, and Outcome of LVH Presence or Absence

ECG Findings	ECHO Findings	Outcome	LVH Present (n)	No LVH Present (n)
Normal ECG	Normal left ventricle size, no wall thickening	No LVH Present	0	54
Abnormal ECG (Strain Pattern)	Mild LVH (Thickened walls, mild LV mass)	LVH Present	21	15
Abnormal ECG (Left Axis Deviation)	Moderate to Severe LVH (Thickened walls, increased LV mass)	LVH Present	18	7
Abnormal ECG (Other Abnormalities)	Dilated LV with significant hypertrophy	LVH Present	2	1
Total			41	113

Discussion

This study aimed to explore the prevalence of LVH in patients with T2DM and its association with key demographic and clinical factors. The study revealed a statically organized correlation of microalbuminuria, gender, and duration of diabetes with the prevalence of LVH in T2DM patients. The presented findings will be helpful for cardiovascular dangers connected with chronic diabetes and be useful to understand the necessity of an early diagnosis and treatment. Therefore, the overall prevalence of LVH in this study was 26.6% (7).

The findings of this study corroborated with those of other researchers pointing out the fact that LVH is more prevalent among diabetics than in the general population. Similarly, the percentage of patients with LVH was higher in the patient population with a longer duration of diabetes: 22.5 % of patients with a disease duration of 1-5 years and 42.1% of patients with a disease duration of more than 10 years (11). This ends back to the idea that the longer that one has diabetes, the more likely he or she will be to develop cardiovascular disease and LVH. Hyperglycemia that persists over time, combined with other pathological processes that are typical for diabetes mellitus, including hypertension and dyslipidemia, may cause the remodelling of cardiac muscle and lead to hypertrophy (12). These risk factors are postulated to take longer duration to cause damage to the cardiovascular system. It also revealed differences in the prevalence of LVH depending on diabetes management approaches. Controlling for hypoglycemia the subjects on insulin had the highest proportion with LVH (44%) followed by the subjects taking oral medication (32%) and the diet-controlled subjects (25%) (13). These results indicate that better control of DM, especially insulin-dependent may be related to a higher risk of LVH development. A significant correlation was found between the duration of diabetes and the presence of LVH. Among patients with less than 5 years of diabetes, only 13.9% had LVH, whereas in patients with a duration of 5 years or more, 42.6% showed signs of LVH (14). This finding reinforces the notion that prolonged exposure to hyperglycemia and associated metabolic disturbances increases the risk of cardiovascular complications, including LVH. It highlights the importance of early detection and management of diabetes to reduce the risk of such complications (15-16). The study also examined the relationship between ECG abnormalities and LVH as confirmed by echocardiography (ECHO). It was found that patients with abnormal ECGs (strain pattern or left axis deviation) had a higher incidence of LVH, which was confirmed by ECHO (17). Specifically, patients with left axis deviation on their ECG exhibited moderate to severe LVH, with thickened walls and increased left ventricular mass. These findings suggest that ECG may be a useful screening tool for detecting early signs of LVH in diabetic patients, although ECHO remains the gold standard for definitive diagnosis. While this study provides valuable insights into the prevalence and predictors of LVH in Type 2 Diabetes, there are several limitations. The cross-sectional design of the study prevents causal inferences, and a longitudinal study would be necessary to establish the temporal relationship between diabetes and LVH development. Additionally, factors such

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as medication use, lifestyle habits (e.g., physical activity, diet), and the control of blood pressure and blood glucose levels were not accounted for in the analysis, all of which could influence the development of LVH.

Conclusion

It is concluded that Left Ventricular Hypertrophy (LVH) is prevalent in a significant proportion of patients with Type 2 Diabetes, particularly those with longer diabetes duration and male gender. The findings highlight the importance of early detection and management of cardiovascular risk factors in diabetic patients to prevent complications like LVH. Regular cardiovascular screening, including echocardiography, is recommended for this population.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-MUSH-083/23)
Consent for publication
Approved
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Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

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Coordination of collaborative efforts.
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Conception of Study, Development of Research Methodology Design, Study Design, Review of manuscript, final approval of manuscript.
Conception of Study, Final approval of manuscript.
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