

Incidence of Diastolic Dysfunction in Poorly Controlled Type 2 Diabetes Mellitus without Hypertension and Coronary Artery Disease

Diastolic Dysfunction in Poorly Controlled Type 2 Diabetes

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ABSTRACT

Objective: The purpose of this study was to study the incidence of left ventricular diastolic dysfunction in type 2 diabetes mellitus patients without hypertension and coronary artery disease and its relation to duration of diabetes mellitus.

Study Design: Descriptive case series study

Place and Duration of Study: This study was conducted at the Department of Medicine of Al- Nafees Medical College & Hospital, Islamabad from April, 2019 to September, 2019.

Materials and Methods: Patients with diabetes mellitus between age of 40 -70 years with poor glycemic control having HbA1c >9% and without history of hypertension, coronary artery disease, heart failure, or valvular heart disease were recruited. The study was conducted after the approval from hospital ethical committee. All the patients were educated and an informed written consent was taken. Exercise tolerance test and Resting ECG were done on every subject to exclude ischemia and echocardiography was performed to assess left ventricular.

Results: A total of 60 poorly controlled diabetic type 2 patients meeting inclusion and exclusion criteria of this study were registered. Of these 60 study cases, 26(43.33%) were male and 34(56.66%) were female. Diastolic Dysfunction was found to be present in 37(61.66%) while it was found to be absent in 23(38.33%) of poorly controlled diabetic (type 2) patients without coronary artery disease as well as hypertension.

Conclusion: Diastolic Dysfunction is very common, over 60%, in poorly controlled type 2 diabetic patients and this finding correlates with HbA1c levels and duration of diabetes mellitus and does not correlate with age and gender.

Key Words: Diabetic Cardiomyopathy (DCM), Coronary Artery Disease (CAD), Left ventricle diastolic dysfunction (LVDF), Hypertension (HTN), Diabetes Mellitus (Type 2)

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INTRODUCTION

There are almost 537 million adults (20-79 years) are living with diabetes according to The International Diabetes Federation (IDF).¹ The leading universal health crisis of twenty-first century is T2DM, and there is rapid increase in its prevalence and incidence especially in adults.²

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The major cardiovascular disease related with T2DM are coronary artery disease, ischemic heart disease, heart failure, stroke, and peripheral artery disease, and these complications lead to death in at least 50% of patients with T2DM.² Diabetic cardiomyopathy refers to cardiac dysfunction in diabetic people who do not have ischemic heart disease, valvular heart disease, or hypertension.³

Autonomic nervous system dysfunction, microangiopathy, and abnormal cellular calcium transport are all factors that cause diabetic cardiomyopathy. The stiffening of the ventricular wall is caused by structural changes in intracellular proteins in the myocardium and the buildup of collagens. Thirty percent to fifty percent of all heart failure hospitalizations are due to diastolic dysfunction.⁴

Heart failure rate in the old age have risen dramatically in recent years. It is believed that diabetes is a significant independent risk factor for the onset of diastolic dysfunction. Diastolic dysfunction of the left ventricle may be the earliest sign of diabetic cardiomyopathy, highlighting the need for regular

monitoring of blood sugar levels in people with diabetes. There is evidence linking poorly managed diabetes to diastolic dysfunction.⁵ Clinical and pathological studies have demonstrated that even in the absence of large-vessel atherosclerosis, abnormalities of left ventricular function, cardiomegaly and failure can occur. This may be related to microangiopathy of the coronary circulation. Up to half of individuals with diabetes mellitus in the community develop heart failure due to diastolic dysfunction despite LV adequate ejection fraction (EF), as demonstrated by several epidemiological surveys.⁶

In the Framingham Heart Study, diabetes mellitus was considered an independent risk factor for heart failure.⁷ Left ventricular diastolic dysfunction (LVDD) is considered the first manifestation of cardiac remodeling in diabetic patients by many researchers. The only 1% increase in HbA1c level is related with 8% increased risk of HF, independently of other cardiovascular risks. Moreover, quality of life and the therapeutic effect of hypoglycaemic agents is also worsen by heart failure. There should be early detection and management of myocardial dysfunction in the diabetic patients before the development of overt heart failure.⁸

In this study, we investigated the incidence LV diastolic dysfunction in poorly controlled type 2 diabetes mellitus patients without hypertension and coronary artery disease.

MATERIALS AND METHODS

The descriptive case series study was conducted at outpatient department, Al-Nafees Medical College & Hospital, Islamabad from 1st April 2019 – 30th September 2019 after approval from hospital ethical committee. The sample size was calculated (n=60) with confidence interval 95%, estimated true proportion 50% by Epitools software.

Patients with evidence of diastolic dysfunction according to criteria of American society of echocardiography and European association of cardiovascular imaging were selected through echocardiography by mitral E/A ratio, average E/e' ratio and LV relaxation¹⁰ after fulfilling the inclusion criteria as poorly controlled Type 2 diabetic patients without hypertension and coronary artery disease while excluding patients having valvular heart disease, congestive heart failure, hypertension, connective tissue disease, known coronary artery disease, myocardial infarction (recent or previous), renal and thyroid disease.

Complete history, full clinical examination and relevant laboratory and imaging tests done on every patient. The history highlights complications, ischemic heart disease, and duration of diabetes mellitus, drug history, heart failure and hypertension. The HbA1c level is used to diagnose diabetes mellitus.

After collecting the data, it was entered in a specially designed performa. Data was analyzed by the Statistical Package for Social Sciences (SPSS) version 23. Age, gender, the length of diabetes, hemoglobin A1c, and the Ejection fraction on Doppler echocardiography with intact diastolic function and with diastolic dysfunction are the factors. Information presented as Mean±SD. The differences between participant groups evaluated using analysis of variance. Chi square test was used to compare the dysfunction of the left ventricle during diastole. A 0.05 p-value is regarded as significant. The degree of relationship between two variables is assessed using Pearson's correlation analysis.

RESULTS

A total of 60 type 2 diabetes individuals who matched the study's inclusion and exclusion criteria were registered. 26 (43.4%) men and 34 (56.7%) women made up 60 study cases (Table-1). The study's sample's average age was 55. (minimum age was 40 years while maximum was 70 years). The majority of instances, according to the study's findings, were between the ages of 45 and 65. Diastolic dysfunction was found in 37 (61.7%) of the studied cases whereas it wasn't in 23 (38.4%) as shown in Figure 1. The results of diastolic dysfunction with mitral E/A ratio and average E/e' ratio with LV relaxation are shown in Table 2 and 3. The patients were also asked how long they had diabetes, on average in years (the lowest was 5 years and the highest was >15 years) as shown in Table 4.

Table No.1: Frequency of Gender wise distribution in patients with poorly controlled Type 2 Diabetes Mellitus. (n=60)

| MALE/FEMALE | | | | |
|-------------|-----------|---------|---------------|--------------------|
| Gender | Frequency | Percent | Valid Percent | Cumulative Percent |
| Male | 26 | 43.3 | 43.3 | 43.3 |
| Female | 34 | 56.7 | 56.7 | 100.0 |
| Total | 60 | 100.0 | 100.0 | |

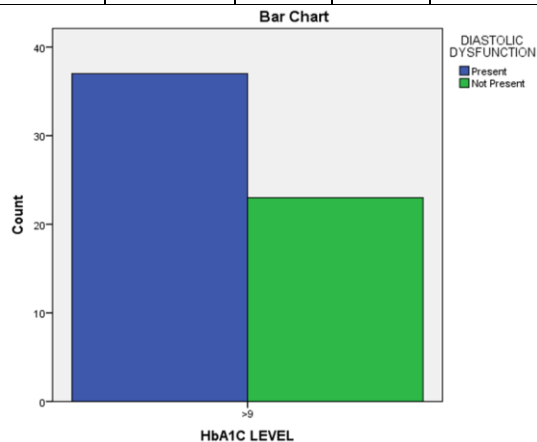


Figure No.1: Diastolic Dysfunction Frequency in poorly controlled Type 2 Diabetes Mellitus with HbA1C level (n=60)

Table No.2: Diastolic Dysfunction by Mitral E/A Ratio with HbA1C level in poorly controlled Type 2 Diabetic patients with Diastolic Dysfunction. (n=60)

| Count | | Mitral e/a ratio | | Total |
|-----------------------|-------------|------------------|-------|-------|
| | | 0.8 | 0.8-2 | |
| Diastolic dysfunction | Present | 0 | 37 | 37 |
| | Not present | 23 | 0 | 23 |
| Total | | 23 | 37 | 60 |

Table No.3: Diastolic Dysfunction by Average E/e' Ratio with HbA1C level in poorly controlled Type 2 Diabetic patients with Diastolic Dysfunction. (n=60)

| Count | | Average e/e' ratio with Lv relaxation | | Total |
|-----------------------|-------------|---------------------------------------|---------------------------------|-------|
| | | <10 with impaired lv relaxation | >10 with impaired lv relaxation | |
| Diastolic dysfunction | Present | 3 | 34 | 37 |
| | Not present | 0 | 23 | 23 |
| Total | | 3 | 57 | 60 |

Table No.4: Frequency of Diastolic Dysfunction in poorly controlled Type 2 Diabetes Mellitus with Duration of Diabetes. (n=60)

| Count | | Diastolic dysfunction | | Total |
|----------------------|-------------|-----------------------|-------------|-------|
| | | Present | Not present | |
| Duration of diabetes | 5-10 years | 5 | 11 | 16 |
| | 10-15 years | 14 | 5 | 19 |
| | >15 years | 18 | 7 | 25 |
| Total | | 37 | 23 | 60 |

Table No.5: Chi-Square Test

| | Value | df | Asymp. Sig. (2-sided) |
|--------------------|-------|----|-----------------------|
| Likelihood Ratio | 8.458 | 2 | .015 |
| Pearson Chi-Square | 8.552 | 2 | .014 |
| N of Valid Cases | 60 | | |

DISCUSSION

Diastolic dysfunction is a condition that is characterized by abnormal left ventricular relaxation and filling diastolic defect resulted due to ventricular wall stiffness. Patients with diabetes who have poorer glycemic control are more likely to experience significant diastolic dysfunction. Almost 30% of individuals with T2DM manifest impaired left

ventricular diastolic function (LVDF) without demonstrated coronary artery disease (CAD) or hypertension. The E/A ratio, by both imaging modalities, was significantly lower in Type 2 diabetes mellitus (T2DM) vs normal glucose tolerance (NGT).¹⁰ With statistically significant differences (p 0.05), diastolic dysfunction was discovered in 61.7% of the patients in our research who had HbA1c levels higher than 9%. These findings provide credence to the idea of a particular subclinical diabetic cardiomyopathy that may be influenced by glycemic management.⁴ HbA1c level has a detrimental impact on the myocardium with left ventricular (LV) diastolic dysfunction.¹¹ HbA1c is a good reliable marker for chronic glycemia and is associated with the long-term risk of diabetes complications, so it is currently considered the investigation of choice for monitoring and management of chronic cases of diabetes.¹² HbA1c level and duration of diabetes mellitus show a significant statistical difference, but not age or gender. Even an increase of 1% in HbA1c concentration was associated with (about 30% increase in all-cause mortality and 40% increase in cardiovascular or ischemic heart disease mortality, among individuals with diabetes.¹³ These findings match the published data quite well.¹⁴ Similar to our work, people with diabetes frequently experience asymptomatic diastolic dysfunction. The severity of this dysfunction is connected with glycemic management and length of diabetes mellitus. Our investigation demonstrated that age and gender had no bearing on the occurrence of diastolic dysfunction. Similar findings were also published by Wojciech et al., who found that there were other causes for diabetic cardiomyopathy beyond smoking history, gender, age, blood pressure, and body mass index.¹⁵ It is also obvious that, diastolic dysfunction correlates well with diabetes duration and HbA1c. Diastolic dysfunction as being the cause of diabetic cardiomyopathy may be very helpful as the predictor of cardiac failure with preserved ejection fraction and medium to long-term mortality. Currently, the management options for a diastolic heart failure with normal systolic function are very limited.¹⁶ According to my research, diabetic individuals who have poor glycemic control are more likely to experience diastolic dysfunction.

CONCLUSION

Over 60% of poorly managed type 2 diabetic patients experience diastolic dysfunction, and this finding is correlated with HbA1c levels and the duration of diabetes mellitus but not with age or gender.

Author's Contribution:

Concept & Design of Study: Safdar Hussain
 Drafting: Syed Saif Ur Rehman, Abida Mateen

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 Revisiting Critically: Ayesha Basharat
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Conflict of Interest: The study has no conflict of interest to declare by any author.

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