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Original Research Article

THE STUDY OF PREVALENCE OF LV DIASTOLIC DYSFUNCTION IN TYPE 2 DIABETES MELLITUS

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ABSTRACT

Background: The intertwined narrative of type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD) unfolds like a historical epic, with each chapter revealing new layers of complexity and challenge. This study aims to the prevalence ofdiastolic dysfunction in type 2 diabetes mellitus patients and to study the clinical profile of patients with diastolic dysfunction.

Materials and Methods: In this observational cross-sectional study conducted at ACS Medical College and Hospital, Velappanchavadi, Chennai, patients were recruited over a period of six months. The study aimed to assess normotensive type 2 diabetic patients, as per the American Diabetes Association (ADA) guidelines of 2017, within a sample size of 96 cases.Inclusion criteria were established to include normotensive type 2 diabetic patients meeting specific diagnostic parameters outlined by the ADA guidelines. These criteria included patients with HbA1C levels greater than or equal to 6.5%, fasting plasma glucose levels exceeding 126 mg/dl, and 2-hour plasma glucose levels surpassing 200 mg/dl during an Oral Glucose Tolerance Test. Additionally, patients exhibiting classic symptoms of hyperglycemia or hyperglycemic crisis were included if their random plasma glucose levels exceeded 200 mg/dl. Patients within an age range of 30 to 70 years, encompassing both males and females, were considered eligible for participation.

Results: The prevalence of diastolic dysfunction was found to be 59.37%. Within this subset, 5.3% were aged between 30 and 40 years, 17.5% were aged between 41 and 50 years, majority comprising 43.8%, were aged between 51 and 60 years, and around 33.4% were aged between 61 and 70 years. Notably, the majority of individuals with diastolic dysfunction were male, accounting for approximately 52.6% of the cases. Regarding the duration of diabetes among those with diastolic dysfunction, approximately 73.7% had been diagnosed within the past 1 to 10 years, while 22.8% had been diagnosed between 11 and 20 years ago, and only 3.5% had been diagnosed for over 20 years. Furthermore, in terms of body mass index (BMI), the majority fell within the range of 25.0 to 29.9 (50%), followed by 37.5% falling within the range of 18.6 to 24.9. The ejection fraction (EF) levels averaged 58.05□5.48 in the diastolic dysfunction group and 61.21□5.04 in the non-diastolic dysfunction group.

Conclusion: The findings of this study underscore the multifaceted nature of diastolic dysfunction in the context of diabetes mellitus, emphasizing the need for comprehensive assessment and management strategies to address this significant cardiovascular complication in diabetic patients.

Keywords: Ventricular dysfunction, diabetes mellitus, age, Type 2, risk factors, prevalence.

INTRODUCTION

The intertwined narrative of type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD) unfolds like a historical epic, with each chapter revealing new layers of complexity and challenge. At the heart of this saga lies a vicious circle, where T2DM heightens the risk of CVD, and CVD, in turn, becomes a significant complication, comorbidity, and mortality factor in T2DM patients.[1,2] In recent years, the global prevalence of both T2DM and CVD has surged, amplifying concerns about their interconnectedness.[3] A comprehensive systematic review spanning 57 papers and over 4.5 million T2DM patients exposed a troubling reality: nearly a third of type 2 diabetic patients also suffer from some form of CVD, with CVD emerging as the cause of death in half of these cases.[3]

Yet, amidst this sobering backdrop, a paradox emerges. Type 2 diabetic patients may harbor underlying CVD without exhibiting overt symptoms until it's too late. The subtlety of these subclinical manifestations poses a formidable challenge in quantifying the true extent of the problem.[4,5] However, strides have been made in proposing appropriate terminology and advocating for early screening tools to identify diabetic subjects at risk of CVD, even in the absence of symptoms.[4,5] The concept of "unrecognized diabetic cardiac impairment" sheds light on these silent manifestations, including atypical findings on resting electrocardiograms (ECG) and left ventricular diastolic dysfunction (LVDD). LVDD, if left unchecked, can escalate into life-threatening heart failure, underscoring the critical need for early detection and intervention.[4]

Despite the promise of early screening measures, challenges persist in scaling up screening programs to encompass the entire population of diabetic patients at risk of CVD in a cost-efficient manner.[6] Nevertheless, LVDD stands out as a relatively easier impairment to diagnose among the spectrum of early subclinical cardiac complications in type 2 diabetes, emphasizing the practical significance of early echocardiographic diagnosis.[4] The narrative of diabetes extends far beyond its cardiovascular implications. It is a syndrome characterized by hyperglycemia and disturbances in carbohydrate, protein, and fat metabolism, stemming from relative or absolute insulin deficiency.[7] Diabetes remains the commonest metabolic disorder afflicting people worldwide, with profound implications for multiple organ systems.[8]

Diabetic cardiomyopathy, marked by microangiopathic lesions, myocardial fibrosis, and lipid accumulation, underscores the multifaceted nature of this syndrome, with diastolic dysfunction emerging as a key mechanistic player.9The historical tapestry of diabetes traces back millennia, from ancient descriptions of polyuria to the landmark discovery of insulin in 1921, transforming the landscape of diabetes management.10In parallel, the epidemiological landscape of diabetes has evolved dramatically, with developing countries bearing a disproportionate burden. India, in particular, has emerged as the diabetes capital of the world, grappling with a soaring prevalence and its associated economic and healthcare ramifications.[11] As we navigate this intricate tapestry of T2DM and CVD, from its historical roots to its contemporary epidemiological challenges, one truth remains clear: the bidirectional relationship between these two conditions demands a comprehensive and multifaceted approach to mitigate their devastating consequences. This study aims to the prevalence ofdiastolic dysfunction in type 2 diabetes mellitus patientsand to study the clinical profile of patients with diastolic dysfunction.

MATERIAL AND METHODS

In this observational cross-sectional study conducted at ACS Medical College and Hospital, Velappanchavadi, Chennai, patients were recruited over a period of six months. The study aimed to assess normotensive type 2 diabetic patients, as per the American Diabetes Association (ADA) guidelines of 2017, within a sample size of 96 cases.

Inclusion criteria were established to include normotensive type 2 diabetic patients meeting specific diagnostic parameters outlined by the ADA guidelines. These criteria included patients with HbA1C levels greater than or equal to 6.5%, fasting plasma glucose levels exceeding 126 mg/dl, and 2-hour plasma glucose levels surpassing 200 mg/dl during an Oral Glucose Tolerance Test. Additionally, patients exhibiting classic symptoms of hyperglycemia or hyperglycemic crisis were included if their random plasma glucose levels exceeded 200 mg/dl. Patients within an age range of 30 to 70 years, encompassing both males and females, were considered eligible for participation.

Exclusion criteria were established to ensure the homogeneity of the study population and eliminate confounding factors. Patients diagnosed with type 1 diabetes mellitus were excluded, as were those with hypertension, coronary artery disease, valvular heart disease, chronic kidney disease, hypertrophic obstructive cardiomyopathy, and thyroid disorders. These criteria aimed to create a study cohort that was representative of normotensive type 2 diabetic patients without complicating comorbidities.

The methodology focused on recruiting a specific subset of patients who met stringent criteria for normotensive type 2 diabetes, ensuring the study's relevance to this particular patient population. By delineating clear inclusion and exclusion criteria, the study aimed to minimize confounding variables and enhance the validity of its findings.

RESULTS

The prevalence of diastolic dysfunction was found to be 59.37%. Within this subset, 5.3% were aged between 30 and 40 years, 17.5% were aged between 41 and 50 years, majority comprising 43.8%, were aged between 51 and 60 years, and around 33.4% were aged between 61 and 70 years. Notably, the majority of individuals with diastolic dysfunction were male, accounting for approximately 52.6% of the cases. Regarding the duration of diabetes among those with diastolic dysfunction, approximately 73.7% had been diagnosed within the past 1 to 10 years, while 22.8% had been diagnosed between 11 and 20 years ago, and only 3.5% had been diagnosed for over 20 years. Furthermore, in terms of body mass index (BMI), the majority fell within the range of 25.0 to 29.9 (50%), followed by 37.5% falling within the range of 18.6 to 24.9. [Table 1]

The average hemoglobin levels were 11.79±1.67 in the diastolic dysfunction group and 16.11±26.51 in the non-diastolic dysfunction group. Similarly, the mean fasting blood sugar (FBS) levels were 173.42±61.97 in the diastolic dysfunction group and 180.64±60.06 in the non-diastolic dysfunction group. The average glycatedhemoglobin (HbA1c) levels were 9.07±2.03 in the diastolic dysfunction group and 8.62±2.26 in the non-diastolic dysfunction group. Cholesterol levels averaged 210.65±50.86 in the diastolic dysfunction group compared to 194.10±49.85 in the non-diastolic dysfunction group. Low-density lipoprotein (LDL) levels averaged 109.39±36.34 in the diastolic dysfunction group and 96.08±27.83 in the non-diastolic dysfunction group. Triglyceride (TGL) levels averaged 173.25±56.93 in the diastolic dysfunction group and 144.05±63.91 in the non-diastolic dysfunction group. Lastly, ejection fraction (EF) levels averaged 58.05±5.48 in the diastolic dysfunction group and 61.21±5.04 in the non-diastolic dysfunction group. [Table 2]

Table 1: Distribution of demographic profile among the study participants (N=96)

Sl no	Variable	Diastolic dysfunction present (n=57)	Diastolic dysfunction Absent (n=39)	X^2 (df), p
1	**Age** 30-40 41-50 51-60 61-70	 3 (5.3) 10 (17.5) 25 (43.8) 19 (33.4)	 7 (17.9) 16 (41.0) 8 (20.5) 8 (20.5)	 13.31 (3) 0.003
2	**Gender** Female Male	 27 (47.4) 30 (52.6)	 17 (43.6) 22 (56.4)	 0.133 (1) 0.72
3	**Duration of diabetes** 1-10 11-20 >20	 42 (73.7) 13 (22.8) 2 (3.5)	 31 (79.5) 7 (17.9) 1 (2.6)	 0.43 (2) 0.81
4	**Body Mass Index** <18.5 18.6-24.9 25.0-29.9 30.0-34.9	 2 (3.6) 21 (37.5) 28 (50) 5 (8.9)	 4 (10.3) 17 (43.6) 15 (38.5) 3 (7.7)	 2.56 (3) 0.47

Table 2: Distribution of clinical variables among the study participants (N=96)

Sl no	Clinical variables	Diastolic dysfunction present (n=57)	Diastolic dysfunction Absent (n=39)	p
1	Haemoglobin	11.79±1.67	16.11±26.51	0.22
2	FBS	173.42±61.97	180.64±60.06	0.58
3	HBA1C	9.07±2.03	8.62±2.26	0.31
4	Cholesterol	210.65±50.86	194.10±49.85	0.12
5	LDL	109.39±36.34	96.08±27.83	0.06
6	TGL	173.25±56.93	144.05±63.91	0.02
7	EF	58.05±5.48	61.21±5.04	0.005

DISCUSSION

The findings of this study shed light on several key aspects related to diastolic dysfunction within the context of diabetes mellitus. Firstly, the observed prevalence of diastolic dysfunction at 59.37% underscores the significant burden of this condition among diabetic patients. This high prevalence rate highlights the importance of understanding and addressing diastolic dysfunction as a notable complication in individuals with diabetes. Regarding the demographic distribution within the subset of patients with diastolic dysfunction, age emerged as a significant factor. The majority of individuals with diastolic dysfunction were found to be in the older age groups, 43.8% in 50-60 years and33.4% falling within the 61-70 years category. This age distribution aligns with the known association between age and

the development of cardiovascular complications, emphasizing the need for heightened vigilance and targeted interventions in older diabetic patients.

Furthermore, the gender distribution within the subset of patients with diastolic dysfunction revealed a higher prevalence among males, comprising approximately 52.6% of the cases. This gender disparity warrants further investigation into potential underlying mechanisms or risk factors contributing to the increased susceptibility of males to diastolic dysfunction in the context of diabetes. Regarding the duration of diabetes among individuals with diastolic dysfunction, the majority (73.7%) had been diagnosed within the past 1 to 10 years. This finding suggests that diastolic dysfunction may manifest relatively early in the course of diabetes, highlighting the importance of early screening and intervention strategies to mitigate the progression of cardiovascular complications in diabetic patients.

In terms of metabolic parameters, individuals with diastolic dysfunction exhibited differences in hemoglobin levels, fasting blood sugar (FBS) levels, glycatedhemoglobin (HbA1c) levels, cholesterol levels, low-density lipoprotein (LDL) levels, and triglyceride (TGL) levels compared to those without diastolic dysfunction. These differences underscore the intricate interplay between metabolic dysregulation and cardiovascular health in diabetic patients with diastolic dysfunction. Lastly, ejection fraction (EF) levels, a key indicator of cardiac function, were found to be lower in the diastolic dysfunction group compared to the non-diastolic dysfunction group. This finding highlights the adverse impact of diastolic dysfunction on cardiac performance and underscores the importance of early detection and management strategies to preserve cardiac function in diabetic patients.

In certain Western studies, left ventricular diastolic dysfunction (LVDD) has been noted to exhibit a higher prevalence compared to left ventricular systolic dysfunction (LVSD) among patients without documented coronary artery disease. For instance, in the SHORTWAVE study involving 386 Italian patients, approximately 42% were confirmed to have LVDD, predominantly classified as Grade 1 dysfunction, while a smaller proportion, 3.6%, exhibited an ejection fraction (EF) of less than 50%. Notably, the mean age of this cohort exceeded 60 years, with a relatively short duration of type 2 diabetes mellitus (T2DM) averaging around 4 to 5 years. A significant portion of these patients, 72%, were prescribed renin-angiotensin system (RAS) blockers, and 45% were on statins. The relatively low prevalence of both LVSD and LVDD in this study can be attributed to several factors, including the exclusion of inducible ischemia through stress echocardiography, the short duration of T2DM, and the widespread utilization of RAS blockers.[12,13]

Conversely, in a Danish cohort of T2DM patients without established coronary artery disease or evident heart disease, the prevalence of Grade 2 LVDD was marginally higher at 18%, with the overall incidence of LVDD lower at 40% compared to the findings of our study. This discrepancy may be explained by the comparable mean age of patients in both cohorts, albeit with a shorter mean duration of T2DM, approximately 4.5 years, which could contribute to the lower prevalence observed in the Danish cohort. Furthermore, only 9% of individuals in the Danish cohort exhibited LVSD, although specific details regarding therapy were not provided.

In another study involving French T2DM patients with a mean diabetes duration of 11 years, excluding individuals with EF below 55% and coronary artery disease diagnosed within one month of enrollment through stress testing or myocardial perfusion studies, the prevalence of LVDD stood at 47%, comprising 33% with Grade 1 dysfunction and 14% with Grade 2 dysfunction. The comparatively lower prevalence of LVDD in this cohort, in contrast to our findings, can be attributed to the younger age of patients and the exclusion of individuals with coronary artery disease using functional and imaging modalities. However, it is noteworthy that despite the prolonged duration of T2DM and the absence of RAS blocker utilization, the prevalence of LVDD remained relatively low in this French cohort, indicating potential differences in disease progression or management practices warranting further investigation.[14,15]

CONCLUSION

Overall, the findings of this study underscore the multifaceted nature of diastolic dysfunction in the context of diabetes mellitus, emphasizing the need for comprehensive assessment and management strategies to address this significant cardiovascular complication in diabetic patients. Further research is warranted to elucidate the underlying mechanisms and optimize treatment approaches to improve outcomes in this patient population.

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