International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 13, No. 11, November 2024 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_13.11.2024.130

ORIGINAL RESEARCH

Study of diastolic dysfunction in newly detected cases of type 2 diabetes mellitus and its correlation with HbA1c

[1]Dr. R.M.Honntagi, [2]Dr. Chaitanya C. Patil, [3]Dr. Deepak Chinagi, [4]Dr. Vinod Kumar Reddy

[1]Professor, [2,4]Post Graduate, [3]Assistant Professor, Department of General Medicine, Shri B.M. Patil Medical College and Research Centre, Vijayapura, India

Corresponding author
Dr. Chaitanya C. Patil
Post Graduate, Department of General Medicine, Shri B.M. Patil Medical College and Research Centre, Vijayapura, India
Email: chaitanyaapatil97@gmail.com

Received Date: 27 September, 2024 Accepted Date: 30 October, 2024

ABSTRACT

Background: Diastolic abnormalities pertaining to the left side of ventricle imply the early categorization of heart disorders related to Diabetes, including Diabetic Cardiomyopathy. The diastolic abnormalities occur before the systolic abnormalities, and echocardiography is critical in the early determination of diastolic abnormalities. A cross-sectional study, aiming to understand the incidence of diastolic dysfunction among cases of diabetes mellitus in the first three months of their diagnosis and to correlate diastolic dysfunction and values of HbA1c. **Materials and Methods:** The study in Vijayapura in Karnataka had 63 patients with recently detected Diabetes Mellitus. Individuals with severe anemia, hemoglobinopathies, renal failure, valvular, ischaemic, and hypertensive cardiac disease, and patients with diagnosed Diabetes on medications were not included. The patients who were included gave their consent. In order to evaluate further, postprandial blood sugars, fasting blood samples, and HbA1c were obtained. Echocardiography was also performed to assess diastolic dysfunction. A statistical analysis was conducted utilising the Mann-Whitney and Chi-square tests. **Results:** Thirty-seven male and twenty-six female patients made up the 63 participants in the study. 49.2% of people had diastolic dysfunction. In patients with HbA1c of more than 8, 51.6% had diastolic dysfunction and 62.5% did not have diastolic dysfunction. p value was 0.383. Patients with diastolic dysfunction had mean fasting blood sugar levels of 169.65 mg/dl, while those without diastolic dysfunction had mean levels of 162.75 mg/dl. The p-value was 0.842. Patients with diastolic failure had mean postprandial blood sugars of 206, whereas patients without diastolic dysfunction had mean blood sugars of 223. p value was 0.251.Eight individuals with left ventricular hypertrophy had diastolic dysfunction. Albuminuria was present in 24 individuals with diastolic dysfunction.p value was 0.193. **Conclusion:** Diastolic abnormalities of the left ventricle are the first hallmark of diabetic Cardiomyopathy, and the degree is correlated with HbA1c levels. Diastolic dysfunction in diabetic patients leads to relatively early onset of congestive heart failure.Pulsed wave Doppler echocardiography can detect diastolic dysfunction early in the course of the illness.

Keywords: diastolic dysfunction, HbA1c, metabolic syndrome, diabetic cardiomyopathy

INTRODUCTION

Type 2 Diabetes Mellitus is the most prevalent and statistically significant metabolic disease in the world. Globally, there were an estimated 382 million diabetic people in 2013. It is concerning that the incidence of T2D is rising, and by 2035, more than 590 million people are expected to have been diagnosed with the illness.[1] According to the ADA and IDF criteria, the prevalence of diabetes worldwide for those aged 20 to 79 was 8.8% in 2017. By 2045, it is predicted to rise to 9.9%. This represents that the patients with Diabetes in 2017 were 424.9 million globally, with projections showing a 48% growth to 628.6 million by 2045. [2] The risk of having diabetic Cardiomyopathy and, thus, diastolic dysfunction also correlates with the values of fasting and postprandial blood sugars. [3]Heart Failure and Type 2 Diabetes Mellitus are serious public health issues that place a significant financial strain on Western society's health systems. As compared to HFrEF, HFpEF has a stronger correlation with Diabetic patients. [4] Diastolic dysfunction and myocardial hypertrophy are thought to be the primary characteristics of Diabetic Cardiomyopathy, with systolic followed by diastolic dysfunction as the disease progresses. Cardiomyocyte stiffening as a result of increased tone and

DOI: 10.69605/ijlbpr_13.11.2024.130

cytoskeleton breakdown is the first functional change. Myocardial SGLT-2 receptor abnormalities, coronary microvascular dysfunction, impairment of the myocardial NO pathway, inflammation and reactive oxygen species play a major role. [5]

There is a clear correlation between increased potential of acquiring heart failure and suboptimal glycemic management and reduced insulin sensitivity. Though LV diastolic function has been linked with HFpEF, T2DM independently is also a significant cause of HFpEF. Glycaemic variability and the development of cardiac events are correlated in patients with Type 2 diabetes mellitus. [6]

A decrease in the myocardial diastolic compliance or left ventricular active relaxation can result in diastolic dysfunction. Dilated Cardiomyopathy can happen irrespective of the status of systolic function and with or without congestive cardiac failure. Owing to this, dysfunction in diastole can be considered due to decreased mechanical properties of the heart, whereas the heart failure associated with diastole represents a symptomatic condition. [7] Diastolic failure can be detected before the development of symptoms by use of Doppler echocardiographic assessment in diabetic patients. [8]

AIMS AND OBJECTIVES

1. To interpret the prevalence associated with diastolic dysfunction among candidates of recently detected Diabetes Mellitus in the first three months of diagnosis.
2. To compare the severity of diastolic dysfunction with the values of HbA1c.

MATERIAL AND METHODS

The research project was held in Shri B.M. Patil Medical College in Vijayapura. It was done for 24 month starting in September 2022 and ending in May 2024. The study comprised 63 patientswith Type 2 Diabetes Mellitus in people aged 25–85 years who were diagnosed within the first three months of the condition's onset. The values of HbA1c, postprandial blood sugar levels, and fasting blood sugar readings were used to detect diabetes.

Fasting blood sugars more than 126mg/dl, Postprandial blood sugars more than 200mg/dl, and HbA1c more than 6.5% were the parameters considered to diagnose Type 2 Diabetes Mellitus. [9]

When gathering the patients' clinical histories, particular attention was paid to any comorbidities, addictions, and significant family history of cardiovascular disease. Every patient went through relevant clinical examination, and tests were performed to diagnose diastolic dysfunction, including HbA1c, complete blood count, renal and liver profile, fasting and postprandial blood sugars, and 2D echocardiography. The left ventricle ejection fraction was determined using the Modified Simpsons technique.

The presence of diastolic dysfunction was indicated when 2/4 criteria were fulfilled-

- The average E/e' ratio is more than 14.
- Septal e' velocity less than 7 cm/sec OR Lateral e' velocity less than 10 cm/sec
- The velocity of Tricuspid Regurgitation > 2.8 meters per second
- Index of LA volume > 34 ml/m2

Grades of Diastolic Dysfunction:

1: E/A ratio <1 or Delayed relaxation time
2: False Normalisation
3: Reversible restriction pattern
4: Irreversible restriction pattern

Inclusion criteria

Recently diagnosed caseswith Type 2 Diabetes Mellitus within the first three months of diagnosis.

Exclusion criteria

Participants with Chronic Kidney Disease, Chronic Obstructive Pulmonary Disease, Anemia, Valvular, Ischemic, Heart disease associated with Hypertension, Congestive heart failure, Cardiomyopathy, Known cases of Haemoglobinopathies, participants consuming drugs improving left ventricular diastolic dysfunction like Diuretics, ACE Inhibitors, ARB's were not includedin the study.

STATISTICAL ANALYSIS

Statistical software was used to conduct the statistical analysis on a Microsoft Excel document containing the collected data. (20th edition). The chi-square test was used to ascertain the association between left ventricular diastolic dysfunction and HbA1C. Any P-value that was less than 0.05 was taken to be statistically significant. Every statistical test had two tails.

RESULTS

63 patients with diabetes who were diagnosed within the first three months were taken in the study. Thirty-seven male patients and twenty-six female patients were studied. A total of patients , 15 males and 16 females had diastolic dysfunction. p-value was 0.101 (Table 1)

Table 1- Demographic details of sex and Diastolic Dysfunction

GENDER	LVDD		TOTAL
	PRESENT	ABSENT	
MALE	15	22	37
FEMALE	16	10	26
TOTAL	31	32	63

DOI: 10.69605/ijlbpr_13.11.2024.130

Table 2- Demographic details of age and Diastolic Dysfunction

Age Group(Yrs)	Total	No. Of Patients With LVDD
<25	1	0
25-44	6	0
45-64	33	18
>65	23	13

Diastolic dysfunction was most prevalent among 45-65 year age group. (Table 2)
Diastolic dysfunction was found in 48.4% of individuals with a HbA1c <8 and 51.6% of those with a HbA1c >8. Thus patients who had HbA1c >8 had greater prevalence of diastolic dysfunction. 37.5% of patients with HbA1c <8 and 62.5% with HbA1c >8 did not have diastolic dysfunction. p value was 0.383. (Table 3)

Table 3- Correlation of HbA1c with Diastolic Dysfunction

		LVDD		Total
		ABSENT	PRESENT	
HbA1c	< 8.0	12	15	27
		37.5%	48.4%	42.9%
	>8.0	20	16	36
		62.5%	51.6%	57.1%
Total		32	31	63

Patients with diastolic failure had a mean systolic blood pressure of 121.60, while those who did not have diastolic failure had a mean systolic blood pressure of 132.13.
p-value was 0.013, as a result of which this data was statistically significant.
The mean diastolic blood pressure was 75.63 in individuals with diastolic dysfunction and 79.37 in those without diastolic dysfunction. p value in this population of patients was 0.128.
Those without diastolic dysfunction had a mean fasting blood sugar level of 162.75 mg/dl, whereas patients with diastolic dysfunction had a mean level of 169.65 mg/dl. (p = 0.842)
In patients without diastolic dysfunction, the mean postprandial blood sugar value was 206, whereas in patients with diastolic dysfunction, it was 232. (p = 0.251)
Diastolic dysfunction was evident in 8 out of the individuals with left ventricular hypertrophyand absent in 4 individuals. Diastolic dysfunction was absent in twenty-eight patients and present in twenty-three patients without left ventricular hypertrophy.
A total of 46 patients had albuminuria. Out of these, diastolic dysfunction was present in 24 and absent in 22. p-value was 0.193. (Table 4)

Table 4- Correlation of various parameters with diastolic dysfunction and their respective p values.

PARAMETERS	WITH LVDD	WITHOUT LVDD	p- value (t-test)
Mean HbA1c	8.79	8.94	0.383
Mean FBS	169	162	0.842
Mean PPBS	232	206	0.251
Mean SBP	121.60	132.13	0.013
Mean DBP	75.63	79.37	0.128
No. of patients with LVH	8	4	0.178
Albuminuria	24	22	0.193

DISCUSSION

In the present investigation, we evaluated the frequency associated with diastolic dysfunction and its association with HbA1c values as well as left ventricular hypertrophy, fasting and postprandial blood sugars, blood pressure and albuminuria.
It was conducted in the first three months after diagnosis in 63 candidates with recently detected Diabetes mellitus. Diastolic failure was present in 49.2% of the candidates who participated.
Comparison of diastolic failure among various groups of research

Table 5- Comparison of diastolic failure among various groups of research

Researches	Diastolic Failure
Abhay Kumar et al. [10]	41%
Rishi T Guria et al. [11]	54%
RajendraDhar et al.[12]	39%

41.9% of cases among the age group of 65-74 possessed diastolic failure, and it was maximum in this age group. Diastolic dysfunction was directly proportional to the age of the patients. The average age of patients with diastolic dysfunction in the Abhay Kumar Chaudhary et al. study was 50.08 ± 6.32 years.

DOI: 10.69605/ijlbpr_13.11.2024.130

As the age increased, diastolic dysfunction became more common.[10]

In our study, 27 patients (42.9%) had HbA1c of less than 8 and 36 patients (57.1%) had HbA1c of more than 8. 15 patients with HbA1c less than 8 had diastolic dysfunction, and 16 patients with HbA1c more than 8 had diastolic dysfunction. P-value was 0.383. Rishi T. Guria et al. conducted research in which patients with LVDD had a mean HbA1c that was higher (11.07 ± 3.66%) than that of individuals with normal LVDD (9.11 ± 2.95%).p-value was 0.004, because of which the study was statistically significant.[11]

Themean HbA1c of the LVDD population in the study conducted by RajendraDhar et al. was higher (11.07 ± 3.66%) than that of the normal LVDD in the population (9.11 ± 2.95%). P value of 0.004 indicates that this difference was statistically significant. [12] (Table 5)

Here, the mean FBS was 169.65 in patients having diastolic dysfunction and the mean PPBS was 232. According to research by G Suresh et al., diabetic individuals with diastolic dysfunction had average fasting blood glucose levels of 197.33 mg/dL and average postprandial blood sugar levels of 245.03 mg/dL. [13]

Diastolic dysfunction was present in eight patients with left ventricular hypertrophy and was absent in four patients.Out of the 100 patients in Sanjeev Kumar et al.'s study, 72 had left ventricular hypertrophy and they had a higher incidence of diastolic failure. [14]

Albuminuria was present in 24 candidates having diastolic dysfunction and absent in 22 cases; the p-value was 0.193. In the Tanjung Wang et al. study, there was a 60% increase in diastolic failure in the patients having albuminuria, 77 patients had microalbuminuria, and 28 patients did not have macroalbuminuria. [15]

CONCLUSION

Individuals with diastolic dysfunction are more likely to have cardiac abnormalities and typically have higher HbA1c levels. Patients who do not obtain prompt diagnosis and treatment when diabetes and left ventricular failure combine usually have higher rates of morbidity and death. According to the current investigation, diastolic failure of the heart had more prevalence among candidates who had HbA1c values that were more significant than eight than in those with values below eight. Those with inadequate glycaemic management had a higher percentage of diastolic dysfunction, although the difference was statistically insignificant (p-value = 0.383).

REFERENCES

1. Reed J, Bain S, Kanamarlapudi V. A review of current trends with type 2 diabetes epidemiology, aetiology, pathogenesis, treatments and future perspectives. Diabetes, Metabolic Syndrome and Obesity. 2021 Aug 10:3567-602.https://www.tandfonline.com/doi/full/10.2147/DMSO.S319895#abstract
2. Standl E, Khunti K, Hansen TB, Schnell O. The global epidemics of diabetes in the 21st century: Current situation and perspectives. European journal of preventive cardiology. 2019 Dec 1;26(2_suppl):7-14.https://doi.org/10.1177/2047487319881021
3. Yun JS, Ko SH. Current trends in epidemiology of cardiovascular disease and cardiovascular risk management in type 2 diabetes. Metabolism. 2021 Oct 1;123:154838. https://doi.org/10.1016/j.metabol.2021.154838
4. Bouthoorn S, Valstar GB, Gohar A, den Ruijter HM, Reitsma HB, Hoes AW, Rutten FH. The prevalence of left ventricular diastolic dysfunction and heart failure with preserved ejection fraction in men and women with type 2 diabetes: A systematic review and meta-analysis. Diabetes and Vascular Disease Research. 2018 Nov;15(6):477-93. https://doi.org/10.1177/1479164118787415
5. NikolajevićStarčević J, Janić M, Šabovič M. Molecular mechanisms responsible for diastolic dysfunction in diabetes mellitus patients. International journal of molecular sciences. 2019 Mar 9;20(5):1197. **https://doi.org/10.3390/ijms20051197**
6. Yokota S, Tanaka H, Mochizuki Y, Soga F, Yamashita K, Tanaka Y, Shono A, Suzuki M, Sumimoto K, Mukai J, Suto M. Association of glycemic variability with left ventricular diastolic function in type 2 diabetes mellitus. Cardiovascular diabetology. 2019 Dec;18:1-8. https://doi.org/10.1186/s12933-019-0971-5
7. Madhumathi R, Gowdaiah PK, Dudhwewala A, Chaithra AN, Dande T. Echocardiographic evaluation of diastolic dysfunction in asymptomatic type 2 diabetes mellitus patients. diabetes. 2014;89.https://www.researchgate.net/profile/Amogh-Dudhwewala-2/publication/314424033_ECHOCARDIOGRAPHIC_EVALUATION_OF_DIASTOLIC_DYSFUNCTION_IN_ASYMPTOMATIC_TYPE_2_DIABETES_MELLITUS_PATIENTS/links/5bf2f455299bf1124fde58a3/ECHOCARDIOGRAPHIC-EVALUATION-OF-DIASTOLIC-DYSFUNCTION-IN-ASYMPTOMATIC-TYPE-2-DIABETES-MELLITUS-PATIENTS.pdf
8. Catena E, Volontè A, Rizzuto C, Bergomi P, Gambarini M, Fossali T, Ottolina D, Perotti A, Veronese A, Colombo R. The value of a dynamic echocardiographic approach to diastolic dysfunction in intensive care medicine. Journal of Clinical Ultrasound. 2024 Jan;52(1):95-102. https://doi.org/10.1002/jcu.23610
9. Sherwani SI, Khan HA, Ekhzaimy A, Masood A, Sakharkar MK. Significance of HbA1c test in diagnosis and prognosis of diabetic patients. Biomarker insights. 2016 Jan;11:BMI-S38440. https://doi.org/10.4137/BMI.S38440
10. Chaudhary AK, Aneja GK, Shukla S, Razi SM. Study on diastolic dysfunction in newly diagnosed type 2 diabetes mellitus and its correlation with glycosylated haemoglobin (HbA1C). Journal of clinical and diagnostic research: JCDR. 2015 Aug;9(8):OC20.doi: 10.7860/JCDR/2015/13348.6376
11. Guria RT, Prasad MK, Mishra B, Marandi S, Kumar A, Dungdung A. Association of glycosylated haemoglobin (hba1c) level with left ventricular diastolic dysfunction in patients with type 2 diabetes. Cureus. 2022 Nov;14(11).doi: 10.7759/cureus.31626

DOI: 10.69605/ijlbpr_13.11.2024.130

12. Dhar R, Lal B, Thakuria R, Pandey M, Bhardwaj S. Diabetes Mellitus Type II: Correlation between HBA1C Level and Left Ventricular Diastolic Dysfunction. Annals of International Medical and Dental Research. 2016;2(5):13.doi: 10.7759/cureus.31626
13. Suresh G, Alva R, Prakash PS, Saya RP. Prevalence of asymptomatic left ventricular diastolic dysfunction in type 2 diabetic patients and healthy controls: a comparative study. Archives of Medicine and Health Sciences. 2017 Jan 1;5(1):30-3.DOI: 10.4103/amhs.amhs_92_16
14. Kumar S, Aneja GK, Trivedi A, Atam V, Singh A, Verma N, Panwar PK. Glycosylated Hemoglobin (HbA1c) is a reliable Predictor of left ventricular hypertrophy (LVH) and left ventricular diastolic dysfunction (LVDD) in newly diagnosed type 2 diabetic patients of western Uttar Pradesh. DIABETES. 2014;126(200):6-5.
15. Wang T, Zhong H, Lian G, Cai X, Gong J, Ye C, Xie L. Low-grade albuminuria is associated with left ventricular hypertrophy and diastolic dysfunction in patients with hypertension. Kidney and Blood Pressure Research. 2019 Aug 6;44(4):590-603.https://doi.org/10.1159/000500782