Bangladesh Journal of Medicine (BJM)
ISSN : 1023 - 1986
eISSN : 2408 - 8366

ORIGINAL ARTICLE

STUDY OF LEFT VENTRICULAR DYSFUNCTION IN TYPE 2 DIABETES MELLITUS PATIENTS WITHOUT KNOWN CO-MORBIDITIES

MD. NAZIM UDDIN[1], MD. DAHARUL ISLAM[2], MOHAMMAD SARWAR ALAM[3], MD.ATAUR RAHMAN[4] , SHAZEDUR RAHMAN[5] KHORSHED MINHAJUL ALAM MONDLE[6], S.M MAHMUD HASAN[7], AHMED HOSSAIN[8]

Abstract

Background: *Subclinical left ventricular dysfunction in type 2 diabetes mellitus (DM) patients may precede the development of symptomatic heart failure. Detecting this dysfunction early could potentially prevent its progression. However, there is a scarcity of studies on this topic in Bangladesh. Therefore, this study aimed to explore the left ventricular function status in type 2 DM patients without any known co-morbid conditions in a tertiary care hospital.* ***Methods:*** *A cross-sectional study was conducted at the Department of Internal Medicine in Sir Salimullah Medical College & Mitford Hospital over a one-year period. A total of 100 patients with a diagnosis of type 2 DM, meeting the inclusion-exclusion criteria, were enrolled. Written informed consent was obtained from each participant, followed by the collection of socio-demographic data, detailed clinical history, and routine investigations. Echocardiograms were performed on all participants to assess the presence of systolic and diastolic dysfunction using various modes. Data analysis was conducted using the statistical software SPSS 23.0.* ***Results:*** *The mean age of the study patients was 47.23±9.13 (SD) years, with the majority in the age group of 40-49 years (43%). Female patients accounted for 58% of the sample, while male patients comprised 42%. The frequency of left ventricular diastolic dysfunction (LVDD) was 65%. The presence of LVDD was associated with longer duration of diabetes mellitus, higher HbA1C levels, older age, and increased BMI (p<.05).* ***Conclusion****: The majority of type 2 diabetic patients in this study exhibited left ventricular diastolic dysfunction, with a prevalence of 65%. Further larger-scale studies are recommended to validate these findings.*

Keywords: *Diabetes mellitus, left ventricular dysfunction, Echocardiography.*

Received: 15.07.2023 *Accepted: 16.08.2023*
DOI: https://doi.org/10.3329/bjm.v34i3.68429

Citation: *Uddin MN, Islam MD, Alam MS, Rahman MA, Rahman S, Mondle KMA et al. Study of Left Ventricular Dysfunction in Type 2 Diabetes Mellitus Patients without Known Co-Morbidities. Bangladesh J Medicine 2023; 34: 229-234.*

1. Junior Consultant Medicine, Upazilla Health Complex, Daulatpur Kushtia, Bangladesh.
2. Professor, Department of Medicine, Sir Salimullah Medical College, Dhaka, Bangladesh.
3. Assistant Professor , Department of Cardiology, Sir Salimullah Medical College, Dhaka, Bangladesh.
4. Junior Consultant Medicine, Sher–e-Bangla Medical Hospital, Barishal, Bangladesh.
5. MD (Cardiology) Student, Dept. of Cardiology, Sir Salimullah Medical College, Dhaka, Bangladesh.
6. MD (Medicine) Student, Dept. of Medicine, Sir Salimullah Medical College , Dhaka, Bangladesh.
7. Medical officer (Dialysis), Department of Nephrology, Rajshahi Medical College & Hospital, Rajshahi, Bangladesh.
8. Professor & Head , Department of Medicine, Sir Salimullah Medical College, Dhaka, Bangladesh.

Address of Correspondence: Dr. Md. Nazim Uddin**,** Junior Consultant Medicine, Upazilla Health Complex, Daulatpur Kushtia, Bangladesh. E-mail:nazimrmc@gmail.com

Introduction:

Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia. Several distinct types of DM are caused by a complex interaction of genetics and environmental factors (Chandey et al. 2020) .[1] Two broad categories of DM are Type 1 or Type 2. Type 1 is the result of complete or near-total insulin deficiency. Type 2 DM is a heterogeneous disorder characterized by variable degrees of insulin resistance, impaired insulin secretion, and increased glucose production (Kumar et al. 2017; Masugata et al. 2008)[2]. Diabetes is a significant public health problem regionally and globally. It is a leading cause of death in most countries (Zimmet et al. 2014)[3]. In 2019, the International Diabetes Federation estimated that 465 million (9.3%) people worldwide had diabetes and by 2045, the number may rise to 700 million (10.9%). A progressive increase in the prevalence of diabetes and pre-diabetes has been observed both in urban and rural areas in South Asia, primarily due to lifestyle changes and the transition to urbanization and industrialization (Chowdhury et al. 2018; Patil et al. 2011; Akhtar et al. 2020)[4]. Bangladesh is not an exception; based on published studies, the prevalence of diabetes ranges from 2.21% to 35% in this developing country (Saquib et al. 2013; Akhtar et al. 2020).[5]

Metabolic dysregulation associated with DM causes secondary pathophysiologic changes in multiple organ systems that lead to long-term chronic complications, accounting for further morbidity and mortality attributed to the disease (Kumar et al. 2017).[6]

It is associated with many cardiovascular complications, e.g., increased atherosclerotic coronary artery disease, myocardial infarction, congestive heart failure, coronary microangiopathy, systemic arterial hypertension, and cardiomyopathy. An early diagnosis on that account can be of great help to prevent or delay the development of these complications (Chawla, Chawla and Jaggi 2016).[7]

Diabetic cardiomyopathy refers to a disease process that affects the myocardium in diabetic patients causing a wide range of structural abnormalities eventually leading to left ventricular hypertrophy and diastolic and systolic dysfunction or a combination of these. In diabetic cardiomyopathy, a long subclinical course can be present in most patients before the development of symptoms (Chandey et al. 2020).[8]

Left ventricular diastolic dysfunction (LVDD) represents the earliest pre-clinical manifestation of diabetic cardiomyopathy, preceding the systolic dysfunction and evolving to symptomatic heart failure. Diastolic dysfunction is the dominant cause of heart failure in patients having diastolic heart failure. In diabetes mellitus, diastolic dysfunction results from abnormal myocardial active relaxation and increased passive stiffness due to metabolic derangements, microvascular disease, autonomic dysfunction, and structural remodeling. However, the exact pathogenesis of diabetic cardiomyopathy is still unclear (Freire et al. 2007; Silbiger 2019; Yadava et al. 2017).[9]

Doppler echocardiography has emerged as a valuable noninvasive diagnostic tool for assessing cardiac function, including diastolic and systolic function. Advanced echocardiographic techniques, such as tissue Doppler and color M-mode, have improved the detection of moderate diastolic dysfunction, particularly the pseudonormal pattern. Given the cardiometabolic implications of DM, a comprehensive evaluation of cardiovascular function is essential in diabetic patients.

Previous studies have reported varying prevalence rates of LVDD in Type 2 DM, ranging from 47% to 71%, and in individuals with left ventricular systolic dysfunction, the prevalence ranges from 6% to 25%. However, there is considerable uncertainty regarding the correlation between glycemic control and LVDD, with conflicting results reported in the literature. Therefore, this study aims to investigate left ventricular function abnormalities in patients with Type 2 DM without known co-morbidities, shedding light on the presence and characteristics of LVDD in this population.

Methods:

This study employed a cross-sectional design and was conducted at the Department of Internal Medicine in Sir Salimullah Medical College & Mitford Hospital. The study period spanned from January 2021 to December 2021, following the acceptance of the protocol. A total of 100 patients diagnosed with Type 2 DM were enrolled based on predefined inclusion and exclusion criteria.

Upon enrollment, written informed consent was obtained from each participant. Socio-demographic data, along with a detailed medical history, were collected from each patient. A thorough clinical examination was performed, and routine investigations were conducted. The glycemic status of the participants was assessed using the measurement of HbA1C.

Furthermore, each participant underwent an echocardiogram to evaluate the presence of both systolic and diastolic dysfunction. Echocardiographic assessment was performed using 2D mode, M-mode, and Doppler mode with color flow mapping. The left ventricular function was specifically assessed using these techniques. The echocardiogram was conducted with the patient in a left lateral recumbent position, utilizing standard parasternal, short axis, and apical views. The pulsed Doppler spectrum of mitral flow was analyzed to measure the peak velocity of early filling (E) and peak velocity of atrial filling (A). The ratio of E/A was calculated.

Diagnosis of diastolic dysfunction was determined based on the E/A ratio measured by M-mode echocardiographic measurements. A ratio of E/A less than 1 or greater than 2 indicated left ventricular diastolic dysfunction. Left ventricular systolic function was assessed by estimating the left ventricular ejection fraction (EF) using the modified Simpson's method. An ejection fraction less than 50% indicated left ventricular systolic dysfunction.

Data collected during the study were tabulated and analyzed using the statistical package SPSS version 23.0. Categorical variables were presented as frequency and percentage, while continuous variables were presented as mean and standard deviation. The association between variables was established using appropriate statistical tests such as chi-square test, t-test, or non-parametric tests. A confidence interval of 95% and an error margin of 5% were employed for data analysis. A p-value less than 0.05 was considered statistically significant.

The study protocol received approval from the ethical committee of Sir Salimullah Medical College, Dhaka. Strict confidentiality measures were implemented to safeguard the information and records of the participants. Moreover, the participants had the right to withdraw from the study at any time during the research period.

Results:

This cross-sectional study was conducted in the Outdoor Department of Sir Salimullah Medical College Medical College and Hospital. The study patients were selected from the attending patients with a confirmed diagnosis of type 2 diabetes mellitus and no known co-morbidities. A total of 100 patients were selected according to inclusion and exclusion criteria. The aim of the study was to assess the left ventricular function status of the studied patients.

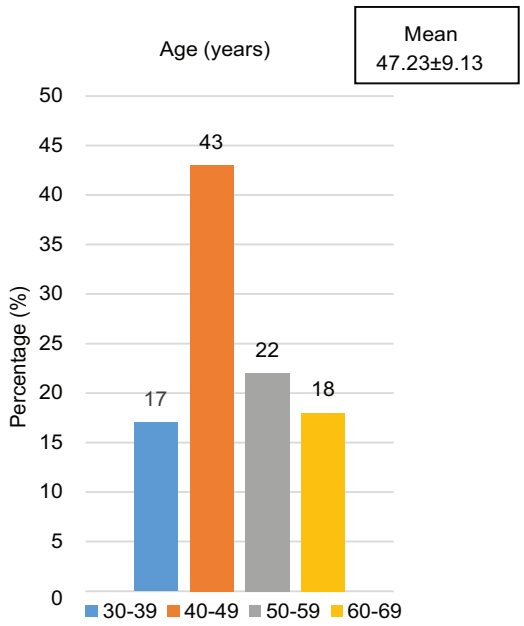

Figure 1: *Distribution of the study respondents according to age (n=100)*

The distribution of the study respondents according to age revealed that the majority of patients belonged to the 40-49 years age group (43%), followed by 50-59 years (22%), 60-69 years (18%), and 30-39 years (17%). The mean age of the patients was 47.23±9.13 (SD) years.

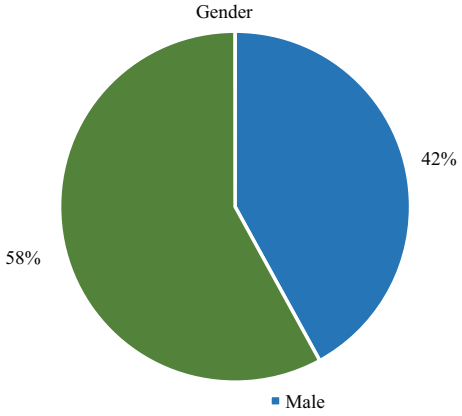

Figure 2: *Distribution of the study respondents according to gender (n=100)*

In terms of gender distribution, approximately 58% of the patients were female, while 42% were male.

Table-I

HbA1C among the study respondents (n=100)

H HbA1C (%)	n (%)	Mean±SD
<6.5	0	5.21±1.19
≥6.5	70	8.99±1.88

Regarding HbA1C levels, 30% of patients had HbA1C levels below 6.5% (mean 5.21±1.19%), while 70% had HbA1C levels equal to or above 6.5% (mean 8.99±1.88%)

Table II

Duration of type 2 DM among the study respondents (n=100)

Duration (years)	Percentage (%)	Mean±SD
≤5	59	5.79±4.0
6-10	32	
11-15	5	
16-20	4	

The mean duration of type 2 diabetes mellitus among the patients was 5.79±4.0 (SD) years. About 59% of the patients had type 2 diabetes for less than or equal to 5 years, 32% had it for 6-10 years, 5% had it for 11-15 years, and 4% had it for 16-20 years.

Table-III

Presence and type of left ventricular dysfunction among the study respondents (n=100)

LVD	Percentage (%)
Left ventricular diastolic dysfunction (present)	65
Left ventricular dysfunction (absent)	35
Left ventricular systolic dysfunction	00

In this study, about 65% of type 2 DM patients were observed with left ventricular diastolic dysfunction (LVDD).

Table IV

Association between the presence of LVD and HbA_1C among the study respondents (n=100)

HbA1C	LVD		Total	p value
	Yes n (%)	No n (%)		
<6.5	2(6.7)	28(93.3)	30	<.001*
≥6.5	63(90)	7 (10)	70	

p value was determined by chi-square test*

Patients with HbA1C levels equal to or above 6.5% had a higher prevalence of LVDD compared to those with HbA1C levels below 6.5%.

Table V

Relationship between the presence of LVD and duration of type 2 DM (n=100)

Duration of DM (years)	LVD		Total value	p value
	Yes n (%)	No n (%)		
d" 5	32 (54.2)	27 (45.8)	59	.044*
6-10	25 (78.1)	7 (21.9)	32	
11-15	4 (80)	1 (20)	5	
16-20	4 (100)	0	4	

p value was determined by chi-square test*

Values are expressed within parenthesis percentage (%) over row in total

Table VI

Relationship between the presence of LVD with age of the study respondents (n=100)

Age (years)	LVD		Total	p value
	Yes n (%)	No n (%)		
30-39	4 (23.5)	13 (76.5)	17	.001*
40-49	27 (62.8)	16 (37.2)	43	
50-59	19 (86.4)	3 (13.6)	22	
60-69	15 (83.3)	3 (16.7)	18	

p value was determined by chi-square test*
Values are expressed within parenthesis percentage (%) over row in total

The presence of LVD was statistically associated with the older age (p<.05).

Table VII

Comparison between the LVD and BMI (mean±SD) among the study respondents (n=100)

LVD	BMI (kg/m^2) mean±SD	*p* value
Yes	27.16±2.48	<.022*
No	24.83±2.71	

p value was independent student t test*

The mean BMI was also higher among the patients with LVD than the patients who didn't develop LVD (27.16±2.48kg/m^2 vs 24.83±2.71kg/m^2, p<.05).

Discussion:

This cross-sectional study focused on type 2 diabetic patients and provided insights into the prevalence of left ventricular dysfunction (LVDD) and its association

with various factors. The average age of the patients in this study was 47 years, with a majority falling in the 40-49 years age group. Additionally, female predominance was observed among type 2 DM patients, aligning with previous research by Safita et al. and Hira et al[10]. The influence of genetic factors, hormonal differences, and behavioral/environmental variations may contribute to the higher prevalence of type 2 DM in females (Kautzky-Willer, Harreiter, & Pacini)[11]

In terms of BMI, the majority of patients in this study were classified as obese (41%), followed by overweight (28%). A smaller percentage (12%) fell into the morbidly obese category, while only 19% had a normal BMI. These findings are consistent with studies by Mugharbel & Al-Mansouri, Al-Sharaf & Gunaid, Basukala, Sharma & Pandeya[12], which also reported high rates of increased BMI among type 2 DM patients.

The frequency of LVDD in this study was found to be 65%, with no cases of left ventricular systolic dysfunction (LVSD). This could be attributed to the fact that a significant portion (59%) of the type 2 DM patients had a disease duration of d" 5 years. Other studies, such as those conducted by Chandey et al[13]., Kumar et al[14]., Shrestha et al[15]., and Dike Ojji et al[16]., reported varying rates of LVDD, ranging from 66% to 81%. Dodiyi-manuel et al[17]. observed a lower prevalence of systolic dysfunction at 15.56%. These variations could be attributed to differences in study populations, diagnostic criteria, and patient characteristics.

The mean duration of type 2 DM in this study was 5.79±4.0 years. It was found that both longer disease duration and higher glycemic status, as indicated by HbA1C levels, were associated with the presence of LVDD. Older age and increased BMI were also identified as factors associated with LVDD. These findings are in line with previous studies highlighting the impact of glycemic control, disease duration, age, and BMI on the development of LVDD in type 2 DM patients.

Overall, this study provides valuable insights into the prevalence of LVDD among type 2 DM patients and its association with various factors. The findings underscore the importance of early detection, glycemic control, and lifestyle interventions, such as weight management, in preventing or managing LVDD in this population. Further research and larger-scale studies are warranted to validate these findings and explore additional factors contributing to LVDD in type 2 DM patients.

Conclusion:

The majority of type 2 diabetic patients in this study exhibited left ventricular diastolic dysfunction (LVDD) at a prevalence of 65%. The presence of LVDD was associated with longer duration of diabetes mellitus, higher HbA1C levels, older age, and increased BMI. These findings emphasize the importance of screening type 2 diabetic patients for subclinical LVDD using echocardiography to facilitate early interventions and prevent further deterioration.

Limitations:

Several limitations should be considered when interpreting the results of this study. Firstly, the samples were collected from a single site, which may limit the generalizability of the findings. Additionally, the sample size was small due to the constraints imposed by the Covid-19 pandemic. The study design was cross-sectional, which limits the ability to establish causal relationships. Furthermore, other parameters of diastolic dysfunction measurement, such as tissue Doppler imaging, were not included in the study.

Data Availability:

The datasets analysed during the current study are not publicly available due to the continuation of analyses but are available from the corresponding author on reasonable request.

Conflict of Interest:

The authors stated that there is no conflict of interest in this study

Funding:

This research received no external funding.

Ethical consideration:

The study was conducted after approval from the ethical review committee. The confidentiality and anonymity of the study participants were maintained

Acknowledgements:

The authors are thankfulto the study subjects for their active, sincere and voluntary participation. The authors are also grateful to the Department of Medicine, Salimullah Medical College and Mitford Hospital, Dhaka, Bangladesh for their kind support.

References:

1. Chandey, M., Kamboj, R., Sikri, T. & Kaur, N., Left ventricular dysfunction in patients with type 2 diabetes mellitus. International Journal of Advances in Medicine,2020; 7(1), 27-33. https://doi.org/10.18203/2349-3933.ijam20195610

2. Kumar, V.S., Sreelatha, M., Ramesh, K. & Shekar, G.C., 2017. Study of Left Ventricular Diastolic

Dysfunction in Type 2 Diabetes Mellitus Patients. International Journal of Scientific Study, 5(4), 219-214.

3. Zimmet, P.Z., Magliano, D.J., Herman, W.H. & Shaw, J.E. Diabetes: A 21st century challenge. The Lancet Diabetes and Endocrinology,2014; 2(1), 56-64. https://doi.org/10.1016/S2213-8587(13)70112-8 PMid:24622669

4. Chowdhury, M.Z.I., Anik, A.M., Farhana, Z., Bristi, P.D., Abu Al Mamun, B.M., Uddin, M.J., et al. Prevalence of metabolic syndrome in Bangladesh: A systematic review and meta-analysis of the studies. BMC Public Health, 2018;18(308). https://doi.org/10.1186/s12889-018-5209-z. PMid:29499672 PMCid:PMC5833131

5. Saquib, N., Khanam, M.A., Saquib, J., Anand, S., Chertow, G.M., Barry, M., et al. High prevalence of type 2 diabetes among the urban middle class in Bangladesh. BMC Public Health, 2013;13, 1032. https://doi.org/10.1186/1471-2458-13-1032. PMid:24172217 PMCid:PMC3924340

6. Akhtar, S., Nasir, J.A., Sarwar, A., Nasr, N., Javed, A., Majeed, R., et al. Prevalence of diabetes and pre-diabetes in Bangladesh: a systematic review and meta-analysis. BMJ open, 2020;10(9), 1-10. https://doi.org/10.1136/bmjopen-2019-036086. PMid:32907898 PMCid:PMC7482481

7. Chawla, A., Chawla, R. & Jaggi, S., 2016. Microvasular and macrovascular complications in diabetes mellitus: Distinct or continuum? Indian Journal of Endocrinology and Metabolism, 2016;20(4), 546-553. https://doi.org/10.4103/2230-8210.183480. PMid:27366724 PMCid:PMC4911847

8. Chandey, M., Kamboj, R., Sikri, T. & Kaur, N., Left ventricular dysfunction in patients with type 2 diabetes mellitus. International Journal of Advances in Medicine,2020;7(1), 27-33. https://doi.org/10.18203/2349-3933.ijam20195610

9. Silbiger, J.J. Pathophysiology and Echocardiographic Diagnosis of Left Ventricular Diastolic Dysfunction. Journal of the American Society of Echocardiography, 2019;32(2), 216-232.e2. https://doi.org/10.1016/j.echo.2018. 11.011. PMid:30717860

10. Safita, N., Mohammed, S., Islam, S., Chow, C.K., Niessen, L. & Lechner, A., The impact of type 2 diabetes on health related quality of life in Bangladesh/ : results from a matched study comparing treated cases with non-diabetic controls. Health and Quality of Life Outcomes,2016; 1-9. https://doi.org/10.1186/s12955-016-0530-7. PMid:27624600 PMCid:PMC5022158

11. Hira, R., Miah, M.A.W. & Akash, D.H., Prevalence of Type 2 Diabetes Mellitus in Rural Adults (>_31years) in Bangladesh. Faridpur Medical College Journal, 2018; 13(1), 20-23. https://doi.org/10.3329/fmcj.v13i1.38013

12. Kautzky-Willer, A., Harreiter, J. & Pacini, G., Sex and gender differences in risk, pathophysiology and complications of type 2 diabetes mellitus. Endocrine Reviews, 2016;37(3), 278-316. https://doi.org/10.1210/er.2015-1137. PMid:27159875 PMCid: PMC 4890267

13. Chandey, M., Kamboj, R., Sikri, T. & Kaur, N., Left ventricular dysfunction in patients with type 2 diabetes mellitus. International Journal of Advances in Medicine, 2020;7(1), 27-33. https://doi.org/10.18203/2349-3933.ijam20195610

14. Kumar, V.S., Sreelatha, M., Ramesh, K. & Shekar, G.C, Study of Left Ventricular Diastolic Dysfunction in Type 2 Diabetes Mellitus Patients. International Journal of Scientific Study,2017;5(4), 219-214.

15. Shrestha NR, Sharma SK, Karki P, Shrestha NK, A.P. Echocardiographic evaluation of diastolic function in asymptomatic type 2 diabetes. JNMA, 2009;48(173), 20-23. https://doi.org/10.31729/jnma.185

16. Ojji D, Parsonage W, Dooris M, Adebiyi A, Oladapo O, A.J. Left ventricular diastolic function in normotensive type-2 diabetic subjects. J Natl Med Assoc., 2008;100(9), 1066-72. https://doi.org/10.1016/S0027-9684(15)31446-2. PMid:18807437

17. Dodiyi-Manuel et al,Vascular Health and Risk Management 2013:9 529-533© 2013. https://doi.org/10.2147/VHRM.S44540. PMid:24109188 PMCid:PMC3792947