Journal of Cardiovascular Disease Research

ISSN: 0975-3583, 0976-2833 **VOL14, ISSUE 11, 2023**

Original Article

Study of Diastolic Dysfunction in Normotensive Type 2 Diabetes Mellitus

Dr. Harikrushna Prajapati [1*], Dr. Ajay Dabhi[2], Dr. Ami Jhala[3], Dr. Mirang Patel[4], Dr. Hardik Dabhi[5]

[1,3]Assistant Professor, Department of Medicine, Medical College Baroda, Vadodara, Gujarat, India
[2]Associate Professor, Department of Medicine, Medical College Baroda, Vadodara, Gujarat, India
[4,5]Resident Doctor, Department of Medicine, Medical College Baroda, Vadodara, Gujarat, India

***Corresponding Author:Dr. Harikrushna Prajapati**
Assistant Professor, Department of Medicine
Medical College Baroda, Vadodara, Gujarat, India
prajapatiharihkp@gmail.com

Abstract

Introduction: Diabetes Mellitus (DM) is one of the largest prevalence disease. It is a chronic progressive metabolic disease, which involves myocardium at relatively early stage even before clinical manifestations become obvious. Myocardial involvement in diabetes may occur early in the course of disease, initially impairing early diastolic relaxation and when more extensive causing decreased myocardial contraction.

Material and Methods: This cross sectional study comprised a total 100 cases of type 2 Diabetes Mellitus between age of 30 to 60 years who clinically had no symptoms of cardiovascular involvement and blood pressure <140/90 mm of Hg with normal ECG. The diagnosis of diabetes mellitus was made based on biochemical investigations like fasting blood sugar, postprandial blood sugar and HbA1C and / or past history of diabetes mellitus type 2. Observations were interpreted with p value <0.05 being considered statistically significant

Results: Out of 100 patients, 57 were male and 43 were female patients. Majority of cases were within first 10 years of duration since diabetes detected (84%). Out of 100 cases, 53% had HbA1C level >8 while 12% had HbA1C 6.5-7. Out of 100, 45% (cases) were detected to have diastolic dysfunction. Comparison with other study.

Conclusion: This study showed diabetes as an independent risk factor for diastolic dysfunction. Among 100 cases, 45% had diastolic dysfunction. Among the other variables, Age, duration of diabetes mellitus and HbA1C were found to be associated with diastolic dysfunction.

Key Words: Cardiovascular, Diabetes, Diastolic, Dysfunction

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 11, 2023

Introduction

Diabetes Mellitus (DM) is one of the largest prevalence disease. The worldwide prevalence of DM is 425 million in 2017 and it is expected to rise up to 629 million by 2045 according to International Diabetes Federation reports [1].

Myocardial involvement in diabetes may occur early in the course of disease, initially impairing early diastolic relaxation and when more extensive causing decreased myocardial contraction. More frequent incidence of heart failure in diabetics even in the absence of ischemic heart disease, valvular heart disease or another disorder outside DM, leads to the presumption that DM unfavourably affects the heart muscle by its complications [2].

Diastolic dysfunction (DD) of left ventricle may represent the reversible first stage of diabetic cardiomyopathy preceding changes in systolic function, reinforcing the importance of early assessment of diastolic function of left ventricle in patients with DM. Diastolic heart failure is a clinical entity that in most cases has a silent course and may be totally asymptomatic especially in early stage and almost constitute one half of all cases of heart failure.

Hence, diastolic function assessment should be included during an evaluation of cardiac function because approximately 50% of patients who develop heart failure have a preserved left ventricular ejection fraction (LVEF) [3]. Currently, echocardiography is the best non-invasive way to assess diastolic function of ventricles. The study intends to assess echocardiographic detection of left ventricular diastolic dysfunction in DM patients excluding other comorbidities.

Material and Methods

The main objective of study to determine the echocardiographic assessment of diastolic dysfunction in normotensive type 2 diabetes mellitus patients attending as outpatient or inpatient in the Department of Medicine.

This cross-sectional study included of 100-sample size to get 50% diastolic dysfunction among normotensive type 2 Diabetes Mellitus patient with 20% relative precision and 95% confidence.

INCLUSION CRITERIA:

1. A case of Type 2 Diabetes Mellitus.
2. Age: 30 – 60 years.
3. Blood Pressure: <140/90 mm of Hg. (At least 3 recordings with the highest recording taken into consideration.)

EXCLUSION CRITERIA:

Patient with:

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 11, 2023

1. Systemic Hypertension (BP>140/90 mm of Hg) or known case of Hypertension on antihypertensive.

2. Ischemic heart disease, Congestive heart failure, Congenital or acquired valvar heart disease, chronic renal failure.

6. Age <30 and >60 years.

7. Blood Urea >40 mg/dl and serum creatinine >1.2 mg/dl.

8. Ejection fraction less than 50% and Retinopathy.

The diagnosis of diabetes mellitus was made based on biochemical investigations like fasting blood sugar, postprandial blood sugar and HbA1C and / or past history of diabetes mellitus type 2.

A detailed clinical history with specific reference to cardiovascular symptoms, smoking, and alcohol consumption was taken. A general and systemic examination particularly for related to cardiovascular status was carried out. Patients with history of cardiac diseases like valvular heart disease, ischemic and hypertensive heart diseases, congestive heart failure, renal failure were excluded from the study.

All participants were subjected to the following after informed consent;

All the subjects underwent resting transthoracic 2-dimensional echocardiography and Doppler imaging to assess left ventricular diastolic function. The examinations were done with the patient in left lateral decubitus, utilizing left parasternal long axis, short axis apical 4 and 5 chamber views. The measurements included; LVEF and LV diastolic function were obtained from Doppler examination of mitral valve flow pattern. The transducer was positioned in the apical four chamber views; the sample volume marker was positioned at the level of mitral annulus.

Study data were analysed by Frequency percentage, Mean Standard Deviation (SD) and Chi Square test. Microsoft word and excel were used for charts and tables. Relation and association between variables were analysed with help of chi square test. Observations were interpreted with p value <0.05 being considered statistically significant and p value <0.01 being considered statistically highly significant.

Results

100 cases of patients fulfilling the inclusion criteria were taken in this cross-sectional study.

Out of 100 patients, 57 were male and 43 were female patients.

Out of 100 Cases, 23 were in 31-40 age group; while 42 and 35 in 41-50 and 51-60 age group, respectively.

The study cases were divided in 3 groups according to duration of DM since detection as below:

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 11, 2023

Table 1: Distribution of cases according to Duration of DM

Duration of DM (Yrs.)	0-5	6-10	>10	Total
Male	23	25	9	57
Female	17	19	7	43
Total	40	44	16	100

Majority of cases were within first 10 years of duration since diabetes detected (84%). [Table 1]

The study population was divided in 3 groups according to HbA1C levels.

Table 2: Distribution of cases according to HbA1C

HbA1C (%)	6.5-7	7.1-8	>8	Total
Male	9	20	28	57
Female	3	15	25	47
Total	12	35	53	100

Out of 100 cases, 53% had HbA1C level >8 while 12% had HbA1C 6.5-7. [Table 2]

Table 3: Gender wise distribution of Diastolic Dysfunction

DD	PRESENT	ABSENT	TOTAL
MALE	26 (45.6%)	31 (54.4%)	57
FEMALE	19 (44.2%)	24 (55.8%)	43

Out of 57 male cases, DD was present in 26 males (45.6%).

Out of 43 females taken, DD was present in 19 females (44.2%). [Table 3]

Table 4: Age wise distribution of Diastolic Dysfunction

DD\AGE (yrs.)	31-40	41-50	51-60
PRESENT	5 (21.7%)	18 (42.9%)	22 (62.9%)
ABSENT	18 (78.3%)	24 (57.1%)	13 (37.1%)
TOTAL	23	42	35

Out of 42 cases in the age group of 41-50 years, 18 cases (42.9%) had DD whereas 22 cases (62.9%) out of 35 in 51-60 years age group had DD. Therefore, percentages of DD increased with Age. [Table 4]

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 11, 2023

Out of 57 male cases, 20 were smokers out of which 10 (50%) had DD; and out of 37 non-smokers, 16 (43.2%) had DD.

Out of 57 male patients, 18 were alcoholic out of which 7 (38.9%) had DD; whereas out of 39 non-alcoholic patients, 19 (48.7%) had DD.

Table 5: Correlation of Duration of DM with DD

DD \ DURATION (yrs.)	0-5	6-10	>10
PRESENT	11 (27.5%)	23 (52.3%)	11 (68.8%)
ABSENT	29 (72.5%)	21 (47.7%)	5 (31.3%)
TOTAL	40	44	16

Out of 16 cases with duration of DM >10 years, 11 cases (68.8%) had DD as compared to 11 cases (27.5%) out of 40 cases had DD with duration of DM between 0-5 years. As the duration of DM since detection increased, the percentage of DD also increased. [Table 5]

Table 6: Correlation of HbA1C with DD

DD\HbA1C (%)	6.5-7	7.1-8	>8
PRESENT	3 (25%)	10 (28.6%)	32 (60.4%)
ABSENT	9 (75%)	25 (71.4%)	21 (39.6%)
TOTAL	12	35	53

Out of 53% cases with HbA1C levels >8, 60.4% (32cases) had DD; whereas out of 35% cases with HbA1C 7.1 to 8, 28.6% (10cases) had DD; and out of 12% with HbA1C 6.5 to 7.25% had DD. [Table 6]

Chi square test - It shows statistically significant correlation ofHbA1C with DD as p value 0.004 (less than 0.05).

Discussion

This cross-sectional study included 100 cases of normotensive type 2 diabetes mellitus meeting the inclusion criteria attending the inpatient and outpatient department of general medicine at SSG hospital.

Out of 100, 45% (cases) were detected to have diastolic dysfunction. Comparison with other study,

Study	Percentage
Virendra Patil et al	54.33 %
Markuszewsk et al	43 %

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 11, 2023

Poirier et al	60 %
Present Study	45 %

Comparison shows that this study has similar result of 45% of prevalence of diastolic dysfunction among study cases with Markuszewsk et al; while discordant result with other two studies.

Gender wise distribution of cases suggested that 44.2% of females had DD whereas 45.6% of males had DD. The gender wise distribution was not statistically significant.

Out of cases, none of females had any addictions.

Out of 57 male cases, 20 were smokers (35.1%) and 37 were non-smokers (64.9%). Out of smoker cases, 50% had DD; whereas among non-smoker cases, 43.2% had DD. The correlation was not statistically significant. (P value 0.625).

Out of 57 male cases, 18 were alcoholic (31.6%) and 39 were non-alcoholic (68.4%). Out of alcoholic males, 38.9% had DD; whereas among non-alcoholic cases, 48.7% had DD. The correlation was not statistically significant. (P value 0.489).

Out of total 100 cases, 23% were in age group of 31-40 years, 42% in 41-50 and 35% in 51-60 years. Out of 35 cases in the age group of 51-60 years, 22 cases (62.9%) had DD; 42.9% in the age group of 41-50 years had DD, whereas 21.7% in 31-40 age group had DD.

The incidence of DD was highest in the age group 51-60 years. This finding was statistically significant (P value 0.008). Thus, older the age group, more the DD. Similar results were found in Virendra Patil et al (2011) – DD was significantly higher in age >45 years compared to age <45 years.

In the study, population was divided in 3 groups in relation to duration of DM; 40% were having duration of DM detection from 0-5 years, 44% with 6-10 years and 16% with duration of more than 10 years. Out of the 0-5 years group 27.5% cases had DD; 52.3% of the duration 6-10 years had DD and 68.8% of cases with duration more than 10 years had DD. This was found to be statistically significant (P value 0.008). The same concluded by Gani et al (2005) and found that the duration of DM had significant correlation with DD (P value <0.01).

Out of study population, 49% were on OHA; out of which 36.7% had DD. 21% on insulin, out of which 47.6% had DD and 30% were on both out of which 56.7% had DD. There was found to be no statistically significant relation of treatment taken and DD (P value 0.216).

Out of study population, 19% were have BMI >30; 49% had BMI 25-29.9; 22% had BMI 23-24.9, whereas only 10% were in normal BMI group. In the present study, 68.4% of the BMI

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 11, 2023

>30 cases had DD; 44.9% of the BMI 25-29.9 diabetics had DD, 31.8% of diabetics with BMI 23-24.9 had DD and 30% (3 out of 10 cases) of the normal BMI group with DD. Therefore, correlation of BMI with DD was not statistically significant (p value 0.0834).

In the study, out of 100 cases, 12% had HbA1C levels between 6.5 to 7 %; 35% had HbA1C levels between 7.1 to 8% and 53% had HbA1C more than 8%. The prevalence of DD increased as the glycemic control decreased. In this study, 60.4% of HbA1C >8% had DD; 28.6% had DD with HbA1C between 7.1 to 8% and 25% of cases with HbA1C of 6.5 to 7% had DD. The correlation was found to be statistically significant (P value 0.004).

In previous study like, Virendra Patil et al (2011) showed that cases with HbA1C > 7.5% had more prevalence of DD. Markuszewsk et al found that DD was observed in 43% of cases with HbA1c >6.1% as compared to 4.5% of patients with HbA1C less than or = to 6.1%. Thus, it is concluded that HbA1C is an independent risk factor in diabetes mellitus causing diastolic dysfunction.

Limitations of study

1. A Sample size of 100 for study of such a disease, which has high prevalence worldwide, is not sufficient for better precise results.
2. On echocardiographic examination, only E/A ratio was used for assessment of diastolic function. There is another measure like DT-E (deceleration time of E wave) and IVRT (isovolumic relaxation time) can be used for better detection of diastolic function. Which we have not done as facility is not available here at SSGH
3. Follow up of patients is required, irrespective of diastolic dysfunction was present or not at, to know whether diastolic dysfunction has developed or not in due course of time.

Conclusion

This study showed diabetes as an independent risk factor for diastolic dysfunction. Among 100 cases, 45% had diastolic dysfunction. Among the other variables, Age, duration of diabetes mellitus and HbA1C were found to be associated with diastolic dysfunction.

By comparing the presence and absence of diastolic dysfunction among the diabetic cases, the variables (Age, Duration of diabetes mellitus, HbA1C level) were found to be statistically significant.

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 11, 2023

References

1. International Diabetes Federation. Diabetes Atlas, 8th edition.
2. G.S V, Shettigar UU. Echocardiographic Study of Left Ventricular Diastolic Dysfunction in Diabetes Mellitus. IJHSR 2014; 4(2): 78-85.
3. Harrison's Principles of Internal Medicine, 19th edition, vol.2,1501
4. Zile MR. Baicu CF: Alterations in ventricular function: diastolic heart failure. In "Heart Failure, A Companion to Braunwald's Heart Disease" Edited by: Mann D. Saunders: 2004.
5. Braunwald's Heart Disease, 9th edition.
6. Caruana L. Petrie MC. Davie AP, McMurray JJ: Do patients with suspected heart failure and preserved left ventricular systolic function suffer from "diastolic heart failure" or from misdiagnosis? A prospective descriptive study. BMJ 2000. 321:215-218.
7. Vasan RS. L arson MG. Benjamin EJ. Evans JC. Rsiss CK. Levy D: Congestive heart failure in subjects with normal versus reduced left ventricular ejection fraction: prevalence and mortality in a population-based cohort. J Am CollCardiol 1999. 33:1948-1955.
8. Hogg K. Swedberg K. McMurray J: Heart failure with preserved left ventricular systolic function: epidemiology, clinical characteristics, and prognosis. J Am CollCardiol 2004, 43:317-327.
9. Yusuf S. Pfeffer MA, Swedberg K, et al Effects of candesartan In patients with chronic heart failure and preserved left-ventricular ejection fraction: The CHARM-Preserved Trial. Lancet 362:777-781, 2003
10. Nishimura RA, Tajik AJ: Evaluation of diastolic filling of left ventricle in health and disease: Doppler echocardiography is the clinician's Rosetta Stone. J Am CollCardiol 30:8-18. 1997
11. Zile MR. Brutsaert DL: New concepts in diastolic dysfunction and diastolic heart failure. Part I. Diagnosis, prognosis, and measurements of diastolic function. Circulation 105:1387-1393, 2002
12. Redfield MM. Jacobsen SJ. Burnett Jr JC. et al: Burden of systolic and diastolic ventricular dysfunction in the community: Appreciating the scope of the heart failure epidemic. JAMA 289:194-202. 2003
13. Yusuf S, Pfeffer MA, Swedberg K, et al: Effects of candesartan in patients with chronic heart failure and preserved left ventricular ejection fraction: The CHARM-Preserved Trial. Lancet 2003;362:777

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE 11, 2023

14. Flather MD, Shibata MC. Coats AJS et al. Randomized trial to determine the effect of nebivolol on mortality and cardiovascular hospital with heart failure. Eur Heart J 2005: 26: 215-25.
15. Chen HH, Lainchbury JB, Senni M, Redfield MM. Factors influencing survival in patients with diastolic heart failure in Olmsted County, Minn. *Circulation*. 2000;102:II412
16. Angomachalelis N, Hourzamanis AI, Sideri S, Serasli E, Vamvalis C. Improvement of left ventricular diastolic dysfunction in hypertensive patients 1 month after ACE inhibition therapy: evaluation by ultrasonic automated boundary detection. *Heart Vessels*. 1996;11:303–9
17. Mitsunami K, Inoue S, Maeda K, Endoh S, Takahashi M, Okada M, et al. Three-month effects of candesartan cilexetil, an angiotensin II type 1 (AT1) receptor antagonist, on left ventricular mass and hemodynamics in patients with essential hypertension. *Cardiovasc Drugs Ther*. 1998;12:469–74
18. Warner JG Jr, Metzger DC, Kitzman DW, Wesley DJ, Little WC. Losartan improves exercise tolerance in patients with diastolic dysfunction and a hypertensive response to exercise. *J Am Coll Cardiol*. 1999;33:1567–72
19. Pitt B, Zannad F, Remme WJ, Cody R, Castaigne A, Perez A, et al., for the Randomized Aldactone Evaluation Study Investigators.. The effect of spironolactone on morbidity and mortality in patients with severe heart failure. *N Engl J Med*. 1999;341:709–17.
20. Cohn JN, Johnson G, for the Veterans Administration Cooperative Study Group. Heart failure with normal ejection fraction. The V-HeFT Study. *Circulation*. 1990;81(2 suppl):III48–53.
21. Redifield MM. Jacobsen SJ. Burnett JC Jr. Mahoney DW, Bailey KR, Rodeheffer RJ. Burden of systolic and diastolic ventricular dysfunction in the community: appreciating the scope of the heart failure epidemic. JAMA, 2003, 289, 194-202.
22. Bella JN. Palmieri V. RomanMJ, et al. Mitral ration of peak early to late diastolic filling velocity as a predictor of mortality in middle-aged and elderly adults: the Strong Heart Study. Circulation, 2002, 105, 1928-33.
23. Poirier P. Garneau C, Bogaty P. Et al. Impact of LV diastolic dysfunction on maximal treadmill performance in normotensive subjects with well controlled type 2 diabetes mellitus. AmJCardiol, 2000, 85, 473-7.