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Original Research Article

Glycosylated hemoglobin and left ventricular diastolic dysfunction in patients with type 2 diabetes mellitus

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ABSTRACT

Background: Diabetes mellitus is one of the most common diseases. Left ventricular diastolic dysfunction may represent the early stage of diabetic cardiomyopathy thus reinforcing the importance of the early examination of diastolic function in individuals with diabetes.
Methods: This is a hospital based cross-sectional study done at a tertiary care hospital catering mainly to rural population. Patients having type 2 diabetes mellitus were scrutinized for doppler echocardiography and HbA1c levels. As per the previous studies and considering the prevalence of asymptomatic diastolic dysfunction in diabetics, the sample size was calculated. Statistical analysis was done by using descriptive and inferential statistics using chi square test.
Results: In the present study 45 patients had HbA1C between 6.5- 8.0, out of which 9 had type I diastolic dysfunction, 1 had type II diastolic dysfunction and 35 had no diastolic dysfunction. 16 patients had HbA1C between 8.1- 9.5, out of which 7 had type I diastolic dysfunction, 8 had type II diastolic dysfunction and 1 had no diastolic dysfunction. 14 patients had HbA1C more than 9.5, out of which 4 had type I diastolic dysfunction, 5 had type II diastolic dysfunction, 4 had type III diastolic dysfunction and 1 patient did not had any diastolic dysfunction. The Chi-Square value is 55.51 and p value is 0.000 (Significant).
Conclusions: Diastolic dysfunction correlates with the levels of glycosylated hemoglobin, duration of diabetes mellitus, presence of microvascular complications like diabetic retinopathy, neuropathy and nephropathy.

Keywords: Cardiomyopathy, Diabetes, Diastolic dysfunction, Glycosylated hemoglobin

INTRODUCTION

Diabetes mellitus is one of the most common diseases in the world and is aquiring epidemic proportions. The World Health Organization estimates that diabetics may be more than 500 million by 21st century.[1] India is the 'Diabetic Capital of the World.[1]

The major risk factors associated with diabetes are age, positive family history, obesity, physical inactivity and insulin resistance.

The association of diabetes and heart is known since many years. In 1972, Rubler et al first brought diabetic cardiomyopathy to notice.[2] In 1974, Framingham study stated that heart failure is more common in diabetics due to diabetic cardiomyopathy.

The Framingham Heart Study revealed a marked increase in congestive heart failure, coronary artery disease and myocardial infarction in diabetic patients.[2] Several causative mechanisms for diabetic cardiomyopathy are postulated including microangiopathy, autonomic

nervous dysfunction, defective cellular calcium transport as well as structural changes in myocardial intracellular proteins and accumulation of collagens leading to increased stiffening of the ventricular wall.[3] Left ventricular diastolic dysfunction may represent the initial stage of diabetic cardiomyopathy thus reinforcing the importance of the early examination of diastolic function in individuals with diabetes.[4]

This study "Glycosylated hemoglobin and left ventricular diastolic dysfunction in patients with type 2 diabetes mellitus" was undertaken to evaluate left ventricular diastolic function in diabetics and to assess the correlation of diastolic dysfunction and HbA1c levels.

The aims and objectives of the study was to assess the diastolic dysfunction in patients with type 2 diabetes mellitus and the correlation of diastolic dysfunction and HbA1c level.

METHODS

A total of 75 patients of Type 2 diabetes mellitus were selected for the study from November 2012 to November 2014 at Lata Mangeshkar Hospital attached to N.K.P Salve Institute of Medical Sciences, Hingna, Nagpur. Patients having type 2 diabetes mellitus admitted at Lata Mangeshkar Hospital were scrutinized for doppler echocardiography and HbA1c levels after taking written consent.

After obtaining Informed consent from the patient, a demographic data of the patient (age, sex) was obtained. Detailed history related to diabetes (age at onset, duration of diabetes from time of being diagnosed, treatment taken, and complication of diabetes were noted. Lifestyle risk factors (alcohol use, tobacco use, smoking, exercise) were also noted. Physical and systemic examination was carried out. Following tests were carried out-urine (albumin, sugar, microscopy), FBS, PMBS, HbA1c, TSH, blood urea, creatinine, Fundoscopy, lipid profile, and 2DECHO.

Inclusion criteria

- Patients with type 2 diabetes mellitus in the age group of 30-55 years independent of sex,
- Patients willing to participate in the study.

Exclusion criteria

- Patients of Ischaemic heart disease, hypertension, thyroid diseases, cardiomyopathy, valvular heart disease, peripheral vascular disease,
- Patients with BMI of more than 35,
- Patients with regional wall motion abnormality on 2D ECHO.

Study design

This is a hospital based cross-sectional study to be done at a tertiary care hospital catering mainly to rural population.

Calculation of sample size

As per the previous studies and considering the prevalence of asymptomatic diastolic dysfunction in diabetics, the sample size calculated is as follows:

For a prevalence of 63%

P=63, q=100-63=37, L=Allowable Error = 20% of p = 20 x 63/100 =12.6

Sample size

n= 4pq / L2 = 4x 63 x 37/(12.6 x 12.6)=58.73= 60 approx.

Thus, based on prevalence of left ventricular diastolic dysfunction in Type 2 diabetes patients, sample size is taken as 75.

Diabetic retinopathy

Diabetic retinopathy was diagnosed on fundus examination. It was defined as the presence of micro-aneurysms alone or with any of the following lesions – haemorrhages, cotton wool spots, intra-retinal micro-vascular abnormalities, retinal hard exudates, venous beading, venous loops and/or replication, fibrous proliferations, pre-retinal haemorrhage, vitreous haemorrhage and new vessels. Fundus examination was done by direct ophthalmoscopic examination after dilating the pupil, by an expert single observer.

Diabetic neuropathy

The diagnosis of diabetic neuropathy was based on clinical evaluation.

Diabetic nephropathy

Diabetic nephropathy was diagnosed on the basis of albuminuria in urine routine examination.

Doppler echocardiography

2 D Echo machine of Toshiba Diagnostic Ultrasound system, Erbis Engineering Company (Model No: UIDL-580 A) was used for doppler echocardiography. In the doppler echocardiography following parameters were studied pre valsalva and during valsalva maneuver to unmask the pseudo normal pattern. The Valsalva maneuver was done by asking patients to blow BP

apparatus where >30mm of Hg was sustained for 10sec during which recordings were taken.

- E-wave -> Peak early transmitted filling velocity during early diastole,
- A-wave-> peak transmitral atrial filling velocity during late diastole,
- E: A ratio,
- DT -> Deceleration time. Diastolic dysfunction was measured and was classified as per following

Table 1: Stages of diastolic dysfunction.

Parameter	Normal	Stage I Impaired relaxation	Stage II (Pseudo normal)	Stage III restrictive filling (irreversible)	Stage IV restrictive filling (irreversible)
E/A ratio	0.9-1.5	<0.9	0.9-1.5	1.8	>2.0
E/A with VALSALVA	Both E and A decrease, ratio unchanged	Both E and A decrease, ratio unchanged	E decreases, A increase, ratio reverses	Ratio decreases but still >1	No response
Deceleration time (MS)	140-240	>240	140-200	<140	<130

Statistical analysis

Statistical analysis was done by using descriptive and inferential statistics using chi square test. The software used in the analysis were SPSS 17.0 and Graphpad Prism 5.0 and $p<0.05$ is considered as level of significance. Glycosylated hemoglobin (HbA1c) is measured using the Nycocard HbA1c test. Nycocard HbA1c is in vitro diagnostic medical device for quantitative determination of glycated hemoglobin (HbA1c) in human whole blood.

Test principle-Nycocard HbA1c is a boronate affinity assay. The kit contains test devices with a porous membrane filter, test tubes prefilled with reagent and a washing solution. The reagent contains agents that lyse erythrocyte and precipitate hemoglobin specifically as well as a blue boronic acid conjugate that binds cis-idols of glycated hemoglobin. When blood is added to the reagent, the erythrocytes immediately lyse. All hemoglobin precipitates.

The boronic acid conjugate binds to the cis-idol configuration of glycated hemoglobin. An aliquot of the reaction mixture is added to the test device, and all the precipitated hemoglobin, conjugate- bound and unbound, remains on the top of the filter. Any excess of coloured conjugate is removed with the washing solution.

The precipitate is evaluated by measuring the blue (glycated hemoglobin) and the red (total hemoglobin) colour intensity with the Nycocard READER II, the ratio between them being proportional to the percentage of HbA1c in the sample.

Characteristics of the test

Nycocard HbA1c measures the total glycated hemoglobin and reports the HbA1c value. The following hemoglobin variants do not affect the test result: HbAC, HbAF, HbAJ, HbAS and Hb Yamagata. Carbamylated and pre-glycated hemoglobin does not affect the test result. Nycocard HbA1c is standardized to the IFCC Reference Method for measurement of HbA1c.

Limitations of the test

- Elevated amounts of glucose, bilirubin, lipids and fructosamine were added to blood samples with normal and elevated HbA1c values. No interference was obtained,
- Hemolysed samples with plasma Hb >3g/100ml will interfere with the test system.

RESULTS

In the present study 7 patients belong to age group of 30-39 years, out of which 1 had type I and 1 had type II diastolic dysfunction. Rest patients had no diastolic dysfunction. 29 patients belong to age group of 40-49 years, out of which 7 had type I diastolic dysfunction, 3 had type II diastolic dysfunction and 2 had type III diastolic dysfunction. Rest patients had no diastolic dysfunction. 39 patients belong to age group of 50-55 years, out of which 12 had type I diastolic dysfunction, 10 had type II diastolic dysfunction and 2 had type III diastolic dysfunction. Rest patients had no diastolic dysfunction. The Chi-Square value is 5.52 and p value is 0.47 (Non-Significant).

Table 2: Distribution of age with lv diastolic dysfunction.

Age	Normal (%)	Type I DD (%)	Type II DD (%)	Type III DD (%)	Type IV DD (%)	Total (%)
30-39 yrs	5 (6.67)	1 (1.33)	1 (1.33)	0 (0)	0 (0)	7 (9.33)
40-49 yrs	17 (22.67)	7 (9.33)	3 (4)	2 (2.67)	0 (0)	29 (38.67)
50-55yrs	15 (20)	12 (16)	10 (13.33)	2 (2.67)	0 (0)	39 (52)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (100)
N2-Value	5.52					
P-Value	0.47, NS, P>0.05					

In the present study 35 were males out of which 12 had type I diastolic dysfunction, 7 had type 2 diastolic dysfunction and 3 had type III diastolic dysfunction. Rest patients had no diastolic dysfunction.40 were females out of which 8 had type I diastolic dysfunction, 7 had type 2 diastolic dysfunction and 1 had type III diastolic dysfunction. Rest patients had no diastolic dysfunction. Chi-Square value is 4.75 and p value is 0.19 (Non-Significant).

Table 3: Distribution of sex with LV diastolic dysfunction.

Gender	Normal (%)	Type I DD (%)	Type II DD (%)	Type III DD (%)	Type IV DD (%)	Total (%)
Male	13 (17.33)	12 (16)	7 (9.33)	3 (4)	0 (0)	35 (46.67)
Female	24 (32)	8 (10.67)	7 (9.33)	1 (1.00)	0 (0)	40 (53.33)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (100)
N2-value	4.75					
P-value	0.19, ns, p>0.05					

In the present study 58 patients had DM of less than 5 years duration out of which 15 had type I diastolic dysfunction, 3 had type II diastolic dysfunction and 3 had type III diastolic dysfunction. Rest of the patients had no diastolic dysfunction.16 patients had DM of 5- 10 years duration out of which 5 had type I diastolic dysfunction, 11 had type II diastolic dysfunction and rest of the patients had no diastolic dysfunction. 1 patient had diabetes mellitus of more than 10 years duration and he had type III diastolic dysfunction. The Chi-Square value is 56.25 and p value is 0.000 (significant).

Table 4: Distribution of duration of diabetes mellitus with LV diastolic dysfunction.

Duration of DM	Normal (%)	Type I DD (%)	Type II DD (%)	Type III DD (%)	Type IV DD (%)	Total (%)
< 5 yrs	37 (49.33)	15 (20)	3 (4)	3 (4)	0 (0)	58 (77.33)
5-10 yrs	0 (0)	5 (6.67)	11 (14.67)	0 (0)	0 (0)	16 (21.33)
>10 yrs	0 (0)	0 (0)	0 (0)	1 (1.33)	0 (0)	1 (1.33)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (100)
N2-value	56.25					
P-value	0.000, s, p<0.05					

In the present study there were 21 patients who had their FBS between 100-125, out of which 5 had type I diastolic dysfunction, 2 had type II diastolic dysfunction and the rest patients had no diastolic dysfunction.54 patients had their FBS above 125 mg/dl, out of which 15 had type I diastolic dysfunction, 12 had type II diastolic dysfunction and 4 had type III diastolic dysfunction. Rest patients were normal. The Chi-Square value is 4.72 and p value is 0.19 (Non-Significant).

Table 5: Distribution of FBS with LV diastolic dysfunction.

FBS	Normal (%)	Type I DD (%)	Type II DD (%)	Type III DD (%)	Type IV DD (%)	Total
<100	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
100-125	14 (18.67)	5 (6.67)	2 (2.67)	0 (0)	0 (0)	21 (28)
>125	23 (30.67)	15 (20)	12 (16)	4 (5.33)	0 (0)	54 (72)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (10000)
N2-value	4.72					
P-value	0.19, ns, p>0.05					

In the present study 2 patients had PMBS less than 140, out of which 1 had type I diastolic dysfunction and 1 had type II diastolic dysfunction, rest had no diastolic dysfunction. 23 patients had PMBS between 140- 200 mg/dl, out of which 5 had type I diastolic dysfunction ,4 had type II diastolic dysfunction,1 had type III diastolic dysfunction and rest had no diastolic dysfunction. 50 patients had PMBS above 200 mg/dl, out of which 14 had type I diastolic dysfunction, 9 had type II diastolic dysfunction, 3 had type III diastolic dysfunction and rest had no diastolic dysfunction. The Chi-Square value is 3.17 and p value is 0.78 (Non-Significant).

Table 6: Distribution of PMBS with LV diastolic dysfunction.

PMBS	Normal (%)	Type I DD (%)	Type II DD (%)	Type III DD (%)	Type IV DD (%)	Total (%)
<140	0 (0)	1 (1.33)	1 (1.33)	0 (0)	0 (0)	2 (2.67)
140-200	13 (17.33)	5 (6.67)	4 (5.33)	1 (1.33)	0 (0)	23 (30.67)
>200	24 (32)	14 (18.67)	9 (12)	3 (4)	0 (0)	50 (66.67)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (100)
N2-Value	3.17					
P-Value	0.78, NS, P>0.05					

In the present study 1 patient had BMI below 20 and who had no diastolic dysfunction. 47 patients had BMI between 20-25, out of which 11 had type I diastolic dysfunction, 10 had type II diastolic dysfunction, 2 had type III diastolic dysfunction and rest had no diastolic dysfunction. 27 patients had BMI between >25-30, out of which 9 had type I diastolic dysfunction, 4 had type II diastolic dysfunction, 2 had type III diastolic dysfunction and rest had no diastolic dysfunction. The Chi-Square value is 2.53 and p value is 0.86 (Not Significant).

Table 7: Distribution of BMI (kg/m^2) with LV diastolic dysfunction.

BMI	Normal (%)	Type I DD (%)	Type II DD (%)	Type III DD (%)	Type IV DD (%)	Total (%)
<20	1 (1.33)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1.33)
20 - 25	24 (32)	11 (14.67)	10 (13.33)	2 (2.67)	0 (0)	47 (62.67)
>25 - 30	12 (16)	9 (12)	4 (5.33)	2 (2.67)	0 (0)	27 (36)
>30 - 35	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (100)
N2-Value	2.53					
P-Value	0.86, NS, P>0.05					

In the present study 45 patients had HbA1C between 6.5-8.0, out of which 9 had type I diastolic dysfunction, 1 had type II diastolic dysfunction and 35 had no diastolic dysfunction. 16 patients had HbA1C between 8.1-9.5, out of which 7 had type I diastolic dysfunction, 8 had type II diastolic dysfunction and 1 had no diastolic dysfunction.

14 patients had HbA1C more than 9.5, out of which 4 had type I diastolic dysfunction, 5 had type II diastolic dysfunction, 4 had type III diastolic dysfunction and 1 patient did not had any diastolic dysfunction. The Chi-Square value is 55.51 and p value is 0.000 (Significant).

Table 8: Distribution of HbA1C with LV diastolic dysfunction.

HBA1C	Normal (%)	Type I DD (%)	Type II DD (%)	Type III DD (%)	Type IV DD (%)	Total (%)
6.5-8.0	35 (46.67)	9 (12)	1 (1.33)	0 (0)	0 (0)	45 (60)
8.1-9.5	1 (1.33)	7 (9.33)	8 (10.67)	0 (0)	0 (0)	16 (21.33)
>9.5	1 (1.33)	4 (5.33)	5 (6.67)	4 (5.33)	0 (0)	14 (18.67)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (100)
N2-Value	55.51					
P-Value	0.000, S, P<0.05					

In the present study 19 patients had diabetic neuropathy, out of which 6 had type I diastolic dysfunction, 8 had type II diastolic dysfunction, 2 had type III diastolic dysfunction and 3 patients did not had any diastolic dysfunction. 56 patients did not have diabetic neuropathy, out of which 14 had type I diastolic dysfunction, 6 had type II diastolic dysfunction, 2 had type III diastolic dysfunction and 34 patients did not had any diastolic dysfunction. The Chi-Square value is 14.81 and p value is 0.002 (Significant).

Table 9: Distribution of Diabetic neuropathy with LV diastolic dysfunction.

DIABETIC NEUROPATHY	Normal (%)	Type I DD (%)	Type II DD (%)	Type III DD (%)	Type IV DD (%)	Total (%)
Present	3 (4)	6 (8)	8 (10.67)	2 (2.67)	0 (0)	19 (25.33)
Absent	34 (45.33)	14 (18.67)	6 (8)	2 (2.67)	0 (0)	56 (74.67)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (100)
N2-Value	14.81					
P-Value	0.002, S, P<0.05					

In the present study 20 patients had diabetic nephropathy, out of which 8 had type I diastolic dysfunction, 7 had type II diastolic dysfunction, 2 had type III diastolic dysfunction and 3 patients did not had any diastolic dysfunction. 55 patients did not have diabetic nephropathy, out of which 12 had type I diastolic dysfunction, 7 had type II diastolic dysfunction, 2 had type III diastolic dysfunction and 34 patients did not had any diastolic dysfunction. The Chi-Square value is 15.51 and p value is 0.05 (Significant).

Table 10: Distribution of Diabetic nephropathy with LV diastolic dysfunction.

DIABETIC NEUROPATHY	Normal (%)	Type I DD (%)	Type II DD (%)	Type III DD (%)	Type IV DD (%)	Total (%)
Present	3 (4)	8 (10.67)	7 (9.33)	2 (2.67)	0 (0)	20 (26.67)
Absent	34 (45.33)	12 (16)	7 (9.33)	2 (2.67)	0 (0)	55 (73.33)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (100)
N2-Value	15.51					
P-Value	0.0032, S, P<0.05					

In the present study 10 patients had diabetic retinopathy, out of which 3 had type I diastolic dysfunction, 5 had type II diastolic dysfunction, 1 had type III diastolic dysfunction and 1 patient did not had any diastolic

dysfunction. 65 patients did not have diabetic retinopathy, out of which 17 had type I diastolic dysfunction, 9 had type II diastolic dysfunction, 3 had type III diastolic dysfunction and 36 patients did not had any diastolic dysfunction. The Chi-Square value is 10.20 and p value is 0.017 (significant).

Table 11: Distribution of retinopathy with LV diastolic dysfunction.

Diabetic nephropathy	Normal (%)	Type I DD (%)	Type II DD (%)	Type III DD (%)	Type IV DD (%)	Total (%)
Present	1 (1.33)	3 (4)	5 (6.67)	1 (1.33)	0 (0)	10 (13.33)
Absent	36 (48)	17 (22.67)	9 (12)	3 (4)	0 (0)	65 (86.67)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (100)
N2-value	10.20					
P-value	0.017, S, P<0.05					

In the present study, 43 patients had total cholesterol below 200mg/dl, out of which 11 had type I diastolic dysfunction, 10 had type II diastolic dysfunction, 2 had type III diastolic dysfunction and 20 patients did not had any diastolic dysfunction. 32 patients had total cholesterol above 200mg/dl, out of which 9 had type I diastolic dysfunction, 4 had type II diastolic dysfunction, 2 had type III diastolic dysfunction and 17 patients did not had any diastolic dysfunction. The Chi-Square value is 1.43 and p value is 0.69 (not significant).

Table 12: Distribution of Total cholesterol with LV diastolic dysfunction.

Total cholesterol	Normal (%)	Type I DD (%)	Type II DD (%)	Type III DD (%)	Type IV DD (%)	Total (%)
<200	20 (26.67)	11 (14.67)	10 (13.33)	2 (2.67)	0 (0)	43 (57.33)
≥200	17 (22.67)	9 (12)	4 (5.33)	2 (2.67)	0 (0)	32 (42.67)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (100)
N2-value	1.43					
P-value	0.69, NS, P>0.05					

In the present study 67 patients had triglycerides values below 165mg/dl, out of which 16 patients had type I diastolic dysfunction, 14 had type II diastolic dysfunction, 4 had type III diastolic dysfunction and 33 patients had no diastolic dysfunction. 8 patients had triglycerides values above 165mg/dl, out of which 4 patients had type I diastolic dysfunction and 4 patients had no diastolic dysfunction. The Chi-Square value is 3.97 and p value is 0.26 (non-significant).

Table 13: Distribution of TG with LV diastolic dysfunction.

TG	Normal (%)	Type I DD (%)	Type II DD(%)	Type III DD (%)	Type IV DD (%)	Total (%)
<165	33 (44)	16 (21.33)	14 (18.67)	4 (5.33)	0 (0)	67 (89.33)
≥165	4 (5.33)	4 (5.33)	0 (0)	0 (0)	0 (0)	8 (10.67)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (100)
N2-value	3.97					
P-value	0.26, NS, P>0.05					

In the present study 47 patients had HDL (High Density Lipoproteins) below 40mg/dl, out of which 9 patients had type I diastolic dysfunction, 10 had type II diastolic dysfunction and 3 had type III diastolic dysfunction. Rest patients had no diastolic dysfunction.

28 patients had HDL (High Density Lipoproteins) above 40mg/dl, out of which 11 patients had type I diastolic dysfunction, 4 had type II diastolic dysfunction and 1 had type III diastolic dysfunction. Rest patients had no diastolic dysfunction. The Chi-Square value is 3.76 and p value is 0.28 (non-significant).

Table 14: Distribution of HDL with LV diastolic dysfunction.

HDL	Normal (%)	Type I DD (%)	Type II DD (%)	Type III DD (%)	Type IV DD (%)	Total (%)
<40	25 (33.33)	9 (12)	10 (13.33)	3 (4)	0 (0)	47 (62.67)
≥ 40	12 (16)	11 (14.67)	4 (5.33)	1 (1.33)	0 (0)	28 (37.33)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (100)
N2-value	3.76					
P-value	0.28, NS, P>0.05					

In the present study 58 patients had low density lipoproteins (LDL) below 140mg/dl, out of which 15 patients had type I diastolic dysfunction, 10 had type II diastolic dysfunction, 3 had type III diastolic dysfunction and 30 patients did not had any diastolic dysfunction. 17 patients had low density lipoproteins (LDL) above 140mg/dl, out of which 5 patients had type I diastolic dysfunction, 4 had type II diastolic dysfunction, 1 had type III diastolic dysfunction and 7 patients did not had any diastolic dysfunction. The Chi-Square value is 0.64 and p value is 0.88 (non-significant).

Table 15: Distribution of LDL with LV diastolic dysfunction.

LDL	Normal (%)	Type I DD (%)	Type II DD (%)	Type III DD (%)	Type IV DD (%)	Total (%)
<140	30 (40)	15 (20)	10 (13.33)	3 (4)	0 (0)	58 (77.33)
≥140	7 (9.33)	5 (6.67)	4 (5.33)	1 (1.33)	0 (0)	17 (22.67)
Total	37 (49.33)	20 (26.67)	14 (18.67)	4 (5.33)	0 (0)	75 (100)
N2-value	0.64					
P-value	0.88, NS, P>0.05					

DISCUSSION

This study is conducted to highlight that diabetic patients with poor glycemic control are at an increased risk of developing severe Left ventricular diastolic dysfunction and find the correlation of various parameters suggestive of poor glycemic control with left ventricular diastolic dysfunction.

Table 16: Comparison of LVDD in patients of well controlled diabetes, moderately controlled diabetes and poorly controlled diabetes on the basis of HbA1c values, with previous studies.

	Present study	Hameedullah et al
Well controlled diabetes	1.08±0.17	1.38± 0.29
Moderately controlled diabetes	0.86±0.24	1.16± 0.29
Poorly controlled diabetes	1.14±0.46	0.60± 0.15

Apart from diabetes the other conditions that cause LV diastolic dysfunction include systemic hypertension, thyroid diseases, cardiomyopathy, valvular heart diseases, elderly, ischemic heart disease.

Table 17: Comparison of correlation of HbA1c and LVDD with other studies.

Studies	P value
Present study	<0.05
Hameedullah et al	0.0001
Mehrdad et al[5]	<0.05
Wojcieh et al[6]	0.031
Mehdi et al[7]	0.01
Miguel et al[8]	<0.001
Virendra patil et al	<0.02

All these patients were excluded from the study. It was found that 50.66% of the patients in study group had left ventricular diastolic dysfunction. The left ventricular diastolic dysfunction in patients of present study group showed correlation with glycosylated hemoglobin,

duration of diabetes, presence of diabetic retinopathy, neuropathy and nephropathy. The mean E/A in poorly controlled diabetes as determined by high HbA1c levels in present study was 1.14±0.46 while in Hameedullah et al it was 0.60±0.15.

In the present study significant correlation was found between HbA1c and left ventricular diastolic dysfunction, with a p value of <0.05. Similar results were obtained in above mentioned studies.

Table 18: Comparison of duration of diabetes mellitus and LVDD with other studies.

Studies	P value
Present study	<0.05
Mishra et al	0.05
Patil V et al	<0.02
Annonu et al	<0.05

In the present study, significant correlation was also found between duration of diabetes and the diastolic dysfunction. These findings are supported by previous studies.

Table 19: Comparison of retinopathy and LVDD with other studies.

Studies	P value
Present study	0.017
Mishra et al	<0.05
Annonu et al	0.01
Kurioka S et al	0.02

There was significant correlation found between presence of retinopathy and left ventricular diastolic dysfunction with a p value of 0.017. Similar observations were found in studies done by Mishra et al, Annonu et al and Soichi kurioka et al.

Table 20: Comparison of peripheral neuropathy and LVDD with other studies.

Studies	P value
Present study	0.002
Mishra et al	<0.05
Annonu et al	0.02

In the present study there was significant correlation found between left ventricular diastolic dysfunction and diabetic neuropathy and nephropathy as was supported by similar previous studies.

Table 21: Comparison of diabetic nephropathy and LVDD with other studies.

Studies	P value
Present study	0.032
Mishra et al	<0.05

The E/A ratio in Strong Heart Study was more decreased in patients having poor glycaemic control (as indicated by higher levels of haemoglobin A1C and fasting glucose) than in patients having well controlled of diabetic status.[9] Mehrdad et al, showed a significant correlation of HbA1c with E/A ratio.[5]

In study by Markuszewski et al, diastolic dysfunction was seen in 43% of patients with HbA1c >6.1% as compared to 4.5% in the group with HbA1c level <6.1%.[10]

In the present study, there was no correlation of LV diastolic dysfunction with lipid profile, fasting blood sugar, post-prandial blood sugar, sex differentiation. Our results indicate that diabetic patients with poor glycaemic control are at an increased risk of early diastolic dysfunction. Further study is needed to determine whether glycaemic control improves diastolic parameters.[11,12]

CONCLUSION

This is a Doppler echocardiographic study of 75 patients of diabetes mellitus admitted during the study period of 17 months at Lata Mangeshkar Hospital, Hingna, Nagpur. Detailed clinical evaluation, laboratory investigations, ECG, X ray chest PA view, lipid profile, HbA1c, fundus examination, urine examination and Doppler echocardiography were done. Patients between 30 to 55 years age group having type 2 diabetes mellitus admitted at Lata Mangeshkar Hospital were scrutinized for doppler echocardiography and HbA1c levels after taking written consent. Patients of Ischaemic heart disease, hypertension, thyroid diseases, cardiomyopathy, valvular heart disease, peripheral vascular disease, systolic dysfunction, BMI of more than 35, patients with regional wall motion abnormality on 2D ECHO were excluded from the study. Patients were divided in three groups on the basis of their HbA1c values as between 6.5 to 8.0, between 8.1 to 9.5 and more than 9.5.

Diastolic dysfunction was measured using doppler echocardiography by calculating the E/A ratio, pre valsalva and during valsalva to unmask the pseudonormal pattern. Diastolic dysfunction correlates with the levels of glycosylated hemoglobin, duration of diabetes mellitus, presence of microvascular complications like diabetic retinopathy, neuropathy and nephropathy.

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REFERENCES

1. Howard BV, Rodriguez BL, Bennett PH, Harris MI, Hamman R, Kuller LH, et al. Prevention conference VI: diabetes and cardiovascular disease. Circulation. 2002;105(18):e132-7.

2. Garcia MJ, Mcnamara PM, Gordon T. 16 year follow up study: morbidity and mortality in diabetes in the Framingham population diabetes. Am J Cardiol. 1976;23:105.
3. Diamant M, Lamb HJ, Endert EL, Smit WA, Bax JJ, Romijn JA, et al. Diastolic dysfunction is associated with altered myocardial metabolism in asymptomatic normotensive patients with well-controlled Type 2 diabetes mellitus. J Am Coll Cardiol. 2003;42:328-35
4. Cheitlin MD, Armstrong WF, Aurigemma GP, Beller GA, Bierman FZ, Davis JL, et al. ACC/AHA/ASE 2003 guideline update for the clinical application of echocardiography: summary article: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/ASE Committee to Update the 1997 Guidelines for the Clinical Application of Echocardiography). J Ame Coll Cardiol. 2003;42(5):954-70.
5. Mehrdad S, Zoleikha J. Relation of HbA1c to left ventricular diastolic function in patients with type 1 diabetes mellitus and without overt heart disease. Diabetologia Croatica. 2006;24:35-7.
6. Wojciech K, Monika PK, Walentyna M. Comparison of left ventricular function by tissue Doppler imaging in patients with diabetes mellitus without systemic hypertension versus diabetes mellitus with systemic hypertension. Am J Cardiol. 2004;94:395-9.
7. Mehdi HS, Byron JH, Paul S, Steven PM, Jing PS, Jianbo L, et al. Relation of hemoglobin A1c to left ventricular relaxation in patients with type 1 diabetes mellitus and without overt heart disease. Am J Cardiol. 2003;19:1514-7.
8. Miguel Z, Magdy F, Ismail, Lori A, Fathi A. Prevalence of diastolic dysfunction in normotensive, asymptomatic patients with well controlled type 2 diabetes mellitus. Am J Cardiol. 2001;87:320-3.
9. Liu JE, Palmieri V, Roman MJ, Bella JN, Rabsitz R, Howard BV, et al. The impact of diabetes on left ventricular filling pattern in normotensive and hypertensive adults: The Strong Heart Study. J Am Cardiol. 2001;37:1943-9.
10. Markuszewski L, Gycewicz T, Pietruszynski R, Michalkiewicz D, Roszczyk N. Glycosylated hemoglobin and left ventricular diastolic dysfunction in patients with type 2 diabetes mellitus. Pol Merkur Lekarski. 2006;21:8-11.
11. Premlatha G, Shanthi Rani CS, Deepa E. Prevalence of diabetic complications in south Indians. Novo Nordisk, Diabetic Update. 2000;5962.
12. Rubler S, Deluges, J, Yuceoglu YZ, Kuma T, Bran wood AW, Grishman A. New type of cardiomyopathy associated with diabetic glomerulosclerosis. Am J Cardiol. 1975;30:595-602.

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