

A Descriptive Comparative Study of Left Ventricular Dysfunction in Normotensive Type 2 Diabetes Patients

Dr.V.K.Sinha^{1*}

^{1*}Associate Professor, Department of General Medicine, M.G.M Medical College, Jamshedpur, Jharkhand.

Corresponding Author: Dr.V.K.Sinha

Abstract

Introduction: Diabetes mellitus (DM) refers to a group of common metabolic disorder that shares phenotype of hyperglycemia. In India, the prevalence rates are estimated to be around 20% in cities, and recent figures showed surprising increasing rates in rural areas.

Materials and Methods: The present study entitled "Study of Left Ventricular Dysfunction in Normotensive type-2 diabetic patients by 2D echocardiography" was carried out in Department of Medicine, M.G.M Medical College, and Jamshedpur from January 2018 to December 2018. This descriptive comparative study comprises of 100 patients who are normotensive, diabetic and 80 normal healthy patients with age >35 years were included in the study with convenient consecutive sampling after proper written informed consent. The patients were taken from OPD and indoor wards of medicine department with type 2 diabetes mellitus with fasting glucose more than 126mg/dL and /or 2-hr PP glucose more than 200 mg/dL were included in the study. Investigations like Fasting and Postprandial blood sugar levels, Serum creatinine, fasting lipid profile, HbA1c and ECG were carried out and Echocardiographic assessment was done by using Model HD7 XE Phillips 2D ECHO machine.

Results: 16 (16%) patients had significantly decreased ejection fraction of < 50% out of 100, 82 (82%) patients had A/E ratio of >1 among 100 patients. A strong association of LVD with severity of Diabetes HbA1c ($p<0.001$) was observed, but there was no correlation with duration of Diabetes.

Conclusion: Uncontrolled diabetes with high level of HbA1c were found to have a strong association with LVD. It is recommended that all patients with long-term and uncontrolled type 2 DM should be screened for LVD.

Key Words: LVD, HbA1C, ECHO machine

Date of Submission: 27-11-2019

Date of Acceptance: 12-12-2019

I. Introduction

Diabetes mellitus (DM) refers to a group of common metabolic disorder that shares phenotype of hyperglycemia. In India, the prevalence rates are estimated to be around 20% in cities, and recent figures showed surprising increasing rates in rural areas.¹ To ascertain the true prevalence in any community, it is essential that there must be standardized methods for the diagnosis with proper acceptable criteria so that the results are comparable. 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.²

Metabolic dysregulation associated with DM causes secondary pathophysiologic changes in multiple organ system that leads to long-term chronic complications which account for much of the morbidity and mortality, attributed to the disease.³ An early diagnosis on that account can be of great help to prevent or delay the development of these complications.⁴

This underlines the necessity of early diagnosis. Since the advent of insulin, there has been a progressive decline in mortality from diabetes complications such as gangrene and infection but a progressive rise in the deaths from cardiovascular disease.⁵

The association of coronary heart disease and DM is well known, but recent evidence suggests that diabetics may develop congestive heart failure in excess of the predicted prevalence of coronary heart disease.⁶

Clinical and pathological studies have shown that abnormalities of left ventricular (LV) function, cardiomegaly and failure may occur with normal coronary arteries possibly due to microangiopathy of coronary circulation independent of large-vessel atherosclerosis.⁸

II. Materials And Methods

The present study entitled “Study of Left Ventricular Dysfunction in Normotensive type-2 diabetic patients by 2D echocardiography” was carried out in Department of Medicine, M.G.M Medical College, Jamshedpur from January 2018 to December 2018. This descriptive comparative study comprises of 100 patients who are normotensive, diabetic and 80 normal healthy patients with age >35 years were included in the study with convenient consecutive sampling after proper written informed consent. The patients were taken from OPD and indoor wards of medicine department with type 2 diabetes mellitus with fasting glucose more than 126mg/dL and /or 2-hr PP glucose more than 200 mg/dL were included in the study. Investigations like Fasting and Postprandial blood sugar levels, Serum creatinine, fasting lipid profile, HbA1c and ECG were carried out and Echocardiographic assessment was done by using Model HD7 XE Phillips 2D ECHO machine.

Inclusion Criteria

1. Patients with Diabetes mellitus who are Normotensive type 2 diabetic patients’ aged 35-65 yrs.
2. Patients with type 2 diabetes mellitus without any complications of diabetes.

Exclusion Criteria

- a. Patients with Pre-existing ischaemic heart disease.
- b. Thyroid Disease.
- c. Renal Disease.

Patients taken in the study were treated as per standard treatment schedule except beta blockers, which was withheld one week before Echocardiography. Data were entered in MS Excel spread sheet and analysed with the help of SPSS version 16 software packages and Statistical analysis was done by using percentages, mean values, standard deviation, standard error, X2test (Chi-square test) (with Yates correction), t-test (unpaired). The level of significance used was 0.05 level for the corresponding degree of freedom to draw the inference. A p-value < 0.05 was considered statistically significant and a p > 0.05 was considered as not statistically significant with value <0.001 as highly significant.

III. Results

All the patients were evaluated for cardiac functions by non-invasive cardiac diagnostic techniques. Nomograms of 80 age and sex matched normal subjects were taken for comparison-Group 1 -Type 2 diabetes mellitus patients (Study group). Group 2 -Normal population (Control group). Maximum number of patients were in the age group of 35-40 and least number of patients were in the age group of >60 present in our study. 50.0% of the male and 45.0% of the female were present and male : female ratio was 1.22:1. Majority of patients (76.0%) had duration of diabetes > 5 years and only 24.0% had duration of diabetes < 5 years and mean duration of diabetes in study group was 7.62 years (25±19.30). In study group, mean FBS was 183.7±15.0 and PPBS was 252±25.67 which were higher than control group. Hence, mean FBS and PPBS in study group was highly statistically significant (p<0.001) as compared to control group (Table 1). Maximum number of patients, i.e. 50.0% were in the range of HbA1c level from 7.1 to 8% and least number of the patients i.e. 12.0% were in the range of >8.0%. 16% (16) of the patients had decreased EF <50% out of 100 in the study group as compared to control group 2% (80), which is statistically significant i.e. p<0.001 (Table 2). EF >50% were 84% present; in duration of diabetes mellitus from 5 to 15 years and patients with EF <50% were 16% present in duration of diabetes mellitus from 5 to 15 years. There is no positive correlation of EF with the duration of diabetes mellitus (Table 3). A/E ratio >1 was present in 82% of the patient in study group indicating Diastolic Dysfunction and A/E ratio <1 in study group and control group were 18% and 100% respectively. Hence, A/E ratio >1 were present only in study group, which was highly statistically significant (Table 4). Maximum number of patients with A/E >1, i.e. 82% were in the duration of diabetes mellitus from 5 to >15 yrs. and A/E <1 i.e. 18% were in duration of the diabetes mellitus from 5 to >15 yrs. Hence, there is no positive correlation of duration of diabetes mellitus with A/E ratio >1 (Table 5). In the present study, 70 patients had IVRT of > 100. All these patients also had A/E ratio of > 1. IVRT was within normal range in 20 patients and it was < 60 msec in 10 patients who also had coexisting LV systolic dysfunction with ejection fraction of < 50%.

Mean Value

S.No	Study Group	FBB	PPBS	P Value
1	Study Group	183.7 ± 15.0	252 ± 25.67	p<0.001
2	Control Group	80.2 ± 13.25	112.4 ± 16.20	

Table 1: Blood Glucose levels

S.No	Study Group	EF>50%	EF<50%	Total	P Value
1	Study Group	84 (84%)	16 (16%)	100	p<0.001
2	Control Group	80 (98%)	80 (2%)	80	

Table 2: Ejection Fraction

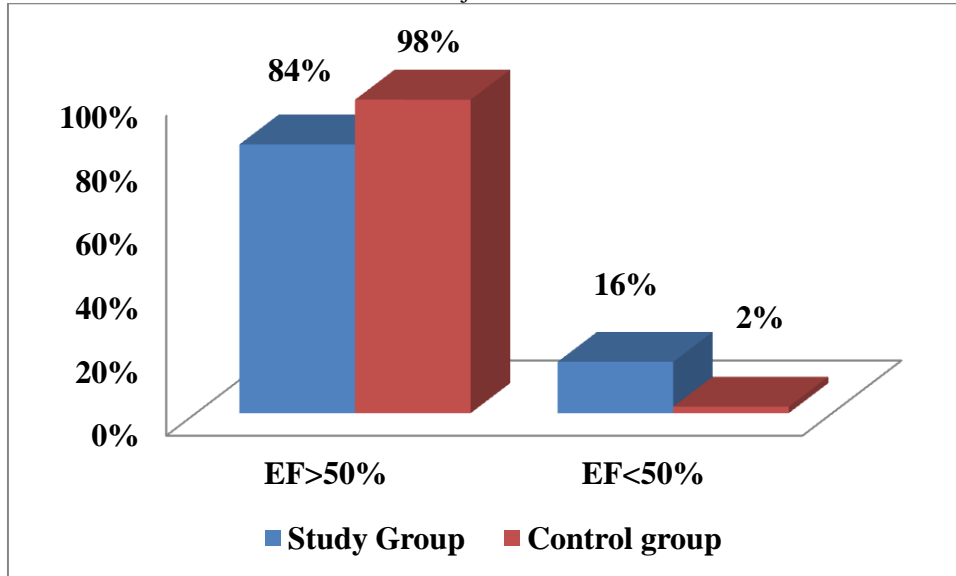


Figure 1: Showing ejection fraction

S.No	Duration	EF>50%	EF<50%	Total
1	<5 years	21 (87.5%)	03 (12.5%)	24
2	5 to 10 years	43 (82.69%)	09 (17.31%)	52
3	10 to 15 years	14 (82.35%)	03 (17.65%)	17
4	>15 years	06 (85.71%)	01 (14.29%)	07
		84	16	100

Table 3: The relation of duration of DM with ejection fraction

S.No	Group	A/E>1	A/E<1	Total	P value
1	Study Group	82 (82%)	18 (18%)	100	P<0.001
2	Control Group	00	80 (100%)	80	

Table 4: Ratio of A-Wave velocity and E-Wave velocity

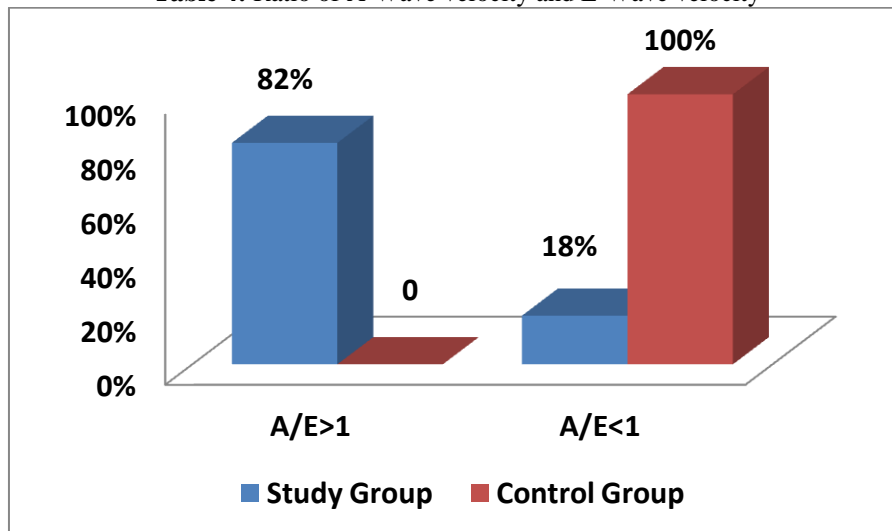


Table 5: Duration of diabetes mellitus with A/E Ratio

Figure 2: Ratio of A-Wave velocity and E-Wave velocity S.No	Duration	AE>1	A/E<1	Total
1	<5 years	21 (87.5%)	03 (12.5%)	24
2	5 to 10 years	42 (80.76%)	10 (19.24%)	52
3	10 to 15 years	13 (76.47%)	04 (23.53%)	17
4	>15 years	06 (85.71%)	01 (14.29%)	07
		82	18	100

IV. Discussion

In our study, mean age of the present study (47) was comparable to that of Poirieet al (2003) (48 years), Khaliqet al(2001) (51 years) and Boyer et al (2004) (49.8 years). In the present study,50.0% of the male and 45.0% of the female were present which is comparable to Patilet al(2007) studies 50 diabetic patients of which 28 (56%) were male and 22(44%) were female.⁹ Poantäet al (2010) studies 62 diabetic patients, of which 32 (51.62%) were male and 30(48.38%) were female. The present study has mean duration of the disease as 7.6 years, which is comparable to that of Poirieet al (2003) (4.8 years), Khaliqet al(2001)(4 years) and Boyer(2004) (5.8 years).The FBS (183 mg%) and PPBS (252mg%) levels in the present study are significantly lower, which is comparable to study by Khaliq et al(2001) showed the mean FBS of 203 ± 51 and mean PPBS of 261 ± 56 .¹⁰ This may be because of factors like genetics and environmental factors, modes of management of diabetes and BMI. In the present study, 16 (16%) patients had significantly decreased ejection fraction of <50%. Whereas, Naiket al (2009) showed EF < 50% in 6% of diabetic patients and Khaliqet al (2001) had 18 (28%) patients with ejection fraction <50%.¹¹

Velocities of mitral A-wave A/E ratio were significantly higher in the present study indicating left ventricular diastolic dysfunction. In the present study, 82 patients had A/E ratio of >1 constituting 82% of study group, which is comparable to that of Boyer et al and Valle et al which is 75% and 51% respectively. 18 patients had A/E ratio < 1. A/E > 1 is very sensitive and specific indicator of LV diastolic dysfunction.¹²

In the present study, the late atrial filling wave (A) was significantly increased, probably due to elevated LV filling pressure secondary to impaired relaxation among diabetic individuals. The diastolic abnormalities in diabetic patients most likely to indicate reduced LV compliance secondary to small vessel disease, infiltrative myocardial process, metabolic derangement or a combination of the three. Zarichet al (1988) and Papillolecet al (1989) reported that diabetics who had normal ejection fraction had evidence of diastolic dysfunction in the form of increased A/E ratio. They also found that LV fractional shortening was normal in majority of subjects who had increased A/E ratio among diabetics.¹³

In the present study, there was no correlation of diastolic dysfunction with the duration of diabetes which is comparable to the study by Grandi et al (2006) who concluded that the severity of diabetes mellitus is more important than duration of diabetes mellitus for the development of diastolic dysfunction. In the present study, the isovolumetric relaxation time (IVRT) showed mean and SD of 102 ± 20.14 as compared to IVRT mean of Poirie et al(2003) and Boyer et al(2004) showing 109.11 msec and 79.14 msec respectively, which is statistically significant. The prolongation of IVRT more than 100 msec is a significant indicator of early LV diastolic dysfunction.¹⁴

In the present study, 70 patients had IVRT of > 100. All these patients also had A/E ratio of > 1. Hiramatsu (1992) and Papillolecet al (1989) showed in their studies that diabetic patients had greater isovolumetric relaxation time. In the present study, echocardiographic evidence of LV diastolic dysfunction among asymptomatic type 2 diabetes mellitus patient was recognized in more than 50% of patients and systolic dysfunction was seen in only 16% of patients.¹⁵

V. Conclusion

Cardiac dysfunction, predominantly involving LV diastolic function is commonly seen in asymptomatic normotensive Type 2 DM patients. Alteration of A/E ratio > 1 is a sensitive and specific indicator of early diastolic dysfunction. There is a positive correlation of diastolic dysfunction with severity of diabetes mellitus, but not with the duration of diabetes mellitus. Hence, severity of diabetes mellitus is more important than duration of diabetes mellitus because patient with short duration of diabetes mellitus but with uncontrolled blood glucose level can lead to early diastolic dysfunction in diabetic patients. LV diastolic dysfunction in asymptomatic normotensive patients with type 2 DM without evidence of coronary heart disease is significantly higher.LV systolic dysfunction was seen in a small number of asymptomatic normotensive Type 2DM,which may point towards prevalence of silent cardiac muscle disease in asymptomatic Type 2 DM. Conventional echocardiography is a simple economical test for detecting LV dysfunction in normotensive, asymptomatic and

type 2 diabetic patients, and should be applied to detect early Left ventricular dysfunction so that actively preventive and therapeutic treatment could be planned early to prevent long-term morbidity and mortality and LV functions may be preserved for long.

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Dr.V.K.Sinha. "A Descriptive Comparative Study of Left Ventricular Dysfunction in Normotensive Type 2 Diabetes Patients." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, vol. 18, no. 12, 2019, pp 12-16.