

Original Research Article

Echocardiographic evaluation of diastolic dysfunction in type 2 diabetes mellitus with normal systolic function and correlation with duration of diabetes mellitus and HbA1C

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ABSTRACT

Background: The incidence of heart failure in diabetic subjects is high even in absence of hypertension and coronary artery disease. Studies have reported a high prevalence of preclinical diastolic dysfunction among subjects with diabetes mellitus. The aim of this study was to assess relationship of diastolic dysfunction with duration of diabetes mellitus and HbA1c level.

Methods: This cross-sectional observational study was conducted in 200 consenting patients with diabetes mellitus without history of hypertension and established coronary artery disease with normal systolic function from the period of February 2013 to October 2014. All diabetic patients were studied for HbA1c level, time period since 1st diabetes was diagnosed, and echocardiography was performed and diastolic function parameters were measured.

Results: In this study, out of 32 subjects with HbA1c 7.1-8.0%, 25 (78.12%); out of 80 subjects with HbA1c 8.1-10.0%, 69 (86.25%); and out of 24 subjects with HbA1c >10%, 24 (100.0%) had diastolic dysfunction. Out of 88 subjects with duration of diabetic mellitus 0-5 years, 34 patients (38.63%); out of 64 subjects with duration of diabetic mellitus of 6-10 years, 53 patients (82.81%); out of 42 subjects with duration of diabetic mellitus 11-15 years, 38 patients (90.47%); and out of 6 subjects with duration of diabetic mellitus >15 years, 6 patients (100.0%) had diastolic dysfunction.

Conclusions: Diastolic dysfunction is significantly associated with duration of disease and glycemic control assessed by HbA1c.

Keywords: Diabetes mellitus, Echocardiographic, ECG, HbA1C, Normal systolic function, OHA

INTRODUCTION

Cardiovascular diseases and diabetes are rapidly gaining pandemic proportions in the South East Asian subcontinent, and India is leading the race of numbers. Over the last three decades a number of epidemiological and autopsy studies have proposed the diabetic heart disease as a distinct clinical entity. The existence of a diabetic cardiomyopathy was first suggested by Rubler, et al.¹ in 1972 on the basis of postmortem findings in four

diabetic adults who had CHF in the absence of atherosclerotic, valvular, congenital, hypertensive, or alcoholic heart disease. Further support for the existence of a diabetic cardiomyopathy was provided by Hamby et al., who noted an increased incidence of diabetes in patients with idiopathic cardiomyopathy. The incidence of heart failure in diabetic subjects is high even in absence of hypertension and coronary artery disease.² Studies have reported a high prevalence of preclinical diastolic dysfunction among subjects with diabetes

mellitus (DM).³ The evidence indicates that myocardial damage in diabetic subjects affects diastolic function before the systolic function. Several mechanisms for diabetic cardiomyopathy have been proposed including autonomic dysfunction, small and microvascular disease, metabolic derangements, interstitial fibrosis and the development of fibrosis, possibly caused by the accumulation of a periodic acid-Schiff-positive glycoprotein, leading to myocardial hypertrophy and diastolic dysfunction. Growth hormone also appears to be involved in the pathogenesis of angiopathy in the diabetic patients.⁴⁻⁷ The pathogenesis of this ventricular dysfunction remains unknown and has been somewhat controversial.⁸ Studies discussing the prevalence of diastolic dysfunction in diabetic subjects are available in Western literature, such similar studies are however sparse in India. The need for such a study assumes tremendous significance as it is well known that the patient population and pattern of disease in India varies considerably from that of the West. The present study was done to identify the prevalence of diastolic dysfunction in type 2 diabetes subjects with normal systolic function; without hypertension and established coronary artery disease, and to analyze whether its prevalence varies with glycemic control and duration of diabetes.

Aim of the Study was to study diastolic dysfunction in patients with diabetes mellitus and assess relationship of diastolic dysfunction with duration of diabetes mellitus and HbA1C level.

METHODS

This cross-sectional observational study was conducted in 200 patients with Type 2 diabetes mellitus from the period of February 2013 to October 2014. Diabetic patients irrespective of their age and sex were studied for HbA1c level and time period since 1st diabetes was diagnosed. A thorough clinical examination was done and detailed medical history was collected. All routine lab parameters, fasting and post-prandial sugars, Chest X-ray, electrocardiogram (ECG), and echocardiogram (ECHO) was performed, and following diastolic function parameters were measured: peak early diastolic filling (E) and late diastolic filling (A) velocities, E/A ratio, E deceleration time, early diastolic septal mitral annular

velocity (e'), and E/e' as an index of LV filling pressure. Left atrial dimension was calculated. Diastolic dysfunction was assessed according to ASE guidelines.⁹ Diabetic patients with history of angina, presence of established cardiovascular disease, hypertension (more than 140/90mm of Hg), abnormal resting ECG, positive TMT, renal failure, signs of vascular involvement (defined as absent peripheral pulses in the lower limb, amputation because of gangrene), severe anemia (hemoglobin <8.00g/dl), hemodynamically significant valvular disease, prosthetic valve replacement, constrictive pericarditis, left ventricle systolic dysfunction, evidence of left ventricular hypertrophy on echocardiography, subjects with poor transthoracic echo window, and ventricular pacemaker were excluded from study. Percentage analysis was used to describe distribution of study variables.

Informed consent

Written informed consent was obtained from all patients for participation in the study.

RESULTS

Total 200 patients were studied, majority of patients (80 patients) were in the 50-59 years age group, 24 patients were <40 years of age, 40 patients belonged to 40-49 years of age group, 44 patients were between 60-69 years of age, and only 12 patients were age of 70 years or above. The youngest patient was 30 years old and oldest one was 81 years of age (Table 1). In this study, 115 patients (57.50%) were male and 85 patients (42.50%) were female.

Table 1: Age and sex wise distribution of cases (N= 200).

Age in years	Female	Male	Total
<40	9	15	24
40-49	14	26	40
50-59	31	49	80
60-69	22	22	44
≥70	9	3	12
Total	85	115	200

Table 2: Duration of diabetes according to the sex / correlation with diastolic dysfunction.

Duration in years	No of cases			%	Diastolic dysfunction	
	Male	Female	Total		Present	Absent
0-5	49	39	88	44	34	54
6-10	44	20	64	32	53	11
11-15	19	23	42	21	38	4
>15	3	3	6	3	6	0
Total	115	85	200		131	69

In this study, 88 patients (44%) were suffered from diabetes for ≤ 5 years, 64 patients (32%) had duration diabetes 6-10 years, 42 patients (21%) had duration diabetes 10-15 years, and 6 patients (3%) were diabetic since >15 years (Table 2). Out of 88 subjects with duration of diabetic mellitus 0-5 years, 34 patients (38.63%); out of 64 subjects with duration of diabetic mellitus of 6-10 years, 53 patients (82.81%); out of 42 subjects with duration of diabetic mellitus 11-15 years, 38 patients (90.47%); and out of 6 subjects with duration of diabetic mellitus >15 years, 6 patients (100.0%) had diastolic dysfunction (Table 2).

In this study, 77 patients were on oral hypoglycemic agents (OHA), 67 patients were treated with Insulin Injection only, and 56 patients were on both OHA and Insulin (Table 3).

Table 3: Correlation of treatment profile with diastolic dysfunction.

Type of treatment	Total Number of cases	Diastolic dysfunction	
		Absent	Present
Insulin	67	20	47
OHA	77	32	45
Both	56	17	39
Total	200	69	131

Out of 200 patients in this study, 64 patients (32%) had HbA_{1c} between 6.4-7.0%, 32 patients (16%) had HbA_{1c} between 7.1-8.0%, 80 patients (40%) had HbA_{1c} between 8.1-10%, and 24 patients (12%) had HbA_{1c} $>10\%$ (Table 4). Out of 64 subjects with HbA_{1c} 6.4-7.0%, 13 (20.31%); out of 32 subjects with HbA_{1c} 7.1-8.0%, 25 (78.12%); out of 80 subjects with HbA_{1c} 8.1-10.0%, 69 (86.25%); and out of 24 subjects with HbA_{1c} $>10\%$, 24 (100.0%) had diastolic dysfunction (Table 4).

Table 4: Correlation of diastolic dysfunction with hbA_{1c} level.

HbA _{1c} levels	6.4-7%	7.1-8%	8.1-10%	$>10\%$
Diastolic dysfunctions				
Present	13	25	69	24
Absent	51	7	11	0
No. of cases	64	32	80	24

DISCUSSION

Our findings demonstrate that, diastolic dysfunction was more frequent in poorly controlled diabetic patients as assessed by HbA_{1c} level and Prevalence of diastolic dysfunction increased gradually with the rise in HbA_{1c} levels. In this study, out of 32 subjects with HbA_{1c} 7.1-8.0%, 25 (78.12%); out of 80 subjects with HbA_{1c} 8.1-10.0%, 69 (86.25%); and out of 24 subjects with HbA_{1c} $>10\%$, 24 (100.0%) had diastolic dysfunction. These

finding are consistent with study conducted by M.B. Patil et al, found that diastolic dysfunction was present 18.75% of patients with HbA_{1c} between 6.4-7% (good glycemic control).¹⁰ 75% of patients between 7.1 and 8 and 85% of patients between 8.1 to 10 % HbA_{1c}. Hameedullah et al, in their study population of 60 patients with type 2 DM found that there was strong correlation between HbA_{1c} level indices.¹¹

The current study shows that the more duration of suffering from DM associated with higher prevalence of diastolic dysfunction. In this study, out of 88 subjects with duration of diabetic mellitus 0-5 years, 34 patients (38.63%); out of 64 subjects with duration of diabetic mellitus of 6-10 years, 53 patients (82.81%); out of 42 subjects with duration of diabetic mellitus 11-15 years, 38 patients (90.47%); and out of 6 subjects with duration of diabetic mellitus >15 years, 6 patients (100.0%) had diastolic dysfunction. These findings are consistent with observation of other investigators; Aaron et al, found that there was a significant association between the ratio of early mitral velocity E to medial mitral annulus velocity (e') and time of diabetes diagnosis to echocardiogram.¹² They also found that a duration of diabetes >4 years was independently associated with LV diastolic dysfunction ($E/e' > 15$) in multivariable logistic regression modelling after adjustment of age, gender, BMI, previous coronary disease, previous hypertension and ejection fraction (odd ratio 1.9%), 95% CI-1.19 TO 3.07, P=.007. V.C.Patil also found that patient with longer duration of diabetes mellitus (11-15 years) had higher prevalence of diastolic dysfunction ($p < .02$). In a study done by Attali et al, it was observed that LV diastolic dysfunction was present in patients who were free of cardiovascular disease, had diabetes of less than 5 years, in other study by Bonito et al, it was observed that diastolic dysfunction could be present in patients having diabetes less than 4 years and sometimes less than 1 year.¹³

CONCLUSION

From the foregoing discussion it can be concluded that diastolic dysfunction is significantly associated with duration of disease and glycemic control assessed by HbA_{1c}. It can be suggested that all patients of diabetes should be routinely and repeatedly subjected to echocardiographic evaluation to assess cardiac function for long term management.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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