ORIGINAL RESEARCH

Study of cardiac co-morbidities in newly diagnosed type 2 diabetes mellitus patients with help of 2D echocardiography

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ABSTRACT

Background: Diabetes mellitus is a metabolic disorder distinguished by chronic hyperglycaemia resulting from defects in insulin secretion, insulin action, or both. Cardiovascular diseases (CVDs)-majorly coronary artery disease (CAD), heart failure (HF), and stroke are the major cause of death and disability in patients with type 2 diabetes mellitus (T2DM). The aim of the study was to asses cardiac co-morbidities in newly diagnosed type 2 diabetes mellitus with the help of echocardiography at a tertiary hospital.

Material and Methods: Present study was single-center, cross-sectional, observational study conducted in newly diagnosed patients of type 2 diabetes mellites (diagnosed in last 3 months), clinically asymptomatic, blood pressure <130/80mmHg, with normal ECG, underwent, conventional 2 D echocardiography.

Results: In present study, 60 asymptomatic type 2 diabetes mellitus patients underwent 2-D echocardiography, majority were male (73.33 %) as compared to females (26.67 %). Most common age group was 41-50 years and 51-60 years (26.66 % each), followed by 31-40 years (21.67 %). On 2-D echocardiography, diastolic dysfunction was noted in 10 patients (16.67 %). Grade I, II and III diastolic dysfunction was noted in 10 %, 5 % and 1.67 % patients respectively. Reduced early mitral inflow velocity was noted in 7 cases (11.67 %) and mitral annular early diastolic velocity was noted in 11 cases (18.33 %). As HbA1c increases, severity of left ventricular diastolic dysfunction increases, difference was statistically significant. We noted a statistically significant difference in values of age (years), BMI (kg/m2), FBS (mg/dl), PPBS (mg/dl) and HbA1c (%) between patients with LVDD and patients without LVDD. Conclusion: 2D Echo is recommended for screening for cardiovascular abnormalities in newly diagnosed type 2 diabetes melites patients to prevent further progression to symptomatic cardiovascular abnormalities.

Keywords: Diabetes melites, Type 2 DM, echocardiography, HbA1c

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INTRODUCTION

Diabetes mellitus is a metabolic disorder distinguished by chronic hyperglycaemia resulting from defects in insulin secretion, insulin action, or both.[1] Diabetes can cause premature atherosclerosis affecting micro as well as macro-vasculature commonly presenting as coronary artery disease and as nephropathy at times.[2] Cardiovascular diseases (CVDs)-majorly coronary artery disease (CAD), heart failure (HF), and stroke are the major cause of death and disability in patients with type 2 diabetes mellitus (T2DM).[1] Diabetes mellitus is associated with increased risk of diastolic dysfunction and diabetic cardiomyopathy due to several factors including microangiopathy, autonomic nervous dysfunction, defecting cellular calcium transport, structural changes in myocardial intracellular proteins, accumulation of collagens leading to increased stiffening of the ventricular wall, deposition of glycoprotein, activation of rennin-angiotensin system, and decreased adiponectin level.[3] The quantification of cardiac chamber size and function is the cornerstone of cardiac imaging, with echocardiography being the most commonly used noninvasive modality because of its unique ability to provide real-time images of the beating heart, combined with its availability and portability.[4] The aim of the study was to asses cardiac co-morbidities in newly diagnosed type 2 diabetes mellitus with the help of echocardiography at a tertiary hospital.

MATERIAL AND METHODS

Present study was single-center, cross-sectional, observational study conducted in department of general medicine, at XXX medical college and hospital, XXX, India. Study duration was of 1 year (January 2021 to December 2021). Study approval was obtained from institutional ethical committee.

Inclusion criteria

- Newly diagnosed patients of type 2 diabetes mellites (diagnosed in last 3 months), clinically asymptomatic, blood pressure <130/80mmHg, with normal ECG, willing to participate.in present study

Exclusion criteria

- Subjects with evidence of coronary artery disease (excluded by history of angina, chest pain, ECG changes)
- Subjects with evidence of valvular disease
- Hypertensive patients, subjects receiving antihypertensive agents, E/O left ventricular hypertrophy on echocardiography.
- Subjects with arrhythmia or pericardial disease
- Subjects with systolic dysfunction (LVEF≤40%)
- Subjects not willing to participate in study,

Patients attending diabetes OPD, for consultation, satisfying study criteria were considered for this. Study was explained to patients in local language and written consent was taken for participation and study. Detailed history for complaints, medical history (past illness, medications) and physical examination findings were noted. Investigations such as FBS, PPBS, Renal function tests, including electrolytes, Glycosylated hemoglobin (HbA1c),

urine routine and microscopy, ECG, Fundoscopy, Chest x-ray and Echocardiography were done in all patients.

All patients underwent, conventional 2 D echocardiography in the left lateral decubitus position, using a commercially available ultrasound system Phillips CX 50 (Bothell, WA, USA) S4-2 phased-array transducer with M-mode, two-dimensional, pulsed and continuous wave, color-flow, and tissue Doppler capabilities. In Echocardiography ejection fraction, E-peak velocity of early mitral flow, E-peak velocity of late mitral flow, E/A ratio and Left atrial size was calculated in all patients. E/A <1 and increase in LA size was considered as the evidence of left ventricular Diastolic Dysfunction.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi-square test or Fisher exact test as applicable. P value less than 0.5 was considered as statistically significant.

RESULTS

In present study, 60 asymptomatic type 2 diabetes mellitus patients underwent 2-D echocardiography, majority were male (73.33 %) as compared to females (26.67 %). Most common age group was 41-50 years and 51-60 years (26.66 % each) , followed by 31-40 years (21.67 %).

Table 1: Age group distribution

Age group (years)	**Male (%)**	**Female (%)**	**Total (%)**
31-40	9 (15 %)	4 (6.67 %)	13 (21.67 %)
41-50	10 (16.67 %)	6 (10 %)	16 (26.66 %)
51-60	14 (23.33 %)	2 (3.33 %)	16 (26.66 %)
61-70	6 (10 %)	2 (3.33 %)	8 (13.33 %)
>70	5 (8.33 %)	2 (3.33 %)	7 (11.67 %)
Total	**44 (73.33 %)**	**16 (26.67 %)**	**60**

On 2-D echocardiography, diastolic dysfunction was noted in 10 patients (16.67 %). Grade I, II and III diastolic dysfunction was noted in 10 %, 5 % and 1.67 % patients respectively.

Table 2: Diastolic dysfunction

Grade	**No. of patients**	**Percentage**
Impaired Relaxation (Grade 1)	6	10.00%
Pseudonormal (Grade 2)	3	5.00%
Restrictive Filling (Grade 3)	1	1.67%
Normal	50	83.33%

In present study, reduced early mitral inflow velocity was noted in 7 cases (11.67 %) and mitral annular early diastolic velocity was noted in 11 cases (18.33 %).

Table 3: Early mitral inflow velocity and mitral annular early diastolic velocity

Parameters	**No. of patients**	**Percentage**
Early Mitral Inflow Velocity(E)		
<50 Cm/S	7	11.67 %
>50 Cm/S	53	88.33%

Mitral Annular Early Diastolic Velocity		0.00%
< 7 cm/s	11	18.33%
≥ 7 cm/s	49	81.67%

We noted that, as HbA1c increases, severity of left ventricular diastolic dysfunction increases, difference was statistically significant (Chi-square test, p value <0.001). A case with grade 3 diastolic dysfunction had HbA1c >9.5, while 2 out of 7 subjects with HbA1c >9.5 had grade 2 diastolic dysfunction and 3 out of 7 subjects with HbA1c >9.5 had grade 1 diastolic dysfunction all of them had LVDD.

Table 4: Comparison of LVDD and Hba1c

Hba1c	**LVDD Grade**				
	I	**II**	**III**	**Absent**	**Total**
6.5-7.5	0	0	0	37 (61.67 %)	37 (61.67 %)
7.5-8.5	1 (1.67 %)	0	0	8 (13.32 %)	9 (15 %)
8.5-9.5	2 (3.33 %)	1 (1.67 %)	0	4 (6.66 %)	7 (11.67 %)
> 9.5	3 (5 %)	2 (3.33 %)	1 (1.67 %)	1 (1.67 %)	7 (11.67 %)
Total	6 (10 %)	3 (5 %)	1 (1.67 %)	50 (83.33 %)	60

We noted a statistically significant difference in values of age (years), BMI (kg/m^2), FBS (mg/dl), PPBS (mg/dl) and HbA1c (%) between patients with LVDD and patients without LVDD.

Table 5: Distribution of patients according to duration of Diabetes.

	patients with LVDD (Mean ±SD)	**Patients without LVDD (Mean ±SD)**	**P value**
Age (years)	52.34 ± 11.73	46.48 ± 9.54	0.046
BMI (kg/m^2)	25.13 ± 4.22	23.29 ± 3.12	0.039
FBS (mg/dl)	160.24 ± 14.39	131.45 ± 18.25	0.048
PPBS (mg/dl)	212.82 ± 23.46	184.27 ± 21.92	0.043
HbA1c (%)	8.45 ±1.34	7.31 ± 1.12	0.031

DISCUSSION

Heart failure (HF) is a complex syndrome in which both systolic and diastolic functional abnormalities can be identified. Primary abnormality in systolic dysfunction is reduction in contractile reserve with poor pumping function of the left ventricle whereas diastolic dysfunction is associated with impaired relaxation and inability of the ventricle to accept an adequate amount of blood.[5,6]

Diastolic dysfunction is characterized by prolonged relaxation and increased filling pressure that lead to reduction in contraction velocity and reduction in cardiac output.[5] Decreased ventricular function in turn stimulate rennin angiotensin and sympathetic nervous system which further cause myocardial damage and if untreated results in myocardial remodeling. arrhythmias, pump failure and death.[6,7] Thus, diastolic dysfunction should be recognized early and treated promptly to prevent associated morbidity and mortality.

Khade SK *et al.*,[8] noted that prevalence of diastolic dysfunction was observed to be 44.4% in patients of type 2 diabetes mellitus without cardiac manifestations. Prevalence of diastolic dysfunction was seen in 47.4% males in comparison to 42.9% females. Prevalence of diastolic dysfunction was 11.1%, 77.3% and 80% in cases with disease duration of 0-5 years, 6-10 years and more than 10 years respectively. Prevalence of diastolic dysfunction

was more in cases with poor glycaemic control i.e. hemoglobin A1c (HbA1c) value >8% as compared to cases with good glycemic control.

Madhumathi R *et al.*,[9] noted that diastolic dysfunction was present in 24(48%) patients out of whom 8 were males and 16 females. The maximum number of patients with LV diastolic dysfunction was in age group 50 – 59 years. There was a linear increase in prevalence of diastolic dysfunction with increasing age, increased duration of diabetes mellitus and increasing HbA1c levels. There was also significant correlation between LV diastolic dysfunction (LVDD) and microangiopathy. Out of 13 patients who had diabetic retinopathy, 8 patients had LVDD and out of 11 patients with microalbuminuria, 9 patients had LVDD.

In study by Pratik D M *et al.*,[10] out of 175 patients, majority from age group 51-60 years, were male (62%), had HbA1c in the range of 7-10% (79%). Most of the patients had normal cardiac diastolic function, whereas only 15 (8%) patients restrictive filling (grade 3 diastolic dysfunction). Grade 2 and 3 diastolic dysfunction was more common in a higher age range i.e. 51-60 and >60 years whereas it was absent in less than 40 year. Diastolic dysfunction was more common in patients having proteinuria >200 mg/dl, higher serum cholesterol levels, hba1c levels > 10% and in patents having E/e' ratio > 14. 47 patients were systolic dysfunction <50% with hba1c less than 10%, whereas only 3 patients had EF <50% with hba1c >10%.

Jain S *et al.*,[11] noted that 63 out of 100 subjects had LVDD. There was significant positive correlation between HbA1c and LVDD (p value <0.001). As HbA1c increased, severity of LVDD increased. In this study, as BMI increased, HbA1c and LVDD increased and both findings were statistically significant (p value =0.001). They concluded that myocardial damage in patients with diabetes affects diastolic function before systolic function and higher HbA1C level is strongly associated with presence of LVDD. Patients should be advised strict control of diabetes in order to reduce the risk for developing LVDD which is a precursor for more advanced disease.

In study by Chandey M *et al.*,[12] diastolic dysfunction was present in 81(81%) patients. systolic dysfunction was present in 14(14%) patients. There was a linear increase in prevalence of diastolic dysfunction with increasing age, increased FPG, increased BMI. There was also significant correlation between LV diastolic dysfunction (LVDD) and LA size. While no statistical correlation found between gender, duration of diabetes, HbA1c with diastolic and systolic dysfunction. LV diastolic dysfunction is an early manifestation of diabetic cardiomyopathy. LVDD contributes significantly to morbidity of congestive heart failure in diabetic patients. Echocardiography is a very useful noninvasive tool in detecting LVDD and systolic dysfunction in type 2 DM patients.

K M Hassan *et al.*, noted that 61 % had diastolic dysfunction with preserved ejection fraction. Left ventricular diastolic dysfunction (LVDD) was more prevalent in diabetic patients with HbA1c ≥ 8.1 (75%) Patients with LVDD had significant dyslipidaemia in comparison to those without LVDD. Multivariate logistic regression analysis showed that WHR and HbA1c levels are the only predictors of impaired diastolic function in patients with new-onset DM. Kaplan-Meier survival curves showed a significant correlation between the incidence of diastolic dysfunction and the duration of DM, with higher incidence with HbA1c ≥ 8.1.

Shankar Roy *et al.*,[14] studied 226 patients (151 males, 75 females), cardiac abnormality was found in 29.2% patients. Diabetic microvascular complications (e.g. neuropathy, retinopathy and nephropathy) were strongly associated with it (each with p <

0.0001) in addition to dyslipidaemia, history of hypertension, higher body mass index and poor glycaemic parameters

Of several imaging techniques available, echocardiography is preferred in patients with suspected HF due to its accuracy, availability/ portability, safety, and cost. It can accurately assess and very well differentiate between the HF, diastolic dysfunctions, valvular heart diseases, and coronary heart disease.[15,16]

Diastolic dysfunction is an important risk factor for development of heart failure and morbidity in diabetic patients. Early recognition and treatment can prevent its progress to heart failure. . Routine screening of all diabetics for such complications and subsequently high-risk patients undergoing strain echocardiography can be a very cost-effective diagnostic, therapeutic and prognostic modality.

CONCLUSION

In all newly diagnosed type 2 diabetes melites patients with or without cardiovascular symptoms, screening for cardiovascular abnormalities by 2D Echo is recommended, so that early interventions can be done to prevent further progression to symptomatic cardiovascular abnormalities.

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