Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/17224
DOI URL: http://dx.doi.org/10.21474/IJAR01/17224

RESEARCH ARTICLE

CARDIAC FUNCTION EVALUATION THROUGH ECHOCARDIOGRAM IN RECENTLY DIAGNOSED TYPE 2 DIABETES MELLITUS PATIENTS

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Manuscript Info

Manuscript History
Received: 10 May 2023
Final Accepted: 14 June 2023
Published: July 2023

Key words:-
Diabetes Mellitus-Type 2, Echocardiogram, Heart Failure

Abstract

Introduction: Diabetes mellitus being a modern day disease has occupied a significant place in burdening the health care system.The abnormalities in the glucose metabolism have a significant impact on the cardiovascular system and usually is an unfavourable outcome.In this study, persons with type II diabetes mellitus were assessed for developing cardiac dysfunction (Left ventricular) and its prevalence by comparing with asymptomatic control group. Age and gender were matched among these two groups.

Objectives: The primary objective was toevaluate the left ventricular reserve (systolic & diastolic) in recently diagnosed type 2 diabetes mellitus patients. The secondary objective is to assess the risk factorscontributing in the development of heart failure among diabetic patients.

Methods: This case control study was explored among the recently diagnosed diabetes mellitus (Type 2) patients who were visitingdiabetic OPD. Approval for the conductance of the study was obtained from the Institute's scientific committee and the Institute's ethics committee. The study period was from January, 2022 to March, 2023. In study group recently diagnosed type 2 diabetes mellitus patients were considered as the participants based on the revised criteria for diagnosing diabetes mellitus taken from American Diabetes Association. LV systolic functionwas assessed from the following calculated with the M- mode echocardiogram.

Results: Incidence of diastolic dysfunction in study population was 28%, whereas in control population was 10%. Diastolic dysfunction based on the distribution amongst study population is 50% between 40-50 years. Gender distribution of derangement in diastolic function amongst study population were 31.25% amongstfemales, 22% amongst males and in controls was 10% amongst females, 10% amongst males.

Conclusion: The incidence of abnormal diastolic function was notablyincreasing in recently diagnosed diabetes mellitus (type 2) patients as paralleled to participants with normal glucose metabolism. Prevalence of diastolic dysfunction amongst newly diagnosed male and female diabetics is in the ratio of 2:1. Risk factors like advanced age, abnormal BMI, PPBS, raised HbA1c, elevated cholesterol and triglyceride values are significantly associated with diastolic dysfunction.

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Introduction:-

Diabetes mellitus which comes under the non-communicable disease typehas occupied a significant place in burdening the health care service. Modern world delivers all comfort to anindividual which have resulted in obesity due to sedentary life style, isthe important risk factors for the emergence of Diabetes Mellitus (type 2)which is the major contributor for cardiovascular diseases.[1] The entire organ system of human body is being affected due to the involvement of micro blood vessels and also larger vesselsin diabetic patients. The microvascular changes in diabetes mellitus affecting the morphology of heart leads to diabetic cardiomyopathy. Early changes in diabetic cardiomyopathy includes left ventricular hypertrophy and reduction in the diastolic filling pressure. Obese patients tend to have an unfavourable change in the functioning of Natriuretic peptides (NPs). These peptides play a vital role as a shield against cardiac pressure overload affecting the cardiac function. Along with cardiac function NPs involve as a key component in maintaining the insulin sensitivity. Diabetes mellitus and obesity setting a vicious cycle affecting the NPs have a contribution in the incidence of Heart failure. [1,2]

According to the DECODE study [3], prediabetic levels of blood sugars determine the predisposal to cardiovascular disorder. Such as that, diabetes mellitus carries equivalent cardiovascular risk to a person who has already had a coronary event.[1]

This increased risk of disease burden and death because of cardiovascular disease is due to the abnormalities in glucose metabolisms when compared between persons who are normal and those with clinical diabetes.[3,4]The Framingham study showed the association of heart failure and diabetes mellitus regardless of underlying cardiovascular illnesses (Hypertension, coronary artery disease) [3,4]

Cardiac function is affected in the diastolic phase earlier than the systolic phasewhich leads to pathophysiological changes resulting in congestive cardiac failure. There is good proof that,initially left ventricular function is affected in the early stage of the diabetic cardiomyopathy. Hencetimely detection ofdysfunction in left ventricles in diabetic patients have a great impact in the prognosis of heart failure following proper treatment.[5-10]

The current study explores the association of recently diagnosed diabetes mellitus and cardiac function.In this study, persons with type II diabetes mellitus were assessed for developing cardiac dysfunction (Left ventricular) & its contributing factors and also its prevalence by comparing with asymptomatic control group. Age and gender were matched among these two groups

Materials And Methods:-

The setting of the study (case control study) was at the OPD for diabetic patients in ESIC Medical College & PGIMSR, KK Nagar in Chennai. The scientific committee followed by the Ethics committee of the Institute approved the study. Participants were recruited into the study by taking their consent for the same. Screening (clinical examination, routine blood investigations, ECG and Echocardiogram) were done among 77 patients, out of which 50 were recruited as participants into the study. The age and gender were matched with appropriate controls. The study period was from January, 2022 to March, 2023. Type 2 diabetes mellitus recently diagnosed patients were recruited into the study based on the revised criteria for diagnosing diabetes mellitus taken from American Diabetes Association. Criteria for the disease diagnosis (diabetes mellitus)[6], patients with HgbA1c of $\geq$ 6.5% is new diagnostic criterion, done in a lab setting using NGSP certified method and following DCCT standard, Fasting Plasma Glucose > or = 126 (no calories for 8 hours), 2 hour plasma glucose > or = 200mg/dl using 75gm OGTT, Random plasma glucose > or = 200 with hyperglycemia symptoms.

Patients above 70 years and who has systemic HTN, ECG changes, Ischemic heart disease, Angina, Heart failure, cardiomyopathy, valvular heart disease, pericardial disease, COPD, sustained arrhythmia, kidney disease, liver disease, thyroid disease and pregnant patients were not added into the study.

All the participants undergone Echocardiogram under cardiology department in ESIC medical college & PGIMSR at KK Nagar, Chennai. Esaote`S My Lab50 (Echocardiogram) was used. A two-dimensional, M mode, Pulsed wave and continuous wave Doppler and colour flow imaging. Phased array transducers 2.5 - 3.5 MHz frequencies were used to obtain 2-D / M-mode echo cardiography. Images were obtained with subjects in 30 degree lateral decubitus

position. Freezed images were used to measure the various parameters and inference were drawn out of the recordings.

Left Ventricular (LV) systolic functionwas assessed by the following parameters calculated from the M- mode echocardiogram obtained at the level of mitral valve chordae(LV dimension diastole (LVId) systole (LVsd) and thickness of inter ventricular septum, left ventricular posterior wall thickness in diastole). LV diastolic functionwas assessed with the following parameters,

1. LV filling during the early rapid phase(E wave m/s),
2. LV filling during the atrial contraction (A wave m/s)
3. Ratio of the filling velocity E/A ratio
4. Deceleration time (from the peak of E wave to the point at which the deceleration velocity reaches the base line)
5. Isovolumetric relaxation time. (from the aortic valve closure to that of the beginning of E wave)

All the above-mentioned parameters were recorded with the help of doppler trans mitral flow velocities (apical chamber view). Positioning of pulsed doppler was in between the tips of leaflets of mitral valve.

Statistical Analysis

The data were represented in mean +/- SD. Data collected were analysed using SPSS software version 21. The groups were analyzed with the help of Student's T test.Variables among patients with or without LV dysfunction were analysed with Fisher's Exact Test. p value of < 0.05 was considered to be statistically significant.

Results:-

Table 1:- Incidence of diastolic dysfunction.

Study group	With diastolic dysfunction	Without diastolic dysfunction	Total
New diabetic patients	14	36	50
control	5	45	50

By Fischer's test with two sided p value at 0.0395, relative risk was 2.80 and is considered to be significant. Out of the 50 diabetics, LVDD was diagnosed in 28% while out of the 50 controls, LVDD was diagnosed in 10% showing a threefold increased risk in incidence of LVDD in new diabetics.

Table 2:- Diastolic dysfunction and age distribution.

Age	Diastolic dysfunction	
	New diabetic patients	Control group
40-50	7	0
51-60	4	2
61-70	3	3

Incidence of diastolic dysfunction was higher in new diabetics by about 50% being in the age group of 40-50 years.

Table 3:- Gender distribution of diastolic dysfunction.

study group	diabetic patients		control group	
	normal function	with diastolic dysfunction	normal function	with diastolic dysfunction
male	14	4	18	2
female	22	10	27	3

In the diabetics, out of the 32 female subjects, 31.25% had LVDD while out of the 18 male subjects, 22% had LVDD. In the control group, out of 30 female subjects, 10% had LVDD, while out of 20 male subjects, 10% had LVDD too.

Table 4:- Analysis of associated risk factors in new diabetic patients with diastolic dysfunction.

Total	BMI>25	WHR >1/>.85	FBS>200	PPBS>300	HbA_1C > 9	T. chol > 240	TGL >200	HDL <40	LDL >30
14	8	7	5	9	6	4	8	8	5

Out of 14 subjects, 4 male and 10 female. 73% were obese, 68% had high waist-hip ratio. 46% had FBS>200, 82% had PPBS >300, 57% had HbA1c>9% and 50% were dyslipidemic.

Table 5:- Analysis of associated risk factors in control group with diastolic dysfunction.

Total	BMI>25	WHR >1/>.85	T. Chol> 240	TGL >200	HDL <40	LDL >30
5	1	3	0	1	2	1

Out of 5 subjects, 2 male and 3 female. When compared in relationship with diastolic dysfunction amongst the diabetic and control groups, diabetics had higher BMI(77) and dyslipidemia.Higher PPBS value showed anabnormal diastolicfunction.

Discussion:-

Diabetic patients found to develop Heart failure which was the first demonstration made by Kannel and McGee from the data obtained from Framingham cohort study.[3] These findings suggest the association of diabetes mellitus with dysregulation in cardiac function.

Epidemiological data among diabetic patients showed its association with cardiovascular diseases mainly heart failure. Deranged diastolic function is 30% to 70% prevalent in diabetic patients. [11]

Picking up the abnormality in left ventricular function early affects the prognosis of diabetic cardiomyopathy since it is involved in the initial stage of diabetic cardiomyopathy. Hence following up of patient with diabetes mellitus for cardiology screening is required. The current study exhibited the prevalence of deranged diastolic function as 28% in diabetic patients (recently diagnosed) but in control population the prevalence was 10%.Even after ruling out high

blood pressure and ischaemic heart diseasein diabetic patients(with absence of microvascular complications) diastolic function was derangedwhich was detected with the help of Doppler echocardiography (E/A ratio).[12,13,14]

Gough et al[11] selected patients having normal blood pressure with recently diagnosed diabetes mellitus, for whom LV diastolic function was evaluated (pulsed wave doppler mitral flow velocity).The E/A ratio was reduced in significant way in diabetic group but further change was not noticed after 3rd and 6th month of antidiabetic management despite better HbA1c levels.Beljic et al [13]studied the LV diastolic function at different time period with regards to the diabetic treatment (disease onset, 6th month and 12th month of treatment). Patients before getting treated with antidiabetic drugs showed significant reduction in peak E/A ratio whereas after 12 months of treatment there was no significant change.In study done byVanninen et al.[14]on evaluating recently found diabetic patients, reduction in the blood glucose level at the end of 15-month period resulted in better diastolic function.

Study conducted by Celentano *et al*,[15]*had* three groups namely normal Euglycaemic group, participants havingderanged glucose level and those having diabetes mellitus (type 2). They were using oral glucose tolerant test for diagnosis and dividing the groups as per WHO recommendations. This study focussed on initial signs of deranged diastolic function specified by E/A mitral flow ratio. The assessment was made after removing confounders (high blood pressure, increased body weight and ischemia). [15, 16]

A study done by Bajraktari and collegues[17]showed the abnormality in ventricular diastolic function was 68.8% among asymptomatic diabetic patients (type 2) whereas control group (free of diabetes) was 34.9 % and this higher incidence is due to diabetic cardiomyopathy. Women with diabetes showed increased incidence and more severe diastolic function derangement compared to men.

In this present study, out of the 32 female patients 10 of them (31.25%) had LVDD while out of the18 male patients 4 of them (22%) had LVDD. In Framingham study also females out numbered the males. According to Devereuex and his colleagues, diastolic dysfunction is highly prevalent in female than male. [17,18].

Conditions such as increased blood pressure and coronary heart disease leads to abnormal left ventricular function. Few studies have demonstrated diabetes mellitus being a contributor for deranged left ventricular function. In our study post prandial blood sugar (PPBS) and HbA1c significantly correlated with diastolic dysfunction. As per Holzmann and his colleagues, concentration of blood glucose at fasting, post prandial state and HbA1clevels have an association with abnormal diastolic function.[19]BMI was higher in patients with diastolic dysfunction, it has direct correlation with LVDD. But WHR (waist hip ratio) not significantly correlate with diastolic dysfunction Diabetic patients who had abnormal lipid values had increased incidence of LVDD than who had normal lipid values, particularly total cholesterol and TGL.

Significant contributing factors responsible for the derangement in diastolic function among type 2 diabetes mellitus were as follows:

1. Patients above 45 years have three times increased risk for having abnormal diastolic function
2. Female patients developed twice the risk of abnormal diastolic function on comparison with male patients
3. People with diabetes with high PPBS and high HbAIc were found to have increased risk of developing abnormal diastolic function
4. Diabetic patients with high BMI and dyslipidemia were associated with higher risk for the emergence of dysfunction in left ventricle (during diastolic phase).[20]

Conclusion:-

The incidence of abnormal diastolic function was notablyincreasing in recently diagnosed diabetes mellitus (type 2) patients as paralleled to participants having normal glucose metabolism.Prevalence of abnormal diastolic function amongst newly diagnosed male and female diabetics is in the ratio of 1:2. Risk factors like advanced age, abnormal BMI, PPBS, raised HbA1c, elevated cholesterol and triglyceride values are significantly associated with diastolic dysfunction. Hence, all newly diagnosed diabetics with risk factors need to be evaluated for cardiac function with echocardiography.

Limitations:

TMT was not done in our study which can be considered as a limitation. The small sample size in this study can be considered as a lacuna which can be addressed in future researches.

Conflicts Of Interest:
No conflicts of interests.

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