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Diastolic dysfunction in diabetics versus non-diabetics by 2D-ECHO including Tissue Doppler method

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ABSTRACT

Introduction: Diastolic dysfunction is a common complication of diabetic cardiomyopathy, and it is often present in patients with type 2 diabetes, even in the absence of systolic ventricular failure. Tissue Doppler imaging is a valuable technique for detecting subclinical diastolic dysfunction. Early diagnosis of diastolic dysfunction is crucial for timely intervention and prevention of long-term cardiovascular complications. The Tissue Doppler method, combined with 2nd ECHO, was used to examine diastolic dysfunction in diabetics and non-diabetics.

Material and methods: A total of 129 subjects (case) with type 2 diabetes were compared with 333 non-diabetic subjects. 2D-ECHO including Tissue Doppler method was performed to assess left ventricular diastolic function.

Results: 76% from diabetic group had diastolic dysfunction, and 3.3% in non-diabetic group had diastolic dysfunction ($P < 0.05$).We found mitral valve and tricuspid valve regurgitation, aortic valve stenosis and LVH was more common among diabetics compared to non-diabetics ($p<0.05$).We found LV diastolic dysfunction, PAH (Pulmonary arterial hypertension) and PE

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(Pulmonary embolism) was more common among diabetics compared to non-diabetics ($p<0.05$).

Conclusion: In the current investigation, the overall prevalence of diastolic dysfunction in asymptomatic type 2 diabetes patients was 76%. When comparing asymptomatic type 2 diabetes to healthy individuals, diastolic dysfunction was far more common. When diabetic individuals are thought to have healthy hearts, routine screening for diastolic dysfunction may be justified by the use of tissue Doppler imaging.

Keywords: Tissue Doppler imaging, Diastolic dysfunction, diabetes mellitus, echocardiography.

INTRODUCTION

Globally, the prevalence of diabetes mellitus (DM) is rising and quickly approaching epidemic levels. Numerous epidemiological, clinical, and autopsy research conducted during the past three decades have suggested that diabetic heart disease exists as a separate clinical entity. Another name for diastolic heart failure (HF) is HF with intact left ventricular systolic function.

Myocardial and vascular abnormalities are components of cardiac illness in both metabolic syndrome and diabetes mellitus. The latter are mostly marked by diastolic dysfunction, which, despite its ubiquity, has proven challenging to assess. Diastolic function abnormalities are found in type 2 diabetes patients who do not have systolic ventricular failure as determined by conventional techniques or tissue Doppler imaging. These abnormalities are thought to be an early indicator of diabetic cardiomyopathy.[1–8] The primary reason for the strong correlation between diabetes and elevated cardiovascular morbidity and death is the heightened incidence of ischemic heart disease.

It is beyond dispute that those over 65 have a significant prevalence of heart failure that is primarily diastolic. In the overall population, this prevalence is 16%, but in those who have the metabolic syndrome, it is 35%.[9,10] Nonetheless, it is 50% in people with overt type 2 diabetes and prediabetes, 60% in CAD patients, and 70% in people with diabetes and CAD combined.[11–14] Clinically significant is diastolic myocardial dysfunction with a normal left ventricular ejection fraction, which accounts for almost half of all hospital admissions for acute heart failure.[15]

New technologies allow detailed quantification of global and regional diastolic function, while traditional Doppler echocardiographic parameters allow only semi-quantitative assessment of diastolic function and cannot reliably distinguish perturbations in loading conditions from altered diastolic functions. Tissue Doppler imaging, which is now routinely

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used in modern clinical practice, is the most accessible method for quantifying subclinical diastolic insufficiency.

Numerous studies demonstrate that TDI is more accurate than traditional echo-Doppler in the early detection of diastolic dysfunction. It is ideal to diagnose diastolic dysfunction as soon as possible. Early diagnosis results in early intervention, protecting the patient from DM's long-term repercussions. The TDI technique is a useful addition to the diagnostic toolbox since it aids in the early detection of diastolic dysfunction in diabetes. This study used the Tissue Doppler method for ECHO together with 2nd ECHO to examine diastolic dysfunction in diabetics and non-diabetics.

MATERIAL AND METHODS

Following ethics committee approval, a single centre comparative study comprised of 462 subjects of both genders. 129 patients were with diabetes mellitus and 333 a non-diabetics, who were referred to Department of Cardiology were included.

Group A: Diabetic patients: N=129

Controls: Non-diabetic patients: N=333

Based on their medical histories and physical examinations, all individuals were found to be in otherwise good health. The following patients were excluded: those with congestive cardiac failure diagnosed by signs and symptoms, chest radiograph or echocardiography, heart rates < 50 or > 100 per minute and 1° AV block, atrial fibrillation or any other cardiac arrhythmias diagnosed by clinical examination and electrocardiogram, hypertensive (BP > 140/90 mmHg), structural heart defects, and pulmonary obstructive disease. Patients with coronary artery disease were diagnosed by symptoms, previous documents, and electrocardiogram, or regional wall motion abnormality on echocardiogram. 2D echocardiograms were captured with GE's VIVID E9 machine. The subjects had routine parasternal long axis, short axis, and apical views examinations while in the left lateral decubitus and supine position. The American Society of Echocardiography's guidelines were followed by the same observer, a consultant cardiologist, for all measures and recordings.[16]

A ratio of less than 0.8 was used to define diastolic dysfunction.[17] For normal patients, propagation velocity was classified as more than 50 m sec, while for diastolic dysfunction, it was less than 50 m sec.[18] Colour TDI was acquired using the 2-chamber and 4-chamber orientations from an apical window. The image capture performance was carried out during apnea in order to prevent further artefacts caused by complete heart motion during breathing. To guarantee that the sample window was aligned parallel, the picture angle was changed. The diastolic myocardial velocities of E and A were measured, and their ratio was calculated. At

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100 mm/s, the TDI signals were recorded. At the lateral corner of the mitral annulus, a sample volume of less than 5 mm was used to record the velocity profiles. For normal participants, mitral valve velocities measured by tissue Doppler imaging (E/e) ratio were considered to be equal to or less than 8.[18] For normal individuals, the ejection fraction (EF) was considered to be equal to or higher than 55.[18]

333 individuals who were not diabetics (as determined by blood sugar levels) made up the control group. The study received institutional approval, and the subjects provided informed consent.

SPSS Inc. Chicago IL)'s IBM SPSS Version 22 was used for all of the analysis. The Student's t-test was used to compare continuous variables between the two groups, while the Chi-square test was used to evaluate categorical data. The threshold for statistical significance was fixed at P 0.05.

RESULTS

Table 1 shows the baseline characters of our study groups. Diabetics had their mean age more compared to non-diabetics ($p<0.05$). Also, we found that diabetic group had increased hypertensive, smokers and alcoholics compared to non-diabetic group ($P<0.05$)

Table 1: Baseline characteristics of study groups

Baseline characteristics		**Group A (N=129)**	**Group B (N=333)**	**P-value**
Age		52.14±6.4	39.6±7.2	**<0.001**
Gender	**Males**	107 (82.9%)	261 (78.4%)	0.304
	Females	22 (17.1%)	72 (21.6%)	
Co-morbidities	**Hypertension**	27 (20.9%)	3 (0.9%)	**<0.001**
	Smoking	23 (17.8%)	13 (3.9%)	**<0.001**
	Alcoholism	25 (19.4%)	3 (0.9%)	**<0.001**

Table 2 shows the valve disorders in study groups. We found mitral valve and tricuspid valve regurgitation, aortic valve stenosis and LVH was more common among diabetics compared to non-diabetics ($p<0.05$).

Table 2: Valve disorders in study groups

		Group A (N=129)	**Group B (N=333)**	**P value**
	Absent	129 (100%)	333 (99.1%)	0.557

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Mitral valve stenosis	**Mild**	0	1 (0.3%)	
	Moderate	0	2 (0.6%)	
Mitral valve regurgitation	**Absent**	0	49 (14.7%)	**<0.001**
	Mild	129 (100%)	284 (85.3%)	
Tricuspid valve regurgitation	**Absent**	125 (96.9%)	333 (100%)	**0.001**
	Mild	4 (3.1%)	0	
Aortic valve stenosis	**Absent**	124 (96.1%)	333 (100%)	**0.002**
	Mild	5 (3.9%)	0	
Aortic valve regurgitation	**Absent**	127 (98.4%)	333 (100%)	0.078
	Mild	2 (1.6%)	0	
LVH	**Absent**	104 (80.6%)	331 (99.4%)	**<0.001**
	Mild concentric	14 (10.9%)	1 (0.3%)	
	Concentric	11 (8.5%)	1 (0.3%)	

Table 3 shows the ECHO findings in study groups. We found LV diastolic dysfunction, PAH (Pulmonary arterial hypertension) and PE (Pulmonary embolism) was more common among diabetics compared to non-diabetics ($p<0.05$).

Table 3: ECHO findings in study groups

		Group A (N=129)	**Group B (N=333)**	**P value**
LV diastolic dysfunction	**Absent**	31 (24%)	322 (96.7%)	**<0.001**
	Grade I	88 (68.2%)	11 (3.3%)	
	Grade II	10 (7.8%)	0	
RV function	**Normal**	128 (99.2%)	333 (100%)	0.108
	Mild dysfunction	1 (0.8%)	0	
Pulmonary arterial hypertension	**Normal**	126 (97.7%)	333 (100%)	**0.005**
	Mild	3 (2.3%)	0	
Pulmonary embolism	**Absent**	125 (96.9%)	333 (100%)	**0.005**
	Trace	2 (1.6%)	0	
	Mild	2 (1.6%)	0	

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DISCUSSION

Up until recently, the heart's systolic functions were assigned the utmost attention. However, over the past ten years, researchers and clinicians have found that abnormalities of the left ventricle's diastolic function, both reversible and irreversible, play a significant role in the symptoms and morbidity of patients with a range of cardiac disorders, including those whose systolic function is normal or nearly normal. According to our latest research, pre-clinical diastolic dysfunction is prevalent in DM patients. Diastolic dysfunction in patients without symptoms of heart failure (HF) and normal systolic function is referred to as pre-clinical diastolic dysfunction. The current study's group of people with type 2 diabetes had a high burden of diastolic dysfunction.

Subjects with type 2 diabetes had considerably greater diastolic dysfunction than those in the control group ('P'< 0.05). In a case control study involving 55 people with type 2 diabetes, Soldatos et al.[19]discovered that a sizable fraction of people with type 2 diabetes had diastolic dysfunction. The ejection fraction in diabetics did not significantly decrease, according to the current study. Our findings were compared with those of other investigations. Patil et al. identified a considerable incidence of diastolic dysfunction (54.33%) in their study of 127 Type II diabetics without symptoms.[20] In the current investigation, diastolic dysfunction was evident in 76% of the participants belonging to the diabetes group and 3.3% of the control group ($P < 0.005$).

In patients with diabetes mellitus, excessive diastolic left ventricular stiffness plays a significant role in heart failure. Diabetes is thought to cause myocardial deposition of collagen and advanced glycation end products, which increases stiffness. In a similar vein, 76% of the case group participants in the current study had diastolic dysfunction with normal LVEF.

In their case control study of 71 individuals with type 2 diabetes, Mishra et al.[21] discovered that, in comparison to healthy participants, asymptomatic diabetic patients had decreased LV systolic and diastolic function. Patients with type-2 diabetes mellitus are far more likely to have LV diastolic failure, which is an early indicator of diabetic cardiomyopathy. 76% of participants in our study had type 2 diabetes. In their 114-person study, Exiara et al.[22] found that LV diastolic dysfunction is highly prevalent and rises with age in normotensive, asymptomatic, and well-controlled type 2 diabetes patients. In their study, diastolic dysfunction was present in 63.2% of patients, whereas our incidence was 76%. These results are consistent with our observations.

In a study of 1,760 diabetes patients, Aaron et al.[23] discovered that 411 (23%) of the patients had diastolic dysfunction, and that diabetic patients who had diastolic dysfunction had

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a noticeably greater death rate than those who did not. According to Boyer et al.[24], a significant proportion of asymptomatic, normotensive patients with type 2 diabetes have LV diastolic dysfunction. In 75% of the individuals, diastolic dysfunction was detected. It was also discovered that, compared to other echocardiographic parameters, TDI identified diastolic dysfunction more frequently. 76% of the participants in our study had diastolic dysfunction.

In their prospective observational research of 305 patients with type 2 diabetes, Poulsen et al.[25] discovered a strong correlation between defective myocardial perfusion on myocardial perfusion scintigraphy and abnormal left ventricle filling. Regardless of the severity of DM and renal dysfunction, Takeda et al.[26] found that diastolic dysfunction (impaired relaxation) plays a crucial role in the induction of HF with normal systolic function in their population of 544 consecutive Japanese DM patients with ejection fraction ≥ 50%. These results partially agree with our investigation, which found that diastolic dysfunction was more common in patients with a HbA1c > 7.5. In their research population of 60 individuals with type 2 diabetes, Hameedullah et al.[27] discovered a substantial association ('P' < 0.05) between diastolic indices and HbA1c levels.

Diastolic dysfunction is associated with glycaemic management and was more common in people with poorly managed diabetes. Schannwell et al.[28] found that even in young individuals with diabetes mellitus, diastolic ventricular function is abnormal but systolic function is normal in their sample population of 87 participants. According to our research, type 2 DM patients have a high incidence of pre-clinical diastolic dysfunction. These findings obliquely imply that diastolic dysfunction may occur as a result of metabolic and/or hormonal causes. The most plausible possibility among these is insulin resistance and the hyperinsulinemia it is associated with.

CONCLUSION

In the current investigation, the overall prevalence of diastolic dysfunction in asymptomatic type 2 diabetes patients was 76%. When comparing asymptomatic type 2 diabetes to healthy individuals, diastolic dysfunction was far more common. When diabetic individuals are thought to have healthy hearts, routine screening for diastolic dysfunction may be justified by the use of tissue Doppler imaging.

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