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A hospital-based cross-sectional study to examine the echocardiographic features of patients with type-2 diabetes

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Abstract

Aim: This study aimed to investigate echocardiographic features in patients with diagnosed T2DM.

Material & Methods: A hospital-based, cross-sectional observational study included 100 patients with diagnosed type 2 diabetes, who presented to Medicine Department K S Hegde hospital for one year. This study included type 2 diabetes diagnosed as per American diabetes association 2018 criteria. Their ECG findings were noted and correlated with their blood sugar levels.

Results: There were 55 males and 45 females. Out of 100 cases, 5 cases (5%) of newly diagnosed type 2 diabetes were in age group 31-40 years, 24 cases (24%) were in age group 41-50 years, 26 cases (26%) were in age group 51-60 years, 30 cases (30%) were in age group 61-70 years, 10 cases (10%) were in age group 71-80 years and 5 cases (5%) were above 81 years. Out of 100 cases of newly diagnosed type 2 diabetes, 54 cases (54%) were smokers and 46 (46%) were non-smokers, 20 (20%) consumed alcohol and 80 (80%) didn't consume alcohol. Out of 100 cases of newly diagnosed type 2 diabetes, 50 cases (50%) had HTN, 25 (25%) had CAD and 75 (75%) did not have CAD. Out of 100 newly diagnosed type 2 diabetes, 40 cases (40%) had left ventricular diastolic dysfunction, 26 cases (26%) had left ventricular hypertrophy (LVH), 15 cases (15%) had RWMA, 10 cases (10%) had RA/RV dilated, 6 cases (6%) had dilated LV and 3 cases (3%) had dilated LA.

Conclusion: Type 2 diabetics without cardiovascular symptoms must be screened for cardiovascular abnormalities so that early interventions can be done to prevent further progression to symptomatic cardiovascular abnormalities. ECG should be done to predict cardiovascular risk in type 2 diabetic patients without cardiovascular symptoms. Echocardiographic abnormalities are very common in outpatients with type 2 diabetes, but neither cardiac symptoms nor clinical characteristics are effective to identify patients with echocardiographic abnormalities.

Keywords: Diabetes Mellitus-Type 2, Echocardiography

Introduction

Type 2 diabetes mellitus (T2DM) is an endocrine disorder characterized by hyperglycemia resulting from variable degrees of insulin resistance and deficiency ^[1]. Chronic hyperglycemia in diabetes can lead to multi-organ damage resulting in renal, neurologic, cardiovascular, and other serious complications ^[1]. The worldwide prevalence of T2DM was 9% in men and 7.9% in women in 2014 ^[2]. Cardiovascular disease (CVD) is the main cause of mortality among diabetic patients ^[3] and these patients have a high risk of coronary artery disease that is many times silent ^[4]. The cardiac changes associated with diabetes are thought to comprise thickening of the myocardium and is characterised by predominantly diastolic dysfunction, the diabetic cardiomyopathy. In addition, because of advancing age and comorbidities, including hypertension and obesity, patients with type 2 diabetes are also prone to other cardiac pathologies affecting prognosis including but not limited to left ventricular hypertrophy, ^[5, 6] reduced left and right ventricular ejection fraction, ^[7] dilated left atrium ^[8] or valve disorders ^[9]. Even more, contemporary, intensive treatment of hypertension, hyperglycaemia, dyslipidemia and lifestyle factors ^[10] may have changed the risk profile for having echocardiographic abnormalities making it difficult to choose which patients to refer to echocardiography. Thus, knowledge on echocardiographic abnormalities and their association with cardiac symptoms and clinical characteristics from a large, contemporary cohort of patients with type 2 diabetes is lacking.

Most diabetic cardiovascular diseases are asymptomatic (silent or painless ischemia) due to autonomic neuropathy. Many patients with left ventricular dysfunction remain undiagnosed and untreated until advanced disease causes disability or death. This is the biggest challenge for primary physicians. This delay can be avoided if screening techniques are used to identify left ventricular dysfunction in its preclinical phase^[4].

Therefore, the aim of the study was to determine the prevalence of echocardiographic abnormalities in outpatients with type 2 diabetes and to determine their relation to cardiac symptoms and clinical characteristics and evaluate these as basis of referral to echocardiography.

Material and Methods

A cross sectional study of 100 patients is a representative sample of patients with type 2 diabetes in the department of Endocrinology for 1 year. Patients with inadequate glycaemic control or diabetes-related complications are referred to the department to optimise medical treatment. Patients with less well-controlled type 2 and/or increasing severity of complications and/or co-morbidity are followed continuously with specialised and multidisciplinary treatment in the outpatient clinics. All patients with type 2 diabetes were eligible to participate. All participants were given written informed consent.

Study visit

Prior to the study visit, patients received study information and answered questionnaire on diabetes duration, presence of diabetic complications, current medication, prior heart disease (myocardial infarction, percutaneous coronary intervention, coronary artery bypass grafting, congestive heart failure and atrial fibrillation), prior stroke and peripheral artery disease, hypertension, hypercholesterolemia, family history of coronary artery disease, known lung disease (asthma and chronic obstructive lung disease), smoking habits, exercise, alcohol consumption, height and weight. At the visit, the questionnaire including current medication was reviewed with the patient. Cardiac symptoms, dyspnoea and chest were evaluated with the patient by investigator P.G.J. Dyspnoea was graded mild when corresponding to New York Heart Association class II and moderate/ severe when class III–IV. Chest pain was graded characteristic when reported as central, oppressive and occurring in relation to physical exercise and uncharacteristic when not. A 12-lead electrocardiogram was collected (Cardiosoft version 6.61, GE Healthcar) and interpreted at a time later than the study visit and, thus, independently of the echocardiographic examination by a single experienced interpreter (P.G.J.). Electrocardiographic abnormalities were defined as pathologic/abnormal Q-waves, ST-segment and T-wave changes and left and right bundle branch block.

Blood pressure was measured in supine position with a cuff adjusted to arm circumferential after at least 15 min of rest. Hypertension was defined as patients receiving antihypertensive medication or systolic blood pressure > 140 mmHg or diastolic blood pressure > 90 mmHg. Atrial fibrillation was considered present when either self-reported or present at the time of the echocardiography.

Echocardiography was performed using a Philips iE33 Doppler echocardiography system equipped with a real-time three-dimensional probe X3-1 (frequency of 1–3 MHz)

(Philips, Best, and the Netherlands). Images of the left ventricle were taken in the short axis of the great artery, the long axis of the left ventricle, the short axis views of various levels, and standard apical 4-chamber and 2-chamber sections in the resting state; 3–5 cardiac cycles were measured continuously to obtain average readings. Interventricular septal thickness (IVST), left ventricular end-diastolic diameter (LVEDD), posterior left ventricular wall thickness (PWTD), LVM, end-diastolic thickness of left ventricular posterior wall (DD), aortic root diameter, left atrial diameter (Lad), left atrial diameter fraction-shortening values, and left ventricular ejection fraction (LVEF) were determined routinely^[16]. A senior technician collected all the images and another technician recorded and 35 analysed the data.

LVM was derived according to the following formula:

$$LVM = 0.8 \times 1.04 [(LVST + PwT + LVDd)^3 - LVDd^3] + 0.6.$$

Statistical Analysis

Statistics were calculated using R for Mac, version 2.15.3 (R Project for Statistical Computing, Vienna University of Economics and Business Administration, Wien, Austria).

Results

Table 1: Demographic details

Gender	N%
Male	55 (55)
Female	45 (45)
Age groups	
31-40	5 (5)
41-50	24 (24)
51-60	26 (26)
61-70	30 (30)
71-80	10 (10)
> 80	5 (5)
Habits	
Smoking	
Yes	54 (54)
No	46 (46)
Alcohol	
Yes	20 (20)
No	80 (80)
Comorbidity	
CAD	
Yes	25 (25)
No	75 (75)
HTN	
Yes	50 (50)
No	50 (50)

There were 55 males and 45 females. Out of 100 cases, 5 cases (5%) of newly diagnosed type 2 diabetes were in age group 31–40 years, 24 cases (24%) were in age group 41–50 years, 26 cases (26%) were in age group 51–60 years, 30 cases (30%) were in age group 61–70 years, 10 cases (10%) were in age group 71–80 years and 5 cases (5%) were above 81 years. Out of 100 cases of newly diagnosed type 2 diabetes, 54 cases (54%) were smokers and 46 (46%) were non-smokers, 20 (20%) consumed alcohol and 80 (80%) didn't consume alcohol. Out of 100 cases of newly diagnosed type 2 diabetes, 50 cases (50%) had HTN, 25 (25%) had CAD and 75 (75%) did not have CAD.

Table 2: Symptoms

Symptoms	N%
Abnormal Thirst	44 (44)
Polyuria	36 (36)
Weight loss	34 (34)
Claudication	15 (15)
Fatigue	12 (12)
Chest	10 (10)
Sob	9 (9)
Decreased Vision	8 (8)

Out of 100 cases, 44 cases (44%) of newly diagnosed type 2 diabetes presented with abnormal thirst, 36 (36%) presented with polyuria, 34 (34%) presented with weight loss, 15 (15%) presented with claudication, 12(12%) presented with fatigue, 10 (10%) presented with chest discomfort, 9 (9%) presented with shortness of breath on exertion and 8 (8%) presented with decreased vision.

Table 3: Echo characteristics of newly diagnosed type 2 diabetes

Echo characteristics	N%
LVDD	40 (40)
LVH	26 (26)
RWMA	15 (15)
RA/RV Dilated	10 (10)
Dilated LV	6 (6)
Dilated LA	3 (3)

Out of 100 newly diagnosed type 2 diabetes, 40 cases (40%) had left ventricular diastolic dysfunction, 26 cases (26%) had left ventricular hypertrophy (LVH), 15 cases (15%) had RWMA, 10 cases (10%) had RA/RV dilated, 6 cases (6%) had dilated LV and 3 cases (3%) had dilated LA.

Discussion

T2DM is still a major cause of worldwide morbidity and mortality, due to complications such as neuropathy, nephropathy, stroke, and coronary artery disease [11]. A strong correlation between cardiovascular diseases and diabetes mellitus type 2 (DM) has been found. Adults with DM are two to four times more likely to have heart disease than adults without diabetes [12]. Whether T2DM is independently associated with structural heart abnormalities is controversial because of confounders (hypertension, abnormal lipid level, obesity and lack of physical activity) associated with T2DM [13]. Diastolic dysfunction, left ventricular hypertrophy and left atrial enlargement were most commonly found in echocardiography of diabetic patients and neither cardiac symptoms nor clinical characteristics were effective to identify this patients [14].

There were 55 males and 45 females. Out of 100 cases, 5 cases (5%) of newly diagnosed type 2 diabetes were in age group 31-40 years, 24 cases (24%) were in age group 41-50 years, 26 cases (26%) were in age group 51-60 years, 30 cases (30%) were in age group 61-70 years, 10 cases (10%) were in age group 71-80 years and 5 cases (5%) were above 81 years. In a study done in Nepal the median age (\pm SD) of the study group was 47.37 (\pm 9.95) years. Maximum number (31%) of the study participants were in the age group 45-54 years [15]. The importance of age as a risk factor is consistent with another study done in Bangladesh [16]. Out of 100 cases, 44 cases (44%) of newly diagnosed type 2 diabetes presented with abnormal thirst, 36 (36%) presented with polyuria, 34 (34%) presented with weight loss, 15 (15%)

presented with claudication, 12(12%) presented with fatigue, 10 (10%) presented with chest discomfort, 9 (9%) presented with shortness of breath on exertion and 8 (8%) presented with decreased vision. Frequent urination was reported by every patient assessed during the study period followed by frequent drinking/thirst (79%), general body weakness (51%), blurred vision (38%), frequent eating (33%), excessive sweating (27%), joint pains (22%), numbness (21%) and headache (21%) [17]. Thirst, polyuria, weight loss, skin infections and lethargy were significantly associated with diabetes [18].

Out of 100 cases of newly diagnosed type 2 diabetes, 54 cases (54%) were smokers and 46 (46%) were non-smokers, 20 (20%) consumed alcohol and 80 (80%) didn't consume alcohol. Random-effects meta-analysis of four T2DM studies showed that the differences in T2DM status among smokers and non-smoker were not significant. Random-effects model showed that T2DM status among alcoholic and non-alcoholic groups were not statistically significant [19]. Out of 100 cases of newly diagnosed type 2 diabetes, 50 cases (50%) had HTN, 25 (25%) had CAD and 75 (75%) did not have CAD. Hypertension was more common in overt protein uric diabetes than person with micro albuminuria and non-albuminuria [20]. The prevalence of hypertension in newly diagnosed type 2 diabetes was 61.9% [21].

Out of 100 newly diagnosed type 2 diabetes, 40 cases (40%) had left ventricular diastolic dysfunction, 26 cases (26%) had left ventricular hypertrophy (LVH), 15 cases (15%) had RWMA, 10 cases (10%) had RA/RV dilated, 6 cases (6%) had dilated LV and 3 cases (3%) had dilated LA. Diastolic dysfunction, systolic dysfunction, LVH and wall motion abnormalities were present in 55.0%, 21.8%, 19.3% and 4.0% respectively of all the participants with mean duration of diabetes of 2 months [22]. In a study done in India, incidence of LVDD was 41%. Grade 1 LVDD was most common. Mean HbA1C level was higher in group with LVDD as compared to group without LVDD [23]. Prevalence of diastolic dysfunction was found to be 44.4% in patients of type 2 diabetes mellitus without cardiac manifestations [24].

Conclusion

Type 2 diabetics without cardiovascular symptoms must be screened for cardiovascular abnormalities so that early interventions can be done to prevent further progression to symptomatic cardiovascular abnormalities. ECG should be done to predict cardiovascular risk in type 2 diabetic patients without cardiovascular symptoms. Echocardiographic abnormalities are very common in outpatients with type 2 diabetes, but neither cardiac symptoms nor clinical characteristics are effective to identify patients with echocardiographic abnormalities.

Conflict of Interest

Not available

Financial Support

Not available

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