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NONINVASIVE ASSESSMENT OF SUBCLINICAL CARDIAC DIASTOLIC DYSFUNCTION IN DIABETIC PATIENTS

Cardiology

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ABSTRACT

A cross sectional study of 50 type 2 diabetes normotensive patients evaluating cardiac functions using noninvasive methods including 2D-Echocardiography and ECG. Conventional echocardiography is a simple economical test for detecting subtle LV dysfunction in normotensive and asymptomatic diabetic patients. Alteration of E/A ratio is a sensitive and specific indicator of early diastolic dysfunction. 56% patients accounted for diastolic dysfunction indicated by reduced E/A ratio and increased isovolumetric relaxation time. Early identification of subclinical signs of heart failure by these noninvasive and less expensive methods may improve outcomes in type 2 diabetes patients.

KEYWORDS

diabetes mellitus, diastolic dysfunction, E/A ratio

INTRODUCTION

Diabetes mellitus is a syndrome often familial and characterised by chronic hyperglycemia and disturbances of carbohydrate, fat and protein metabolism associated with absolute or relative deficiency in insulin secretion and/or action, which is modulated by genetic, HLA and environmental factors. [1]

Diabetic subjects have been reported to develop congestive heart failure in the absence of coronary heart diseases, hypertension or any known structural heart disease.[2]The term 'diabetic cardiomyopathy' has been introduced for this condition. It has been suggested that microangiopathic lesions of the myocardium, altered composition and fibrosis of myocardial interstitium and accumulation of lipids in myocardial cells are involved in pathogenesis of diabetic cardiomyopathy.[3] Subclinical abnormalities of left ventricular function are recognized in both Type 1 and Type 2 diabetes mellitus using Doppler echocardiography.[4] Thus, abnormal diastolic function may be an early indicator of cardiac involvement.

It seems as though diabetes increases the severity of heart failure at any given level of left ventricular systolic and diastolic dysfunction. Likewise, the link between diabetes and myocardial dysfunction may exist independent of coronary artery disease. [5] This study thus aims to study the subclinical left ventricular diastolic dysfunction in normotensive diabetic patients using noninvasive methods

MATERIAL AND METHODS

The study was conducted on adult normotensive, type 2 diabetes patients who attended the medical OPD of tertiary care institute of New Delhi. Fifty patients between age group 18-65 were selected for the present study by Simple Random Sampling method. All the patients were evaluated for left ventricular systolic and diastolic dysfunction after prior informed consent. Patient with any major comorbidities including CHF, CAD and chronic liver or kidney dysfunction were excluded.

A comprehensive history and examination was conducted by the principle investigator. Routine haematological investigation and imaging were performed and systematically documented. Cardiovascular assessment was made by non invasive tests including ECG and 2D Echocardiography(Agilent Image Point machine with 2.5 to 5 MHz probes). All recordings were done with patients in supine and left lateral position. Following parameters were used to assess LV diastolic dysfunction.

1. Mitral 'E' velocity (Peak velocity of early mitral flow)
2. Mitral 'A' velocity (Peak velocity of late (atrial) mitral flow)
3. Mitral E/A ratio (Normal 1-2)
4. Isovolumic relaxation time (IVRT) (Normal 60-100 msec)
5. Deceleration time of mitral 'E' curve (DT of E) (Normal 150-200 msec).

RESULTS

Fifty diabetic patients who were normotensive and asymptomatic were selected as per the inclusion criteria. The mean age of the patients in the study is 48.8 ± 6.06 years. The mean duration of diabetes of patients in the study was 8.54 ± 3.21 years and mean BMI of the patients in the study was 26.9 ± 2.3 (kg/ m²).The mean Ejection fraction of patients was 68.36 % .

Diastolic parameters

1. E/A ratio

E/A ratio being the most sensitive and specific parameter of diastolic dysfunction. The majority of patients had E/A ratio <1, 28(56%) accounting for diastolic dysfunction whereas 22(44%) had E/A ratio within normal limit(Fig. 1). The mean E/A of all patients was 1.10±0.27.

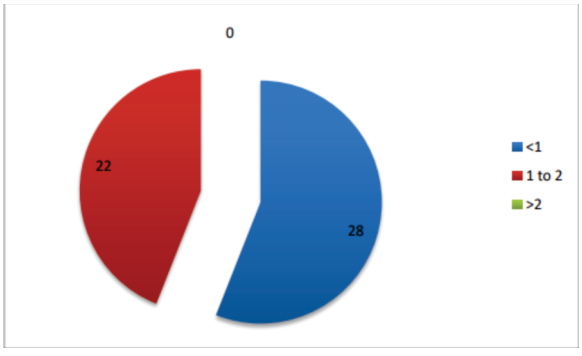

Fig 1. Graphical distribution of patients with respective E/A value

2. Isovolumetric relaxation time (IVRT)

The mean of IVRT of patients in study was 96.7 ± 9.89. 22 (44%) patients had values between 60-100 msec and 28 (56%) had > 100 msec(Table 1).

Table 1. Isovolumetric relaxation time

IVRT (msec)	No. Of pateints
<60	0
60-100	22 (44%)
>100	28 (56%)

3. Deceleration time of E (DT of E)

28(56%) patients had value of DT of E (msec) >200, denoting significant diastolic dysfunction, whereas 22(44%) of patients within normal limits, 150-200(Table 2). The mean of DT of E(msec) of patients was 200.42(msec) with standard deviation 18.64.

Table 2. Values of DT of E among subjects

DT of E (msec)	No. Of pateints
<150	0
150-200	22
>200	28

DISCUSSION

The term 'diabetic cardiomyopathy' has been used for diabetic subjects who have reported to develop congestive heart failure in the absence

of coronary heart diseases, hypertension or any known structural heart disease. It may be due to an increase in left ventricular wall thickness and myocardial mass related to the hyperglycemia per se [6,7]. A patient with diabetes has higher mortality for cardiovascular reasons rather than because of the diabetes itself. [8] It is therefore important to improvise the early detection and of this connection.

The exact mechanisms underlying the association between diabetes and heart failure are still the subject of debate, although there are several possibilities. Lundbaeck suggested the possibility of a diabetes-specific cardiomyopathy back in 1954. [9] Microangiopathic lesions of the myocardium, accumulation of lipids in myocardial cells and fibrosis of myocardial interstitium and are involved in pathogenesis of diabetic cardiomyopathy. [2] After the onset of diastolic dysfunction, progressive myocardial dysfunction occurs, with structural and functional abnormalities such as myocyte hypertrophy, deposition of PAS- positive glycoproteins, collagen, interstitial oedema, intramyocardial collagen accumulation and interstitial fibrosis. [10] Several of these changes are believed to be a consequence of oxidative stress induced by hyperglycaemia. This suggests a causative link between hyperglycaemia, oxidative stress, cardiomyocyte apoptosis and diabetic cardiomyopathy.[11]

Diagnosis of myocardial diastolic dysfunction is difficult, as it comprises abnormalities in left ventricular relaxation, distensibility and filling. There are three main types of abnormal echocardiographic filling patterns. The first, seen in the early stages, is impaired relaxation in the early phase of diastole, with a decrease in the early transmitral peak flow (E) velocity with a compensatory increase in the atrial transmitral peak flow (A) velocity, resulting in a decrease in the ratio of peak mitral flow velocities (E/A ratio). [12] The second stage, seen in patients with intermediate diastolic dysfunction, is characterised by a normalised E/A ratio, a normal deceleration time and a normal performance of the E- and A-wave, called pseudonormalisation, and can be disclosed by other Doppler parameters such as pulmonary venous flow or Tissue Doppler Imaging (TDI). [13] Relaxation is disturbed in all stages, whereas compliance is lower in intermediate and severe conditions.

The most reliable technique for assessing diastolic function is invasive cardiac catheterisation and this method is still the golden standard. It is, however, not generally accessible and is invasive method. For this reason, echocardiographic and Doppler techniques are more useful in clinical practice. 2D-Echocardiography is still the most reliable, safe, inexpensive and relatively effective non-invasive tool for assessing diastolic function of the heart.. A complementary method is Tissue Doppler Imaging (TDI), which estimates myocardial systolic and diastolic tissue velocities more directly, thus providing a more accurate measurement of left ventricular relaxation. [15] In particular, the ratio of diastolic peak annular velocities (E/E´ ratio) correlates closely with left ventricular filling pressures.

Epidemiological evidence indicates that diabetes increases the risk of future heart failure. In 2001 and 2004, Nichols et al. reported on the close links between diabetes and heart failure In a hospital-based registry. [16] They diagnosed 9,591 individuals with heart failure diagnosed with type 2 diabetes without clinical symotoms. The prevalence was 11.8% among those with diabetes and 4.5% among those without diabetes. The incidence when examined 2.5 years later was 7.7 and 3.4% in those free from heart failure at baseline. Notably, the patients with diabetes were ten years younger on average at the time of the heart failure. Similar findings were seen in the Reykjavik population-based study conducted by Thrainsdottir et al. [17]

Better understanding of the mechanisms underlying diastolic heart failure in patients with diabetes, including additional potential targets for treatment, is needed. There is also a need for further refinement of the diagnostic opportunities. The methods that are currently available are still not sufficiently specific and demanding, in particular when it comes to the screening of early signs of diastolic dysfunction in diabetic patients. Moreover, early uncontrolled observations relating to the opportunity to improve diastolic function by means of meticulous glucose control still have to be confirmed. It would then be of particular importance to see whether it is possible to influence the signs of this kind of dysfunction without cardiovascular symptoms, thereby hopefully creating an opportunity to counteract progression towards advanced symptomatic heart failure. To summarise; heart failure and diabetes are two increasingly common conditions. It is therefore important to improve the early detection and treatment of this connection

CONCLUSIONS

LV diastolic dysfunction is commonly seen in asymptomatic normotensive Type 2 DM patients. Alteration of E/A ratio < 1 in 2D echocardiography is a sensitive and specific indicator of early diastolic dysfunction. LV diastolic dysfunction in asymptomatic normotensive patients with type 2 DM without evidence of coronary heart disease was significantly higher in our subjects than previously suspected. It is thus a marker of evolving heart disease among diabetics. Conventional echocardiography is a simple economical test for detecting subclinical LV dysfunction in type 2 normotensive, asymptomatic, diabetes mellitus patients.

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