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Original Article

Myocardial Performance Index (Tei Index): A simple tool to identify cardiac dysfunction in patients with diabetes mellitus

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ABSTRACT

Background: Cardiac dysfunction is the major cause of morbidity and mortality in diabetes. Myocardial Performance Index (MPI/Tei Index) includes both systolic and diastolic time intervals to assess the global cardiac dysfunction. Our aim was to assess the MPI in patients with type 2 diabetes.

Material and methods: This hospital-based analytic observational study was performed in the tertiary care center. The conventional Doppler parameters, tissue Doppler-derived E/E′ and MPI, were measured in all patients.

Results: 100 patients with type 2 diabetes were included in the study. 65 patients showed diastolic dysfunction, 33 with Grade I diastolic dysfunction, 23 with Grade II diastolic dysfunction, and 14 patients with Grade III diastolic dysfunction. The conventional Doppler showed abnormality in 44% of patients (33 patients with Grade I and 14 patient with Grade III). 23 patients were in Grade II diastolic dysfunction (12 patients showed reversal E/A on valsalva maneuver and 11 patients showed abnormality in tissue Doppler-derived E/E′, E/E′ > 15). MPI with cut-off 0.36 was found to have 94% sensitivity, 100 specificity, and 94% PPV for the detection of cardiac dysfunction. MPI negatively correlated with systolic dysfunction (rho = 0.455, $p < 0.001$) and positively correlated with grade of diastolic dysfunction (rho = 0.832, $p < 0.001$) and NYHA grading of dyspnea (rho = 0.872, $p < 0.001$)

Conclusions: MPI as a single parameter can be used for assessment in diabetic cardiac dysfunction.

1. Introduction

Cardiac dysfunction is the major cause of morbidity and mortality in diabetes.[1] Most commonly the cardiac dysfunction in diabetes is caused by the coronary atherosclerosis. But the epidemiological and clinical data show that diabetes mellitus independently increases the risk for cardiac dysfunction and heart failure.[2–5] Diabetic cardiomyopathy was first reported in 1972 by Rubler.[4] It is characterized by the development of diastolic dysfunction at the early stage,

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followed by systolic dysfunction in the absence of coronary artery disease, hypertension, or significant valvular heart disease.

Cardiac dysfunction in diabetes can manifest as both systolic as well as diastolic dysfunction, and routinely ejection fraction and conventional Doppler parameters are used for its evaluation. Ejection fraction is a less sensitive parameter in early systolic dysfunction and cannot be used routinely in asymptomatic patients.[6] The sensitivity for the detection of diastolic dysfunction by conventional Doppler parameters is decreased by pseudonormalization pattern in Grade II diastolic dysfunction. This calls for the use of tissue Doppler-derived indices, *i.e.*, *E*/*E*′ for differentiation.

Myocardial Performance Index (MPI/Tei Index), which includes both systolic and diastolic time intervals to assess the global cardiac dysfunction was used by Tei and his co-workers in 1995.[7] Tei Index uses the measurement possible on flow wave Doppler and is as sensitive as the tissue Doppler measurements. The index is mainly used in amyloidosis, dilated cardiomyopathy, ischemic heart disease, and congestive heart failure.

Our aim was to assess the MPI in patients with type 2 diabetes without hypertension, regional wall motion abnormality, chronic alcoholism, and valvular heart disease.

2. Material and methods

This hospital-based analytic observational study was performed in the tertiary care center. Patients with type 2 diabetes were screened for inclusion. All the subjects were interviewed, examined, and investigated as per the predesigned proforma, and the study was approved by the institutional ethics committee. Fasting lipid profile, blood urea and serum creatinine, fasting and post-meal blood sugar, and 12-lead ECG were done in all study subjects.

2.1. *Echocardiographic protocol*

Their echocardiographic indices were evaluated serially using PHILLIPS HD11XE with frequency of 4.2 MHz.

2.1.1. *Transmitral flow Doppler measurement*

For recordings of the mitral inflow velocity pattern, the sample volume of the pulsed Doppler was placed between the tips of the mitral leaflets in the apical four-chamber view. From the transmitral recordings, the following measurements were carried out: peak *E* velocity in meters per second (peak early transmitral filling velocity during early diastole), peak *A* velocity in meters per second (peak transmitral atrial filling velocity during late diastole), and deceleration time in milliseconds (time elapsed between peak *E* velocity and the point where the extrapolation of the deceleration slope of the *E* velocity crosses the zero baseline). The definitions published by the Canadian consensus on diastolic dysfunction by echocardiography were used to classify diastolic function as follows: normal, impaired relaxation, pseudonormal, and restrictive pattern.[8] To distinguish subjects with normal diastolic function from those with a pseudonormalized pattern of ventricular filling TDI derived *E*/*E*′ >15 and valsalva maneuver were used.

2.1.2. *Tissue Doppler measurement*

TDI of the mitral annulus was obtained from the apical four-chamber view. A 1.5-mm sample volume was placed sequentially at the medial mitral annulus. Early diastolic velocity *E*′ was measured and *E*/*E*′ was calculated (Fig. 1).

2.1.3. *MPI measurement*

Doppler time intervals were measured from mitral inflow and left ventricular outflow Doppler tracings, as described by Tei and co-workers[7]. The interval '*a*' from cessation to onset of mitral inflow is equal to the sum of isovolumic contraction time (ICT), ejection time (ET), and isovolumic relaxation time (IRT). ET '*b*' is derived from the duration of the left ventricular outflow Doppler velocity profile. The sum of ICT and IRT was obtained by subtracting *b* from *a*. The MPI was calculated as shown in Fig. 1: $(a - b)/b$.

2.2. *Statistical analysis*

All demographic, echo parameters were presented as mean ± SD. Categorical variables were expressed in actual number and percentage. Age, duration of diabetes, and all echo parameters were compared between different groups by performing unpaired *t*-test for normalized data; Mann–Whitney test was performed for non-normalized data. Categorical variables were compared by chi-square test. Receiver operating characteristic (ROC) curve was used to derive cut-off value for the MPI to detect cardiac dysfunction. All the tests were two sided; p-value < 0.05 was considered as statistically significant. Pearson correlation test was used to

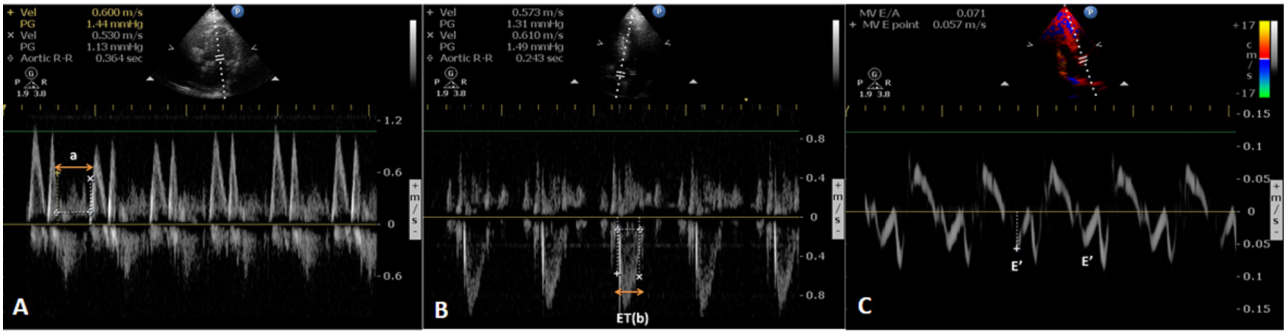

Fig. 1 – (A and B) Measurement of MPI and is calculated by $(a - b)/b$ and (C) tissue Doppler-derived *E*′.