Clinical Investigation

Myocardial Performance Index Determined by Tissue Doppler Imaging in Patients With Systolic Heart Failure Predicts Poor Long-Term Prognosis: An Observational Cohort Study

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ABSTRACT

Background: Myocardial performance index (MPI) is an echocardiographic parameter that reflects left ventricular (LV) function. MPI determined by means of tissue Doppler imaging (TDI) at different LV sites (global MPI) and its long-term prognostic implications in congestive heart failure (HF) have not been evaluated.
Methods and Results: A total of 110 patients with HF during acute hospitalization were followed for a mean of 5.0 years for survivors. The myocardial velocities at 4 different LV sites near the mitral annulus from apical views were recorded with the use of pulsed-wave TDI. From myocardial velocity profiles, the MPI at each LV site was calculated: MPI = (isovolumetric contraction time + isovolumetric relaxation time)/ejection time. The global MPI was calculated as the mean from the 4 LV sites. Mean ejection fraction was 25%. A total of 61 patients died during the study period. On multivariate analysis, only MPI emerged as an independent predictor of mortality. With a cutoff value of 0.67, the hazard ratio for cardiovascular mortality during the follow-up period was 13 (95% confidence interval 5.03–34.44; $P < .001$). A cutoff MPI value of ≥0.67 identified patient mortality during the study period with a sensitivity of 86% and a specificity of 79%.
Conclusion: Global TDI-derived MPI in patients with HF is a powerful predictor of cardiovascular mortality in patients with systolic HF. (*J Cardiac Fail 2016;22:611–617*)
Key Words: Myocardial performance index, congestive heart failure, prognosis.

The assessment of left ventricular (LV) function is of great clinical importance in patients with known or suspected heart disease. Both systolic and diastolic LV functions have been shown to be of prognostic significance. The traditional approaches to assess LV function, namely, ejection fraction, wall motion score index, and transmitral inflow velocity derivatives, have been used in patients with congestive heart failure (CHF) with different prognostic information.[1–3] However, in recent years, the myocardial velocity of the LV recorded by means of tissue Doppler imaging (TDI) has emerged as a new method of assessing LV function[4,5] and has been shown to be of prognostic importance.[6–8] Both traditional echocardiography and TDI methods have traditionally focused on either systolic or diastolic function.

Myocardial performance index (MPI), first described by Tei et al in 1995,[9] is a method that combines both systolic and diastolic phases of the cardiac cycle by dividing the sum of the isovolumetric contraction time (ICT) and the isovolumetric relaxation time (IRT) by the ejection time. MPI represents global LV function and corresponds well with invasive measures of systolic and diastolic function.[10] In patients with impaired cardiac function, the ICT and IRT are prolonged, and the ejection phase might be shortened. Thus, the index values are higher in patients with heart disease than in healthy subjects. Several studies have addressed the prognostic importance of MPI, eg, after myocardial infarction, in patients with dilated cardiomyopathy, or in the general

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population.[11–13] Recently, studies of the MPI as determined with the use of TDI have been reported.[14,15] The advantages of using TDI are the possibility to calculate MPI from the same screen/image and the fact that it is almost always possible to obtain recordings of sufficient quality. Moreover, TDI-derived MPI seems to be less dependent on load and heart rate.[16] With a few exceptions, the studies mentioned above focused on a limited region of the LV to calculate MPI, which could therefore be regarded as a regional MPI. This might be misleading in patients with regional impairment of cardiac function. To the best of our knowledge, there have been no prognostic studies in which several LV sites have been used to calculate MPI, a variable that could be regarded as global TDI-derived MPI. The purpose of the present study was to characterize global TDI-derived MPI sampled from 4 LV sites and to evaluate its association with long-term outcome, with mortality as outcome variable, in a moderately sized cohort of patients with systolic heart failure. Our hypothesis is that this parameter adds prognostic value to established clinical and echocardiographic parameters.

Methods

The study protocol was approved by the regional Committee of Research Ethics in Stockholm, and the study was performed according to the Declaration of Helsinki.

Patients

This study consisted of a moderate-size cohort of patients with systolic heart failure; 200 patients who were admitted to the South General Hospital in Stockholm (Södersjukhuset) because of signs and symptoms of heart failure (dyspnea, orthopnea, 3rd heart sound, rales, etc) were screened. Inclusion criteria were symptomatic heart failure due to either nonischemic cardiomyopathy or ischemic heart disease and left ventricular ejection fraction (LVEF) ≤40%. Patients with left bundle branch block, atrial fibrillation, or severe valvular heart disease were excluded. A total of 110 patients (31 with nonischemic and 79 with ischemic cardiomyopathy) were included. Ischemic heart disease was defined as a history of myocardial infarction or the presence of significant coronary artery disease as determined with the use of either coronary angiography or noninvasive methods. Before discharge and when in a relatively stable clinical condition, each patient underwent an echocardiographic examination in which conventional and TDI parameters were recorded. The patients were then followed for a mean of 5.0 years (1825 days) for survivors. At the end of the follow-up period, data from the Swedish National Registry of Deaths were collected. No patients were lost to follow-up. The outcome variables were all-cause mortality and cardiovascular mortality. All patients received standard medical treatment for heart failure.

Echocardiography

The apparatus used was a Philips Sonos 5500. All of the echo-Doppler parameters were recorded according to the recommendations of the American Society of Echocardiography.[17] Ejection fraction was measured according to the Simpson biplane method. The myocardial velocities of the LV were recorded from 4 sites near the mitral annulus from the apical 4- and 2-chamber views as described previously.[18] A mean value for the 4 sites was used to assess systolic velocity (s′) and early-diastolic velocity (e′). MPI at each site was calculated as follows: ([duration of isovolumic contraction time + ejection time + isovolumic relaxation time] − ejection time)/ejection time.[14] In Fig. 1, the method of calculating the

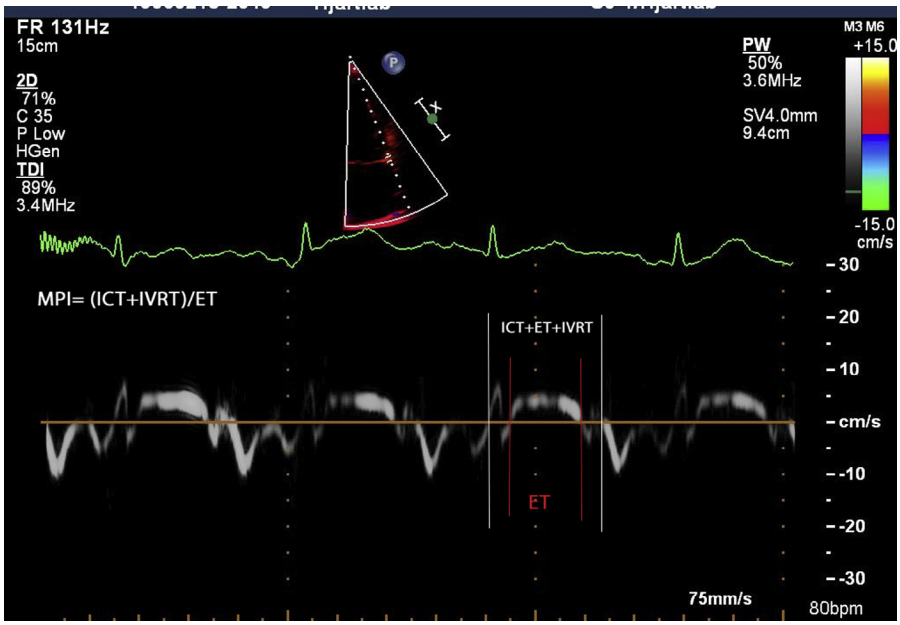

Fig. 1. Pulsed-wave tissue Doppler recording from an apical 4-chamber view. MPI, myocardial performance index; ICT, isovolumic contraction time; ET, ejection time; IVRT, isovolumic relaxation time.