

Editorial Comment

Myocardial Performance Index or Tei Index: Valuable in Research but Doubtful in Clinical Practice

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Physicians have a burning desire to express the distinction between normal and abnormal as a number. Cardiologists – and the informed patient, too – have accepted that left ventricular systolic function is expressed in terms of the ejection fraction, even though it is not unusual to find a lack of correspondence between the value of this parameter and the clinical manifestations of the disease or cases where the ejection fraction shows pseudo-normal behaviour (e.g. mitral regurgitation). But while the ejection fraction is considered an index of left ventricular systolic performance, the absence of any reliable, non-invasive and easy to use index for the evaluation of diastolic function is plain.

The index of myocardial performance, or Tei index, celebrates its tenth birthday this year.¹ It belongs to the category of indexes for the measurement and calculation of cardiac time intervals for the evaluation of cardiac function. Its inventors maintain that the sum of the isovolumic contraction and relaxation times divided by the ejection time is an index for the overall estimation of left ventricular function, including both the systolic and the diastolic phase.

The temporal precision of the sequence of events in the cardiac cycle (isovolumic relaxation → mitral valve opening → left ven-

tricular filling → isovolumic contraction → aortic valve opening → ejection of blood from the left ventricle) is a prerequisite for normal cardiac function. Temporal disturbances, even of thousandths of a second, are in some cases indicative of specific cardiac dysfunction. Clinical physicians suspect the existence of an atrial septal defect from a fixed splitting of the second sound, or the severity of mitral stenosis from the timing of the opening snap. The diagnostic use of cardiac time intervals started many years ago with the electrocardiogram and continued with phonocardiography, carotid pulse recording and apexcardiography. Since the nineteen sixties the duration of isovolumic contraction and the pre-ejection period have been used as indexes of left ventricular systolic function and the ejection fraction as a measure of stroke volume. Weissler et al² introduced the term "systolic time interval," which was expressed by the ratio of pre-ejection period to left ventricular ejection time and had normal values 0.34 ± 0.04 . That index was destined to rule for many years as a measure of left ventricular systolic function. It had the advantage of being relatively unaffected by changes in heart rate and its increase denoted a deterioration of systolic function. However, over time it was proved to show significant variability in various forms of systolic dysfunction and it became progressively much less

used. The “isovolumic index” of Mancini et al³ (isovolumic contraction plus relaxation time divided by left ventricular ejection time) was considered more reliable than Weissler’s “systolic time interval” since it included both isovolumic contraction and relaxation. However, in patients with disturbances of stimulus conduction (e.g. complete left bundle branch block) the time interval of electromechanical systole, from the R wave on the ECG until the opening of the mitral valve, was an unmeasurable factor affecting the diagnostic accuracy of the “isovolumic index.” The index of myocardial performance is a development of the “isovolumic index”, since using Doppler echocardiography the time intervals of isovolumic contraction and relaxation may be determined more directly and precisely, without the intervention of electromechanical delay. The myocardial performance index has been used for the overall estimation of both left and right ventricles under a variety of diseased conditions, such as dilated cardiomyopathy, amyloidosis, coronary artery disease, heart transplantation, heart failure, as well as in prospective studies of the general population.⁴⁻¹³ However, a number of studies have cast doubt on its value and considered it to be something like “sedimentation rate,” in that increased values of the index do not determine the cause.¹⁴⁻¹⁶ The myocardial performance index has been shown to be affected by changes in loading in both the right and left ventricles. One significant problem affecting the reliability of the Tei index is the bidirectional course of the isovolumic relaxation time during the development of heart failure, because of the complex interaction between systolic and diastolic dysfunction. The isovolumic relaxation time is prolonged as relaxation deteriorates and shortens during the increase of left ventricular filling pressure, while increased left atrial pressure leads to early mitral valve opening.

The existence of the above problem was confirmed in the study by Nearchou et al published in this issue.¹⁷ In this study, changes in the Tei index were evaluated in relation to the type of diastolic dysfunction shown by patients with acute myocardial infarction. The findings of the study show that the Tei index increases significantly and clearly discriminates between patients with relaxation disturbances and those with normal diastolic function. However, in patients with a further deterioration in diastolic function of the type found in restrictive syndrome the index decreased and could not be distinguished from that of patients with normal diastolic function. This “pseudonormalisation” of the index represented an

important limitation in the study of patients with diastolic heart failure.

The evaluation of diastolic function involves peak velocities measured from the Doppler echocardiogram of transmitral flow, pulmonary venous flow and the movement of the mitral annulus, as well as cardiac time intervals. Measurement of time intervals is more difficult and shows greater variability. In the Department of Clinical Therapeutics we had sample measurements of the same time intervals made by two different physicians with an average level of knowledge of echocardiography. The variability of values was significant. The index of myocardial performance is simple and attractive in its application. However, further studies are needed to determine its value in clinical practice and the boundaries of normal ranges according to age, and to examine the significance of changes under pharmaceutical or other interventions. The index has undoubtedly contributed to research into diseases of the left and right ventricle through the global evaluation of their systolic and diastolic function. It has also proved to be a useful clinical tool for studying the prognosis of patients. However, its clinical value for the evaluation of each individual patient remains in doubt.

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