Prognostic Significance of Myocardial Performance Index in Patients with Ischemic Heart Disease

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Abstract

Estimation of Myocardial performance is always a field for Enovation. Accurate estimation of ventricular contractile functions of utmost importance in deciding the whole management and detecting prognosis. Many parameters were developed to estimate the myocardial functions and with every newly discovered limitation to these parameters others were developed.

One of the recent indices used to estimate both systolic and diastolic myocardial functions is the myocardial performance index MPI which used time intervals to estimate myocardial performance. It is calculated by adding IVCT+IVRT and dividing it by ET with a normal value of 0.4. MPI is less dependent on heart rate and it is reproducible and easy to obtain, but it has its limitations like the presence of arrhythmias, conduction defects and pacemakers or when Doppler images of sufficient quality cannot be acquired. Furthermore, it is affected to some degree by loading conditions.

Key Words:

Role of Echocardiography in Myocardial infarction, **Echocardiographic changes in myocardial infarction**, **Tissue Doppler Imaging (TDI)**

List of abbreviations

1D: one-dimensional echocardiography.

2D: Two-dimensional echocardiography.

3D: Three dimensional echocardiography.

AMI: acute myocardial infarction.

ASE: American society of echocardiography.

CABG: coronary arteries bypass graft.

CAD: Coronary artery disease.

CHF: congestive heart failure.

CK: creatine kinase.

CK-MB: creatine kinase-MB isoenzyme.

CO: Cardiac output.

ECG: Electrocardiogram.

ET: ejection time.

HTN: Hypertension.

IHD: Ischemic heart disease.

IMVG: Intra-myocardial velocity gradient.

IRA: infarction related annulus.

IVC: Isovolumic contraction.

IVCT: Isovolumic contraction time.

List of abbreviations

IVR: Isovolumic relaxation.

IVRT: Isovolumic relaxation time.

LV: Left ventricular.

LVEDD: Left ventricular end diastolic dimension.

LVEDV: Left ventricular end diastolic volume.

LVEF: Left ventricular ejection fraction.

LVESD: Left ventricular end systolic dimension.

LVESV: Left ventricular end systolic volume.

LVET: Left ventricular ejection time.

LVOT: Left ventricular outflow tract.

MAV: Mitral annular velocity.

MI: Myocardial infarction.

MPI: Myocardial performance index.

MVG: Myocardial velocity gradient.

NIRA: non infarction related annuli.

PEP: Pre ejection period.

PH: pulmonary hypertension.

PSLA: Parasternal long axis view.

PSSA: Parasternal short axis view.

List of abbreviations

PSV: Pulsed systolic velocity.

PV: Pulmonary vein.

RAAS: Renin-angiotensin-aldosterone system.

RIVRT: Regional isovolumic relaxation time.

RV: Right ventricle.

RWMA: Regional wall motion abnormality.

SRI: Strain rate imaging.

STEMI: ST segment elevation myocardial infarction.

TDI: Tissue Doppler imaging.

TEE: Trans esophageal echocardiography.

TTE: Trans thoracic echocardiography.

TVI: Time velocity integral.

WMSI: Wall motion score index.

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Introduction

Probably no application for echocardiography is less well understood than its use as a diagnostic tool in patients with known or suspected coronary artery disease [(1)]. The segmental nature of left ventricular dysfunction in patients with coronary artery disease has been the principal negative criticism of the standard M-mode dimensions used to evaluate left ventricular function. So, clinicians have become impressed with clinical utility of the ejection fraction as a mean of evaluating left ventricular function. Doppler echocardiography can also be useful in assessing global left ventricular function. Aortic velocities are useful in evaluating global systolic function by calculation of mean or peak acceleration or time velocity integral to provide an assessment of systolic function [(2)]. Left ventricular inflow is commonly used to evaluate diastolic left ventricular performance [(3, 4)].

In the 1960s, the duration of isovolumic contraction time (IVCT) and preejection period (PEP) were studied extensively as a measure of cardiac systolic function and left ventricular ejection time (LVET) was used to assess left ventricular stroke volume. Although myocardial dysfunction prolongs PEP and shortens LVET, these intervals are also influenced by many hemodynamic and electrical variables. Weissler et al [(5)] derived an index (PEP/LVET) called "systolic time interval" which was less heart rate dependent as a measure of left ventricular systolic function. However, the variability of this index as a measure of left ventricular systolic dysfunction was significant and a lengthening of the systolic time interval was found to occur after left ventricular systolic function deterioration [(6)].

Because isovolumic relaxation time (IVRT) is also affected by left ventricular function, Mancini et al [(7)] incorporated IVRT into an index called "isovolumic index" derived as (IVCT + IVRT)/ LVET. The sum of IVCT and IVRT was measured by subtracting the LVET from the peak of the R wave on the electrocardiogram to the onset of mitral valve opening. The isovolumic index was considered more sensitive for cardiac dysfunction than the systolic time interval because it contains IVRT as well as IVCT.

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However, the interval from the R wave peak to the onset of mitral valve opening contains an interval of electromechanical delay which can be pronounced in patients with left bundle branch block.

With the advent of Doppler echocardiography, it has become easier to determine cardiac time intervals more reliably. Tei et al [8] proposed a "myocardial performance index" (MPI) (or a Tei index) that is independent of the electromechanical delay (IVCT + IVRT)/ LVET, using Doppler echocardiography to identify the exact onset of IVCT. So, MPI is an attempt to expand the use of such time intervals in order to characterize both systolic and diastolic function and to describe performance with a single value which would have a quantitative and prognostic significance.

In a study by Bruch et al [9], the utility of the Tei index in congestive heart failure (CHF) patients of various origins (including ischemic and dilated cardiomyopathy, hypertensive heart disease and constrictive pericarditis) was assessed. The results showed that the index provided useful information even in patients with mild to moderate CHF and nearly preserved systolic function (left ventricular ejection fraction 46 ± 11). In another study by Arnlov et al [10], the index was shown elevated in elderly men and the subjects in the higher quartiles had an increased risk of subsequently developing CHF. This suggests that the index may detect subclinical myocardial dysfunction and can distinguish between hearts that are prone to develop CHF and hearts that are not.

According to this concept, MPI may be useful in detecting prognosis in other cardiac diseases like ischemic heart disease. Another question that took place is the usefulness of tissue Doppler MPI in detecting myocardial dysfunction at global and regional levels.

This work was done to help in the clarification of these questions.

Aim of work

Myocardial performance index (MPI) has been regarded as an important parameter in the evaluation of left ventricular function [8].

The aim of this study is to investigate the relationship between MPI (as measured by conventional PW Doppler and tissue Doppler imaging) and the usual parameters of left ventricular systolic function mainly left ventricular ejection fraction (LVEF), wall motion score index (WMSI) and systolic velocity by TDI in patients with acute ST segment elevation myocardial infarction STEMI.