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Original Article

Left ventricular myocardial performance index for assessment of acute periprocedural outcomes in coronary artery disease patients after successful percutaneous coronary intervention

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ABSTRACT

Background: To investigate prospectively the improvement of myocardial performance index (MPI) in coronary artery disease (CAD) patients after successful percutaneous coronary intervention (PCI), to assess prognostic value of MPI in predicting acute periprocedural adverse events and to analyze influence of other correlating factors on MPI and its post PCI improvement.

Methods: After patient selection, detailed clinical history was taken and risk factors (diabetes mellitus (DM), hypertension (HTN), smoking, obesity) were noted. Body mass index was measured. Baseline ST segment deviation in 12 lead electrocardiogram (ECG) on the day of PCI was calculated. MPI, left ventricular ejection fraction (LVEF), wall motion score index (WMSI) were measured serially one day before PCI and one day after successful PCI.

Results: A total of 101 patients with CAD were included in the study. Age, sex, diabetic status, presence of HTN and degree of ST segment deviation did not affect the baseline MPI but New York heart association (NYHA) class III ($p = 0.04$), WMSI ($p = 0.002$), LVEF ($p < 0.05$), degree of stenosis ($p = 0.05$) and diastolic dysfunction Grade III ($p < 0.001$) had significant influence on MPI. A significant positive correlation was observed between baseline MPI and WMSI (standardized β coefficient 0.3, $p = 0.002$). Significant negative correlation was found between baseline MPI and ejection fraction of left anterior descending artery (LAD) group (standardized β coefficient = 0.47, $p < 0.05$). On Cox univariate regression analysis, we identified baseline WMSI ($p = 0.01$) and presence of American College of Cardiology Class (ACC)-C lesions ($p = 0.02$) as independent predictors of adverse outcome after PCI. Neither baseline MPI ($p = 0.29$) nor post PCI MPI ($p = 0.79$) was independently related to adverse outcomes in this study model.

Conclusion: In current era of stenting, neither baseline nor post PCI MPI can predict acute periprocedural adverse events. WMSI and complex lesion morphology are good predictors of acute periprocedural adverse outcomes.

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1. Introduction

Percutaneous intervention (PCI) is a very common revascularization procedure performed in patients with stable coronary artery disease (CAD). PCI has shown promise in terms of reduction of symptoms and improvement of quality of life. However, physiological cardiac changes following improvement of anatomical blood flow after PCI are still unclear.

Myocardial performance index (MPI, Tei index) which incorporates both systolic and diastolic time intervals expresses global systolic and diastolic functions of the ventricle.[1] Tissue Doppler MPI can measure both regional and global myocardial performance which is more sensitive than conventional MPI in predicting LV function, especially in the presence of regional wall motion abnormality. It has less interobserver and intraobserver variations.[2] MPI is a useful prognostic parameter in heart failure[3,4] cardiomyopathy[5] and valvular heart diseases.

This parameter was recently evaluated in CAD and found to have multiple clinical implications.[6–13] Progressive ventricular remodeling is pathognomonic of myocardial infarction (MI) and ischemia.[7] So, prognosis in these patients finally depends on the amount of myocardium salvaged and its function. A combined measure of left ventricular performance may be more representative of overall cardiac function than systolic or diastolic measures alone.[14]

In acute myocardial infarction (AMI), MPI was considered more sensitive than EF and its value may range from 0.45 in lower risk patients, to 0.8 in higher risk patients with increased mortality.[9]

Kouris et al[9] observed abnormal values of the Tei index in patients with coronary artery disease and apparently normal systolic and diastolic function. Moller,[10] demonstrated that, mitral deceleration time and the Tei index have independent and important prognostic value after AMI.[10] Sajan Narayan et al,[11] showed that left ventricular MPI >0.5 was associated with 10% more risk of death, 15% recurrence rate of ischemic events and repeat revascularization. In contrast to above studies, Schwammenthal et al[12] concluded that left ventricular ejection fraction (LVEF) and E deceleration time were powerful predictors of poor outcome following AMI, superior to indices of global LV performance.

MPI improvement and success of revascularization after primary PCI depends on the status of microvascular blood flow.[7] Patients with high MPI values after successful PCI were found to have microvascular damage and no reflow phenomenon.[7,15] This subgroup of patients were having high mortality and morbidity on follow up, so it is essential to stratify the patients after PCI.[16] In previous trials, MPI was studied for predicting procedural success, and long term clinical outcomes after PCI.[10] Results in these trials concluded that, MPI is one of the best noninvasive parameter for predicting periprocedural outcomes.[17] But the evaluated trials are limited in number and of lesser study population. So, there is a need for further evaluation of this independent parameter in patients undergoing coronary interventions.

2. Methods

A prospective observational study done in the Department of Cardiology, Sri Venkateswara Institute of Medical Sciences (SVIMS), Tirupati, India, from August 2006 to December 2007. Study population included 101 consecutive patients with CAD. After obtaining informed consent, study population was divided into 4 groups based on the coronary artery territory involved. Group I = left anterior descending artery (LAD), Group II = right coronary artery (RCA), Group III = left circumflex artery (LCX) and Group IV = multi vessel disease group (MVD) if more than one coronary territory was involved.

Inclusion criteria were a) Patients with acute coronary syndrome (acute myocardial infarction (AMI), non-ST elevation MI (NSTEMI), unstable angina (UA)), chronic stable angina (CSA) with significant angiographic coronary artery stenosis. b) Patients of NYHA class I, II and III, c) Patients with normal, mild, moderate and severe LV systolic dysfunction, d) Patients with any or all coronary risk factors: diabetes (DM), hypertension (HTN), smoking, dyslipidemia, obesity etc, e) All types of American College of Cardiology (ACC) classified angiographic lesions and f) Patients with right and or left coronary artery lesions.

Exclusion criteria were a) Patients with severe systemic illness fever, moderate to severe renal failure, malignancy, electrolyte imbalance, b) Patients with cardiomyopathy [Dilated, Hypertrophic (non hypertensive), Restrictive], c) Patients with valvular heart disease, d) Age >75 years, d) Patients with atrial fibrillation, atrial flutter, atrioventricular block, large pericardial effusion. This study was approved by the Institutional Ethics committee of Sri Venkateswara Institute of Medical Sciences.

3. Procedure details

After patient selection, detailed clinical history was taken and risk factors (DM, HTN, smoking, obesity) were noted. Body mass index (BMI) was measured. Baseline ST segment deviation in 12 lead electrocardiogram (ECG) on the day of PCI was calculated. Baseline serum creatinine and urea were measured and repeated 48 h after PCI in all high risk patients.

3.1. *Echocardiography*

MPI, LVEF, wall motion score index (WMSI) were measured serially one day before PCI and one day after successful PCI. Echocardiography was done with PHILIPS AGILENT SONOS 4500, 7 MHz transthoracic probe.

A parasternal long axis or short axis view at the mid left ventricular level was used to measure the left ventricular end systolic and end diastolic dimensions. WMSI was calculated before and after PCI. The left ventricular wall was divided into 16 segments and the regional wall motion score of each segment was noted. WMSI was scored according to a modified recommendation of the American Society of Echocardiography (score of 1-normal segment, 2-hypokinetic segment, 3-akinetic segment, and 4-dyskinetic