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Original Article

Myocardial performance index as an echocardiographic predictor of early in-hospital heart failure during first acute anterior ST-elevation myocardial infarction

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ABSTRACT

Objectives: To determine the value of Myocardial Performance Index (MPI) as an echocardiographic predictor of early in-hospital heart failure (HF) during first acute anterior ST-Elevation Myocardial Infarction (STEMI).

Background: Myocardial infarction induces variable degrees of impairment in left ventricular (LV) systolic and diastolic functions. The ejection fraction (EF) and transmitral flow, the most frequently used methods for evaluation of systolic and diastolic functions respectively, both have considerable limitations. The MPI is a single parameter, capable of estimating combined systolic and diastolic performance and lacks such limitations.

Methods: We enrolled 60 patients presented with a first acute anterior STEMI who have undergone primary PCI. Echocardiography was done within 24 h of chest pain with measurement of MPI. The LV MPI was calculated as (isovolumic contraction time "ICT" + relaxation time "IRT")/Ejection time "ET". Besides, clinical and echocardiographic variables were analyzed and CHF was defined as Killip class $\geq$ II.

Results: Early in-hospital HF occurred in 23 of patients (38%). Ejection fraction was found to have a highly significant negative correlation with the development of in-hospital HF ($p = .0001$), while MPI was found to have a highly significant positive correlation ($p = .0001$). A cut-off point of MPI > 0.73 showed a very high specificity (94.6%) and sensitivity (78.3%) for identifying patients with HF. On the other hand, a cut-off point of EF $\leq$ 33% has shown 94.6% specificity and 56.5% sensitivity for HF prediction.

Conclusions: The MPI might be a strong predictor of in-hospital HF after first acute anterior STEMI.

1. Introduction

Acute myocardial infarction (MI) remains a leading cause of morbidity and mortality worldwide. It induces variable degrees of impairment in left ventricular (LV) systolic and diastolic functions.[1] ST segment elevation myocardial infarction is the most serious presentation of atherosclerotic coronary artery disease carrying the most hazardous consequences.[2] Heart failure (HF) is one of the most dreadful complications following myocardial infarction (MI) affecting morbidity and mortality. Early detection of patients with acute MI at risk of development of in-hospital HF is necessary to limit myocardial injury and LV dysfunction.[3]

Echocardiography allows assessment of systolic and diastolic LV functions which are predictors of HF. The ejection fraction (EF) and the trans-mitral flow, the most frequently used methods for evaluation of systolic and diastolic functions respectively; both have considerable limitations especially in the setting of an acute MI.[4] A single index that allows assessment of the global myocardial performance has been suggested as an alternative to the individual assessment of systolic and diastolic functions.[5]

In 1995, Tei and colleagues proposed an index; Tei index or myocardial performance index (MPI) which is a Doppler derived time interval index defined as the sum of iso-volumic contraction time (IVCT) and iso-volumic relaxation time (IVRT) divided by ET. This index is easily obtained from trans-mitral flow and LV outflow velocity time intervals with good reproducibility, and is independent from LV geometry and heart rate.[5] It has a good correlation with invasive measures of LV function (systolic and diastolic),[6] and was also found to be superior to conventional echocardiographic parameters in correlation with patient outcome in various

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myocardial diseases.[7,8] However, there is limited data on the clinical value of the MPI in patients with acute MI.[9,10]

2. Methods

Briefly, the study was a single center, prospective, observational study designed to measure the MPI within 24 h in patients with anterior ST elevation myocardial infarction (STEMI) treated by Primary Percutaneous Coronary Intervention (PPCI). It included 60 patients who presented with documented first acute anterior STEMI and underwent PPCI in Ain Shams University hospitals in the time period from November 2014 till June 2015.

This study was approved by the ethical committee of Ain Shams University Hospitals. Informed consent was obtained from each participant.

All patients were subjected to thorough history taking, physical examination, Killip classification,[11] 12 lead ECG, and then they have undergone PPCI with documentation of pain-to-door (PTD) time. All angiographic and procedural details were noted, including TIMI flow and myocardial blush grade following PPCI.

A trans-thoracic echocardiography was done during first 24 h of admission. Standard echocardiographic measurements were done as well as measurement of MPI. From trans-mitral flow and LV outflow velocity time intervals, Doppler time intervals were measured as shown in Fig. 1. The interval "a" from the cessation to the onset of trans-mitral flow was equal to the sum of isovolumic contraction time (ICT), ejection time (ET), and isovolumic relaxation time (IRT). The interval "b" was the LV outflow ET. The LV Tei index was calculated as (a − b)/b, which means (ICT + IRT)/ET (Fig. 1).[12]

Patients with known history of dilated cardiomyopathy were excluded. Patients were also excluded when they had had previous PCI or Coronary Artery Bypass Grafting (CABG). Other exclusion criteria were patient's refusal and non-sinus rhythm.

2.1. Statistical analysis

Continuous variables are reported as the mean ± SD and were compared using one-way analysis of variance. Categorical variables are reported as frequencies (percentages) and were compared with the Pearson's chi-square test. A p-value < .05 was considered statistically significant in all analyses. Data were analyzed with SPSS 21 (IBM, Armonk, New York).

3. Results

A total number of 60 patients were recruited. Baseline demographic and clinical characteristics of the study population are listed in Table 1. The study population was divided into 2 groups according to Killip classification during hospital stay.[11] Group 1 (no HF group) included 37 of patients (61.7%) with Killip class I. Group 2 (HF group) included 23 patients (38.3%) with Killip class > I. Of patients in group 2, 17 patients (28.3%) were in Killip class II, 6 patients (10%) were in Killip class III, and none were in Killip class IV (Fig. 2).

The MPI for the overall population ranged from 0.4 to 1.35, with a mean ± SD of 0.69 ± 0.2. Ejection fraction ranged from 25 to 51%, with a mean ± SD of 38.06 ± 6.01%. In the group of patients with HF, the MPI ranged from 0.57 to 1.35, with a mean ± SD of 0.88 ± 0.18 while it ranged from 0.4-0.79, with a mean ± SD of 0.58 ± 0.11 in those with no HF (p = .0001). For EF, it ranged from 25 to 43%, with a mean ± SD of 33.91 ± 5.37% for HF group as opposed to a range of 32–51%, with a mean ± SD of 40.64 ± 4.86 in those with no HF (p = .0001). Clinical, electrocardiographic, echocardiographic

Table 1
Socio-demographic data and risk factors in both groups.

		Group 1 (HF)[a] (n = 23)	Group 2 (no HF)[a] (n = 37)	P-value
Age	Mean ± SD	56.6 ± 8.98	51.67 ± 12.26	.1
Gender	Females	4	7	.075
	Males	19	7	
Hypertension	Negative	12	26	.2
	Positive	11	11	
Diabetes mellitus	Negative	14	22	.9
	Positive	9	15	
Smoking	Negative	5	8	.9
	Positive	18	29	

[a] Heart failure.

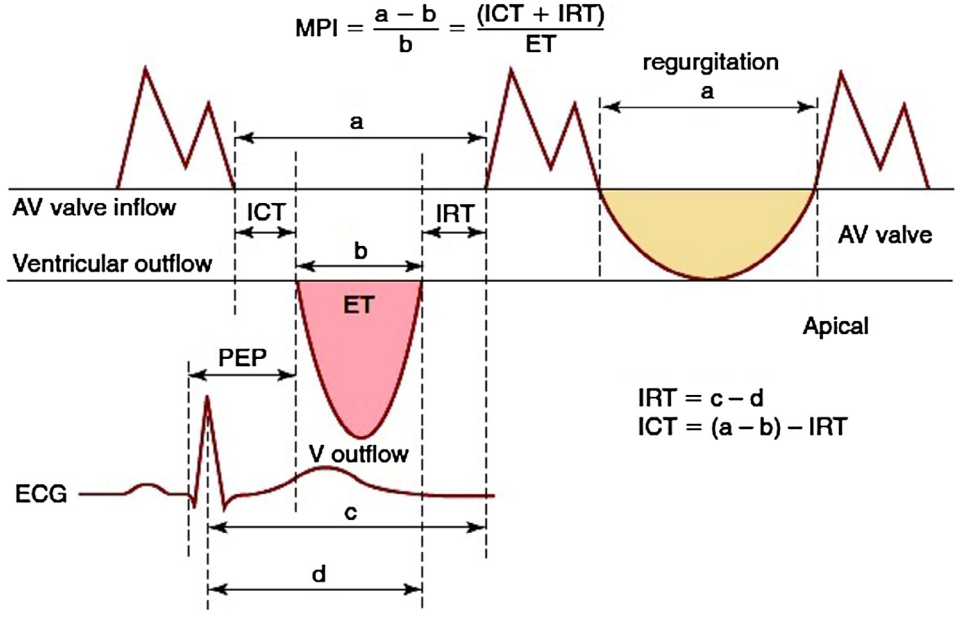

Fig. 1. Doppler flow diagram explaining Tei index calculation.

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