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MYOCARDIAL PERFORMANCE INDEX AS AN ECHOCARDIOGRAPHIC PREDICTOR OF EARLY HEART FAILURE IN ACUTE ST ELEVATION MYOCARDIAL INFARCTION

Cardiology

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ABSTRACT

Myocardial infarction causes variable degrees of left ventricular (LV) systolic and diastolic dysfunctions. The ejection fraction (EF) and transmitral flow are the frequently used method for evaluating the systolic and diastolic functions respectively with considerable limitations. The MPI is a single independent parameter, capable of estimating both systolic and diastolic performance combined and lacks such limitations. We enrolled 100 patients presented with a first acute STEMI who have undergone Thrombolysis. 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". simultaneously, clinical and echocardiographic variables were analyzed and CHF was defined as Killip class >=II. Results: Early in-hospital HF occurred in 38 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 > 0.72 showed a very high specificity (93.6%) and sensitivity (77.3%) for identifying patients with HF. On the other hand, a cut-off point of EF <=32% has shown 93.4% specificity and 57.5% sensitivity for HF prediction. Conclusions: The MPI might be a strong predictor of in-hospital HF after acute ST elevation MI.

KEYWORDS

Ejection Fraction, Heart Failure, Myocardial Performance index.

INTRODUCTION

Acute myocardial infarction (MI) remains a leading cause of mortality and morbidity worldwide. Consequences leads to 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 than NSTEMI or Unstable angina also carrying the most hazardous consequences (2) Heart failure (HF) is the most dreadful complications following myocardial infarction (MI). Early detection of Heart failure in patients with acute MI at risk in-hospital is necessary to limit LV dysfunction and myocardial injury (3) Echocardiogram allows the assessment of systolic and diastolic functions of LV ,these are the predictors of HF. The ejection fraction (EF) and the trans-mitral flow are the most frequently used methods for evaluation of both systolic and diastolic functions respectively; these two functions have considerable limitations mainly in the setting of an acute MI. (4) A single performance index that allows the assessment of global myocardial performance has been suggested as alternative to the assessment of systolic and diastolic functions (5)

In 1995, Tei proposed an index; Tei index or myocardial performance index (MPI). MPI 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 Ejection Time (ET). This index is easily obtained from trans-mitral flow and LV outflow velocity time intervals with clear reproducibility, and is independent of heart rate and Left Ventricle geometry.(5). It has a good correlation with the measures of LV function (systolic and diastolic), and also the index was found to be superior to conventional echo parameters in correlation with the outcome of the patient in various myocardial diseases especially in Myocardial infarction.

AIM AND OBJECTIVE:

To determine the value of Myocardial Performance Index (MPI) in acute ST elevation Myocardial Infarction as a predictor of early in hospital- heart failure

METHODS:

Study Design:

OBSERVATIONAL STUDY Briefly, the study was a single center, prospective observational study designed to measure the MPI within 24 h in patients with acute ST elevation myocardial infarction (STEMI) treated by Thrombolysis. It included 100 patients who presented with acute STEMI and treated by thrombolysis in Department of cardiology, Coimbatore medical college hospital in the time period from November 2019 till october 2020.This study was approved by the ethical committee. Informed consent was obtained from each participant.

All patients were subjected to history taking, physical examination, Killip classification (7) , 12 lead ECG , and treatment they have undergone with documentation of pain-to-door (PTD) time. 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 . 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

Inclusion Criteria:

Patients admitted in ICU with Acute ST elevation MI Age > 18 years, patients with risk factors diabetes, hypertension ,also included

Exclusion Criteria:

Patients with history of dilated cardiomyopathy were excluded, previous PCI or Coronary Artery Bypass Grafting (CABG). Patients with irregular rhythum also were excluded

RESULTS

A total number of 100 patients were studied. Baseline demographic and clinical characteristics of the study population are listed in Table The study population was divided into 2 groups according to Killip classification during hospital stay.(11)Group 1 (HF group) included 38 of patients (39%) with Killip class > I. Group 2 (no HF group) included 62 patients (62%) with Killip class I. Of patients in group 1, 28 patients (28.%) were in Killip class II, 10 patients (10%) were in Killip class III, The MPI for the overall population ranged from 0.42 to 1.36, with a mean±SD of 0.63±0.18. Ejection fraction ranged from 23 to 51%, with a mean±SD of 37.16±5.01%. In the group of patients with HF, the MPI ranged from 0.51 to 1.25, with a mean±SD of 0.86±0.08 while it ranged from 0.43-0.76, with a mean±SD of 0.52±0.11 in those with no HF (p=0.0001). For EF, it ranged from 25 to 45%, with a mean±SD of 33.81±4.27% for HF group as opposed to a range of 31–50%, with a mean±SD of 41.64±4.96 in those with no HF (p=0.0001). Clinical, electrocardiographic, echocardiographic detailsare listed in following Table. It has been found that MPI greater than 0.72 has a sensitivity of 77.3% and specificity of 93.6% in

prediction of in-hospital heart failure. On the other hand, EF less than or equal to 32% has a sensitivity of 57.5% and 93.4%.

		Group 1 (HF) N=38	Group 2 (No HF) N=62	P-value
Age	Mean±SD	55.6 ± 7.88	52.67 ± 11.26	0.1
Gender	Females	8	18	0.075
	males	32	44	
Hypertension	Negative	20	44	0.2
	Positive	18	18	
Diabetes mellitus	Negative	23	37	0.9
	Positive	15	25	
Smoking	Negative	8	13	0.9
	Positive	31	48	

		Group 1 (HF) N=38	Group 2(No HF) N=62	P-value
LVISD	Mean±SD	37.81 ± 3.48	37.01±4.10	0.5
LVIDDb	Mean±SD	51.24±4.18	49.22±4.85	0.015
EF	Mean±SD	32.81±4.27	41.64±4.96	0.001
MPI	Mean±SD	0.86±0.08	0.52±0.11	0.001
Dtf	Mean±SD	160.11 ± 52.9	158.78 ± 43.42	0.9

		Group 1 (HF) N=38	Group 2(No HF) N=62	P-value
ST elevation resolution after 60 minutes of reperfusion	25%	2	0	0.2
	50%	20	11	0.02
	75%	16	38	0.007
	100%	0	13	
Pain-to-door time (hours)	Mean±SD	9.15 ± 3.05	4.31 ± 3.07	0.0001

DISCUSSION

In this study, MPI was significantly higher in patients who experienced in-hospital HF (Killip class ≥ II) compared to patients with no HF (Killip class I); 0.86 ± 0.08 and 0.52± 0.11 respectively (p = .0001). This study adds a supporting to MPI as a predictor for HF in patients with STEMI. A clear correlation between MPI and in-hospital HF after acute MI was confirmed by many reports. Souza et al. (10) reported that MPI was prolonged in patients with HF after studying the echo predictors of early in-hospital HF in patients presented with acute STEMI (0.65 ± 0.16 vs 0.57 ± 0.14, p = .01). Yuasa et al (11)have studied MPI with 80 patients have found that MPI was also significantly higher in patients with in-hospital adverse outcomes (0.69 ± 0.16 vs 0.5 ± 0.11, p = <.0001). This was also concluded by Ascione et al(12) studied MPI in 94 patients presented with first acute MI and stated that MPI was significantly higher in patients with cardiac events and HF (0.65 ± 0.20 vs 0.43 ± 0.16, P = .0001). Though they differ in demographics and clinical characteristics, there are other studies emphasizing the significant correlation between MPI and in-hospital HF following acute MI, The mean MPI in current study (0.86) was higher than previous studies (0.50–0.85). This may be due to the fact that we have studied a comparatively a higher number of patients and patients with acute STEMI, while other studies either included all types of acute MI (NSTEMI and different types of STEMI)(9, 13, 14). Interestingly, the other study which only included all STEMI showed similar mean MPI (0.86).

Both EF and MPI were found to be strong predictors of development of in-hospital HF (p = .0001). A cut-off point of MPI > 0.72 and EF ≤ 32% showed a very high specificity (93.6%) for identifying patients with HF. However, MPI showed a higher sensitivity (77.3%) than EF (57.5%). Results of Ascione et al (12) showed that a cut-off point of MPI > 0.47 had a sensitivity of 90% and a specificity of 68% for whereas a LV EF < 50% had a sensitivity of 85% and a specificity of 65%. Yuasa et al(12) found MPI > 0.59 showed 76% sensitivity and 79% specificity, while of EF < 45% showed 69% sensitivity and 79% specificity indicating higher sensitivity of MPI, which is concordant with our results. Poulsen et al (9)found a cut-off point of MPI > 0.45 with 100% sensitivity and 41% specificity, while a cut-off point of EF < 50% had 50% sensitivity and 33% specificity.

The current study showed a lower cut-off for EF and a higher cut-off for MPI, and higher values of sensitivity and specificity acompared to previous studies. This can be attributed to differences in the study population, as we included only patients with acute STEMI unlike the previous studies that included all types of acute MI. It is worthy to note in the current study that there was no significant correlation between socio-demographic parameters as sex, smoking, hypertension diabetes mellitus and the development of in-hospital HF after acute MI.

Our study have some limitations. First of all, it was a single tertiary center study. Moreover, the number of patients subjected was small and so the clinical significance of results should be validated by a larger multi-center studies. The design was observational, and even though there were no significant demographic or clinical differences between both groups (HF and no HF groups), confounding results may remain to certain extent. Also, the study only included patients with an acute STEMI (other types of NSTEMI and Unstable angine with heart failure were excluded). Besides, MPI was measured only at the time of admission within the first 24 h of presentation and not followed up

CONCLUSIONS:

The simply obtained non-geometric MPI might be a strong predictor of in-hospital HF after acute STEMI.Whereas both MPI and EF were able to highly predict in-hospital HF in the setting of acute STEMI, MPI was more sensitive than EF. However, the clinical application of these results requires further validation.

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