

## ORIGINAL ARTICLES

# Association between Myocardial Performance Index and Severity of Coronary Artery Disease Assessed with SYNTAX Score

NOOR MOHAMMAD<sup>1</sup>, MOHAMMAD SAFIUDDIN<sup>2</sup>, MD MUKHLESUR RAHMAN<sup>2</sup>, KHURSHED AHMED<sup>2</sup>, SAJAL KRISHNA BANERJEE<sup>2</sup>, TANJIMA PARVEEN<sup>2</sup>, MST NILUFAR FARZANA<sup>3</sup>, MD. NAZMUL HASAN<sup>2</sup>

<sup>1</sup>Department of Medicine, Patuakhali Medical College, Patuakhali, <sup>2</sup>Department of Cardiology, Bangabandhu Sheikh Mujib Medical University, Dhaka, <sup>3</sup>Department of Radiology, Shaheed Suhrawardy Medical College, Dhaka

**Address of Correspondence:** Noor Mohammad, Assistant Professor, Department of Medicine, Patuakhali Medical College, Patuakhali, Email: nmohammad25@yahoo.com

### Abstract:

**Background:** Despite improvement in risk scoring, there are patients with stable angina identified as low risk who experience CAD events, as well as, patients deemed high risk remained free of CAD events. Invasive coronary angiogram is the gold standard method for assessment of extent and severity of CAD. However, search for additional noninvasive tool that may aid in risk discrimination is going on. Myocardial performance index (MPI) is emerging as one of them. **Objective:** To assess the relationship between Myocardial Performance Index and severity of coronary artery disease assessed with SYNTAX Score in chronic stable angina. **Methods:** This cross-sectional study was conducted in the department of Cardiology, University Cardiac Centre of BSMMU during the period of January, 2014 to December, 2014 among the patients of chronic stable angina undergoing elective coronary angiogram. Total 90 patients were enrolled by random purposive sampling. All the data were recorded in structured questionnaire. Coronary angiogram with SYNTAX scoring was done during index hospital admission. Doppler study was done 1 day prior to CAG to measure MPI. **Result:** The mean age was found 45.5±26.1 years varied from 36 to 68 years. Male female ratio was 1.9:1. A negative significant correlation ( $r=-0.792$ ;  $p=0.001$ ) was found between ejection fraction (EF) and myocardial performance index (MPI). Regarding the association between risk factors with MPI status, the mean MPI was found 0.65±0.10 in diabetes mellitus and 0.57±0.10 in without diabetes mellitus. Mean MPI was significantly higher in diabetes mellitus, others risk factors are not significantly associated with MPI status. Majority (38.9%) patient's SYNTAX score belonged to 0-22, 28(31.1%) was SYNTAX 23-32 score and 27(30.0%) was SYNTAX ≥33 score. The mean MPI was found 0.51±0.04 in low SYNTAX, 0.61±0.03 in intermediate SYNTAX and 0.74±0.07 in high SYNTAX score. The mean MPI was significantly ( $p<0.05$ ) elevated with increased SYNTAX score. A positive significant correlation ( $r=0.985$ ;  $p=0.001$ ) was found between MPI with SYNTAX score. Higher value of SYNTAX score (>22) had a 2.29 times increase (95%CI 0.16 to 33.70%) in odds of having CAD. A subject with diabetes mellitus had 1.52 times increase (95%CI 2.02 to 21.54%) in odds having CAD. Others factors are not significantly associated with CAD in Multiple regression models. **Conclusion:** The MPI value measured by Doppler is a cheap, radiation free, available noninvasive method and may be considered as an additional risk stratification tool beyond other investigations.

**Key words:** Chronic stable angina, SYNTAX score, diabetes mellitus, myocardial performance index.

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### Introduction:

Chronic stable angina constitutes a major fraction of coronary artery disease (CAD). Though there is substantial understanding of the pathobiology of stable angina, the transition from a clinically stable coronary

syndrome to an acute life-threatening event remains largely unpredictable. As a result of improved survival rates following MI, the size of the patient population living with chronic stable angina is increasing. So, timely diagnosis, identification of high risk group and appropriate

therapy is of paramount importance to improve clinical outcome of the patients with chronic stable angina.<sup>1,2,3,4</sup>

Despite improvement in risk scoring, there are patients with stable angina identified as low risk who experience CAD events, as well as, patients deemed high risk remained free of CAD events. Invasive coronary angiogram is the gold standard method for assessment of extent and severity of CAD. However, search for additional noninvasive tool that may aid in risk discrimination is going on. Myocardial performance index (MPI) is emerging as one of them.

Myocardial performance in patients with primary myocardial systolic dysfunction. It is considered as Myocardial performance index (MPI) is a numeric value, which could be obtained by using cardiac time intervals. This numeric value is defined as the sum of isovolumetric contraction time (ICT) and isovolumetric relaxation time (IRT) divided by ejection time (ET) and could be calculated for each ventricle individually. Myocardial performance index has been invented as a Doppler index of combined systolic and diastolic a reliable parameter to assess global left ventricular function.<sup>5,6,7</sup>

The SYNTAX (Synergy between PCI with TAXUS™ and Cardiac Surgery) study was organized for patients with significant lesions in the left main stem and/or the three epicardial coronary arteries. The study provided as a scoring system of the atherosclerotic lesions of coronary artery. The SYNTAX score (SS) is a lesion-based angiographic scoring system originally devised to grade the complexity of coronary artery disease (CAD).<sup>8</sup> It is able to aid revascularization decisions and predict mortality and morbidity in patients with CAD.<sup>9,10,11</sup>

#### **Method:**

The aim of the study is to investigate the relationship between severity of coronary artery disease (CAD) assessed with SYNTAX score (SS) and myocardial performance index (MPI) in chronic stable angina. This cross-sectional study was conducted in the department of Cardiology, University Cardiac Centre of BSMMU during the period of January, 2014 to December, 2014 among the patients of chronic stable angina undergoing elective coronary angiogram. Total 90 patients were enrolled by random purposive sampling. All the patients admitted for coronary angiogram fulfilling the inclusion and exclusion criteria during the study period at the study place was enrolled in the study. After taking detailed medical history and complete physical examination, all patients were questioned for the major cardiovascular

risk factors such as age, sex, DM, smoking status, hypertension, and family history of CAD. In addition, body mass index and systolic blood pressure and diastolic blood pressure were recorded. Fasting venous blood samples were obtained from all patients to determine their plasma levels of fasting blood glucose, total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein cholesterol, triglyceride, creatinine, and hemoglobin.

All echocardiographic examinations were performed using commercially available equipment (Vivid-7; GE Vingmed Sound, Horten, Norway) with a 2.5–3.5 MHz transducer. Simultaneous ECG recordings were obtained. The two-dimensional and Doppler tracings were recorded on strip charts at a paper speed of 50 or 100 mm/sec, and videotaped for later playback and analysis. All patients were examined at rest in the left lateral decubitus position. Echocardiographic techniques and calculations of different cardiac dimensions were performed in accordance with the recommendations of The American Society of Echocardiography. Echocardiographic parameters were EF, LVEDD, LVESD, ET, IVRT, IVCT, MPI.

All patients were undergone selective coronary angiography with the Judkins technique using the Siemens Angioscop X-ray (Siemens Artis zee; Siemens Healthcare, Muenchen, Germany). From the baseline diagnostic angiogram, each coronary lesion producing >50% diameter stenosis in vessels >1.5 mm was scored separately and added together to provide the overall SS, which was calculated prospectively using the SS algorithm (Sianos et al. 2005). All angiographic variables pertinent to SS calculation were computed by interventional cardiologists on diagnostic angiograms obtained before the procedure. The final score was calculated on a patient basis from the individual lesion scores, which was saved in a dedicated database as Syntax.

#### **Statistical analysis:**

Statistical analysis was carried out by using the Statistical Package for Social Sciences version 20.0 for Windows (SPSS Inc., Chicago, Illinois, USA). A descriptive analysis was performed for all data. The mean values were calculated for continuous variables. The quantitative observations were indicated by frequencies and percentages. Unpaired t-test was used to compare the means of two groups. ANOVA test was used to compare the means of three groups. Spearman's correlation was calculated between ejection fraction (EF), SYNTAX score and myocardial performance index (MPI) patients. Bivariate and multivariate was used of the MPI

values in obstructive coronary artery disease patients. A 'p' value of <0.05 was considered as significant.

### Results and Observations:

This cross-sectional study was carried out in the department of Cardiology, University Cardiac Centre, BSMMU, Dhaka, during the period from January 2014 to December 2014. This study was done with an aim to find out the association between the myocardial performance index and severity of coronary artery disease in patients with chronic stable angina assessed with SYNTAX score. Total of 90 patients with chronic stable angina, admitted to undergo coronary angiography were included in the study. Coronary angiogram was done during hospital admission. Correlations between MPI and SYNTAX score were evaluated. The mean age was found  $45.5 \pm 26.1$  years varied from 36 to 68 years. Male female ratio was 1.9:1. A negative significant correlation ( $r = -0.792$ ;  $p = 0.001$ ) was found between ejection fraction (EF) and myocardial performance index (MPI). Regarding the association between risk factors with MPI status, the mean MPI was found  $0.65 \pm 0.10$  in diabetes mellitus and  $0.57 \pm 0.10$  in without diabetes mellitus. Mean MPI was significantly higher in diabetes mellitus, others risk factors are not significantly associated with MPI status. Majority (38.9%) patient's SYNTAX score belonged to 0-22, 28(31.1%) was SYNTAX 23-32 score and 27(30.0%) was SYNTAX  $\geq 33$  score. The mean MPI was found  $0.51 \pm 0.04$  in low SYNTAX,  $0.61 \pm 0.03$  in intermediate SYNTAX and  $0.74 \pm 0.07$  in high SYNTAX score. The mean MPI was significantly ( $p < 0.05$ ) elevated with increased SYNTAX score. A positive significant correlation ( $r = 0.985$ ;  $p = 0.001$ ) was found between MPI with SYNTAX score. Higher value of SYNTAX score ( $> 22$ ) had a 2.29 times increase (95% CI 0.16 to 33.70%) in odds of having CAD. A subject with diabetes mellitus had 1.52 times increase (95% CI 2.02 to 21.54%) in odds having CAD. Others factors are not significantly associated with CAD in Multiple regression models.

**Table-I**

*Distribution of the study patients according to risk factors (n=90)*

Risk factors	Number of patients	Percentage
Hypertension	54	60.0
Smoker	54	60.0
Diabetes mellitus	50	55.6
Dyslipidemia	42	46.7
Family history of CAD	18	20.0

**Table-II**

*Distribution of the study patients according to ejection fraction (n=90)*

EF (%)	Number of patients	Percentage
50-55	22	24.4
55-70	68	75.6
Mean $\pm$ SD	58.9	$\pm 5.0$
Range (min-max)	50	-69

**Table-III**

*Distribution of the study patients according to myocardial performance index (n=90)*

MPI	Number of patients	Percentage
$d < 0.54$	28	31.1
$> 0.54$	62	68.9
Mean $\pm$ SD	0.61	$\pm 0.10$
Range (min-max)	0.43	-0.93

**Table IV**

*Association between SYNTAX score with MPI (n=90)*

SYNTAX score	MPI			P value
	n	Mean $\pm$ SD	Range (min-max)	
0-22 score (low)	28	$0.51 \pm 0.04$	0.43-0.63	
23-32 score (intermediate)	35	$0.61 \pm 0.03$	0.56-0.65	0.001 <sup>s</sup>
$\geq 33$ score (high)	27	$0.74 \pm 0.07$	0.66-0.93	

### Discussion:

This cross-sectional observational study was carried out with an aim to determine demographic characteristic, myocardial performance index and to assess SYNTAX score of study population and also to evaluate the relationship between MPI and severity of coronary artery disease assessed by SYNTAX scoring.

In this present study it was observed that majority (41.1%) patients were in 5<sup>th</sup> decade and the mean age was found  $45.5 \pm 26.1$  years with range from 36 to 68 years. Buyukkaya et al. showed the mean age was  $47.8 \pm 7.9$  years, which is closely resembled with the present study.<sup>12</sup> On the other hand, Sahin et al. and Alarhabi, et al. found the mean age of his study subjects were  $57.6 \pm 9.5$  years and  $54.1 \pm 9.10$  years respectively, which are higher with the current study. Similarly, higher mean age also obtained by Bruch et al. (2000) where the authors observed the mean age was  $68.0 \pm 6.0$  years.<sup>13,14</sup>

In this study (68.9%) patients myocardial performance index were  $>0.54$ . The mean myocardial performance index was found  $0.61 \pm 0.10$  with range from 0.43 to 0.93. Carluccio et al. (2011) found the mean MPI was  $0.71 \pm 0.19$ , which is higher with the current study. On the other hand Sahin et al. (2013) and Tekten et al. (2003) found the mean MPI was  $0.45 \pm 0.106$  and  $0.48 \pm 0.09$  respectively, which is lesser with the current study. This apparent discrepancy may be explained by the homogeneity of the studied population.<sup>15,16</sup>

In this study negative significant correlation ( $r = -0.792$ ;  $p = 0.001$ ) was found between ejection fraction (EF) with myocardial performance index (MPI). Similarly, Sahin et al. (2013) found that the MPI value negative significantly correlated with ejection fraction ( $r = -0.224$ ,  $P < 0.05$ ). The ejection fraction (EF) is the most reliable estimator of systolic function. But, when the elliptical cardiac chamber is transformed to a spherical one, the accuracy of EF is tend to be low reported by Kuroda et al. (1994). The myocardial performance index (MPI) has been widely used to quantitatively assess myocardial performance Tei et al. (1995). It is more reflective of overall cardiac function than systolic or diastolic function alone, and applied to independently assess the myocardial performance of left and right ventricles (Bruch et al. 2000; Vizzardi et al. 2012). Sahin et al. (2013) also mentioned that although the EF was normal, MPI value was impaired in proportion to the severity of CAD. In another study Carluccio et al. (2012) reported that MPI improved ( $0.59 \pm 0.26$ ,  $P < 0.05$ ) and its improving value was significantly correlated with the improvement in EF ( $r = 0.68$ ,  $P < 0.05$ ).<sup>17</sup>

In this present study it was observed that mean MPI was found  $0.65 \pm 0.10$  in diabetes mellitus and  $0.57 \pm 0.09$  in without diabetes mellitus. The mean value of MPI was significantly ( $p < 0.05$ ) higher in diabetes mellitus compared to without diabetes mellitus but other risk factors were not significantly ( $p > 0.05$ ) associated with MPI value. In our country a study done by Nahar et al. (2014) in BSMMU observed the mean MPI was  $0.57 \pm 0.04$  in diabetes mellitus and  $0.53 \pm 0.02$  in without diabetes mellitus. Similarly, Abdelaziz and Daoud (2011) reported that patients with diabetes have a higher MPI values compared with normal subjects. Abdelaziz and Daoud (2011) showed right ventricular myocardial performance index (MPI) was significantly higher in diabetic group. The above study findings are closely resembled with the present study.<sup>13,14,15</sup>

In this study it was observed that majority (38.9%) patients was found SYNTAX 23-32 score, 28(31.1%)

was SYNTAX 0-22 score and 27(30.0%) was SYNTAX  $\geq 33$  score. Sahin et al. (2013) study found SYNTAX score low was 33.0% patients, mid in 34.0%, high in 33.0%. Similar type of result was also observed by Ranjith el al. (2014) in patients with coronary artery disease, which are comparable with the current study.<sup>14,15</sup>

In this study it was observed that mean MPI was found  $0.51 \pm 0.04$  varied from 0.43 – 0.63 in low SYNTAX,  $0.61 \pm 0.03$  varied from 0.56 – 0.65 in intermediate SYNTAX and  $0.74 \pm 0.07$  varied from 0.66 – 0.93 in high SYNTAX score. The mean MPI was significantly ( $p < 0.05$ ) increased with elevated SYNTAX score. Sahin et al. (2013) showed the MPI value of patients with SYNTAX score high were higher than compared with all other groups (SYNTAX score mid, SYNTAX score low, and control groups) ( $P < 0.05$ , for all). Also, the MPI value of control group was lower than compared with SYNTAX score mid and SYNTAX score high groups ( $P < 0.05$ , for all). Similar type of result was in a study conducted in patients with coronary artery disease by Ranjith el al.<sup>18</sup>

In this present study it was observed that a positive significant correlation ( $r = 0.985$ ;  $p = 0.001$ ) was found between MPI with SYNTAX score. Similarly, Sahin et al. observed the relation between myocardial performance index (MPI) and SYNTAX score and found strong correlation ( $r = 0.564$ ,  $P < 0.001$ ) between MPI and SYNTAX score, which is closely resembled with the present study.<sup>18</sup>

In this present study it was observed that higher value of SYNTAX score ( $> 22$ ) had a 2.29 times increase (95%CI 0.16 to 33.70%) in odds of having CAD. A subject with diabetes mellitus had 1.52 times increase (95%CI 2.02 to 21.54%) in odds having CAD. Others factors are not significantly associated with CAD in Multiple regression models. Sahin et al. (2013) obtained multivariate regression analysis showed that MPI was independently associated with SS and diabetes in chronic stable angina patient. The relationships between MPI with systemic hypertension (HT) and diabetes were reported in previous studies Gur et al. (2008) and Orem et al. (2004). There was independent relation between MPI value and diabetes. It has been reported that patients with diabetes have a higher MPI values compared with normal subjects reported by (Orem et al. (2004). The relationship between cardiac autonomic neuropathy and Tei index in patients with type II DM was also demonstrated in a previous study done by Aydin Kaderli et al. (2008). In diabetes, an underlying ischemic heart disease,

extracellular collagen deposition, interstitial fibrosis, microangiopathy, calcium transport abnormalities, and neurohormonal alterations, alone or in combination, may impair ventricular relaxation by promoting a nonuniform distribution of the load and inactivation (Schaffer et al. 1989; Flarsheim et al. 1996.) All above-mentioned mechanisms may contribute to relationship between increased MPI values with DM. The above findings are comparable with the present study.<sup>19,20</sup>

### Conclusion:

The MPI value measured by Doppler is a cheap, radiation free, available noninvasive method and may be considered as an additional risk stratification tool beyond other investigations.

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