Section: Cardiology

Original Research Article

A PROSPECTIVE STUDY OF MYOCARDIAL PERFORMANCE INDEX AS A PREDICTOR OF ANGIOGRAPHIC SEVERITY OF CORONARY ARTERY DISEASE IN PATIENTS WITH ACUTE CORONARY SYNDROME IN TERTIARY CARE CENTRE

Brajesh Kumar[1], Sarita Choudhary[2], Manish Khandelwal[1], Pradeep Kumar Meena[2]

[1]Senior Resident, Department of Cardiology, SMS Medical College and Hospital, Jaipur, India.
[2]Professor, Department of Cardiology, SMS Medical College and Hospital, Jaipur, India.

Received : *12/01/2026*
Received in revised form : *01/03/2026*
Accepted : *17/03/2026*

Keywords:
Acute coronary syndrome, Angiographic severity, Coronary artery disease, Myocardial performance index, SYNTAX score.

Corresponding Author:
Dr. Manish Khandelwal,
Email: mkrock03@gmail.com

DOI: 10.47009/jamp.2026.8.2.101

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (2); 546-551

ABSTRACT

Background: Acute coronary syndrome (ACS) remains a leading cause of cardiovascular morbidity and mortality despite advances in reperfusion and pharmacotherapy. The myocardial performance index (MPI), a Doppler-derived parameter integrating systolic and diastolic function, provides a simple, non-invasive measure of global ventricular performance. The SYNTAX score is an angiographic tool that quantifies the severity and complexity of coronary artery disease (CAD). Objective- To evaluate the myocardial performance index (MPI) as a predictor of angiographic severity of CAD, assessed by SYNTAX score, and to determine its prognostic value in predicting major adverse cardiovascular events (MACE) at 30 days in patients with ACS. **Materials and Methods:** This prospective, hospital-based study was conducted in the Department of Cardiology over one year and included 145 ACS patients meeting the inclusion criteria. Detailed clinical evaluation, laboratory investigations, echocardiography for MPI calculation, and coronary angiography for SYNTAX scoring were performed. Patients were followed for 30 days to record MACE. **Result:** The majority of patients were males (69%) aged 61–70 years. Diabetes and hypertension were common comorbidities. The mean ejection fraction was 45.8%, and mean MPI was 0.56 ± 0.05. A strong positive correlation was observed between MPI and SYNTAX score ($r = 0.953$, $p < 0.001$). Patients who developed MACE had significantly higher MPI and SYNTAX scores compared to those without MACE. **Conclusion:** MPI showed a significant positive correlation with angiographic severity and effectively predicted short-term adverse outcomes. It can serve as a reliable, non-invasive echocardiographic parameter for early risk stratification and prognostic assessment in ACS patients.

INTRODUCTION

Acute coronary syndrome (ACS) encompasses unstable angina, non–ST-elevation ACS, and ST-elevation myocardial infarction and is diagnosed based on symptoms, ECG changes, and high-sensitivity cardiac troponin dynamics, with early risk stratification guiding invasive management[1]. Despite advances in reperfusion and antithrombotic therapy, residual risk of adverse outcomes remains substantial, underscoring the need for simple, reproducible indices that capture global ventricular function beyond conventional measures such as ejection fraction (EF) and wall-motion scoring.[1,2]

The myocardial performance index (MPI, Tei index) is a Doppler-derived, dimensionless ratio integrating systolic and diastolic time intervals—calculated as (isovolumic contraction time + isovolumic relaxation time) ÷ ejection time—thereby reflecting overall ventricular performance. In seminal work, Tei and colleagues demonstrated that MPI is feasible at the bedside and relatively independent of preload, afterload, and heart rate compared with conventional parameters.[3,4] Subsequent reviews have highlighted its practicality across diverse cardiac conditions, including ischemic heart disease, and its appeal in settings where rapid, non-geometric, and vendor-agnostic measurements are desirable.[5,6]

Pathophysiologically, ACS perturbs both contraction and relaxation through ischemia-reperfusion injury, microvascular dysfunction, and neurohumoral activation; therefore, a composite timing index may better mirror the net impact on ventricular function than isolated systolic or diastolic metrics. Early post-infarction studies showed that higher MPI values were associated with worse outcomes and evolving heart failure, and that serial improvements in MPI paralleled recovery after acute myocardial infarction.[7] Long-term follow-up further confirmed the prognostic utility of MPI in post-MI populations, supporting its use for risk stratification beyond EF alone.[8]

Crucially for invasive decision-making, emerging clinical evidence links MPI to angiographic disease burden. In patients with non-ST-elevation myocardial infarction, MPI correlated positively with the Gensini score and independently predicted higher angiographic severity categories, indicating that a single Doppler measurement captured the cumulative hemodynamic impact of multi-vessel complex coronary disease.[9] Although evaluated in stable coronary syndromes, MPI (both pulsed-wave and tissue Doppler variants) also predicted a high SYNTAX score, reinforcing biological plausibility that worse global timing performance accompanies diffuse atherosclerotic complexity.[10] Together, these data suggest that MPI could serve as a rapid, noninvasive gateway test to anticipate angiographic severity, inform urgency and strategy of revascularization, and complement guideline-recommended risk tools in ACS. Given the continued emphasis on early invasive pathways in ACS and the limitations of EF and regional wall-motion analysis in acute ischemia, systematically examining the relationship between MPI and angiographic severity is clinically meaningful. Therefore, this study was designed to evaluate myocardial performance index (MPI) as a predictor of angiographic severity of coronary artery disease assessed by SYNTAX score in patients with acute coronary syndrome, and to determine its prognostic value in predicting major adverse cardiovascular events (MACE) at 30 days.

MATERIALS AND METHODS

Study Type and Design: This study was conducted as a hospital-based prospective study in the Department of Cardiology at our tertiary care hospital over a period of one year.

Study Population: The study population consisted of patients who reported to the Department of Cardiology through the Emergency or Outpatient Department (OPD), fulfilled the inclusion criteria, and were willing to participate after providing written informed consent.

Inclusion Criteria

Adults aged 18 years and above, presenting with chest pain or its equivalent, and diagnosed with acute coronary syndrome (ACS), who underwent coronary angiography were included in the study.

Exclusion Criteria

Patients with chronic stable angina, previous history of percutaneous transluminal coronary angioplasty (PTCA) or coronary artery bypass grafting (CABG), moderate to severe valvular heart disease or history of valvular surgery, atrial fibrillation or atrial flutter, significant tachyarrhythmias or bradyarrhythmias, pacemaker implantation (temporary or permanent), restrictive cardiomyopathy, constrictive pericarditis, congenital heart disease, chronic renal failure, chronic pulmonary or hepatic disease, malignancy, or poor acoustic windows precluding optimal echocardiographic recording were excluded. Patients unwilling to undergo coronary angiography were also excluded.

Sample Size: The required sample size was calculated to be 114 ACS patients, based on previous studies that reported an AUC of 0.997, SE of 0.005, and sensitivity of 83% at a 95% confidence interval. And during study period we enrolled 145 ACS patients reported to the department of Cardiology.

Data Collection: For every patient enrolled in the study, a detailed and systematic data collection process was followed. At the time of admission, complete demographic information such as age, sex, occupation, and residence was recorded. A thorough medical history was obtained, including presenting complaints, duration of symptoms, risk factors for coronary artery disease (such as hypertension, diabetes mellitus, smoking, dyslipidemia, and family history of premature CAD), and any history of prior cardiovascular or systemic illnesses. Relevant treatment history, including the use of antiplatelets, statins, beta-blockers, or other cardiovascular medications, was also documented.

A general physical examination was performed, and vital parameters such as blood pressure, heart rate, respiratory rate, and oxygen saturation were noted. A detailed systemic examination with special emphasis on the cardiovascular system was carried out in all patients. Baseline laboratory investigations including complete blood count, renal function tests, liver function tests, random blood sugar, lipid profile, and cardiac biomarkers (such as troponins) were performed as part of the routine workup.

Electrocardiography (ECG) was done in all patients at the time of admission to assess ST-T changes, arrhythmias, conduction disturbances, and evidence of acute ischemia.

Echocardiographic evaluation was carried out within 24 hours of diagnosis, prior to coronary angiography. Two-dimensional echocardiography, Doppler, and M-mode studies were performed using a standardized protocol. Specific echocardiographic parameters including isovolumic relaxation time (IVRT), isovolumic contraction time (IVCT), ejection time (ET), and transmitral Doppler velocities (E and A waves) were measured. The myocardial performance index (MPI) was then

ISSN (O): 2687-5365; ISSN (P): 2753-6556

calculated as (IVRT + IVCT) ÷ ET. Left ventricular dimensions, systolic and diastolic functions, and regional wall motion abnormalities were also noted to ensure a comprehensive evaluation.
All patients subsequently underwent coronary angiography using the Judkins technique. Angiograms were performed in standard projections to visualize all major coronary arteries. The severity and complexity of coronary artery disease were quantified using the SYNTAX scoring system. Each angiographic finding was independently evaluated, and SYNTAX scores were calculated according to established guidelines.
Finally, patients were followed up during their hospital stay and for a period of 30 days after the index event. Information regarding the occurrence of major adverse cardiovascular events (MACE), such as recurrent angina, re-infarction, need for revascularization, hospitalization for heart failure, arrhythmias, or death, was collected and recorded.
Statistical Analysis: The collected data were entered into Microsoft Excel sheets and were further analyzed using SPSS version 26 software. Continuous variables were summarized as mean ± standard deviation (SD), while categorical variables were expressed as frequencies and percentages.
The difference between two means was analyzed using the Student's t-test. For comparisons of continuous variables across more than two groups, one-way analysis of variance (ANOVA) was applied for normally distributed data. The chi-square test was used to analyze nominal variables. Correlation between MPI and SYNTAX score was calculated using the Pearson correlation coefficient. A p-value of less than 0.05 was considered statistically significant.

RESULTS

[Table 1] In the present study, the majority of patients were aged 61–70 years (34.5%), and males constituted 69% of the study population. Among comorbidities, diabetes was most common (50.3%), followed by hypertension (34.5%) and a positive family history of coronary artery disease (35.9%). The most frequent clinical presentations were NSTEMI (29.0%) and AWMI (26.2%), each followed by USAP (26.2%) and IWMI (18.6%).

Table 1: Distribution of Patients by Age, Sex, Co-morbidities, and Type of ACS

Variable		Number (n=145)	Percentage
Age Group (Years)	31-40	5	3.4
	41-50	26	17.9
	51-60	24	16.6
	61-70	50	34.5
	71-80	28	19.3
	81-90	12	8.3
Sex	Female	45	31
	Male	100	69
	Total	145	100
Co-Morbidities	HTN	50	34.5
	Diabetes	73	50.3
	Smoking	47	32.4
	Dyslipidaemia	42	29
	Family History of CAD	52	35.9
ACS type	AWMI	38	26.2
	IWMI	27	18.6
	NSTEMI	42	29
	USAP	38	26.2

In our study, major adverse cardiovascular events (MACE) within 30 days were present in 13 patients (9.0%), and rest 132(91%) were free from MACE event.
[Figure 1] The majority of patients 79(54.5%) had a SYNTAX score of 23–32, followed by 29.6% of patients in the low category (0–22), and least 23(15.9%) were in the high category (≥33).

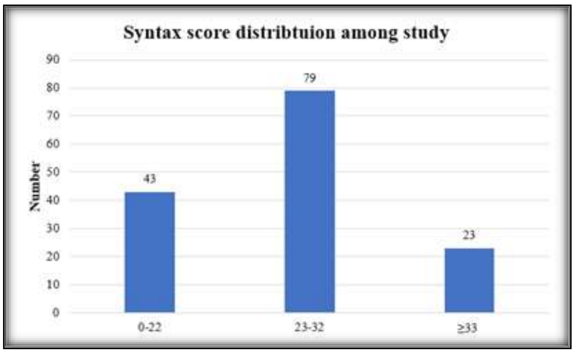


Figure 1: Distribution of SYNTAX Score Categories

[Figure 2] A significant positive correlation was observed between MPI and SYNTAX score ($r = 0.953$, $p < 0.001$). This indicates that as the SYNTAX score increased, the MPI values also showed a proportionate rise.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

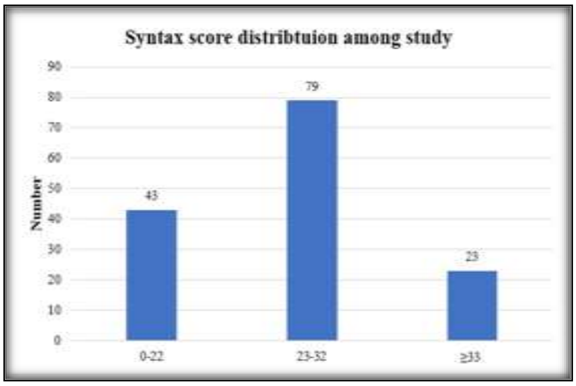
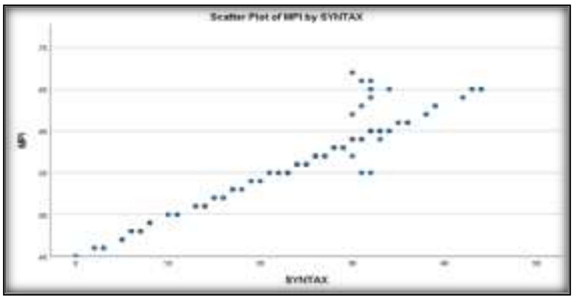


Figure 2: Scatter plot of correlation of MPI with SYNTAX Score



[Table 2] The mean E velocity was 67.27±15.91 cm/s and the mean A velocity was 64.97±6.59 cm/s. The mean E/A ratio was 1.02±0.31. The mean medial e' velocity was 7.92±1.77 cm/s, while the mean E/e' ratio was 8.88±2.84. The mean ejection fraction by Simpson's method was 45.84±9.38%. The mean myocardial performance index (MPI) was 0.56±0.05. The mean SYNTAX score was 24.39±9.81.

Table 2: Echocardiographic and Angiographic Parameters

Variable	Mean	Std. Deviation
E velocity (cm/s)	67.27	15.91
A velocity (cm/s)	64.97	6.59
E/A ratio	1.02	0.31
Medial e' velocity (cm/s)	7.92	1.77
E/e'	8.88	2.84
Ejection fraction (%) by Simpsons	45.84	9.38
MPI	0.56	0.05
SYNTAX	24.39	9.81

[Table 3] In the present study, patients who developed MACE within 30 days had a significantly higher mean SYNTAX score compared to those without MACE. Similarly, the mean MPI value was also significantly higher among patients with MACE compared to those without MACE. In the present study, the mean MPI in patients with a SYNTAX score of 0–22 was 0.50 ± 0.03, in those with a score of 23–32 it was 0.58 ± 0.27, and in those with a score >33 it was 0.62 ± 0.02. The difference in MPI across the three SYNTAX categories was statistically significant using One-Way ANOVA test ($p < 0.001$).

Table 3: Comparison of SYNTAX Score and MPI with MACE within 30 Days

Variable	MACE within 30 Days	Mean	SD	p-value
SYNTAX Score	Yes	31.54	1.2	<0.001
	No	23.69	10.08	
MPI	Yes	0.62	0.04	<0.001
	No	0.56	0.05	

DISCUSSION

Acute coronary syndrome (ACS), encompassing unstable angina, NSTEMI, and STEMI, continues to be a major cause of cardiovascular morbidity and mortality despite advances in care. The myocardial performance index (MPI), a simple Doppler-derived parameter, reflects combined systolic and diastolic function and provides an overall assessment of global cardiac performance. The SYNTAX score, on the other hand, is a validated angiographic tool to grade the severity and complexity of coronary artery disease. In this background, our study aimed to assess the relationship between MPI and SYNTAX score in ACS patients and to determine the prognostic value of MPI in predicting 30-day major adverse cardiovascular events (MACE).

In the present study, most patients were in the 61–70 years age group, and a male predominance was observed. This finding is consistent with the natural progression of atherosclerosis, which increases with age, and with the fact that men tend to present earlier with coronary artery disease due to higher exposure to conventional risk factors. Large Indian registries such as CREATE and the Kerala ACS registry also reported mean ages around 55–60 years and a male predominance of nearly 70%, which aligns closely with our observations, although our peak age group was slightly older.[11,12] Similar demographic distributions were also reported in studies evaluating the prognostic role of the myocardial performance index (MPI) in acute myocardial infarction (AMI).[13]

In our cohort, diabetes present in half of the patients, followed by hypertension, family history of CAD, smoking, and dyslipidaemia. These factors are known to accelerate ischemic injury and microvascular dysfunction, leading to prolongation of isovolumic contraction and relaxation phases and thereby raising MPI. Previous studies have emphasized that MPI is sensitive to both systolic and diastolic abnormalities and deteriorates in the presence of cardiometabolic risk factors.[14,15] Abacı et al9 also reported that in stable CAD patients, higher angiographic disease severity was associated with higher MPI values, supporting the link between comorbidity burden and impaired global myocardial performance.

Our study included a balanced distribution of anterior wall myocardial infarction, inferior wall myocardial infarction, unstable angina, and NSTEMI, with non-ST elevation events forming a large share. This pattern reflects the clinical profile commonly seen in tertiary centers. The Kerala ACS registry also reported a similar distribution with a substantial proportion of NSTEMI and unstable angina.[12] Studies have shown that MPI abnormalities are observed across all ACS subtypes, reinforcing the applicability of our findings across different presentations.[13]

The 30-day major adverse cardiovascular event (MACE) rate was 9%, and patients who experienced MACE had significantly higher SYNTAX scores and MPI values. This suggests that both anatomical complexity and impaired global myocardial performance are important predictors of early adverse outcomes. The systematic review by Bennett et al,[13] demonstrated that elevated MPI was associated with heart failure hospitalization, reinfarction, and death in AMI patients across multiple cohorts. Similarly, Abuomara et al,[16] found that higher MPI values predicted in-hospital heart failure in anterior STEMI. Prognostic significance of the SYNTAX score has also been reported in NSTE-ACS and NSTEMI, where higher scores predicted increased in-hospital mortality and adverse events.[17,18]

More than half of our patients had intermediate SYNTAX scores, while about 16% were in the high category. The SYNTAX score is an established tool to quantify lesion complexity, and higher scores have been strongly associated with adverse PCI outcomes and decisions for surgical revascularization.[19] Prognostic use of the SYNTAX and SYNTAX II scores in NSTE-ACS populations has also been validated, supporting the clinical significance of our findings.[17,18]

A strong positive correlation was observed between MPI and SYNTAX score ($r = 0.953$). This demonstrated that as coronary anatomical complexity increases, myocardial performance becomes more impaired. Prior studies in stable CAD have shown similar results. Şahin et al,[20] found a positive correlation between MPI and SYNTAX score, and Mansour et al10 demonstrated that MPI could predict high SYNTAX scores in patients with chronic coronary syndrome. Mohammad et al,[21] also reported a high correlation between MPI and SYNTAX in chronic stable angina. Our findings extend this association to the acute coronary syndrome setting, where ischemia may accentuate the relationship.

The mean ejection fraction in our study was moderately reduced at 45.8%, while the mean MPI was 0.56. These values indicate global left ventricular dysfunction, which is expected in ACS. The MPI, originally validated by Tei et al,[22] has been shown to integrate systolic and diastolic function and to predict adverse outcomes. Reviews confirm its role as a simple and reproducible parameter of overall cardiac performance.[15] The prognostic association observed in our study is therefore consistent with previous literature.[13]

The comparison of MPI across SYNTAX categories showed a stepwise rise from low to intermediate to high scores, with the difference being statistically significant. This step-up pattern mirrors findings from prior studies in stable coronary disease, where MPI increased with greater lesion complexity.[20,21] Our results add to this evidence by demonstrating a similar gradient in ACS patients, highlighting the potential of MPI as a non-invasive marker for identifying patients with complex coronary anatomy.

This study was carried out prospectively and included a reasonable number of patients with acute coronary syndrome. Both the SYNTAX score and the MPI were studied together, giving a comprehensive view of the disease in terms of anatomical severity and functional impairment. Standardized methods were used for echocardiography and angiography, which increases the reliability of the results. However, there are also some limitations. The study was conducted at a single tertiary care center, so the results may not apply to all populations. The follow-up period was only 30 days, which does not allow assessment of long-term outcomes. In addition, there is a possibility of inter-observer variation in echocardiographic measurement of MPI, which was not fully addressed.

CONCLUSION

In the present study, myocardial performance index (MPI) was evaluated in patients with acute coronary syndrome (ACS) and compared with angiographic severity of coronary artery disease assessed by the SYNTAX score. The analysis demonstrated a strong and statistically significant positive correlation between MPI and SYNTAX score, indicating that higher MPI values were associated with greater severity and complexity of coronary artery disease.

Patients with higher SYNTAX score categories showed proportionately higher MPI values compared to those in the lower categories, and the difference was statistically significant. This finding supports the role of MPI as a non-invasive echocardiographic marker for predicting angiographic severity.

The prognostic evaluation further revealed that patients who developed major adverse cardiovascular events (MACE) within 30 days had significantly higher MPI and SYNTAX scores compared to those without MACE. This highlights the value of MPI not only as a diagnostic tool but also as a prognostic indicator in ACS.

Thus, MPI can be considered a reliable, non-invasive, and easily obtainable parameter for predicting both the severity of coronary artery disease and short-term outcomes in patients with acute coronary syndrome. Its incorporation into routine echocardiographic assessment may improve early risk stratification and guide timely management decisions.

REFERENCES

1. Byrne RA, Rossello X, Coughlan JJ, Barbato E, Berry C, Chieffo A, et al; ESC Scientific Document Group. 2023 ESC Guidelines for the management of acute coronary syndromes. Eur Heart J. 2023 Oct 12;44(38):3720-3826. doi: 10.1093/eurheartj/ehad191. Erratum in: Eur Heart J. 2024 Apr 1;45(13):1145.
2. Rao SV, O'Donoghue ML, Ruel M, Rab T, Tamis-Holland JE, Alexander JH, et al. 2025 ACC/AHA/ACEP/NAEMSP/SCAI guideline for the management of patients with acute coronary syndromes: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Journal of the American College of Cardiology. 2025 Jun 10;85(22):2135-237.
3. Tei C, Ling LH, Hodge DO, Bailey KR, Oh JK, Rodeheffer RJ, Tajik AJ, Seward JB. New index of combined systolic and diastolic myocardial performance: a simple and reproducible measure of cardiac function--a study in normals and dilated cardiomyopathy. J Cardiol. 1995 Dec;26(6):357-66.
4. Tei C. New non-invasive index for combined systolic and diastolic ventricular function. J Cardiol. 1995 Aug;26(2):135-6.
5. Lakoumentas JA, Panou FK, Kotseroglou VK, Aggeli KI, Harbis PK. The Tei index of myocardial performance: applications in cardiology. Hellenic J Cardiol. 2005 Jan-Feb;46(1):52-8.
6. Abuomara HZA, Hassan OM, Rashid T, Baraka M. Myocardial performance index as an echocardiographic predictor of early in-hospital heart failure during first acute anterior ST-elevation myocardial infarction. Egypt Heart J. 2018 Jun;70(2):71-75.
7. Poulsen SH, Jensen SE, Nielsen JC, Møller JE, Egstrup K. Serial changes and prognostic implications of a Doppler-derived index of combined left ventricular systolic and diastolic myocardial performance in acute myocardial infarction. Am J Cardiol. 2000 Jan 1;85(1):19-25.
8. Szymański P, Rezler J, Stec S, Budaj A. Long-term prognostic value of an index of myocardial performance in patients with myocardial infarction. Clin Cardiol. 2002 Aug;25(8):378-83.
9. Abaci O, Kocas C, Oktay V, Arslan S, Turkmen Y, Bostan C, Coskun U, Yildiz A, Ersanli M. Relationship between myocardial performance index and severity of coronary artery disease in patients with non-ST-segment elevation acute coronary syndrome. Cardiovasc J Afr. 2017 Jan/Feb;28(1):4-7
10. Mansour H, Nassar AI, Abdel Rehim WA, Roushdy AM, Abobakr M, Zaki HM, Aboubakr El Missiri AM. Can Tei Index Predict High Syntax Score in Patients with Chronic Coronary Syndrome and Normal Left Ventricular Systolic Function? J Cardiovasc Echogr. 2021 Jan-Mar;31(1):11-16.
11. Xavier D, Pais P, Devereaux PJ, Xie C, Prabhakaran D, Reddy KS, et al; CREATE registry investigators. Treatment and outcomes of acute coronary syndromes in India (CREATE): a prospective analysis of registry data. Lancet. 2008 Apr 26;371(9622):1435-42.
12. Mohanan PP, Mathew R, Harikrishnan S, Krishnan MN, Zachariah G, Joseph J, et al; Kerala ACS Registry Investigators. Presentation, management, and outcomes of 25 748 acute coronary syndrome admissions in Kerala, India: results from the Kerala ACS Registry. Eur Heart J. 2013 Jan;34(2):121-9.
13. Bennett S, Wong CW, Griffiths T, Stout M, Khan JN, Duckett S, et al. The prognostic value of Tei index in acute myocardial infarction: a systematic review. Echo Res Pract. 2020 Dec;7(4):49-58.
14. Goroshi M, Chand D. Myocardial Performance Index (Tei Index): A simple tool to identify cardiac dysfunction in patients with diabetes mellitus. Indian Heart J. 2016 Jan-Feb;68(1):83-7.
15. Askin L, Yuce Eİ, Tanriverdi O. Myocardial performance index and cardiovascular diseases. Echocardiography. 2023 Jul;40(7):720-725.
16. Abuomara HZA, Hassan OM, Rashid T, Baraka M. Myocardial performance index as an echocardiographic predictor of early in-hospital heart failure during first acute anterior ST-elevation myocardial infarction. Egypt Heart J. 2018 Jun;70(2):71-75.
17. Wang XF, Zhao M, Liu F, Sun GR. Value of GRACE and SYNTAX scores for predicting the prognosis of patients with non-ST elevation acute coronary syndrome. World J Clin Cases. 2021 Nov 26;9(33):10143-10150.
18. Aktürk E, Aşkın L, Taşolar H, Türkmen S, Kaya H. Comparison of the Predictive Roles of Risk Scores of In-Hospital Major Adverse Cardiovascular Events in Patients with Non-ST Elevation Myocardial Infarction Undergoing Percutaneous Coronary Intervention. Med Princ Pract. 2018;27(5):459-465.
19. Serruys PW, Onuma Y, Garg S, Sarno G, van den Brand M, Kappetein AP, et al. Assessment of the SYNTAX score in the Syntax study. EuroIntervention. 2009 May;5(1):50-6.
20. Sahin DY, Gür M, Elbasan Z, Uysal OK, Özaltun B, Şeker T, Öz et al. Relationship between myocardial performance index and severity of coronary artery disease assessed with SYNTAX score in stable coronary artery disease. Echocardiography. 2013 Apr;30(4):385-91.
21. Mohammad N, Safiuddin M, Hasan MN. Relationship between Myocardial Performance Index and the Severity of Coronary Artery Disease Assessed with SYNTAX Score in Chronic Stable Angina Patients in Bangladesh. Mymensingh Med J. 2023 Jan;32(1):161-167.
22. Tei C, Nishimura RA, Seward JB, Tajik AJ. Noninvasive Doppler-derived myocardial performance index: correlation with simultaneous measurements of cardiac catheterization measurements. J Am Soc Echocardiogr. 1997 Mar;10(2):169-78.