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Original article

Comparison of the TIMI risk score with coronary angiography in patients with ST-segment elevated myocardial infarction, unstable angina and non-ST-segment elevation myocardial infarction.

Dr Shashidhar S Devarmani[1], Dr. Anuja M K[2], Dr Akhil Raj Madamsetti[3]

[1]Professor, [2]Assistant professor, [3]Post graduate student, Department of General Medicine, Shri B M Patil Medical College Hospital and Research Centre, Vijayapura, Karnataka.

Corresponding author: Dr Akhil Raj Madamsetti

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Abstract

Introduction: In 1983, the TIMI (Thrombolysis in Myocardial Infarction) study group (Brigham and Women's Hospital, Boston, Massachusetts) chose to conduct a randomized, double-blind, multicenter study to assess the efficacy of intravenous (IV) streptokinase. Phase 1 studied IV streptokinase and IV tPA (tissue plasminogen activator) and assessed "recanalization of the totally occluded artery 90 minutes after the start of drug infusion." For this study, the *TIMI Coronary Grade Flow* was established to ensure a uniform and consistent method of recording epicardial perfusion on coronary arteriography. **Objective:** The present study aims to systematically compare the TIMI risk score with coronary angiography in patients with ST-segment elevated myocardial infarction, unstable angina and non-ST-segment elevation myocardial infarction. **Materials and methods:** This is a prospective cross-sectional study to evaluate correlation between TIMI score and number of vessels involved in angiographic study of STEMI, NSTEMI and UA patients presenting to BLDE hospital. **Results:** The symptom distribution in this study reveals that the most prevalent symptom is "Chest Pain, Radiating Pain" (31.58%), followed by "Chest Pain" alone (29.47%). TIMI risk scores were predominantly in the 4 and 5 categories (each 36.84%), indicating moderate to high risk. Coronary Angiography revealed DVD in 42.11% of patients, highlighting the severity of coronary artery disease in the cohort. Unstable Angina patients also predominantly have higher TIMI scores, with a notable concentration at TIMI 4. Unstable Angina patients predominantly have SVD (single vessel disease) but still present with DVD and TVD in smaller numbers. **Conclusion:** The evaluation of the TIMI risk score against coronary angiography findings in this study provides valuable insights into its utility and limitations in predicting coronary artery disease (CAD) severity.

Key words: TIMI score, unstable angina, non-ST-segment elevation myocardial infarction.

Introduction

Coronary artery disease (CAD) remains a leading cause of morbidity and mortality worldwide. It is a condition characterized by the narrowing or blockage of the coronary arteries due to the buildup of atherosclerotic plaques, which impedes blood flow to the heart muscle and can result in ischemia and infarction. According to the World Health Organization, CAD accounted for an estimated 17.8 million deaths globally in 2017, representing 31% of all global deaths [1]. In India, CAD is also a significant health concern, contributing to a substantial proportion of cardiovascular-related morbidity and mortality [2].

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The clinical presentations of CAD include silent ischemia, stable angina pectoris, unstable angina, myocardial infarction (MI), heart failure, and sudden death. Patients with chest pain represent a very substantial proportion of all acute medical hospitalizations in Europe. Distinguishing patients with acute coronary syndromes (ACS) within the very large proportion with suspected cardiac pain is a diagnostic challenge, especially in individuals without clear symptoms or electrocardiographic features. Despite modern treatment, the rates of death, MI, and read mission of patients with ACS remain high.

Given the potentially life-threatening nature of atherothrombotic disease, risk stratification criteria have been established to aid clinicians in promptly deciding on pharmacological treatment and coronary revascularization strategies customized to each patient.

Chest pain serves as the primary symptom triggering the diagnostic and therapeutic process, with patient classification relying on the electrocardiogram (ECG)[2].

Patients typically fall into two categories

1) **STEMI:** Patients with acute chest pain and persistent (>20min) ST-segment elevation.
2) **NSTEMI:** Patients with acute chest pain but without persistent ST-segment elevation

Early and accurate diagnosis of CAD is crucial for the effective management and prevention of adverse cardiovascular events. Traditionally, coronary angiography has been considered the gold standard for the diagnosis and assessment of the severity of CAD. Coronary angiography is an invasive imaging technique that provides detailed visualization of the coronary arteries, allowing for the identification and quantification of stenotic lesions [3].

The present study aims to systematically compare the TIMI risk score with coronary angiography in patients with suspected CAD.

Objective

The present study aims to systematically compare the TIMI risk score with coronary angiography in patients with ST-segment elevated myocardial infarction, unstable angina and non-ST-segment elevation myocardial infarction.

Materials and methods

Study design

This is a prospective cross-sectional study to evaluate correlation between TIMI score and number of vessels involved in angiographic study of STEMI, NSTEMI and UA patients presenting to BLDE hospital.

Source of data

The study will include inpatients of BLDE(DU) Shri B.M. Patil medical college Hospital

and research center, Vijayapura. The patients will be informed about the study in all aspects

and informed consent will be obtained. Period of study is from October 2022 to April 2024

METHODS

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Patients attending BLDE (DU) Shri B.M. Patil medical college Hospital and research center, Vijayapura diagnosed with unstable angina, ST-segment elevated myocardial infarction, non-ST-elevated Myocardial Infarction will be selected for study.

Nature and purpose of study will be explained to patients and informed consent will be taken. A detailed history, including demographics (age, sex), risk factors, weight, hypertension, diabetes, smoking, and family history of coronary artery disease will be noted.

Method of collection of data:

Study patients:

A detailed history, general physical examination, systemic examination, and investigation will be performed on all patients who will fulfill inclusion criteria, both male and female, who will get admitted in B.L.D.E. (D.U) Shri B M Patil medical college hospital and research center, Vijayapura.

Statistical analysis:

To achieve a power of 99% for detecting a difference in Proportion (EXACT Proportion: Difference from constant (binomial test, one sample case)) with 5% level of significance. Advanced data manipulation, analysis, and visualization were conducted using Python programming language, specifically utilizing libraries such as Pandas for data handling, NumPy for numerical operations, Matplotlib and Seaborn for data visualization, and Stats models for statistical modeling and regression analysis. The entire analysis process was documented and executed in Jupyter Notebook, providing an interactive and reproducible research environment. This study requires a sample size of 82.

Inclusion criteria:

- Patients aged greater than 18 years presenting with ST-segment elevated myocardial infarction, unstable angina and non-ST-elevated myocardial infarction will be included.

Exclusion criteria:

- History of prior coronary artery bypass graft (CABG).
- Atypical chest pain.
- Those who did not give consent for participation in this study.

Analysis and interpretation

Analyzing and translating play vital roles in the testing process. Analyzing aims to improve, categorize, standardize, and summarize the collected information for better identification and understanding, ensuring a full response to the initial question that triggered the test.

Analyzing without thorough understanding falls short, just as translation depends on a suitable Analyzation. Consequently, these processes rely on each other. This part involves a detailed

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review of the gathered data in line with established goals. The study's results support testing hypotheses, leading to explanations and conclusions.

In this study, various software tools were employed to ensure robust data analysis and visualization. Initial data entry and preliminary cleaning were performed using Microsoft Excel. Advanced data manipulation, analysis, and visualization were conducted using Python programming language, specifically utilizing libraries such as Pandas for data handling, NumPy for numerical operations, Matplotlib and Seaborn for data visualization, and Stats models for statistical modeling and regression analysis.

The entire analysis process was documented and executed in Jupyter Notebook, providing an interactive and reproducible research environment.

TABLE NO:1 Age wise distribution of study population

Age Group	Number of patients	Percentage
20-40 years	0	0
41-60 years	1	1.05
More than 60 years	94	98.94

This table indicates that the majority of respondents (98.92%) are in the age group of 61 years and above. There is only one respondent in the age group of 41-60 years, and none in the age group of 20-40 years.

Table 2: Distribution according to gender

Sex	**Number of patients**	**Percentage**
MALE	61	64.21
FEMALE	34	35.78

The sex distribution indicates that 64.21% of respondents are male, while 35.79% are female. This suggests a higher prevalence of male participants in the study.

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Table 3: Distribution according to symptoms

Symptom Category	Number of patients	Percentage
Chest Pain, Radiating Pain	30	31.57
Chest Pain	28	29.47
Chest Pain, Radiating Pain, Breathlessness	18	18.94
Chest Pain, Breathlessness	11	11.57
Breathlessness	8	8.42

The symptom distribution in this study reveals that the most prevalent symptom is "Chest Pain, Radiating Pain" (31.58%), followed by "Chest Pain" alone (29.47%). A significant portion of patients (18.95%) reported "Chest Pain, Radiating Pain, Breathlessness," indicating multiple concurrent symptoms. "Chest Pain, Breathlessness" and "Breathlessness" alone were less common but still notable, reflecting the diverse presentations of coronary artery disease symptoms among the patient population. This distribution highlights the need for comprehensive assessment and management of chest pain and associated symptoms in this study.

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Table 4: Analysis of ECG, Troponin levels, Echo finding (RWMA), TIMI score and CAG findings: -

Parameter	Category	Number of patients	Percentage
Troponin	Positive	81	85.26315789
Troponin	Negative	14	14.73684211
ECG	STEMI	30	31.57894737
ECG	NSTEMI	55	57.89473684
RWMA	Anterior Wall	54	56.84210526
RWMA	Infero-Lateral Wall	40	42.10526316
TIMI Risk Score	1	2	2.10
TIMI Risk Score	2	6	6.31
TIMI Risk Score	3	15	15.78
TIMI Risk Score	4	35	36.84
TIMI Risk Score	5	35	36.84
TIMI Risk Score	6	2	2.10
Coronary Angiography	SVD	30	31.57
Coronary Angiography	DVD	40	42.10
Coronary Angiography	TVD	25	26.31

The combined summary table provides a concise overview of key findings in the study. The majority of patients tested positive for Troponin (85.26%), with a significant portion presenting with NSTEMI (57.89%). Anterior Wall RWMA was observed in 56.84% of patients.

TIMI risk scores were predominantly in the 4 and 5 categories (each 36.84%), indicating moderate to high risk. Coronary Angiography revealed DVD in 42.11% of patients, highlighting the severity of coronary artery disease in the cohort.

Graph 1: Correlation between Timi scores and Coronary angiography results

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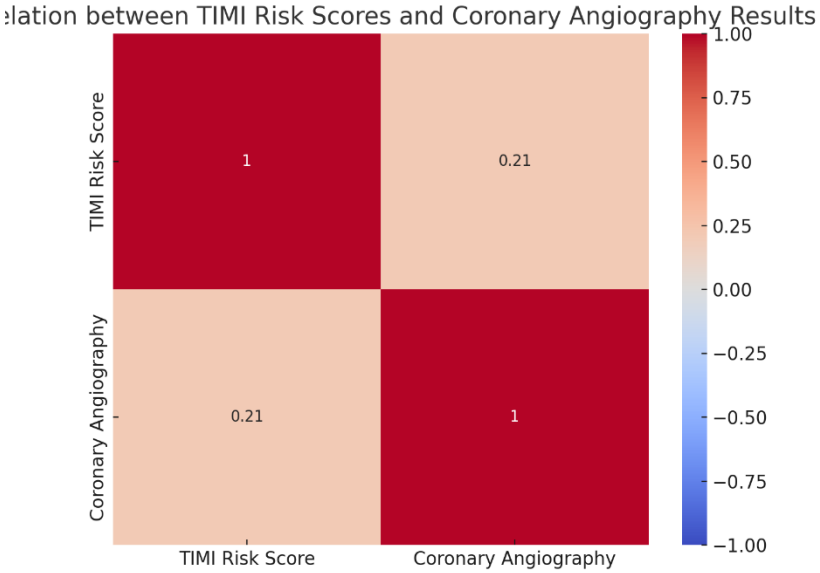

The heatmap visually represents the correlation between TIMI risk scores and types of coronary angiography results. The correlation coefficient of 0.207 indicates a positive but weak correlation between these variables.

The correlation analysis reveals a weak positive correlation (r = 0.207) between TIMI risk scores and the severity of coronary artery disease as indicated by coronary angiography results. This suggests that higher TIMI risk scores are somewhat associated with more severe coronary artery disease (progressing from SVD to DVD and TVD), but other factors also likely play a significant role.

Table 5: Cross-tabulation between ECG findings (NSTEMI, STEMI, Unstable Angina) and TIMI scores:

ECG	TIMI 1	TIMI 2	TIMI 3	TIMI 4	TIMI 5	TIMI 6
NSTEMI	0	5	12	18	17	3
STEMI	2	1	3	10	15	0
Unstable Angina	0	0	0	7	3	0

The cross-tabulation table shows the distribution of TIMI scores across different ECG categories. The majority of patients with NSTEMI and STEMI have higher TIMI scores (4 and 5), indicating moderate to high risk. Unstable Angina patients also predominantly have higher TIMI scores, with a notable concentration at TIMI 4.

Table 6: Cross-tabulation between ECG findings (NSTEMI, STEMI, Unstable Angina) and coronary angiogram (CAG) results

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ECG	SVD	DVD	TVD
NSTEMI	13	22	20
STEMI	9	15	6
Unstable Angina	8	3	2

The cross-tabulation table shows the distribution of coronary angiogram results across different ECG categories. Patients with NSTEMI and STEMI are more likely to have DVD (double vessel disease) and TVD (triple vessel disease), indicating more severe coronary artery involvement.

Unstable Angina patients predominantly have SVD (single vessel disease) but still present with DVD and TVD in smaller numbers.

Discussion

The main goal of this study was to see how well the TIMI risk score predicts the severity of coronary artery disease (CAD) compared to the gold standard, coronary angiography. The findings offer several key insights into the relationship between these two diagnostic tools and their implications for clinical practice.

The TIMI risk score is a widely used clinical tool designed to predict adverse cardiovascular events in patients with unstable angina and non-ST-segment elevation myocardial infarction (NSTEMI). It includes seven clinical and laboratory parameters to classify patients into different risk categories.

Despite its widespread use, our study found that the TIMI risk score had only a weak positive correlation ($r = 0.207$) with the severity of CAD as determined by coronary angiography. This correlation, while showing some relationship, wasn't strong enough to be considered statistically significant. This result matches previous research, which also noted differences in the predictive accuracy of the TIMI risk score across different patient groups and clinical settings.

Effective risk stratification is integral to the management of patients with acute coronary syndromes.[4] Even among patients with STEMI, for whom initial therapeutic options are well-defined, patient risk characteristics have an impact on early therapeutic decision making. [5,6] In addition, increasing economic pressures have intensified the need for appropriate triage and clinical resource utilization, including decisions regarding transfer to tertiary centers. [7] In particular, the capacity to reliably identify patients at very low risk for fatal recurrent events may offer the opportunity to select low-risk patients for early hospital discharge. [8,9] Tools that enhance the clinician's ability to rapidly and accurately assess risk are thus of substantial interest.

Investigators have developed a number of simplified risk stratification schemes, which may be calculated at the bedside without the aid of a computer.[10] Several of these models were developed before the widespread use of thrombolysis. [11,12,13] Of those derived in the era of reperfusion, several were formed by using general measures of severity of illness, such as the Acute Physiology and Chronic Health Evaluation II scoring system, [14] whereas others were based on expert opinion and prior investigation. Models that have integrated weighting information from multivariate regression in a fashion similar to the TIMI risk score are few and have not been derived for prediction of short-term outcomes in STEMI. [14]

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Conclusion:

TIMI risk score is a valuable tool for initial risk stratification in CAD, its limitations require a multifaceted approach to diagnosis and management. Combining clinical risk scores with advanced imaging, biomarkers, and comprehensive lifestyle interventions offers the best potential for improving outcomes in patients with CAD.

The evaluation of the TIMI risk score against coronary angiography findings in this study provides valuable insights into its utility and limitations in predicting coronary artery disease (CAD) severity.

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